

ENG

### Models 2416, 2408 and 2404 PID Controllers

These instruments are high stability, temperature or process controllers intended for permanent installation, for indoor use only, and to be enclosed in an electrical panel.

Select a location where minimum vibrations are present and the ambient temperature is within 0 and 50°C (32 and 122°F).

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

To assure IP65 and NEMA 4 front protection, use a panel with smooth surface texture.

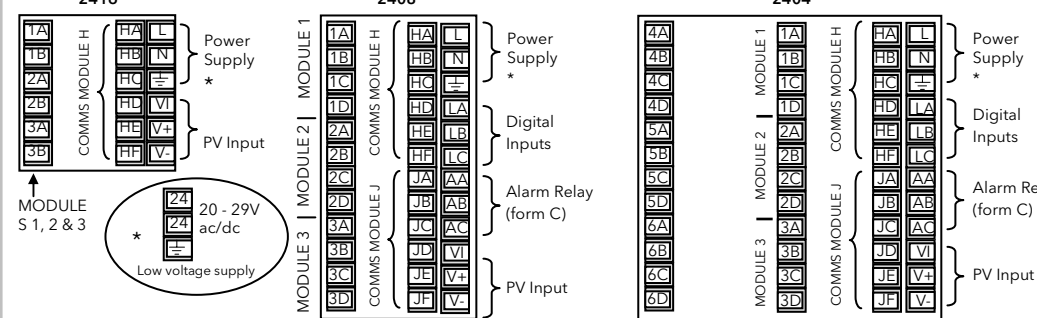
Please read the section *Safety & EMC Information* before proceeding and refer to the EMC Booklet part number HA025464. For details not covered in this guide, handbooks, part no. HA025041 and HA025132, are available for models 2416 and 2408/04 respectively. These documents may be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

#### Parts Supplied and Dimensions



① Latching ears	③ Panel retaining clips	⑤ Terminals with covers
② IP65 sealing gasket	④ Sleeve	

#### Rear Terminal Layout

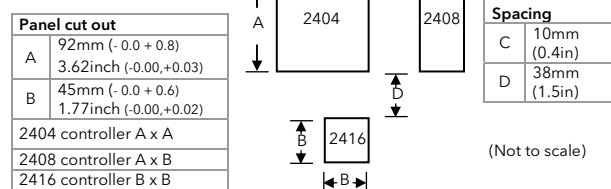


HA030240/2 CN30147

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#### Installation

1. Cut out the panel to the size shown.



2. Fit the IP65 sealing gasket behind the front bezel of the instrument
3. Insert the instrument in its sleeve through the cut-out.
4. Spring the panel retaining clips into place. Secure the instrument in position by holding it level and pushing both retaining clips forward.
5. Peel off the protective cover from the display

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

#### To Remove the Controller from its Sleeve

Ease the latching ears outwards and pull the controller forward.

When plugging back in ensure that the latching ears click into place to maintain the IP65 sealing



**Polarising keys** are intended to prevent modules, not supported by this controller, from being fitted. Supported modules are defined by the order code - the arrow on the polarising key points in the upward direction when these are fitted. An example of an unsupported module is an un-isolated module (coloured red). It is possible to fit such a module but it is the users responsibility to ensure that it is safe to install it in the particular application. When this has been verified the polarising key may be adjusted with a screwdriver to point in the down direction.

#### Wire Sizes

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

#### Standard Connections

These are connections which are common to all instruments in the range.

#### PV Input (Measuring Input)

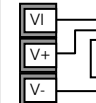
1. Run input wires separate from power cables
2. When shielded cable is used, it should be grounded at one point only
3. Any external components (such as zener barriers, etc) connected between sensor and input terminals may cause errors in measurement due to excessive and/or un-balanced line resistance or possible leakage currents
4. This input is not isolated from logic I/O A and logic I/O B

#### Thermocouple Input



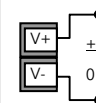
- Use the correct type of thermocouple compensating cable, preferably shielded, to extend wiring
- It is not recommended to connect two or more instruments to one thermocouple

#### RTD Input



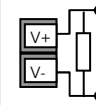
- The resistance of the three wires must be the same
  - The line resistance may cause errors if it is greater than 22Ω
- Note 1: The RTD wiring is not the same as 3000 series instruments.  
Note 2: For 2-wire this is a local link

#### Linear Input V, mV



- mV range ±100mV
- High level range 0 - 10V
- A high line resistance for voltage inputs may cause measurement errors

#### Linear Input mA



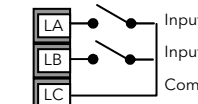
- For mA input connect the 2.49Ω resistor supplied across the input terminals
- The resistor supplied is 1% accuracy 50ppm temperature coefficient
- A resistor 0.1% accuracy 15ppm resistor can be ordered as a separate item. Part No. SUB35/ACCESS/249R.1

#### Digital Inputs - 2408 and 2404 only



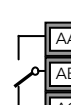
The Digital Inputs are not isolated from the PV input. The controller is designed to operate normally if the input sensor is connected to 240Vac, but in this case these terminals will be at this potential.

#### Contact Closure Inputs



- On state <100Ω input resistance
- Off state >28KΩ input resistance

#### Alarm/Event Relay (AA) - 2408 and 2404 only



- Relay shown in de-energised state
- Isolated 240Vac
- Relay rating: Max: 264Vac 2A resistive; min: 1V, 1mAdc to provide sufficient whetting current.

#### Plug in I/O Module Connections

Module positions 1, 2 and 3 are plug in modules. Two terminal modules can be fitted in all models. Four terminal modules can only be fitted in models 2408 and 2404.

The function of the connections varies depending on the type of module fitted in each position as shown below.

Note: The terminal number is pre-fixed by the module number (x). For example, Module 1 is connected to terminals 1A, 1B, 1C, 1D; module 2 to 2A, 2B, 2C, 2D, and module 3 to 3A, 3B, 3C, 3D.

If modules have been added, removed or changed it is recommended that this is recorded on the instrument code label.

All modules are isolated 240Vac CATII unless otherwise stated.

#### Two Terminal Modules. (These can be fitted in all models).

##### Relay

- Hardware Code: R2, fitted unconfigured; RH, heating; RC, cooling; RU/RW, valve raise/lower; PO, program event (2416 only).
- Rating: min 12Vdc, 100mA (to provide sufficient whetting current). Max 2A, 264Vac resistive,.

##### Logic - non isolated

- Hardware Code: L2, fitted unconfigured; LH, heating; LC, cooling.
- **Non isolated**
- Rating: 18Vdc at 20mA

##### Triac

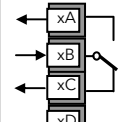
- Hardware Code: T2, fitted unconfigured; TH, heating; TC, cooling; TU/TW, valve raise/lower
- Rating: 1A, 30 to 264Vac

##### Analogue

- Hardware Code 2416 only: D2, fitted unconfigured; H/C1, 0 to 20mA; H/C2, 4 to 20mA; H/C3, 0 to 5V; H/C4, 1 to 5V; H/C5, 0 to 10V (Heating/Cooling)
- **Non isolated**
- Rating: 10Vdc, 20mA max.

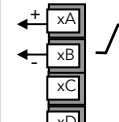
#### Four Terminal Modules. (2408 and 2404 instruments only)

##### Changeover Relay



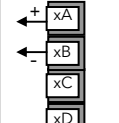
- Hardware Code: R4, fitted unconfigured; YH, Heating; YC, cooling; RP/RL, Valve raise/lower; PO, program event; PE, program End.
- Rating: 2A, 264Vac max or 100mA, 12V min to provide sufficient whetting current

##### Analogue Output Isolated



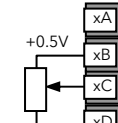
- Hardware Code: Control output: D4, fitted unconfigured; H/C6, 0 to 20mA; H/C7, 4 to 20mA; H/C8, 0 to 5V; H/C9, 1 to 5V; H/CZ, 0 to 10V (Heating/Cooling)
- Hardware Code: Retransmission (resolution 1 in 10,000) modules 2 and 3 only: D6, fitted unconfigured; (First character) Vx, process value; Sx, setpoint; Ox, Output; Zx, Error; (second character) x1, 0 to 20mA; x2, 4 to 20mA; x3, 0 to 5V; x4, 1 to 5V; x5, 0 to 10V.
- Rating: 10V, 20mA max.

##### 24V Transmitter Supply. Module 2 and 3 only.



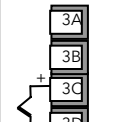
- Hardware Code: MS.
- Rating: 24V, 20mA max.

##### Potentiometer Input. Module 2 and 3 only.



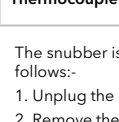
- Hardware Code: VU, fitted unconfigured; VS, valve position feedback; VR, setpoint input.
- Rating: 100Ω to 15KΩ

##### DC Remote Input or Process Value 2. Module 3 only.

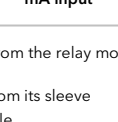


- Hardware Code: D5, fitted unconfigured; W2, 4 to 20mA setpoint; W5, 0 to 10V setpoint; WP, second PV input

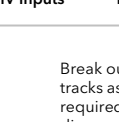
##### Thermocouple



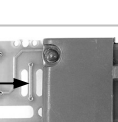
##### RTD



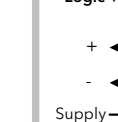
##### mA input



##### Volts or mV inputs



##### 10V input



#### Snubbers

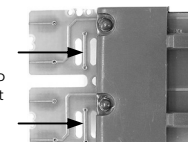
Relay and triac modules have an internal 15nF/100Ω 'snubber' connected across the output(s), which is used to prolong contact life and to suppress interference when switching inductive loads, such as mechanical contactors and solenoid valves.

However, snubbers pass 0.6mA at 110V and 1.2mA at 230Vac, which may be sufficient to hold on high impedance loads. If this type of device is switched by a relay it will be necessary to remove the snubber from the circuit.

The snubber is removed from the relay module as follows:-

1. Unplug the controller from its sleeve
2. Remove the relay module
3. Use a screwdriver or similar tool to snap out the track.

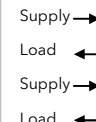
Break out tracks as required to disconnect the snubber



#### Plug in I/O Module Connections (continued)

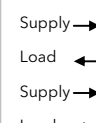
#### Dual Modules (2408 and 2404 only)

##### Dual Relay



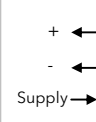
- Hardware Code: RR, fitted unconfigured; RD, PID heat + PID cool; RM, valve raise/lower; PP, program events 1 & 2 (module 2) or 4 & 5 (module 3).
- Rating: 2A, 264Vac max or 100mA, 12V min to provide sufficient whetting current.

##### Dual Triac - Module 1 only.



- Hardware Code: TT, fitted unconfigured; TD, PID heat + PID cool; TM, valve raise/lower.
- Rating: 1A, 30 to 264Vac

##### Logic + Relay - Module 1 only.



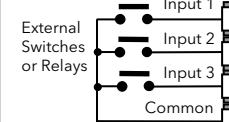
- Hardware Code: LR, fitted unconfigured; LD, PID heat + PID cool; QC, mode 2 + cool.
- Logic rating: 18Vdc at 20mA. **Logic is non isolated.**
- Relay rating: 1A, 30 to 264Vac.

##### Logic + Triac - Module 1 only.



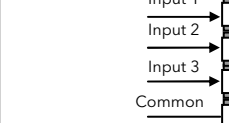
- Hardware Code: LT, fitted unconfigured; GD, PID heat + PID cool; QD, mode 2 + cool.
- Logic rating: 18Vdc at 20mA. **Logic is non isolated.**
- Triac rating: 1A, 30 to 264Vac.

#### Triple Contact Input



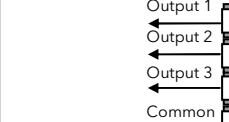
- Hardware code: TK, fitted unconfigured. To configure see manual HA025132
- On state: <100Ω input resistance
- Off state: >28KΩ input resistance

#### Triple Logic Input



- Hardware code: TL, fitted unconfigured. To configure see manual HA025132
- Current sinking
- Off state: -3 to 5Vdc @ <-0.4mA
- On state: 10.8 to 30Vdc @2 to 8mA

#### Triple Logic Output



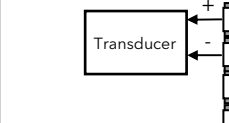
- Hardware code: TP, fitted unconfigured. To configure see manual HA025132
- Off state: 0 to 0.7Vdc
- On state: 12Vdc, 8mA per channel

#### Isolated Logic Output



- Hardware code: LO, fitted unconfigured. To configure see manual HA025132
- 18Vdc, 20mA

#### Transducer Power Supply - Modules 1 and 2 only



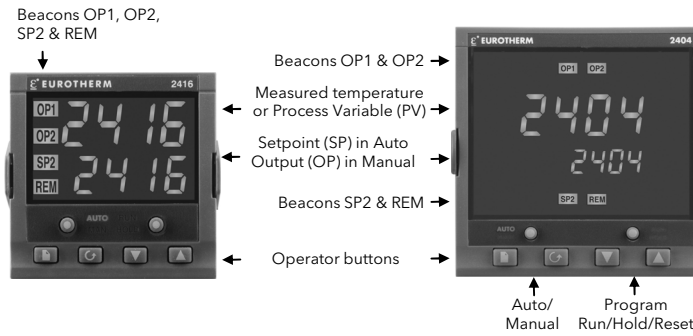
- Hardware Code: G3, 5Vdc; G5, 10Vdc
- Output Rating: 5 or 10Vdc 20mA

## Basic Operation

Switch on the power to the controller. It runs through a self-test sequence for about three seconds and then shows the measured temperature, or process value, in the upper readout and the target value, called the *setpoint*, in the lower readout. This is called the **Home** display.

Button or Indicator	Name	Explanation
OP1	Output 1	When lit, it indicates that the output installed in module position 1 is on. This is normally the heating output on a temperature controller.
OP2	Output 2	When lit, it indicates that the output installed in module position 2 is on. This is normally the cooling output on a temperature controller.
SP2	Setpoint 2	When lit, this indicates that setpoint 2, (or a setpoint 3-16) has been selected.
REM	Remote setpoint	When lit, this indicates that a remote setpoint input has been selected. 'REM' will also flash when communications is active.
AUTO MAN	Auto/ Manual Button	This toggles between automatic and manual mode: <ul style="list-style-type: none"> <li>In auto the controller automatically adjusts the output to maintain control. 'AUTO' will be indicated and the controller setpoint shown in the lower display.</li> <li>In manual the controller output power is continuously adjusted by  or  buttons. 'MAN' will be indicated and the controller output power shown in the lower display.</li> </ul> The Auto/Manual button can be disabled in configuration level.
RUN HOLD	Run/Hold /Reset Button	<ul style="list-style-type: none"> <li>Press once to start a program (RUN light on.)</li> <li>Press again to hold a program (HOLD light on)</li> <li>Press again to cancel hold and continue running (HOLD light off and RUN light ON)</li> <li>Press and hold in for two seconds to reset a program (RUN and HOLD lights off)</li> </ul> The RUN light will flash at the end of a program. The HOLD light will flash during holdback or when a PDS retransmission output is open circuit. The RUN/HOLD button can be disabled in configuration level.
		Return to the HOME display
	Page	Press to select a new list of parameters
	Scroll	Press to select a new parameter in a list
	Down	Press to decrease a value in the lower display
	Up	Press to increase a value in the lower display

## Typical HOME Display 2416 and 2404 Controllers - not to scale



## To Set The Required Temperature (Setpoint)

In the view above (with the AUTO light on), press or to lower or raise the setpoint value.

The new setpoint is accepted when or is released and is indicated by a brief flash of the setpoint value.

(Note: If Setpoint Rate Limit has been enabled, then the lower readout will show the active setpoint. If or is pressed, it will change to show and allow adjustment of, the target setpoint.)

## To Display Controller Units

A momentary press of or button will show the units  $^{\circ}\text{C}$ ,  $^{\circ}\text{F}$ ,  $^{\circ}\text{R}$  for 0.5 seconds, if these have been configured.

## To Display Output Power

Press (twice). The % output power demand is displayed in the lower readout. This is a read-only value.

Note: Pressing from the Output Power display may access further parameters. These may be in this scroll list if the 'Promote' feature has been used (see section - *Edit Level*).

## Shortcut Key Presses

Backpage	Press  followed by . With  held down continue to press  or  to scroll page headers backwards or forwards.
Backscroll	When in a list of parameters, press  followed by . With  held down continue to press  or  to scroll parameters backwards or forwards.

## Parameters and how to access them

Parameters are settings, within the controller, that determine how the controller will operate. For example, alarm setpoints are parameters that set the thresholds at which alarms will occur. For ease of access, the parameters are arranged in lists as shown in the Navigation Diagram.

A list header can be recognised by the fact that it always shows 'Li SE' in the lower readout. The upper readout is the name of the list. List header displays are read-only.

To see all the available parameters you must select Full level. See section - *Access Levels*.

To step through the list headers, press . Keep pressing to step through the list headers, eventually returning to the Home display.

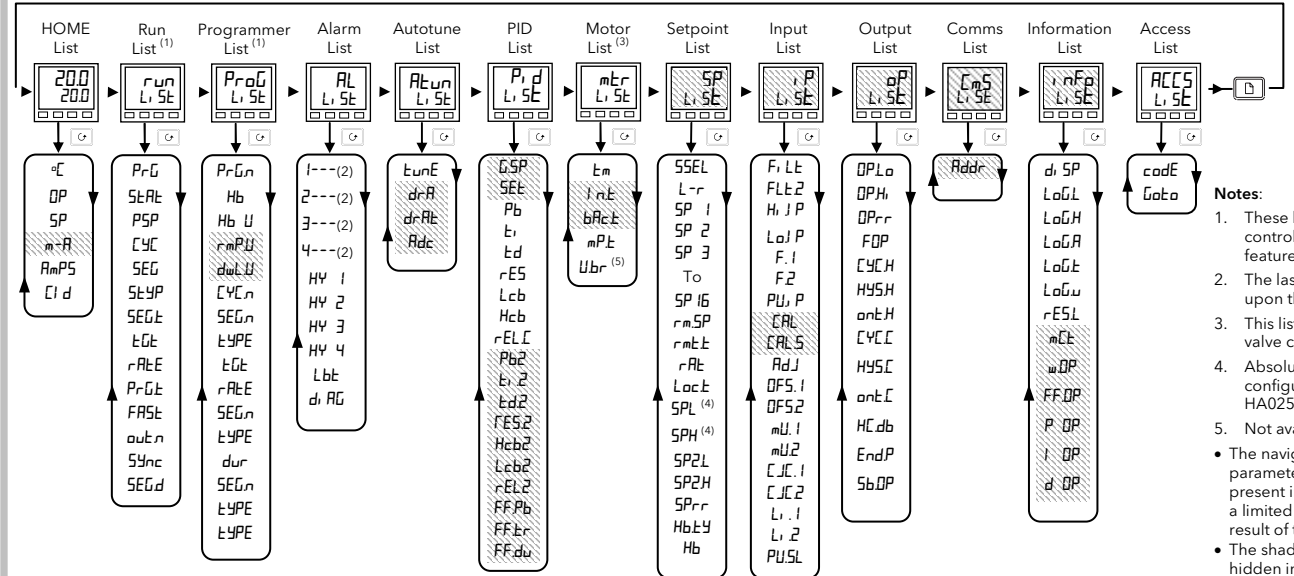
To step through the parameters within a particular list, press .

When you reach the end of the list, you will return to the list header.

From within a list you can return to the current list header at any time can by pressing .

To step to the next list header, press once again.

## Navigation Diagram



- Notes:**
- These lists are present only in controllers with the programming feature.
  - The last three characters depend upon the type of alarm configured.
  - This list is only present in motorised valve controllers.
  - Absolute setpoint limits are set in configuration, see manuals HA025132 and HA025041.
  - Not available in 2416
- The navigation diagram shows all the parameters that can, potentially, be present in the controller. In practice, a limited number of them appear, as a result of the particular configuration
- The shaded boxes are normally hidden in Operator level.

## Parameter Tables

Home list	
Home	Measured value and Setpoint
OP	% Output level
SP	Target setpoint (if in Manual mode)
m-A	Auto-man select
AmPS	Heater current (With PDS mode 2)
Cl d	Customer defined identification number
+ Extra parameters, if the 'Promote' feature has been used (see section, <i>Edit Level</i> ).	
Program run list - Present only in setpoint programming controllers	
PrG	Active program number (Only on 4, or 20, program versions)
StRE	Program status (OFF, run, hold, HbRc, End)
PSP	Programmer setpoint
CYC	Number of cycles remaining in the program
SEG	Active segment number
StYP	Active segment type
SEgt	Segment time remaining in the segment units
EGt	Target setpoint
rRE	Ramp rate (if a rate segment)
PrGt	Program time remaining in hours
FRSt	Fast run through program (no / YES)
ouEt	Event output states (OFF / on) (not 8-segment programmer)
Sync	Segment synchronisation (no / YES) (not 8-segment programmer)
SEGd	Flash active segment type in the lower readout of the home display (no / YES)
Program Edit List - Present only in setpoint programming controller.	
For a more detailed explanation of these parameters refer to manuals HA025132 or HA025041	
PrGn	Select program number (Only on 4 or 20 program versions)
Hb	Holdback type may be configured to operate for the program as a whole or per segment. Holdback freezes the program if the process value (PV) does not track the setpoint (SP) by more than a user defined amount. The instrument will remain in HOLDBACK until the PV returns to within the requested deviation from setpoint. (OFF, no holdback; Lo, deviation low; Hi, deviation high or bAnd deviation high & low).
Hb U	Holdback value (in display units)
rmPU	Ramp units (SEC, min, or Hour) [for both rmPR and rmPE type segments]
dwLU	Dwell units (SEC, min, or Hour)
CYCn	Program cycles - the number of times a program is repeated (1 to 999, or continuous)
SEgn	Segment number
LYPE	Segment type: (End) (rmPR - ramp rate) (rmPE - ramp time) (dwell) (SEEP) (cALL - allows a program to be inserted as a sub-program. Call is only available in multi-program controllers).
The following parameters depend on the LYPE selected, as shown below.	
Hb	Holdback type: OFF, Lo, Hi, or bAnd
EGt	Target setpoint for a 'rmPE' or 'SEEP' segment
rRE	Ramp rate for a 'rmPR' segment
dur	Dwell time or Time to target for a 'rmPE' segment. 0.01 to 99.99.
PrGn	cALLed Program number
CYCn	No. of cycles of cALLed program
ouEt	Event output: OFF/on (not 8-segment programmer)
Sync	Segment synchronisation: no/YES (not 8-seg progr)
Endt	End of program type - dwell control at last setpoint, rSEt reset to program start, 5 OP set to a pre-determined output power

Alarm list	
1---	Alarm 1 setpoint value
2---	Alarm 2 setpoint value
3---	Alarm 3 setpoint value
4---	Alarm 4 setpoint value
In place of dashes, the last three characters indicate the alarm type. See alarm types table:	
HY 1	Alarm 1 Hysteresis (display units)
HY 2	Alarm 2 Hysteresis
HY 3	Alarm 3 Hysteresis
HY 4	Alarm 4 Hysteresis
Lb t	Loop Break Time in minutes
di AG	Enable Diagnostic alarms 'no' / 'YES'

Alarm types table	
-FSL	PV Full scale low alarm
-FSH	PV Full scale high alarm
-dEu	PV Deviation band alarm
-dHi	PV Deviation high alarm
-dLo	PV Deviation low alarm
-LCr	Load Current low alarm
-HCr	Load Current high alarm
-FL2	Input 2 Full Scale low alarm
-FH2	Input 2 Full Scale high alarm
-LOP	Working Output low alarm
-HOP	Working Output high alarm
-LSP	Working Setpoint low alarm
-HSP	Working Setpoint high alarm
4rRE	Rate of change (AL 4 only)

Autotune list	
AutnE	One-shot autotune enable
drRE	Adaptive tune enable
drRE	Adaptive tune trigger level in display units. Range = 1 to 9999
Adc	Automatic Droop Compensation (PD control only)
PID list	
Pr d	If Gain Scheduling has been enabled, PID set 1 will be active when the PV is below G.SP and PID set 2 will be active when the PV is above G.SP.
SEt	Pi d, I or P, d2 selected
Pb	Proportional Band in display units (SEE t)
Et	Integral Time in secs (SEE t)
Ed	Derivative Time in secs (SEE t)
rES	Manual Reset (%) (SEE t)
Hcb	Cutback High (SEE t)

PID list (continued)	
Lcb	Cutback Low (SEE t)
rELC	Relative Cool Gain (SEE t)
Pb2	Proportional Band (SEE 2)
Et 2	Integral Time in secs (SEE 2)
Ed2	Derivative Time in secs (SEE 2)
rES2	Manual Reset (%) (SEE 2)
Hcb2	Cutback High (SEE 2)
Lcb2	Cutback Low (SEE 2)
rEL2	Relative Cool Gain (SEE 2)
The following three parameters are used for cascade control only.	
FFPb	SP, or PV, feedforward propband
FFtr	Feedforward trim %
FFdu	PID feedforward limits $\pm\%$

## Parameter Tables (continued)

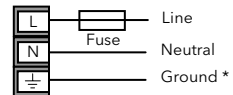
Motor list	
tm	Valve travel time in seconds
Int	Valve inertia time in seconds
bRct	Valve backlash time in seconds
mPE	Minimum ON time of output pulse
Ubr	Valve sensor break strategy (not available in 2416)
Setpoint list	
SP	Select SP 1 to SP 16, depending on configuration
L-r	Local (Loc) or remote (rMt) setpoint select
SP 1	Setpoint one value
SP 2	Setpoint two value
SP3 to SP 16	Setpoint 3 to 16 value if configured. Not available in 2416
rmSP	Remote setpoint value
rMt	Remote setpoint trim
rRE	Ratio setpoint
Loc t	Local setpoint trim
SP L	Setpoint 1 low limit
SP H	Setpoint 1 high limit
SP2L	Setpoint 2 low limit
SP2H	Setpoint 2 high limit
SPrr	Setpoint Rate Limit
HbLY	Holdback Type for SPrr - (OFF, Lo, Hi, or bAnd)
Hb	Holdback Value for setpoint rate limit in display units. (HbLY $\neq$ OFF)

Input list	
Fi Lt	IP1 filter time constant (0.0 - 999.9 seconds).
Fi Lt2	IP2 filter time constant (0.0 - 999.9 seconds).
Hi J P	Transition of control between P, I and P2 (if configured). The transition region is set by the values of 'Lo J P' and 'Hi J P'.
Lo J P	PV = P, I below 'Lo J P'.
	PV = P, I above 'Hi J P'.
F, I	Derived function, (if configured)
	$PV = (F, I \times P, I) + (F, I \times P, I)$
F, 2	F, I and F, 2 are scalars with the range -9.99 to 10.00
PU, P	Selects 'P, I' or 'P, 2'

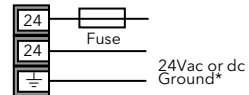
Input list - continued	
The next 3 parameters appear if User Calibration has been enabled. (Refer to HA025132 and HA025041.) By default they are hidden when in Operator level. To prevent unauthorised adjustment, we recommend that they are only made available in Full access level.	
CAL	'FRCE' - reinstates the factory calibration and disables User calibration. Next 2 parameters will not appear.
	'USER' - reinstates any previously set User calibration. All parameters below now appear.
CAL 5	Selected calibration point - 'nonE', 'P 1L', 'P 1H', 'P 2L', 'P 2H'
Adj *	User calibration adjust, if CAL 5 = 'P 1L', 'P 1H', 'P 2L', 'P 2H'
DFS, 1	IP1 calibration offset
DFS, 2	IP2 calibration offset
mU, 1	IP1 measured value (at terminals)
mU, 2	IP2 measured value (at terminals), if DC input in Module 3 position
CJC, 1	IP1 cold junction temp. reading
CJC, 2	IP2 cold junction temp. reading
Li, 1	IP1 linearised value
Li, 2	IP2 linearised value
PU, SL	Shows the currently selected PV input - 'P, I' or 'P, 2'
* Do not make adjustments using the Adj parameter unless you wish to change the controller calibration.	
Output list	
Does not appear if Motorised Valve control configured.	
OPLo	Low power limit (%)
OPHi	High power limit (%)
OPrr	Output Rate Limit (% per sec)
FOP	Forced output level (%)
CYCH	Heat cycle time (0.25 to 999.9S)
hVSH	Heat hysteresis (display units)
onEH	Heat output min. on-time (seconds). Auto (0.05S), or 0.1 - 999.9S
CYCC	Cool cycle time (0.25 to 999.9S)
hVSC	Cool hysteresis (display units)
onEC	Cool output min. on-time (seconds). Auto (0.05S), or 0.1 - 999.9S
HcdB	Heat/cool deadband (display units)
EndP	To set power level in end segment
SbOP	Sensor Break Output Power (%)

Comms list	
Addr	Communications Address
DeviceNet (additional parameters)	
nm5t	Indicates network status
run	Network connected and operational
rdy	Network connected but not operational
offL	Network not connected
Information list	
Configure lower readout of Home display to show:	
UPoS	Valve position
Std	Standard - display setpoint
AmPS	Load current in amps
OP	Output
StRE	Program status
PrGt	Program time remaining in hours
Li, 2	Process value 2
rRE	Ratio setpoint
PrG	Selected program number
rSP	Remote setpoint
LoGL	PV minimum
LoGH	PV maximum
LoGA	PV mean value
LoGt	Time PV above Threshold level
LoGL	PV Threshold for Timer Log
rESL	Logging Reset - 'YES/no'
The following set of parameters is for diagnostic purposes.	
uOP	Working output
FFOP	Feedforward component of output
UD	PID output to motorised valve
Access List	
ACC5	Access password
codE	Goto level - DPEr, FuLL, Ed t or conF
Goto	Configuration password.
conF	For configuration details see handbooks HA025132 or HA025041.

## Power Supply



- High voltage supply:  
100 to 230Vac, ±15%, 48 to 62 Hz; 10W max.



- Low voltage supply:  
24Vac, -15%/+10%, 48-62Hz;  
24Vdc, -15%/+20%;  
10W max.

\* The ground connection is provided as a return for internal EMC filters. It is not required for safety purposes but must be connected in order to satisfy EMC requirements.



Ensure that you have the correct supply for your controller.  
Before connecting the instrument to the power line, make sure that the line voltage corresponds to the description on the identification label.

- For supply connections use 16SWG or larger wires rated for at least 75°C.
- Use copper conductors only.
- For 24V the polarity is not important.
- The power supply input is not fuse protected. This should be provided externally.

Recommended external fuse ratings are as follows:-

For 24 V ac/dc, fuse type: T rated 4A 250V

For 100-230Vac, fuse type: T rated 1A 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.

## PDS (Pulse Density Signaling)

PDS stands for 'Pulse Density Signalling' Input/Output. This is a proprietary technique developed for bi-directional transmission of analogue and digital data over a simple two wire connection.

There are different modes of operation:-

**Mode 1** (hardware code M1). PDS heater break detect. A logic output, from module 1, delivers a power demand to a TE10S SSR and the SSR responds with a single load failure message.

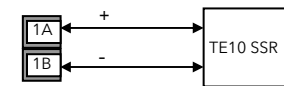
**Mode 2** (hardware code M2). PDS current monitoring. The SSR responds with the ON state RMS load current and low and high current, SSR and heater fail messages.

Modes 1 & 2 are supported in Module 1 only. Further details on Load Current Monitoring may be found in 2400 series handbooks HA025041 and HA025132 which may be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

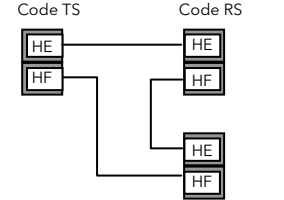
**PDS Retransmission.** PDS can also be used to digitally transmit the setpoint from a 2400 series master to a number of 2200e or 2400 slaves

Hardware codes: M6, PDS input fitted unconfigured; RS, setpoint input; M7, PDS output fitted unconfigured; PT, PV retransmission; TS, setpoint retransmission; OT, output retransmission. In 2416 these modules are fitted in place of digital communications. In 2408 and 2404 they are normally fitted in Communications slot J.

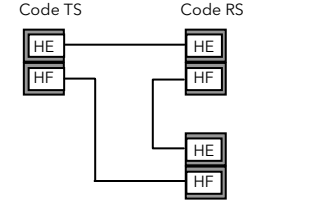
### PDS mode 1 and 2



### 2416 Code TS



### 2408/04 Code TS



## Digital Communications

All 2408 and 2404 controllers can be fitted with up to two plug-in communications modules.

Only one of the two modules can be for serial communications and this will normally be installed in position COMMS H (although it is possible to install the serial communications module in position COMMS J. Serial communications may be configured for either Modbus or EI bisynch protocol.

It is also possible to fit a PDS module in one or other of these positions.

2416 controllers can be fitted with one plug-in serial communications module or one PDS module in position H.

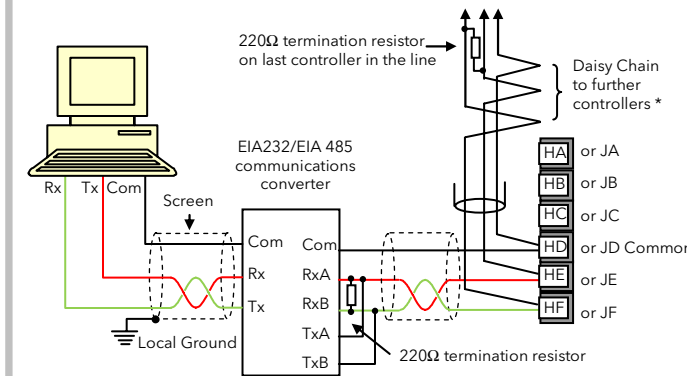
Note:- In order to reduce the effects of RF interference the transmission line should be grounded at both ends of the screened cable. However, if such a course is taken care must be taken to ensure that differences in the earth potentials do not allow circulating currents to flow, as these can induce common mode signals in the data lines. Where doubt exists it is recommended that the Screen (shield) be grounded at only one section of the network as shown in all of the following diagrams.

A further description of Modbus and EIBisynch communications is given in 2000 series Communications Handbook, Part No. HA026230, which can be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

- Digital communications modules isolated 240Vac CATII

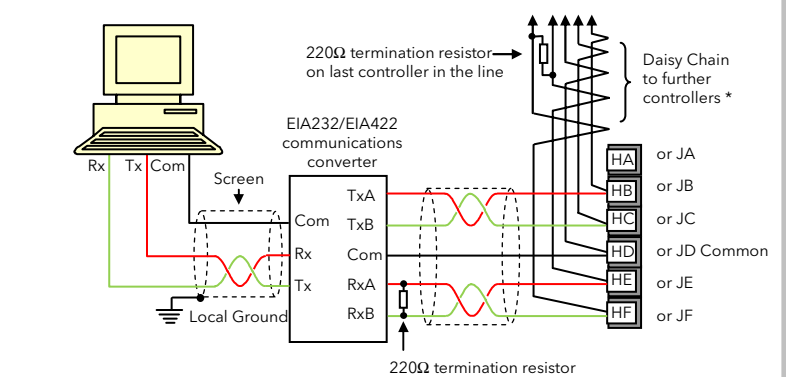
### EIA485 3-Wire Connections

- Hardware code: Y2, fitted unconfigured; YM, Modbus; YE, EI Bisynch.



### EIA422/EIA485 5-Wire Connections

- Hardware code: F2, fitted unconfigured; FM, Modbus; FE, EI Bisynch.



\* The use of bootlace ferrules may be an aid to wiring where two wires are to be connected to the same terminal

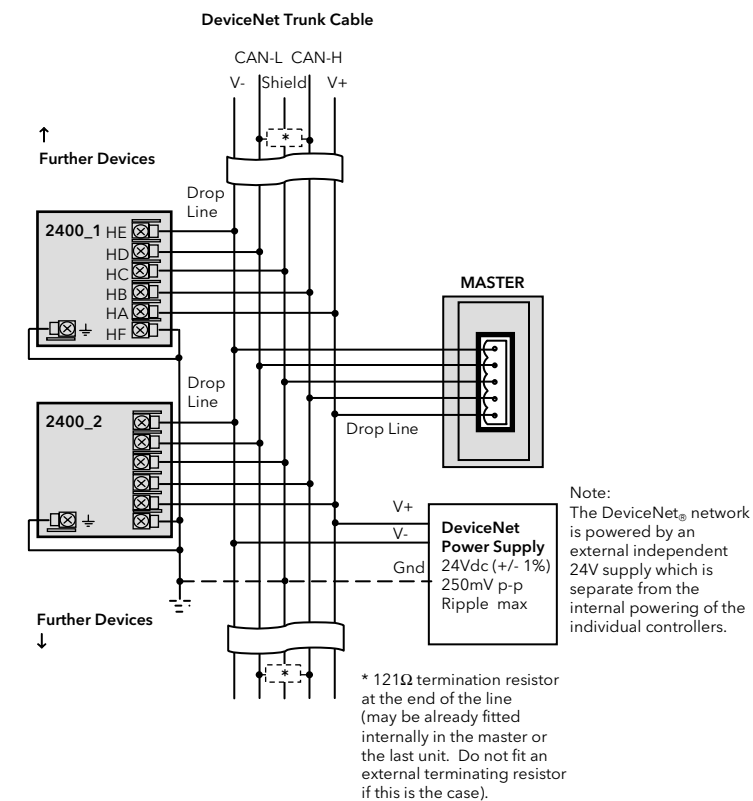
The KD485 communications converter is recommended for interfacing to EIA 485. This unit is also used to buffer an EIA 485 network when it is required to communicate with more than 32 instruments on the same bus, and may also be used to bridge 2-wire EIA485 to 4-wire EIA 422.

= Twisted pairs

## DeviceNet<sup>®</sup> Wiring

Instruments fitted with software versions 4 onwards can be fitted with DeviceNet<sup>®</sup> communications in 2408 and 2404 controllers only. Further information is available in the DeviceNet<sup>®</sup> Communications Handbook Part No HA027506 which can be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

### Example DeviceNet<sup>®</sup> Wiring



This table shows standard cable connections.

Controller Terminal	CAN Label	Wire Colour	Description
HA	V+	Red	DeviceNet <sup>®</sup> network power positive terminal. Connect the red wire of the DeviceNet <sup>®</sup> cable here. If the DeviceNet <sup>®</sup> network does not supply the power, connect to the positive terminal of an external 24 Vdc power supply.
HB	CAN_H	White	DeviceNet <sup>®</sup> CAN_H data bus terminal. Connect the white wire of the DeviceNet <sup>®</sup> cable here.
HC	SHIELD	None	Shield/Drain wire connection. Connect the DeviceNet <sup>®</sup> cable shield here. To prevent ground loops, the DeviceNet <sup>®</sup> network should be grounded in only one location.
HD	CAN_L	Blue	DeviceNet <sup>®</sup> CAN_L data bus terminal. Connect the blue wire of the DeviceNet <sup>®</sup> cable here.
HE	V-	Black	DeviceNet <sup>®</sup> network power negative terminal. Connect the black wire of the DeviceNet <sup>®</sup> cable here. If the DeviceNet <sup>®</sup> network does not supply the power, connect to the negative terminal of an external 24 Vdc power supply.
HF			Connect to instrument earth

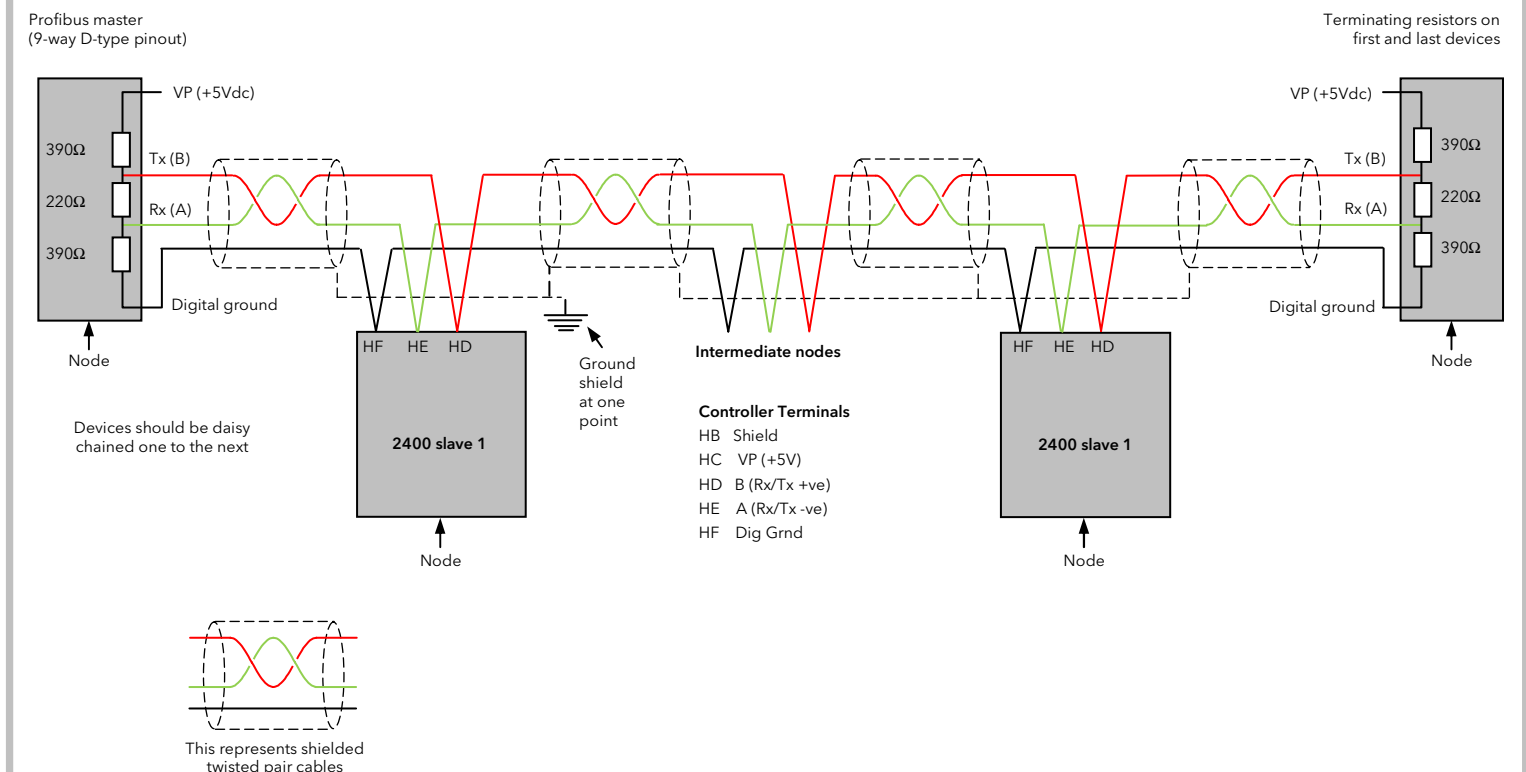
Note: Power taps are recommended to connect the DC power supply to the DeviceNet<sup>®</sup> trunk line. Power taps include:

- A Schottky Diode to connect the power supply V+ and allows for multiple power supplies to be connected.
- 2 fuses or circuit breakers to protect the bus from excessive current which could damage the cable and connectors.
- The earth connection, HF, to be connected to the main supply earth terminal.

## Profibus

Controllers supplied with model numbers 2408f and 2404f are fitted with Profibus communications modules in the H slot. Profibus is not available in 2416 controllers. A description of Profibus is given in the Profibus Communications Handbook Part No HA026290 which can be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

### Example Profibus Wiring



## Alarms

If the controller detects an alarm condition, it flashes an alarm message in the Home display. A new alarm is displayed as a double flash followed by a pause, old (acknowledged) alarms as a single flash followed by a pause. If there is more than one alarm condition, the display cycles through all the relevant alarm messages. The table below shows a list all of the possible alarm messages and their meanings.

Message	What it means	Message	What it means
<b>FSL*</b>	PV Full Scale Low alarm	<b>FL2*</b>	Input 2 Full Scale Low alarm
<b>FSH*</b>	PV Full Scale High alarm	<b>FH2*</b>	Input 2 Full Scale High alarm
<b>dEu*</b>	PV Deviation Band alarm	<b>LDP*</b>	Working Output Low alarm
<b>dHo *</b>	PV Deviation High alarm	<b>HDP*</b>	Working Output High alarm
<b>dLo*</b>	PV Deviation Low alarm	<b>LSP*</b>	Working Setpoint Low alarm
<b>LcLr*</b>	Load Current Low alarm	<b>HSP*</b>	Working Setpoint High alarm
<b>HcLr*</b>	Load Current High alarm	<b>CrAL</b>	PV Rate of change alarm. <i>Always assigned to Alarm 4</i>

\* In place of the dash, the first character will indicate the alarm number 1, 2, 3, or 4.

### Alarm acknowledgement and resetting

Pressing both and at the same time will acknowledge any new alarms and reset any latched alarms.

### Alarm modes

Alarms will have been set up to operate in one of several modes, either:

- Non-latching**, which means that the alarm will reset automatically when the Process Value is no longer in the alarm condition.
- Latching**, which means that the alarm message will continue to flash even if the alarm condition no longer exists and will only clear when reset.
- Blocking**, which means that the alarm will only become active after it has first entered a safe state on power-up.
- Event** the alarm is used to trip an external event - the alarm message will not appear.

### Diagnostic alarms

These indicate that a fault exists in either the controller or the connected devices. A list of diagnostic alarms is given in manuals HA025132 and HA025041 which can be downloaded from [www.eurotherm.co.uk](http://www.eurotherm.co.uk).

## To Set an Alarm Threshold

Select **FuLL** access level - see section *Access Levels*.

Press until Alarm List is displayed

Press to select the first alarm configured. This is indicated by the mnemonic shown in the table above.

The lower display shows the alarm threshold. Press or to adjust the value.

Note: By default the Alarm List is only shown in **FuLL** access level, however, it is possible to 'promote' this list to Operator level - see section *Edits Level*. In this case it is not necessary to select **FuLL**.

## To Select Manual Mode

Press **AUTO/MAN** button. The MAN light comes on.

The lower readout shows the % output. The transfer from Auto to Manual is 'bumpless'. This means the output will remain at its current value at the point of transfer. Similarly, when transferring from manual to auto, the current value will be used. This will then slowly change to the value demanded automatically by the controller.

The output power changes continuously when or are pressed.

## Types of Control

The controller may be ordered (or subsequently configured) as:-

**PID** Order codes CC, CG, CP, P4, CM. This is a three term controller containing parameters:- Proportional Band **Pb**; Integral time **t<sub>i</sub>**; Derivative time **t<sub>d</sub>**; High Cutback **Hcb**;

Low cutback **Lcb**; Relative cool gain **rEL**

**Motorised Valve Control** Order codes VC, VG, VP, V4 or VM. This algorithm is designed specifically for positioning motorised valves. It can operate in one of two ways:- **Boundless** mode which does not require a feedback potentiometer, although one can be connected and used purely to display the valve's position.

**Bounded** (or position) mode which requires a feedback potentiometer. This is closed loop control determined by the valve's position.

These modes are set in Configuration level and are described in handbooks HA025132 and HA025041.

See *Parameter Tables* for the list of 'Motor' parameters.

**On/Off Control** Order codes NF, NG, NP, N4, NM. The controller turns power off when the setpoint is reached and on again when the process value falls below the setpoint (heating) or above the setpoint (cooling).

## To Auto Tune the Controller

In tuning, you match the characteristics of a PID or Valve Position controller to those of the process being controlled in order to obtain good control.

Auto Tuning automatically sets the three term parameters listed above:-

### How to Tune

Select **FuLL** access level - see section *Access Levels*.

- Set the setpoint to the value at which you will normally operate the process.
- In the 'Atun' list, select 'tunE' and set it to 'on'.
- Press the Page and Scroll buttons together to return to the Home display. The display will flash 'tunE' to indicate that tuning is in progress.
- The controller induces an oscillation in the temperature by first turning the heating on, and then off. The first cycle is not complete until the measured value has reached the required setpoint.
- After two cycles of oscillation the tuning is completed and the tuner switches itself off.
- The controller then calculates the PID parameters listed above and resumes normal control action.

See HA025132 or HA025041 for a full description of Loop Tuning.

## Example: To Create or Edit a Program

This example shows how the operator buttons are used to set up a simple ramp/dwell/step program.

Refer also to the Parameter Tables - Program Edit List.

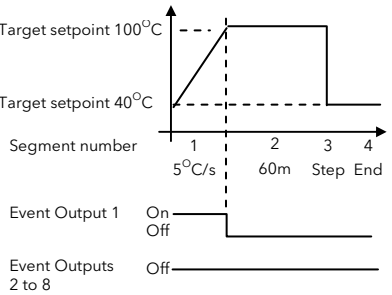
A program can only be edited when it is in Reset or Hold.

Press to select **Prog L, 5t**.

Press to select parameters

Press or to change parameter values

Parameter Description	Mnemonic	and Setting for the above example
<b>PrUn</b>	Program Number. 4 or 20 program controllers only.	Between <b>1</b> and <b>20</b> .
<b>Hb</b>	Holdback (configured for whole program)	<b>OFF</b>
<b>Hb U</b>	Holdback value	<b>00</b>
<b>rmPU</b>	Ramp units	<b>5Ec</b> (seconds)
<b>dwl U</b>	Dwell units	<b>mi n</b> (minutes)
<b>CYC.n</b>	Program cycles	<b>1</b>
<b>SEG.n</b>	Segment number	<b>1</b>
<b>TYPE</b>	Segment 1 Type	<b>rmPr</b> (Ramp Rate)
<b>tGt</b>	Target Setpoint	<b>100</b> (°C)
<b>rAtE</b>	Ramp Rate	<b>50</b> (°C/second)
<b>out 1</b>	Event output 1	<b>on</b>
<b>out 1/8</b>	Event outputs 2 to 8	<b>OFF</b>
<b>SEG.n</b>	Segment 2	<b>2</b>
<b>TYPE</b>	Segment 2 Type	<b>dwELL</b>
<b>dur</b>	Duration	<b>600</b>
<b>out 1</b>	Event output 1	<b>OFF</b>
<b>out 1/8</b>	Event outputs 2 to 8	<b>OFF</b>
<b>SEG.n</b>	Segment 3	<b>3</b>
<b>TYPE</b>	Segment 3 Type	<b>SLEP</b>
<b>tGt</b>	Target Setpoint	<b>400</b>
<b>SEG.n</b>	Segment 4	<b>4</b>
<b>TYPE</b>	Segment 4 Type	<b>End</b>
<b>Endt</b>	End Type	<b>dwELL</b>



## Example: To Run/Hold/Reset a Program

If you are using a 4, or 20, program version of the controller, you must first select the number of the program that you want to run. Do this in the 'run' list.



Then press

- Press once to run a program (RUN light on)

- Press again to hold a program (HOLD light on)

- Press again to cancel hold and continue running (HOLD light off, RUN light on)

- Press and hold in for two seconds to reset a program (RUN and HOLD lights off).

The RUN/HOLD button can be disabled, either when ordering the controller, or subsequently in configuration - see Handbooks HA025132 and HA025041. This will force you to operate the programmer from the 'run' list all the time. Select parameter **StAR** and set this to **run, hold** or **OFF**.

The main advantage of this method is that it will reduce the chance of accidentally changing the state of the program.

## Access Levels

There are four access levels:

- Operator level**, operators can view and adjust the value of parameters defined in Edit Level.
- Full level**, all parameters relevant to a particular configuration are visible. All alterable parameters may be adjusted. Generally used to commission the controller.
- Edit level**, is used to set up the parameters that you want an operator to be able to see and adjust when in Operator level.
- Configuration level**, is used to set up the fundamental characteristics of the controller.

Access to, Full, Edit and Configuration levels is protected by security codes. For Full and Edit the code is set to '1' when the controller is shipped from the factory. For Configuration refer to manuals HA025132 and HA025041.

### To Select an Access Level

- Press to select **AccS L, 5t**.
- Press to select **codE**
- Press or to enter the security code. **PRSS** is displayed if the code is correct or the display will remain at 'codE' if the password is incorrect
- Press to select **Gato**
- Press or to select **FuLL** or **Edt E**.

## Edit Level

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

Having selected the required parameter, use or to set its availability in Operator level.

Each parameter can be set to:

**ALtE** - makes a parameter alterable in Operator level.

**PrE** - Promotes a parameter into the Home display list.

**rEAd** - Makes a parameter, or list header, read-only (*it can be viewed but not altered*).

**Hi dE** - Hides a parameter, or list header.

## Returning to Operator Level

To return to operator level from either 'FuLL' or 'Edt E' level, repeat entry of the password and select 'OPER' on the 'Gato' display.

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

## Safety and EMC Information

This instrument is intended for industrial temperature and process control applications within the requirements of the European Directives on Safety and EMC.

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.

**The safety and EMC protection can be seriously impaired if the unit is not used in the manner specified. The installer must ensure the safety and EMC of the installation.**

**Safety.** This instrument complies with the European Low Voltage Directive 2006/95/EC, by the application of the safety standard EN 61010.

**Unpacking and storage.** If on receipt, the packaging or unit is damaged, do not install but contact your supplier. If being stored before use, protect from humidity and dust in an ambient temperature range of -20°C to +70°C.

**Electrostatic discharge precautions.** Always observe all electrostatic precautions before handling the unit.

**Service and repair.** This instrument has no user serviceable parts. Contact your supplier for repair.

**Cleaning.** Isopropyl alcohol may be used to clean labels. Do not use water or water based products. A mild soap solution may be used to clean other exterior surfaces.

**Electromagnetic compatibility.** This instrument conforms with the essential protection requirements of the EMC Directive 2004/108/EC, by the application of a Technical Construction File. It satisfies the general requirements of the industrial environment defined in EN 61326.

**Caution: Charged capacitors.** Before removing an instrument from its sleeve, disconnect the supply and wait at least two minutes to allow capacitors to discharge. Avoid touching the exposed electronics of an instrument when withdrawing it from the sleeve.

**Safety Symbols.** Symbols used on the instrument have the following meaning:

Caution, refer to accompanying documents) Protective Conductor Terminal

**Installation Category and Pollution Degree.** This unit has been designed to conform to BSEN61010 installation category II and pollution degree 2, defined as follows:-

- Installation Category II (CAT II). The rated impulse voltage for equipment on nominal 230V supply is 2500V.
- Pollution Degree 2. Normally only non conductive pollution occurs. However, a temporary conductivity caused by condensation must be expected.

**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 if the temperature sensor is connected directly to an electrical heating element. However, you must ensure that service personnel do not touch connections to these inputs while they are live. With a live sensor, all cables, connectors and switches for connecting the sensor must be mains rated for use in 230Vac ±15% CATI.

**Wiring.** It is important to connect the unit in accordance with the data in this sheet ensuring that the protective earth connection is ALWAYS fitted first and disconnected last. Wiring must comply with all local wiring regulations, i.e. UK, the latest IEE wiring regulations, (BS7671), and USA, NEC Class 1 wiring methods.

**Do not connect AC supply to low voltage sensor input or low level inputs and outputs.**

**Voltage rating.** The maximum continuous voltage applied between any of the following terminals must not exceed 230Vac ±15%.

- 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 230Vac with respect to ground and the product would not be safe.

**Conductive pollution.** Electrically conductive pollution i.e. carbon dust, MUST be excluded from the enclosure in which the controller is installed. To secure a suitable atmosphere in conditions of conductive pollution, fit an air filter to the air intake of the enclosure. Where condensation is likely, include a thermostatically controlled heater in the enclosure.

**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.

To prevent overheating of the process under fault conditions, a separate over-temperature protection unit should be fitted which will isolate the heating circuit. This must have an independent temperature sensor.

**Note: Alarm relays within the unit will not give protection under all failure conditions.**

**Installation Requirements for EMC.** To comply with European EMC directive certain installation precautions are necessary:-

- General guidance. Refer to *EMC Installation Guide*, Part no. HA025464.

- Relay outputs. It may be necessary to fit a suitable filter to suppress conducted emissions. Filter requirements depend on the type of load.
- Table top installation. If using a standard power socket, compliance with commercial and light industrial emissions standard is usually required. To comply with conducted emissions standard, a suitable mains filter must be installed.

Restriction of Hazardous Substances (RoHS)						
<b>Product group</b>		2400				
<b>Table listing restricted substances</b>						
Chinese						
限制使用材料一览表						
有毒有害物质或元素						
产品	铅	汞	镉	六价铬	多溴联苯	多溴二苯醚
印刷线路板组件	X	O	O	O	O	O
附属物	O	O	O	O	O	O
显示器	X	O	O	O	O	O
模块	X	O	X	O	O	O
O	表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006标准规定的限量要求以下。					
X	表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。					
English						
Restricted Materials Table						
Toxic and hazardous substances and elements						
Product	Pb	Hg	Cd	Cr(VI)	PBB	PBDE
PCBA	X	O	O	O	O	O
Enclosure	O	O	O	O	O	O
Display	X	O	O	O	O	O
Modules	X	O	X	O	O	O
O	Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.					
X	Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.					
Approval						
Name:	Position:	Signature:	Date:			
Martin Greenhalgh	Quality Manager		09/11/20/2007			
IA029470U470 (CN23172) Issue 1 Feb 07						

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