3216 PID Temperature Controller

Installation and Basic Operation

1. WHAT INSTRUMENT DO I HAVE?

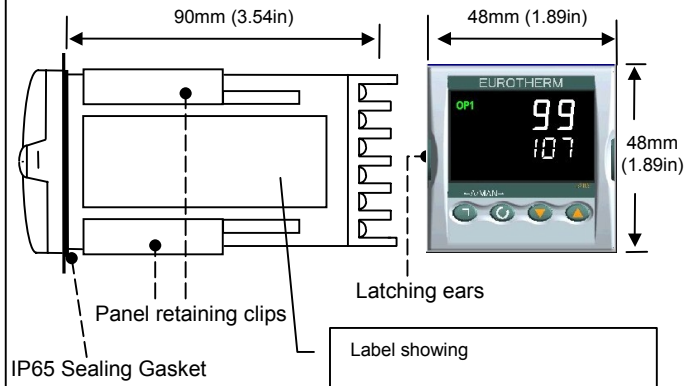
Thank you for choosing the 3216 Temperature Controller.

This User Guide takes you through step by step instructions to help you to install, wire, configure and use the controller. For features not covered in this User Guide, a detailed Engineering Manual, Part No HA027986, and other related handbooks can 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 at the bottom of this page.

1.1. Dimensions



Label showing

Order Code

Serial Number including date of manufacture

1.2. 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°C (32 - 122°F)

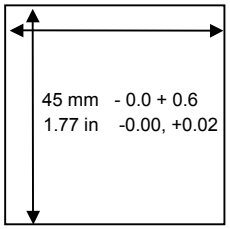
The instrument can be mounted on a panel up to 15mm thick

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

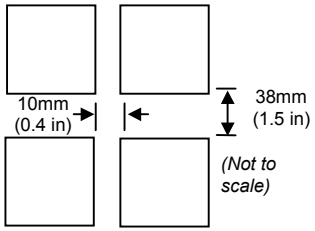
Please read the safety information in section 4 before proceeding and refer to the EMC Booklet part number HA025464 for further installation information.

1.2.1. Panel Mounting the Controller

1. Prepare a square cut-out in the mounting panel to the size shown
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 display



Recommended minimum spacing of controllers



1.2.2. 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.

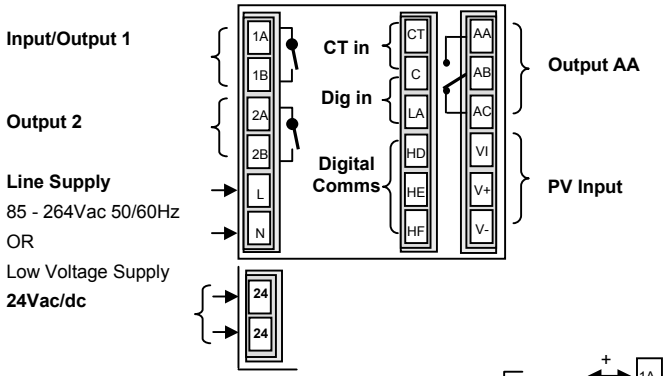
3. STEP 2: WIRING

3.1. Terminal Layout

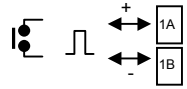
Warning

Ensure that you have the correct supply for your controller

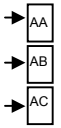
Check order code of the controller supplied



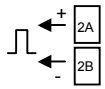
Input/Output 1 Relay or Logic Output or Digital Input



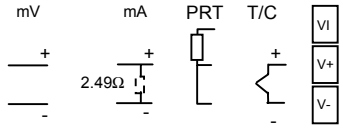
Output AA
Changeover Relay



Output 2
Relay or Logic

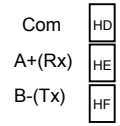


PV Input
Thermocouple, PRT, mA or mV



Digital Communications

RS232 Connect directly to comms port of PC
RS485 Daisy chain to further controllers/comms converter



2. ORDER CODE

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

Power Supply	
20 – 29V	VL
110 –240V	VH

Input/output 1 & Output 2		
OP1	OP2	
L	X	Logic I/O
L	L	Logic I/O + logic OP
L	R	Logic I/O + relay
R	R	Relay + relay
X	X	Not fitted

Output AA	
Relay (Form C)	R
Not fitted	X

Communications, CT & Digital input			
X	X	X	Not fitted
4	X	L	RS485 comms & dig in
2	X	L	RS232 comms & dig in
4	C	L	RS485 comms CT & dig in
2	C	L	RS232 comms CT & dig in
X	X	L	Digital input
X	C	L	CT and digital input

Language	
English	E

Fascia colour	
Green	G
Silver	S

Quick Start Code
See Switch On section

invensys
EUROTHERM

ENG

3216 User Guide Part No. HA027985 Issue 1.0 June-03

3.2. 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).

3.3. PV Input (Measuring Input)

1. Do not run input wires together with power cables
2. 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

3.3.1. Thermocouple Input

For thermocouple input use the correct compensating cable preferably shielded

3.3.2. RTD Input

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

3.3.3. Linear Input (mA or V)

A line resistance for voltage inputs may cause measurement errors

For volts input an external module is required. Input resistance 100KΩ.

For mA input connect burden resistor of 2.49Ω across the + and - input as shown

3.4. AA Output Relay (Optional)

Changeover relay (Form C) rated 2A 264Vac resistive

3.5. Input/Output 1 (Relay or Logic - Optional)

This may be an input or an output

Relay output normally open (Form A), 2A 264Vac resistive

OR

Logic output to drive SSR (not isolated)

Logic level On/High - 12Vdc at 5 to 40mA max

Logic level Off/Low - <100mV <100µA

OR

Digital Input (contact closure)

3.6. Output 2 (Relay or Logic)

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

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

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

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

WARNING

When the relay contact is open or it is connected to a high impedance load, the snubber passes a current (typically 0.6mA at 110Vac and 1.2mA at 240Vac). 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.

3.7. 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.

3.8. Current Transformer/Logic Input (Optional)

A current transformer can be connected directly to the controller to monitor the actual 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.

3.8.1. Current Transformer Input

CT input current 0 to 50mA rms (sine wave) 50/60Hz, input impedance <20Ω

CT input resolution – 0.1A for scale up to 10A, 1A for scale 11 to 100A

CT input accuracy – 4% of reading

3.8.2. Logic Input

Digital Input	Contact closure 12V @ 5-40mA
	contact open > 500Ω
	contact closed < 200Ω

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

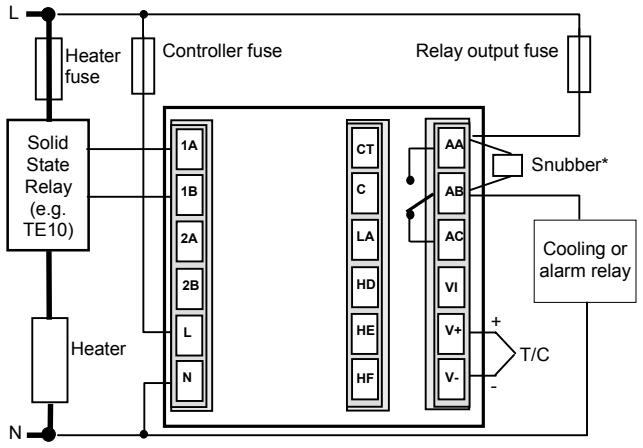
3.9. Power Supply

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

Instrument fuse ratings are as follows:-

- For 24 V ac/dc fuse type T rated 2A 250V
- For 85/265Vac fuse type T rated 2A 250V

3.10. Example Wiring Diagram



4. INSTALLATION SAFETY REQUIREMENTS

Safety Symbols

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

Caution, (refer to accompanying documents)

Equipment protected throughout by DOUBLE INSULATION

Personnel

Installation must only be carried out by suitably qualified personnel

Enclosure of Live Parts

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

Caution: Live sensors

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

Overcurrent protection

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

Voltage rating

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

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

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

Conductive pollution

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

Over-temperature protection

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

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

Installation requirements for EMC

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

For general guidance refer to Eurotherm Controls EMC Installation Guide, HA025464.

When using relay outputs it may be necessary to fit a filter suitable for suppressing the emissions. The filter requirements will depend on the type of load. For typical applications we recommend Schaffner FN321 or FN612.

5. STEP 3: SWITCH ON

A brief start up sequence consists of a self test in which all bars 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 5.1. for an instrument already configured go to section 5.2.

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. ^ indicates the option is not fitted
2. Press ▲ or ▼ to change the character currently flashing to the code as 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.
4. When the last digit has been selected press ↻ again, the display will show EXIT. Press ▲ or ▼ to YES. The controller will re-start. Now go to section 5.2

SET 1

In put Sensor type	Range	I/O Module 1	Output Module 2	Output Relay AA
Thermocouple	C = °C Full Range	**Control**	**Control**	**Control**
B = Type B	F = °F Full Range	H = PID heat	H = PID heat	H = PID heat
J = Type J	0 = 0-100°C	C = PID cool	C = PID cool	C = PID cool
K = Type K	1 = 0-200°C	J = On/off heat	J = On/off heat	J = On/off heat
L = Type L	2 = 0-400°C	K = On/off cool	K = On/off cool	K = On/off cool
N = Type N	3 = 0-600°C	**Alarm 1 (energised in alarm)**	**Alarm 2 (energised in alarm)**	**Alarm 3 (energised in alarm)**
R = Type R	4 = 0-800°C	0 = High	0 = High	0 = High
S = Type S	5 = 0-1000°C	1 = Low	1 = Low	1 = Low
T = Type T	6 = 0-1200°C	2 = Deviation high	2 = Deviation high	2 = Deviation high
C = Custom	7 = 0-1400°C	3 = Deviation low	3 = Deviation low	3 = Deviation low
RTD	8 = 0-1600°C	4 = Deviation band	4 = Deviation band	4 = Deviation band
P = Pt100 PRT	9 = 0-1800°C	**Alarm 1 (de-energised in alarm)**	**Alarm 2 (de-energised in alarm)**	**Alarm 3 (de-energised in alarm)**
Linear	G = 32-212°F	5 = High	5 = High	5 = High
M = 0-80mV	H= 32-392°F	6 = Low	6 = Low	6 = Low
2 = 0-20mA	J= 32-752°F	7 = Deviation high	7 = Deviation high	7 = Deviation high
4 = 4-20mA	K = 32-1112°F	8 = Deviation low	8 = Deviation low	8 = Deviation low
	L = 32-1472°F	9 = Deviation band	9 = Deviation band	9 = Deviation band
	M = 32-1832°F	**Logic Input**		
	N = 32-2192°F	W = Alarm ack		
	P = 32-2552°F	M = Manual		
	R = 32-2912°F	R = Run/hold		
	T = 32-3272°F	L = Key lock		
		P = Setpoint 2		
		T = Reset		

SET 2

Input CT Scaling	Digital Input	Lower Display
1 = 10 Amps	W = Alarm Ack	T = Setpoint
2 = 25 Amps	M = Manual	P = Output power %
5 = 50 Amps	R = Run/hold	R = Time to run
6 = 100 Amps	L = Keylock	E = Elapsed time
	P = Setpoint 2	1 = Alarm 1 setpoint
	T = Reset	A = Amps
		N = None

In any column, - = Unconfigured: X = Not fitted

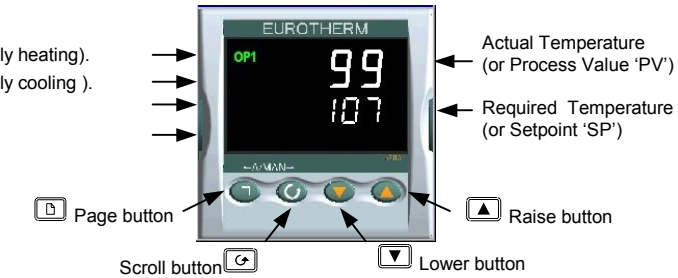
5.1.1. To Re-enter Quick configuration Mode

This mode can always be entered by holding down the ⎘ button during power up and then entering a passcode. This 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.

5.2. Normal Operation

The controller will start up in operator level 1 and in the mode in which was last switched off. 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 this mode you will see the display shown below. It is called the HOME display.



When this view is first entered (or ⎘ 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 below:-

5.2.1. To Acknowledge an Alarm.

Press ⎘ and ↻ 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 in section 6.2.

5.2.2. To Set The Required Temperature.

Press ▲ to raise the setpoint, or ▼ 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.

5.2.3. Manual operation

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.**

5.2.4. To Select Manual Operation and Adjust the Output Power

1. Press and hold ▼ and ▲ together. '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.
4. Press ▼ or ▲ to raise or lower the power. The output power is continuously updated when the buttons are pressed
5. To Return to Automatic operation, press and hold ▼ and ▲ together. Then press ▼ to select 'Auto'

7. TIMER OPERATION

A timer can be configured to operate in three different modes. These can be selected in Level 2.

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

There are four operating states, all of which are available in Level 1:

Run may be initiated by pressing ▲ and ▼ together.

Reset (of End State) when timer has timed out, may be initiated by pressing 🗋 and ↺ (Ack),

Reset, during timing, may be initiated by pressing and holding ▲ and ▼

(Note pressing Ack at this point does not reset the timer. The reason for this is that if the display is on any view other than the HOME display then pressing these two buttons will jump to HOME).

Hold may be initiated by pressing ▲ and ▼ To run the timer from hold, press quickly ▲ and ▼ again

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

- Edge trigger a suitably configured digital input
- Power cycle the controller
- 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 or through Digital Communications.

Timer operation is indicated by a beacon labelled RUN:

Timer Status	RUN beacon
Reset	Off
Run	On
Hold	Flashing
End	Off

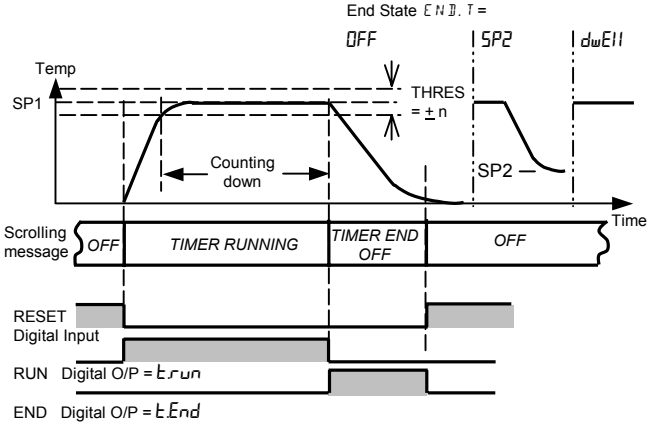
Logic outputs The timer may be configured to operate an output when it is running or during the end state

Note:-

- **Power up** - the 'run' state is selected if a Soft Start or Delay timer is configured or the 'Reset' state is selected if a Dwell timer is configured.
- **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

7.1. Dwell Timer

A dwell timer (TI.CFG = DWELL) 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 the END.T parameter.

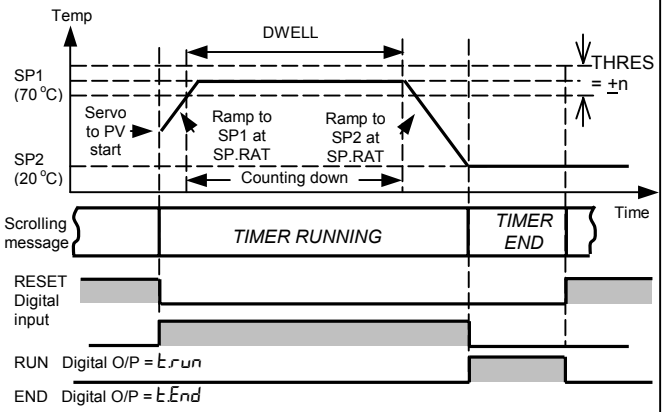


Notes:

1. If THRES = 2° (for example) timer will show TIMER RUNNING with the RUN beacon on but will not start counting down until the temperature is, first, within 2° of SP. Then the threshold is ignored.
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 may be necessary to reselect Auto mode

7.1.1. Simple Programmer

A four segment programmer is achieved using a dwell type timer with the set point rate limit and threshold parameters set.

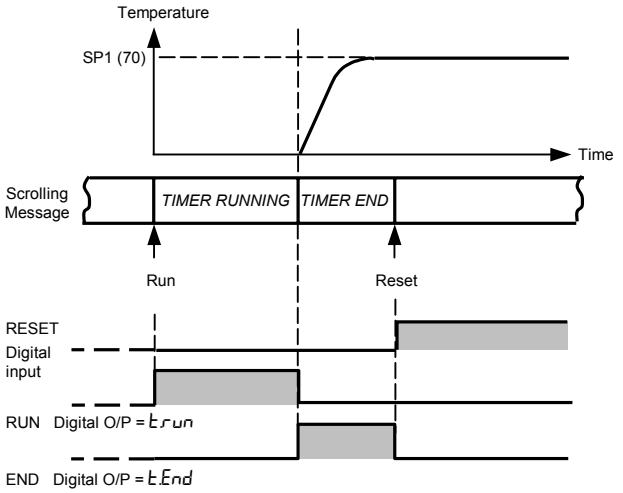


7.2. Delayed Switch On timer

The timer is used to switch on the output power after a set time.

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

When the timer status = reset, the control output is controlling at SP1

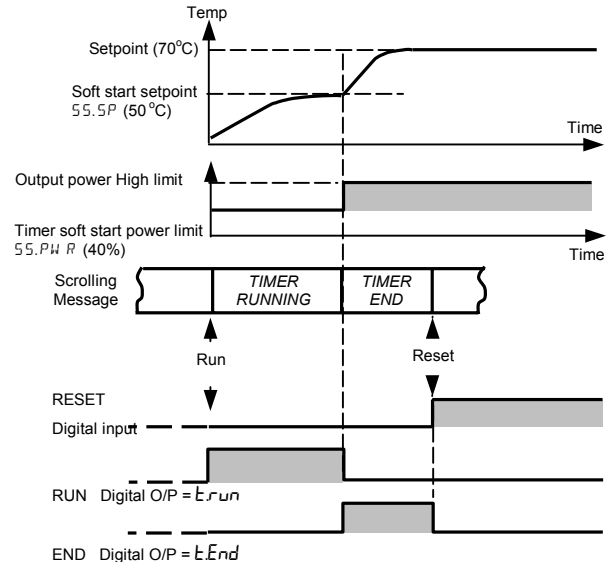


7.3. Soft Start Timer

The timer is used to start a process at reduced power and/or reduced setpoint. Timing starts at power up or when 'Run' is selected.

When the Timer Status = Run, the controller power is limited by the soft start power limit parameter. The Soft Start setpoint is a threshold which, when exceeded, sets the timer to end. If the temperature is already above this threshold when the timer is set to run, the timer will time out immediately.

When the timer status = reset, the controller is controlling at SP1



7.4. To Run A Timer

The example given here is for the simple programmer shown in section 7.1.1. with the following settings:-

Type = Dwell SP1 = 70°C End.T = SP2 = 20°C Ramp Rate Set to 20°C/min Threshold = 1°C

At start of run the controller servos to PV (starts at the current temperature). The procedure to Run, Hold, or Reset is the same for all timer types.

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 'TIMER RUNNING' Controller ramping up to SP1 (70°C) at the set rate (20°C/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 'TIMER 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

7.4.1. 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 controlling at SP1 (70 °C)
4. Momentarily press ▲ and ▼ together to run the timer from the hold condition		RUN beacon on Scrolling display 'TIMER RUNNING' Controller continues controlling at SP1 (70 °C)

7.4.2. 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

7.4.3. Power Cycling

If the power is turned off when the timer is running it will come back on as follows:-

For a Dwell type timer it will come back on in Reset

For a Delayed Switch on timer or a Soft Start timer, the controller will come back on in the Run condition and start again from the beginning.

8. FURTHER LEVELS OF OPERATION

Access to further levels of operation are described in the Engineering Handbook Part No HA027986 available on www.eurotherm.co.uk

CE This indicator meets the European directives on safety and EMC

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