3116 and 3216 PID Temperature Controller

1. Installation and Basic Operation

1.1 WHAT INSTRUMENT DO I HAVE?

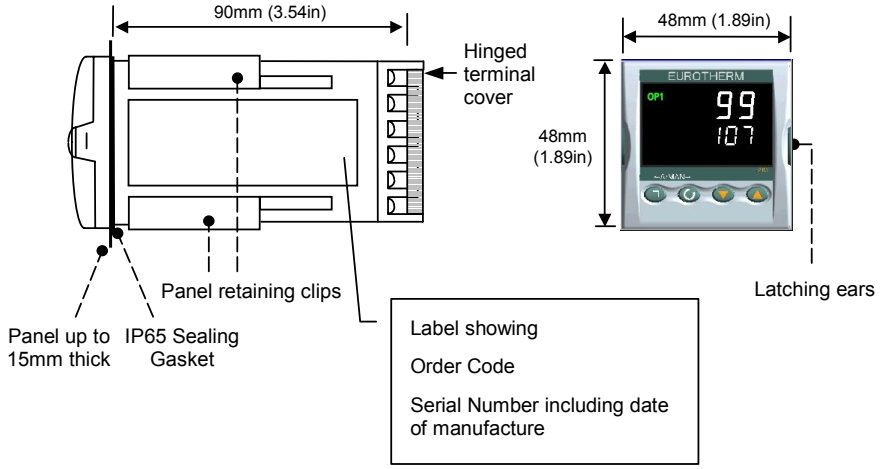
Thank you for choosing this Temperature Controller.

This Chapter takes you through step by step instructions to help you to install, wire, configure and use the controller. This manual can also be downloaded from www.eurotherm.co.uk.

Depending on how it was ordered, the controller may need to be configured when it is first switched on.

The ordering code is shown on a label fixed to the side of the controller. The hardware installed and the way in which it has been configured may be checked against the ordering code, section 1.2.

1.1.1 Dimensions



1.1.2 Contents of Package

The following parts should be supplied in the package

The controller fitted in its mounting sleeve, illustrated above

Installation and User Guide Part No HA027985 (3216); HA028005 (3116)

Accessories – 2.49Ω shunt resistor for current inputs

1.2 ORDER CODE

3116

Model		Power supply	Input/output 1 & output 2				Fascia colour	Language	Quick start code
3116	CC			XX	X	XXX			Optional

Power Supply		Input/output 1 & output 2			Fascia colour		Language		Quick Start Code
VL	20 – 29V	OP1	OP2		G	Green	I	English	See Switch On section
VH	110 –240V	L	R	Logic I/O + relay	S	Silver			
		R	R	Relay/Relay					

3216

Model		Power supply	Input/output 1 & output 2	X	Output AA	Comms, CT & Digital input	Fascia colour	Language	Quick start code
3216	CC								Optional

Power Supply		Input/output 1 & Output 2			Output AA		Communications, CT & Digital input			
VL	20 – 29V	OP1	OP2		R	Relay (Form C)	X	X	X	Not fitted
VH	110 – 240V	L	X	Logic I/O			4	X	L	RS485 comms 2-wire & dig in
		L	L	Logic I/O + logic OP			2	X	L	RS232 comms 2-wire & dig in
		L	R	Logic I/O + relay			4	C	L	RS485 comms CT & dig in
		R	R	Relay + relay	X	Not fitted	2	C	L	RS232 comms CT & dig in
		X	X	Not fitted			X	X	L	Digital input only
							X	C	L	CT and digital input

Fascia colour		Language		Quick Start Code
G	Green	E	English	See Switch On section
S	Silver			

1.3 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 and the ambient temperature is within 0 and 55^{o}C (32 - 130^{o}F)

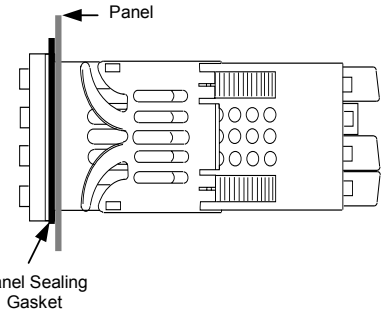
The instrument can be mounted on a panel up to 15mm thick

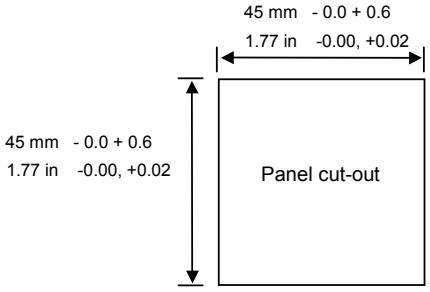
To ensure IP65 and NEMA 4 front protection, mount on a non-textured surface.

Please read the safety information in Appendix A before proceeding and refer to the EMC Booklet part number HA025464 for further installation information.

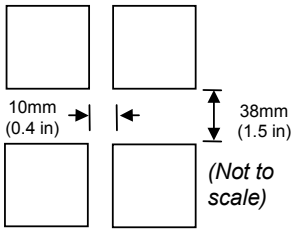
1.3.1 Panel Mounting the Controller

1. Prepare a square cut-out in the mounting panel to the size shown below
2. Fit the IP65 sealing gasket, if required, 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 front of the display





Recommended minimum spacing of controllers



1.3.2 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.

1.4 STEP 2: WIRING

Warning

Ensure that you have the correct supply for your controller

Please read the SAFETY and EMC INFORMATION Appendix A before proceeding

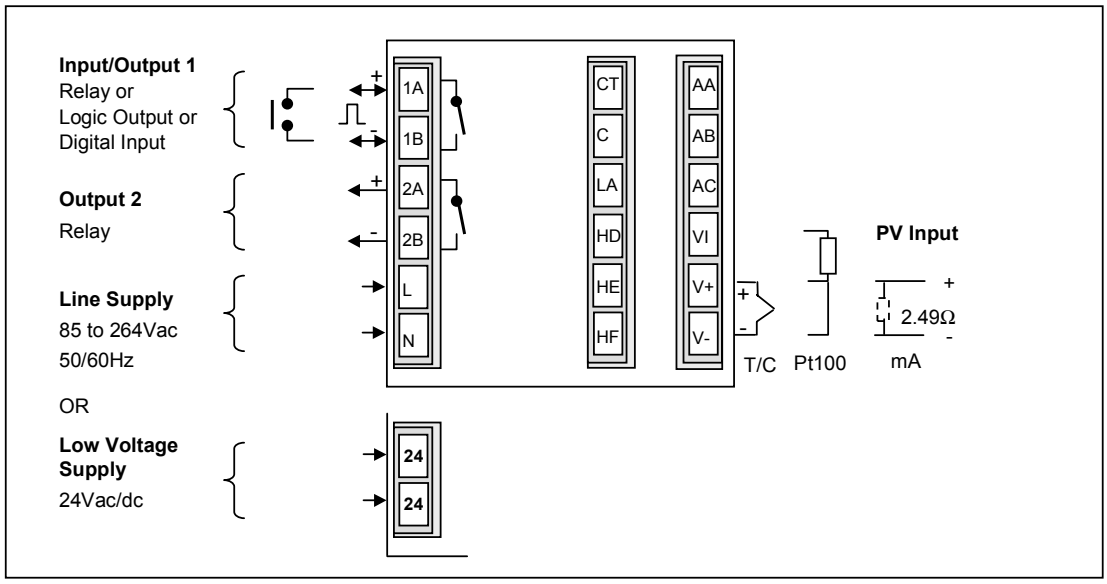
Check the order code of the controller supplied

1.4.1 Wire Sizes

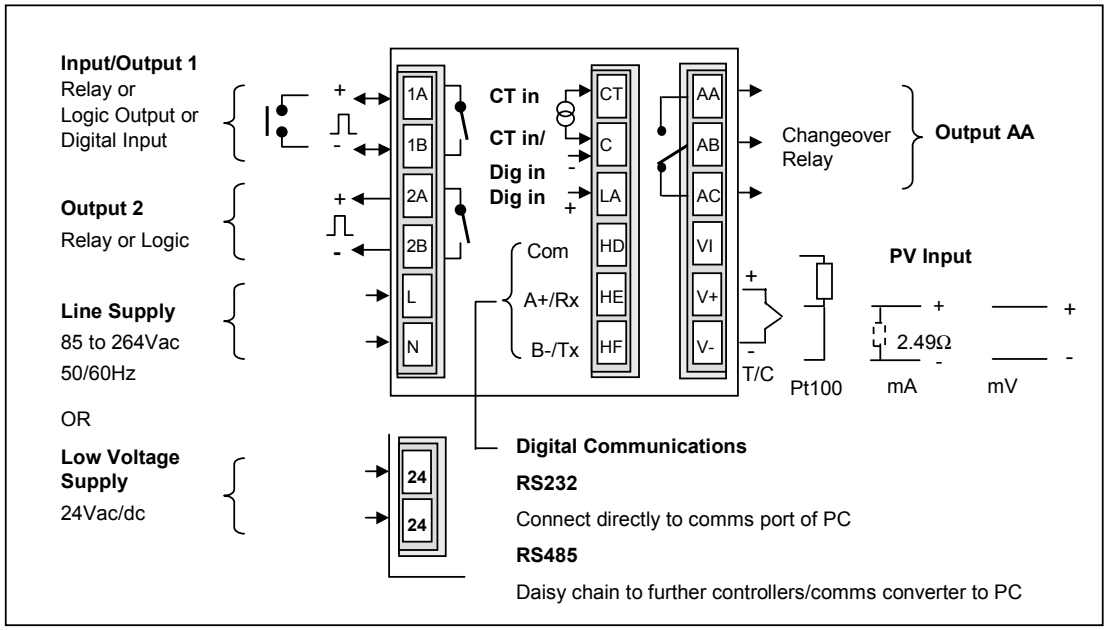
The screw terminals accept wire sizes from 0.5 to 1.5 mm (16 to 22AWG). Hinged covers prevent hands or metal making accidental contact with live wires. The rear terminal screws should be tightened to 0.4Nm (3.5lb in).

1.4.2 Terminal Layout

3116



3216



1.4.3 PV 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

Thermocouple Input

- For thermocouple input use the correct thermocouple compensating cable, preferably shielded

RTD Input

- The resistance of the three wires must be the same. The line resistance may cause errors if >22Ω

Linear Input (mA or V)

- The maximum input voltage is 80mV, input resistance 100KΩ . An external potential divider module is required for volts input.
- A line resistance for voltage inputs may cause measurement errors
- For mA input connect the burden resistor of 2.49Ω (supplied in the accessory pack) across the + and - input as shown in section 1.4.2.

1.4.4 AA Output Relay (Optional)

- This output is available as an option on the 3216 controller. It is not available on 3116 controller.
- Changeover relay (Form C) rated 2A 264Vac resistive

1.4.5 Input/Output 1 (Relay or Logic - Optional)

- This is optional and may be an input or an output as follows:-

Output	Relay	Normally open (Form A), 2A 264Vac resistive
	Logic	Drive to SSR (not isolated) Logic level On/High - 12Vdc at 5 to 40mA max Logic level Off/Low - <100mV <100μA
Input	Logic (Digital)	Contact closure 12V @ 5-40mA Contact open > 500Ω Contact closed < 200Ω

1.4.6 Output 2 (Relay or Logic)

- This is optional and is output only. It may be relay or logic output only as output 1.

General Note About Relays Switching 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 typically consists of a 15nF capacitor and 100Ω resistor connected in series. 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). It is the responsibility of the installer to ensure that this current does not hold on the power to an electrical load. If the load is of this type the snubber should not be connected.

1.4.7 Digital Communications (Optional)

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

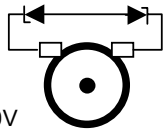
For further details see Series 2000 Communications Handbook Part No HA026230 available on www.eurotherm.co.uk/controls.

1.4.8 Current Transformer/Logic Input (Optional)

A current transformer can be connected directly to the controller to monitor the actual rms ac current supplied to an electrical load.

⚠ A digital (logic) input from a volt free contact can be configured to select Setpoint 2, Keylock, Run/Hold, Reset, Alarm Acknowledge or Auto/Manual. The common connection is shared for each of these inputs and is, therefore, not isolated.

Current Transformer Input (CT)



- CT input current — 0 to 50mA rms (sine wave, calibrated) 50/60Hz, the burden resistor, value 10Ω, is fitted 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.
- CT input resolution — 0.1A for scale up to 10A, 1A for scale 11 to 100 Amps
- CT input accuracy — ±4% of reading

Logic Input (LA)

- Digital input — Contact closure 12V @ 5-40mA
  Contact open > 600Ω
  Contact closed <400Ω

Note: This supplies 12Vdc up to 10mA to terminal LA

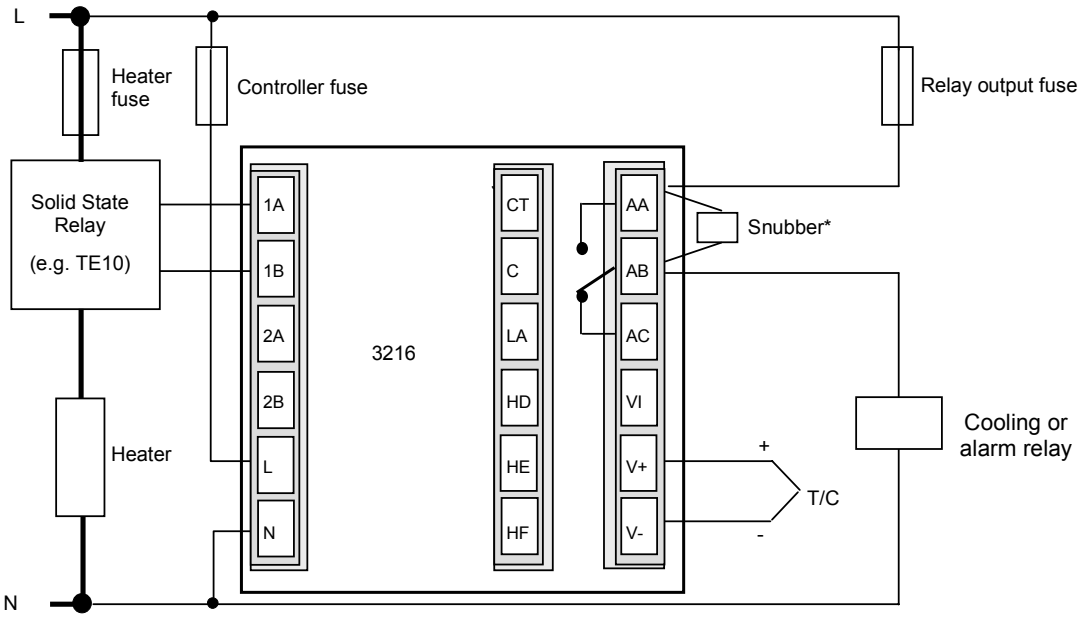
1.4.9 Power Supply

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. Fuses should be provided externally
   - For 24 V ac/dc fuse type T rated 2A 250V
   - For 85/265Vac fuse type T rated 2A 250V

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

1.4.10 Example Wiring Diagram



1.5 STEP 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 whether the instrument is new or has been switched on before.

For a new controller, go to section 1.5.1. For an instrument already configured, go to section 1.5.3.

1.5.1 New Controller (Unconfigured)

When the controller is switched on it will start up showing the 'Quick Configuration' codes. This enables you to configure the controller to match the process.

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 to suit your process as follows:-.

1. Press any button. The * characters will change to '-' the first one flashing. X indicates the option is not fitted
2. Press ▲ or ▼ to change the character currently flashing to the required code shown in the tables below
3. Press ⟳ to scroll to the next character (press ⟲ to return to the first character). When all five characters have been configured in Set 1 the display will go to Set 2 (3216 only).
4. When the last digit has been entered press ⟳ again, the display will show No EXIT Press ▲ or ▼ to YES. The controller will automatically re-start. Now go to section 1.5.2.

SET 1

In put Sensor type	Range	I/O Module 1	Output Module 2	Output Relay AA
Thermocouple B = Type B J = Type J K = Type K L = Type L N = Type N R = Type R S = Type S T = Type T C = Custom **RTD** P = Pt100 PRT **Linear** M = 0-500mV 2 = 0-20mA 4 = 4-20mA - = Unconfigured	C = °C Full Range F = °F Full Range 0 = 0-100.0°C 1 = 0-200°C 2 = 0-400°C 3 = 0-600°C 4 = 0-800°C 5 = 0-1000°C 6 = 0-1200°C 7 = 0-1400°C 8 = 0-1600°C 9 = 0-1800°C G = 32-212°F H= 32-392°F J= 32-752°F K = 32-1112°F L = 32-1472°F M = 32-1832°F N = 32-2192°F P = 32-2552°F R = 32-2912°F T = 32-3272°F - = Unconfigured	**Control** H = PID heat C = PID cool J = On/off heat K = On/off cool **Alarm (1) (energised in alarm)** 0 = High 1 = Low 2 = Deviation high 3 = Deviation low 4 = Deviation band **Alarm (1) (de-energised in alarm)** 5 = High 6 = Low 7 = Deviation high 8 = Deviation low 9 = Deviation band **Logic Input** W = Alarm ack M = Manual R = Run/hold L = Key lock P = Setpoint 2 T = Reset - = Unconfigured X = Not fitted	**Control** H = PID heat C = PID cool J = On/off heat K = On/off cool **Alarm (2) (energised in alarm)** 0 = High 1 = Low 2 = Deviation high 3 = Deviation low 4 = Deviation band **Alarm (2) (de-energised in alarm)** 5 = High 6 = Low 7 = Deviation high 8 = Deviation low 9 = Deviation band - = Unconfigured X = Not fitted	(3216 only) **Control** H = PID heat C = PID cool J = On/off heat K = On/off cool **Alarm (4) (energised in alarm)** 0 = High 1 = Low 2 = Deviation high 3 = Deviation low 4 = Deviation band **Alarm (4) (de-energised in alarm)** 5 = High 6 = Low 7 = Deviation high 8 = Deviation low 9 = Deviation band - = Unconfigured X = Not fitted

SET 2

(Not available on 3116)

Input CT Scaling	Digital Input	Lower Display
1 = 10 Amps 2 = 25 Amps 5 = 50 Amps 6 = 100 Amps X = Not fitted - = Unconfigured	W = Alarm Ack M = Manual R = Run/hold L = Keylock P = Setpoint 2 T = Reset X = Not fitted - = Unconfigured	T = Setpoint (standard) P = Output power % R = Time to run E = Elapsed time 1 = Alarm 1 setpoint A = Amps N = None - = Unconfigured

1.5.2 To Re-enter Quick configuration Mode

This mode can always be entered by holding down the [Page] button during power up and then entering a passcode. The passcode is defaulted to 4.

Note:-

If during normal operation a change is made to any of the parameters in the quick code list, then the quick code displayed during power up will show the characters separated by decimal points. The controller can be left to operate in this way.

1.5.3 Normal Operation

The controller will start up in operator level 1 and in the mode in which it was last switched off. The mode may be Auto, Manual or Off and these modes are described in section 1.5.5. In AUTO mode you will see the display shown below. It is called the HOME display.

Beacons:-

OP1 lit when output 1 is ON (normally heating)

OP2 lit when output 2 is ON (normally cooling)

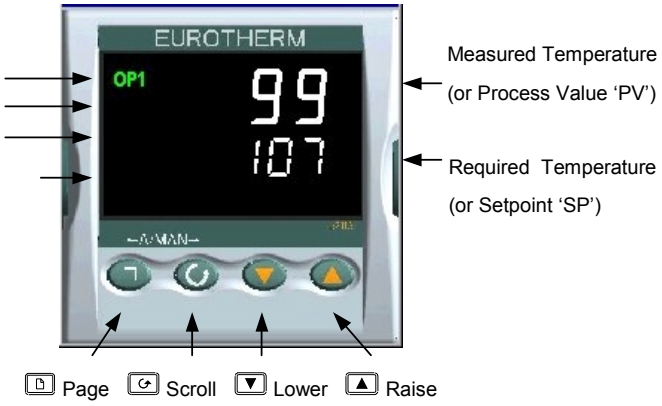
OP4 lit when AA relay is ON

SPX Alternative setpoint in use (SP2)

RUN Timer running

MAN Manual

ALM Alarm active (Red)



Operator Buttons

When this view is first entered (or [Scroll] is pressed) the lower display scrolls a 'help' message which gives the name of the parameter being displayed, e.g. 'WORKING SETPOINT'

In level 1 you can acknowledge alarms, adjust temperature setpoint, select auto or manual operation as described in the following sections:-

(Note: It is possible, using iTools configuration software, to restrict access to these settings).

1.5.4 To Acknowledge an Alarm.

Press [Page] and [Scroll] together

If an alarm is still current the red ALM beacon will flash, a scrolling message will give the source of the alarm and any relay attached to the alarm will operate. When acknowledged, these functions will change as described under 'ALARM LATCHING'.

1.5.5 To Set The Required Temperature.

Press [Raise] to raise the setpoint, or

[Lower] to lower the setpoint –

when the HOME display is being shown.

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

1.5.6 Auto/Manual Operation

Auto is the normal closed loop temperature control mode, which means that the output power is adjusted automatically by the controller in response to the measurement from the input sensor. In Manual mode the controller can be set so that the output power can be adjusted directly by the operator. This may be useful during commissioning or if the sensor becomes faulty and it is required to continue temporary operation of the plant until the sensor is repaired or replaced.

⚠ **Manual operation must be used with care and the power level set must be chosen such that no damage can occur to the process. The use of a separate 'over-temperature' controller is recommended.**

1.5.7 To Select Auto/Manual and Adjust the Output Power

Press ▼ and ▲ (Mode) together. This can only be accessed from the HOME display.

1. 'AUTO' is shown in the upper display. The lower display will scroll the longer alternate description of this parameter, ie 'LOOP MODE – AUTO MANUAL OFF'

2. Press ▲ to select 'mAn'. This is shown in the upper display and the **MAN** beacon is lit.
3. The controller will return to the HOME display. The upper display is the PV. The lower display is the demand power. At the point of changeover the manual demand power is the same as it was when in Auto (bumpless transfer auto to manual).

4. Press ▼ or ▲ to lower or raise the power. The output power is continuously updated when the buttons are pressed
5. The loop can also be turned off (zero power output demand) by selecting 'OFF' in the upper display. Loop break is also turned off. The controller will return to the HOME display. The upper display shows the PV. The lower display shows OFF. The **MAN** beacon is lit in this mode.
6. To Return to Automatic operation, press ▼ or ▲ together. Then press ▼ to select 'AUTO'. At the point of changeover to automatic operation the power demand takes the current value and gradually changes to that required by the controller (bumpless transfer manual to auto)

1.5.8 Other Commonly Used Operator Parameters

Press ⟳ to scroll through a list of commonly used parameters.

A list of other operating parameters is available each time this button is pressed. The parameter mnemonic and its scrolling description is shown in the lower display. The value of the parameter is shown in the upper display. The actual parameters shown depend upon the functions configured and are:-

Parameter and Scrolling Display	Description	Alterability
WRK.OP - WORKING OUTPUT	The current output	Read only in Auto mode. In Manual mode this parameter is shown in the HOME display
WKG.SP WORKING SETPOINT	The setpoint which the controller is currently using	Read only in Manual mode In Auto mode this parameter is shown in the HOME display
SP 1 - SETPOINT 1	Setpoint 1 (main setpoint)	Alterable using ▼ or ▲
SP2 - SETPOINT 2	Setpoint 2 (secondary setpoint)	Alterable using ▼ or ▲
DWEL SET TIME DURATION	Set dwell time	Only shown if timer configured. Alterable using ▼ or ▲
Ax.xx ALARM x SETPOINT	Alarm 1, 2, 3 or 4 setpoint if configured. XX indicates the alarm type, e.g. A 1.HI	Read only
A.TUNE AUTOTUNE ENABLE	To start autotune	Select on to enable oFF to disable
LD.AMP LOAD CURRENT	Load current	Read only and only shown if CT input configured

1.6 OPERATOR LEVELS

Operator level 1 is designed for day to day operation of the controller and is not protected by a security code. Level 2 provides access to additional parameters and access is protected by a security code.

1.6.1 To Enter Level 2

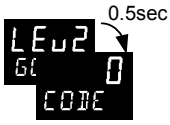
From any display press and hold [page].

After a few seconds the display will show 'LEu 1 GOTO'.

Release [page].

(If no button is pressed for about 20 seconds the display returns to the HOME display)

Press [▲] or [▼] to choose LEu 2 (Level 2)



Press [▲] or [▼] to enter the correct code

By default this is set to '2'

If an incorrect code is entered the display reverts to the HOME display

To Return to Level 1

Press and hold [page]

Press [▼] to select LEU 1

It is not necessary to enter a code when going from a higher level to a lower level.

When Level 1 is selected the display reverts to the HOME display

1.6.2 Level 2 Parameters

Press [scroll] to scroll through the list of parameters. This is a longer list than that available in Level 1. The mnemonic of the parameter is shown in the lower display, followed once by a single scrolling help message showing a description of the parameter.

The value of the parameter is shown in the upper display. Press [▲] or [▼] to adjust the value.

If no key is pressed for a few seconds the display returns to 'HOME'

WKG.SP	**WORKING SETPOINT** is the current target setpoint. It may be derived from SP1 or SP2, or, if the controller is ramping (see SP.RAT), it is the current ramp value.
WRK.OP	**WORKING OUTPUT** is the output from the controller expressed as a percentage of full output. Range –100% (Max cooling) to +100% (max heating). 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
T.STAT	**TIMER STATUS** is only shown if a timer is configured. Allows the timer to be put into Run, Hold or Reset mode.
UNITS	**DISPLAY UNITS** can be selected from °C, °F, °K, PERC (percent), none. All temperature related parameters, eg PB, are rescaled if UNITS = None
SP.HI	**SETPOINT HIGH** applies a high limit to SP1 and SP2
SP.LO	**SETPOINT LOW** applies a low limit to SP1 and SP2
SP1	**SETPOINT 1** to adjust the value of the setpoint 1
SP2	**SETPOINT 2** to adjust the value of the setpoint 2
SP.RAT	**SETPOINT RATE LIMIT** sets the rate of change of setpoint. Limits the rate of heating or cooling.
TI.CFG	**TIMER CONFIGURATION** configures the timer type - Dwell, Delay, Soft Start or none (only when in Reset)
TM.RES	**TIMER RESOLUTION** selects hours or minutes (only when in Reset)
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.
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.
DWELL	**SET TIME DURATION** - can be adjusted while the timer is running.

T.REM	**TIME REMAINING** time left before the timer times out
SS.PWR	**SOFT START POWER LIMIT** sets a reduced power limit to be applied after start up to prevent damage to heaters. This limit is applied until SS.SP is exceeded or the time has elapsed
SS.SP	**TIMER SOFT START THRESHOLD** If the PV is greater than this setting the soft start power limit is not applied
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 bnd Deviation Band HI Full Scale High dLO Deviation Low dHI Deviation High
AI.LAT to A4.LAT	**ALARM 1 (2, 3 or 4) LATCH TYPE** is used to latch the alarm condition once an alarm has been detected. It may be configured as:- nonE **Non latching**: The alarm will only be active when an alarm condition persists. If the alarm is still present when acknowledged, the alarm beacon will stay on. An output (relay) associated with this alarm will remain active. Auto **Automatic**: The alarm continues to be active until both the alarm condition is removed AND the alarm is acknowledged. 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. Evnt **Event:** No alarm indication
A1.HYS to A4.HYS	**ALARM 1 (2, 3 or 4) 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 positive indication of the alarm condition and to prevent alarm relay chatter.
A1.BLK to A4.BLK	**ALARM 1 (2, 3 or 4) BLOCKING** – the alarm only occurs after the start up of the process when the alarm has first entered a safe state. The alarm is only indicated the next time it is active. Select YES to enable, No to disable.
A.TUNE	**AUTOTUNE** automatically sets the control parameters to match the process characteristics.
PB	**PROPORTIONAL BAND** sets an output which is proportional to the size of the error signal. Units may be % or display units.
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.
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.
HYST.H	**HEATING HYSTERESIS** sets the difference in PV units between the output (relay) turning off and turning on. **Only shown if the control action is On/Off**.
MR	**MANUAL RESET** applies to a P or 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.
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 controller only**.
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. See also section 7.8.1.
OP.HI	**OUTPUT HIGH** limits the maximum heating power applied to the process or a minimum cooling output.
LBT	**LOOP BREAK TIME** allows a time to be set before a loop break alarm is initiated. A loop break is signalled if the PV does not move towards the setpoint after the power has been saturated for the loop break time. For an On/Off controller LBT is not shown and loop break alarm is inhibited.
1.PLS, 2.PLS, 4.PLS	**OUTPUT 1 (2 or 4) MINIMUM PULSE TIME** when the output operates it remains on for a time set by this parameter. Relay outputs are adjustable from 1.0 to 150 seconds. Logic outputs may be set to Auto = 110ms.
	This section applies to Current transformer input only.
LD.AMP	**LOAD CURRENT** is the measured load current when the power demand is on.
LK.AMP	**LEAK CURRENT** is the measured leakage current when the power demand is off.

'LD.ALM' -	**LOAD CURRENT THRESHOLD** sets a low alarm trip point for the load current flowing while the controller output is on. This detects partial load failure
LK.ALM	**LEAK CURRENT THRESHOLD** sets a high alarm trip point for the leakage current flowing while the controller output is off.
HC.ALM	**OVERCURRENT THRESHOLD** sets a high alarm trip point while monitoring the current flowing at all times.
	This section applies to digital communications only.
ADDR	**ADDRESS** - communications address of the controller. 1 to 254
HOME	**HOME DISPLAY** defines the parameter which appears in the lower section of the HOME display when the controller is in Operator Level. This can be selected from:- Std (Standard) OP (Output Power) Ct (Current) AL1 (Alarm 1) tr (Time Remaining) ELAP (Time Elapsed – when Timer is configured) CLr (Clear – lower display blank) tmr (combined setpoint and time display) Note Standard is the default which shows Setpoint in Auto or Output in Manual
ID	**CUSTOMER ID** is a number from 0 to 9999 entered as a customised identification number for the controller
REC.NO	**CURRENT RECIPE NUMBER** selects a recipe from none, 1, 2, 3, 4, or 5 – the most frequently used parameter s can be stored in a recipe.
STORE	**RECIPE TO SAVE** current parameter values can be saved to recipe numbers 1, 2, 3, 4, or 5 (or none)

☺ Press [page] at any time to return immediately to the HOME screen at the top of the list.

☺ Hold [scroll] down to continuously scroll through the above list

2. Access to Further Parameters

Parameters are available under different levels of security and are defined as Level 1 (LEV 1), Level 2 (LEV2), Level 3 (LEV 3) and Configuration (CONF). Level 1 has no security password since it contains a minimal set of parameters generally sufficient to run the process on a daily basis. Level 2 allows parameters, generally used in commissioning a controller, to be adjusted. This has been described in the previous section.

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

2.1.1 Level 3

Level 3 makes all operating parameters available and alterable (if not read only)

Examples are:-

Range limits, setting alarm levels, communications address.

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

2.1.2 Configuration Level

This level makes available all parameters including the operating 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.

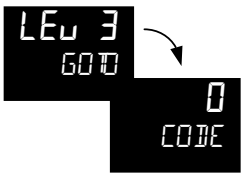
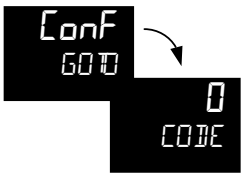
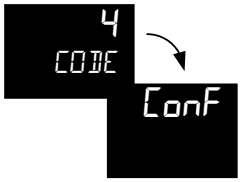
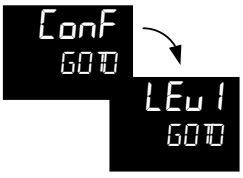
WARNING

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

2.1.3 To Select Access Level 3 or Configuration Level

Do This	The Display You Should See	Additional Notes
	To Select Level 3	
1. From any display press and hold [page] for more than 5 seconds		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
	To Select Configuration level	
3. From 1 above, press [▲] to go to 'ConF'		Note: [▲] must be pressed 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
	To Return to a Lower Level	
5. Press and hold [page] for more than 3 seconds 6. Press [▼] to select the required level eg LEV 1		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 [page] 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 8.3 '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 [page] button for more than 3 seconds. Then press [page] again to select 'ACCES'

2.2 PARAMETER LISTS

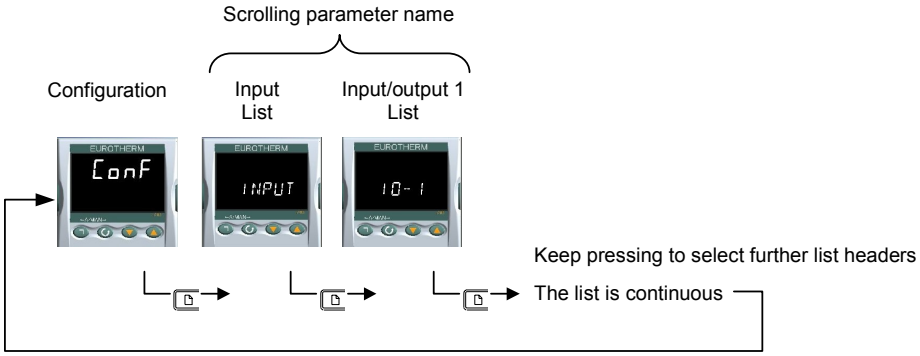
Parameters are organised in simple lists. The top of the list shows the list header only. The name of the list header describes the generic function of the parameters within the list. For example, the list header 'ALARM' contains parameters which enable you to set up alarm conditions.

2.2.1 To Choose Parameter List Headers

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

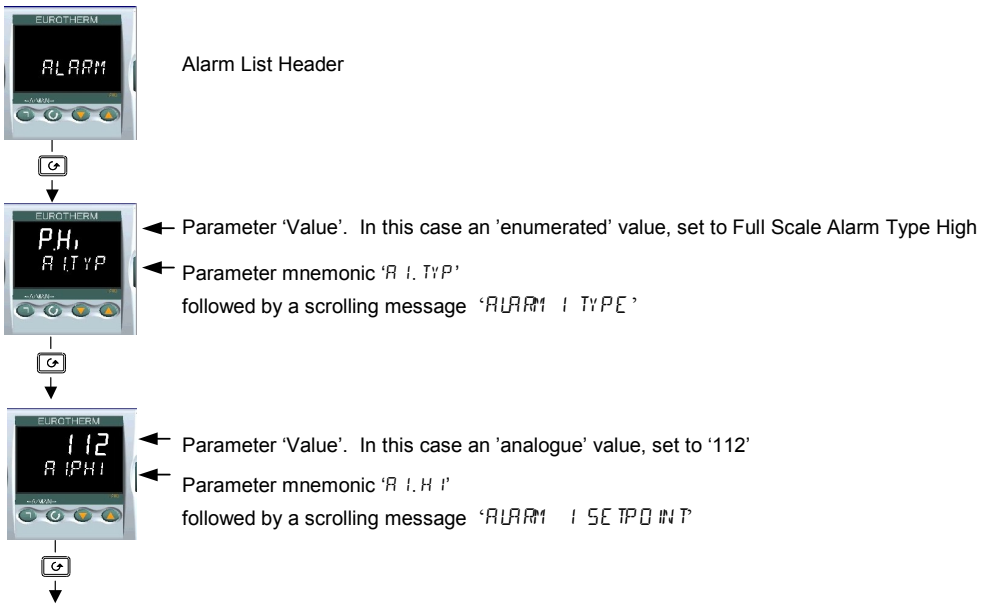
The list header name appears in the lower display, followed immediately by a scrolling longer description of the name.

The following example shows how to select the first three list headers.



2.2.2 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 three parameters in the ALARM List. All parameters in all lists follow the same procedure.



☺ Press to jump back to the list header.

2.2.3 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 when the parameter is first accessed.

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

2.2.4 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 immediately.

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

2.2.5 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.

2.2.6 Time Out

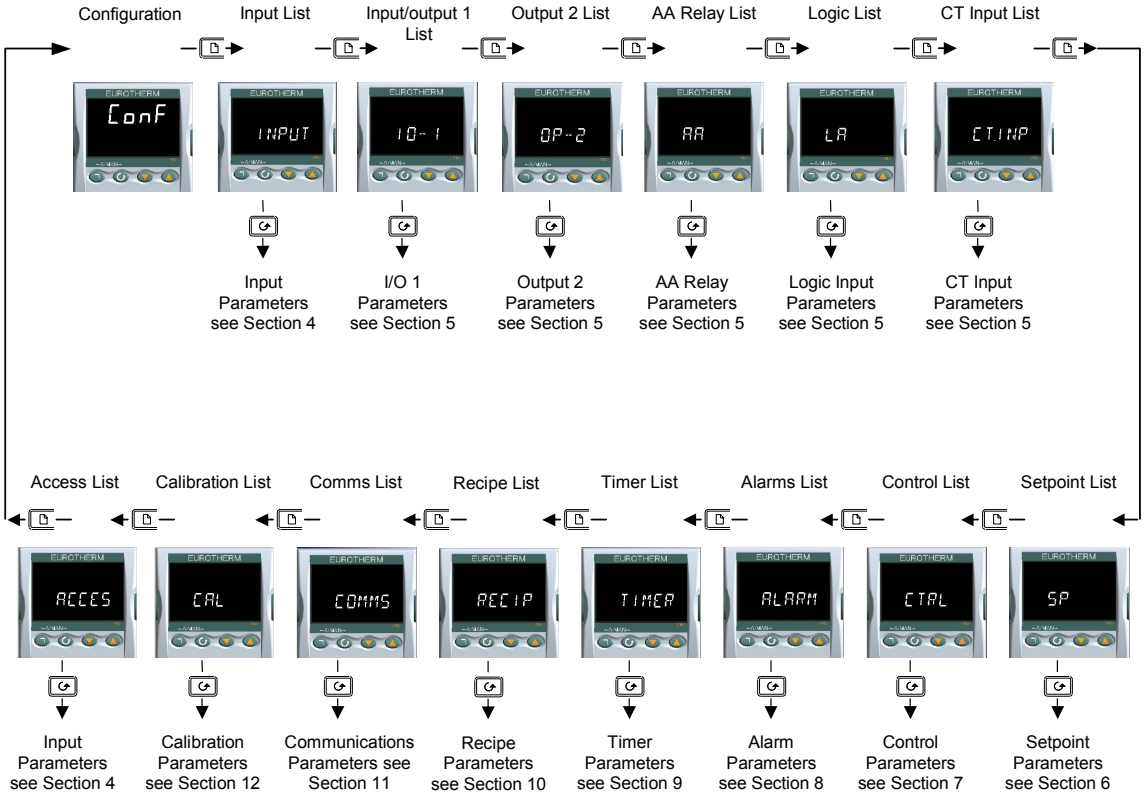
A time out applies to the 'Go To' and 'Control Mode' parameters. If no key presses are detected within a period of 5 seconds the display will revert back to the HOME list.

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

2.3 NAVIGATION DIAGRAM

The diagram below shows the all list headings available in configuration level for 3116 and 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.



The above diagram is shown for 3216 controllers. For 3116 AA Relay List, Logic List, CT Input List and Comms List are not present.

2.4 ACCESS PARAMETERS

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

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

ACCESS LIST	'ACCS'					
Name	Scrolling Display	Parameter Description	Values Allowed		Default	Access Level
GOTO	GOTO	Allows the user to change the access level of the controller. Passwords prevent accidental edit	LEv.1 LEv.2 LEv.3 Conf	Operator mode level 1 Operator mode level 2 Operator mode level 3 Configuration level	LEv.1	Conf
LEV2.P	LEVEL 2 PASSCODE	Level 2 passcode	0-9999 0 = no passcode will be requested		2	Conf
LEV3.P	LEVEL 3 PASSCODE	Level 3 passcode			3	Conf
CONF.P	CONFIG PASSCODE	Configuration level passcode			4	Conf
ID	CUSTOMER ID	To set the identification of the controller	0-9999			Conf
HOME	HOME DISPLAY	To configure the parameter to be displayed in the lower line of the HOME display	Std OP tr ELAP AL 1 Ct CLr tmr	Setpoint Output demand Time remaining Time elapsed Alarm 1 setpoint Current transformer No parameter Time remaining	SP	Conf
K.LOC	KEYBOARD LOCK	To inhibit operation of the front panel buttons when in operator levels	nonE ALL Edit mod mAn	Unlocked All buttons locked Edit keys locked (1) Mode key locked (2)	nonE	Conf
COLD	COLD START ENABLE/ DISABLE	**This parameter should be used with care.** When set to yes the controller will return to factory settings on the next power up	No YES	Disable Enable		Conf

Note 1

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

Note 2

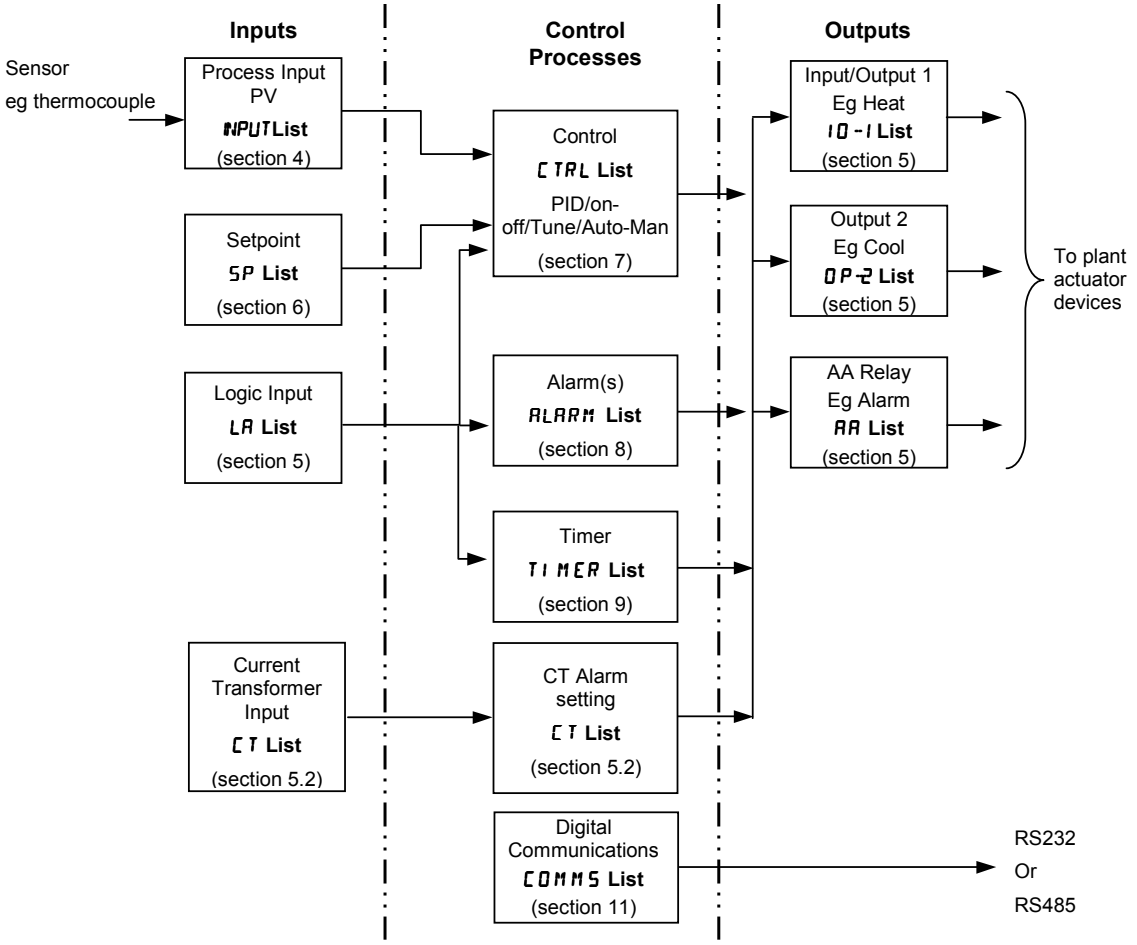
Mode key locked. Timer run, hold, reset and Auto/Manual cannot be operated from the Mode key.

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.

3. 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 Process Variable (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 3216 controllers. For 3116 Logic Input List, CT Input List, Timer List, Digital Communications List, AA Relay List and Output 3 List are not present.

4. Process Input

Parameters in the process input list configure the input to match your sensor. The Process Input 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 4.1.1. 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 4.2. 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^{o}C with one decimal point.

4.1 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 4.1.1. for input types available			Conf L3 R/O
UNITS	DISPLAY UNITS	Display units shown on the instrument	None °C °F °K PErc	No units - only for custom linearisation Celsius Fahrenheit Kelvin %	°C	L3
DEC.P	DISPLAY POINTS	Decimal point position	nnnn nnn.n nn.nn	No DP One DP Two DP	nnnn	Conf L3 R/O
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 'Low Range Limit' parameter plus one display unit to the high limit of the selected input type. See Section 4.3 for further details		1200	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. See Section 4.3 for further details		0	Conf L3 R/O
PV.OFS	PV OFFSET	A simple offset applied to all input values. See section 4.2.1.	Generally one decimal point more than PV			L3
FILT.T	FILTER TIME	Input filter time	OFF to 59.9 seconds		1.6	L3
CJ.TYP	CJC TYPE	Configuration of the CJC type	Auto 0°C	Automatic Fixed at 0°C	Auto	Conf and if T/C L3 R/O
SB.TYP	SENSOR BREAK TYPE	Defines the action which is applied to the output if the sensor breaks (open circuit)	oFF on LAt	No sensor break will be detected Open circuit sensor will be detected Latching	on	Conf L3 R/O
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 value of the process variable	Minimum display to maximum display range			Conf L3 R/O
MV.IN	INPUT VALUE	Millivolts measured at the rear PV Input terminals	xx.xx mV - read only			Conf L3 R/O

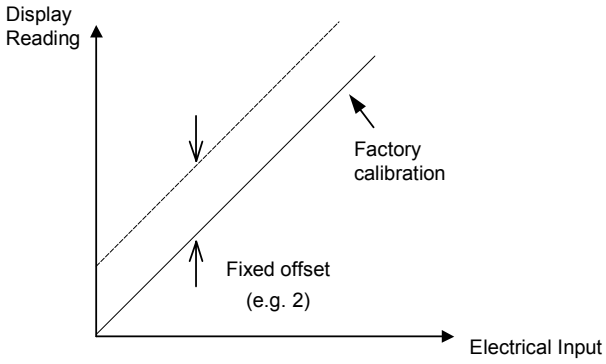
4.1.1 Input Types and Ranges

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
rtd	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 display sensor break (unless sensor break is disabled).						

4.2 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 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:-



4.2.1 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	The Display You Should See	Additional Notes
1. Select Level 3 or Conf as described in Chapter 2. Then press [▯] to select '**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		Scrolling display 'PV OFFSET' In this case an offset of 2.0 units is applied

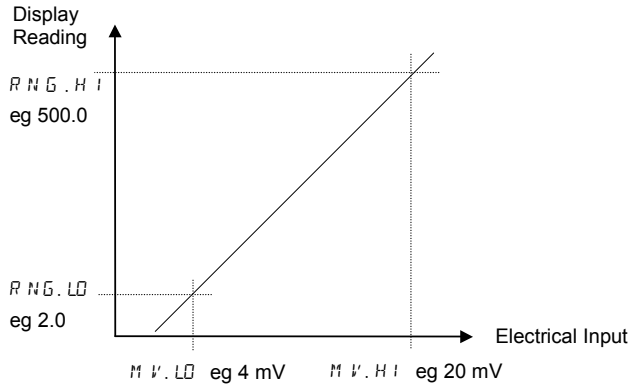
It is also possible to apply a two point offset which adjusts both low and high points. This is done in Level 3 using the CAL List, and the procedure is described in the Calibration section 12.

4.3 PV INPUT SCALING

PV 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 PV 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.



For mA inputs

4-20mA = 9.96-49.8mV with 2.49Ω load resistor

0-20mA = 0-49.8mV with 2.49Ω load resistor

mA input will detect sensor break if mA < 3mA

Use a current source to remove shunt resistor errors

To Scale a Linear Input:-

Do This	The Display You Should See	Additional Notes
1. Select Conf as described in Chapter 2. Then press [page] to select '**INPUT**'		Scrolling display '*PROCESS INPUT LIST*'
2. Press [scroll] to scroll to '**IN.TYP**' 3. Press [▲] or [▼] to '**mV**'		Scrolling display '*INPUT TYPE*'
4. Press [scroll] to scroll to '**MV.HI**' 5. Press [▲] or [▼] to '**20.00**'		Scrolling display '*LINEAR INPUT HIGH*'
6. Press [scroll] to scroll to '**MV.LO**' 7. Press [▲] or [▼] to '**4.00**'		Scrolling display '*LINEAR INPUT LOW*'
8. Press [scroll] to scroll to '**RNG.HI**' 9. Press [▲] or [▼] to '**500.0**'		In operator level the controller will read 500.0 for a mV input of 20.00 Scrolling display '*RANGE HIGH LIMIT*'
10. Press [scroll] to scroll to '**RNG.LO**' 11. Press [▲] or [▼] to '**2.0**'		In operator level the controller will read 2.0 for a mV input of 4.00 Scrolling display '*RANGE LOW LIMIT*'

5. Input/Output

This section refers to Digital Inputs, Current Transformer Input and 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							
I/O-1	✓	✓		✓	✓	Heat Cool Alarm	Normal Inverted	OP1	1A, 1B
OP-2	✓	✓		✓		Heat Cool Alarm	Normal Inverted	OP2	2A, 2B
AA Relay (OP4)		✓		✓		Heat Cool Alarm	Normal Inverted	OP4	AA, AB, AC
OP-3		N/A		✓		Heat Cool Alarm	Normal Inverted	OP3	3A, 3B
LA		✓			✓		Normal Inverted		C, LA
LB		N/A			✓		Normal Inverted		
CT		✓			✓				C, CT

5.1 INPUT/OUTPUT PARAMETERS

5.1.1 INPUT/OUTPUT 1 LIST (IO-1)

Input/Output 1. May be configured to accept a digital input from external switch contacts or relay or logic output to plant devices. 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**
1.TYPE	I/O 1 TYPE	I/O channel 1 hardware type defined by the hardware fitted	nonE rELY Lio	No IO Relay OP Logic Input/Output	As ordered	Read only
1.FUNC	I/O 1 FUNCTION	I/O channel function	nonE doutt HEAt CooL din	Disabled. If disabled no further parameters are shown Digital OP Heat OP Cool OP Digital IP if '1.TYPE' = 'Lio'	HEAt	Conf
1.SRC.A	I/O 1 SOURCE A	These parameters only appear when the channel function is a Digital OP, i.e. 1.FUNC = dout 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 5.1.3	nonE	No event connected to the output	nonE	Conf
1.SRC.B	I/O 1 SOURCE B		AL1	Alarm 1		
			AL2	Alarm 2		
1.SRC.C	I/O 1 SOURCE C		AL3	Alarm 3		
			AL4	Alarm4		
1.SRC.D	I/O 1 SOURCE D		ALLA	All alarms		
			nwAL	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		
1.DIN	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 = din Only one function may be activated by a physical input	nonE AcAL SP2 Locb trES trun trrS tHLd mAn Sby	Input not used Alarm acknowledge Setpoint 2 select Front keypad disable (keylock) Timer reset Timer run Timer run/reset. Make to run, break to reset Timer hold Manual status Standby mode. In this mode control outputs go to zero demand	AcAL	Conf
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
1.SENS	I/O 1 SENSE	To configure the polarity of the input or output channel	nor Inu	Normal See also section 4.3.2 Inverted See also section 4.3.2	nor	Conf if module enabled

5.1.2 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'.

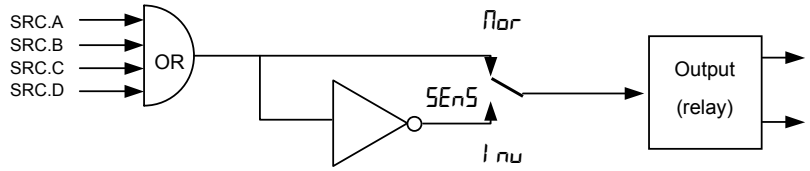
'Inverted' means a relay output is energised for 0% PID demand

For an alarm output set this parameter to 'inv' 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.

5.1.3 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. '1.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.



To configure this function:-

Do This	The Display You Should See	Additional Notes
1. Select the output, eg IO-1, which you want to operate when the event occurs using [▯] button	IO-1	Scrolling display 'IO-1 LIST'
2. Press [⟳] to scroll to '1.ID' 3. Press [▲] or [▼] to select 'rELY'	rELY 1.ID	This is the identification of the hardware fitted and cannot be adjusted
4. Press [⟳] to scroll to '1.FUNC' 5. Press [▲] or [▼] to select 'd.out'	d.out 1.FUNC	The output must be configured for a relay or digital I/O Scrolling display 'IO 1 FUNCTION'
6. Press [⟳] to scroll to '1.SRC.A' 7. Press [▲] or [▼] to select the event which you want to operate the output, eg 'AL.1'	AL 1 1.SRCA	In normal operation the output will activate if either alarm 1 or alarm 2 occur Scrolling display 'IO 1 SOURCE A'
8. If a second event is required to operate the same output, press [⟳] to select '1.SRC.B' 9. Press [▲] or [▼] to select the second event which you want to operate the output, eg 'AL.2'	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
10. Press [⟳] to scroll to '1.SENS' 11. Press [▲] or [▼] to select 'inv'	inv 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'

5.1.4 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 the IO-2 output channel.

OUTPUT LIST 2 'OP-2'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
2.IO	OUTPUT 2 TYPE	Output channel 2 hardware type	none rELY LOP	Output not fitted Relay OP Logic output	As ordered	Read only
2.FUNC	FUNCTION	Output channel 2 function	none dout HEAt CooL	Disabled. If disabled no further parameters are shown Digital OP Heat OP Cool OP	dout	Conf
2.SRC.A	I/O 2 SOURCE A	These parameters only appear when the channel function is a Digital OP, i.e. 2.FUNC = dOut 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 5.1.3.	none	No event connected to the output	none	Conf
			AL1	Alarm 1 *		
2.SRC.B	I/O 2 SOURCE B		AL2	Alarm 2 *		
			AL3	Alarm 3 *		
2.SRC.C	I/O 2 SOURCE C		AL4	Alarm4 *		
			ALLA	All alarms		
2.SRC.D	I/O 2 SOURCE D		nwAL	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		
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 Inv	Normal See also section 4.3.2. Inverted See also section 4.3.2.	nor	Conf if module enabled

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

5.1.5 AA RELAY (AA)

This is a changeover relay and is optionally available in 3216 controllers. It is not available 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 OP		Read only
4.FUNC	FUNCTION	Output channel 4 function	nonE d.OUt HEAt CooL	Disabled Digital OP Heat OP Cool OP	d.OUt	Conf
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 5.1.3.	nonE	No event connected to the output	nonE	Conf
			AL 1	Alarm 1 *		
4.SRC.B	I/O 4 SOURCE B		AL2	Alarm 2 *		
			AL3	Alarm 3 *		
4.SRC.C	I/O 4 SOURCE C		AL4	Alarm4 *		
			ALLA	All alarms		
4.SRC.D	I/O 4 SOURCE D		nwAL	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		
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 Inu	Normal See also section 4.3.2. Inverted See also section 4.3.2	nor	Conf if module enabled

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

5.1.6 Logic Input Parameters

Input A. This is a digital input wired to terminals C and LA, typically from a voltage free contact, which can be configured to operate a number of functions as determined by parameters in the LA.

LOGIC INPUT LIST 'LA'						
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.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 reset		
			t.run	Timer run		
			t.rrS	Timer run/reset. Make to run, break to reset		
			t.HLd	Timer hold		
			mAn	Manual status		
			Sby	Standby mode. In this mode control outputs go to zero demand		
L.SENS	LOGIC INPUT SENSE	To configure the polarity of the input channel	nor	Normal	nor	Conf
			Inu	Inverted		

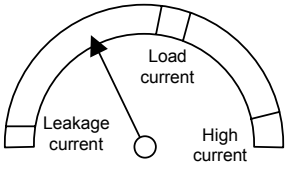
5.2 CURRENT TRANSFORMER INPUT PARAMETERS

The 3216 controller can measure, via an external current transformer, the current flowing through the heating control electrical load when the heat output is 'on' (load current) and also when it is 'off' (leakage current). This input is not applicable to 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

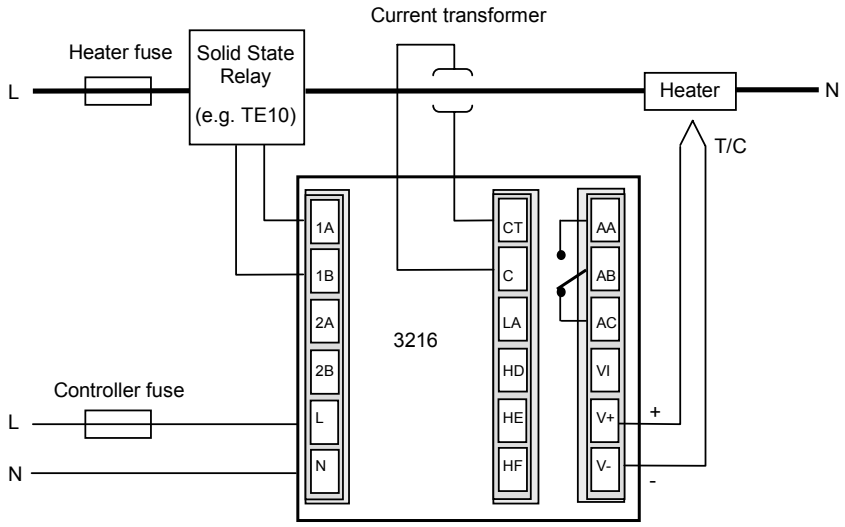
CURRENT TRANSFORMER LIST 'CT-INP'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
CT.ID	MODULE TYPE	CT module identity	CTIn	CT input circuit fitted	As order code	Conf read only
CT.SRC	CT SOURCE	Selects the output controlling the current measured by the CT input	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			
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
LD.AM	LOAD CURRENT THRESHOLD	Load open circuit alarm threshold	OFF to CT full scale value – low alarm			Read only
LK.ALM	LEAK CURRENT THRESHOLD	Leakage current in the off state alarm threshold	OFF to CT full scale value – high alarm			Read only
HC.AM	OVER CURRENT THRESHOLD	Overcurrent threshold	OFF to CT full scale value – high alarm			
LD.AMP	LOAD CURRENT	Measured load current				L3 if CT input enabled
LK.AMP	LEAK CURRENT	CT input leakage current				L3 if CT input enabled

5.2.1 Analogue Representation of Current Alarms

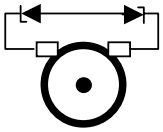


5.2.2 Current Transformer Wiring Diagram

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



6. 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 3. The following functions are avaiable:-

Number of setpoints	Two, SP1 and SP2. Each may be selected by a dedicated parameter or externally switched via a digital input suitably configured as described in section 5. 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

6.1 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	SP1 SP2	Setpoint 1 selected Setpoint 2 selected	SP1	L3
SP1	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		1200	L3
SP.LO	SETPOINT LOW LIMIT	Minimum allowable setpoint setting	Low range limit to Setpoint high limit (SP.HI)		0	L3
SP.RAT	SETPOINT RATE LIMIT	Limits the rate of change of the setpoint. Operates on both SP1 and SP2	Step change (OFF) to 3000 display units per minute. Resolution one decimal place more than PV		0	L3

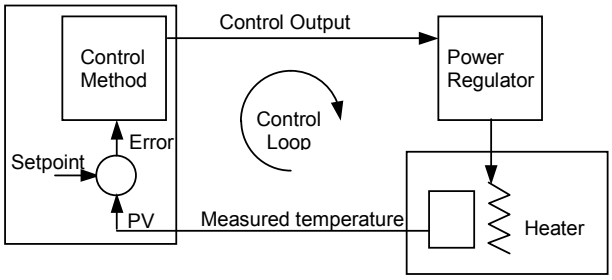
6.2 EXAMPLE: TO SET RAMP RATE

This is available in Level 3.

Do This	The Display You Should See	Additional Notes
1. Press [page] as many times as necessary to select **'SETPOINT LIST'**		
2. Press [scroll] 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 [scroll] to scroll to **'SP2'** 5. Press [▲] or [▼] to adjust setpoint 2		
6. Press [scroll] 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 minute. It will also change at the same rate when switching between SP1 and SP2 The setpoint rate resolution is generally one decimal point more than setpoint/PV resolution

7. CONTROL

This section allows you to set up the control loop. 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.

7.1 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.

7.2 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.

7.2.1 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.

7.2.2 One-shot Tuning

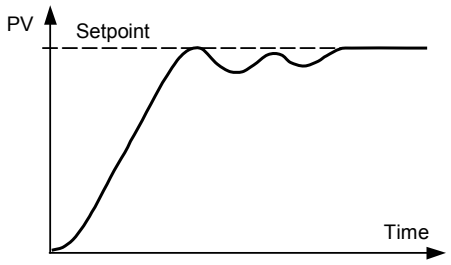
The 'one-shot' tuner works by switching the output on and off to induce an oscillation in the measured value. From the amplitude and period of the oscillation, it calculates the tuning parameter values.

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

7.2.3 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.

7.2.4 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 control	2.2xB	0.8xT	OFF
P + I + D control	1.7xB	0.5xT	0.12xT

7.2.5 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.

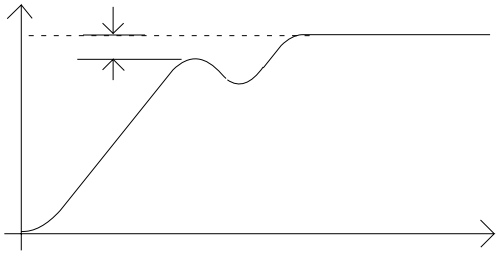
Proceed as follows:

Set the low and high cutback values to three proportional bandwidths (that is to say, $Cb.HI = Cb.LO = 3 \times Pb$).

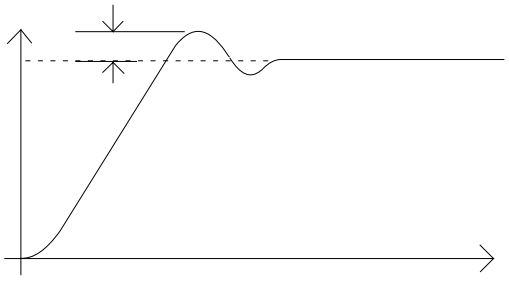
Note the level of overshoot, or undershoot, that occurs for large PV changes (see the diagrams below).

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.

7.3 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.

7.4 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.

7.5 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).

7.6 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.

7.7 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.

7.8 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.

7.9 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 oFF on.oF	PID Heating off On/Off	As order code	Conf
CTRL.C	COOLING TYPE	oFF Pid on.oF	Cooling disable PID On/Off	OFF	Conf
CTRL.A	CONTROL ACTION	rEu dir	Reverse acting. Output decreases as PV increases Direct acting. Output increases as PV decreases	rEu	Conf
PB.UNT	PROPORTIONAL BAND UNITS	EnG PErc	In engineering units In percent		
ATUNE	AUTO-TUNE ENABLE	OFF On	Autotune off Set to 'on' to start auto-tuning	OFF	L3
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		60 sec	L3
R2G	RELATIVE COOL GAIN See also section 7.4	0.1 to 10.0		1.0	L3
CBHI	CUTBACK HIGH See also section 7.2.5.	Auto or 1to 3000 display units		Auto = 3xPb	L3
CBLO	CUTBACK LOW See also section 7.2.5.	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% Adjust to limit the maximum heating power applied to the process		100.0%	L3
OP.LO	OUTPUT LOW	±100% Adjust to limit the maximum cooling power applied to the process or to apply a minimum heating power		0.0%	L3
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 OIL H2O FAn	Linear Oil cooling Water cooling Forced air cooling		
A-M	LOOP MODE – AUTO MANUAL OFF see also section 1.5	Auto mAn OFF	To select automatic operation To select manual operation Control outputs inhibited		
LBR	LOOP BREAK	No YES	Shows the current status of loop break.		Read only

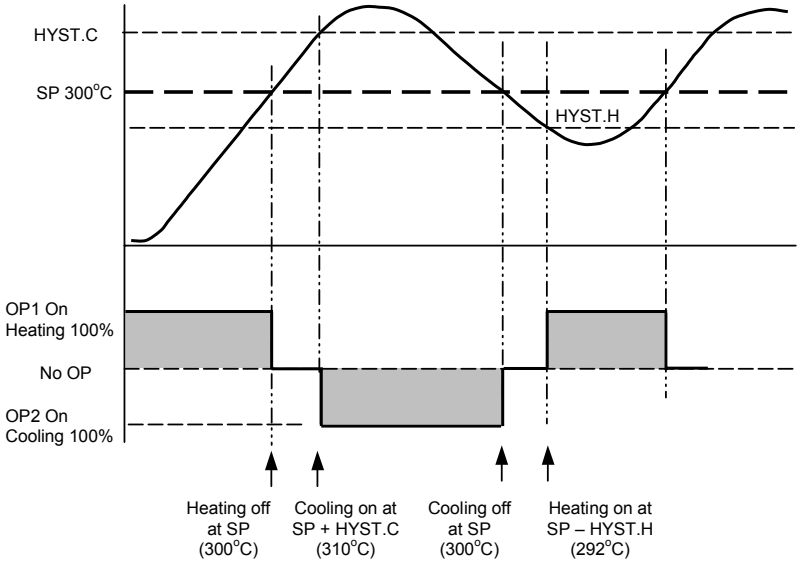
7.9.1 Effect of Control Action, Hysteresis and Deadband

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.



Heating and Cooling Type both on/off

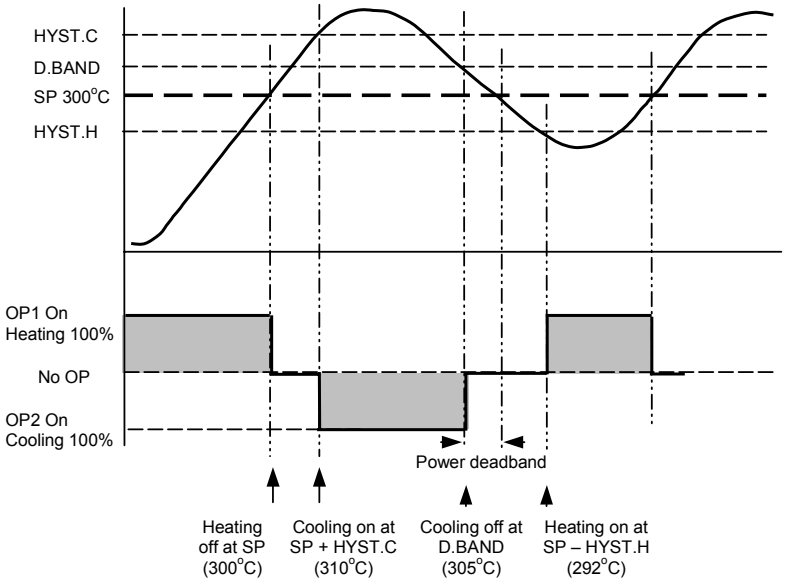
Setpoint = 300°C

Control Action = reverse

Heating Hysteresis = 8°C

Cooling Hysteresis = 10°C

Deadband = OFF



Heating and Cooling Type both on/off

Setpoint = 300°C

Control Action = reverse

Heating Hysteresis = 8°C

Cooling Hysteresis = 10°C

Deadband 50% of cooling hysteresis = 5°C

7.10 EXAMPLE: TO CONFIGURE HEATING AND COOLING

Enter configuration level as described. Then:-

Do This	The Display You Should See	Additional Notes
1. Press [page] as many times as necessary to select **'CTRL'**		
2. Press [scroll] to scroll to **'CTRLH'** 3. Press [▲] or [▼] to select the **heating type**		Heating Type choices are:- PId PID (3 term) control OnOFF On/Off control
4. Press [scroll] to select **'CRTL.C'** 5. Press [▲] or [▼] to select the **cooling type**		Cooling Type choices are:- OFF No cooling output configured PId PID (3 term) control OnOFF On/Off control
6. Press [scroll] to select **'CTRL.A'** 7. Press [▲] or [▼] to 'rEu'		Control Action choices are:- rEu Reverse - heating control dir Direct - cooling only control
8. Press [scroll] 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 [scroll] 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.

8. 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 8.1.1) – to allow external devices to be operated when an alarm occurs. Alarms only operate if they have been ordered and configured.

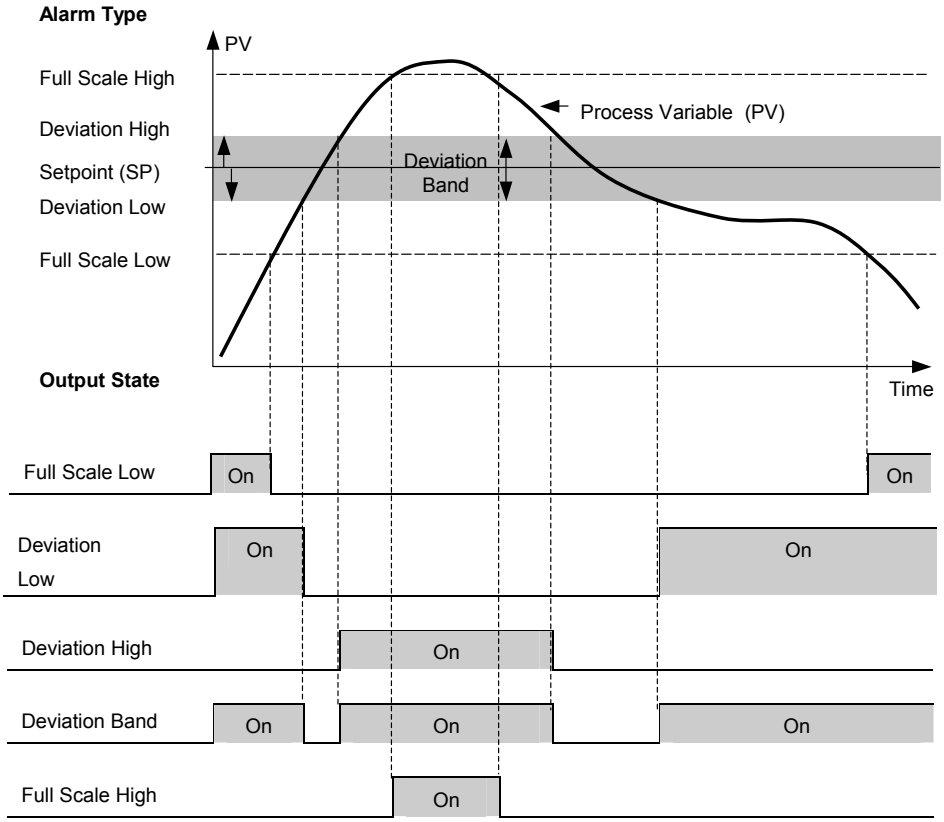
Up to seven different alarms are available:-

- 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 5)

Events are indication only but can operate an output. They can also be configured, using the editing tool (iTools), to provide scrolling text messages on the display.

8.1 TYPES OF ALARM USED IN THE 3200 CONTROLLER

This section shows graphically the operation of different types of alarm used in the controller. The graphs show changes in PV 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.

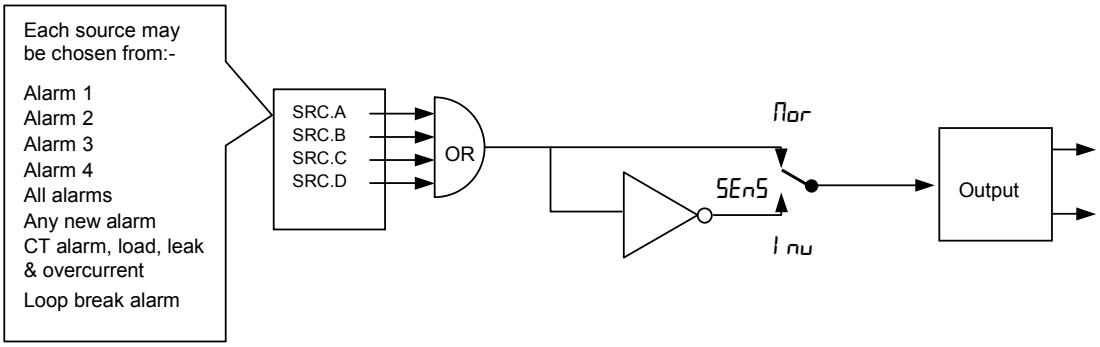
Latching Alarm — is used to hold the alarm condition once an alarm has been detected. It may be configured as:-

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 and a scrolling message will appear if this has been configured.

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, for example, to ignore start up conditions which are not representative of running conditions. A blocking alarm is re-initiated after a setpoint change.

8.1.1 Alarm Relay Output

As explained in section 5, 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.



8.1.2 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

8.1.3 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 8.1.

8.2 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 Hi Lo dHi dLo bnd	Alarm not configured Full Scale High Full Scale Low Deviation High Deviation Low Deviation band	As order code	Conf
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 output	OFF On	Alarm output deactivated Alarm output activated		
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 AUto mAn EvE	Non latching Automatic Manual Event (no alarm flashing beacon but messages can be displayed)	As order code	Conf
A1.BLK	ALARM 1 BLOCKING	See description at the beginning of this section	no YES	No blocking Blocking	no	Conf
The above parameters are repeated for Alarm 2, A2; Alarm 3, A3; Alarm 4, A4						

8.2.1 Example: To Configure Alarm 1

Enter configuration level as described. Then:-

Do This	The Display You Should See	Additional Notes
1. Press [page] as many times as necessary to select 'ALARM'		
2. Press [scroll] to select 'A1.TYP' 3. Press [up] or [down] to select the required alarm type		Alarm Type choices are:- OFF Alarm not configured Hi Full Scale High Lo Full Scale Low dHi Deviation High dLo Deviation Low bnd Deviation Band
4. Press [scroll] to select 'A1.---' 5. Press [up] or [down] 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 [scroll] to select 'A1STS'		This is a read only parameter which shows the status of the alarm output
7. Press [scroll] to select 'A1HYS' 8. Press [up] or [down] 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 [scroll] to select 'A1LAT' 10. Press [up] or [down] 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 [scroll] to select 'A1BLK' 12. Press [up] or [down] to 'YES' or 'No' 13. Repeat the above to configure alarms 2, 3 and 4 if required		

8.3 DIAGNOSTIC ALARMS

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

Display shows	What it means	What to do about it
EConF	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.
ECAL	Calibration error	Re-instate Factory calibration
E2Er	EEPROM error	Return to factory for repair
EEEr	Non-vol memory error	Note the error and contact your supplier
ELin	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

9. Timer

A timer can be configured to operate in three different modes. These can be selected in Level 3 or configuration level.

1. Dwell timer
2. Delayed switch on timer
3. Soft start timer

For clarity the operation of each type of timer is shown individually in the following pages in this section.

There are four operating states, all available in Level 1

Reset
Run
Hold
End

Run press ▲ and ▼ together.

Reset (of End State) when timer has timed out, press 🗋 and ↺ (Ack),

Reset, during timing, press and hold ▲ and ▼ (for more than 2 seconds)

Hold press ▲ and ▼ . Quickly pressing these buttons together toggles between Run and Hold

The above states may also be set by the following methods:-

- Edge trigger a suitably configured digital input
- Power cycle the controller – a soft start timer starts automatically on power up
- Digital communications command

End cannot be set - it occurs automatically when the timer has counted down to zero

Switching from Hold to Run through the front panel buttons is not allowable if the Hold status is forced by a logic input.

Timer operation is indicated by a beacon labelled RUN:

RUN beacon	Timer Status	Default Message
Off	Reset	
On	Run	TIMER RUNNING
Flashing	Hold	TIMER HOLD
Off	End	TIMER END

Logic outputs The timer may be configured to operate an output while it is running or during the end state

Notes:-

- **Power up** –

Type of Timer	Soft Start	Delay	Dwell
Start up State	RUN	RUN	RESET

- **Auto/Manual** is only available when the timer is in Reset
- **Ramp Rate** – it is recommended that ramp rate is used only with a Dwell type timer
- Quick access to the timer operating parameters is available in Level 2 by pressing ↺. Repeat pressing of this button shows Timer Status, Dwell, Working Output, SP1, SP2, etc

9.1 DWELL TIMER

A dwell timer is used to control a process at a fixed temperature for a defined period.

The action which occurs at the end of the timed period depends on the configuration of other parameters and will be described in the following pages.

9.1.1 Example: End Type (End.T) = OFF Setpoint 1 (SP1) = 70°C

If the End Type is configured as OFF, the controller outputs go to zero at the end of the period.

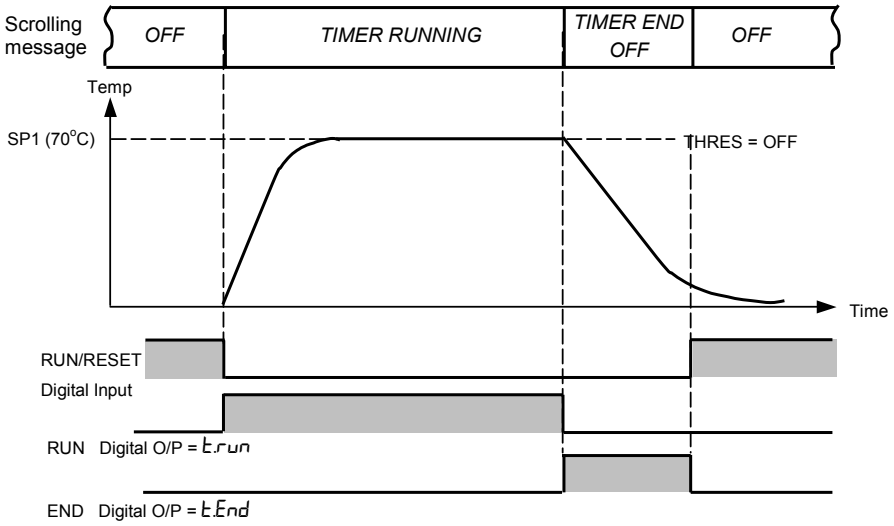


Figure 9-1: Dwell Timer, End Type OFF, Threshold OFF

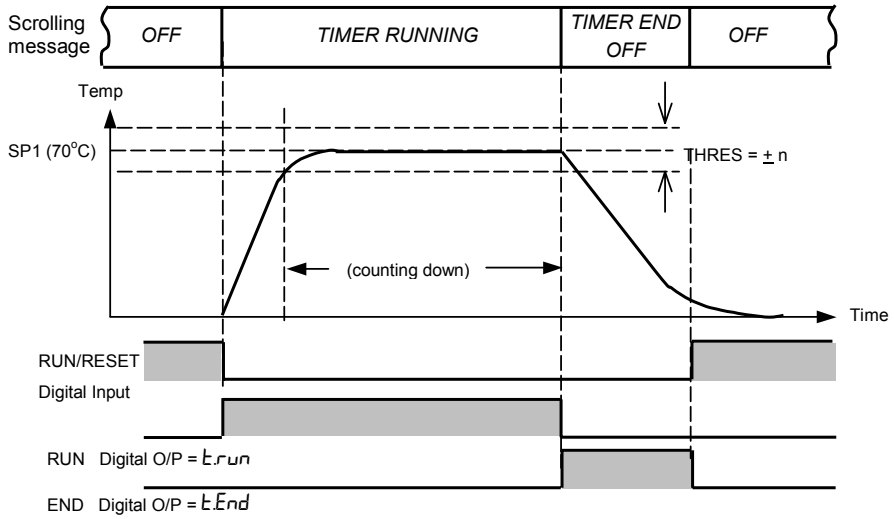


Figure 9-2: Dwell Timer, End Type OFF, Threshold Set to a Value (±n)

Notes:

1. If THRES = 2° (for example) timer will display the message 'TIMER RUNNING' and RUN beacon will be on but will not start counting down until temp is initially within 2° of SP
2. The DWELL period can be reduced or increased when the timer is running. If it is reduced to meet the Time Elapsed the timer will change to the End state. .
3. A-M can only be selected when in reset
4. If the timer is re-configured to a different type or the End Type is re-configured (a dwell, for example), it is necessary to press ▲ and ▼ together to enter Auto/Manual mode. Then press ▲ to change from OFF mode to Auto. The timer can then be re-run in its new configuration.

9.1.2 Example: End Type (End.T) = Dwell Setpoint 1 (SP1) = 70°C

If the End Type is configured as Dwell, control will continue at the end of the time period. An external device can be triggered when END is reached.

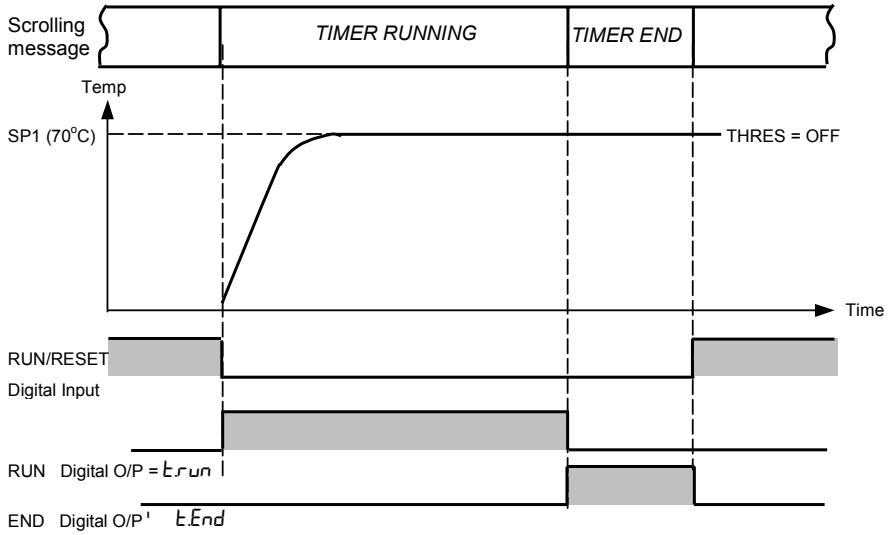
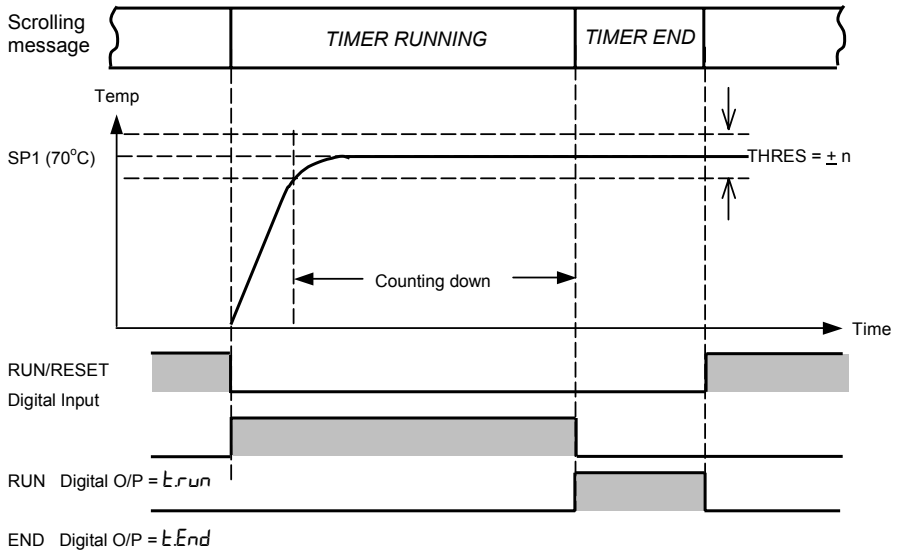


Figure 9-3: Dwell Timer, End Type Dwell, Threshold OFF



☺ The timer does not start to count down until the PV reaches the deviation set by the threshold value

Figure 9-4: Dwell Timer, End Type Dwell, Threshold Set to a Value

9.1.3 Example: End Type (End.T) = SP2 = 20°C Setpoint 1 (SP1) = 70°C

If the End Type is configured as SP2 the process will control at this setpoint at the end of the period.

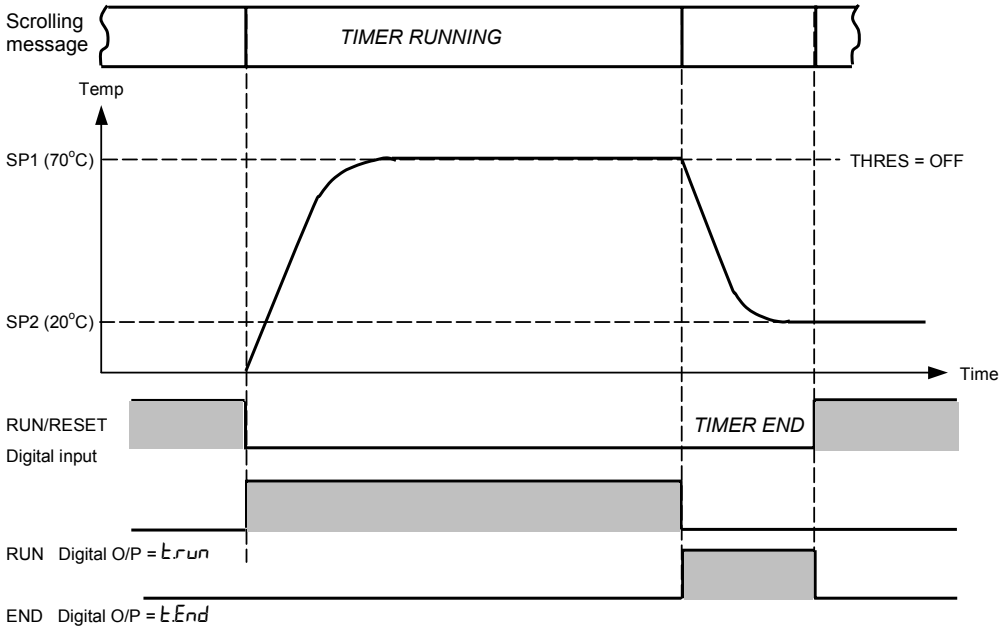
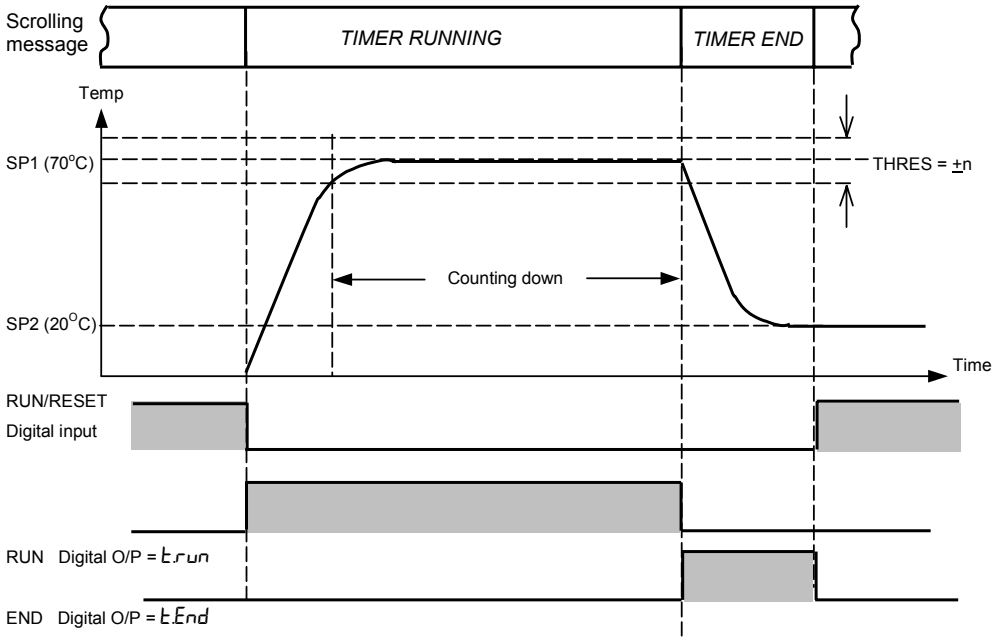


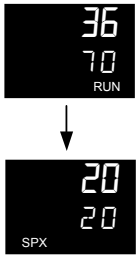
Figure 9-5: Dwell Timer, End Type SP2, Threshold OFF



☺ The timer does not start to count down until the PV reaches the deviation set by the threshold value

Figure 9-6: Dwell Timer, End Type SP2, Threshold Set to a Value

9.1.4 To Run a Dwell Type Timer

Do This	The Display You Should See	Additional Notes
1. Momentarily press ▲ and ▼ together		RUN beacon on Controller heating towards SP1 (70°C) Scrolling display 'TIMER RUNNING' When timed out. Scrolling display 'TIMER END' RUN beacon off The control action and display depend on the End Type:
		The timer can be run again from this point
2. Press 🗋 and ↻ (Ack) together to reset the timer		RUN beacon off TIMER END message cancelled The control action and display depend on the End Type as shown above The timer can be run again from this point

End.T	Control Action	Display
OFF	Control outputs at zero	OFF
Dwell	Controlling as set by SP1	Value of SP1 (70°C)
SP2	Controlling as set by SP2	Value of SP2 (20°C) SPX beacon on

9.1.5 To Hold the Timer

While the timer is running it can be put into Hold (timer stops counting down)

Do This	The Display You Should See	Additional Notes
3. Momentarily press ▲ and ▼ together		RUN beacon flashing Scrolling display 'TIMER HOLD' Controller heating towards SP1 (70 °C) If End.T = OFF or Dwell the 'TIMER HOLD' message scrolls
4. Momentarily press ▲ and ▼ together to run the timer from the hold condition		RUN beacon on Scrolling display 'TIMER RUNNING' Controller continues heating towards SP1 (70 °C)

9.1.6 To Reset the Timer

While the timer is running it can be Reset

Do This	The Display You Should See	Additional Notes
5. Press and hold ▲ and ▼ together)		The control action and display depend on the End Type as shown above If reset T.REMN and T.ELAP stay at their values prior to reset. These reset to their start values when the timer is run again

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

In this mode a ramp/dwell, ramp/dwell programmer is configured. 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 .

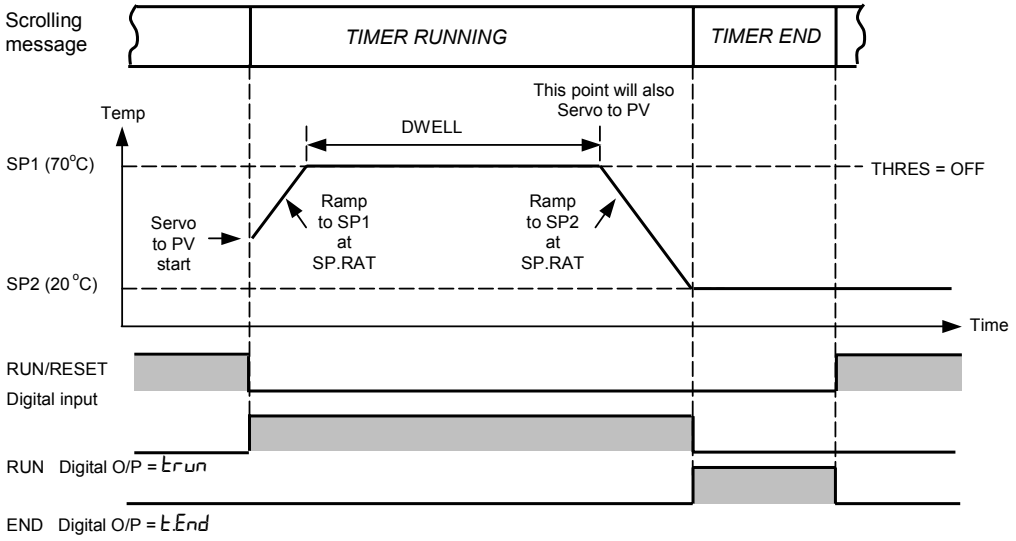


Figure 9-7: Dwell Timer, End Type SP2, Threshold OFF

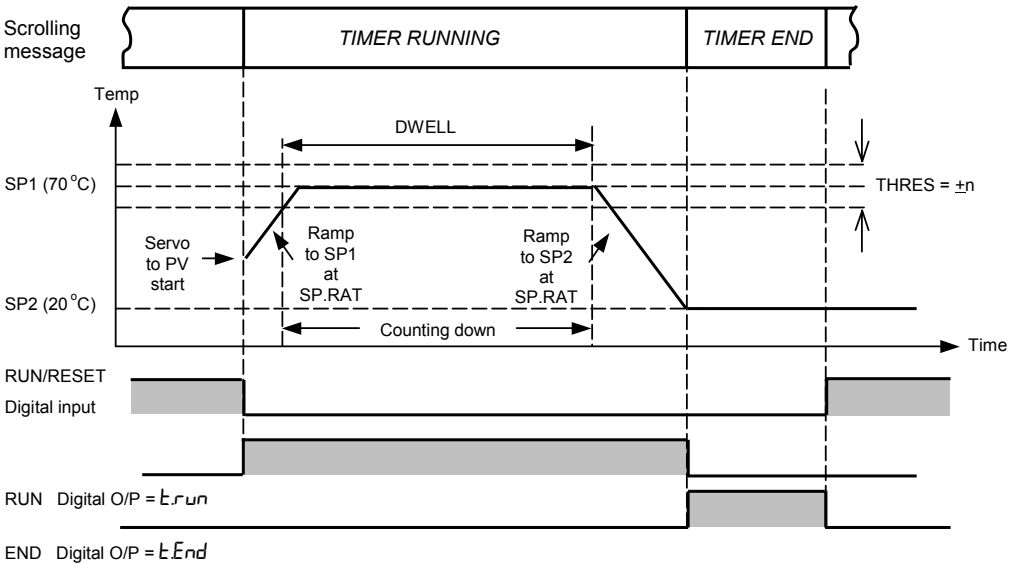


Figure 9-8: Dwell Timer, End Type SP2, Threshold Set to a Value

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

9.1.8 To Run a Timer Configured as a Simple Programmer

At start of run controller servos to PV and , therefore, starts at the current temperature

Do This	The Display You Should See	Additional Notes
1. Momentarily press ▲ and ▼ together		RUN beacon on Scrolling display 'TIM ER RUNNING' Controller ramping up to SP1 (70°C) at the set rate (20/min max - for this example) When SP1 reached the controller will control at this temperature until the end of the DWELL period set. This is from the point at which the timer was set to run. To ensure the dwell starts from SP1 (or close to) set THRES = a small value (eg2) When timed out Scrolling display 'TIM ER END' will be indicated Controller ramp to SP2 (20 °C) at the set rate (20 °C /min max - for this example) SPX beacon on
2. Press 🗋 and ⟳ (Ack) together to reset the timer		RUN beacon off Controller controlling at SP2 (20 °C) TIMER END message cancelled SPX beacon on (indicating control at SP2) The timer can be run again from this point

9.1.9 To Hold the Timer

While the timer is running it can be put into Hold (timer stops counting down)

Do This	The Display You Should See	Additional Notes
3. Momentarily press ▲ and ▼ together		RUN beacon flashing Scrolling display 'TIM ER HOLD' Controller controlling at SP1 (70 °C)
4. Momentarily press ▲ and ▼ together to run the timer from the hold condition		RUN beacon on Scrolling display 'TIM ER RUNNING' Controller continues controlling at SP1 (70 °C)

9.1.10 To Reset the Timer

While the timer is running it can be Reset

Do This	The Display You Should See	Additional Notes
5. Press and hold ▲ and ▼ together		When the timer is running it cannot be reset using the Ack button(s) since pressing these will return the display to the HOME display If reset T.REMN and T.ELAP stay at their values prior to reset. These reset to their start values when the timer is run again

9.2 DELAYED SWITCH ON TIMER

9.2.1 Example: Timer Cfg = Dely Setpoint 1 (SP1) = 70°C

The timer is used to switch on the controller output power after a fixed length of time. It could be used to turn on a process at a particular time.

It is initiated by any of the following:

- Switching on power
- Momentarily pressing ▲ and ▼ together
- Setting the parameter T.STAT to run
- A command through serial communications
- A logic input suitably configured

When the timer status = run, the control output is off

When the timer status = reset, the control output is controlling

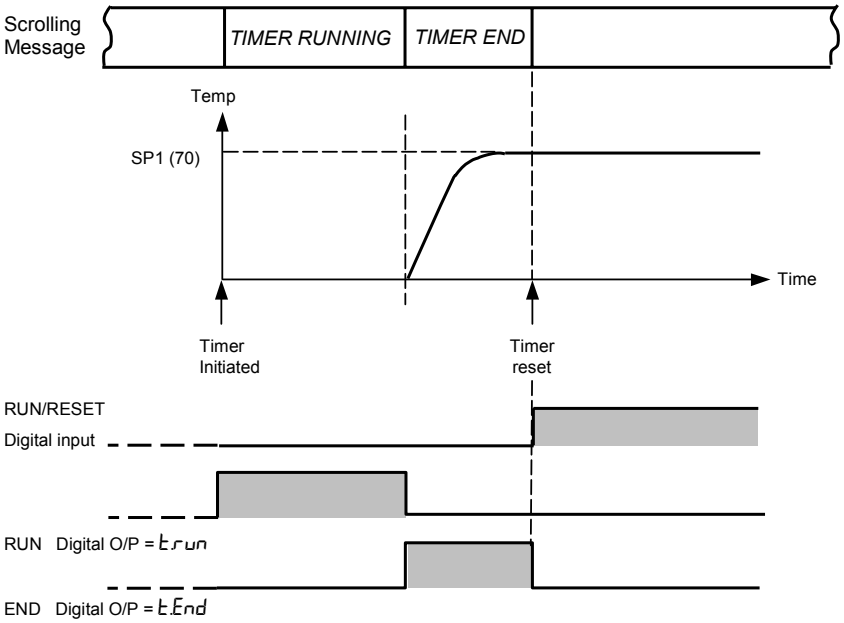
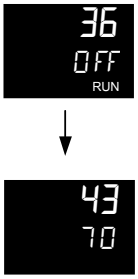


Figure 9-9: Delayed Start Timer

9.2.2 To Run a Delayed Switch-on Timer

At start of run controller switches to OFF mode.

Do This	The Display You Should See	Additional Notes
1. Momentarily press ▲ and ▼ together		RUN beacon on Scrolling display alternates between 'TIM ER RUNNING' and 'END' Controller heating towards the setpoint (70°C) Scrolling display 'TIM ER END' When timed out TIMER END will be indicated RUN beacon off Any digital output configured as t.End will operate Any digital output configured as t.run will cancel
2. Press 🗋 and ↻ (Ack) together to reset the timer		Controller continues to control at setpoint (70 °C) TIMER END message cancelled Any digital output configured as t.End will cancel The timer can be run again from this point

9.2.3 To Hold the Timer

While the timer is running it can be put into Hold (timer stops counting down)

Do This	The Display You Should See	Additional Notes
3. Momentarily press ▲ and ▼ together		RUN beacon flashing Scrolling display 'TIM ER HOLD' Controller not controlling It is possible to reset the timer when in hold by pressing and holding ▲ and ▼ or a digital input etc. It cannot be reset using Ack.
4. Momentarily press ▲ and ▼ together to run the timer from the hold condition		RUN beacon on Scrolling display 'TIMER RUNNING' Controller controlling at setpoint (70 °C)

9.2.4 To Reset the Timer

While the timer is running it can be Reset

Do This	The Display You Should See	Additional Notes
5. Press and hold ▲ and ▼ together		If reset T.REMN and T.ELAP stay at their values prior to reset. These reset to their start values when the timer is run again

9.3 SOFT START TIMER

9.3.1 Example: Timer Cfg = SF.ST Setpoint 1 (SP1) = 70°C
Soft Start SP (SS.SP) = 50°C Soft Start Power (SS.PWR) = 40%

The timer is used to start a process at reduced power and/or reduced setpoint. It may be used where it is required to dry out a heater before applying full power, such as hot runner applications.

It is initiated by any one of the following:

- Switching on power
- Pressing ▲ and ▼ together
- Setting the parameter T.STAT to run
- A command through serial communications
- A logic input suitable configured

When the timer status = run, the control output is limited to a reduced start up power until parameter SS.SP is exceeded. If the PV is already greater than SS.SP the reduced power limit is not applied and the timer times out.

When the timer status = reset, the control output is controlling at a level limited by the output high and low limits.

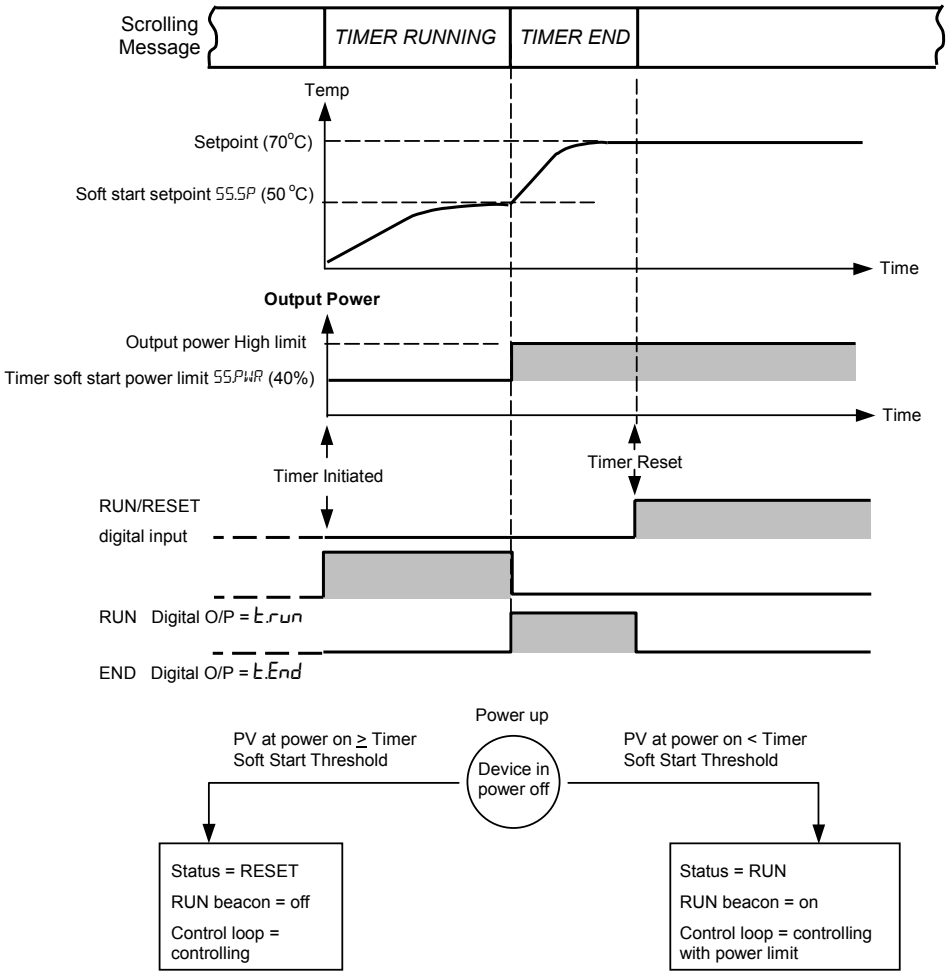


Figure 9-10: Soft Start Time

9.3.2 To Run a Soft Start Timer

At start of run controller selects the soft start setpoint and limits the power to the timer soft start power limit.

Do This	The Display You Should See	Additional Notes
1. Momentarily press ▲ and ▼ together **The timer will not count down if the PV is greater than SP2**	 ↓ 	RUN beacon on Scrolling message 'TIM ER RUNNING' SPX beacon on Controller controlling to soft start setpoint Output power limited (40%) Any digital output configured as t.run will operate ↓ When timed out Scrolling display 'TIM ER END' will be indicated Timer end will occur at the end of the Dwell period set even if the soft start temperature has not been reached Controller controlling at the setpoint (70) °C RUN beacon off Any digital output configured as t.End will operate Any digital output configured as t.run will cancel
2. Press 🗋 and ↻ (Ack) together to reset the timer		Controller continues to control at setpoint (70 °C) TIMER END message cancelled Any digital output configured as t.End will cancel The timer can be run again from this point

9.3.3 To Hold the Timer

While the timer is running it can be put into Hold (timer stops counting down)

Do This	The Display You Should See	Additional Notes
3. Momentarily press ▲ and ▼ together		RUN beacon flashing Scrolling display 'TIM ER HOLD' Controller controlling to soft start setpoint (50 °C) It is possible to reset the timer when in hold by pressing and holding ▲ and ▼ or a digital input etc. It cannot be reset from Ack.
4. Momentarily press ▲ and ▼ together to run the timer from the hold condition		RUN beacon on Scrolling display 'TIM ER RUNNING' Controller controlling at soft start setpoint (50 °C)

9.3.4 To Reset the Timer

While the timer is running it can be Reset

Do This	The Display You Should See	Additional Notes
5. Press and hold ▲ and ▼ together		If reset T.REMN and T.ELAP stay at their values prior to reset. These reset to their start values when the timer is run again

9.4 TIMER PARAMETERS

The following parameters are available to set up the different timers:-

TIMER LIST 'TIMER'						
Name	**Scrolling Display**	**Parameter Description**	**Value**		**Default**	**Access Level**
TM.CFG	TIMER CONFIGURATION	Timer type configuration	nonE dwEll dELY SFSt	Timer disabled Dwell Delayed switch on Soft start	As order code	L3
TM.RES	TIMER RESOLUTION	To set the time units	Hour min	Hours HH:MM Minutes MM:SS		Conf R/O in L3
THRES	TIMER START THRESHOLD	To set the maximum deviation between SP and PV before the timer starts. Units above and below setpoint **Dwell timer only**	Off or 1 to 3000			L3
ENT.T	TIMER END TYPE	To determine the action which takes place when the timer has timed out. **Dwell timer only**	OFF dwEll SP2	Control outputs go to zero % Control continues at SP1 Go to setpoint 2		Conf
SS.SP	SOFT START SETOINT	Seta the threshold which determines if the power must be 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 run hoLd End	Reset Running (counting) Running (hold) Timed out		L3
DWELL	SET TIMER DURATION	To set the time duration	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. The timer can be restarted from the Reset condition by changing the time remaining parameter.	0:00 to 99.59 hh:mm or mm.ss			L3

9.5 EXAMPLE: TO CONFIGURE A TIMER AS A SIMPLE TWO STEP PROGRAMMER

The example shown in 9.1.7 will be used with the controller 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:-

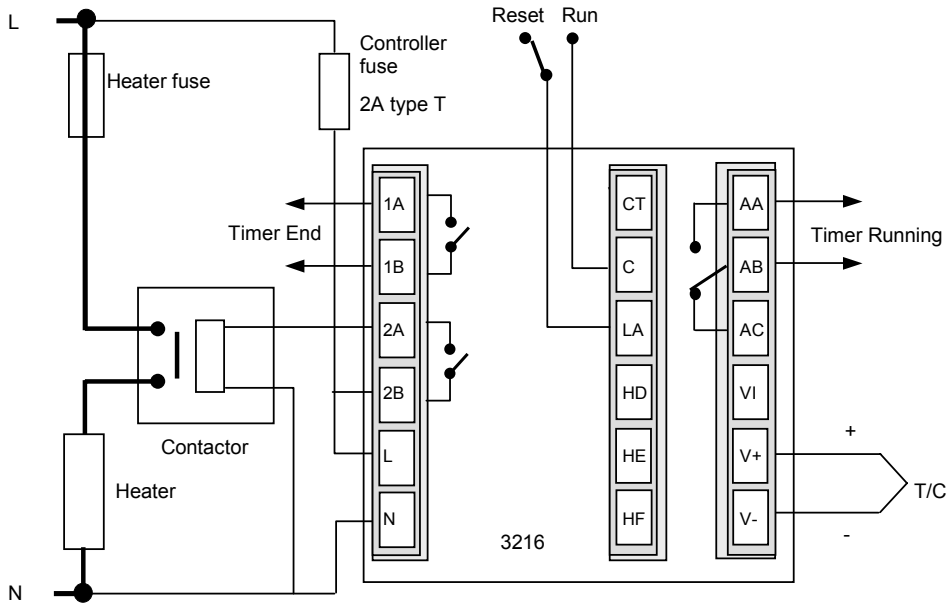


Figure 9-11: Wiring Diagram

Configure the I/O

Enter configuration level described in section 2.1.3. Then:-

Do This	The Display You Should See	Additional Notes
1. Press [page] as many times as necessary to select '**io-1**'		To configure the timer end digital output signal Scrolling display 'io-1 LIST'
2. Press [scroll] (twice) to select '**1.FUNC**' 3. Press [▲] or [▼] to choose **d.out**		Scrolling display 'io-1 FUNCTION'
4. Press [scroll] to scroll to '**1.SRC.A**' 5. Press [▲] or [▼] to choose **t.End**		Also 1SRC.B 1.SRC.C 1.SRC.D =**nonE** and 1SENS =**nor** to energise the relay when the timer is in the end state Scrolling display 'io-1 SOURCE'
6. Press [page] 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 = 50 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 trun		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'

Configure the timer

Do This	The Display You Should See	Additional Notes
14. 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'
15. Press to select 'TM.CFG' 16. Press or to choose dwEll		Also TM.RES = min or Hour as required Scrolling display 'TIMER CONFIGURATION'
17. Press to select 'THRES' 18. Press or to choose 2		To ensure the dwell starts when PV reaches 2° of setpoint Scrolling display 'TIMER START THRESHOLD'
19. Press to select 'END.T' 20. Press or to choose SP2		Also set DWELL to the time period required Scrolling display 'TIMER END TYPE'
21. Return to Level 3 and operate the timer as previously described in section 9.1.8		

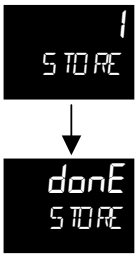
10. Recipe

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 10.3.1.

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.

10.1 TO SAVE VALUES IN A RECIPE

Do This	The Display You Should See	Additional Notes
1. Press [Page] as many times as necessary to select 'RECIP'		Scrolling display RECIPE LIST
2. Press [Scroll] 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 If a recipe number is chosen which has not been saved then FAIL will be displayed

10.2 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 [Page] to scroll to 'CTRL'		Scrolling display CONTROL LIST
2. Press [Scroll] to scroll to PB 3. Press [▲] or [▼] to change the value eg 22		Scrolling display PROPORTIONAL BAND
4. Press [Page] to scroll to 'RECIP		Scrolling display RECIPE LIST
5. Press [Page] to 'STORE 6. Press [▲] or [▼] to 2		Scrolling display RECIPE TO SAVE

10.3 TO SELECT A RECIPE TO RUN

Do This	The Display You Should See	Additional Notes
1. Press [Page] as many times as necessary to select 'RECIP'		Scrolling display RECIPE LIST
2. Press [Scroll] 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 used

10.3.1 List of Default Recipe Parameters:

Instrument resolution is always saved and restored, as are instrument 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		

11. 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 present on 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.

11.1 DIGITAL COMMUNICATIONS WIRING

11.1.1 RS232

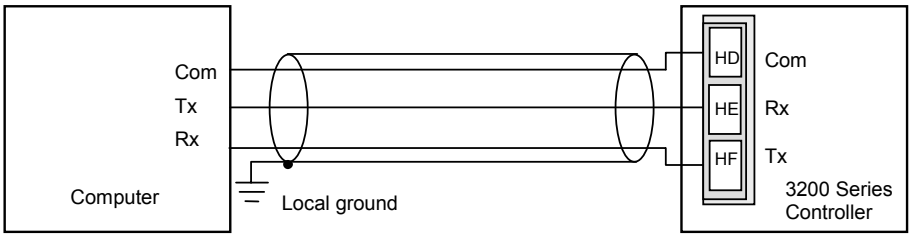
To use RS232 the PC will be equipped with an RS232 port, usually referred to as COM 1.

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 Colour	PC socket pin no.		PC Function *	Instrument Terminal	Instrument Function
	9 way	25 way			
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.



11.1.2 RS485

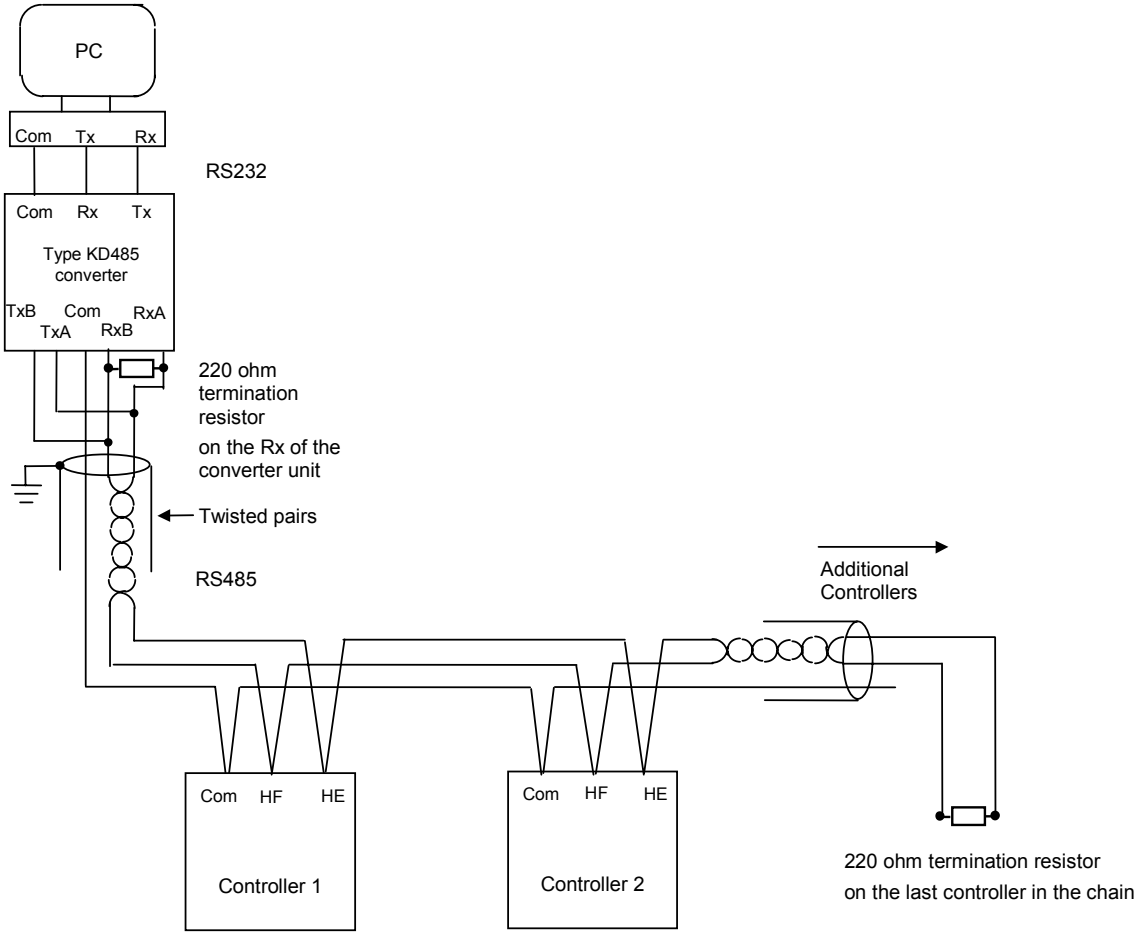
To use RS485, buffer the RS232 port of the PC with a suitable RS232/RS485 converter. The Eurotherm Controls KD485 Communications Adapter unit is recommended for this purpose. The use of a RS485 board built into the computer is not recommended since this board may not be isolated, which may cause noise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



11.2 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 r232 r485	No module fitted RS 232 Modbus interface RS485 Modbus interface	As order code	Conf L3 R/O
ADDR	COMMUNICATIONS ADDRESS	Communications address of the instrument	1 to 254		1	L3
BAUD	COMMUNICATIONS BAUD RATE	Communications baud rate	1200 2400 4800 9600 19.20	1200 2400 4800 9600 19,200	9600	Conf L3 R/O
PRTY	COMMUNICATIONS PARITY	Communications parity	none EuEn Odd	No parity Even parity Odd parity	none	Conf L3 R/O
DELAY	RX/TX DELAY TIME		OFF on	No delay Fixed delay. This inserts a delay between Rx and Tx to ensure that drivers have sufficient time to switch over.		Conf L3 R/O

11.3 EXAMPLE TO SET UP INSTRUMENT ADDRESS

This can be done in operator level 3:-

Do This	The Display You Should See	Additional Notes
1. Press [page] as many times as necessary to select **'COMMS LIST'**		Scrolling display 'COMMS LIST'
2. Press [scroll] to scroll to **'ID'** 3. Press [▲] or [▼] to select RS232 or RS485 comms		Scrolling display 'ID'
4. Press [scroll] 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 available on www.eurotherm.co.uk

11.4 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 continously 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 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

Parameter Mnemonic	Parameter Name	Modbus Address
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 continously 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 in preference.***	24
SP2	Setpoint 2 ***NB – do not write continously 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 in preference.***	25
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
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 – not used B15 – Autotune Status In each case, a setting of 1 signifies ‘Active’, 0 signifies ‘Inactive’.	75

Parameter Mnemonic	Parameter Name	Modbus Address
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 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
LK.AMP	Measured Leakage Current	111
SP.HI	Setpoint High Limit	111
SP.LO	Setpoint Low Limit	112
ADDR	Comms Address	131
PV.OFS	PV Offset	141
C.Adj	Calibration Adjust	146
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
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

Parameter Mnemonic	Parameter Name	Modbus Address
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	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
CTRL.H	Heat/Ch1 Control Type 0 – Off 1 – On/Off Control 2 – PID Control	512
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
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	524

Parameter Mnemonic	Parameter Name	Modbus Address
	2 – Water 3 – Fan	
DEC.P	Decimal Point Position 0 – XXXX. 1 – XXX.X 2 – XX.XX	525
uCAL	User Calibration Enable	533
A1.TYP	Alarm 1 Type 0 – Off 1 –Absolute High 2 – Absolute Low 3 – Deviation High 4 – Deviation Low 5 – Deviation Band	536
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
Sb.tyP	Sensor Break Type 0 – No Sensor Break 1 – Non-Latching Sensor Break	578

Parameter Mnemonic	Parameter Name	Modbus Address
	2 – Latching Sensor Break	
CT.RNG	CT Range	604
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	768
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
K.LOC	 Allows instrument to be locked via a key/digital input (0 = unlocked, 1 = locked)	1104
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.typP	CJC Type 0 – Auto 1 – 0 Degrees C	12291
mV.HI	Linear Input High	12306
mV.LO	Linear Input Low	12307
L.TYPE	Logic Input channel hardware type 0 – None 1 – Logic Input	12352
L.D.IN	Logic input function 40 – None 41 – Acknowledge all alarms 42 – Select SP1/2	12353

Parameter Mnemonic	Parameter Name	Modbus Address
	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 (0 = Normal, 1 = Inverted)	12361
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
Ct.Id	Current Transformer	12608
CT.SRC	CT Source 0 – None 1 – IO1 2 – OP2 8 – AA (OP4)	12609
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	12673

Parameter Mnemonic	Parameter Name	Modbus Address
	48 – Auto/Manual Select 49 – Standby Select	
1.Func	I/O Channel Function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat 3 – Cool 4 – Digital Input	12675
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
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 3 – Cool	12739
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	1277

Parameter Mnemonic	Parameter Name	Modbus Address
4.TYPE	Output AA Type 0 – None 1 – Relay	13056
4.FUNC	Output 4 Channel function 0 – None (or Telemetry Output) 1 – Digital Output 2 – Heat 3 – Cool	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

12. 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 4.2 and 4.3.

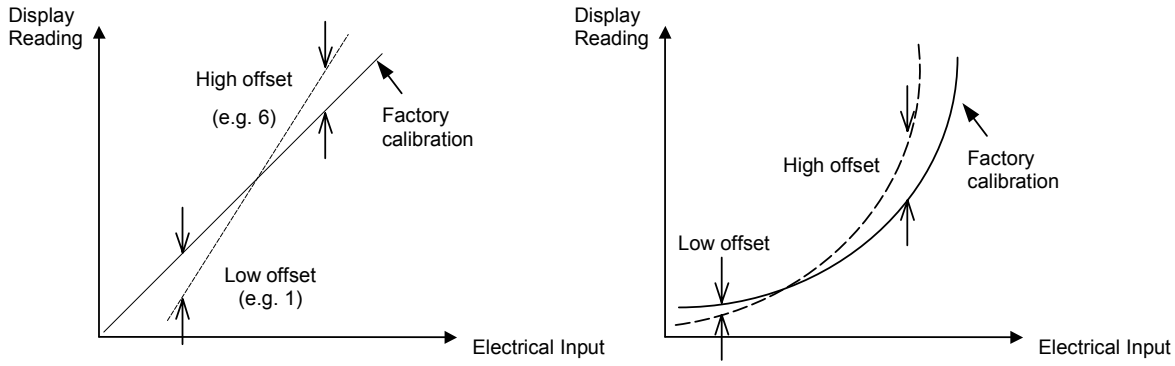
It is also possible to adjust the low and high points as a two point offset. This is done in Level 3 in the CAL list and is described in this section.

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

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

12.1 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	The Display You Should See	Additional Notes
1. Select Level 3 as described in Chapter 2. Then press [page] to select 'CAL'	CAL	
2. Press [scroll] 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 [scroll] 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		

12.2 INPUT CALIBRATION

Inputs which can be calibrated:-

- **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

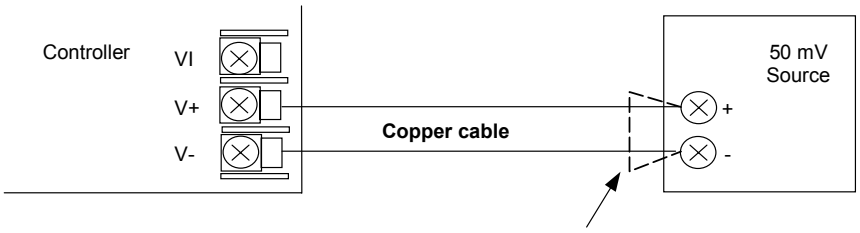
12.3 PRECAUTIONS

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

1. RTD and CJC calibration must not be carried out without prior mV calibration.
2. 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.
3. 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.
4. Allow at least 10 minutes for the controller to warm up after switch on.

12.3.1 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

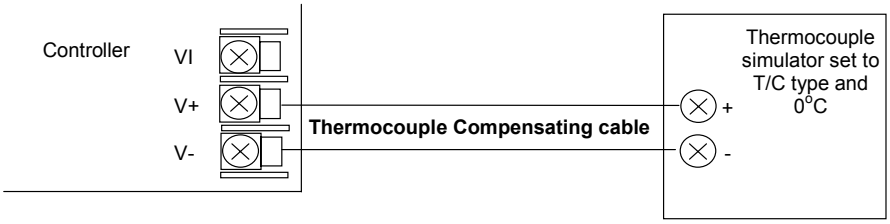
Set the controller input to mV range, then:-

Do This	The Display You Should See	Additional Notes
1. From any display press [page] as many times as necessary until the '**CAL**' page header is displayed.		Scrolling display 'CALIBRATION LIST'
2. Press [scroll] to select '**PHASE**'		Scrolling display 'CALIBRATION PHASE'
3. **Set mV source for 0mV**		
4. Press [up] or [down] to choose '**0**'		
5. Press [scroll] to select '**GO**' 6. Press [up] or [down] to choose '**YES**'	  	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 [scroll] to select '**PHASE**' 9. Press [up] or [down] to choose '**50**' 10. Repeat 5 and 6 above to calibrate the high point		The controller will again automatically calibrate to the injected input mV. If it is not successful then 'FAIL' will be displayed

12.3.2 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	The Display You Should See	Additional Notes
1. From the mV calibration, press ▲ or ▼ to select 'CJC'		
2. Press ↻ to select 'GO' 3. Press ▲ or ▼ to choose 'YES'	  	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

12.3.3 RTD Calibration

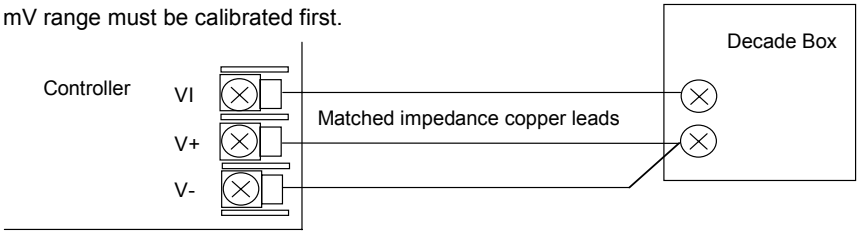
The two points at which the RTD range is calibrated are 150.00Ω and 400.00Ω.

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:

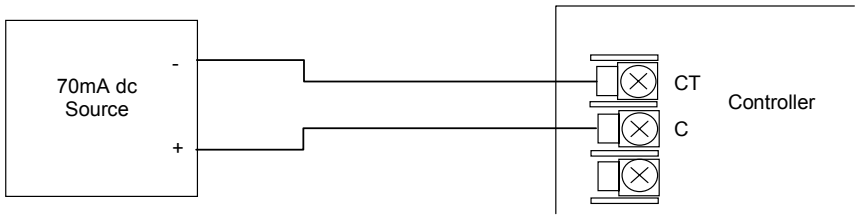
- The mV range must be calibrated first.



Do This	The Display You Should See	Additional Notes
1. From any display press [D] as many times as necessary until the '**CAL**' page header is displayed.		Scrolling display '*CALIBRATION LIST*'
2. Press [G] to select '**PHASE**'		Scrolling display '*CALIBRATION PHASE*'
3. **Set the decade box for 150.00Ω**		
4. Press [▲] or [▼] to choose '**150R**'		
5. Press [G] to select '**GO**' 6. Press [▲] or [▼] to choose '**YES**'	  	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**'		
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

12.3.4 CT Calibration

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



Do This	The Display You Should See	Additional Notes
1. From the **'CAL'** list header press [⟳] to select **'PHASE'** 2. Press [▲] or [▼] to choose 'Ct 0'		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'	  	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'		
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

12.3.5 To Return to Factory Calibration

Do This	The Display You Should See	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

12.4 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**
PHASE	CAL PHASE	To calibrate low and high offset See also section 4.2.2	nonE	Not selected		
			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		
GO		To start the calibration sequence	nO			
			YES	Start		
			buSY	Calibrating		
			PASS	Calibration successful		
			FAiL	Calibration unsuccessful		

13. Appendix A 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.

INSTALLATION SAFETY REQUIREMENTS

Safety Symbols

Various symbols are used on the instrument, 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 installed in an enclosure.

Caution: Live sensors

The controller is designed to operate with the temperature sensor 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. The device should be mounted in close proximity to the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

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, install an air filter to the air intake of the cabinet. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the cabinet.

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

Installation Category 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 EMC Installation Guide, HA025464.
- When using relay outputs it may be necessary to fit a filter suitable for suppressing the conducted emissions. The filter requirements will depend on the type of load. For typical applications we recommend Schaffner FN321 or FN612.
- If the unit is used in 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.

14. Appendix B TECHNICAL SPECIFICATION

Analogue Input

	Sample rate	4Hz (250mS)
	Calibration accuracy	±0.25% of reading
	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)
	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 or alarms
Logic	Rating	On/High 12Vdc at 5 to 44mA
		Off/Low <100mV <100µA
	Application	Heating, cooling, alarms or event

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
	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

Alarms

	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	110 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: 14 to 158°F (-10 to 70°C)
Panel sealing	IP 65, plug-in from front panel
	Safety standards EN61010, installation category 2 (voltage transients must not exceed 2.5kV)
Electromagnetic compatibility	EN61326-1 Suitable for domestic, commercial and light industrial as well as heavy industrial environments. (Class B emissions, Industrial Environment immunity).

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