EPC3000 Programmable Controllers

EPC3016, EPC3008, EPC3004

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Issue Status of this manual

Issue 2 adds:

- A chapter ’Navigation Diagram’
- A section how to set up Ethernet Communications
- More prominent default values
- Minor improvements.

Safety Information

Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Note: Electrical equipment must be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

Note: A qualified person is one who has skills and knowledge related to the construction, and operation of electrical equipment and its installation, and has received safety training to recognise and avoid the hazards involved.

Safety and EMC

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Power down all equipment before starting the installation, removal, wiring, maintenance or inspection of the product.

Always use properly rated voltage sensing device to confirm the power is off.

Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment. i.e. UK, the latest IEE wiring regulations, (BS7671), and USA, NEC Class 1 wiring methods.

Failure to follow these instructions will result in death or serious injury.

Reasonable use and responsibility

The safety of any system incorporating this product is the responsibility of the assembler/installer of the system.

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.

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

Failure to use approved software/hardware with our hardware products may result in injury, harm, or improper operating results.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Do not use the product for critical control or protection applications where human or equipment safety relies on the operation of the control circuit.
This product must be installed, connected and used in compliance with prevailing standards and/or installation regulations. If this product is used in a manner not specified by the manufacturer, the protection provided by the product may be impaired.

Personnel
Electrical equipment must be installed, operated, serviced and maintained only by qualified personnel.

Enclosure of Live Parts
To help prevent hands or metal tools touching parts that may be electrically live, the controller must be installed in an enclosure.

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% CATII.

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 the instrument when withdrawing it from the sleeve.

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 a protective earth ground

Power Isolation
The installation must include a power isolating switch or circuit breaker. This device must be in close proximity of 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 must be fused appropriately to protect the cabling to the controller.

Conductive pollution
Electrically conductive pollution must be excluded from the enclosure in which the controller is installed. 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 enclosure. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the enclosure. This product has been designed to conform to EN61010 installation category II, pollution degree 2. These are defined as follows:
Pollution Degree 2. Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.
Installation Category II (CAT II). The rated impulse voltage for equipment on nominal 230V supply is 2500V.

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.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Safety and EMC
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. This instrument complies with the European Low Voltage Directive 2014/35/EU, by the application of the safety standard EN 61010.
Electrostatic discharge precautions.
Always observe all electrostatic precautions before handling the unit. When the controller is removed from its sleeve, some of the exposed electronic components are vulnerable to damage by electrostatic discharge from someone directly handling the controller.
Service and repair.
This instrument has no user serviceable parts. Contact your supplier for repair
Electromagnetic compatibility.
This instrument conforms with the essential protection requirements of the EMC Directive 2014/35/EU. It satisfies the general requirements of the industrial environment defined in EN 61326.
Installation requirements for EMC.
To comply with the 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.
- Table top installation. If using a standard power socket, compliance with commercial and light industrial emissions standard is required. To comply with conducted emissions standard, a suitable mains filter must be installed.

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 complies 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.
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. In general keep cable lengths to a minimum.
Hazard of Incorrect Configuration.
Incorrect configuration can result in damage to the process and/or personal injury and must be carried out by a competent person authorised to do so. It is the responsibility of the person commissioning the controller to ensure the configuration is correct.
Loss of Communications
If the output is not wired, but written to by communications, it will continue to be controlled by the communications messages. In this case take care to allow for the loss of communications

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

EQUIPMENT AND PERSONNEL PROTECTION

- The designer of any control scheme must consider the potential failure modes which could occur and provide a means to achieve a safe state during and after a failure.
- Independent or redundant devices must be provided for critical control functions.
- The control scheme may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Each implementation of this equipment must be individually and thoroughly tested for its intended operation before being placed into service.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

OVER TEMPERATURE PROTECTION

In temperature control applications a danger could be present if the heating remains constantly on. Apart from potentially spoiling the end product, this could damage the process machinery being controlled, or cause a fire hazard. Consider the following examples:

- a temperature sensor becoming detached from the process
- thermocouple wiring becoming short circuit
- the controller operating with its heating output constantly on
- an external valve or contactor sticking in the heating condition
- the controller setpoint set too high.

The alarm relays within the controller will not give over-temperature protection under all conditions. The installer must, therefore, fit a separate over-temperature protection device, with an independent temperature sensor, to isolate the heating circuit should an over-temperature condition occur.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Unpacking and storage - The packaging should contain an instrument mounted in its sleeve, two mounting brackets for panel installation and an Installation sheet. Certain ranges are supplied with an input adapter.

If upon receipt, the packaging or the instrument is damaged, do not install the product instead contact your supplier.
If the instrument is to be stored before use, protect from humidity and dust in an ambient temperature range of −20℃ to +70℃.

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.

Failure to follow these instructions can result in injury or equipment damage.

Symbols

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

Refer to manual.

Risk of electric shock.

Take precautions against static.

The RCM is a trademark owned by Australian and New Zealand Regulators." with RCM mark

Complies with the 40 year Environment Friendly Usage Period.

Restriction of Hazardous Substances

Cybersecurity

What's in this Chapter

This chapter outlines some good practice approaches to cybersecurity as they relate to use of EPC3000-series controllers, and draws attention to several EPC3000-series features that could assist in implementing robust cybersecurity.

Introduction

When utilising Eurotherm EPC3000-series controllers in an industrial environment, it is important to take 'cybersecurity' into consideration: in other words, the installation's design should aim to prevent unauthorised and malicious access. This includes both physical access (for instance via the EPC3000 front panel or HMI screens), and electronic access (via network connections and digital communications).

Secure network topologies and good practices

Overall design of a site network is outside the scope of this manual. The Cybersecurity Good Practices Guide, Part Number HA032968 provides an overview of principles to consider. This is available from www.eurotherm.co.uk.

Typically, an industrial controller such as the EPC3000 together with any associated HMI screens and controlled devices should *not* be placed on a network with direct access to the public Internet. Rather, good practise involves locating the devices on a firewalled network segment, separated from the public Internet by a so-called 'demilitarized zone' (DMZ).

Security Features

The sections below draw attention to some of the cybersecurity features of EPC3000-series controllers.

Principle of Secure by Default

Some of the digital communication features on the EPC3000-series can provide greater convenience and ease-of-use (particularly in regards to initial configuration), but also can potentially make the controller more vulnerable. For this reason, these features are turned off by default:

Comms ports and channels disabled by default

EPC3000-series controllers support a variety of digital communications (see "EPC3016 Options" on page 34, "EPC3008 and EPC3004 Options" on page 35 and "Communications List (COmm)" on page 140). By default, the ports and channels associated with any digital comms are closed to traffic, unless that method of communication is explicitly selected using the parameters in the mAIn menu (see "Main Sub List (mAIN)" on page 141).

The only exception to this principle is for the configuration port on the left side face of the controller. This is a serial port, used with a bespoke Eurotherm-supplied ‘config clip’ cable, for communication with Eurotherm’s iTools software and for performing firmware upgrades (see "Using the Configuration Clip" on page 182). Whilst this serial port is always enabled, it is physically inaccessible when the controller is installed and mounted in the normal way. It can only be accessed by removing the controller from its mounting, thus disconnecting all other I/O connections.

Bonjour auto-discovery disabled by default

Ethernet connectivity is available as an option on EPC3000-series controllers (see "EPC3016 Options" on page 34 and "Auto discovery" on page 274"Auto discovery" on page 274), including the Bonjour service discovery protocol (see "Bonjour" on page 274). Bonjour enables the controller to be automatically discovered by other devices on the network without the need for manual intervention. However, for cybersecurity reasons, it is disabled by default, as it could be exploited by a malicious user to gain access to the controller.

See also section "Auto discovery" on page 274.

HMI Access Level / Comms Config Mode

As described in "Operator Levels" on page 69, EPC3000-series controllers feature tiered, passcode-restricted operator levels, so that available functions and parameters can be restricted to appropriate personnel.

Level 1 functions are the only ones that do not require passcode access, and are typically appropriate for routine operator use. The controller powers up in this level. All other levels are passcode-restricted. Level 2 makes an extended set of operational parameters available, typically intended for use by a supervisor. Level 3 parameters would typically be set when an authorised person was commissioning the device for use in a particular installation. Config level allows access to all the controller’s parameters. Passcode-restricted access to these parameters is also possible over digital communications, using Eurotherm’s iTools software ("Configuration Using iTools" on page 181),

At config level, it is also possible to customise the other levels from their defaults, restricting certain parameters to only be available at a higher level, or making certain parameters available at lower levels. In particular, you can configure the availability of setpoint program control parameters such as start/stop, auto/manual, setpoint, manual output, program edit and program run (see "Configuration Sub-List" on page 109).

HMI Passcodes

When entering passcodes via the HMI, the following features help protect against unauthorised access:

- Each digit is obscured (replaced with an underscore character) after entry, to help protect against an unauthorized person seeing the passcode as it’s typed in.
- Passcode entry is locked after three invalid attempts. The time it stays locked for is configurable (see "Security Sub-List (SEC)" on page 171). This helps protect against “brute force” attempts to guess the passcode.

- The controller records the number of successful and unsuccessful login attempts for each level of passcode (see "Diagnostics Sub-list" on page 123). Regular auditing of these diagnostics is recommended, as a means to help detect unauthorized access to the controller.

Comms Config Level Passcode

The passcode for Config Level access via iTools has the following features to help protect against unauthorised access (see "Instrument List" on page 186 for more details):

- If the passcode is not changed from its initial default value, or is changed to a password that was used previously, an alert message is displayed.
- By default, each passcode expires after 90 days, and needs to be changed. This expiry period is configurable.
- Passcode entry is locked after three invalid attempts. The time it stays locked for is configurable. This helps protect against “brute force” attempts to guess the passcode.
- The controller records the number of successful and unsuccessful login attempts for each level of passcode. Regular auditing of these diagnostics is recommended, as a means to help detect unauthorized access to the controller.

Ethernet security features

Ethernet connectivity is available as an option on EPC3000-series controllers (see "EPC3016 Options" on page 34 and "EPC3008 and EPC3004 Options" on page 35). The following security features are specific to Ethernet:

Ethernet rate protection

One form of cyberattack is to try to make a controller process so much Ethernet traffic that this drains systems resources and useful control is compromised. For this reason, the EP3000-series includes an Ethernet rate protection algorithm, which will detect excessive network activity and help to ensure the controller’s resources are prioritized on the control strategy rather than the Ethernet. If this algorithm is activated, the *RATE PROTECTION* diagnostic parameter will be set to ON (see "Network Sub List (nWrk)" on page 142).

Broadcast Storm protection

A ‘broadcast storm’ is a condition which may be created by cyberattack: spurious network messages are sent to devices which cause them to respond with further network messages, in a chain reaction that escalates until the network is unable to transport normal traffic. The EPC3000-series includes a broadcast storm protection algorithm, which will automatically detect this condition, stopping the controller from responding to the spurious traffic. If this algorithm is activated, the *BROADCAST STORM* diagnostic parameter will be set to ON (see "Network Sub List (nWrk)" on page 142).

Communications watchdog

EPC3000-series controllers include a ‘comms watchdog’ feature. This can be configured to raise an alert if any of the supported digital communications are not received for a specified period of time. See the four WATCHDOG parameters in "Loop - Main Sub-list" on page 107. These provide a way to configure appropriate action if malicious action interrupts the controller’s digital communications.

Configuration backup and recovery

Using Eurotherm’s iTools software, you can ‘clone’ an EPC3000-series controller, saving all its configuration and parameter settings to a file. This can then be copied onto another controller, or used to restore the original controller’s settings—see "Cloning" on page 213.

For cybersecurity reasons, passcode-restricted parameters are not saved in the clone file when in operator mode (Level 1).

Clone files are digitally signed using an SHA-256 cryptographic algorithm, meaning that if the file contents is tampered with, it will not load back into a controller.

Memory Integrity

FLASH Integrity

When an EPC3000-series controller powers up, it automatically performs an integrity check on the entire contents of its internal flash memory. Additional periodic integrity checks are also performed in 256 byte blocks during normal runtime. If any integrity check detects a difference from what is expected, the controller will stop running and display a FL.Er alert (see "Notification Messages" on page 287).

Non-volatile Data Integrity

When an EPC3000-series controller powers up, it automatically performs an integrity check on the contents of its internal non-volatile memory devices. Additional periodic integrity checks are performed during normal runtime and when non-volatile data is being written. If any integrity check detects a difference from what is expected, the controller enters Standby mode and displays a rAm.S, PA.S', rEG.S or OPt.S alert as appropriate (see "Notification Messages" on page 287 for more details).

Firmware

From time to time, to provide new functionality or address known issues, Eurotherm may make new versions of the EPC3000-series firmware available.

This firmware may be downloaded from the Eurotherm website, and transferred to an EPC3000 controller in the field, via a serial communications link, from a Windows PC running a firmware upgrade utility.

⚠ CAUTION

NON SCHNEIDER ELECTRIC FIRMWARE

There is a potential risk that an attacker could upgrade an EPC3000 with non-genuine firmware that contains malicious code. To mitigate this potential risk, genuine EPC3000 firmware upgrade utility executables are always supplied digitally signed with the publisher as Schneider Electric. Do not use a firmware upgrade utility if it has not been signed by Schneider Electric.

Failure to follow these instructions can result in injury or equipment damage.

Achilles® Communications Certification

The EPC3000-series range of controllers have been certified at Level 1 under the Achilles® Communications Robustness Test Certification scheme. This is an established industry benchmark for the deployment of robust industrial devices recognized by the major automation vendors and operators.

Decommissioning

When an EPC3000-series controller is at the end of its life and being decommissioned, Eurotherm advises reverting all parameters to their default settings (see "Cold Start" on page 214 for instructions). This can help to protect against subsequent data and intellectual property theft if the controller is then acquired by another party.

Legal Information

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Introduction

Controller Concept

The EPC3000 is a range of programmable single loop process and temperature controllers which are certified for cybersecurity communications robustness. A full range of math, logic, totalizer and specialized functions is also available.

A simple "Quick Start" code is used to configure standard applications essential for controlling specific processes. This enables fast commissioning "Out of the Box" without the need for configuration software. Applications include (but are not limited to) heat or heat/cool temperature control, carbon potential control, dew point control, etc. These applications are pre-configured providing the user with a starting point for customising to an individual process.

Eurotherm iTools is a software package which is designed for this purpose by providing user function block wiring in addition to a range of other features. It is available as a free download from www.eurotherm.co.uk or can be ordered on a DVD.

Manual Concept

This manual is generally laid out in the following manner:

- The first part explains mechanical and electrical installation and covers the same topics as in the Installation and wiring sheet supplied with each instrument but in more detail.
- Operation of the instrument, including Quick Start Configuration. In general the descriptions in the manual assume that the controller is configured with no application loaded or with a heat or heat cool controller application loaded.
- Configuration of the instrument from the front panel
- Configuration of the instrument using Eurotherm iTools configuration package
- Description of different function blocks in the instrument, such as Control Loop, Programmer, Digital Communications
- Calibration procedure
- Technical specification

This User Manual describes general control applications which may be configured using the Quick Start Codes.

This User Manual describes general control applications which may be configured using the Quick Start Codes.

Specific applications such as Temperature control (Quick Start codes 1, 2 and 3), Carbon Potential control (Quick Start code 4) and Dew Point control (Quick Start code 5) are described in supplements to this manual. The supplement part numbers are HA033033, HA032987 and HA032842 respectively and are available from www.eurotherm.co.uk.

Installation

What's in this Chapter

- A general description of the instrument
- What is in the package
- Order codes
- Instrument dimensions and mechanically mounting in a panel

What Instrument Do I Have?

Thank you for choosing this controller.

The EPC programmable controller range provides precise control of industrial processes and is available in three standard DIN sizes:

- 1/16 DIN Model Number EPC3016
- 1/8 DIN Model Number EPC3008
- 1/4 DIN Model Number EPC3004

Universal input(s) accept various thermocouples, RTDs or process inputs.

Universal input/output (I/O) can be configured for control, alarm, re-transmission outputs or contact inputs.

A changeover relay is available as standard in all controllers.

Controllers may be powered from either an ac line supply [100 - 230Vac +/-15%] or low voltage [24Vac/dc (nominal) supply] depending on the order code.

EIA485 (RS485) digital communications is available in EPC3008 and EPC3004 as standard and as an option in EPC3016.

Options available are:

1. A current transformer (CT) input plus a further contact input.
2. EtherNet communications protocol
3. EIA232/422 (RS232/422) digital communications using Modbus or EI-Bisynch protocols is available in EPC3016 to provide compatibility with previous products.

The controller may be ordered against a hardware ordering code only ("Order Codes" on page 25). In this case when it is new and first switched on 'out of the box' it will start in a 'Quick Configuration' mode ("Start Up—New Unconfigured Controller" on page 61). Alternatively, it may be ordered against both hardware and software codes, in which case it will be supplied configured and will start up directly showing the operator display ("Start Up - New Configured Controller" on page 65). Labels fitted to the sleeve show the ordering code, serial number, date of manufacture, and terminal connections for the hardware fitted.

A full configuration mode, passcode protected, provides more detailed functionality to be configured ("Configuration Level" on page 84).

Two panel sealing versions are available:

- Curved front. Panel sealing to NEMA 12X/IP65 qualified with indoor use only.
- Washdown. Panel sealing to NEMA 4X/IP66 qualified with indoor use only.

Unpacking Your Controller

The controller is supplied with:

- Controller as ordered fitted in its sleeve, two panel retaining clips and sealing gasket mounted on the sleeve. The views below show the washdown version.



EPC3016



EPC3008



EPC3004

- Component packet containing a snubber for a relay output ("General Information About Relays and Inductive Loads" on page 48) and a 2.49Ω resistor for a current input ("Linear Input (mA, mV or V)" on page 39). The quantity depends on the fitted modules.



- Installation sheet Part Number HA032934 in English, French, German, Spanish, Italian, Chinese and Russian

Order Codes

When purchasing an EPC3000-series controller, use the order codes below to specify the product hardware options you require. Codes marked ‘future’ are intended for future product options and are currently left at their default values. Additionally, you can use ‘Quick Start’ order codes (see "Quick Start Tables" on page 62) to have the controller supplied pre-configured with certain software behaviour.

EPC3016 Hardware Order Codes

Model (see Note 1)	
EPC3016	1/16 DIN Controller

1	Type
CC	Controller only
CP	1 x 8 Segment Basic Programmer
P1	1 x 24 Segment Advanced Programmer
P10	10 x 24 Segment Advanced Programmer

2	Supply Voltage
VH	100 - 230Vac +/-15% (48 to 62Hz)
VL	24Vac +10%, -15% (48 to 62 Hz); 24Vdc +20, -15%; 5% ripple

3	I/O 1
XX	Not Fitted
L2	Logic
R1	Relay Output (without snubber)
R2	Relay (supplied with external snubber)
D1	DC Output
T1	Triac (without snubber)
T2	Triac (supplied with snubber)

4	I/O 2
XX	Not Fitted
L2	Logic
R1	Relay Output (without snubber)
R2	Relay (supplied with external snubber)
D1	DC Output
T1	Triac (without snubber)
T2	Triac (supplied with external snubber)

5	Future
X	Not fitted

6	Future
XX	Future

7	Serial Comms Protocol
XX	MODBUS (Default)
EI	EI Bisynch

8	Ethernet, Comms & Remote SP
XX	None (Default)
C1	CT Input, Dig In, and RS232
C2	CT Input, Dig In, and RS485 (3 wire)
C3	RS422 only (5 wire)
CR	CT Input, Dig In, RSP Input
CE	Digital Input, Ethernet

9	Future
XX	Future

10	Tool Kit Blocks
XX	None (Default 50 wires)
TK	Enabled (includes 200 wires)

11	Future
XXX	Future

12	Bezel
ST	Standard
WD	Washdown

13	Labels
XXXX	None (Default)
Fnnnn	Custom Label

14	Specials
XXXX	None (Default)

15	Future
XX	Future

Quick Start Codes EPC3016

	16	17	18	19	20	21	22	23	24	25	26	27

28

Note 1 Requires purchase of Communications Option (Field 8) with “Dig In”

16	Application
X	None (Default)
1	Heat only
2	Heat/Cool
V	VPU

17	Input 1 Sensor Type
X	Not required
M	Linear 0 to 80mVdc
V	Linear 0 to 10Vdc
2	Linear 0 to 20mA
4	Linear 4 to 20mA
B	Type B Thermocouple
J	Type J Thermocouple
K	Type K Thermocouple
L	Type L Thermocouple
N	Type N Thermocouple
R	Type R Thermocouple
S	Type S Thermocouple
T	Type T Thermocouple
P	PT100
W	PT1000

18	Input 1 Range
X	Not required
F	Full range
1	0 to 100°C or 32 to 212°F or 273 to 373K
2	0 to 200°C or 32 to 392°F or 273 to 473K
3	0 to 400°C or 32 to 752°F or 273 to 673K
4	0 to 600°C or 32 to 1112°F or 273 to 873K
5	0 to 800°C or 32 to 1472°F or 273 to 1073K
6	0 to 1000°C or 32 to 1832°F or 273 to 1273K
7	0 to 1200°C or 32 to 2192°F or 273 to 1473K
8	0 to 1300°C or 32 to 2552°F or 273 to 1573K
9	0 to 1600°C or 32 to 2912°F or 273 to 1873K
A	0 to 1800°C or 32 to 3272°F or 273 to 2073K

19	Future
XX	Future

20	Future
XX	Future

21	CT Input Range
X	Not Used
1	10A
2	25A
5	50A
6	100A
7	1000A

22	Digital Input A Function (see Note 1)
X	Not Used
W	Alarm Acknowledge
M	Auto/Manual
R	Programmer Run/Hold
L	Keylock
K	Loop Track
P	Local Setpoint Select
T	Programmer Reset
U	Remote Setpoint Select
V	Recipe Select

23	Future
XX	Future

24	Future
XX	Future

25	Units
X	Not used (Default)
C	Degrees Celsius (Default)
F	Degrees Fahrenheit
K	Kelvin

26	Future
XX	Future

27	Warranty
XX	Standard warranty

28	Certificate of Conformity
XX	None required
CERT1	Supplied with Certificate of Conformity

EPC3008 and EPC3004 Order Codes

Order Codes EPC3008 / EPC3004

	1	2	3	4	5	6	7	8	9	10	11	12

13	14	15

Note 1. Base EPC3008/4 Model includes RS485 Modbus RTU Slave communications, 1 Form C Relay, 2x Contact Closure Digital inputs, 1 Current Transformer Input, and 24V Transducer Power Supply

Note 2. Digital I/O on I8/IE cannot be used for PID control output

Model (see Note 1)	
EPC3008	1/8 DIN Controller
EPC3004	1/4 DIN Controller

1	Type
CC	Controller only
CP	1 x 8 Segment Basic Programmer
P1	1 x 24 Segment Advanced Programmer
P10	10 x 24 Segment Advanced Programmer

2	Supply Voltage
VH	100 - 230Vac +/-15% (48 to 62Hz)
VL	24Vac +10%, -15% (48 to 62 Hz); 24Vdc +20, -15%; 5% ripple

3	I/O 1
XX	Not Fitted
L2	Logic
R1	Relay Output (without snubber)
R2	Relay (supplied with external snubber)
D1	DC Output
T1	Triac (without snubber)
T2	Triac (supplied with external snubber)

4	I/O 2
XX	Not Fitted
L2	Logic
R1	Relay Output (without snubber)
R2	Relay Output (supplied with external snubber)
D1	DC Output
T1	Triac (without snubber)
T2	Triac (supplied with external snubber)

5	I/O 4
XX	Not Fitted
L2	Logic
R1	Relay Output (without snubber)
R2	Relay Output (supplied with external snubber)
D1	DC Output
T1	Triac (without snubber)
T2	Triac (supplied with external snubber)

6	Future
XX	Future

7	RS485 Function
XX	MODBUS (Default)
EI	EI Bisynch

8	Ethernet, 2nd Input & Option I/O
XX	None (Default)
I8	Second PV Input; 8 Digital Input/Outputs:
IE (see Note 2)	Second PV Input;Ethernet (MODBUS TCP slave) + 4 x Digital I/O

9	Future
XX	Future

10	Tool Kit Blocks
XX	None (Default 50 wires)
TK	Enabled (includes 200 wires)

11	Future
XXX	Future

12	Bezel
ST	Standard
WD	Washdown

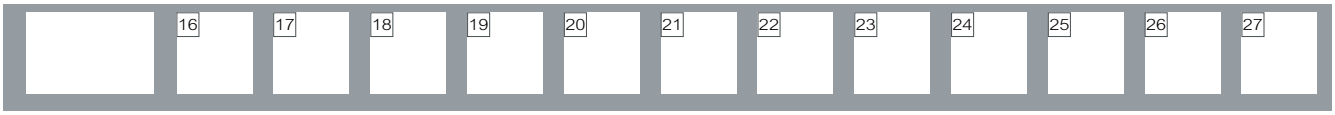
13	Labels
XXXX	None (Default)
Fnnnn	Custom Label

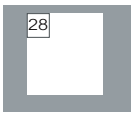
14	Specials
XXXX	None (Default)

15	Future
XX	Future

EPC3008/3004 Quick Start Codes

Quick Start Codes EPC3008 / EPC3004





Note 1. Requires purchase of 2nd Input (Field 8)

Note 2. Requires purchase of Option I/O (Field 8)

16	Application
X	None (Default)
1	Heat only
2	Heat/ Cool
V	VPU
C	Carbon Potential Controller (requires PV2 and Zirconia)
D	Dew Point Controller (requires PV2 and Zirconia)

17	Input 1 Sensor Type
X	Not required
M	Linear 0 to 80mVdc
V	Linear 0 to 10Vdc
2	Linear 0 to 20mA
4	Linear 4 to 20mA
B	Type B Thermocouple
J	Type J Thermocouple
K	Type K Thermocouple
L	Type L Thermocouple
N	Type N Thermocouple
R	Type R Thermocouple
S	Type S Thermocouple
T	Type T Thermocouple
P	PT100
W	PT1000

18	Input 1 Range
X	Not required
F	Full range
1	0 to 100°C or 32 to 212°F or 273 to 373K
2	0 to 200°C or 32 to 392°F or 273 to 473K
3	0 to 400°C or 32 to 752°F or 273 to 673K
4	0 to 600°C or 32 to 1112°F or 273 to 873K
5	0 to 800°C or 32 to 1472°F or 273 to 1073K
6	0 to 1000°C or 32 to 1832°F or 273 to 1273K
7	0 to 1200°C or 32 to 2192°F or 273 to 1473K
8	0 to 1300°C or 32 to 2552°F or 273 to 1573K
9	0 to 1600°C or 32 to 2912°F or 273 to 1873K
A	0 to 1800°C or 32 to 3272°F or 273 to 2073K

19	Input 2 Sensor Type (see Note 1)
X	Not fitted
M	Linear 0 to 80mVdc
V	Linear 0 to 10Vdc
2	Linear 0 to 20mA
4	Linear 4 to 20mA
B	Type B Thermocouple
J	Type J Thermocouple
K	Type K Thermocouple
L	Type L Thermocouple
N	Type N Thermocouple
R	Type R Thermocouple
S	Type S Thermocouple
T	Type T Thermocouple
P	PT100
W	PT1000
Z	Zirconia (HiZ)

20	Input 2 Range (see Note 1)
X	Not required
F	Full range
1	0 to 100°C or 32 to 212°F or 273 to 373K
2	0 to 200°C or 32 to 392°F or 273 to 473K
3	0 to 400°C or 32 to 752°F or 273 to 673K
4	0 to 600°C or 32 to 1112°F or 273 to 873K
5	0 to 800°C or 32 to 1472°F or 273 to 1073K
6	0 to 1000°C or 32 to 1832°F or 273 to 1273K
7	0 to 1200°C or 32 to 2192°F or 273 to 1473K
8	0 to 1300°C or 32 to 2552°F or 273 to 1573K
9	0 to 1600°C or 32 to 2912°F or 273 to 1873K
A	0 to 1800°C or 32 to 3272°F or 273 to 2073K

21	CT Input Range
X	Not Used
1	10A
2	25A
5	50A
6	100A
7	1000A

22	Digital Input A Function
X	Not Used
W	Alarm Acknowledge
M	Auto/Manual
R	Programmer Run/Hold
L	Keylock
K	Loop Track
P	Local Setpoint Select
T	Programmer Reset
U	Remote Setpoint Select
V	Recipe Select

23	Digital Input B Function
X	Not Used
W	Alarm Acknowledge
M	Auto/Manual
R	Programmer Run/Hold
L	Keylock
K	Loop Track
P	Local Setpoint Select
T	Programmer Reset
U	Remote Setpoint Select
V	Recipe Select

24	Programmer I/O Configuration (see Note 2)
X	Not Used/fitted
1	D1 to D8 Programmer Event Outputs 1 to 8
2	D1 to D4 = Programmer Event Outputs 1 to 4, D5 to D7 = BCD Inputs 1 t o3, D8 = Programmer Run/Hold. BCD Output to Program Number
3	D1 to D4 = Programmer Event outputs 1 to 4, D5 to D8 Programmer Run, Hold, Reset, Advance respectively
4	D1 to D4 = Programmer Event inputs 1 to 4, D5 to D7 Programmer Run/ Hold, Reset, Advance respectively, D8 Not Used. BCD Output to Program Number
5	D1 to D8 = BCD Inputs 1 to 8. BCD Output to Recipe Recall
6	D1 to D4 = BCD Inputs 1 to 4, D5 - D8 = Not used. BCD Output to Recipe Recall
7	D1 to D4 Programmer Run, Hold, Reset, Advance respectively, D5 - D8 = Not used
8	D1 to D3 Programmer Run, Hold, Reset respectively, D4 - D8 = Not Used
9	D1 to D4 = Programmer Event Outputs, D5 to D8 = Not Used

25	Units
X	Not used (Default)
C	Degrees Celsius (Default)
F	Degrees Fahrenheit
K	Kelvin

26	Future
XX	Future

27	Warranty
XX	Standard warranty

28	Certificate of Conformity
XX	None required
CERT1	Supplied with Certificate of Conformity

Accessory Order Codes



Model	
EPCACC	EPC Accessories

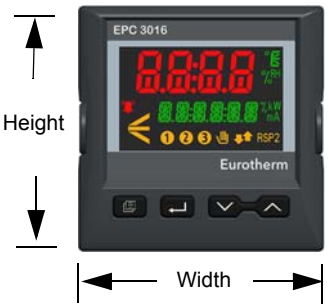
1	Accessories
RES2R9	2.49 Ohm Resistor
RES250	250 Ohm Resistor
RES500	500 Ohm Resistor
SNUBBER	RC SNUBBER
USBCONF	USB Backup lead
CTR10A	Current transformer 10A Primary
CTR25A	Current transformer 25A Primary
CTR50A	Current transformer 50A Primary
CTR100A	Current transformer 100A Primary
ITOOLS	Itools configuration Software

Dimensions

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

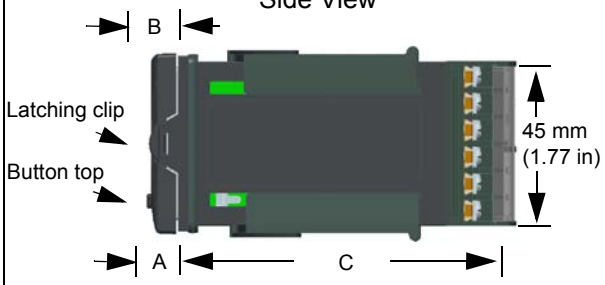
EPC3016 Controller

Front View



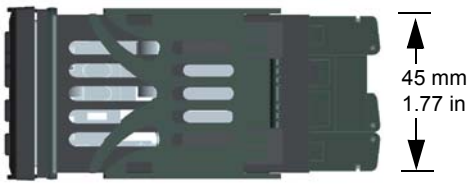
	Curved front	Washdown	Width including latching clips
Width	49.4 mm 1.94 inch	48.1 mm 1.89 inch	50 mm 1.97 inch
Height	49.4 mm 1.94 inch	48.1 mm 1.89 inch	

Side View



A Distance from panel to latching lug	13.7 mm 0.54 inch
B Distance from panel to button top	13.2 mm 0.52 inch
C Distance behind panel	90 mm 3.54 inch

Top View



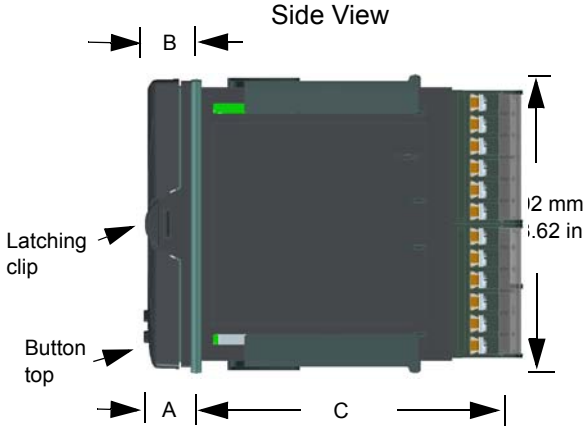
EPC3008 Controller

Front View



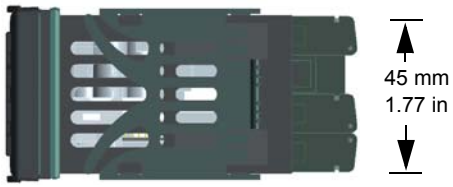
	Curved front	Washdown	Width including latching clips
Width	49.4 mm 1.94 inch	48.1 mm 1.89 inch	50 mm 1.97 inch
Height	97.3 mm 3.83 inch	96.1 mm 3.78 inch	

Side View



A Distance from panel to latching lug	15.1 mm 0.59 inch
B Distance from panel to button top	15.3 mm 0.60 inch
C Distance behind panel	90 mm 3.54 inch

Top View



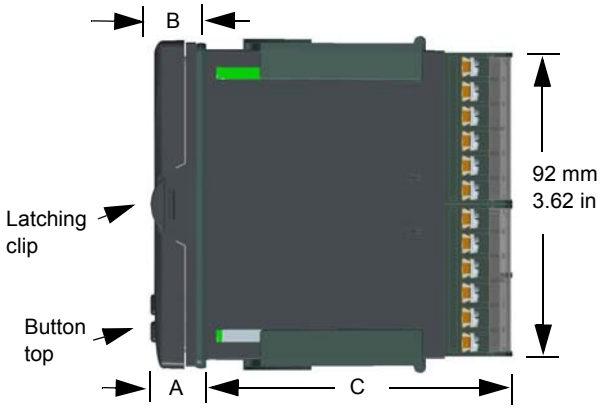
EPC3004 Controller

Front View



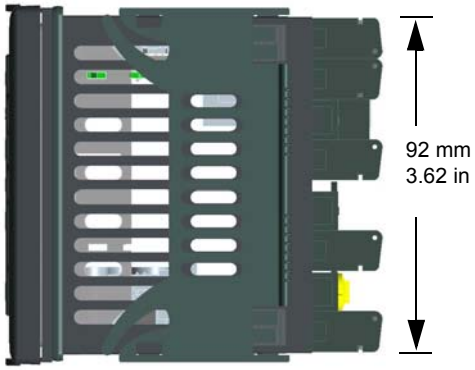
	Curved front	Washdown	Width including latching clips
Width	97.3 mm 3.83 inch	97.3 mm 3.83 inch	98 mm 3.85 inch
Height	97.3 mm 3.83 inch	97.3 mm 3.83 inch	

Side View



A Distance from panel to latching lug	15.3 mm 0.60 inch
B Distance from panel to button top	15.3 mm 0.60 inch
C Distance behind panel	90 mm 3.54 inch

Top View



Installation

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

Select a location which is subject to minimum vibrations the ambient operating temperature is within 0 and 55^{o}C (32 - 131^{o}F) and operating humidity of 0 to 90% RH non condensing.

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

To ensure effective panel sealing, mount on a non-textured surface.

Please read the safety information in "Safety and EMC" on page 11 before proceeding. An EMC Booklet, part number HA025464, gives further installation information and can be downloaded from www.eurotherm.co.uk.

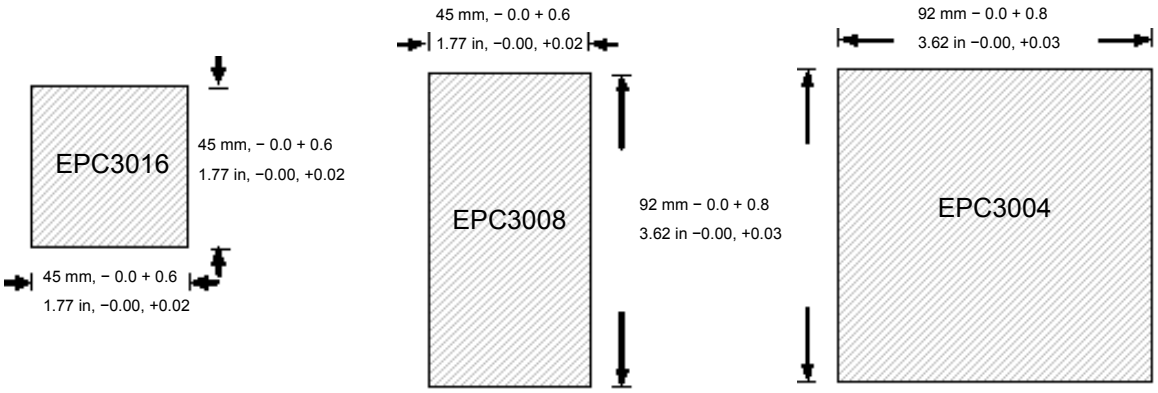
Panel Mounting the Controller

1. Prepare a cut-out in the mounting panel to the size shown. If a number of controllers are to be mounted in the same panel observe the minimum spacing shown, see "Recommended minimum spacing of controllers" on page 33.
2. Carefully remove the panel retaining clips from the sleeve.
3. To achieve effective panel sealing, make sure the gasket is not twisted and is fitted behind the front bezel of the controller.
4. Insert the controller through the cut-out.
5. Spring the panel retaining clips back into place. Secure the controller in position by holding it level and pushing both retaining clips forward.
6. Peel off the protective film from the display.
7. In the unlikely event that it should be necessary to remove the sleeve from the panel, make sure that all power is turned off. Remove the controller from its sleeve. Very carefully unhook the panel retaining clips from the side using a small screwdriver.

The instrument includes polarizing features to help prevent the following:

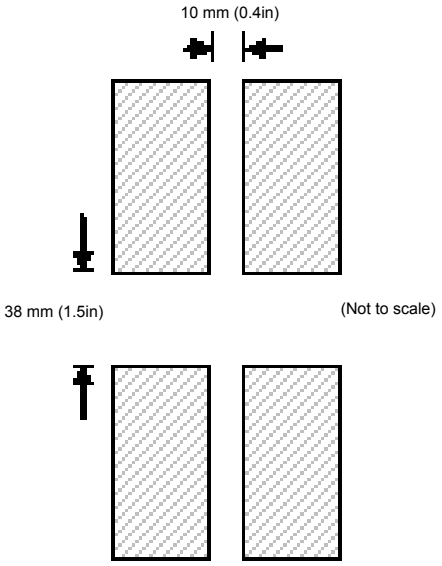
   a. The instrument being inserted upside down into sleeve.
   b. Insertion of Low-Voltage PSU unit into High-Voltage PSU sleeve.
   c. Insertion of other instruments that have a non-compatible terminal assignment.

Panel Cut Out Sizes



Recommended minimum spacing of controllers

Applies to all models



To Remove the Controller from its Sleeve

Ensure that the controller is powered down before attempting to remove it from its sleeve. It can then be removed from its sleeve by easing the latching clips outwards and pulling it forward out of the sleeve. When plugging it back into its sleeve, ensure that the latching clips click back into place to maintain the panel sealing.

If the Ethernet option is fitted, ensure that the Ethernet cable is removed from the rear of the controller before removing it from its sleeve.

Wiring

What's in this chapter

This chapter describes terminal connections and wiring.

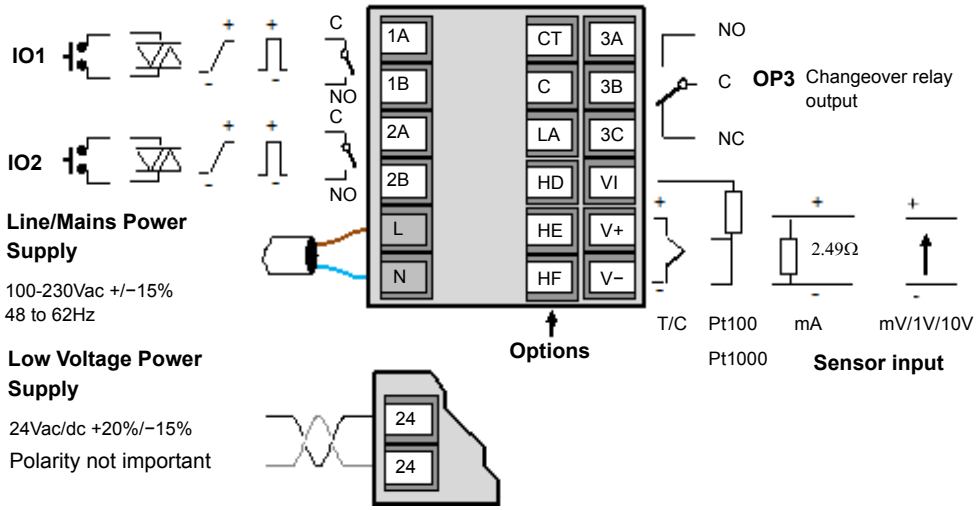
Terminal Layout EPC3016 Controller

⚠ WARNING

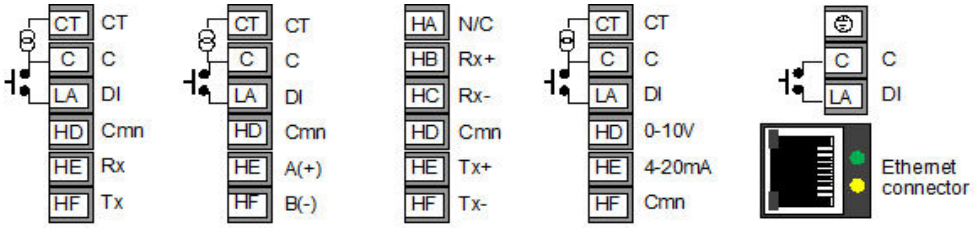
POWER SUPPLY

Ensure that you have the correct supply for your controller. Check the order code of the controller supplied.

Failure to follow these instructions can result in injury or equipment damage.



EPC3016 Options



Option C1
EIA232
CT Input
1 x Digital Input

Option C2
EIA485
CT Input
1 x Digital Input

Option C3
EIA422

Option CR
Remote SP
CT Input
1 x Digital Input

Option CE
Ethernet
Digital Input

Key to symbols used in the wiring diagrams

	Logic (SSR drive) output		Relay output		Changeover relay output
	0-10V/0-20mA analogue output		Triac output		
	Current transformer input		Contact input		

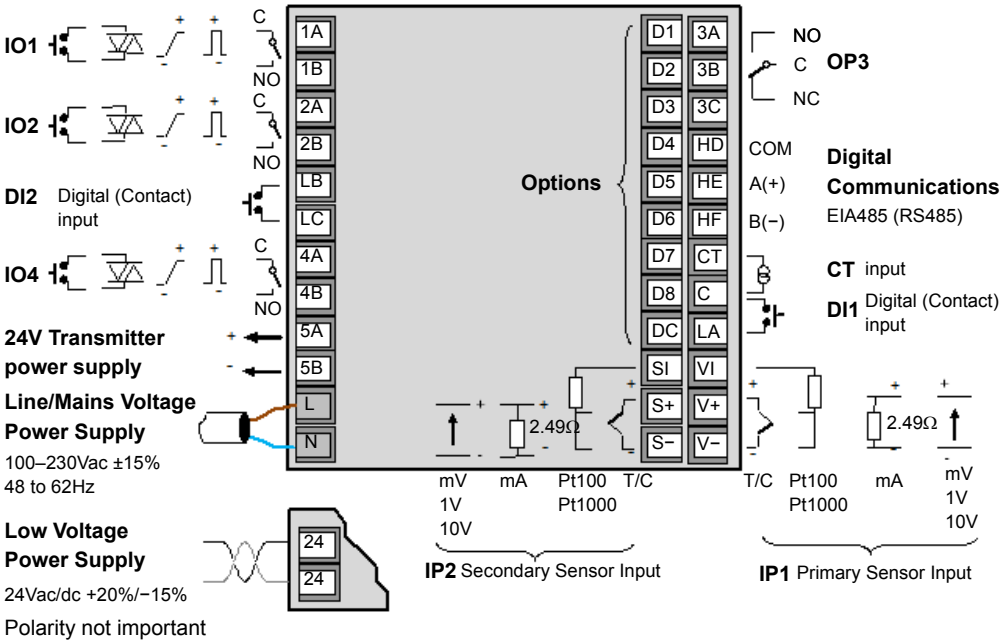
Terminal Layout EPC3008 and EPC3004 Controller

⚠ WARNING

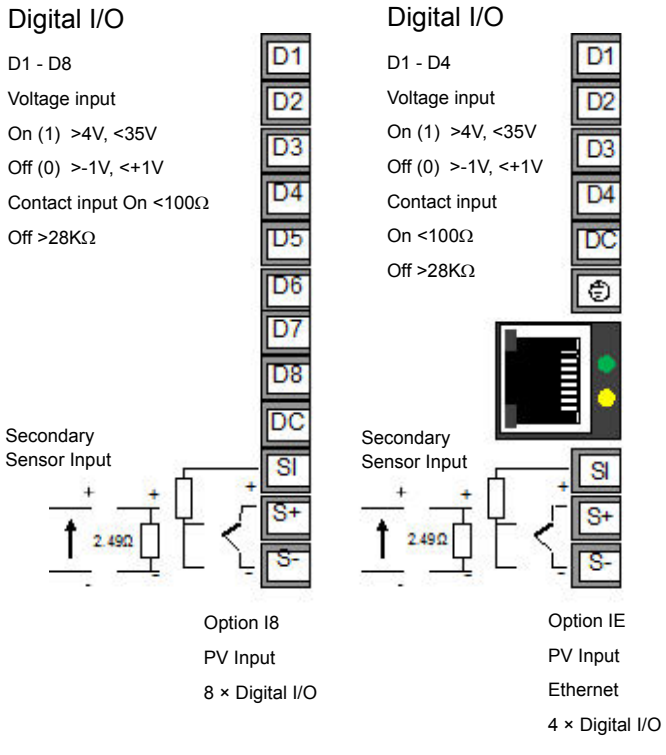
POWER SUPPLY

Ensure that you have the correct supply for your controller.
Check the order code of the controller supplied.

Failure to follow these instructions can result in injury or equipment damage.



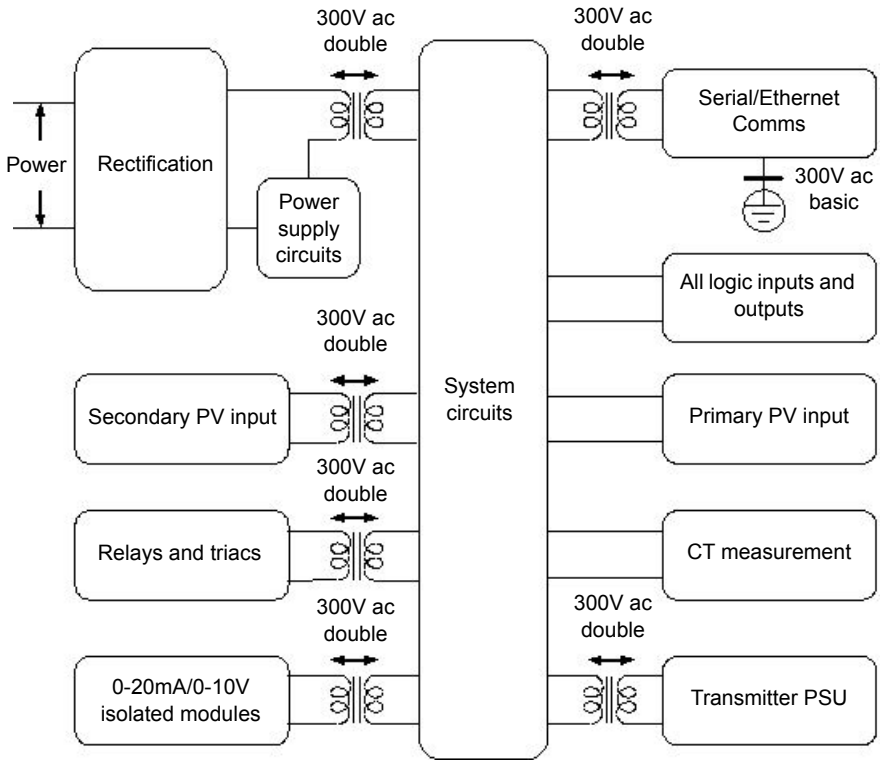
EPC3008 and EPC3004 Options



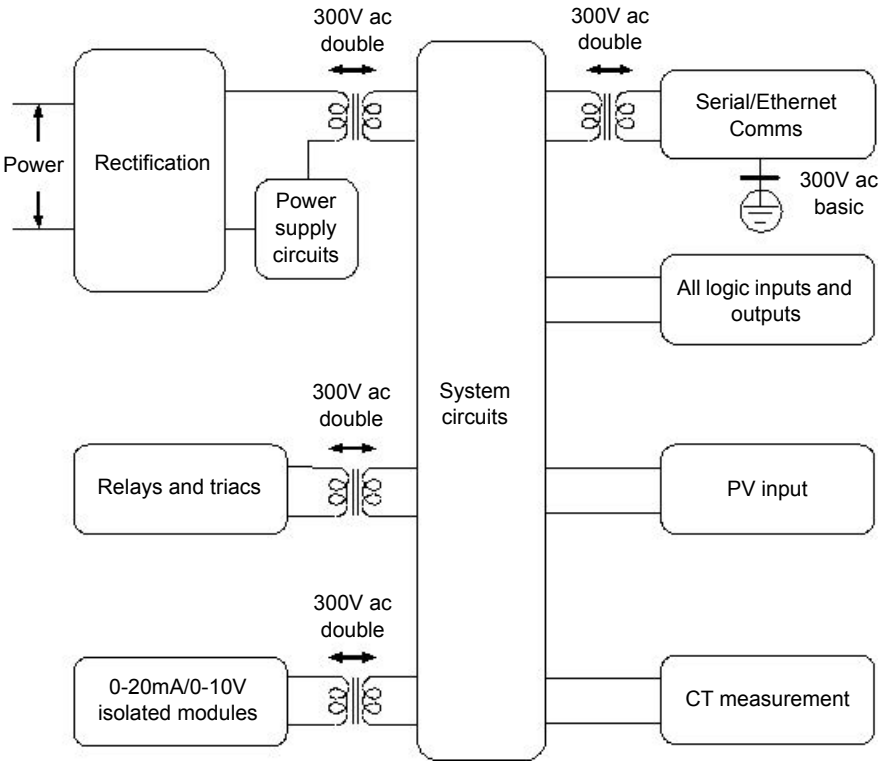
Isolation Boundaries

The drawings show double and basic isolation boundaries.

EPC3008/EPC3004 Isolation



EPC3016 Isolation



Wire Sizes

The screw terminals accept wire sizes from 0.5 to 1.5 mm (16 to 22AWG). Hinged covers help prevent hands or metal making accidental contact with live wires. The rear terminal screws must be tightened to 0.5 N·m (4.4 lb·in).

Controller Power Supply

⚠ WARNING

POSSIBLE EQUIPMENT DAMAGE

Before connecting the instrument to the power line, make sure that the line voltage corresponds to the description on the identification label. If line/mains voltage (e.g. 230V) is connected to the 24V input the unit will be damaged and must be returned to your supplier for repair.

Use only copper conductors.

External fuse protection must be provided to the power supply input to the controller.

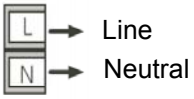
Failure to follow these instructions can result in death, serious injury or equipment damage.

Recommended external fuse ratings are as follows:

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

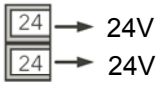
For 100–230Vac, fuse type: T rated 2A 250V.

Line/Mains Voltage Power Supply



- 100 to 230Vac, ±15%, 48 to 62 Hz
- Power rating EPC3016: 6W; EPC3008 and EPC3004: max 9W

Low Voltage Power Supply



- 24Vac, −15%, +10%
- 24Vdc, −15%, +20% ± 5% ripple voltage
- The polarity is not important
- Power rating EPC3016: 6W; EPC3008 and EPC3004: max 9W

Primary Sensor Input (Measuring Input)

This input is available in all models.

⚠ CAUTION

MEASUREMENT INACCURACIES

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 incorrect measurement due to excessive and/or un-balanced line resistance or possible leakage currents

The sensor input is not isolated from the logic outputs & digital inputs

Pay attention to line resistance; a high line resistance may cause measurement inaccuracies

A single sensor must not be connected to more than one instrument. Sensor break operation could be severely compromised

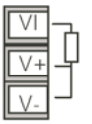
Failure to follow these instructions can result in injury or equipment damage.

Thermocouple Input



- Use the correct compensating cable (preferably shielded) to extend thermocouple cabling, ensure that polarity is strictly followed throughout and that thermal junctions are avoided in any intermediate connections.

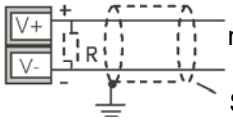
RTD Input



PRT
PRT
Lead Compensation

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

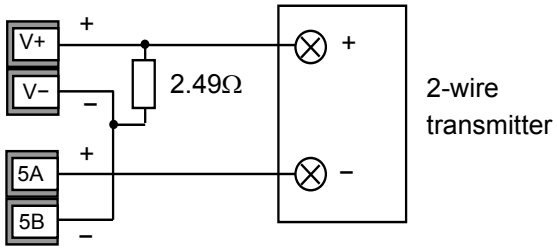
Linear Input (mA, mV or V)



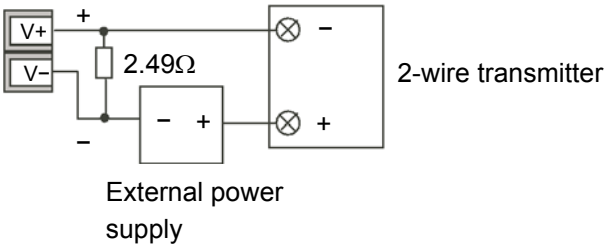
- If shielded cable is used it should only be grounded in one place as shown
- For a mA input connect the 2.49 burden resistor (R) supplied between the + and − input terminals as shown. The resistor supplied is 1% accuracy 50 ppm.

Two-Wire Transmitter Inputs

Using internal 24V power supply (⅛ DIN and ¼ DIN only)



All models using an external power supply



Secondary Sensor Input (Measuring Input)

The secondary sensor input is not available in EPC3016 instrument.

⚠ CAUTION

MEASUREMENT INACCURACIES

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 incorrect measurement due to excessive and/or un-balanced line resistance or possible leakage currents

The sensor input is not isolated from the logic outputs & digital inputs

Pay attention to line resistance; a high line resistance may cause measurement inaccuracies

A single sensor must not be connected to more than one instrument. Sensor break operation could be severely compromised

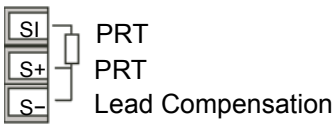
Failure to follow these instructions can result in injury or equipment damage.

Secondary Thermocouple Input



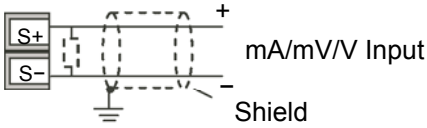
Use the correct compensating cable (preferably shielded) to extend thermocouple cabling, ensure that polarity is strictly followed throughout and that thermal junctions are avoided in any intermediate connections.

Secondary RTD Input



The resistance of the three wires must be the same. The line resistance may cause measurement inaccuracies if it is greater than 22 ohms.

Secondary Linear Input (mA, mV or V)

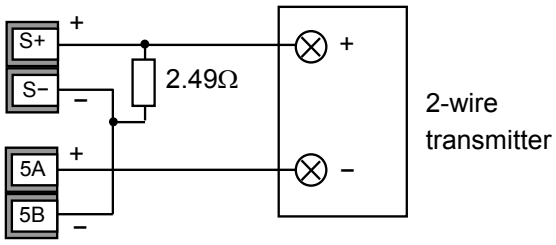


If shielded cable is used it should be grounded in one place only as shown

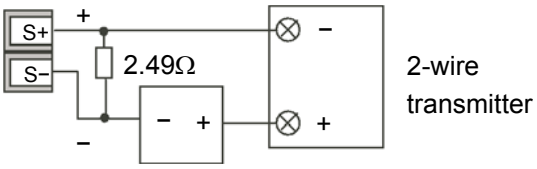
For a mA input connect the 2.49 burden resistor (R) supplied between the + and − input terminals as shown. The resistor supplied is 1% accuracy 50 ppm.

Secondary Two-Wire Transmitter Inputs

Using internal 24V power supply (⅛ DIN and ¼ DIN only)



All models using an external power supply



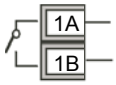
External power supply

Input/Output 1 (IO1)

I/O1 is available as standard in all models. It may be ordered as Contact Input, Triac Output, Logic Output, Analogue Output or Form A Relay Output.

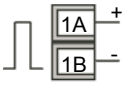
The function of the I/O is fixed by the application ordered, or configured using the Quick Start Codes, "Start Up—New Unconfigured Controller" on page 61. Alternatively, the function can be changed in Configuration level ("I/O List (io)" on page 97) or through iTools ("The 'Browser' List" on page 185).

Relay Output (Form A, normally open)



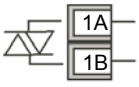
- Isolated output 300Vac CAT II
- Contact rating: 2A 230Vac +15% resistive
- Contact rating minimum: 100mA 12V
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Logic (SSR drive) Output



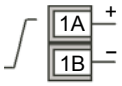
- Not isolated from the sensor input, the current transformer input or the digital inputs
- Output ON state: 12Vdc at 40mA max
- Output OFF state: <300mV, <100 µA
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Triac Output



- Isolated output 300Vac CATII
- Rating: 40mA to 0.75A rms, 30V rms to 230V rms +15% resistive load

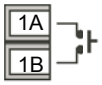
Analogue Output



- Output isolated 300Vac
- Software configurable: 0–10Vdc, 0–20mA or 4–20mA.
- Max load resistance: Voltage >450Ω; Current <550Ω
- Calibration accuracy: % of reading + Offset

  Voltage better than ±(0.5% + 50mV)
  Current better than ±(0.5% + 100µA)
- May also be configured as an isolated contact input

Contact Input



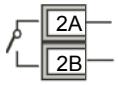
- Not isolated from the current transformer input, the sensor input or logic outputs
- Switching: 12Vdc at 40mA max
- Contact open > 500Ω. Contact closed < 150Ω

Input/Output 2 (IO2)

I/O2 is available as standard in all models. It may be ordered as Contact Input, Triac Output, Logic Output, Analogue Output or Form A Relay Output.

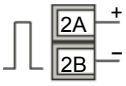
The function of the I/O is fixed by the application ordered, or configured using the Quick Start Codes, "Start Up—New Unconfigured Controller" on page 61. Alternatively, the function can be changed in Configuration level ("I/O List (io)" on page 97) or through iTools ("The 'Browser' List" on page 185).

Relay Output (Form A, normally open)



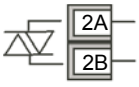
- Isolated output 300Vac CAT II
- Contact rating maximum: 2A 230Vac +15% resistive
- Contact rating minimum: 100mA 12V
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Logic (SSR drive) Output



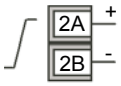
- Not isolated from the sensor input, the current transformer input or the digital inputs
- Output ON state: 12Vdc at 40mA max
- Output OFF state: <300mV, <100 µA
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Triac Output



- Isolated output 300Vac CATII
- Rating: 40mA to 0.75A rms, 30V rms to 230V rms +15% resistive load

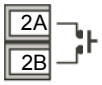
Analogue Output



- Output isolated 300Vac
- Software configurable: 0–10Vdc, 0–20mA or 4–20mA.
- Max load resistance: Voltage >450Ω; Current <550Ω
- Calibration accuracy: % of reading + Offset

  Voltage better than ±(0.5% + 50mV)
  Current better than ±(0.5% + 100µA)
- May also be configured as an isolated contact input

Contact Input



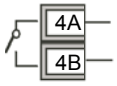
- Not isolated from the current transformer input, the sensor input or logic outputs
- Switching: 12Vdc at 40mA max
- Contact open > 500Ω. Contact closed < 150Ω

Input/Output 4 (IO4)

I/O4 is available as standard in EPC3008 and EPC3004. It is not available in EPC3016. It may be ordered as Contact Input, Triac Output, Logic Output, Analogue Output or Form A Relay Output.

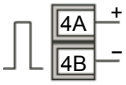
The function of the I/O is fixed by the application ordered, or configured using the Quick Start Codes, "Start Up—New Unconfigured Controller" on page 61. Alternatively, the function can be changed in Configuration level ("I/O List (io)" on page 97) or through iTools ("The 'Browser' List" on page 185).

Relay Output (Form A, normally open)



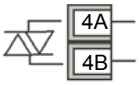
- Isolated output 300Vac CAT II
- Contact rating maximum: 2A 230Vac +15% resistive
- Contact rating minimum: 100mA 12V
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Logic (SSR drive) Output



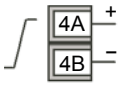
- Not isolated from the sensor input, the current transformer input or the digital inputs
- Output ON state: 12Vdc at 40mA max
- Output OFF state: <300mV, <100 µA
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

Triac Output



- Isolated output 300Vac CATII
- Rating: 40mA to 0.75A rms, 30V rms to 230V rms +15% resistive load

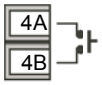
Analogue Output



- Output isolated 300Vac
- Software configurable: 0–10Vdc, 0–20mA or 4–20mA.
- Max load resistance: Voltage >450Ω; Current <550Ω
- Calibration accuracy: % of reading + Offset

  Voltage better than ±(0.5% + 50mV)
  Current better than ±(0.5% + 100µA)
- May also be configured as an isolated contact input

Contact Input

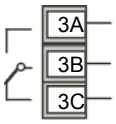


- Not isolated from the current transformer input, the sensor input or logic outputs
- Switching: 12Vdc at 40mA max
- Contact open > 500Ω. Contact closed < 150Ω

Output 3 (OP3)

Output 3 is available in all models. It is a Form C (changeover) Relay. (In some earlier models this was referred to as AA Relay).

The function of the I/O is fixed by the application ordered, or configured using the Quick Start Codes, "Start Up—New Unconfigured Controller" on page 61. Alternatively, the function can be changed in Configuration level ("I/O List (io)" on page 97) or through iTools ("The 'Browser' List" on page 185).



- Isolated output 300Vac CAT II
- Contact rating: 2A 230Vac +15% resistive
- The output switching rate must be set to prevent damage to the output device in use. See "Cycle Time and Minimum OnTime Algorithms" on page 102.

General Information About Relays and Inductive Loads

⚠ CAUTION

RELAYS/TRIACS 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 controller.

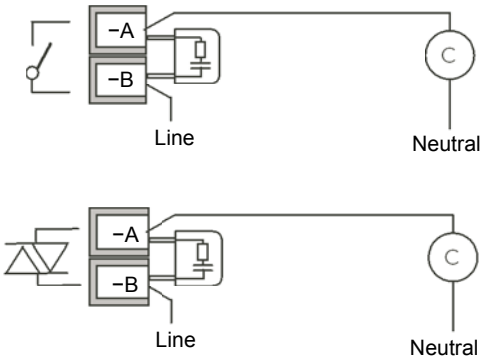
For these types of load it is recommended that a 'snubber' is connected across the normally open contact of the relay switching the load. The snubber recommended consists of a series connected resistor/capacitor (typically 15nF/100Ω). A snubber will also prolong the life of the relay contacts.

A snubber should also be connected across the output terminal of a triac output to help prevent false triggering under line transient conditions.

When the relay contact is open or it is connected to a high impedance load, the snubber passes a current (typically 0.6mA at 100Vac and 1.2mA at 230Vac).

You must ensure that this current will not hold on low power electrical loads. If the load is of this type the snubber should not be connected.

Failure to follow these instructions can result in injury or equipment damage.



Current Transformer

The current transformer input is an option in EPC3016 controller. It is supplied as standard in EPC3008 and EPC3004 controllers.

A further contact input (LA) shares a common terminal (C) with the CT providing up to three (EPC3016) and five (EPC3008 and EPC3004) contact inputs altogether.





- C terminal is common to both the CT input and the contact input (LA). They are, therefore, not isolated from each other, the sensor input or the logic outputs.
- CT input current: 0–50mA rms (sine wave, calibrated) 50/60Hz
- CT input resolution: 0.1A for scale up to 10A, 1A for scale 100A, 10A for scale up to 1000A
- CT input accuracy: +1% of reading.
- A burden resistor, value 10Ω, is fitted inside the controller.

⚠ DANGER

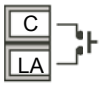
RISK OF ELECTRIC SHOCK

It is recommended that the current transformer is fitted with a voltage limiting device to help prevent high voltage transients if the controller is unplugged (for example, two back-to-back zener diodes - the zener voltage should be between 3 and 10V, rated at 50mA).

Failure to follow these instructions will result in death or serious injury.

Contact Closure Input (LA)

This input is supplied with the current transformer, except on the Ethernet option in EPC3016 where LA is available but the CT is not.

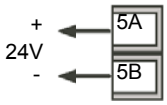


- Not isolated from the current transformer input, the sensor input or logic outputs
- Switching: 12Vdc at 40mA max
- Contact open > 600Ω. Contact closed < 300Ω
- The function of the I/O is fixed by the application ordered, or configured using the Quick Start Codes, "Start Up—New Unconfigured Controller" on page 61. Alternatively, the function can be changed in Configuration level ("I/O List (io)" on page 97) or through iTools ("The 'Browser' List" on page 185).

Transmitter Power Supply

The Transmitter power supply is not available in the Model EPC3016.

It is fitted as standard in the Models EPC3008 and EPC3004.



- Isolated output 300Vac CAT II
- Output: 24Vdc, ±10%. 28mA max.

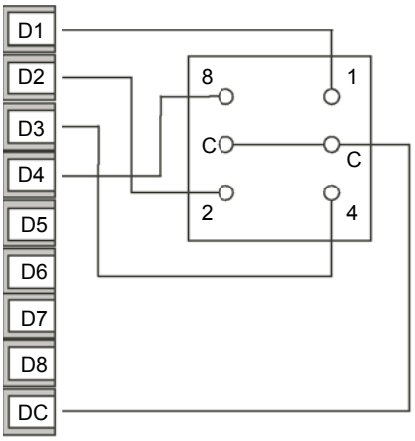
Digital Inputs/Outputs

Up to 8 digital inputs/outputs are available on the options terminals depending on the option fitted. These are marked D1 to D8.

- Current sinking output. External DC PSU 15V minimum, 35V maximum
- Voltage sensing logic input. High level input voltage 4V minimum. 35V maximum. Low level input voltage −1V minimum, +1V maximum
- Contact closure input. Contact closed 0Ω to 100Ω. Contact open >28kΩ.

Example BCD Switch Wiring

The diagram below shows an example of wiring a typical BCD switch using the first four digital inputs of EPC3008 or EPC3004 controllers which could be used to select a program number.



The BCD Inputs can be turned on in Level 3 or Configuration level, see "BCD List (bCd)" on page 135.

Digital Communications Connections

On the EPC3008 and EPC3004, EIA485 (RS485) is standard. EIA232 (RS232) and EIA422 (RS422) are not supported.

On the EPC3016, EIA485 (RS485), EIA422 (RS422) and EIA232 (RS232) are supported via the option board.

ModbusRTU or Bisync protocol is used for compatibility with existing controllers.

Ethernet (ModbusTCP) is also supplied as an option in all controllers.

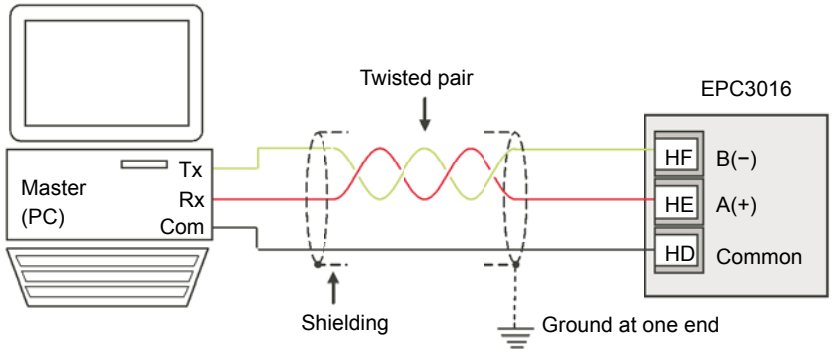
All instruments support EIA232 (RS232) via the configuration clip, however, this connection is not available when the instrument is fitted in a panel.

To help prevent earth ground loops, the cable shield should be grounded at one point only.

Isolated 300Vac CAT II.

EIA232 Wiring

EIA232 is available in EPC3016 only and is used to connect one master and one slave.

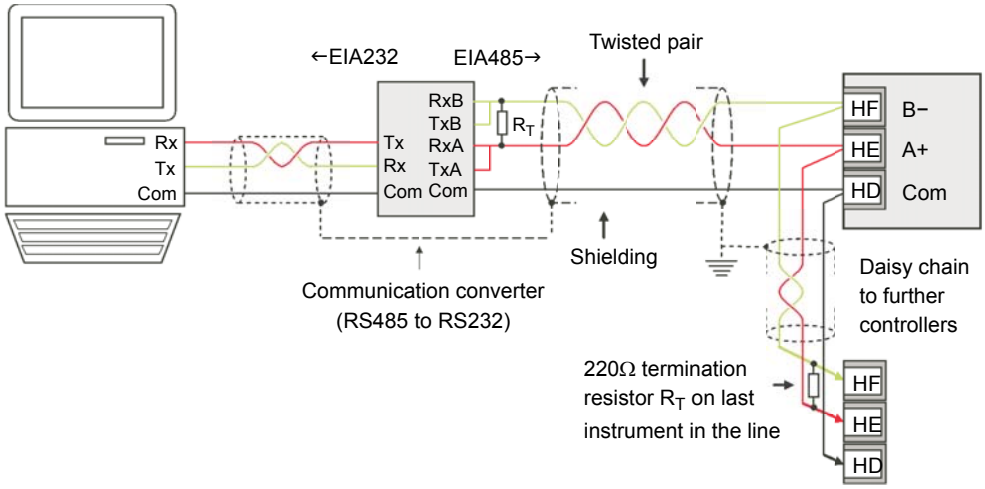


For 2-wire both master and slave ends act as Tx and Rx

EIA485 Wiring

EIA485 allows multi-slaves to be connected to the network. In practice a buffer is necessary to convert EIA485 connections from the controller to the EIA232 port of the PC. A suitable Communications Converter unit is recommended for this purpose. The use of a EIA485 board built into the computer is not recommended since this board may not be isolated and the RX terminals may not be biased correctly for this application. This may cause electrical noise problems or damage to the computer.

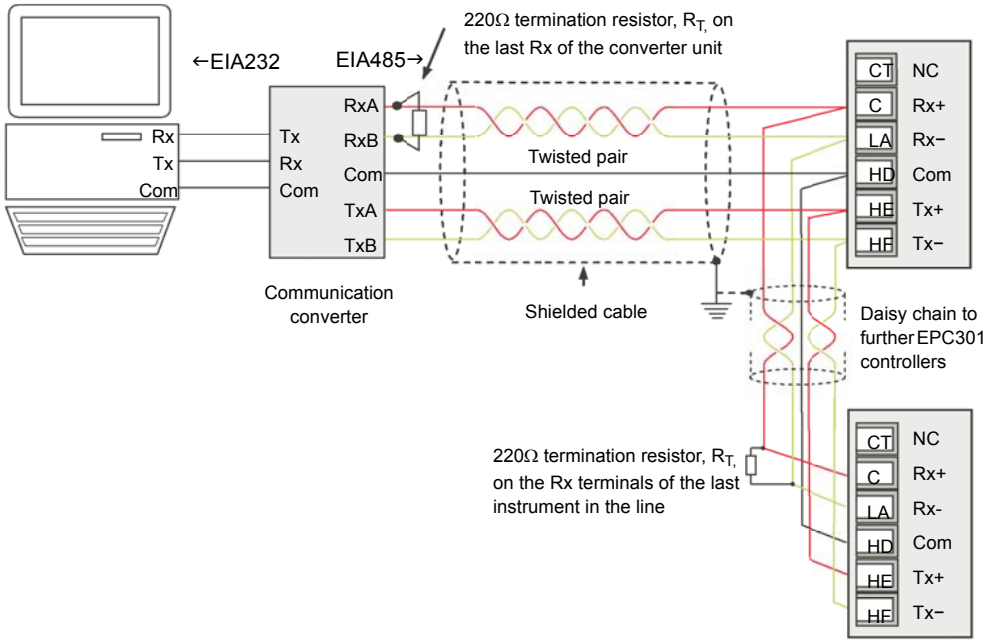
Connections using a suitable converter are shown in the following diagram.



Note: The device physical interface can only support up to 31 devices for each segment. More than 31 devices will require additional buffering. For more details see the Communications Manual HA026230 which can be downloaded from www.eurotherm.co.uk.

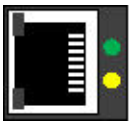
EIA422 Wiring

EIA422 (sometimes referred to as EIA485 4-wire) is available as an option in EPC3016 only. It allows up to 31 slaves to be connected to the network using separate transmit and receive twisted pairs. As with the previous example the use of a suitable communication converter is recommended to convert EIA422 to EIA232. The wiring connections are shown below.



Ethernet Wiring

An Ethernet networking capability is provided by an RJ45 connector, provided on the options board if this has been ordered



The connector has a pair of LED indicators.

Green on = network connection

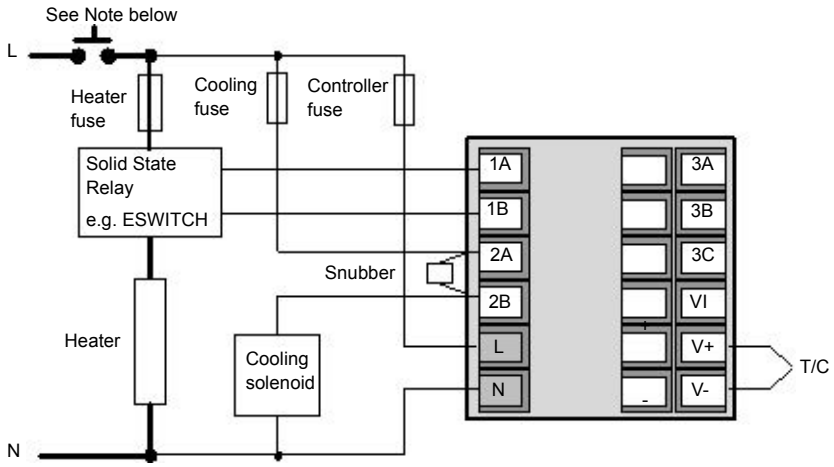
Flashing amber = network activity

The connection is 10/100 base T, autosensing.

Wiring Examples

Heat/Cool Controller

This example shows a heat/cool temperature controller where the heater control uses a SSR, triggered by a logic output on IO1, and the cooling control uses the relay, IO2.



⚠ DANGER

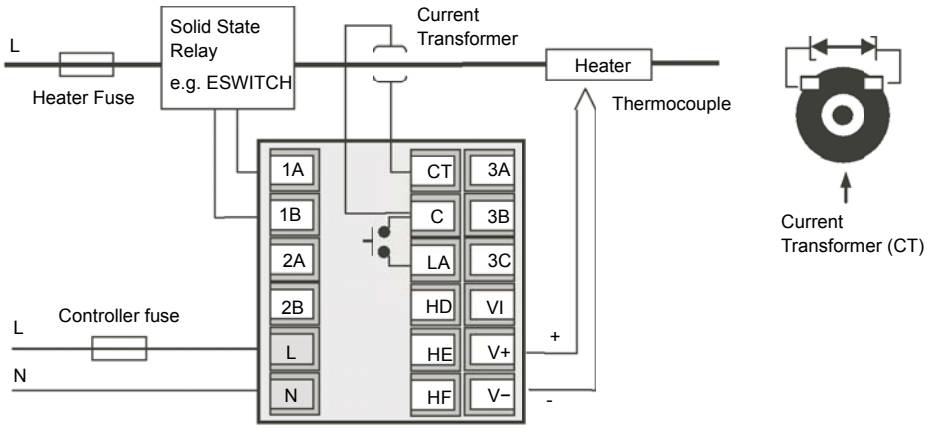
DISCONNECTING DEVICE

For permanently connected equipment, an isolating switch or circuit breaker must be included in the installation, and 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.
Failure to follow these instructions will result in death or serious injury.

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

CT Wiring Diagram

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



Note: A burden resistor value 10Ω is mounted inside the controller.

⚠ DANGER

RISK OF ELECTRIC SHOCK

To help prevent a build up of high voltages at the output of the CT if it is disconnected from the controller, it is recommended that a voltage limiting device be connected directly across the output of the CT. A suitable device is two back to back zener diodes, rated between 3 and 10V at 50mA, as shown in the diagram above.

Failure to follow these instructions will result in death or serious injury.

Start Up Modes

What's in this Chapter

This chapter describes:

- What to expect when the controller is first switched on from new out of the box.
- A general description of the display and button functions.
- Power up after the instrument has been configured or commissioned.

Start up

Start Up (or Power Up) refers to the operation of the controller when Switched On.

EPC3000 range controllers are designed to be application based. Their start up modes will, therefore, vary depending on the way in which the controller was ordered and delivered. This chapter describes the different ways in which the controller can be ordered and delivered and how this affects the operation at power up.

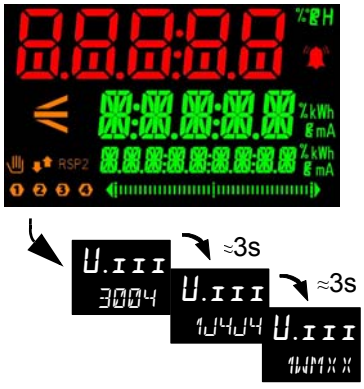
1. Controller new 'out of the box' supplied unconfigured. "Start Up—New Unconfigured Controller" on page 61.
2. Controller new 'out of the box' supplied fully configured according to the order code. "Start Up - New Configured Controller" on page 65.
3. Subsequent start ups - Controller previously configured. Go to section "Subsequent Start-ups" on page 66.

Start up Diagnostic mode

In all cases the controller display will perform a diagnostic in which all bars of each character and every beacon is illuminated. In a configured controller the diagnostic display is followed by the firmware version number and the instrument type number, then a short summary of the Quick Codes. (A new unconfigured controller shows the Quick Codes only, see section "Start Up—New Unconfigured Controller" on page 61). Essentially the start up diagnostics is the same for each model.

The opening display is then dependent upon its configuration status and is described in subsequent sections.

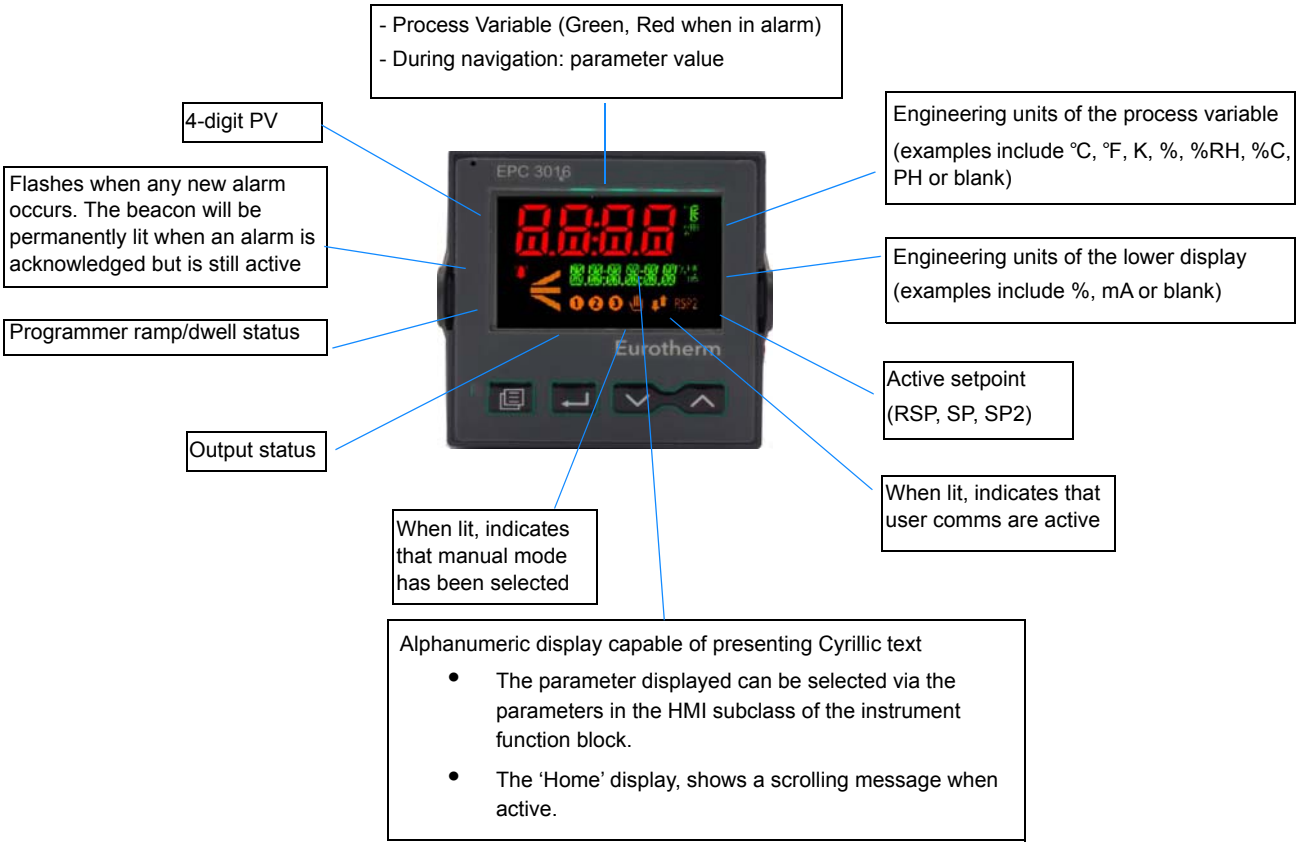
The controller will read the idents of the hardware fitted. If a different hardware is detected a message will be displayed and the instrument will go into standby mode. To clear this message, either replace the module fitted with the expected module type OR the expected module parameter value is to be changed to match the fitted module parameter value.



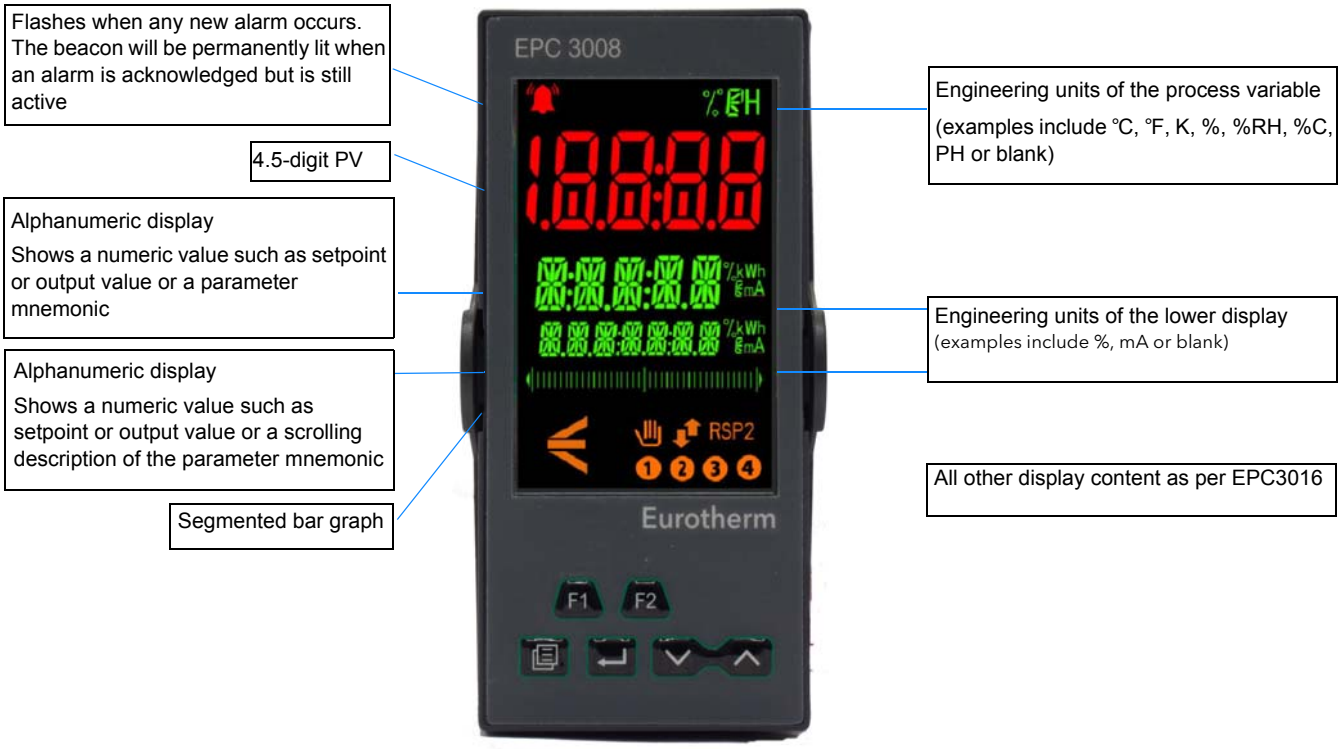
A keyboard check will also be carried out. The controller will go into standby if the check does not complete as expected.

General Description of Front Panel Displays

EPC3016



EPC3008



EPC3004



The actual start up display that automatically follows depends on the way the controller has been supplied or re-configured and is described in subsequent sections.

General Description of Operator Buttons

On EPC3016 only the 4 navigation buttons (Page, Scroll, Down, Up) are available. On EPC3008 and EPC3004 all 6 buttons (4 navigation and 2 function) are available.

Button Layout



Button Operation

Raise

The raise button increments parameter values to limits but there is no wrap-around.

Parameter enumerations, however, do wrap-around.

Lower

The lower button decrements parameter values to limits but there is no wrap-around.

Parameter enumerations, however, do wrap-around.

Page

In Operator levels 1 or 2 the Page button will select between the Home display or the Programmer Edit and Run lists (if one of the programmer features is enabled).

In Levels 3 or Config the Page button will scroll through list headers (no auto-repeat). If the Page button is pressed within a list, the display reverts to the top of the list. The top of the list shows the list header only with no initial parameters.

Page (held for >3 seconds)

The Goto parameter is selected directly. This operation can be performed from any display. If the Page is held for >3 seconds at power-up the Quick Start Mode is selected following the entry of a passcode.

Page+Raise

Scroll back the list headers (with auto-repeat)

Scroll

Select parameters in turn, returning to the first parameter in the list or to a list header if Level 3 or Configuration level is selected. If the button is held down the list will auto-repeat. In levels 1 and 2 this button also scrolls through promoted parameters when the HOME screen is selected.

Scroll+Raise

Scroll back through parameters from bottom to top (with auto-repeat).

Page+Scroll - all variants

Jump directly to the "HOME page". The current operating level remains unchanged. If the HOME page is already selected, these buttons will perform the custom function as detailed in "Functionality of the F1 and F2 and Page + Scroll buttons" on page 170. The default is Alarm Acknowledge.

Raise+Lower (Run/Hold)

If a programmer option is enabled and a program is configured, a momentary press of these keys toggles between Run and Hold modes.

Raise+Lower (hold for >3 seconds - Mode)

If a programmer option is enabled and a configured program is running, holding these buttons will abort the program.

If the HOME page is selected and the Programmer is not running, holding these buttons will invoke the 'Mode' display where the Loop Mode parameter will allow selection of Auto or Manual mode.

F1 and F2

F1 and F2 buttons are not available in EPC3016.

The functionality of these buttons is set by the Instrument function block. The default settings are:

- F1: Auto/Man
- F2: Run/Hold

Note: A time-out applies to all displays. If no button presses are detected within a timeout period (default 60s), the display will revert back to the Level 1 "HOME page".

Start Up—New Unconfigured Controller

If the controller is new and ordered and supplied unconfigured it will start up in 'Quick Start Mode'. This is a built in tool which is provided to configure the product for the most commonly used functions such as the application type, input type, range, and digital input functions. The Quick Configuration code consists of two ‘SETS’ of five characters each. The upper section of the display shows the set selected, the lower section shows the five digits which make up the set. Each digit may result in multiple parameter values being set. The opening set is SET1 as shown.



Initially all characters are shown as an ‘-’. This is generally the default character for ‘not fitted/none’ or ‘use default’. The first character, initially flashing, selects the Application Type as listed in the Quick Start Tables in the following sections. To select the required application type press or .

Note: Quick Code 1 will only be available if the correct hardware is fitted for the application. For example, the VPU application must have IO1 and IO2 as relay, triac or logic outputs.

Press to select the second character. The second character selects the ‘Input 1 Type’ as listed in the Quick Start Tables in the following sections. If hardware or features are not available then the character is skipped over when pressing scroll.

Continue to set up all 5 characters using the Quick Start Tables.

When the last character in SET1 has been entered the display will automatically go to SET2.

Adjust these in the same way as SET1.

At any time to return to the start of SET1, press .

⚠ WARNING

HAZARD OF INCORRECT CONFIGURATION.

Incorrect configuration can result in damage to the process and/or personal injury and must be carried out by a competent person authorised to do so. It is the responsibility of the person commissioning the controller to ensure the configuration is correct.

Failure to follow these instructions can result in serious injury, or equipment damage.

More detailed features available in the product may also be configured by entering a Configuration Level. This is explained in "Configuration Level" on page 84, or by using iTools as explained in "Configuration Using iTools" on page 181. iTools is a configuration package available free of charge from Eurotherm by accessing www.eurotherm.co.uk.

Quick Start Tables

The 1st digit in SET 1 will select an application which automatically configures relevant function block parameters and creates wires between function blocks to make a complete control strategy relevant to that application. Application ‘1’, Heat only controller; application ‘2’ heat/cool controller; application ‘V’ VPU heat only controller are generally covered by this manual. Other applications such as ‘C’ - carbon potential and ‘D’ - dew point control are each provided as an addendum to the User Manual and are available from www.eurotherm.co.uk.

The digits will present "X" when not fitted and the HMI will skip over that field. Similarly, entering a value of "X" in a field will disable that feature, if appropriate.

Quick Code Set 1

Application	Analog Input 1 Type	Analog Input 1 Range	Analog Input 2 Type	Analog Input 2 Range
X = None 1 = PID Heat Only Control 2 = PID Heat/Cool Control V = VPU Heat Only Control C = Carbon Potential Control* D = Dew Point Control*	X = Use Default **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 **RTD** P = Pt100 W = Pt1000 **Linear** M = 0-80mV V = 0-10V 2 = 0-20mA 4 = 4-20mA	X = Use Default 1 = 0-100°C 2 = 0-200°C 3 = 0-400°C 4 = 0-600°C 5 = 0-800°C 6 = 0-1000°C 7 = 0-1200°C 8 = 0-1300°C 9 = 0-1600°C A = 0-1800°C F = Full range	X = Not fitted or Use Default **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 **RTD** P = Pt100 W = Pt1000 **Linear** M = 0-80mV V = 0-10V 2 = 0-20mA 4 = 4-20mA Z = HiZ	X = Not fitted or Use Default 1 = 0-100°C 2 = 0-200°C 3 = 0-400°C 4 = 0-600°C 5 = 0-800°C 6 = 0-1000°C 7 = 0-1200°C 8 = 0-1300°C 9 = 0-1600°C A = 0-1800°C F = Full range

Note: If no application is selected (1st character in SET 1 = X) the display will go directly to the EXIT screen. If accepted the controller will take on a set of default values. Any further configuration may be carried out by accessing the Configuration Level ("Configuration Level" on page 84) or through iTools configuration software ("Configuration Using iTools" on page 181).

Note: For linear inputs the minimum/maximum input voltage/current will cause the display to read range low/high respectively

Note: If the input 2 is not fitted Set 2 will be selected immediately after Input 1 Range has been set.

* Temperature, Carbon potential and dew point control are described as separate supplements to this manual and are available from www.eurotherm.co.uk. Part numbers HA033033, HA032987 and HA032994 respectively.

Quick Code Set 2

CT Input Range	LA Function	LB Function	Option DIO Function	Temperature Units
X = Not fitted or not used 1 = 10A 2 = 25A 5 = 50A 6 = 100A 7 = 1000A	X = Not used W = Alarm Acknowledge M = Auto/Manual R = Program Run/Hold L = Key Lock P = Setpoint Select T = Program Reset U = Remote/Local Select V = Recipe Load Select K = Loop Track	X = Not fitted or not used W = Alarm Acknowledge M = Auto/Manual R = Program Run/Hold L = Key Lock P = Setpoint Select T = Program Reset U = Remote/Local Select V = Recipe Load Select K = Loop Track	X = Not fitted or not used 1 = Config 1 2 = Config 2 3 = Config 3 4 = Config 4 5 = Config 5 6 = Config 6 7 = Config 7 8 = Config 8 9 = Config 9	X = Use Default C = Celsius F = Fahrenheit K = Kelvin

Note: The Quick Code assumes that the CT input is monitoring the current of the heat channel load which in all applications is wired to IO1.PV.

Note: If IO.1 module is a DC Output module then CT Input digit is not alterable.

Note: If CT input is not set to X, the CT Input will be enabled and will monitor the current; however, CT alarms will not be configured. This means that if CT alarms are required they must be wired by the user. A typical example of wiring alarms is shown in section "Example 1: To Wire an Alarm" on page 195.

Quick Codes DIO

Config	Function	Config	Function	Config	Function
Config 1	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Programmer Event Output 5 DIO6 = Programmer Event Output 6 DIO7 = Programmer Event Output 7 DIO8 = Programmer Event Output 8	Config 4	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = Programmer Run/Hold DIO6 = Programmer Reset DIO7 = Programmer Advance DIO8 = Not Used BCD Output wired to Program Number	Config 7	DIO1 = Programmer Run DIO2 = Programmer Hold DIO3 = Programmer Reset DIO4 = Programmer Advance DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used
Config 2	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = BCD Input 1 DIO6 = BCD Input 2 DIO7 = BCD Input 3 DIO8 = Programmer Run/Hold BCD Output wired to Program Number	Config 5	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = BCD Input 5 DIO6 = BCD Input 6 DIO7 = BCD Input 7 DIO8 = BCD Input 8 BCD Output wired to Recipe Load	Config 8	DIO1 = Programmer Run DIO2 = Programmer Hold DIO3 = Programmer Reset DIO4 = Not Used DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used
Config 3	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Programmer Run DIO6 = Programmer Hold DIO7 = Programmer Reset DIO8 = Programmer Advance	Config 6	DIO1 = BCD Input 1 DIO2 = BCD Input 2 DIO3 = BCD Input 3 DIO4 = BCD Input 4 DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used BCD Output wired to Recipe Load	Config 9	DIO1 = Programmer Event Output 1 DIO2 = Programmer Event Output 2 DIO3 = Programmer Event Output 3 DIO4 = Programmer Event Output 4 DIO5 = Not Used DIO6 = Not Used DIO7 = Not Used DIO8 = Not Used

Example of Quick Codes

SET1: 1 . J . 3 . X . X

SET2: X . M . W . X . C

The controller is configured for PID Heat Only, Input 1 Thermocouple Type J, Range 0–400°C, Input 2 and Range not used, CT Input not used, Digital Input LA will select Auto/Manual, Digital Input LB will select Global Acknowledge of Alarms, Temperature Units Degrees Celsius.

To Save or Discard Quick Codes

When all characters have been entered the display will show:



If no is selected (by pressing ↵) the display returns to SET1.

Press ∧ or ∨ to select SAVE then either press ↵ to select or wait for 2 seconds to accept. This accepts the Quick Configuration Codes and the controller enters Operator Level 1.

OR

Press ∧ or ∨ to select diSc then either press ↵ to select or wait for 2 seconds to accept. This discards the last entered codes and returns the controller to its previous settings.

Selecting either SAVE or diSc will result in the instrument performing a restart.

To Re-Enter Quick Code mode

It is possible to re-enter Quick Start mode, by holding down the Page key during power up.

It is then necessary to enter the configuration level passcode. See "To Select Configuration Level" on page 87.

If the configuration of the instrument is subsequently modified by a change made via Configuration Mode this will be shown by the quick code digits being separated by the dp dot (indicating that the codes shown may not reflect the current configuration). If the codes are then accepted the instrument is re-configured to satisfy the code settings.

Note: If the config clip is connected the instrument may be powered from the USB port of the PC. In this case it is necessary to disconnect the config clip to re-enter Quick Start Mode. Alternatively, disconnect the power pins from the config clip. See "Using the Configuration Clip" on page 182.

Note: If a Cold Start (See "Cold Start" on page 214) has been invoked the instrument will always start in Quick Code Mode without the need to enter the configuration passcode.

Start Up - New Configured Controller

If a product has been ordered using the Order Code it will already be configured. When new, ‘out of the box’, it will then power up in operating Level 1.

Also, if it has previously been configured, for example, using the Quick Codes then it will start up in Operating mode.

The start up display is dependent upon the application or the way in which the controller is configured, see ‘Start-up Modes’ in the following section.



The view shown above is generally referred to as the ‘HOME’ Display.

In EPC3008 and EPC3004 the HOME display normally consists of three lines. The upper line normally shows the Process Value "PV",

The centre line normally shows the Working Setpoint "WSP" if the controller is working in its normal Auto mode or the Output demand if it is in Manual Mode.

The lower line shows a scrolling message providing a longer description of the selected parameter. It may also display a further parameter value if this has been set up in the instrument block, see "Display Functionality Sub-List (HmI)" on page 169.

Bar Graph

In EPC3008 and EPC3004 a bargraph may also be configured using iTools. The bargraph may be ‘soft’ wired to any convenient source such as PV input or output demand, see "Example 4: To Configure a Bargraph" on page 196.

EPC3016 has two lines of display. The line below the top one alternates between a mnemonic and the scrolling message. A bargraph is not available.

Setpoint

The Setpoint is defined as the value which the process is required to attain. The value of the setpoint may be obtained from a number of sources, for example, manually using the front panel keys, via the programmer function block, via an external analogue source, via digital communications. The working setpoint is, therefore, defined as the current setpoint derived from any of these sources.

Subsequent Start-ups

When the controller is no longer new and has been in normal use it will start up in Level 1, even when it has been powered down in Operator level 2 or 3. If, however, it was powered down when in Configuration level it will power up in ‘Standby’ and show a message - ‘POWERED DOWN WHILST IN CONFIG MODE’. To clear the message re-enter configuration level (with password - see "To Select Configuration Level" on page 87), then, either continue with changes to the configuration or accept existing changes by exiting configuration level. The reason for this is that the controller may have been part configured prior to shut down and either needs completion of the configuration or confirmation that no further changes are required.

Start-up Modes

The controller may start in manual or in automatic mode depending on the setting of the ‘Recovery Mode’ parameter, see section "Configuration Sub-List" on page 109.

If the Recovery Mode has been set to Manual (default) the controller will start in ‘Man’ mode. It will show the letter ‘M’ and the ‘hand’ symbol in the display. Initially the output will be at the ‘Fallback Value’, see section "OP Sub-list" on page 121, but may then be changed using the raise or lower buttons. Auto mode may also be selected.

If the Recovery Mode has been set to ‘Last’ the controller will start in either in Manual mode or Auto mode depending on whatever mode it was in prior to being powered off. ‘Auto’ mode is shown in the EPC3004 view in the previous section.

For further information on start up modes see section "Start-up and Recovery" on page 257.

Standby

Standby is the term given when the instrument strategy is not controlling due to the following reasons:

- If the instrument is being configured i.e. in Quick Code Mode, Configuration Mode or a clone file is being loaded.
- If the instrument has detected an unexpected condition (for example, was powered down whilst in configuration mode, or fitted hardware does not match expected hardware). See "Start up Diagnostic mode" on page 56 for more information on unexpected conditions that will place the instrument into standby.
- If the instrument is forced into standby via the Instrument.Diagnostics.ForceStandby parameter, see "Subsequent Start-ups" on page 66.

When the instrument is in standby, the following occurs:

- All outputs are placed into their 'Off' state, unless being used as Valve Raise (Up) / Lower (Down) in which case the Standby Action is configurable (Rest, Up, Down).
- The control loop will be placed into Hold.
- If an alarm has the Standby Inhibit parameter set to On, then the alarm is inhibited (active alarms will be turned Off and new alarm conditions will not be acted upon).
- If in standby due to the instrument being configured, a running program will reset.

⚠ WARNING

LOSS OF COMMUNICATIONS

If the output is not wired, but written to by communications, it will continue to be controlled by the communications messages. In this case take care to allow for the loss of communications.

Failure to follow these instructions can result in serious injury, or equipment damage.

Auto-scaling of decimal point

The range of values displayed on the ‘top line’ will vary for each instrument version. If a value exceeds the display capabilities, the resolution will automatically be reduced by a factor of 10, up to the display limit in the table below. If the value cannot be displayed, HHHH or LLLL will be shown.

Auto-scaling is applied to parameter values being edited via the HMI.

Instrument	Decimal points	Minimum	Maximum
EPC3016	0	−1999	9999
	1	−199.9	999.9
	2	−19.99	99.99
	3	−1.999	9.999
EPC3008	0	−1999	19999
	1	−199.9	1999.9
	2	−19.99	199.99
	3	−1.999	19.999
EPC3004	0	−19999	99999
	1	−1999.9	9999.9
	2	−199.99	999.99
	3	−19.999	99.999
	4	−1.9999	9.9999

Operator Levels

What's in this Chapter

This chapter describes the different operator levels:

- Operator Level 1
- Operator Level 2
- Introduction to Operator Level 3
- Return from a higher level to a lower level of operation

Overview

There are 5 levels of operation:-

1. LEu 1 - Level 1 has no passcode, the control is active and only the home list is accessible.
2. LEu2 - Level 2. The control is active and an extended home list is accessible.
3. LEu3 - Level 3. The control is active and the complete operator parameter set is shown and modifiable; the complete Configuration parameter set is shown, read only; the user calibration (two point cal) facility is available.
4. ConF - Configuration level is used to setup the whole controller; the configuration parameters are accessible; the operator parameters are available, without the need to switch to operator mode. The instrument calibration parameters are also available in this mode. See "User Calibration" on page 278.

Levels 2, 3 and Configuration can be restricted by passcodes.

5. In addition the Quick Start Mode (See "Start Up—New Unconfigured Controller" on page 61) is provided to configure the product in the minimum number of operations. It is only available at power up after the instrument is cold started or by holding the Page key during power up.

Operator Level 1

Operator Level 1 is entered:

1. After the Quick Code has been entered for those controllers supplied unconfigured
2. After power up when the controller has been configured

The display shown below is for a typical temperature controller.



Process Value (PV)

Setpoint (SP) (Required Temperature)

Scrolling message

Bargraph (not EPC3016)

Press ^ to increase the setpoint

Press v to decrease the setpoint

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

In general the current value of the process is shown in the upper display and, when in 'Auto' mode, the required value (Setpoint) is shown in the lower display. However, this may depend, for example, upon the application or if the controller is in Manual mode (see below).

Additional scrolling messages are shown, for example, when operator parameters are selected (see section "Level 1 Operator Parameters" on page 72). These may be standard descriptions of the parameter currently selected or they may be user specific messages which have been set up using iTools. (See "Parameter Promotion" on page 203).

Manual Mode

In Operator Level 1 the controller may be placed into manual operation as follows:

- By default in EPC3008 and EPC3004 Auto/Manual may be selected by the user by toggling the F1 button.
- By default in EPC3016 Auto/Manual may be selected by the user by pressing and holding the ^ and v buttons for longer than 3 seconds. This will show the A-M (Auto-manul select) parameter. Then press ^ or v to toggle between auto and manual.



Manual is indicated in the HMI by showing the 'Hand' symbol and the character 'M'.

The current level of the output demand is shown as a percentage. This may be increased or decreased by pressing the ^ or v buttons respectively.

Note: Alternative ways to select Auto/Manual may be configured and will be explained in subsequent chapters of this manual.

System Messages

In addition to standard (or customised) scrolling messages, System Messages may be shown at any time. A list of these is shown in "Notification Messages" on page 287 but a typical message may be ‘USING DEFAULT COMMS CONFIG PASSWORD’. This is shown if the Comms Config Password has not been changed from its default value. For example, it is possible to enter configuration mode via digital communications which is restricted by a passcode. This passcode is only available using iTools and should be changed from its default value to provide additional security. When this has been done the message will not appear in the HMI in operator level.

This particular message may also be disabled in Instrument Configuration mode, see "Security Sub-List (SEC)" on page 171.

Bargraph

In EPC3008 and EPC3004 a bargraph may also be shown which displays the configured value as a horizontal bar. This is set up in Configuration Level (See "Display Functionality Sub-List (Hml)" on page 169).

Comms Configuration Active

The scrolling message ‘COMMS CONFIGURATION ACTIVE’ will be displayed if, for example, iTools is connected to the controller and has been placed in configuration mode by iTools.

The character ‘*H*’ signifies that the controller has been placed into Hold mode and is displayed as shown below.



Note: The displays shown above also apply if the controller is in Operator Levels 1, 2 or 3.

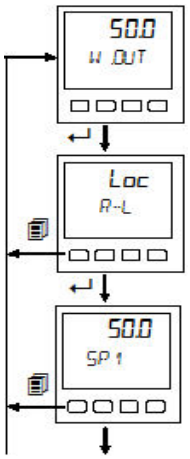
Level 1 Operator Parameters

A minimal list of parameters is available in Operator Level 1 which is designed for day to day use. Access to these parameters is not restricted by a passcode.

Press ↵ to step through the list of available parameters. The mnemonic of the parameter is shown in the lower display. Alternatively, press and hold ↵ then press ∧ to scroll forward through parameters and ∨ to scroll back.

Press ⎘ to return to the Home display.

The value of the parameter is shown in the upper display. If the value is read/write press ∧ or ∨ to adjust. If no key is pressed for 60 seconds the controller returns to the HOME display. The navigation is shown diagrammatically for the first two parameters in the example below:



The parameters that appear depend upon the functions configured. The list can also be customised using iTools by adding or removing parameters. The table below shows an example of the list of parameters in Level 1. Parameters may be added to or deleted from this list, see "Parameter Promotion" on page 203.

Parameter Mnemonic	Scrolling name	Description	Further information
W OUT	WORKING OUTPUT	The output demand – 0% to 100% or −100% to +100%	
R-L	REMOTE-LOCAL SELECT	Selects the Remote or Local setpoint source	"Loop - Main Sub-list" on page 107
SP 1	SETPOINT 1	The value which the process is required to attain as set by setpoint 1	
SP2	SETPOINT 2	The value which the process is required to attain as set by setpoint 2 if selected	
AI 1 PV	PV	The current value of the process (read only) read by the primary input IP1	
AI2 PV	PV	The current value of the process (read only) read by the secondary input IP2	If the secondary input is used
LD I	CT LOAD CURRENT	The current being supplied to the heater as measured by the CT	If the CT is being used

Level 1 Programmer Display

By default, if the controller has the programmer installed, the status of a running program can be displayed .

Programmer List

Press the page button , the display will show 

Repeatedly press to read the currently running program.

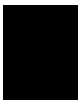
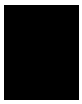
Parameters displayed are (but not limited to depending on the program):

Parameter Mnemonic	Scrolling name	Description
P NUM	PROGRAM NUMBER	Alterable but does not affect the running program
P CUR	CURRENT PROGRAM	Read only
P MODE	PROGRAM MODE	Displays the current mode e.g. Run, Hold, Reset,
P SP	PROGRAM SETPOINT	Read only
P TIM L	PROGRAM TIME LEFT	Read only
P CYC L	PROGRAM CYCLES LEFT	Read only
S NUM	CURRENT SEGMENT NUMBER	Read only
S TYPE	CURRENT SEGMENT TYPE	Read only
S TIM L	SEGMENT TIME LEFT	Read only
EVT x	EVENT x	event off or on. Further events are shown if configured
P ADVN	PROGRAM ADVANCE	Read only

By default the programmer parameters available in Level 1 are read only. It is possible, however, to provide programmer edit access to Level 1, see "Programmer List (PROG)" on page 125. If this has been done the lists of parameters is shown in section "Level 2 Programmer Display" on page 77.

Crows Foot Status Bar

The current status of the running program is displayed as follows:

State	**Ramp/Step Up**		**Dwell**		**Ramp/Step Down**	
Reset						
Run						
Hold/Holdback		Flashing (1 second period 66% duty cycle)		Flashing (1 second period 66% duty cycle)		Flashing (1 second period 66% duty cycle)
Complete (Dwell End)	Not applicable			Flashing (2 seconds period 66% duty cycle)	Not applicable	

Operator Level 2

To Select Operator Level 2

Operator level 2 is normally restricted by a passcode. By default the passcode is 0002 in a new controller. Enter Level 2 as follows:

Operation	Action	Display	Notes
Select Level 2	1. Press and hold until GOTO is shown. 2. Press to choose LEu 2 (Level 2). 3. Press to enter		
Enter the passcode	4. Press or to enter the correct digit value of the passcode 5. Press to accept the value and move to the next digit 6. The controller will now show the top of the HOME list in Level 2		Press to move to the next digit. The default passcode for level 2 is '0002'. A special case exists if a security code has been configured as '0000'. If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME. After three wrong attempts the passcode entry system will lock out for a time set by the 'Passcode Lockout Time' set in the "Security Sub-List (SEC)" on page 171.
Select Level 2 parameters	7. Repeatedly press		The list of available parameters is given in the table in the next section.

Level 2 Operator Parameters

Parameters available in level 1 are also available in level 2, but level 2 includes additional parameters for commissioning purposes and for more detailed operation.

Press ↵ to step through the list of available parameters. The mnemonic of the parameter is shown in the lower display. Press ⧉ to return to the previous parameter.

The value of the parameter is shown in the upper display. If the value is read/write press ∧ or ∨ to adjust. If no key is pressed for 60 seconds the controller returns to the top of the HOME list.

By default the following table lists all possible parameters available in both Levels 1 and 2. Parameters associated with a particular feature will only be shown if that feature is configured.

Parameter Mnemonic	Scrolling name	Description	Further information
W OUT	WORKING OUTPUT	The output current demand – 0% to 100% or -100% to +100%	Level 1 & 2
R-L	LOOP REMOTE/LOCAL	Selects the Remote or Local setpoint source	Level 1 & 2
SP HI	SETPOINT HIGH	Maximum value allowed for the local setpoints (SP1 and SP2).	
SP LO	SETPOINT LOW	Minimum value allowed for the local setpoints (SP1 and SP2).	
SP 1	SETPOINT 1	The value which the process is required to attain as set by setpoint 1	Level 1 & 2
SP2	SETPOINT 2	The value which the process is required to attain as set by setpoint 2 if selected	Level 1 & 2
SP UP	SETPOINT RATE UP	Limits the maximum rate at which the working setpoint can change in an increasing (upwards) direction. Setpoint rate limiting is often used to prevent rapid bumps in controller output that may damage equipment or product, or cause upset to downstream processes	
SP DWN	SETPOINT RATE DOWN	Limits the maximum rate at which the working setpoint can change in an increasing (downwards) direction.	
AI 1 PV	PV	The current value of the process (read only) read by the primary input IP1	Level 1 & 2
AI2 PV	PV	The current value of the process (read only) read by the secondary input IP2	Level 1 & 2
TUNE	AUTOTUNE ENABLE	Starts an autotune	"Autotuning" on page 264
PB H	CH1 PROPORTIONAL BAND	Channel 1 (heat) proportional band	
PB C	CH2 PROPORTIONAL BAND	Channel 2 (cool) proportional band	
TI	INTEGRAL TIME	Integral time	
TD	DERIVATIVE TIME	Derivative time	
CBH	CUTBACK HIGH THRESHOLD	High cutback	
CBL	CUTBACK LOW THRESHOLD	Low cutback	

Parameter Mnemonic	Scrolling name	Description	Further information
MR	CONTROL MANUAL RESET	If the integral parameter is turned off the controller is working in proportional only or proportional + derivative. This parameter allows the output to be adjusted manually to offset and difference between SP and PV.	
HYS.H	CONTROL CH1 ON OFF HYSTERESIS	If channel 1 is configured for On/Off control this parameter allows a difference to be set between the output being on or off.	
HYS.C	CONTROL CH2 ON OFF HYSTERESIS	If channel 2 is configured for On/Off control this parameter allows a difference to be set between the output being on or off.	
C.DB	CONTROL CH2 DEADBAND	The Ch1/Ch2 Deadband is a gap in percent between output 1 going off and output 2 coming on and vice versa. For on/off control this is taken as a percentage of the hysteresis.	
OUT.HI	OUTPUT HIGH LIMIT	To limit the maximum controller output	
OUT.LO	OUTPUT LOW LIMIT	To limit the minimum controller output	
LD.I	CT LOAD CURRENT	This is the sampled RMS current measured during the on time of the heater.	Level 1 & 2
LK.I	CT LEAK CURRENT	The RMS current measured flowing through the load during the off states of the controller.	
LD.SP	CT LOAD THRESHOLD	Sets a threshold to trigger an alarm if the load current is exceeded	
LK.SP	CT LEAK THRESHOLD	Sets a threshold to trigger an alarm if the leak current is exceeded	
OC.SP	CT OVERCURRENT THRESHOLD	Sets a threshold to trigger an over current alarm if the current measured exceeds a maximum limit set by the process	
CS.ID	CUSTOMER ID	A user configurable non-volatile identification parameter	
REC.NO	DATASET TO LOAD	Selects which recipe dataset to load	
STORE	DATASET TO SAVE	Selects which of the 5 recipe dataset in which to store the current active parameters.	

The home list can be customized by adding up to 60 parameters; iTools will be required to configure the promoted parameters, see "Parameter Promotion" on page 203.

Level 2 Programmer Display

By default, if the controller has the programmer installed, the programmer can be edited and operated from the HMI.

Programmer List

Press the page button , the display will show 

Repeatedly press to read the currently running program. The program can be Run, Held or Reset from this list.

Parameters displayed are (but not limited to depending on the program):

Parameter Mnemonic	Scrolling name	Description
P NUM	PROGRAM NUMBER	Alterable, but does not run a program
P CUR	CURRENT PROGRAM	Read only
P MODE	PROGRAM MODE	The programmer can be changed to Run, Hold, Reset,
P SP	PROGRAM SETPOINT	Read only
P TIM L	PROGRAM TIME LEFT	Read only
P CYC L	PROGRAM CYCLES LEFT	Read only
S NUM	CURRENT SEGMENT NUMBER	Read only
S TYPE	CURRENT SEGMENT TYPE	Read only
S TIM L	SEGMENT TIME LEFT	Read only
TSP	TARGET SETPOIN	Read only
R RATE	RAMP RATE	Read only
EVT x	EVENT x	Event off or on. Further events are shown if configured
P ADVN	PROGRAM ADVANCE	Alterable YES/NO. Advances the program to the next segment

Program Setup List

By default programs can be set up in Level 2.

Press the page button , the display will show 

Repeatedly press to read the currently running program. Programs can be edited from this list.

Parameter Mnemonic	Scrolling name	Description
P NUM	PROGRAM NUMBER	Alterable but does not run a program. If the program is running WORk is shown signifying the working program.
HB.STY	HOLDBACK STYLE	Alterable: PROG (holdback applies to the whole program). SEGm (holdback applies to each segment)
HB.TYP	HOLDBACK TYPE	Alterable: OFF, LOW, HIGH, bANd. For a full definition see "Holdback" on page 231
RAMP.U	RAMP UNITS	Alterable: P.SEC (per second), P.mIN (per minute), P.HR (per hour)
DWEL.U	DWELL UNITS	Alterable: SECS, mINS, HrS
P CYC	PROGRAM CYCLES	Alterable: The number of time a program repeats. CONt (continuous) or 1 to 9999 **Default 1**
P END	PROGRAM END TYPE	Alterable: Behaviour when the program ends dWEL (dwell at current setpoint). RSEt (reset). tRAk (track)
S NUM	CURRENT SEGMENT NUMBER	Alterable:
S.TYP	SEGMENT TYPE	RAtE, tImE, dWEL, Step, CALL, ENd
TSP	TARGET SETPOINT	Alterable:
R.RATE	RAMP RATE	Alterable:
EV.OP	EVENT OUTPUT	Alterable:
DUR	DURATION	Alterable: Appears if the segment type is Dwell or Time
R.TIME	TIME TO TARGET	Alterable: Appears if the segment type is Time
C.PROG	CALL PROGRAM	Alterable: Appears if the segment type is Call
C CYC	CALL CYCLES	Alterable: Appears if the segment type is Call

The above is a summary the parameters which are displayed (but not limited to) and depends on the program. A full description of the parameter meanings and how to set up programs is given in the following sections:

Configuration chapter "Programmer List (PROG)" on page 125.

iTools chapter "Programmer" on page 188.

Programmer chapter "Programmer" on page 227

Operator Level 3

In Operator level 3 (and in Configuration Level) all parameters are organised in lists (or groups). Only parameters related to enabled functions are shown.

Each list may contain operator level and configuration parameters; the parameters are only shown when the instrument is in the appropriate mode. If a list does not contain at least one displayable parameter, it is skipped completely.

During navigation, the lower display shows the mnemonic code of the parameter or the List header. After 6 seconds, a scrolling string with either the parameter or the List description will be displayed.

To Enter Level 3

Operation	Action	Display	Notes
Select Level 3	1. Press and hold  until LEu 3 is shown. 2. Press  to enter		LEu 1 is displayed first. Continue to hold the button to obtain LEu3
Enter the passcode	3. Press  or  to enter the correct digit value of the passcode 4. Press  to accept the value and move onto the next digit 5. If the correct passcode has been entered the message PASS will be displayed momentarily. The controller is now operating in Level 3.	 	Press to move to the next digit. The default passcode for level 3 is '0003'. A special case exists if a pass code has been configured as '0000'. If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME If an incorrect code is entered the display will return to HOME. After three wrong attempts the passcode entry system will lock out for a time set by the 'Passcode Lockout Time' set in the "Security Sub-List (SEC)" on page 171.
Select list headers	6. Repeatedly press 		This shows the Analogue Input List. Press  +  to return to the previous list header
Select parameters in the list	7. Repeatedly press 		This shows the Input Type.

To return to the HOME page relevant to the controller mode press the 'Home' key combination (Page+Scroll).

The HOME display is also selected after a timeout period with no key presses. The timeout defaults to 60 seconds but can be adjusted between 0 and 60 seconds. A setting of 0 means no timeout (see "Display Functionality Sub-List (HmI)" on page 169), so that the HMI remains in the selected level.

Level 3 Operator Parameters

The Operator Level 3 lists are essentially the same as configuration level. These are shown in the next chapter.

To Return to a Lower Level

From Level 3 you can select Level 1 or Level 2 as follows:

1. Press and hold  until GOTO is displayed
2. Press  or  to select LEu 1 (or LEu2)
3. Press  to accept.

The display will briefly show PASS and will return to the selected level default display.

A security code is not required when going from a higher level to a lower level.

Note: if the controller had been switched off whilst operating in levels 2 or 3 it will return to operator level 1 when switched on again. If it was switched off when in configuration level it will start up with a message - PCnF - POWERED DOWN WHILST IN CONFIG MODE. See section "Subsequent Start-ups" on page 66.

Navigation Diagram

The Navigation Diagram shows the series of operations of the front panel buttons which are required to navigate to specific parameters.

For ease of access parameters are arranged in lists. Each list has a header and each header is selected by repeated presses of the 'Page' button . Each list header has a title, for example, the first header is the Analogue Input (AI LIST).

A list may have a number of instances. For example, if two Analogue Inputs are supplied then the list is split into 1 INST and 2 INST selected using the 'Raise' and 'Lower' buttons / .

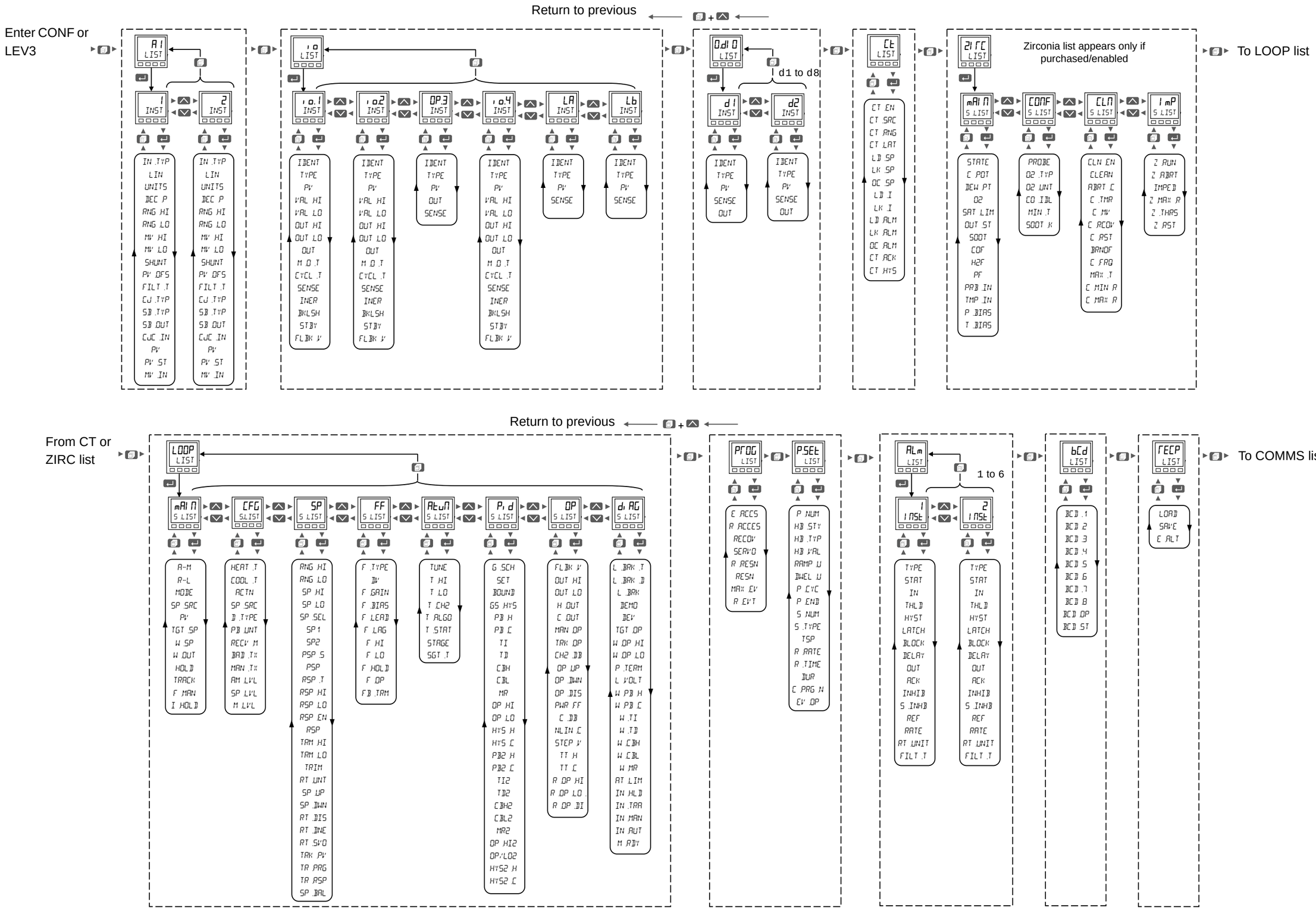
Similarly a list may have a number of Sub-Lists. For example, the LOOP list. The sub-lists are selected by entering the first sub-list, using the 'Scroll' button , then using the 'Raise' or 'Lower' buttons to select the following sub-lists.

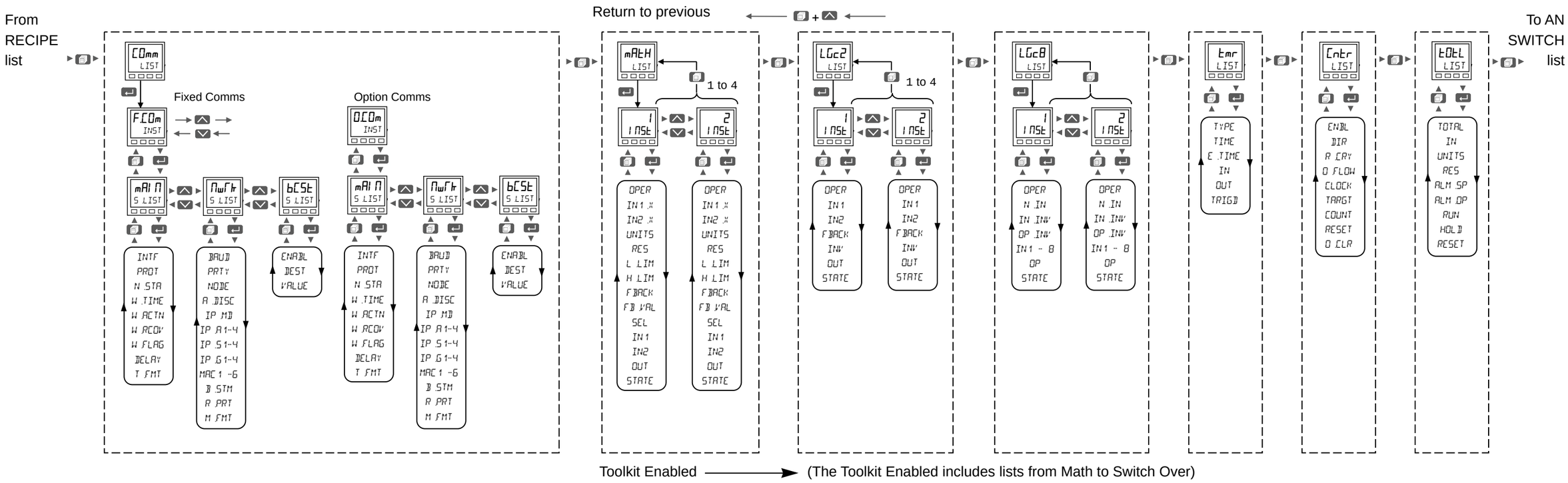
When the appropriate list or sub-list has been selected use the 'Scroll' button to scroll through a list of parameters. Use the Page button to scroll back.

The Navigation Diagram which follows shows these button presses diagrammatically.

The Navigation Diagram generally includes all lists and all parameters available in configuration level. Some parameters may not be shown in Level 3 and only those lists and parameters which are required for a particular application are displayed on the controller.

Navigation Diagram




From RECIPE list
Return to previous
To AN SWITCH list
COMM LIST
Fixed Comms
FCOM INST
MAIN S LIST
NWRK S LIST
BCST S LIST
INTF
PROT
N STA
W TIME
W ACTN
W RCOV
W FLAG
DELAY
T FMT
BAUD
PRTY
NODE
R DISC
IP MD
IP A1-4
IP S1-4
IP G1-4
MAC 1 -6
B STM
R PRT
M FMT
ENABL
DEST
VALUE
Option Comms
OCOM INST
MAIN S LIST
NWRK S LIST
BCST S LIST
MATH LIST
1 to 4
1 INST
2 INST
OPER
IN1 X
IN2 X
UNITS
RES
L LIM
H LIM
FBACK
FB VAL
SEL
IN1
IN2
OUT
STATE
LGC2 LIST
1 to 4
1 INST
2 INST
OPER
IN1
IN2
FBACK
INV
OUT
STATE
LGC8 LIST
1 to 4
1 INST
2 INST
OPER
N IN
IN INV
OP INV
IN1 - 8
OP
STATE
tmr LIST
TYPE
TIME
E TIME
IN
OUT
TRIGD
Cntr LIST
ENBL
DIR
R CRY
O FLOW
CLOCK
TARGT
COUNT
RESET
O CLR
tOtL LIST
TOTAL
IN
UNITS
RES
ALM SP
ALM OP
RUN
HOLD
RESET
Toolkit Enabled
(The Toolkit Enabled includes lists from Math to Switch Over)
From TOTALISER list
Return to previous
Return to AI list
AN.SW LIST
1 to 3
1 INST
2 INST
H LIM
L LIM
FBACK
FB VAL
IN SEL
IN1-IN8
OUT
STATE
RES
UVAL LIST
1 to 4
1 INST
2 INST
UNITS
RES
H LIM
L LIM
VALUE
STATU
I mon LIST
1 INST
2 INST
IN
MAX
MIN
THOLD
D ABV
T ABV
ALM D
ALM TM
AL DP
RESET
IN ST
SW.OU LIST
IN HI
IN LO
SW HI
SW LO
IN 1
IN 2
F VAL
F TYP
SEL IN
D/MOD
OUT
STAT
OR LIST
1 to 8
1 INST
2 INST
IN1
IN2
IN3
IN4
IN5
IN6
IN7
IN8
OUT
1 INST LIST
1 INFO S LIST
LANG
T UNIT
I NUM
I TYPE
PSU
I VER
CM ID
CS ID
HMI S LIST
H DISP
H TIME
K LOCK
BG TYP
BG MAX
BG MIN
BG PV
F1 FN
F2 FN
PS FN
SEC S LIST
L2 P
L3 P
CFG P
C PAS D
C PAS E
P LOCK
C MEM
di AG S LIST
NEW AL
G ACK
SMPL T
T FMT
F STBY
E STAT
R CNT
mODS S LIST
IO F
IO1 E
IO2 F
IO2 E
IO4 F
IO4 E
OPT F
OPT E
CAL LIST
ID
STAT
MODE
C VAL
rEm.I LIST
IN
RNG HI
RNG LO
SCL HI
SCL LO
TIME O
RES
UNITS
OUT
STAT

Configuration Level

Configuration of the instrument through the front panel is particularly useful where relatively small changes are required on site, possibly during commissioning. For larger or more detailed changes the use of Eurotherm iTools configuration package is recommended and this is described in the next chapter.

What's in this Chapter

- This chapter describes how to configure the controller through the HMI.
- Lists all parameters which are available in each function block

To Enter Configuration Level

The procedure is similar to that shown in "To Enter Level 3" on page 79.

Operation	Action	Display	Notes
Select Level 3	1. Press and hold until LEu 3 is shown. 2. Press to select CONF 3. Press to enter	CONF GOTO	LEu 1 is displayed first. Continue to hold the button to obtain LEu3
Enter the passcode	4. Press or to enter the correct digit value of the passcode 5. Press to accept the value and move onto the next digit 6. If the correct passcode has been entered the message PASS will be displayed momentarily. The controller is now operating in Config Level.	0_ _ _ CODE CONF PASS	Press to move to the next digit. The default passcode for Configuration level is '0004'. A special case exists if a security code has been configured as '0000'. If this has been done it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME If an incorrect code is entered the display will return to HOME. After three wrong attempts the passcode entry system will lock out for a time set by the 'Passcode Lockout Time' set in the "Security Sub-List (SEC)" on page 171.
Select list headers	7. Repeatedly press	AI LIST	This shows the Analogue Input List. Press + to return to the previous list header
Select parameters in the list	8. Repeatedly press	tC IN.TYP	This shows the Input Type

To Return to Level 1

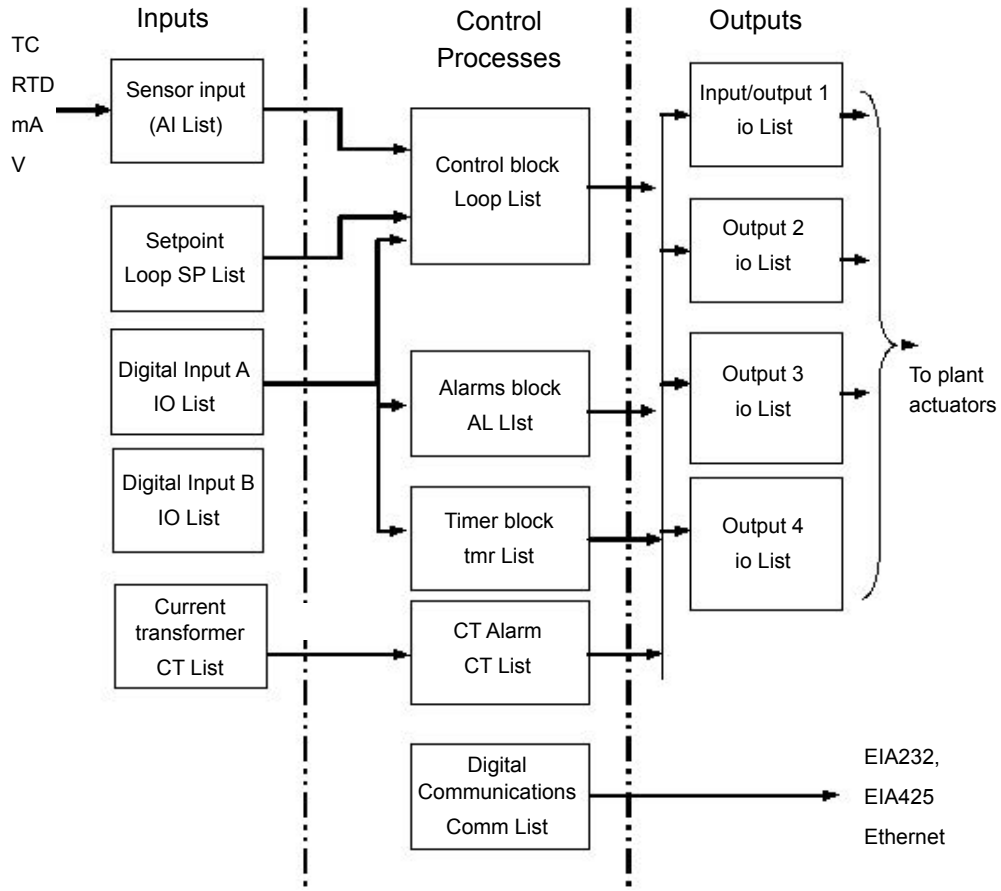
From Configuration level it is not possible to select Level 2 or Level 3.

1. Press and hold until GOTO LEu 1 is displayed
2. Press to accept

Function Blocks

The controller is made up of a number of hardware and software function blocks. Each block has inputs and outputs which are wired together in software (soft wired) to match the application for which the controller is intended.

The following diagram shows an example of function blocks which make up a typical controller.



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

The purpose of the control block is to reduce the difference between SP and PV 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 for data collection, monitoring and remote 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 in Configuration Level.

The controller can also be configured using iTools as described in "Configuration Using iTools" on page 181. iTools is proprietary software designed to configure Eurotherm instruments and may be downloaded from www.eurotherm.co.uk.

Configuration Level Parameters

In Configuration Level all parameters are organised in lists (in the same way as Operator Level 3). Only parameters related to enabled functions are shown.

Each list may contain operator level and configuration parameters; the parameters are only shown when the instrument is in the appropriate mode. If a list does not contain at least one displayable parameter, it is not shown.

During navigation, the centre display (lower display in EPC3016) shows the mnemonic code of the parameter or the List header. A scrolling string with either the parameter or the List description is displayed in the lower section of the display.

To Select Configuration Level

⚠ WARNING

HAZARD OF INCORRECT CONFIGURATION

Incorrect configuration can result in damage to the process and/or personal injury and must be carried out by a competent person authorised to do so. It is the responsibility of the person commissioning the controller to ensure the configuration is correct.

In configuration level the controller does not control the process or provide alarm indication. Do not select configuration level during a live process.

Failure to follow these instructions can result in death, serious injury or equipment damage.

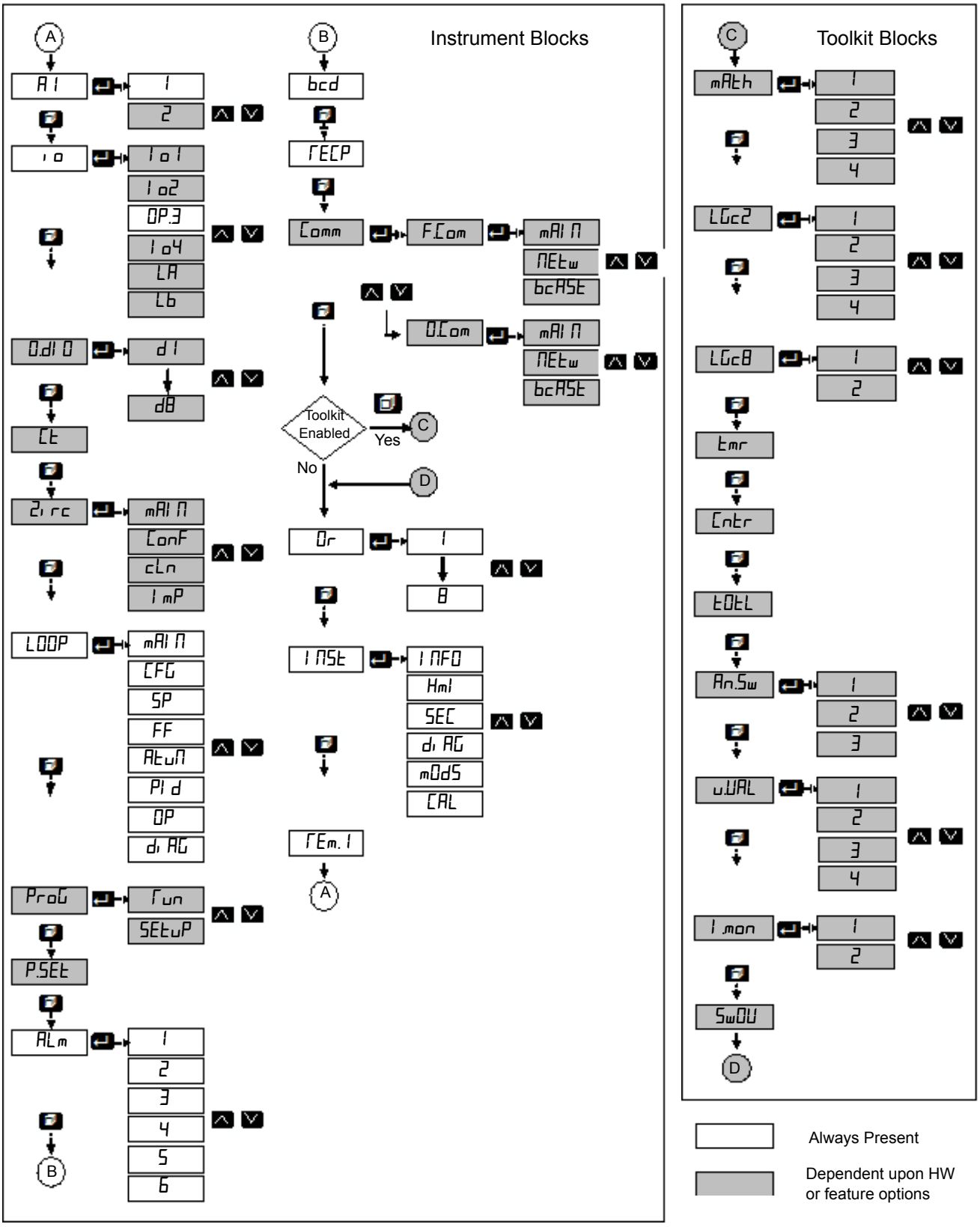
Operation	Action	Display	Notes
Select Level 3 followed by Configuration level	1. Press and hold until LEv3 is shown then press to select ConF. 2. Press to enter	ConF GOTO	LEv1 is displayed first. Continue to hold the button to obtain LEv3
Enter the passcode	3. Press or to enter the correct digit value of the passcode 4. If the correct passcode has been entered the message PASS will be displayed momentarily. The controller is now operating in the selected level.	0 _ _ _ CODE ConF PASS ConF LIST	Press to move to the next digit. The default passcode for configuration level is '0004'. A special case exists if a passcode has been configured as '0000'. Then, it is not necessary to enter a code and the controller will enter the chosen level immediately. If an incorrect code is entered the display will return to HOME. After three wrong attempts the passcode entry system will lock out for a time set by the 'Passcode Lockout Time' set in the 'Instrument Security' menu, see "Security Sub-List (SEC)" on page 171.
Select list headers	5. Repeatedly press	A1 LIST	The first list is the Analogue Input List.
Select sub-lists if sub-lists are appropriate	6. Press to select the first sub-list (if these are available) 7. Press or to scroll forwards or backwards through sub-lists	A2 S.LIST	Some list headers are split into sub-lists. For example, if the secondary input is used parameters associated with this list are shown under the sub-list A2.
Select parameters in a list	8. Repeatedly press	tC IN.TYP	This shows the Input Type
Change a parameter value	9. Press or	mU IN.TYP	Values cannot be changed if they are read only. Parameter values are shown in the 'Menus' in subsequent sections.

When in the 'top' list header, press + to return to the beginning of the lists.

When in a parameter list, press + to return to the previous parameter

Configuration and Level 3 Navigation Diagram

The full navigation diagram for Level 3 and Configuration Levels are shown in section "Navigation Diagram" on page 82. The diagram below is included to serve as a quick check to show the order of the list headers.



Press to scroll through each list header (the name of the function block) in turn

Pressing on one of these headers will do the following depending upon the function block being accessed:

1. Display the first parameter (see Recipes).
2. Display the instance selection (see IO for named instances or Alarm for numbered instances).
3. Display the subclass selection (see Loop).

When at 2 or 3 above, pressing up and down will cycle through the instances/subclasses.

Examples

The following examples show how to navigate through different function blocks

Example 1: no additional instances and no sub-classes

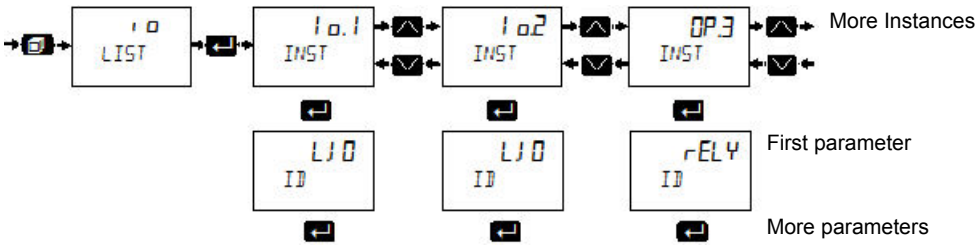
The CT list is an example of a class which contains no additional instances and no sub-classes. In other words it is a simple list of parameters under the heading CT which set up the current transformer.

1. Press until the list is displayed
2. Then press to scroll through the parameters.
3. To change the value of a selected read/write (R/W) parameter press or .

Example 2: multiple instances and no sub-classes (named)

The io List is an example of a class which contains multiple instances and no sub-classes. The instances are named instances, such as io.1, io.2, OP.3 etc (see "I/O List (io)" on page 97). The list of parameters for each instance are not necessarily the same.

The navigation diagram for this type of function block is shown below:



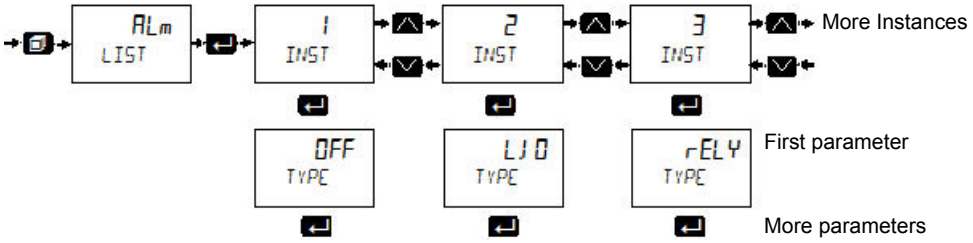
1. Press to scroll to the io List
2. Press to select the first instance of the io parameters. This is displayed as io.1 and INST and denotes that this is the first instance of parameters in that category
3. Press again to scroll through parameters for io.1 or, to select the next and subsequent instances press

4. Press ▼ to scroll back

5. To change the value of a selected read/write (R/W) parameter press ▲ or ▼

Example 3: multiple instances and no sub-classes (numbered)

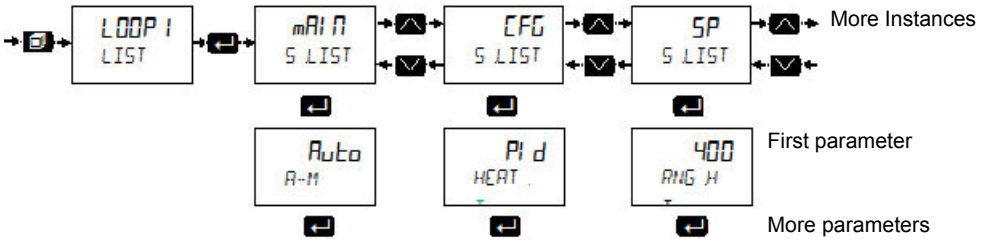
The Alarm List is also an example of a class which contains multiple instances and no sub-classes. The instances in this case are numbered instances, such as 1 to 6 "Alarms List (ALm)" on page 131. The list of parameters for each instance are not necessarily the same.



Example 4: single instance and multiple sub-classes

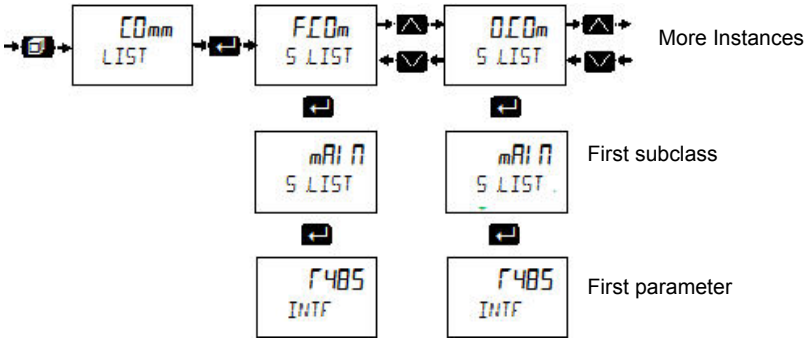
The Loop List is an example of a class that has a single instance and multiple sub-classes. A sub-class (or List) groups parameters under meaningful sub-headings. For example, all parameters associated with the setpoint are grouped together in the SP List (displayed as S LIST). Each subclass will be different.

The navigation diagram for this type of function block is shown below:



Example 5: multiple instances and multiple sub-classes

The communications list is an example of a class which has multiple instances and multiple sub-classes. The instances are Fixed and Option and the Sub Lists are Main, Network, Broadcast.



Parameter Navigation

1. Press ↵ to select parameters in a list
2. Press ^ or v to change the parameter value (if not read only).

Some parameters are analogue in which case the value can be changed between limits.

Some parameters are enumerated which means they have a mnemonic associated with them which can be selected from a list.

The following pages list all parameters which are available in the controller in their respective lists. Parameters are only shown in the controller if the feature has been supplied and enabled.

Notes:

R/W = Read/Write

Conf R/W = Read/Write in configuration level only

Conf only R/W = Shown in configuration level only

L3 R/W = Read/Write in configuration level and level 3

R/O = Read Only in all levels

L3 R/O = Read only in configuration level and level 3

Enumerated values

In the value column for enumerated values in the following tables, the associated numeric value is shown. This is the value that would need to be written if a 3rd party comms master was being used. For example:

tC (0)

mV (1)

V (2)

mA (3)

RTD (4)

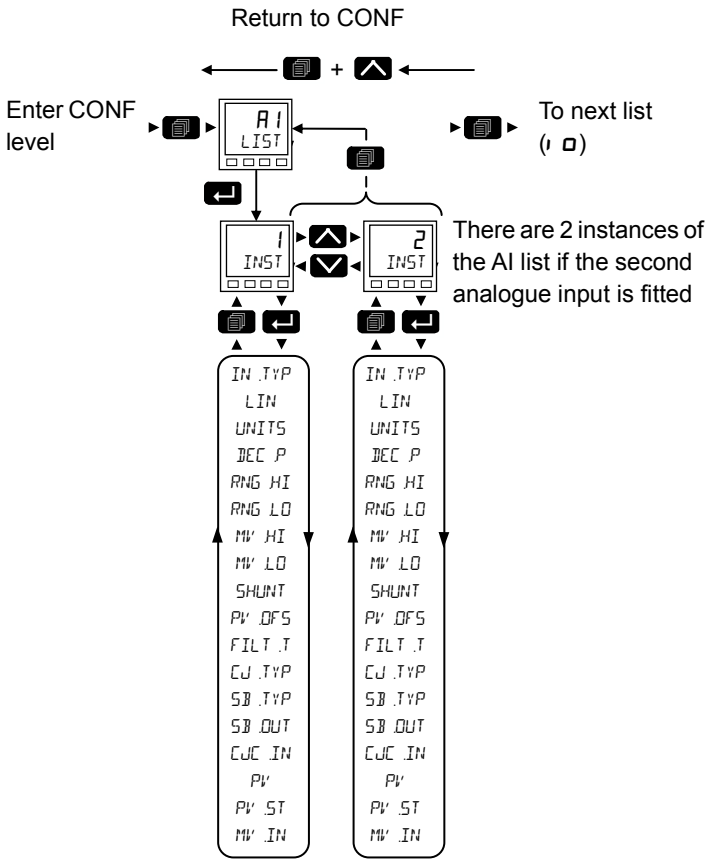
Analogue Input List (A 1 A2)

The first press of after entering Level 3 or Configuration, will show the 'ANALOGUE INPUT LIST'. From this list you can configure the input type and other characteristics of Input 1 (and Input 2, if fitted).

A 1 instance 1 of the AI list contains the parameters available for IP1

A2 instance 2 of the AI list contains the parameters available for IP2. The IP2 input is an option in EPC3008 and EPC3004. It is not available in EPC3016.

Access to the Analogue Input parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



The parameters in the following list are identical for both 1 and 2

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
INST	ANALOGUE INPUT	1		Input 1 List (IP1)	Conf R/W L3 R/O
		2		Input 2 List (IP2) EPC3008 and EPC3004 only.	
IN .TYP	INPUT TYPE	tC	0	Thermocouple **Default: Thermocouple**	Conf R/W L3 R/O
		mV	1	milli volts	
		V	2	Volts	
		mA	3	milli amps	
		rtd	4	Platinum resistance thermometer	
		2 wire	5	High Impedance Zirconia probe (only available on the secondary input)	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
LIN	LINEARISATION TYPE	J	0	Thermocouple type J	Conf R/W L3 R/O
		Hr	1	Thermocouple type K **Default: Type K**	
		L	2	Thermocouple type L	
		r	3	Thermocouple type R	
		b	4	Thermocouple type B	
		n	5	Thermocouple type N	
		t	6	Thermocouple type T	
		S	7	Thermocouple type S	
		CSt.1	8	Custom linearisation 1. To download special linearisation tables see "To Load a Custom Linearisation Table" on page 212.	
		CSt.2	9	Custom linearisation 2. Two tables may be downloaded into the EPC3000 series controllers.	
		100	10	Resistance thermometer type PT100	Only shown for mV, V or mA inputs
		1000	11	Resistance thermometer type PT1000	
		LIN	12	Linear	Only shown if the input is RTD
		Sqr	13	Square root	
UNITS	UNITS			See section "Units" on page 95 for a list of units used throughout	Conf R/W L3 R/W
DEC P	RESOLUTION	nnnnn nnnn.n nnn.nn nn.nnn n.nnnn	0 1 2 3 4	The number of decimal points shown in the display. Range none to four decimal points. **Default: nnnn.n**	Conf R/W L3 R/O
RNG HI	RANGE HIGH			Range high limit. Used to limit ranges of Thermocouple and RTD input types, and scale mV, V and mA inputs. AI2 also includes Zirconia. **Default tc 500; mV 40; V 10; mA 20; RTD 500; Zirconia 2000**	Conf R/W L3 R/O
RNG LO	RANGE LOW			Range low limit. Used to limit ranges of Thermocouple and RTD input types, and scale mV, V and mA inputs. AI2 also includes Zirconia. **Default tc 0; mV 0; V 0; mA 4; RTD 0; Zirconia 0**	
MV HI	INPUT HIGH LIMIT	mV: -800.0 to 800.0 V: -10.00 to 10.00 mA: -800.00 to 800.00		High limit for mV, mA or V inputs **Default: mV 40; V 10; mA 20**	Conf only R/W Not shown for thermocouple or RTD inputs
MV LO	INPUT LOW LIMIT			Low limit for mV, mA or V inputs **Default: mV 0; V 0; mA 4**	
SHUNT	SHUNT VALUE	100 to 1000.00		Value of the shunt resistor for mA inputs. **Default: 2.49Ω**.	Conf only R/W
PV OFS	PV OFFSET	0.0		A simple offset is provided to adjust the process variable by a fixed amount across its span. This can be used to compensate for known thermocouple and other tolerances which may exist in multi instrument installation so that all instruments read the same value. See also "Calibration using a Dry Block or Equivalent" on page 283 which describes the two point calibration adjust method. This may be used to apply a linear correction to the temperature reading. **Default: 0.0**	Conf R/W L3 R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FILT.T	FILTER TIME CONSTANT	0 to 60		Some industrial installations can cause electrical noise to be introduced into the process measurement. This could be due, for example, to EMC or mechanical linkages. A filter is provided to reduce the frequency of electrical noise seen by the instrument. The effect of electrical noise can be reduced by increasing the filter time constant, but a compromise must be achieved as it could affect the closed loop response of the system. The larger the number, the slower the measured temperature will be to respond to fluctuations. **Default: 1.6s**	Conf R/W L3 R/W
CJ.TYP	CJC TYPE	AUTO	0	A thermocouple measures the temperature difference between the measuring junction (hot junction) and the reference junction (cold junction). Auto uses the measurement of the temperature made by the instrument where the thermocouple is connected to its rear terminals. **Default: Auto**	Conf R/W L3 R/O Only shown for thermocouple inputs.
		0	1	The reference junction is held at a fixed known temperature of 0 degrees usually by an external ice point method	
		50	2	The reference junction is held at a fixed known temperature of 50 degrees usually by an external hot box method	
		oFF	3	CJC is turned off. This could be used, for example, where a thermocouple measurement is made by an external transmitter which does not linearise the thermocouple curve.	
SBR.TYP	SENSOR BREAK TYPE	OFF	0	The controller continuously monitors the impedance of a transducer or sensor connected to the input. Off means sensor break is not detected.	Conf R/W L3 R/O
		LO	1	Sensor break is detected if impedance at the terminals is above a low threshold (typically between 3 to 5KOhms) **Default: Low**	
		HI	2	Sensor break is detected if impedance at the terminals is above a high threshold (typically between 12 to 20KOhms)	
SBR.OUT	SENSOR BREAK OUTPUT	OFF	0	No sensor break detected	Conf R/O
		On	1	Sensor break detected. If the sensor break requires to activate a soft alarm the sensor break output parameter can be wired to a Digital High Alarm. (see section "Example 1: To Wire an Alarm" on page 195.	
CJC.IN	CJC TEMPERATURE			The CJC temperature is a measure of the temperature at the instrument terminals. It is relevant only for thermocouple inputs and is provided as a diagnostic aid.	Conf R/O L3 R/O
PV	PV			Process value is the displayed value on the instrument, usually the measured temperature when the instrument is controlling a temperature loop.	Conf R/O L3 R/O
PV.ST	PV STATUS			The state of the PV is continuously monitored. See section "Status" on page 96 for a list of enumerated values	Conf R/O L3 R/O
MV.IN	MEASURED VALUE			This is the measured value in units of mV or ohms, dependent upon input type. The value measured at the rear terminals can be useful as a diagnostic aid to determine if the thermocouple or linear input sensor is wired correctly.	Conf R/O L3 R/O

Units

The list below applies to all function blocks which contain Units

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
UNITS	UNITS	nonE	0	No units will be displayed	Conf R/W L3 R/W
		AtmP	1	Temperature units. °C, °F, K are set in the Instrument Info list section "Instrument List (INSt)" on page 167.	
		U	2	Volts	
		mU	3	Millivolts	
		A	4	Amps	
		mA	5	Milliamps	
		PH	6	pH	
		mmHG	7	Millimeter of mercury	
		PSI	8	Pounds per square inch	
		bAr	9	Bar	
		mbAr	10	millibar	
		PCH	11	Per cent relative humidity	
		PErc	12	Per cent	
		mmwG	13	Millimeter Water Gauge	
		inwG	14	Inches water gauge	
		inww	15	Not used	
		OhmS	16	Resistance (ohms)	
		PSI G	17	Pounds per square inch gauge	
		P.O2	18	Per cent O_2	
		PPm	19	Parts per million	
		P.CO2	20	Per cent CO_2	
		P.CP	21	Per cent carbon	
		P.SEc	22	Per cent per second	

Status

The list below applies to all function blocks which contain global status enumeration.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
		Good	0	The process variable is working correctly	Conf R/W L3 R/W
		OFF	1	Channel is configured to be off	
		OrnG	2	When the input signal exceeds the upper input limit by more than 5% the PV will flash indicating over range. If the value is too high to fit the number of digits on the display "HHHH" will flash (refer to "Auto-scaling of decimal point" on page 68 for display capability for each instrument size).	
		UrnG	3	When the input signal exceeds the lower input limit by more than 5% the PV will flash indicating under range. If the value is too high to fit the number of digits on the display "LLLL" will flash (refer to "Auto-scaling of decimal point" on page 68 for display capability for each instrument size).	
		Hw.S	4	Input hardware status is unknown.	
		rnG	5	The input status is set to Ranging at the point of an analogue input configuration change. It will remain in Ranging until an exit from a config induced instrument restart.	
		OFLw	6	Process variable overflow, possibly due to calculation attempting to divide a number by a relatively small number	
		bAd	7	The PV is not reading correctly which could be due to an open sensor.	
		Hwc	8	The hardware capabilities have been exceeded at the point of configuration, for example configuration set to 0 to 40V when input hardware is capable of up to 10V	
		ndAt	9	Insufficient input samples to perform calculation	

I/O List (i o)

The following modules may be fitted in the controller:

- None
- Logic I/O module
- Form A relay
- Triac
- Isolated DC output

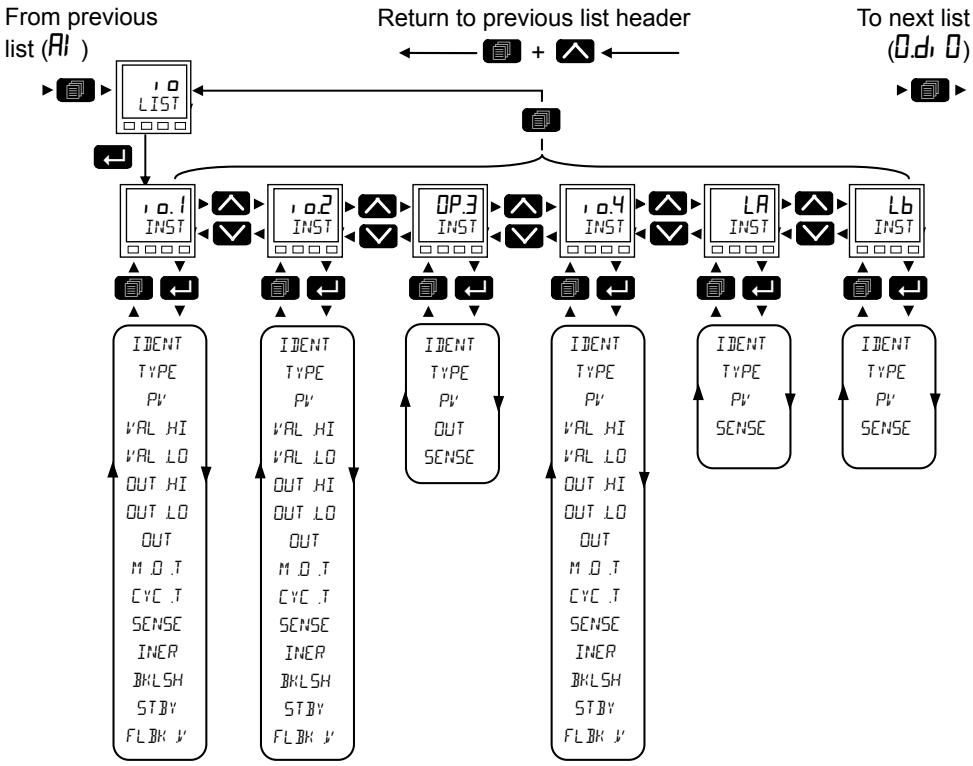
Output 1 beacon is operated from IO(1) when it is configured as an output.

Output 2 beacon is operated from IO(2) when it is configured as an output.

Output 3 beacon is operated from OP(3).

Output 4 beacon is operated from IO(4) when it is configured as an output.

Access to the Input/Output parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



The following table includes all available input/output parameters but the ones displayed depend on how each I/O is configured.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
IDENT	IO HARDWARE ID	NonE	0	This displays the type of IO hardware fitted. Choices are:	Conf R/O L3 R/O
		LIO	1	Logic input/output	
		rELY	2	Relay	
		SSr	3	Triac	
		dc.OP	4	DC output	
		LiP	5	Logic input	
TYPE	TYPE OF IO	OnOF	10	On off output	Conf R/W L3 R/O
		tPo	11	Time proportioning output	
		uP	15	Valve position raise	
		down	16	Valve position lower	
				Valve positioning UP/DOWN works across pairs of outputs ie:- UP : DOWN IO.1 : IO.2 IO.2 : OP3 OP3 : IO.4	
		di	5	Contact closure input	
		mA.OP	0	mA output	
		U.OP	1	Voltage output	
PV	PROCESS VARIABLE			For an Input type : The measured process variable For an Output type : The demanded output value	Conf R/W L3 R/W
VAL HI	DEMAND HIGH			Percentage PID demand value giving maximum output - "OUT.H" - Allows for "Output Splitting" **Default: 100.0**	Conf R/W L3 R/W Only shown for DC or time proportioning output
VAL LO	DEMAND LOW			Percentage PID demand value giving minimum output - "OUT.L" - Allows for "Output Splitting" **Default: 0.0**	
OUT HI	OUTPUT HIGH			The maximum average output power that can be supplied from this output - Allows for "Output Splitting" **Default: 100% for TPO; 20 for mA; 10 for V** i.e. the highest possible value for selected type.	
OUT LO	OUTPUT LOW			The minimum average output power that can be supplied from this output - Allows for "Output Splitting" **Default: 0**	
OUT	OUTPUT			For Digital Output Types A value of 0 indicates that the output is low (relay de-energised) A value of 1 indicates that the output is high (relay energised). For DC Output Types This is the physical output value after the PV has been mapped via the demand range parameters onto the output range.	Conf R/O L3 R/O

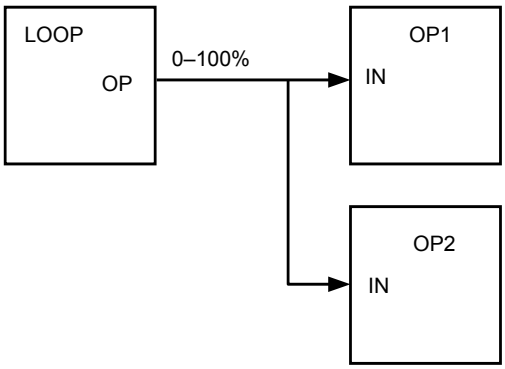
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
M.O.T	MIN ON TIME	Auto to 150.00	0	Minimum pulse time in seconds. This value sets the minimum duration between any two switching events. Although it is named 'MinOnTime', it applies to both on and off pulses equally. A contactor datasheet will often specify the minimum pulse time that will help to ensure correct energizing and de-energizing of the contactor. This may be the lowest value you should consider using as a MinOnTime. Auto(0) - Automatically sets the minimum on time for the output hardware as follows: Relay = 1s (time proportioning) or 0.1s (VP raise/lower), Logic = 0.05s (time proportioning), 0.1s (VP raise/lower) Alternatively, a value may be set manually but it should be noted that this value will be clipped if it is below the minimum permissible value for the hardware that is fitted (relay or logic - see settings above). For VP raise/lower outputs, smaller values of MinOnTime may actually produce less actuator activity. This is because the larger the MinOnTime, the larger the valve movement, and thus the lower the output resolution. This may lead to increased hunting. Generally values less than 0.5s should be used. **Default: Auto**	Conf R/W L3 R/W
CYCL.T	CYCLE TIME	Auto to 600	0	This value sets the time proportioning output (TPO) and cycle time in seconds. It is defined as the period of time between output repetitions. When this parameter is Auto (0), which is the default setting, the TPO algorithm will run in a so-called Constant Ripple Mode. Under this regime, the cycle time will be automatically and continuously adjusted depending on the output demand. This is to maintain the amount of ripple in the process at an approximately constant amplitude. The benefit of this is that actuations are reduced on average, which can increase the lifetime of contactors and relays. As suggested, a demand of 50% will produce the shortest cycle time of 4*MinOnTime, and the cycle time is extended the further the demand moves away from 50%. You should therefore choose a MinOnTime that gives an appropriate minimum cycle time. Alternatively, you can set a value of cycle time directly. When a value is set, the algorithm will run in a so-called Constant Cycle Time Mode. Under this regime, the algorithm will try to keep the cycle time constant, assuming constant demand. Note that the cycle time will be extended if the demand is such that the cycle time cannot be achieved without violating the MinOnTime. In this case, the effective cycle time will be extended just enough to help ensure the MinOnTime and the demand are both achieved. There are a number of factors that may influence the setting of an appropriate CycleTime and it is often a trade off. For example, a longer cycle time may extend the lifetime of contactors but reduce the lifetime of heating elements. A longer cycle time will also increase the amount of ripple in the process variable. **Default: Auto**	Conf R/W L3 R/W
SENSE	SENSE OF IO	nor m	0	Output normal. This is the normal setting for control. Output off when the PID demand is off. For control this is when PV>SP. For a Digital Input the input is active when the input is = 1 **Default: Normal**	Conf R/W
		InU	1	Output inverted This is the normal setting for alarms. Output off is when the alarm is active. Output on is when the alarm is in-active. For a Digital Input the input is active when the input is = 0	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
INER	INERTIA	0.0 to 30.0		Time taken in seconds for the valve motor to stop after power is removed. 0.0 to 30.0 seconds. Applies to valve position outputs only. **Default: 0.0**	L3 R/W
BkLSH	BACKLASH	0.0 to 30.0		Time in seconds to take up any backlash in the valve actuator linkage. 0.0 to 30.0 seconds. Applies to valve position outputs only. **Default: 0.0**	L3 R/W
STBY	STANDBY ACTION			Determines the valve positioning output action (Rest, Raise, Lower) when the instrument is in Standby Mode	Conf R/W
		rESt	0	The valve will remain in the current position **Default: Reset**	
		UP	1	The valve will open. Applies to io1	
		down	2	The valve will close. Applies to io2	
				Valve positioning UP/DOWN works across pairs of outputs ie:- UP : DOWN IO.1 : IO.2 IO.2 : OP3 OP3 : IO.4	
FLBK V	FALLBACK VALUE	0.0		Fallback value which is to be outputted when the status is BAD, **Default: to the value of OUT.L**	Conf R/W

Output Splitting

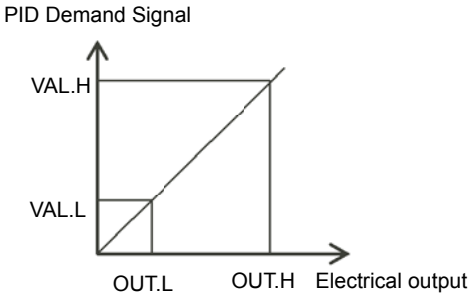
Output splitting is the process of having more than one output being driven from a single control loop. For this to be possible the single loop output signal is divided between two output channels.

This splitting of outputs is not done as a part of the control loop but rather as a part of the output blocks.



Functionality

- The control loop is not affected by the use of output splitting, it will still give its output in the form of a 0–100% value.
- Each output block can be tailored individually in terms of turn on / off points and percentage power output.
- The output from the loop is "wired" to the inputs of two output blocks.
- Each output block has a "ValHigh" and "ValLow" parameter. These values represent the PID demand percentage giving maximum and minimum output power respectively.
- Each output block also has a "OutHigh" and "OutLow" parameter. The values of which determine the percentage limits of output power.
- The relationship between output power and input value can be seen in the graph below:



Cycle Time and Minimum OnTime Algorithms

The ‘Cycle Time’ algorithm and the ‘Min OnTime’ algorithm are mutually exclusive and provide compatibility with existing controller systems. Both algorithms apply to time proportioning outputs only and are not shown for on/off control.

A fixed cycle time allows the output to switch on and off within the time period set by the parameter. For example, for a cycle time of 20 seconds, 25% power demand would turn the output on for 5 seconds and off for 15 seconds, 50% power demand would turn the output on and off for 10 seconds, for 75% power demand the output is on for 15 seconds and off for 5 seconds.

Fixed cycle time may be preferred when driving mechanical devices such as refrigeration compressors.

The ‘Min OnTime’ is described in the ı ◘ table in the previous section.

If the control device is a relay or contactor the minimum on time should be set greater than 10 seconds (for example) to prolong relay life. By way of illustration, for a setting of 10 seconds the relay will switch (approximately) as shown in the table below:-

Power demand	Relay ON time	Relay OFF time
10%	10	100
25%	13	39
50%	20	20
75%	39	13
90%	100	10

The Minimum OnTime algorithm is often preferred for control of switching devices using triac, logic or relay outputs in a temperature control application. It also applies to valve position outputs.

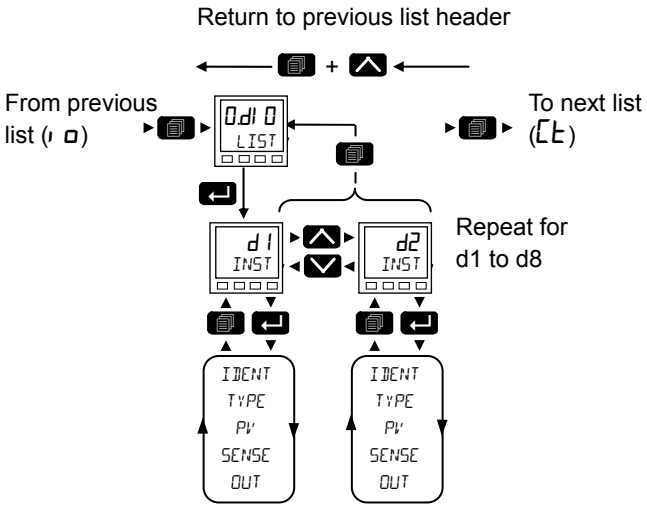
Note: Consideration should be given to the number of operations which the relay is expected to endure during its lifetime. See section "Relay Electrical Endurance" on page 295.

DI/O List (O.dI O)

This list only appears for an EPC3008 or EPC3004 if an option module is fitted that has Digital Input/Output capabilities. EPC3016 does not support this list.

These digital I/O points can only be used as Logic Input or On/Off Outputs (ie : not control outputs)

Access to the Digital Input/Output parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



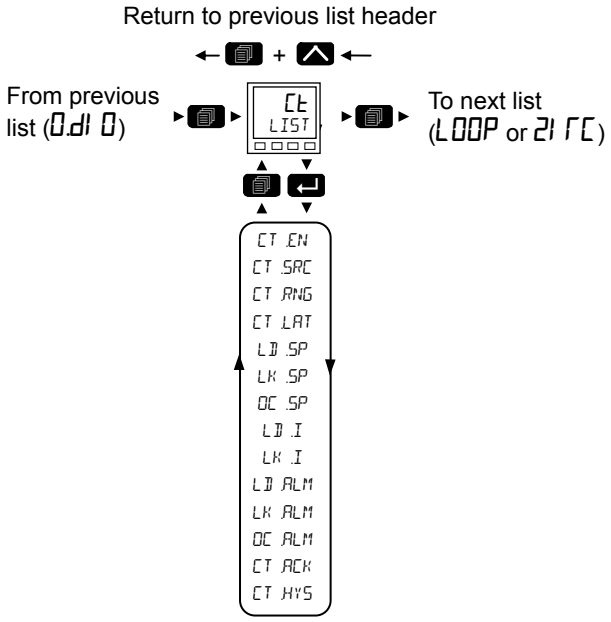
Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
IDENT	HW IDENT			Hardware fitted:	Conf R/O
		ENEt	2	E.NET: Ethernet comms + Secondary PV + 4 DIO Option module	
		AI d8	1	AI.D8: Secondary PV + 8 DIO Option module	
		noNE	0	No options board	
TYPE	TYPE OF IO	d I	0	Logic input	Conf R/W
		OnOF	1	On Off output	
PV	PROCESS VARIABLE	OFF	0	If the type of IO is an input this shows the state of the digital input.	R/O
		On	1	If the type is an output this shows the demand state of the output.	
SENSE	SENSE OF IO	nor m	0	Output normal This is the normal setting for control. Output off when the PID demand is off. For control this is when PV>SP. For a Digital Input the input is active when the input is = 1 **Default: Norm**	Conf R/W
		I nu	1	Output inverted This is the normal setting for alarms. Output off is when the alarm is active. Output on is when the alarm is in-active. For a Digital Input the input is active when the input is = 0	
OUT	OUTPUT	OFF	0	A value of 0 indicates that the output is low (relay de-energised)	Conf R/O L3 R/O
		On	1	A value of 1 indicates that the output is high (relay energised).	

CT List (CT)

This option can measure, via an external current transformer, the current flowing through the electrical load when the heat output is 'on' (load current) and also when it is 'off' (leakage current).

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 conditions is user configurable between 0…5% of CT range, defaulted to 2%.

Access to the Current Transformer parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ∧ or ∨ to change values (if read/write, R/W)			
CT EN	CURRENT TRANSFORMER	no	0	CT module disabled. If set to NO, no further parameters are shown. **Default: No**	Conf R/W L3 R/O
		YES	1	CT module enabled	
CT SRC	CT SOURCE	NONE	0	None **Default: None**	
		I o.1	1	Input/Output 1	
		I o.2	2	Input/Output 2	
		oP.3	3	Relay output	
		I o.4	4	Input/Output 4	
CT RNG	CT RANGE	1000		Sets the CT range from 0 to the full range of the CT (1000). **Default: 100.0**	Conf R/W
CT LAT	CT ALARM LATCH TYPE	NONE	0	No latching **Default: None**	Conf R/W
		AUTO	1	Latched with automatic reset	
		mAn	2	Latched with manual reset	
LD SP	LOAD THRESHOLD	OFF to CT full scale value (1000)	0	Load open circuit current alarm threshold - low alarm. **Default: Off**	Conf R/W
LK SP	LEAK THRESHOLD	OFF to CT full scale value (1000)	0	Leakage current in the off state alarm threshold - high alarm. **Default: Off**	Conf R/W

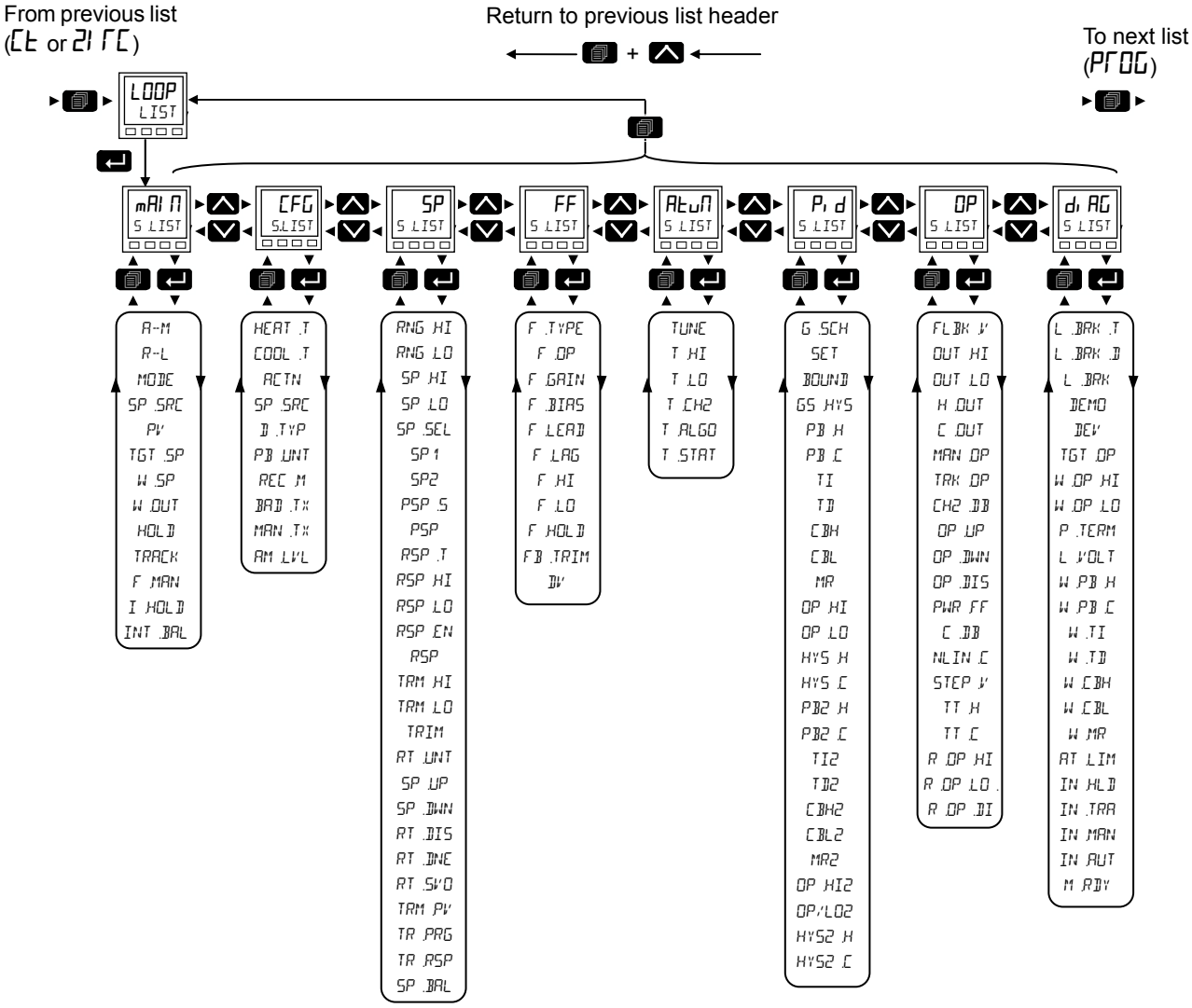
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
OC SP	OVER THRESHOLD	OFF to CT full scale value (1000)	0	Over current alarm threshold - high alarm. **Default: Off**	Conf R/W
LD I	LOAD CURRENT			Measured load current	L3 R/O
LK I	LEAK CURRENT			CT input leakage current	L3 R/O
LD ALM	LOAD CURRENT ALARM	No	0	.	L3 R/O
		YES	1	The low load current alarm status is set high when the detected load current is lower than the LD SP threshold. This may indicate a partial or total failure condition in the load (for example, a defective heating element).	
LK ALM	LEAK CURRENT ALARM	No	0		L3 R/O
		YES	1	The leak current alarm is set high when the measured current exceeds the threshold during the controllers off states	
OC ALM	OVER ALARM	No	0		L3 R/O
		YES	1	The over current alarm is set true if the measured current exceeds the over-current threshold.	
CT Alarms should be soft wired to the input of an alarm block as generally described in section "Example 1: To Wire an Alarm" on page 195					
CT ACK	CT ALARM ACKNOWLEDGE	No	0		L3 R/O
		YES	1	Acknowledge all CT alarms	
CT HYS	CT ALARM HYSTERESIS	2		To help prevent active/inactive alarm conditions due to electrical noise. The alarm conditions moving from active to inactive are evaluated using a hysteresis value as a % of the CT Range (0…5%). **Default: 2%**	Conf R/W

Loop List (LOOP)

For a further explanation of the way in which the loop operates and further descriptions of parameters please refer to "Control" on page 241.

This list contains eight sub-lists: Main (mAI n), Configuration (CFG), Setpoint (SP), Feedforward (FF), Autotune (AtUn), PID (PI d), Output (OP), Diagnostics (dI AG).

Access to the Loop parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Loop - Main Sub-list

The main sub-list defines how the control loop behaves under different modes.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
A-M	AUTO-MANUAL SELECT	AuTo	0	Select automatic (closed loop) control	L3 R/O
		mAn	1	Select manual operation (output power adjusted by the user) **Default: Manual**	
R-L	REMOTE-LOCAL SELECT	Loc	1	Local Setpoint. In Auto mode, the loop uses one of its local setpoints (SP1/SP2) which is alterable via the front panel or over comms. **Default: Local**	L3 R/O
		rEm	0	Remote Setpoint. This selects the remote setpoint source. This mode is commonly used, for example, in a cascade topology or with a multi-zone furnace. Although this parameter is used to select the remote setpoint, it will not necessarily become active. The RSP_En input must be true and the RSP must have a good status before it will become active. If either of these conditions are not met, the loop will fallback to using the local setpoint.	
MODE	LOOP MODE			Reports the currently active operating mode. The loop has a number of possible operating modes which can be selected by the application. It is possible for the application to request several modes at once, so the active mode is determined by a priority model, whereby the mode with the highest priority wins. The modes shown below are listed in their priority order.	R/O
		HoLd	0	Hold. Priority 0: The controller Working Output will be maintained at its current value.	
		trAck	1	Track. Priority 1: The controller output will follow the track output parameter. The track output can either be a constant value or be derived from an external source (e.g. an analogue input).	
		F.mAn	2	Forced Manual. Priority 2: This mode behaves in the same way as Manual but it indicates that Auto mode cannot currently be selected. This mode is selected if the PV status is not good (e.g. sensor break) and, optionally, if a process alarm has triggered. When transferring to Forced Manual from Auto mode, the output will go to the Fallback Value (unless the hold action has been selected). Transferring to Forced Manual from any other mode will always be bumpless. This is used in a number conditions, further described in "Operating Modes" on page 257.	
		mAn	3	Manual. Priority 3: In manual mode, the controller passes authority over the output to the operator. The output is alterable via the HMI or over comms.	
		tunE	4	Tune. Priority 4: This mode indicates that the autotuner is running and has authority over the output.	
		AuTo	5	Auto mode. Priority 5 (lowest): In Auto mode, the automatic control algorithm has authority over the output.	
SP SRC	SETPOINT SOURCE			Indicates the currently active setpoint source	L3 R/O
		FLoc	0	Forced local setpoint. The setpoint has fallen back to the local source because the remote setpoint is not being accessed correctly.	
		rEm	1	The setpoint is derived from a remote source	
		Loc	2	The setpoint is derived locally	
PV	PROCESS VARIABLE			The process variable. This is typically wired from an analogue input.	R/W
TGT SP	TARGET SETPOINT			Adjust and display the current target setpoint. The target setpoint is the value before rate limiting.	L3 R/O

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
W SP	WORKING SETPOINT			Displays the current working setpoint. This setpoint may be derived from a number of sources depending on the application. Examples are from the programmer function block or a remote setpoint source.	R/O
W OUT	WORKING OUTPUT			The current output demand in %	R/O
HOLD	OUTPUT HOLD	OFF	0	When on is selected the controller output will maintain its current value.	L3 R/W
		On	1		
TRACK	OUTPUT TRACK	OFF	0	Used to select Track mode. In this mode, the controller output will follow the Track Output value. The Track output may be a constant value or come from an external source (e.g. an analogue input). Track has priority 1 and so overrides all other modes apart from HOLD.	R/O
		On	1		
F MAN	FORCED MANUAL	OFF	0	When On is selected this mode behaves in the same way as Manual but whilst active it indicates that Auto cannot currently be selected. When transferring to this mode from Auto, and this input is asserted, the output will jump to the Fallback Value. This input can be wired to alarms or digital inputs and used during abnormal process conditions. This mode has priority 2 and so will override all modes, except for Hold and Track	R/O
		On	1		
				When any of the above modes are selected they will be indicated by the MODE parameter above.	
I HOLD	INTEGRAL HOLD	No	0		L3 R/W
		YES	1	If asserted the integral component of the PID calculation will be frozen.	
INT BAL	INTEGRAL BALANCE	No	0	This is a feature included in the controller which is not accessible via the HMI but is available in iTools and is, therefore, included here. This rising edge-triggered input can be used to force an integral balance. This recalculates the integral term in the controller so that the previous output is maintained, balancing out any change in the other terms. This can be used to minimise bumps in output when it is known that, for example, an artificial step change in PV will occur. For example, a compensation factor has just changed in an oxygen probe calculation. The integral balance is intended to prevent any proportional or derivative kick, instead allowing the output to be smoothly adjusted under integral action.	Available in iTools only
		YES	1		

Configuration Sub-List

The configuration sub-list defines control type and how certain parameters behave for particular conditions. These parameters are unlikely to require changing once the application has been configured.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
HEAT .T	CH1 CONTROL TYPE	PId	2	PID Proportional, Integral, derivative, full three term control. **Default: PID**	Conf R/W L3 R/O
		UPu	3	Valve position unbounded (no feedback potentiometer is required)	
		OFF	0	Control loop channel inoperative	
		OnOF	1	On Off control	
COOL .T	CH2 CONTROL TYPE	PId	2	PID Proportional, Integral, derivative, full three term control	Conf R/W L3 R/O
		UPu	3	Valve position unbounded (no feedback potentiometer is required)	
		OFF	0	Control loop channel inoperative **Default: Off**	
		OnOF	1	On Off control	
ACTN	CONTROL ACTION	rEU	0	Reverse acting. Output decreases as PV increases. This is the normal setting for heating processes. Not applicable to on/off control. **Default: Reverse**	Conf R/W L3 R/O
		dIr	1	Direct acting. Output increases as PV increases.	
D .TYP	DERIVATIVE TYPE	PU	0	Only changes in PV cause a derivative output. Generally used for process systems particularly using valve control where it reduces wear on valve mechanics. Not applicable to on/off control. **Default: PV**	Conf R/W L3 R/O
		Err	1	Changes to either PV or SP will cause a derivative output. The derivative term will responds to the rate of change of the difference between PV and the setpoint. Not applicable to on/off control.	
PB UNT	PROPORTIONAL BAND UNITS	EnG	0	The proportional band is set in engineering (PV) units. For example, degrees C. **Default: Eng**	Conf R/W L3 R/O
		PErc	1	The proportional band is set in percent of loop span (RangeHigh minus RangeLow).	
RECV M	RECOVERY MODE			This parameter configures the loop recovery strategy. This strategy is followed in the following circumstances: • Upon instrument start-up, after a power cycle or power outage. • Upon exit from Instrument Configuration or Standby conditions. • Upon exit from Forced Manual (F.MAN) mode to a lower priority mode (e.g. when the PV recovers from a bad status or an alarm condition goes away).	Conf R/W L3 R/W
		LASt	0	Last Mode with Last Output. The loop will assume the last mode with the last output value. **Default: Last**	
		mAn	1	Manual Mode with Fallback Output. The loop will assume MANUAL mode with the fallback output value, unless exiting from Forced Manual (F_MAN) in which case the current output will be maintained.	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
BAD.TX	PV BAD TRANSFER TYPE			If the PV goes 'bad' (e.g. due to a sensor break) this parameter configures the type of transfer to Forced Manual (F_Man). Note that this is only followed if transitioning to F_Man from Auto. Transitioning from any other mode will always be bumpless and transitioning due to the F_Man input being asserted will always go to the Fallback Value.	Conf R/W L3 R/W
		FALL	0	The FallbackValue will be applied to the output. **Default: Fall**	
		HoLd	1	The last good output will be applied. This will be an output value from approximately 1 second before the transition.	
MAN.TX	MANUAL TRANSFER TYPE			Type of auto/manual transfer	Conf R/W L3 R/W
		trAc	0	The Manual Output will track the Working Output while the mode is not MANUAL. This helps to ensure a bumpless transfer when the mode does go into MANUAL. **Default: Trac**	
		StEP	1	The Manual Output will be set to the Manual Step Value while the mode is not MANUAL.	
		LASt	2	The Manual Output will remain at the last value used.	
AM LVL	AUTOMAN ACCESS LEVEL			Used to set the access level at which the AutoMan parameter can be changed from the HMI. It is often used to help prevent unauthorised use of manual mode.	Conf R/W L3 R/W
		LEu1	0	Auto/manual select is available in level 1 **Default: Lev1**	
		LEu2	1	Auto/manual select is available in level 2	
		LEu3	2	Auto/manual select is available in level 3	
SP LVL	SETPOINT ACCESS LEVEL			This sets the access level at which the setpoint can be altered from the HMI. It is often used to help prevent unauthorised changing of setpoints.	Conf R/W L3 R/W
		LEu1	0	Target setpoint is available in level 1 **Default: Lev1**	
		LEu2	1	Target setpoint is available in level 2	
		LEu3	2	Target setpoint is available in level 3	
M LVL	MANOPACCES			This parameter sets the access level at which the manual output can be changed from the home screen.	Conf R/W L3 R/W
		LEu1	0	Manual output can be changed in level 1 **Default: Lev1**	
		LEu2	1	Manual output can be changed in level 2	
		LEu3	2	Manual output can be changed in level 3	

Setpoint Sub-list

The setpoint sub-list defines setpoint parameters such as limits, rates of change, trims and tracking strategies.

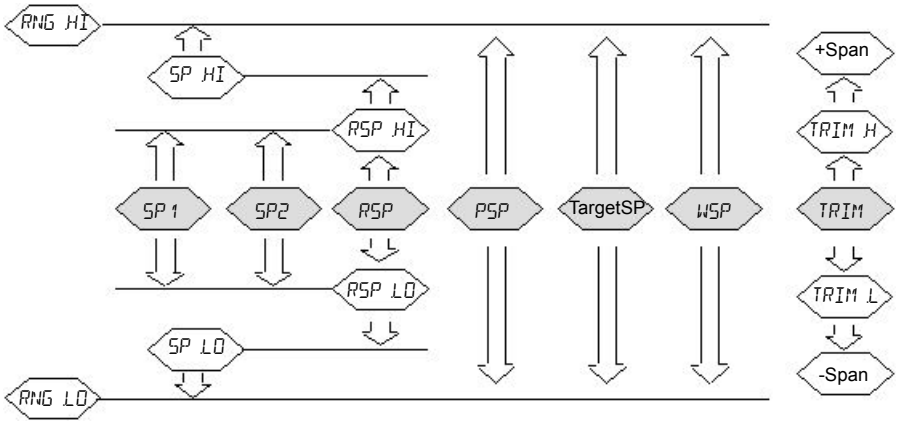
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
RNG HI	RANGE HIGH			Range high limit. Selectable between the high limit of the selected input type to the 'Range Low' limit parameter. **Default: 1372.0**	Conf RW L3 RO
RNG LO	RANGE LOW			Range low limit. Selectable between the low limit of the selected input type to the 'Range High' limit parameter.	Conf RW L3 RO
SP HI	SETPOINT HIGH LIMIT			Maximum allowable setpoint setting. Range is between 'Range High' limit and Range Low' limit. **Default: 1372.0**	Conf RW L3 RW
SP LO	SETPOINT LOW LIMIT			Minimum allowable setpoint setting. Range is between 'Range High' limit and Range Low' limit.	Conf RW L3 RW
SP SEL	SETPOINT SELECT	SP1	0	Select setpoint 1 **Default: SP1**	Conf RW L3 RW
		SP2	1	Select setpoint 2	
SP1	SETPOINT 1			The current value of setpoint 1. Range from Low to high setpoint limits	Conf RW L3 RW
SP2	SETPOINT 2			The current value of setpoint 2. Range from Low to high setpoint limits	Conf RW L3 RW
PSP S	PSP select	OFF	0	Program setpoint not selected	Not available on HMI
		On	1	Program setpoint selected	
PSP	Program Setpoint			The current value of the programmer setpoint	Not available on HMI
RSP T	REMOTE SETPOINT TYPE			This parameter configures the remote setpoint topology.	
		SEtP	0	The remote setpoint (RSP) is used as a setpoint for the control algorithm. If required, a local trim can be applied. **Default: Setp**	
		trim	1	The local setpoint (SP1/SP2) is used as the setpoint for the control algorithm. The remote setpoint (RSP) acts as a remote trim on this local setpoint.	
RSP HI	RSP HIGH LIMIT			Sets the maximum range limit for the remote setpoint **Default: 1572.0**	Conf RW L3 RW
RSP LO	RSP LOW LIMIT			Sets the minimum range limit for the remote setpoint **Default: -1572.0**	
RSP EN	REMOTE SETPOINT ENABLE	On	1	This input is used to enable the remote setpoint (RSP). The remote setpoint cannot become active unless this input is asserted. This is typically used in a cascade arrangement and allows the master to signal to the slave that it is providing a valid output. I.e. the master controller's Loop.Diagnostics.MasterReady parameter should be wired into here.	Conf RW L3 RW
		OFF	0	Disable the remote setpoint	
RSP	REMOTE SETPOINT			The remote setpoint (RSP) is typically used in a cascade control arrangement or in a multi-zone process, where a master controller is transmitting a setpoint to the slave. For the remote setpoint to become active, the RSP status must be good, the RSP_En input must be true and RemLocal must be set to Remote. The RSP can either be used as a setpoint itself (with a local trim if required) or as a remote trim on a local setpoint.	Conf RW L3 RW

Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ▲ or ▼ to change values (if read/write, R/W)			
TRM HI	SETPOINT TRIM HIGH			Local setpoint trim upper limit. Lower range limit is set by the TRM LO.	Conf RW L3 RW
TRM LO	SETPOINT TRIM LOW			Local setpoint trim lower limit. Upper range limit is set by the TRM HI	
TRIM	SETPOINT TRIM			To adjust the value by which the setpoint is being trimmed between TRM HI and TRM LO	Conf RW L3 RW
RT UNT	SETPOINT RATE LIMIT UNITS	P.SEc	0	Set the setpoint rate limit to units per second, units per minute or units per hour **Default: P.Sec**	Conf RW L3 RW
		P.min	1		
		P.hr	2		
SP UP	SETPOINT RATE UP	OFF. 0.1 to full range	0	Limits the rate at which the setpoint can increase when setpoint ramp rate is used. OFF means no rate limit is applied. **Default: Off**	Conf R/W L3 R/W
SP DWN	SETPOINT RATE DOWN	OFF. 0.1 to full range	0	Limits the rate at which the setpoint can decrease when setpoint ramp rate is used. OFF means no rate limit is applied. **Default: Off**	Conf R/W L3 R/W
				The next three parameters are only shown if either of the setpoint rate limit parameters above are set to a value	
RT DIS	SETPOINT RATE LIMIT DISABLE	no	0	Setpoint rate limit enabled	Conf R/W L3 R/W
		YES	1	Disable setpoint rate limit	
RT DNE	RATE LIMIT DONE	no YES	0 1	Indicates that the working setpoint has reached the target setpoint. If the setpoint is subsequently changed it will ramp at the set rate until the new value is reached.	R/O
RT SVO	RATE LIMIT SERVO TO PV			When the setpoint is being rate limited and servo-to-PV is enabled, changing the target SP will cause the working SP to servo (step) to the current PV before ramping to the new target. This feature is only applied to SP1 and SP2 and not to the program or remote setpoints.	Conf R/W L3 R/W
		OFF	0	Disabled	
		On	1	The selected setpoint will servo to the current value of the PV	
TRK PV	SP TRACKS PV IN MANUAL	OFF	0	No setpoint tracking when in manual	Conf R/W L3 R/W
		On	1	When the controller is operating in manual mode the currently selected SP (SP1 or SP2) tracks the PV. When the controller resumes automatic control there will be no step change in the working SP. Manual tracking does not apply to the remote setpoint or programmer setpoint.	
TR PRG	SP TRACKS PROGRAM	OFF	0	No setpoint tracking of the programmer	Conf R/W L3 R/W
		On	1	SP1/SP2 tracks the programmer setpoint while the program is running, so that there will no step change in the Working SP when the program ends and the programmer is reset. This is sometimes referred to as 'Program Tracking'.	
TR RSP	SP TRACKS RSP IN REMOTE	On	1	When the remote setpoint is selected SP1/SP2 tracks the remote setpoint, so that there will be no step change in the Working SP when transitioning to the local setpoint source. The selected setpoint returns to its set value at the rate set by the SP UP and SP DWN parameters.	Conf R/W L3 R/W
		OFF	0	Disabled	
SP BAL	SP CHANGE INTEGRAL BALANCE			When enabled, this causes the control algorithm to perform an integral balance whenever the target setpoint is changed. It only applies when the local setpoint is in use. The effect of this option is to suppress proportional and derivative kicks whenever the setpoint changes, so that the output moves smoothly to its new value under integral action. This option is similar to having both proportional and derivative terms act on PV only, and not error.	Conf R/W L3 R/W
		OFF	0	Disabled	
		On	1	Enable. To suppress proportional and derivative kick.	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
BackCalcPV	Back-calculated PV			This output is the back-calculated PV. It is the value of PV minus the setpoint trim. This is typically wired to the PV input of a setpoint programmer. Wiring this input, rather than the PV itself, helps to ensure that the holdback feature can take account of any setpoint trim that may be applied and also allows setpoint programs to start smoothly with the working setpoint equal to the PV, if configured.	Not available on HMI
BackCalcSP	Back-calculated SP			This output is the back-calculated SP. It is the working setpoint minus the setpoint trim. This is typically wired to the servo input of a setpoint programmer, so that it can start smoothly without bumping the working setpoint, if configured	Not available on HMI

Setpoint Limits

The figure below shows a pictorial overview of setpoint limits



Span is taken to be the value given by Range High Limit - Range Low Limit.

Note: Whilst it is possible to set the RSP Limits outside the Range Limits, the RSP value will still be clipped to the Range Limits.

Feedforward Sub-list

Feedforward is described in "Feedforward" on page 250. This list defines the strategy to be adopted for a particular application.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
F.TYPE	FEEDFORWARD TYPE	OFF	0	No signal fed forward	Conf R/W
		SP	1	The working setpoint is used as the input to the feedfoward compensator.	
		PV	2	The PV is used as the input to the feedfoward compensator. This is sometimes used as an alternative to 'Delta-T' control.	
		rEm	3	The remote Disturbance Variable (DV) is used as the input to the feedfoward compensator. This is usually a secondary process variable that can be used to head-off disturbances in the PV before they have a chance to occur.	
F.OP	FEEDFORWARD CONTRIBUTION	0.0		Feedforward compensator output in percent	R/O
The following parameters are available if F.Type is not set to OFF					
F.GAIN	COMPENSATOR GAIN	1.000		Defines the gain of the feedforward value, the feed forward value is multiplied by the gain. **Default: 1.0**	L3 R/W
F.BIAS	COMPENSATOR OFFSET	0.0		The feedforward compensator bias/offset. This value is added to the feedforward input. Note that the bias is applied after the gain.	L3 R/W
F.LEAD	LEAD TIME CONSTANT	0		The feedforward compensator lead time constant in seconds can be used to 'speed-up' the feedforward action. Set to 0 to disable the lead component. In general, the lead component should not be used on its own without any lag. The lead and lag time constants allow dynamic compensation of the feedforward signal. The values are usually determined by characterising the effect of the input on the process (e.g. by a bump test). In the case of a Disturbance Variable, the values are chosen so that the disturbance and the correction 'arrive' at the process variable at the same instant, thereby minimising any perturbation. As a rule of thumb, the lead time should be set equal to the lag between the controller output and the PV, while the lag time should be set equal to the lag between the DV and the PV.	L3 R/W
F.LAG	LAG TIME CONSTANT	0		The feedforward compensator lag time constant can be used to slow down the feedforward action. Set to 0 to disable the lag component. The lead and lag time constants allow dynamic compensation of the feedforward signal. The values are usually determined by characterising the effect of the input on the process (e.g. by a bump test). In the case of a Disturbance Variable, the values are chosen so that the disturbance and the correction 'arrive' at the process variable at the same instant, thereby minimising any perturbation. As a rule of thumb, the lead time should be set equal to the lag between the controller output and the PV, while the lag time should be set equal to the lag between the DV and the PV.	L3 R/W
F.HI	FEEDFORWARD HIGH LIMIT	+/-200.0 %		The maximum allowed value of feedforward output. This limit is applied to the feedforward output prior to it being added to the PID output. **Default: 200.0%**	L3 R/W
F.LO	FEEDFORWARD LOW LIMIT	+/-200.0 %		The minimum allowed value of feedforward output. This limit is applied to the feedforward output prior to it being added to the PID output. **Default: -200%**	L3 R/W
F.HOLD	HOLD FEEDFORWARD	no	0	When true, the feedforward output will maintain its current value. This can be used to temporarily halt feedforward action.	L3 R/W
		YES	1		

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FB.TRM	PID TRIM LIMIT	0 Range 0.0 to 400.o		The PID trim limit limits the effect of the PID output. The implementation of Feedforward allows the Feedforward component to make the dominant contribution to the control output. The PID contribution can then be used as a trim on the Feedforward value. This arrangement is sometimes known as "Feedforward with Feedback Trim". This parameter defines symmetrical limits (expressed as a percentage of output) around the PID output, to limit the magnitude of the PID contribution. If it is required to allow PID contribution to dominate, set a large value for this parameter (400.0). **Default: 400.0**	L3 R/W
If F.type is set to Remote the following additional parameter is available					
DV	DISTURBANCE VARIABLE	0.0		The remote Disturbance Variable is typically a secondary measured process variable. This is usually a secondary process variable that can be used to head-off disturbances in the PV before they have a chance to occur.	L3 R/W

Autotune Sub-list

Autotune is used to automatically tune the PID loop to match the characteristics of the process. See also "Autotuning" on page 264.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
TUNE	AUTOTUNE	OFF	0	Autotune not enabled or abort an autotune	L3 R/W
		On	1	Enable autotune	
T HI	AUTOTUNE MAXIMUM OUTPUT	−100 to +100%		To set a maximum limit on the output during tuning. **Default: 100**	L3 R/W
T LO	AUTOTUNE MINIMUM OUTPUT	−100 to +100%		To set a minimum limit on the output during tuning. **Default: -100**	L3 R/W
T CH2	CH2 TUNE TYPE			Configures which experiment will be used to determine the relationship between channel 1 and channel 2 proportional bands.	
		Std	0	Standard. Tunes the ch2 proportional band using the standard relative ch2 tuning algorithm. **Default: Std**	
		ALt	1	Alternative relative ch2 tuning Uses a model-based tuning algorithm that has been shown to give enhanced results with higher-order, low-loss plants. In particular, it performs well with heavily-lagged temperature processes.	
		OFF	2	Do not try to determine the relative gain This option can be used to help prevent the autotune trying to determine the ch2 proportional band. Instead, it will maintain the existing ratio between the ch1 and ch2 proportional bands. In general, this option is not recommended unless there is a known reason to select it (e.g. the relative gain is already known and the tuner gives an incorrect value).	
T ALGO	TUNE ALGORITHM			This parameter reports which autotuning algorithm is available for the current control configuration. The appropriate tuning algorithm is autotmatically determined. See also "Autotuning" on page 264 for further information on self tuning.	R/O
		nonE	0	There is no autotuner available for the current control configuration	
		PId	1	The standard autotuner based on a modified relay method. It requires two cycles to complete (not including the relative ch2 tune). This is used for PID-only configurations and where there is no output rate limiting configured.	
		Fourı	2	This algorithm uses the same modified relay method but uses a more complex analysis based on the work of Joseph Fourier. It requires three cycles to complete (not including the relative ch2 tune). This algorithm is used for VP or mixed channel configurations and is also used whenever there is an output rate limit set.	

Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ▲ or ▼ to change values (if read/write, R/W)			
T.STA	AUTOTUNE STATUS			This parameter displays the current state of the autotune	R/O
		OFF	0	Unavailable	
		rdY	1	Ready to run an autotune.	
		trIG	2	Triggered. An autotune has been triggered but a higher priority mode is preventing it from starting. When the higher priority mode is no longer active the tune will start.	
		run	3	Running. The autotuner is running and currently has authority over the controller outputs.	
		donE	4	Complete. The autotune successfully completed and has updated the tuneset parameters.	
		Abor	5	Aborted. Autotune aborted.	
		tOut	6	Time Out. If any stage of the autotune sequence exceeds two hours in duration, the sequence will timeout and be aborted. It could be due to the loop being open or not responding to the demands from the controller. Very heavily lagged systems may produce a timeout if the cooling rate is very slow. The Stage Time parameter counts up the time in each stage.	
		OFLw	7	Overflow. A buffer overflow occurred while collecting process data. Contact your supplier for support.	
STAGE	STAGE OF AUTOTUNE			This reports the stage of the current autotuning sequence.	R/O
		IdLE	0	Idle. Not autotuning	
		moni	1	Monitor. The process is being monitored. This stage lasts one minute. The setpoint can be changed during this stage.	
		InIt	2	Initial. An initial oscillation is being established.	
		Hi	3	Max. Maximum output applied	
		Lo	4	Min. Minimum output applied	
		r2G	5	R2G. Relative channel 2 gain test is running. If the calculated proportional band ratio is outside the range 0.1 and 10.0, The Ch1/Ch2 Proportional Band ratio will be clipped to these limits but all other PID parameters are updated. R2G limit may occur if the gain difference between heating and cooling is too large. This could also occur if the controller is configured for heat/cool but the cooling medium is turned off or not working correctly. It could similarly occur if the cooling medium is on but heating is off or not working correctly.	
		Pd	6	PD Control. The autotuner is trying to control to setpoint and is examining the response.	
		AnLS	7	Analysis. The autotuner is calculating the new tuning parameters.	
STG.T	TIME ELAPSED IN STAGE			The time elapsed in the current autotune stage. This is reset each time the autotuner advances a stage. If this exceeds two hours, a timeout will occur.	

PID Sub-list

The PID is used to display and set the current PID values. See also "PID Control" on page 242.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
G.SCH	GAIN SCHEDULER TYPE			Gain scheduling is provided so that processes which change their characteristics can be controlled. For example, in some temperature processes, the dynamical response may be very different at low temperatures from that at high temperatures. Gain Scheduling typically uses one of the loop's parameters to select the active PID set -- this parameter is known as the scheduling variable (SV). Two sets are available and a boundary is provided which defines the switching point.	Conf R/W
		OFF	0	Gain scheduling not active	
		SEt	1	The PID set can be selected by the operator. It is possible to use soft wiring to control the selection of the gain sets. This could be linked to the programmer segment, changing the PID settings for individual segments or it could be wired to a digital input so that the working PID set can be set remotely.	
		PV	2	The transfer between one set and the next depends on the value of the process variable	
		SP	3	The transfer between one set and the next depends on the value of the working setpoint	
		OP	4	The transfer between one set and the next depends on the value of the output	
		dEV	5	The transfer between one set and the next depends on the value of the difference between the SP and PV	
		modE	6	This parameter selects set 2 when the remote setpoint is active, and set 1 when the local setpoint is active.	
SET	ACTIVE TUNE SET	SEt 1	0	This shows the set being tuned and is displayed if g.sch = SET, PV, SP, OP or dev.	L3 R/W
		SEt2	1		
BOUND	TUNE SET SWITCHING POINT	0.0		Sets the level at which PID set 1 changes to PID set 2. This only applies when the schedule type = PV, SP, OP, dev **Default: 1.0**	L3 R/W
GS HYS	SWITCHING HYSTERESIS	1.0		This specifies the amount of hysteresis around the gain scheduling boundary. This is used to avoid continuous switching as the scheduling variable passes through the boundary.	L3 R/W
PB.H	CH1 PROPORTIONAL BAND	20.0		The proportional band for channel 1. This may be in % or engineering units as set by the parameter PB.UNT. **Default: 20.0%**	L3 R/W These parameters are displayed on the HMI if gain scheduling is off.
PB.C	CH2 PROPORTIONAL BAND	20.0		The proportional band for channel 2. This may be in % or engineering units as set by the parameter PB.UNT. **Default: 20.0%**	
TI	INTEGRAL TIME	360		The integral time in seconds for channel 1. Set to 0 to disable integral action. **Default: 360 seconds**	
TD	DERIVATIVE TIME	60		The derivative time in seconds for channel 1. Set to 0 to disable derivative action. **Default: 60 seconds**	
CBH	CUTBACK HIGH THRESHOLD	Auto	0	Defines a High Cutback threshold in the same units as the proportional band (either engineering units or percent of span, depending on configuration)	
CBL	CUTBACK LOW THRESHOLD	Auto	0	Defines a Low Cutback threshold in the same units as the proportional band (either engineering units or percent of span, depending on configuration).	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
MR	MAN RESET	0.0 to 100.0% (heat only) -100.0 to 100.0% (heat/cool)		Manual reset. This parameter only appears if the control algorithm is PID or VPU, AND the integral time is set to 0 (Off). It is used to manually adjust the output power to offset for any difference between SP and PV. See also "Manual Reset (PD Control)" on page 245.	L3 R/W
OP HI	OUTPUT HIGH	+100.0% to OP.LO		Gain scheduled output upper limit. **Default: 100**	L3 R/W
OP LO	OUTPUT LOW	−100.0% and OP.HI		Gain scheduled output lower limit. **Default: -100**	L3 R/W
HYS H	CH 1 ON/OFF HYSTERESIS	OFF 1 to 99999	0	This parameter is only available if channel 1(heat) is configured for On/OFF control. It sets the hysteresis between the output being on and the output being off. **Default: 10**	L3 R/W
HYS C	CH 2 ON/OFF HYSTERESIS	OFF 1 to 99999	0	This parameter is only available if channel 2 (cool) is configured for On/OFF control. It sets the hysteresis between the output being on and the output being off. **Default: 10**	L3 R/W
PB2 H	CH1 PROPORTIONAL BAND 2	20.0		The proportional band for channel 1, for tuneset 2. This may be in % or engineering units as set by the parameter PB.UNT. **Default: 20.0%**	L3 R/W
PB2 C	CH2 PROPORTIONAL BAND 2			The proportional band for channel 2, for tuneset 2. This may be in % or engineering units as set by the parameter PB.UNT. **Default: 20.0%**	L3 R/W
TI2	INTEGRAL TIME 2	360		The integral time in seconds for tuneset 2. Set to 0 to disable integral action. **Default: 360 seconds**	L3 R/W
TD2	DERIVATIVE TIME 2	60		The derivative time in seconds for tuneset 2. Set to 0 to disable derivative action. **Default: 60 seconds**	L3 R/W
CBH2	CUTBACK HIGH THRESHOLD 2	Auto	0	Defines a High Cutback threshold, for tuneset 2, in the same units as the proportional band (either engineering units or percent of span, depending on configuration)	L3 R/W
CBL2	CUTBACK LOW THRESHOLD 2	Auto	0	Defines a Low Cutback threshold, for tuneset 2, in the same units as the proportional band (either engineering units or percent of span, depending on configuration).	L3 R/W
MR2	MAN RESET 2	0.0 to 100.0% (heat only) -100.0 to 100.0% (heat/cool)		Manual reset for tuneset 2. This parameter only appears if the control algorithm is PID or VPU, AND the integral time is set to 0 (Off). It is used to manually adjust the output power to offset any for any difference between SP and PV. See also "Manual Reset (PD Control)" on page 245.	L3 R/W
OP HI2	OUTPUT HIGH 2	100.0		Gain scheduled output upper limit for tuneset 2. Range between +100.0% to OP.LO 2	L3 R/W
OP LO2	OUTPUT LOW 2	-100.0		Gain scheduled output lower limit for tuneset 2. Range between −100.0% and OP.HI 2.	L3 R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v		Description to change values (if read/write, R/W)	Access
HYS2.H	CH1 ON/OFF HYSTERESIS 2	OFF 1 to 99999	0	On-Off Hysteresis for channel 1/heat, for tuneset 2. This is set in the units of the PV. It defines the point below setpoint where the channel 1 output will turn on. The output will turn off when the PV is at setpoint. The hysteresis is used to minimise the chattering of the output at the control setpoint. If the hysteresis is set to 0 then even the smallest change in the PV, when at setpoint, will cause the output to switch. The hysteresis should be set to a value which provides an acceptable life for the output contacts, but which does not cause unacceptable oscillations in the PV. If this performance is unacceptable, it is recommended that PID control with a time proportioning output is used. **Default: 10**	
HYS2.C	CH 2 ON/OFF HYSTERESIS 2	OFF 1 to 99999	0	On-Off Hysteresis for channel 2/cool, for tuneset 2. This parameter is only available if channel 2 (cool) is configured for On/OFF control. It sets a second value of the hysteresis, for tuneset 2, between the output being on and the output being off. The comments above are also applicable to this parameter. **Default: 10**	L3 R/W

A further description of the above parameters is given in "Control" on page 241.

OP Sub-list

The output sub-list is used to display and set the output parameters. For further descriptions of parameters see "Control" on page 241.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FLBK V	FALLBACK OUTPUT VALUE	0.0%		The Fallback Output Value is used in a number of circumstances: • If the PV status goes bad (e.g. sensor break), the loop will enter Forced Manual mode (F_Man) with either the fallback value or the last good output. This depends on the configured PV Bad Transfer type. • If Forced Manual (F_Man) mode is actived by an external signal (e.g. a process alarm) then the fallback output value is always applied. • If the Recovery Mode is configured as 'ManualModeFallbackOP', then the controller will always start up in Manual mode with the fallback output value. This is also true when exiting Instrument Config or Standby modes.	Conf R/W
OUT HI	OUTPUT HIGH LIMIT	100.0% to - 100.0%		Maximum output power delivered by channels 1 and 2. By reducing the high power limit, it is possible to reduce the rate of change of the process, however, care should be taken as reducing the power limit will reduce the controllers ability to react to disturbances. Range between Output Lo and 100.0%. This parameter does not affect the Fallback Value being achieved in Manual mode. **Default: 100**	L3 R/W
OUT LO	OUTPUT LOW LIMIT	- 100.0% to 100.0%		Minimum (or maximum negative) output power delivered by channels 1 and 2. Range between Output Hi and −100.0% **Default: 0**	L3 R/W
H OUT	CHANNEL 1 OUTPUT	0.0 to 100.0%		The current value of channel 1 output demand. Channel 1 (Heat) output. The Ch1 output is the positive power values (0 to Output Hi) used by the heat output. Typically this is wired to the control output (time proportioning or DC output). Range between Output Hi and Output Lo	R/O
C OUT	CHANNEL 2 OUTPUT	-0.0 to - 100.0%		The current value of channel 2 output demand. The Ch2 output is negative portion of the control output (0 – Output Lo) for heat/cool applications. It is inverted to be a positive number so that it can be wired into one of the outputs (time proportioning or DC outputs). Range between Output Hi and Output Lo	R/O. Shown only if Channel 2 is configured
MAN OP	MANUAL OUTPUT VALUE	0.0 to 100.0%		The output value when in manual or forced manual modes	R/O
TRK OP	OUTPUT TRACK VALUE	- 100.0% to 100.0%		This value will be used as the output when in track mode	L3 R/W
CH2 DB	CHANNEL DEADBAND	OFF or 0.0 to 100.0%	0	The Ch1/Ch2 Deadband is a gap in percent between output 1 going off and output 2 coming on and vice versa. For on/off control this is taken as a percentage of the hysteresis.	L3 R/W. Not applicable to VPU outputs.
OP UP	OUTPUT RATE UP	OFF	0	Increasing output rate limit %/second. Limits the rate at which the output from the PID can change. Output rate limit can be useful in helping to prevent rapid changes in output from damaging the process or the heater elements. However, it should be used with care since the higher setting could significantly affect the process performance. Range OFF or 0.1%/Sec to display range.	L3 R/W. Not applicable to VPU outputs.
OP DWN	OUTPUT RATE DOWN	OFF	0	Decreasing output rate limit %/second. Comments listed for Output Rate Up apply.	L3 R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
OP.DIS	DISABLE OUTPUT RATE LIMITS			When an output rate limit has been configured, this input can be used as part of the strategy to temporarily disable rate limiting.	Conf R/W if OP.UP or OP.DWN is enabled
		No	0	Enable	
		YES	1	Disable	
PWR.FF	POWER FEEDFORWARD	OFF	0	Power Feedforward is a feature which monitors the line voltage and adjusts the output signal to compensate for fluctuations before they affect the process temperature. It is assumed that the supply to the controller is the same as the supply to the load.	Conf R/W L3 R/O Not applicable to VPU outputs.
		On	1		
C.DB	CHANNEL 2 DEADBAND			Ch1/Ch2 De22.0adband is a gap in percent between output 1 going off and output 2 coming on and vice versa. For on/off control this is taken as a percentage of the hysteresis.	L3 R/W. Not applicable to VPU outputs.
NLIN.C	NON-LINEAR COOLING			Channel 2 non-linear cooling algorithm. Selects the type of cooling channel characterisation to be used.	Conf R/W. L3 R/O Not applicable to VPU outputs.
		OFF	0	No non-linear cooling algorithm used. Ch2 output will be linear.	
		Oil	1	Often used in an extruder to provide cooling using oil	
		H2O	2	Often used in an extruder to provide flash cooling using water	
		FAn	3	Often used in an extruder to provide on/off cooling using air or an analogue output to a VFD driving fan	
STEP.V	MANUAL STEP VALUE			If the Manual Transfer type has been configured as 'Step' then this value will be applied to the output on the transition from Auto to Manual.	R/O
TT.H	CH1 VALVE TRAVEL TIME	22.0		The valve travel time in seconds for the channel 1 output. This parameter must be set if the Ch1 Control Type is set to VP. The valve travel time is the time taken for the valve to move from fully-closed to fully-open. This must be the measured time to move from endstop to endstop. This not necessarily the time printed on the valve label. In a Heat/Cool application Channel 1 is the heat valve. **Default: 22.0**	L3 R/W. Only shown if Ch1 is VPU output.
TT.C	CH2 VALVE TRAVEL TIME			The valve travel time in seconds for the channel 2 output. This parameter must be set if the Ch2 Control Type is set to VP. The valve travel time is the time taken for the valve to move from fully-closed to fully-open. This must be the measured time to move from endstop to endstop. This not necessarily the time printed on the valve label. In a Heat/Cool application, Channel 2 is the cool valve. **Default: 22.0**	L3 R/W. Only shown if Ch2 is VPU output.
R.OP.HI	REMOTE OUTPUT HIGH LIMIT	100.0%		Can be used to limit the output of the loop from a remote source or calculation. **Default: 100.0**	L3 R/W
R.OP.LO	REMOTE OUTPUT LOWER LIMIT	-100.0%		Can be used to limit the output of the loop from a remote source or calculation. **Default: 0.0**	L3 R/W
R.OP.DI	DISABLE REMOTE OUTPUT LIMITS	No	0		L3 R/W
		YES	1	Disable remote output limits.	

Diagnostics Sub-list

The diagnostic list contains parameters which may be used for troubleshooting or may be soft wired as part of a control strategy.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
L.BRK.T	LOOP BREAK TIME	OFF	0	Sets the loop break time. This parameter, along with L.BRK.D, sets the condition for loop break detection. The loop break alarm attempts to detect loss of control in the control loop by checking the control output, the process value and its rate of change. Loop break detection works for all control algorithms: PID, VP and ON-OFF. Note: This is not to be confused with load failure and partial load failure.	Conf R/W
L.BRK.D	LOOP BREAK DELTA PV	10.0		If the controller output is saturated, this is the minimum change in PV that the system would expect to see in 2× loop break times. If the output is saturated and the PV has not moved by this amount in 2×LoopBreakTime then the loop break alarm will be activated. **Default: 10.0**	Conf R/W
L.BRK	LOOP BREAK DETECTED	No	0		R/O
		YES	1	This flag indicates the a loop break has been detected	
DEMO	ENABLE DEMO MODE	OFF	0		Conf R/W
		On	1	Turns on the simulated plant for demonstration purposes.	
DEV	DEVIATION			This is the process deviation (sometimes called error). It is calculated as PV minus SP. Therefore, a positive deviation implies that the PV is above Setpoint, while a negative deviation implies that the PV is below Setpoint.	R/O
TGT.OP	TARGET OUTPUT			The requested control output. This is the output taken before rate any limiting.	R/O
W.OP.HI	WORKING HIGH OUTPUT LIMIT			This is the resolved upper output limit that is currently in use. It is derived from the gain scheduled limit, the remote limits and the global limits	R/O
W.OP.LO	WORKING LOW OUTPUT LIMIT			This is the resolved lower output limit that is currently in use. It is derived from the gain scheduled limit, the remote limits and the global limits	R/O
P.TERM	PROPORTIONAL OUTPUT TERM			This is the output contribution from the proportional term. This diagnostic is not available for VP.	R/O
I.TERM	INTEGRAL OUTPUT TERM			This is the output contribution from the integral term. This diagnostic is not available for VP.	R/O
D.TERM	DERIVATIVE OUTPUT TERM			This is the output contribution from the derivative term. This diagnostic is not available for VP.	R/O
L.VOLT	MEASURED LINE VOLTAGE			This is the line voltage measured by the instrument (in volts). This is the value used for Power Feedforward if enabled.	R/O
W.PB.H	SCHEDULED CH1 PROP BAND			The currently active channel 1 proportional band.	R/O
W.PB.C	SCHEDULED CH2 PROPORTIONAL BAND			The currently active channel 2 proportional band.	R/O
W.TI	SCHEDULED INTERGRAL TERM	OFF	0	The currently active integral time.	R/O
W.TD	SCHEDULED DERIVATIVE TERM	OFF	0	The currently active derivative time	R/O
W.CBH	SCHEDULED CUTBACK HIGH	Auto	0	The currently active cutback high threshold.	R/O
W.CBL	SCHEDULED CUTBACK LOW	Auto	0	The currently active cutback low threshold.	R/O

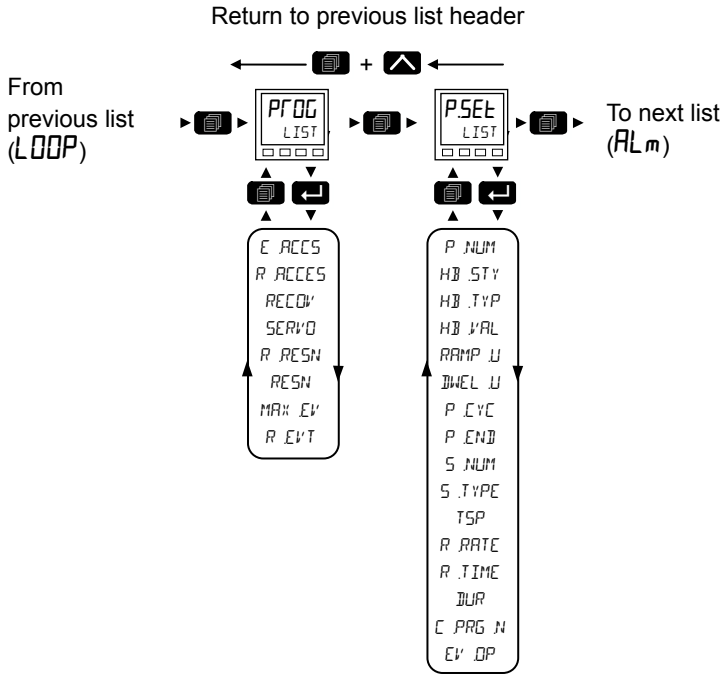
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
W_MR	SCHEDULED MANUAL RESET	OFF	0	The currently active manual reset value	R/O
AT_LIM	OUTPUT IS SATURATED	No	0		R/O
		YES	1	This flag will be asserted whenever the controller output is saturated (has hit a limit). This may be useful for a cascade strategy.	R/O
IN_HLD	HOLD MODE ACTIVE	No	0		R/O
		YES	1	Hold mode is active	R/O
IN_TRA	TRACK MODE ACTIVE	No	0		R/O
		YES	1	Track mode is active	R/O
IN_MAN	MAN OR F_MAN MODE SELECTED	No	0		R/O
		YES	1	Manual or F-mode selected	R/O
IN_AUT	AUTO OR F_AUTO MODE SELECTED	No	0		R/O
		YES	1	Auto mode is selected	R/O
N_REM	NOT REMOTE	No	0		R/O
		YES	1	When true, this flag indicates that the controller is not ready to receive a remote setpoint. Typically this is wired back to the Track output value of a cascade master, such that the master can track the slave SP if the slave is switched to local setpoint.	R/O
M_RDY	MASTER READY	No	0		R/O
		YES	1	When true, this flag indicates that the controller is not able to run as a cascade master. Typically this is wired to the RSP_En input of a cascade slave, such that the slave can control to a local setpoint if the master is taken out of Auto mode.	R/O

Programmer List (PROG)

In this list you set up the 'fixed' programmer conditions which are unlikely to change from program to program, that is, they are generally set once for a particular process.

The actual creation and editing of programs is done in the PROGRAM SETUP list which follows this section.

Access to the Programmer and Program Setup parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



For details of the programmer feature see "Programmer" on page 227.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
E ACCS	EDIT ACCESS	LEV1	0	This parameter sets the lowest HMI access level in which a program may be set up.	Conf R/W
		LEV2	1	**Default: Level 2**	
		LEV3	2		
		CONF	3		
R ACCES	RUN ACCESS	LEV1	0	This parameter sets the lowest HMI access level at which programs can be run, held or reset from the front panel.	Conf R/W
		LEV2	1	**Default: Level 2**	
		LEV3	2		

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
RECOV	RECOVERY STRATEGY			When a program is running and the power to the instrument is interrupted, the status of the program is retained during the power down period. Upon power being restored the programmer can be configured to recover the program as listed below.	Conf R/W
		rAmP	0	Upon recovery the programmer will servo the programmer setpoint to the current PV and then ramp to the target setpoint at the rate set prior to the power outage. Then depending on the current segment type, the ramping behaviour to the target setpoint (TSP) will be as follows: If the segment is a Ramp Rate then the time remaining for the segment will be recalculated using the rate prior to the power outage. If the segment is a Time to Target segment, the calculated ramp rate prior to power outage will be used. If the interrupted segment was a dwell, then the ramp rate will be determined by the previous ramp segment. On achieving the dwell setpoint, the dwell period will continue. If there is no previous ramp segment e.g. the interrupted segment is the first segment of a program, then the dwell will continue at the current programmer setpoint. **Default: Ramp**	
		rSEt	1	Reset. The process is aborted by resetting the program. All event outputs will take the reset state.	
		CONt	2	Continue. The program setpoint returns immediately to its last value prior to the power interruption or sensor break, then continues to dwell or ramp to the target setpoint at the ramp rate set for that segment. This may cause full power to be applied to the process for a short period to heat the process back to its value prior to the power outage.	
SERVO	SERVO TO	PV	0	The programmer setpoint (PSP) will start at the current level of the process variable input (PV input) **Default: PV**	Conf R/W
		SP	1	The programmer setpoint (PSP) will start at the setpoint input (SP input)	
R RESN	RAMP RATE RESOLUTION			Configures the display resolution of segment ramp rate parameters when read/written via scaled integer comms.	Conf R/W
		nnnnn	0	No decimal places	
		nnnn.n	1	One decimal place. **Default: nnnn.n**	
		nnn.nn	2	Two decimal places	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	
RESN	PROGRAM RESOLUTION			Configures the time resolution of the segment time left and the program time left. When read/written via scaled integer comms, the time format displayed on the HMI is shown as: SEC will be MM:SS MIN will be HH:MM HOUR will be HHH.H	Conf R/W
		SEC	0	Seconds **Default: Seconds**	
		mIn	1	Minutes	
		HOur	2	Hours	
MAX EV	MAX EVENTS	0 to 8		Configures the maximum number of events which are available in the program **Default: 1**	Conf R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
R.EVT	RESET EVENT			This parameter sets which event outputs are to be turned on when the program is in its reset state. This is a bit field where the decimal value entered into the HMI converts to binary, as shown in the table below, to determine which events are turned on. For example, set the value to 15 to turn on event outputs 1,2, 3,and 4 in reset. If iTools is used to set the event outputs it is only necessary to tick which events are to be switched on in a segment, see "Event Outputs" on page 189. **Default: 0 (all off)**	

Enable block number								
8	7	6	5	4	3	2	1	Value
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4
0	0	0	0	0	1	0	1	5
0	0	0	0	0	1	1	0	6
0	0	0	0	0	1	1	1	7
0	0	0	0	1	0	0	0	8
0	0	0	0	1	1	1	1	15
0	0	0	1	1	1	1	1	31
0	0	1	1	1	1	1	1	63
0	1	1	1	1	1	1	1	127
1	1	1	1	1	1	1	1	255

Note: A running program shows further parameters in Operator Levels 1 and 2. These are shown in sections "Level 1 Programmer Display" on page 73 and "Level 2 Operator Parameters" on page 75.

Program Setup List (P.SEt)

The Program setup list allows you to set up and edit the profiles of one to ten stored programs and the profile of the currently running program. The list, therefore, has one instance and multiple numbered sub lists.

Access to the Program Setup parameter list is summarised in section "Programmer List (PROG)" on page 125.

See also "Programmer" on page 227 for further details of the programmer feature.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
P NUM	PROGRAM NUMBER	1 to 10		Select the program number to configure or to run. The parameters which follow apply to the selected program number. **Default: 1**	L3 R/W
HB STY	HOLDBACK STYLE			To set the holdback style	L3 R/W
		PrOG	0	Holdback is applied to the whole program. **Default: Programmer**	
		SEGm	1	Holdback is applied to every segment	
HB TYP	HOLDBACK TYPE	OFF	0	Holdback is disabled. This parameter is shown only if Holdback style = PrOG. **Default: Off**	L3 R/W
		Low	1	Holdback is entered when the PV is lower than the Program Setpoint minus Holdback Value..	
		HiGH	2	Holdback is entered when the PV is greater than the Program Setpoint plus Holdback Value..	
		bAnd	3	Holdback is entered when the PV is either greater than the Program Setpoint plus Holdback Value or lower than the Program Setpoint minus Holdback Value.	
HB VAL	HOLDBACK VALUE	0.0		To set the value at which holdback will be entered. This parameter is not shown if Holdback Type = OFF. **Default: 0.0**	L3 R/W
RAMP U	RAMP UNITS			Sets the units for segment ramp rate and ramp time values when read/written via scaled integer comms.	
		P.SEc	0	The setpoint will ramp at units per second **Default: Per second**	
		P.mIn	1	The setpoint will ramp at units per minute	
		P.Hr	2	The setpoint will ramp at units per hour	
DWEL U	DWELL UNITS			Sets the units for dwell duration values when read/written via scaled integer comms.	L3 R/W
		SECS	0	Each dwell period will be in seconds. **Default: Secs**	
		mINS	1	Each dwell period will be in minutes	
		HrS	2	Each dwell period will be in hours	
P CYC	PROGRAM CYCLES	CONt or 1 to 9999	0	The program will repeat continuously or for the set number of times. **Default: 1**	L3 R/W
P END	PROGRAM END TYPE	dwEL	0	At the end of the program the programmer setpoint (PSP) will dwell (remain) at its current value until manual intervention. **Default: Dwell**	L3 R/W
		rSEt	1	At the end of the program the programmer will go into reset state and the program setpoint will servo to either the PVInput or the SPInput depending on the ServoTo parameter value	
		trAck	2	At the end of the program the programmer setpoint (PSP) will dwell at its current value and the control loop will be placed in Track mode.	

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
S.NUM	CURRNT SEGMENT NUMBER	1 to 25		This shows which segment number is currently running. The controller supports 24 segments plus an END segment	R/O
S.TYPE	SEGMENT TYPE	End	0	Program ends. **Default: End**	L3 R/W
		rAtE	1	Ramp to the target value using a configured ramp rate	
		tI mE	2	Ramp to the target value within a configured TimeToTarget value	
		dwEL	3	Dwell at the current programmer setpoint (PSP) for a configured time duration	
		StEP	4	Immediate change of the programmer setpoint from the current value to the target setpoint value (followed by a 1s dwell period to allow event outputs to be triggered)	
		CALL	5	A call segment allows the main program to call another program as a subroutine. See also C.PRG.N below.	
TSP	TARGET SETPOINT			To set the level which the programmer setpoint (PSP) will reach at the end of the segment. **Default: 0.0**	L3 R/W
R.RATE	RAMP RATE			This applies if the Segment Type = 'rAtE' . It sets the ramp rate, in units/time, at which the programmer setpoint (PSP) is to change to reach the target setpoint (TSP). **Default: 0.1**	L3 R/W
R.TIME	TIME TO TARGET	00:00		This applies if the Segment Type = 'tI mE'. It sets the ramp time, which is the time it will take, in the selected segment, for the programmer setpoint (PSP) to move from the current level to the target setpoint (TSP). **Default: 0**	L3 R/W
DUR	DWELL DURATION	00:00		This applies if the segment type is Dwell. It sets the time for a soak period in that segment. **Default: 0.0**	L3 R/W
C.PRG.N	CALL PROGRAM	2 to 10		To select a program number to be run as a subroutine of the current program. The Call program number will be defaulted to the next higher program number, for example, when configuring a Call segment in Program 5, the Call Program Number will default to Program 6. Programs can only call program numbers greater than its own to prevent cyclic calls.	L3 R/W
EV.OP	EVENT OUTPUTS			This parameter sets which event outputs are to be turned on in a particular segment. This is a bit field where the decimal value entered into the HMI converts to binary, as shown in the table below, to determine which events are turned on. For example, set the value to 6 to turn on event outputs 2 and 3 in the selected segment. If iTools is used to set the event outputs it is only necessary to tick which events are to be switched on in a segment, see "Event Outputs" on page 189. **Default: 0 (all off)**	L3 R/W
When a segment has been set up the next segment will be selected and the above parameters will be repeated					

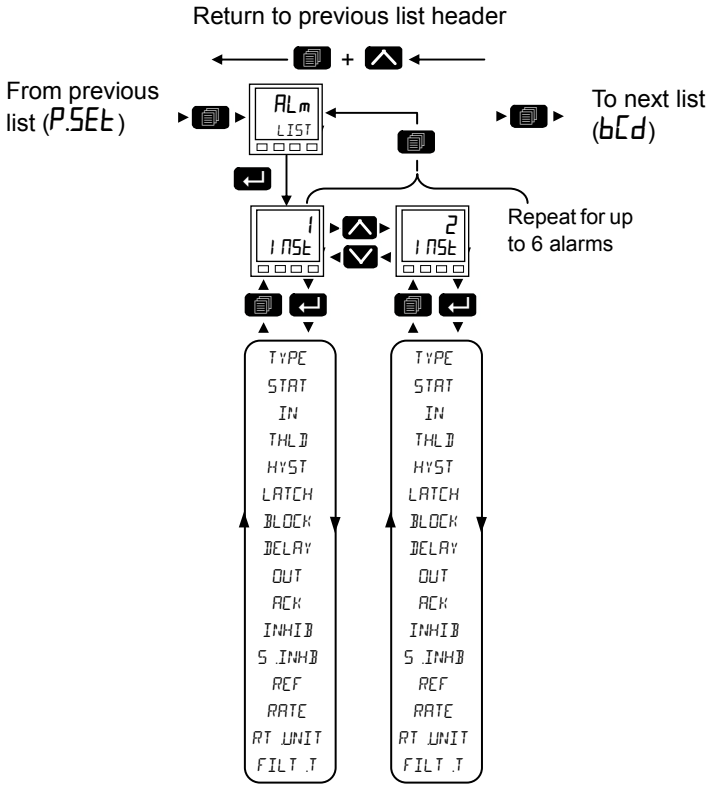
Enable block number								
8	7	6	5	4	3	2	1	Value
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
0	0	0	0	0	1	0	0	4
0	0	0	0	0	1	0	1	5
0	0	0	0	0	1	1	0	6
0	0	0	0	0	1	1	1	7
0	0	0	0	1	0	0	0	8
0	0	0	0	1	1	1	1	15

Enable block number								
8	7	6	5	4	3	2	1	Value
0	0	0	1	1	1	1	1	31
0	0	1	1	1	1	1	1	63
0	1	1	1	1	1	1	1	127
1	1	1	1	1	1	1	1	255

Alarms List (ALm)

See also Chapter "Alarms" on page 215 which describes alarm features.

Access to the Alarms parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



The following parameters are available in the Alarms Menu.

Parameter Mnemonic Press ↵ to select in turn	Parameter Description	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
INST	ALARM NUMBER	1 to 6		Up to 6 alarms may be configured. Select each alarm as required. The parameters in the following list apply to each alarm number.	L3 R/W Conf R/W
TYPE	ALARM TYPE	OFF	0	The alarm is disabled **Default: Off**	L3 R/O Conf RW
		AbS.H	1	The alarm is triggered when the input value becomes greater than the threshold.	
		AbS.L	2	The alarm is triggered when the input becomes less than the threshold	
		dEU.H	3	The alarm is triggered when the input becomes higher than the reference by the amount of the deviation.	
		dEU.L	4	The alarm is triggered when the input becomes lower than the reference by the amount of the deviation.	
		dEU.b	5	The alarm is triggered when the input differs from the reference by the amount of the deviation.	
		rrOC	6	The alarm is triggered when the input changes positively by more than a specified amount within a specified period (second, minute, hour). It will remain active until the input value's positive rate of change falls below the specified rate.	
		FrOC	7	The alarm is triggered when the input changes negatively by more than a specified amount within a specified period (second, minute, hour). It will remain active until the input value's negative rate of change falls below the specified rate.	
		di.H	8	The alarm is triggered when the input is equivalent to a Boolean '1' i.e. >=0.5	
		di.L	9	The alarm is triggered when the input is equivalent to a Boolean '0' i.e. < 0.5	
STAT	ALARM STATUS			This shows that the alarm is Off, Active, InactiveNotAcked or ActiveNotAcked.	R/O
		OFF	0	No alarm. Always shows 'Off' when the alarm is inhibited	
		Act	1	Active. The alarm is still present but has been acknowledged	
		InA	2	Inactive Not Acknowledged means that the alarm trigger source has returned to a non-alarm state, but the alarm is still active because it has not been acknowledged. applies to 'Auto' and 'Manual' latching alarms only,	
		AnA	3	Active not acknowledged means that the source is still active and the alarm has not been acknowledged.	
IN	INPUT			The value being monitored	R/O
THLD	THRESHOLD	1.0		For absolute alarms only, this is the trip point for the alarm. For absolute high alarms, if the input value exceeds the threshold value, then the alarm becomes active, and remains active until the input falls below the value (threshold − hysteresis). For absolute low alarms, if the input falls below the threshold value, then the alarm becomes active and remains active until the input rises above (Threshold + Hysteresis). **Default: 1.0**	L3 R/W Conf R/W
HYST	HYSTERESIS	0.0		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 help prevent alarm relay chatter. A value of 0.0 disables hysteresis. **Default: 0.0**	

Parameter Mnemonic Press ↵ to select in turn	Parameter Description	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
LATCH	LATCHING TYPE	nonE	0	No latching methodology i.e. when the alarm condition is removed the alarm will become inactive without being acknowledged. **Default: None**	L3 R/W Conf R/W
		AutO	1	The alarm will remain active until the alarm condition has been removed and the alarm has been acknowledged. The alarm can be acknowledged at any time after the alarm has become active.	
		mAn	2	The alarm will remain active until the alarm condition has been removed and the alarm has been acknowledged. The alarm can only be acknowledged after the alarm condition has been removed.	
		EVnt	3	Same as a non-latching alarm except the alarm is used as a trigger and therefore will not be announced.	
BLOCK	BLOCKING ENABLE	OFF	0	Blocking disabled **Default: Off**	L3 R/W Conf R/W
		On	1	Alarms with 'Block' set to 'On' are inhibited until the monitored value has entered the working condition after a start-up. This helps to prevent such alarms from becoming active whilst the process is brought into control. If a latching alarm is not acknowledged then the alarm is reasserted (not blocked), unless the alarm threshold or reference value is changed, in which case the alarm is blocked again.	
DELAY	DELAY	0.0 to 9999.9		Initiates a delay in seconds between the trigger source becoming active, and the alarm becoming active. If the trigger source returns to a non alarm state before the delay time has elapsed, then the alarm is not triggered and the delay timer is reset. A value of 0 turns off the delay timer. **Default: 0.0.**	L3 R/W Conf R/W
OUT	OUTPUT	OFF	0	Boolean output which is set to '1' when status is not 'off'	R/O
		ON	1		
ACK	ACKNOWLEDGE	no	0	Not acknowledged	L3 R/W Confi R/W
		YES	1	Select YES to acknowledge the alarm. The display then returns to No.	
INHIB	INHIBIT THE ALARM	OFF	0	Alarm not inhibited	L3 R/W Conf R/W
		On	1	When 'Inhibit' is enabled, the alarm is inhibited and Status is set to 'Off'. If the alarm is active when inhibit is enabled, then it becomes inactive until inhibit is disabled, when its status depends on its configuration. Similarly if the alarm trigger becomes active when the alarm is inhibited, the alarm remains 'off' until inhibit is disabled, when its status depends on its configuration. **Default: Off**	
S.INHB	INHIBIT IN STANDBY	OFF	0	When the instrument is in standby mode, the alarm will be inhibited if this parameter is On. **Default: Off**	L3 R/W Conf R/W
		On	1		
REF	REFERENCE	1		For deviation alarms only, this provides a 'centre point' for the deviation band. For 'deviation high' alarms, the alarm becomes active if the input rises above the value (Reference + Deviation) and remains active until the input falls below (Reference + Deviation - Hysteresis). For 'deviation low' alarms, the alarm becomes active if the input falls below the value (Reference - Deviation) and remains active until the input rises above (Reference - Deviation + Hysteresis). For 'deviation band' alarms, the alarm is active whenever the input lies outside the value (Reference ± Deviation) and remains active until the input returns to within the band, minus or plus Hysteresis as appropriate. **Default: 1.0** Note: If blocking is enabled, changing this parameter will activate alarm blocking. This includes when being wired to. You must ensure that the source value is not noisy, otherwise the alarm will always be blocked.Range −19999 to 99999	L3 R/W Conf R/W
DEV	DEVIATION	1		Used in deviation alarms. The deviation value added to or subtracted from the reference value at which the input is evaluated against. Range −19999 to 99999. **Default: 1.0**	L3 R/W Conf R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Description	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
RATE	RATE	1.00		For rate-of-change alarms only. The alarm becomes active if the input rises (Rising ROC) or falls (Falling ROC) at a rate that is greater than the specified 'Rate' per 'Rate Unit'. The alarm remains active until the rate of change falls below the set 'Rate'. Range −19999 to 99999 **Default: 1.0**	R/O Conf R/W
RT UNIT	RATE UNITS	SEc	0	The rate units, used in rate of change alarms, selects the units for the rate parameter in seconds, minutes or hours. **Default: Seconds**	L3 R/W Conf R/W
		mIn	1		
		Hr	2		
FILT.T	FILTER TIME	0.0		For rate-of-change alarms only. This allows a filter period (for the input) to be entered to reduce nuisance trips due to electrical signal noise, or if the rate of change is hovering around the trip value. Range 0.0 to 9999.9 seconds. **Default: 0.0**	L3 R/W Config RW

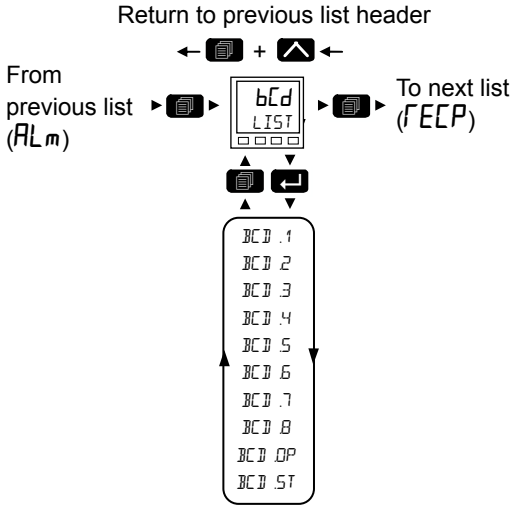
BCD List (bCd)

The BCD Input Function block takes eight digital inputs and combines them to make a single numeric value, typically used to select a program or a recipe.

The block uses 4 bits to generate a single digit.

Two groups of four bits are used to generate a two digit value (0 to 99)

Access to the BCD parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
bCd .1	bCd INPUT 1	OFF	0		L2 R/O Conf R/W
		On	1	Digital input 1	
bCd 2	bCd INPUT 2	OFF	0		
		On	1	Digital input 2	
bCd 3	bCd INPUT 3	OFF	0		
		On	1	Digital input 3	
bCd 4	bCd INPUT 4	OFF	0		
		On	1	Digital input 4	
bCd 5	bCd INPUT 5	OFF	0		
		On	1	Digital input 5	
bCd 6	bCd INPUT 6	OFF	0		
		On	1	Digital input 6	
bCd .7	bCd INPUT 7	OFF	0		
		On	1	Digital input 7	
bCd 8	bCd INPUT 8	OFF	0		
		On	1	Digital input 8	
bCd OP	bCd OUTPUT			Reads the value (in BCD) of the switch as it appears on the digital inputs. See the examples in the table below	read only
bCd ST	bCd SETTLE TIME	1.0 Range 0.0 to 10.0 seconds		As a BCD switch is turned from the current value to another, intermediate values may be seen on the output parameters of the block. These could cause issues in some applications. The Settle Time can be used to filter out these intermediate values by applying a settling period between the inputs changing and the converted values appearing at the outputs. **Default: 1s**	

in1	In2	In3	In4	In5	In6	In7	In8	BCD.OP
1	0	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0	9
0	0	0	0	1	0	0	1	90
1	0	0	0	1	0	0	1	91
1	0	0	1	1	0	0	1	99

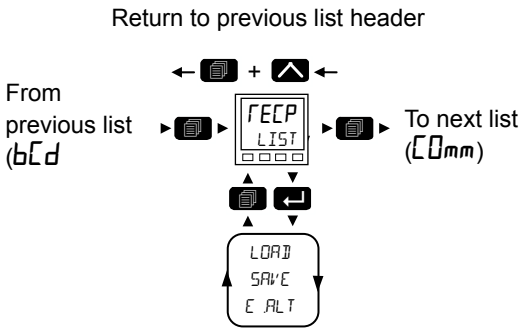
For BCD Switch wiring example, refer to "Example BCD Switch Wiring" on page 50.

Recipe List (rECP)

A recipe is a list of parameters whose values can be captured and stored in a dataset. This dataset can then be loaded into the controller at any time to restore the recipe parameters, thus providing a means of altering the configuration of an instrument in a single operation even in operator mode.

A maximum of 5 datasets are supported, referenced by its name, defaulted to be the dataset number i.e. 1…5

Access to the Recipe parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
LOAD	DATASET TO LOAD	NONE	0	Selects which recipe dataset to load. Once selected, the values stored in the dataset will be copied back over the active parameters. **Default: None**	
		1 to 5		Dataset 1 to 5	
		dONE	101	Load completed successfully	
		u.Suc	102	Dataset selection unsuccessful	
SAVE	DATASET TO SAVE	NONE	0	Selects which of the 5 recipe datasets in which to store the current active parameters. When selected, this parameter initiates a snapshot of the current parameter set into the selected recipe dataset.	
		1 to 5		Dataset 1 to 5	
		dONE	101	Save completed successfully	
		u.Suc	102	Unsuccessful will be displayed if the values were not saved successfully. If it completes OK, then the display does not change.	
E ALT	ENABLE ALTERABILITY CHECKS	YES	1	Enabled. Set to 'Yes' to check all parameters can be written in the current mode before loading a recipe dataset. **Default: Yes**	
		No	0	Disabled. Set to 'No' to write all parameters regardless of their 'config-only' status. See Note below	

Note: Changing configurations and certain parameters whilst in Operator mode can cause disturbances in the process and, therefore, by default, a dataset will not be loaded (no parameters written to) if a parameter contained in the recipe is not writeable in operator mode. To cater for users who require the loading to operate in a similar manner to the 3200 controller (no parameter checking), this functionality can be disabled. However, to reduce disturbances in the process, whilst loading a dataset which contains configuration parameters the Instrument will be forced into standby whilst the loading is in progress.

If the recipe load cannot be completed for any reason (values are invalid or out of range), the instrument will be half configured. The instrument will put itself into Standby and display the "REC.S - INCOMPLETE RECIPE LOAD" message. This will continue after a power cycle, but can be cleared by entering and exiting config mode.

There is no default list of parameters for the EPC3000 series. The parameters required to be held in recipe are defined using iTools, see "Recipes" on page 207.

To Save Recipes

1. Add your required parameters to the Recipe Definition list as described in "Recipe Definitions" on page 207
2. In the controller adjust any of the parameters in the above list (or in your customised list) as required for a particular process or batch.
3. Scroll to the Recipe List, and select 'DATASET TO SAVE'
4. Select a recipe number (1 to 5) in which to store the current parameter values. When the current values have been successfully saved the display will show dONE
5. Repeat the above for a second or subsequent process or batch and save under a different recipe number

To Load a Recipe

To recall a saved recipe

1. Scroll to the Recipe List, and select 'DATASET TO LOAD'
2. Select the required Recipe number. The display will flicker once to show that the selected recipe has been loaded

Notes: Recipes may be saved and recalled in Operator Levels 2, 3 and Configuration by default. It is also possible to Promote the Recipe parameters to Level 1 if required. This is done using iTools as explained in "Parameter Promotion" on page 203.

Notes: Recipes can also be saved and recalled using iTools as described in "Recipes" on page 207.

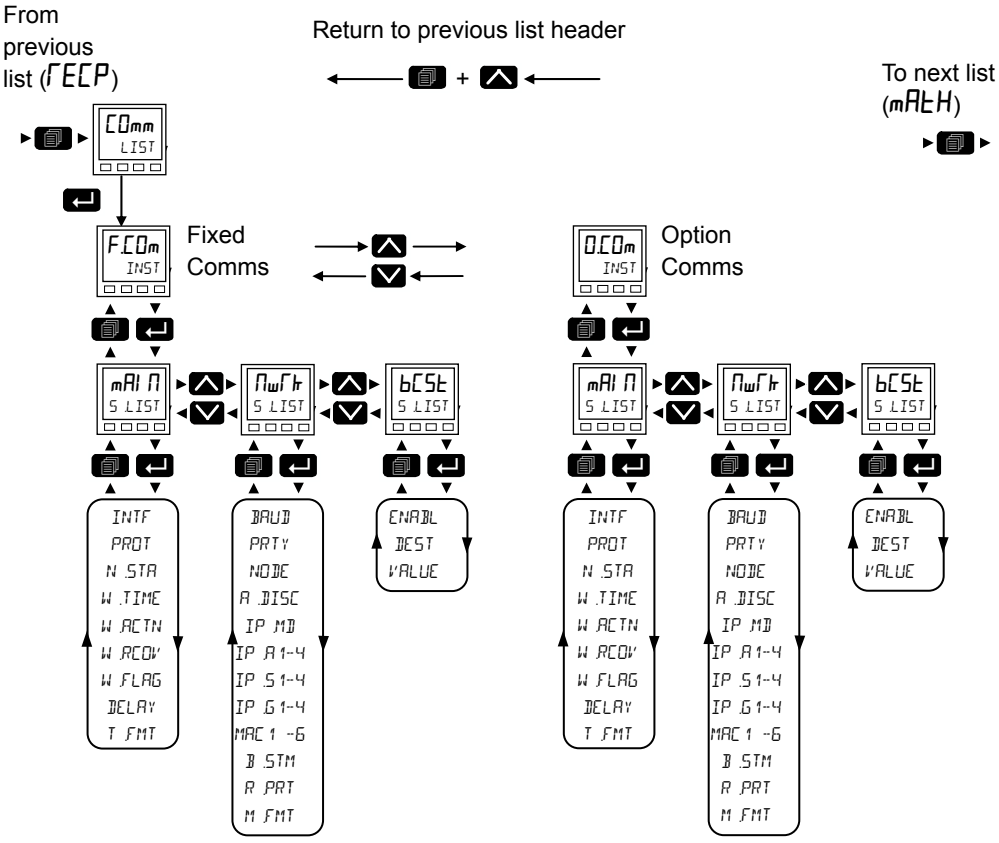
Communications List (COmm)

There are three communications ports available in EPC3000 series. These are:

- Configuration communication port accessed by the Config clip, see "Using the Configuration Clip" on page 182. The configuration communication port has fixed settings and is used in conjunction with iTools to configure the controller. No passcodes are required to place the controller into configuration mode via the CPI clip.
- Fixed communication port accessed via the rear terminal connections HD to HF. This supports the RS485 interface on EPC3008 and EPC3004. EPC3016 has no Fixed communication port but has an Option communication port (see below). The Fixed communications port is used, for example, to communicate with SCADA packages via Modbus RTU or EI-Bisynch protocols. It can also be used to configure the controller using iTools but passcodes are required to place the controller into configuration mode.
- Option communication port currently supports serial RS232, RS422, RS485 and Ethernet (RJ45) interfaces for the EPC3016 and Ethernet interface for the EPC3004 and EPC3008.

Communication settings for Fixed and Option communication ports, sometimes referred to as "User Comms", can be configured via the HMI and iTools using the Comms list. The Fixed and Option lists contain the same parameters, however some parameters may become available/unavailable depending on the interfaces and protocols selected

Access to the Digital Communications parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Main Sub List (mAIn)

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
INTF	INTERFACE			Communications interface. For the Fixed communication port, interface is set according to the hardware fitted. For the Option communication port, it is set according to the configured expected option board in the Instrument function block.	R/O
		nonE	0	No interface.	
		r485	1	EIA485 (RS485)	
		r232	2	EIA232 (RS232). EPC3016 option only.	
		r422	3	EIA422 (RS422). EPC3016 option only.	
		EtH	4	Ethernet (only shown if the Ethernet options is expected). See also section "Ethernet Protocol" on page 273.	
		rSP	7	Remote setpoint. In EPC3016 this enumeration will not be shown	
PROT	PROTOCOL			Protocol running on the comms interface	Conf R/W
		nonE	0	No protocol - when a serial interface is fitted. (No further parameters are shown) **Default: None serial**	
		mrtu	1	Modbus RTU (serial)	
		EI bS	2	EI-Bisynch	
		nonE	10	No protocol - when Ethernet interface is fitted **Default: Ethernet**	
		mtcP	11	Modbus TCP - only shown if the Ethernet option is fitted	
N.STA	STATUS			Status of the communications used by Modbus TCP	R/O
		OFFL	0	Offline and not communicating	
		InIt	1	Initialising communications	
		rdY	2	Ready to accept connection. Not used by Modbus TCP.	
		run	3	Ready to accept connections or controller communicating.	
The following 4 parameters configure the Comms Watchdog Strategy. Used by Modbus RTU and Modbus TCP					
W.TIME	WATCHDOG TIMEOUT	0.0		If the communications stop addressing the instrument longer than this configurable period, the Watchdog Flag will become active. Note: a value of 0 disables the watchdog. **Default: 0**	Conf R/W
W.ACTN	WATCHDOG ACTION	mAn	0	The Watchdog Flag may be cleared Automatically upon reception of valid messages or Manually by clearing the Watchdog Flag parameter. **Default: Manual**	Conf R/W
		Auto	1		
W.RCOV	WATCHDOG RECOVERY	0.0		This parameter is only shown when the Watchdog Action is set to Auto. It is a timer that determines the delay, after reception of valid messages recommences, before the Watchdog Flag is cleared. A value of 0 will reset the Watchdog Flag upon the first valid message received. Other values will wait for at least 2 valid messages to be received within the set time before clearing the Watchdog Flag. **Default: 0**	Conf R/W
W.FLAG	WATCHDOG FLAG	OFF	0	The Watchdog Flag will become active if the communications stop addressing the instrument longer than the Watchdog Timeout period,	L3 R/O
		On	1		
DELAY	DELAY	no	0	Introduces a delay between end of receive and beginning of transmit. This is sometimes necessary if the line transceivers require an extended time to switch to tristate. Comms delay is used by Modbus RTU and EI-Bisynch communication protocols. **Default: No**	Conf R/W
		YES	1		
T.FMT	TIME FORMAT	mSEC	0	Sets the resolution of time parameters on this communications port when read/written via scaled integer comms (Milliseconds, Seconds, Minutes, Hours) **Default: ms**	L3 R/W
		SEC	1		
		mIn	2		
		HOur	3		

Network Sub List (nwrk)

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
The first three parameters apply to Modbus and EI-Bisynch Communications protocols					
BAUD	BAUD RATE			Baud rate of the network communications	
		19k2		**Default for ModbusRTU**	
		9600		**Default for EI-bisynch**	
		4800		Applies to EI-Bisynch protocol only	
PRTY	PARITY			Parity of the network communications **Default: None**	
		NONE	0	No parity	
		EVEN	1	Even parity	
		Odd	2	Odd parity	
NODE	NODE ADDRESS	1 to 254		The address used by the instrument to identify itself on the network. **Default: 1**	
The following parameters apply to Ethernet in the Option Communications sub-list. See also section "Ethernet Protocol" on page 273.					
A.DISC	AUTO DISCOVERY			The controller and iTools software supports automatic discovery of MODBUS TCP enabled instruments. **Default: Off**	Conf R/W
		OFF	0	For cyber security reasons the auto discovery feature is turned OFF by default	
		On	1	To enable this feature set this parameter to ON. Please ensure that your network interface card is set to local. If, for any reason, the controller is not auto-detected and Wi-Fi is enabled on your PC, turn off Wi-Fi and re-start iTools.	
IP MD	IP MODE	StAt	0	Static. The IP address, subnet mask and default gateway are set manually. **Default: Static**	Conf R/W
		dHCP	1	DHCP. The IP address, subnet mask and default gateway are supplied by a DHCP server on the network.	
IP A1	IP ADDRESS 1			1st byte of the IP Address: XXX.xxx.xxx.xxx. **Default: 192**	Conf R/W
IP A2	IP ADDRESS 2			2nd byte of the IP Address: xxx.XXX.xxx.xxx. **Default: 168**	Conf R/W
IP A3	IP ADDRESS 3			3rd byte of the IP Address: xxx.xxx.XXX.xxx. **Default: 111**	Conf R/W
IP A4	IP ADDRESS 4			4th byte of the IP Address: xxx.xxx.xxx.XXX. **Default: 222**	Conf R/W
IP S1	SUBNET MASK 1			1st byte of the Subnet Mask: XXX.xxx.xxx.xxx. **Default: 255**	Conf R/W
IP S2	SUBNET MASK 2			2nd byte of the Subnet Mask: xxx.XXX.xxx.xxx. **Default: 255**	Conf R/W
IP S3	SUBNET MASK 3			3rd byte of the Subnet Mask: xxx.xxx.XXX.xxx. **Default: 255**	Conf R/W
IP S4	SUB NET MASK 4			4th byte of the Subnet Mask: xxx.xxx.xxx.XXX. **Default: 0**	Conf R/W
IP G1	DEFAULT GATEWAY 1			1st byte of the Default Gateway: XXX.xxx.xxx.xxx. **Default: 0**	Conf R/W
IP G2	DEFAULT GATEWAY 2			2nd byte of the Default Gateway: xxx.XXX.xxx.xxx. **Default: 0**	Conf R/W
IP G3	DEFAULT GATEWAY 3			3rd byte of the Default Gateway: xxx.xxx.XXX.xxx. **Default: 0**	Conf R/W
IP G4	DEFAULT GATEWAY 4			4th byte of the Default Gateway: xxx.xxx.xxx.XXX. **Default: 0**	Conf R/W
MAC1	MAC 1			1st byte of the MAC address in decimal: XX:xx:xx:xx:xx:xx	Conf R/O
MAC2	MAC 2			2nd byte of the MAC address in decimal: xx:XX:xx:xx:xx:xx	Conf R/O
MAC3	MAC 3			3rd byte of the MAC address in decimal: xx:xx:XX:xx:xx:xx	Conf R/O
MAC4	MAC 4			4th byte of the MAC address in decimal: xx:xx:xx:XX:xx:xx	Conf R/O
MAC5	MAC 5			5th byte of the MAC address in decimal: xx:xx:xx:xx:XX:xx	Conf R/O
MAC6	MAC 6			6th byte of the MAC address in decimal: xx:xx:xx:xx:xx:XX	Conf R/O
B.STM	BROADCAST STORM	No	0	Broadcast storm active. If the reception rate of Ethernet broadcast packets rises too high, broadcast storm mode will become active and the reception of broadcast packets will be disabled until the rate drops.	R/O
		YES	1		

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
R PRT	RATE PROTECTION	no	0	Rate protection active. If rate at which Ethernet unicast packets are received becomes too high, the instrument will enter a special mode that slows down Ethernet processing to preserve core functionality.	R/O
		YES	1		
M FMT	MSGFORMAT			Defines the format of EI-Bisynch messages	
		FrEE	0	Messages are right aligned within 6 characters including padding spaces if necessary. For example, the value -3.45 will be represented as "-<space>3.45" **Default: Free**	
		FI Fm	1	Messages consist of 5 characters between 0 and 3 decimal places using zeroes as padding if necessary. Decimal point is replaced with minus symbol for negative values. For example, the value -5.30 will be represented as "05-30".	

Note: IP Addresses are usually presented in the form "xxx.xxx.xxx.xxx". Within the instrument each element of the IP Address is shown and configured separately.

Note: It is recommended that the communications settings for each instrument are set up before connecting it to any Ethernet network. This is not essential but network conflicts may occur if the default settings interfere with equipment already on the network. By default the instruments are set to a static IP address of 192.168.111.222 with a default subnet mask setting of 255.255.255.0.

Broadcast Sub List (bCSt)

Broadcast comms applies to serial Modbus only. In EPC3016 this requires the relevant option board to be fitted.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
ENABL	ENABLE	no	0	Broadcast comms not enabled **Default: No**	Conf R/W
		YES	1	Enable single value Modbus broadcast	
DEST	DESTINATION	0		If the Modbus broadcast facility is enabled, this address will be used as the destination register for the value to be written. For example, if the remote instrument requires a setpoint at register address 26 decimal, the parameter should be set to this value. **Default: 0**	Conf R/W
VALUE	BROADCAST VALUE	0		If the Modbus broadcast facility is enabled, this value will be sent to the slave devices, after being transformed into a 'scaled integer' 16 bit value. To use the feature, enable broadcast using BroadcastEnable, and wire any instrument value to this parameter. **Default: 0**	Conf R/W

Maths List (mAtH)

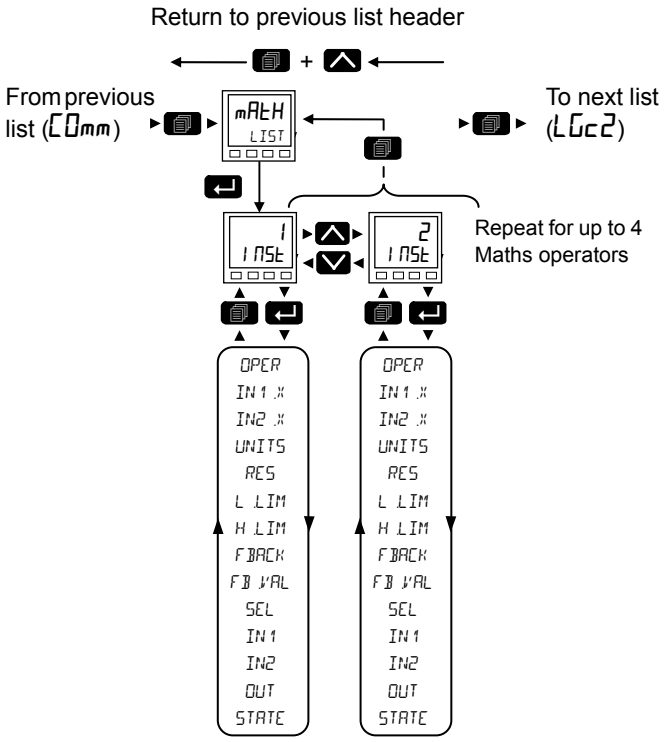
The Maths list is only available if the Toolkit option has been ordered.

Maths Operators (sometimes known as Analogue Operators) allow the controller to perform mathematical operations on two input values. These values can be sourced from any available parameter including Analogue Values, User Values and Digital Values. Each input value can be scaled using a multiplying factor or scalar.

The parameters to use, the type of calculation to be performed and the acceptable limits of the calculation are determined in Configuration level. In access level 3 the values of each of the scalars can be changed.

Up to four maths operators may be configured.

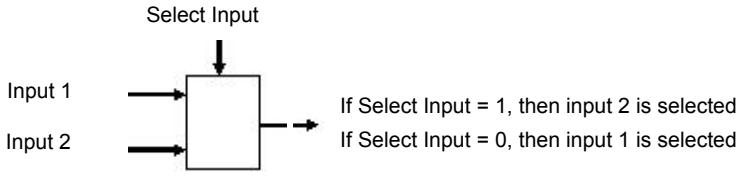
Access to the Maths parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
OPER	OPERATION	OFF	0	The selected analogue operator is turned off. **Default: Off**	Conf R/W L3 R/O
		Add	1	The output result is the addition of Input 1 and Input 2	
		Sub	2	Subtract. The output result is the difference between Input 1 and Input 2 where Input 1 > Input 2	
		mUL	3	Multiply. The output result is Input 1 multiplied by Input 2	
		di U	4	Divide. The output result is Input 1 divided by Input 2	
		AbSd	5	Absolute Difference. The output result is the absolute difference between Input 1 and Input 2.	
		SHi	6	Select Max. The output result is the maximum of Input 1 and Input 2	
		SLo	7	Select Min. The output result is the minimum of Input 1 and Input 2	
		H.SwP	8	HotSwap. Input 1 appears at the output provided input 1 is 'good'. If input 1 is 'bad' then input 2 value will appear at the output. An example of a bad input occurs during a sensor break condition.	
		SHLd	9	Sample and Hold. Normally input 1 will be an analogue value and input B will be digital. The output tracks input 1 when input 2 = 1 (Sample). The output will remain at the current value when input 2 = 0 (Hold). If input 2 is an analogue value then any non zero value will be interpreted as 'Sample'.	
		Pwr	10	The output is the value at input 1 raised to the power of the value at input 2, i.e. Input $1^{Input\ 2}$.	
		Sqrt	11	Square Root. The output result is the square root of Input 1. Input 2 has no effect.	
		LoG	12	The output is the logarithm (base 10) of Input 1. Input 2 has no effect	
		Ln	13	The output is the logarithm (base n) of Input 1. Input 2 has no effect	
		E	14	The output result is the exponential of Input 1. Input 2 has no effect	
		10	15	The output result is 10 raised to the power of Input 1 value. i.e. $10^{input\ 1}$. Input 2 has no effect	
		SEL	51	Select input is used to control which Analogue Input is switched to the output of the Analogue Operator. If the select input is true input 2 is switched through to the output. If false input 1 is switched through to the output. See "Select Input" on page 146.	
IN1.x	INPUT 1 SCALE	1.0		Input 1 scaling factor **Default: 1.0**	L3 R/W
IN2.x	INPUT 2 SCALE	1.0		Input 2 scaling factor **Default: 1.0**	L3 R/W
UNITS	OUTPUT UNITS			See section "Units" on page 95 for a list of units used throughout	Conf R/W
RES	OUTPUT RESOLUTION			Resolution of the output value.	Conf R/W L3 R/O
		nnnnn	0	No decimal places. **Default: nnnnn**	
		nnnn.n	1	One decimal place	
		nnn.nn	2	Two decimal places	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	
L LIM	OUTPUT LOW LIMIT	-999		To apply a low limit to the output. **Default: -999**	Conf R/W
H LIM	OUTPUT HIGH LIMIT	9999		To apply a high limit to the output **Default: 9999**	Conf R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FBACK	FALLBACK STRATEGY			The fallback strategy will come into effect if the status of the input value is bad or if the input value is outside the range of Input Hi and Input Lo.	Conf R/W
		CbAd	0	If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Bad'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value. **Default: Cbad**	
		CGd	1	If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Good'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value.	
		FbAd	2	If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Bad'.	
		FGd	3	If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Good'	
		uAd	4	If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'High Limit'.	
		dbAd	6	If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'Low Limit'.	
FB VAL	FALLBACK VALUE	0.0		Defines (in accordance with Fallback) the output value when fallback strategy is active. **Default: 0**	Conf R/W
SEL	SELECT	IP1	0	Select between input 1 and Input 2	R/O
		IP2	1		
IN1	INPUT 1 VALUE	0		Input 1 value (normally wired to an input source). Range −99999 to 99999 (decimal point depends on resolution)	L3 R/W
IN2	INPUT 2VALUE	0		Input 2 value (normally wired to an input source). Range −99999 to 99999 (decimal point depends on resolution)	L3 R/W
OUT	OUTPUT VALUE			The analogue value of the output, Between high and low limits	R/O
STATE	STATUS			This parameter is used in conjunction with Fallback to indicate the status of the operation. Typically, it is used to flag the status of the operation and used in conjunction with the fallback strategy. It may be used as an interlock for other operations.	R/O
				See section "Status" on page 96 for a list of enumerated values	

Select Input



Logic Operator List (LGC2)

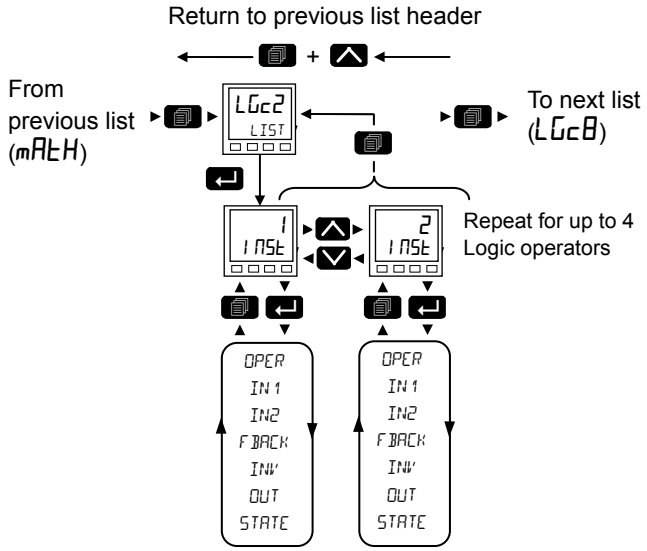
The Logic Operator is only available if the toolkit option has been ordered.

The two-input Logic Operator allows the controller to perform logical calculations on two input values. These values can be sourced from any available parameter including Analogue Values, User Values and Digital Values.

Up to four Logic Operators may be configured.

The parameters to use, the type of calculation to be performed, invert the input value and 'fallback' type are determined in Configuration level. In levels 1 to 3 you can view the values of each input and read the result of the calculation.

Access to the Logic Operator parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ∧ or ∨ to change values (if read/write, R/W)		Description	Access
OPER	OPERATION	OFF	0	The selected logic operator is turned off **Default: Off**	Conf L3 R/O
		AND	1	The output result is ON when both Input 1 and Input 2 are ON	
		OR	2	The output result is ON when either Input 1 or Input 2 is ON	
		E.OR	3	Exclusive OR. The output result is true when one and only one input is ON. If both inputs are ON the output is OFF.	
		LTCH	4	Input 1 sets the latch, Input 2 resets the latch.	
		EQL	5	Equal. The output result is ON when Input 1 = Input 2	
		NEQL	6	Not equal.The output result is ON when Input 1 ≠ Input 2	
		GT	7	Greater than. The output result is ON when Input 1 > Input 2	
		LT	8	Less than. The output result is ON when Input 1 < Input 2	
		GTEQ	9	Greater than or equal. The output result is ON when Input 1 ≥ Input 2	
		LTEQ	10	Less than or equal. The output result is ON when Input 1 ≤ Input 2	
IN1	INPUT 1	0		Normally wired to a logic, analogue or user value. May be set to a constant value if not wired.	L3
IN2	INPUT 2				

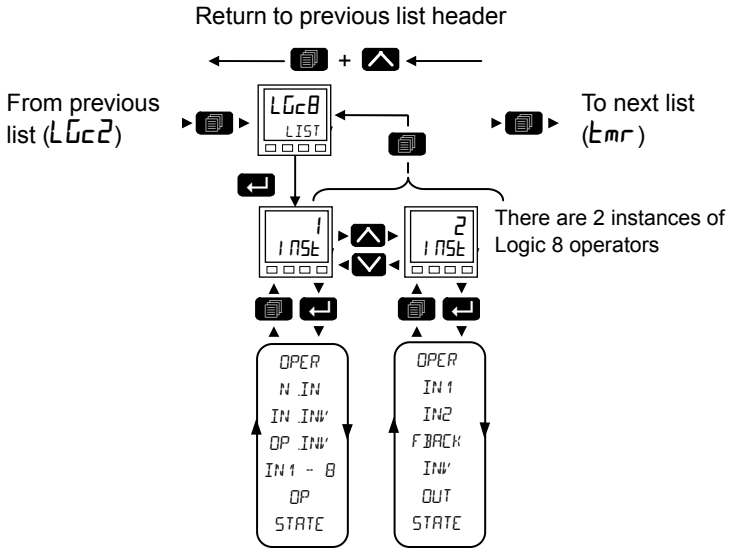
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FBACK	FALLBACK TYPE	FbAd	0	The output value is FALSE and the status is BAD. **Default: Fbad**	Conf L3 R/O
		tbAd	1	The output value is TRUE and the status is BAD	
		FGd	2	The output value is FALSE and the status is GOOD	
		tGd	3	The output value is TRUE and the status is GOOD.	
INV	INVERT	nonE	0	The sense of the input value, may be used to invert one or both of the inputs **Default: None**	Conf L3 R/O
		In1	1	Invert input 1	
		In2	2	Invert input 2	
		both	3	Invert both inputs	
OUT	OUTPUT	On	1	The output from the operation is a boolean (true/false) value.	R/O
		OFF	0		
STATE	OUTPUT STATUS			The status of the result value (good/bad). See section "Status" on page 96 for a list of enumerated values.	R/O

8 Input Logic Operator List (LGC8)

The 8 Input Logic Operator is only available if the toolkit option has been ordered.

The eight input Logic Operator only appears if the function has been enabled, and allows the controller to perform logical calculations on up to eight input values. These values can be sourced from any available parameter including Analogue Values, User Values and Digital Values. Up to two eight input logic operators are available.

Access to the 8 Input Logic Operator parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
OPER	OPERATION	OFF	0	Operator is turned off. **Default: Off**	Conf R/W L3 R/O
		And	1	Output is ON when ALL inputs are ON	
		Or	2	Output is ON when one or more of the 8 inputs are ON	
		E.Or	3	Exclusive OR. The output is based on the inputs being cascaded XOR'd together (True logical XOR equation) i.e. Cascading XOR performs an odd parity function, so if an even number of inputs are on, the output is off. If and odd number of inputs are on, the output is on.	
N IN	NUMBER OF INPUTS	2 to 8		This parameter is used to configure the number of inputs for the operation. **Default: 2**	Conf R/W L3 R/O
IN INV	INVERT INPUTS	0 to 255		Invert selected inputs. This is a status word with one bit per input. 0x1 - input 1 0x2 - input 2 0x4 - input 3 0x8 - input 4 0x10 - input 5 0x20 - input 6 0x40 - input 7 0x80 - input 8	L3 R/W

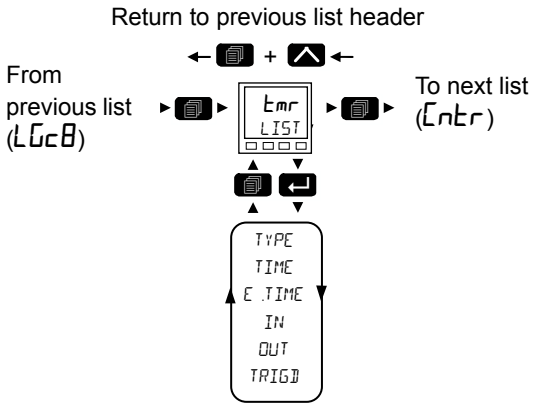
Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
OP INV	INVERT OUTPUT	No	0	Output not inverted **Default: No**	L3 R/W
		YES	1	Output inverted	
IN1 to IN8	INPUT1 to INPUT8			Normally wired to a logic, analogue or user value. All values are interpreted as follows: <0.5 = Off, >=0.5 = On May be set to a constant value if not wired.	L3 R/W
		OFF	0	Input is false	
		On	1	Input is true	
OP	OUTPUT	OFF	0	Output result of the operator (output not activated)	R/O
		On	1	Output result of the operator (output activated)	

Timer List (tmr)

The Timer list is only available if the Toolkit option has been ordered.

EPC3000 series contains one timer function block which can be configured from this list.

Access to the Timer parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.

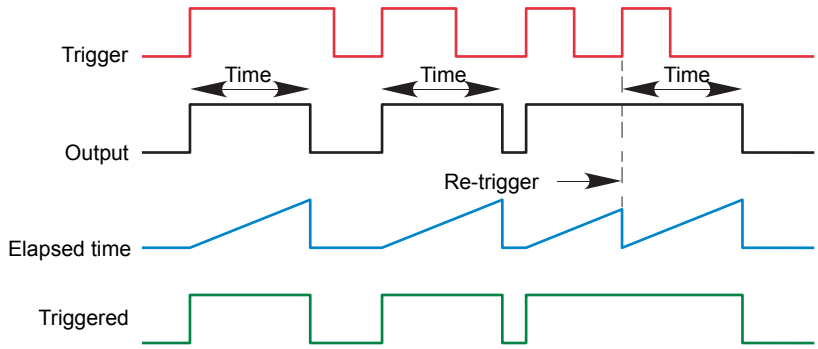


Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
TYPE	TYPE	OFF	0	Timer not activated. **Default: Off**	Conf R/W
		OnPS	1	On Pulse. Generates a fixed length pulse from an edge trigger	
		On.d	2	On delay. Provides a delay between input trigger event and timer output	
		OnE.S	3	One shot. Simple oven timer which reduces to zero before switching off	
		mi n.O	4	Minimum on time. Compressor timer so that the output remains ON for a time after the input signal has been removed	
TIME	TIME	00:00		Duration of the timer. For re-trigger timers this value is entered once and copied to the time remaining parameter whenever the timer starts. For pulse timers the time value itself is decremented. Range 00:00 to 999:59 minutes **Default: 0**	Conf R/W L3 R/W
E .TIME	ELAPSED TIME	00:00		Elapsed time. Range 00:00 to 999:59 minutes	R/O
IN	INPUT	OFF	0	Trigger/Gate input. **Default: Off**	Conf R/W L3 R/W
		On	1	Turn On to start timing	
OUT	OUTPUT	OFF	0	Timer output is off	R/O
		On	1	Timer output is on	
TRIGD	TRIGGERED			This is a status output to indicate that the input to the timer has been detected	L3 R/O
		OFF	0	Not timing	
		On	1	Timer has been triggered and is operational.	

Timer Modes

On Pulse Timer Mode

Output goes ‘on’ as soon as the trigger input goes active, and remains on until the time period has elapsed. If the timer is re-triggered during the timing period, the timer restarts.



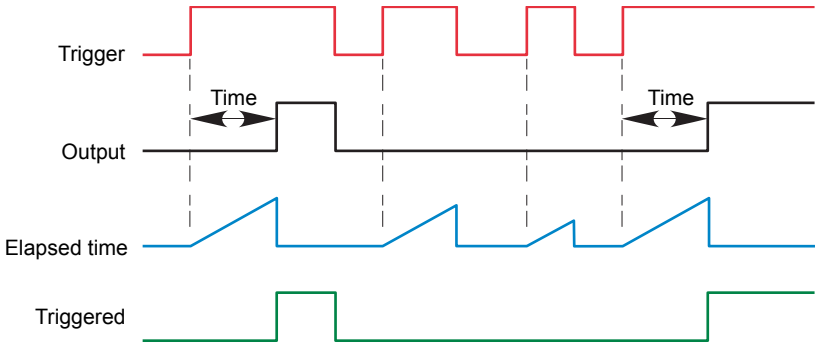
On Delay Timer Mode

Provides a delay between the trigger point and the timer output becoming active.

This type of timer is used to help ensure that the output is not set unless the input has been valid for a pre-determined period of time, thus acting as a kind of input filter.

Rules

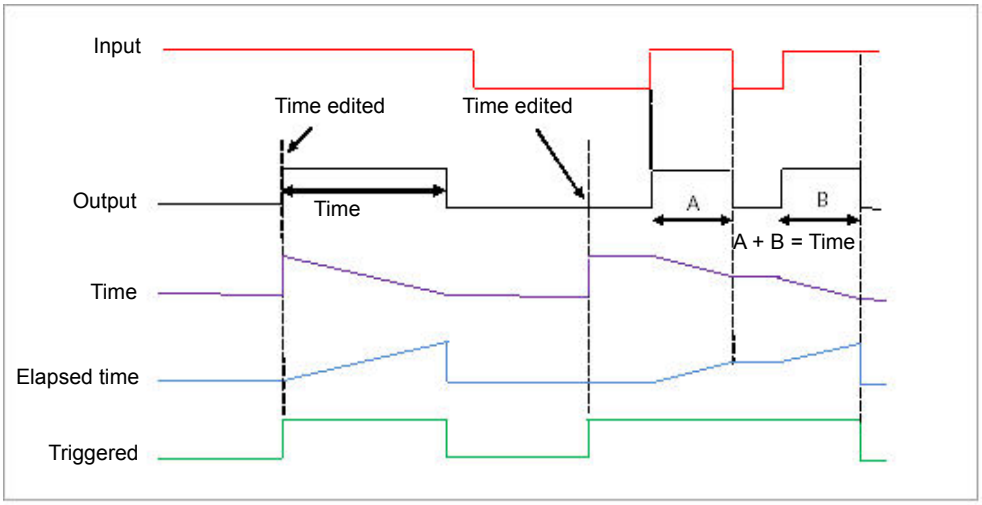
1. After the trigger goes active, the output switches on after the delay time has elapsed, and stays on until the trigger goes inactive.
2. If the trigger goes inactive before the delay time has elapsed, the output does not switch on.



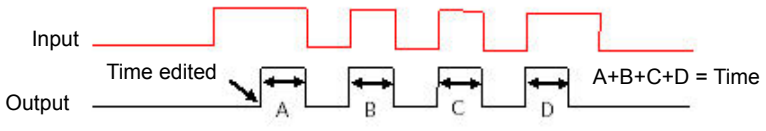
One Shot Timer Mode

- The Time value is decremented on each tick until it reaches zero. When the timer reaches zero the Output is cleared to OFF.
- The Time value can be edited at any instant to increase/decrease the duration of the On time.
- Once set to zero, the Time is not reset to a previous value, it must be edited by the operator to start the next On-Time.
- The input is used to gate the output. If the Input is set, the Time will count down to zero. If the Input is cleared to OFF, then the Time will Hold and the Output will switch OFF until the Input is next set.
- Since the Input is a Digital Wire, it is possible for the operator to NOT wire it, and set the Input value to ON which permanently enables the timer.
- The Triggered variable will be set to ON as soon as the Time is edited. It will reset when the Output is cleared to OFF.

The behaviour under different conditions is shown below



This diagram shows how the Input can be used to gate the Timer as a type of hold



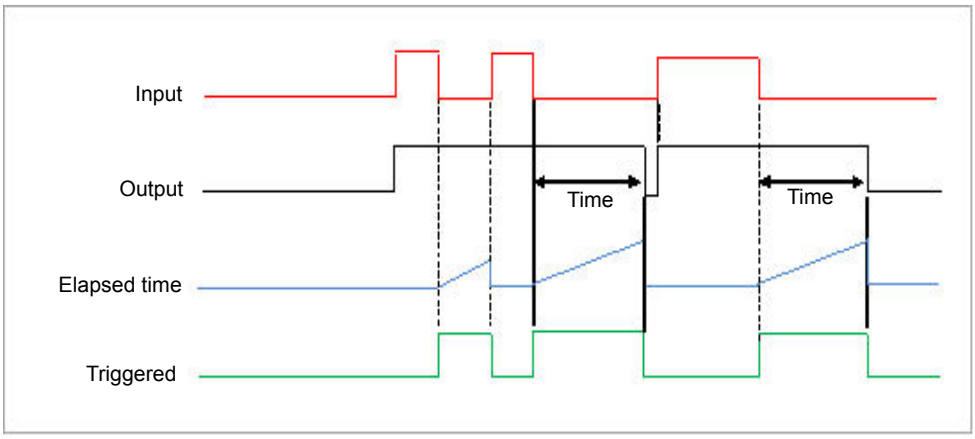
Minimum On Timer Mode or Compressor

The input goes active and remains on for a specified period after the input goes inactive.

It may be used, for example, to help ensure that a compressor is not cycled excessively.

- The output will be set to On when the Input changes from Off to On.
- When the Input changes from On to Off, the elapsed time will start incrementing towards the set Time.
- The Output will remain On until the elapsed time has reached the set Time. The Output will then switch Off.
- If the Input signal returns to On while the Output is On, the elapsed time will reset to 0, ready to begin incrementing when the Input switches Off.
- The Triggered variable will be set while the elapsed time is >0. It will indicate that the timer is counting.

The diagram illustrates the behaviour of the timer under different input conditions



Counter List (CntR)

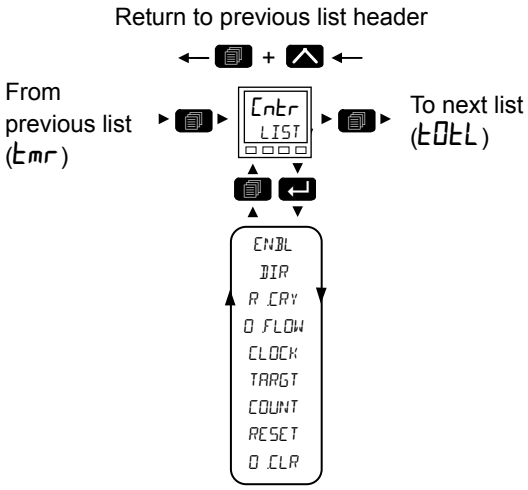
The counter list is only available if the Toolkit option has been ordered.

One counter function block is available in EPC3000 series.

Each time the 'Clock' input is triggered the 'Count' output is incremented by 1 for an Up Counter and decremented by 1 for a Down Counter. A target value can be set and when this is reached the Ripple Carry flag is set. This flag can be wired to operate an event or other output.

A simple wiring example is shown in the iTools chapter. "Graphical Wiring" on page 194.

Access to the Counter parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
ENBL	ENABLE	no	0	Count is frozen while Enable is FALSE **Default: No**	Conf R/W L3 R/W
		YES	1	Count responds to Clock events when Enable is TRUE	
DIR	DIRECTION OF COUNT	uP	0	Up counter. See note below. **Default: Up**	Conf R/W L3 R/W
		down	1	Down counter. See note below.	
R CRY	RIPPLE CARRY			Ripple carry is normally used to act as an enabling input to the next counter. However, in EPC3000 series only one counter is available. Ripple carry is turned On when the counter reaches the target set. This can be wired to operate an event or alarm or other function as required.	R/O
		OFF	0	Off	
		On	1	On	
O FLOW	OVERFLOW FLAG	no	0	Overflow flag is held true (Yes) when the counter reaches zero (Down) or passes target (Up)	R/O
		YES	1		
CLOCK	CLOCK	0 1		Clock input to counter. The counter will increment (for an UP Counter) on a positive going edge (FALSE to TRUE). This is normally wired to an input source such as a digital input.	Read only if wired
TARGT	COUNTER TARGET	0 to 99999		Level count to which the counter is aiming. **Default: 9999**	Conf R/W L3 R/W
COUNT	COUNT	0		Counts each time a clock input occurs until the target is reached. Range 0 to 99999.	R/O

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
RESET	COUNTER RESET	no	0	Counter not reset	Conf R/W L3 R/W
		YES	1	When the Reset is set TRUE, the Count is set to 0 in 'up' mode or to Target in 'down' mode. The Reset also clears the overflow flag.	
O.CLR	CLEAR OVERFLOW	no	0	Not cleared	Conf R/W L3 R/W
		YES	1	Clears the overflow flag	

Note: When configured as an Up counter, Clock events increment Count until reaching the Target. On reaching Target RippleCarry is set true. At the next clock pulse, Count returns to zero. Overflow is latched true and RippleCarry is returned false.

When configured as a down counter, Clock events decrement Count until it reaches zero. On reaching zero RippleCarry is set true. At the next clock pulse, Count returns to the Target count. Overflow is latched true and RippleCarry is reset false

Totaliser List (tOtL)

The Totaliser list is only available if the Toolkit option has been ordered.

A totaliser is an electronic integrator, primarily used to record the numeric total over time of a measured value that is expressed as a rate. For example, the number of litres (since reset), based on a flow rate in litres per minute.

One totaliser function block is available in EPC3000 series. A totaliser can, by soft wiring, be connected to any measured value. The outputs from the totaliser are its integrated value and an alarm state. The user may set a setpoint which causes the alarm to activate once the integration exceeds the setpoint.

The totaliser has the following attributes:-

1. Run/Hold/Reset

In Run the totaliser will integrate its input and continuously test against an alarm setpoint. The higher the value of the input the faster the integrator will run.

In Hold the totaliser will stop integrating its input but will continue to test for alarm conditions.

In Reset the totaliser will be zeroed, and alarms will be reset.

2. Alarm Setpoint

If the setpoint is a positive number, the alarm will activate when the total is greater than the setpoint.

If the setpoint is a negative number, the alarm will activate when the total is lower than the setpoint.

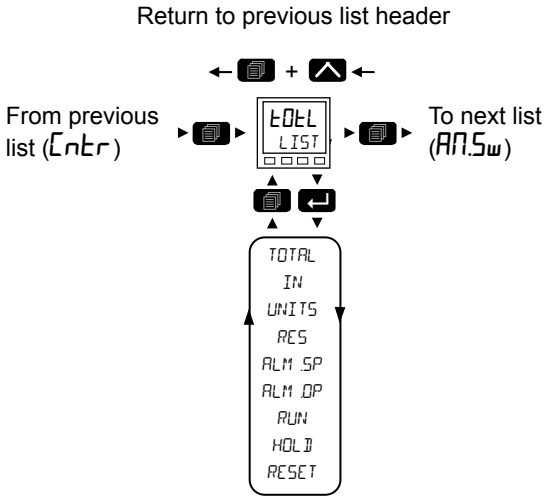
If the totaliser alarm setpoint is set to 0.0, the alarm will be off. It will not detect values above or below.

The alarm output is a single state output. It may be cleared by resetting the totaliser, stopping the Run condition, or by changing the alarm setpoint.

3. The total is limited to max and min 32-bit floating point values
4. The totaliser helps ensure that resolution is maintained when integrating small values onto a large total. However, very small values will not be integrated into a relatively very large value i.e. 0.000001 will not be integrated into 455500.0 this is due to the limitations of 32-bit floating point resolution.

One totaliser function block is available in EPC3000.

Access to the Totaliser parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
TOTAL	TOTAL OUTPUT	0		The totalised value.	L3 R/O
IN	INPUT	0.0		The value to be totalised. The totaliser stops accumulating if the input is 'Bad'	Conf R/W L3 R/W
UNITS	UNITS			See section "Units" on page 95 for a list of units used throughout	Conf R/W
RES	RESOLUTION	nnnnn	0	Totaliser resolution. **Default: nnnnn - no decimal places**	Conf R/W
		nnnn.n	1	One decimal place	
		nnn.nn	2	Two decimal places	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	
ALM .SP	ALARM SETPOINT	0.0000		Sets the totalised value at which an alarm will occur.	
ALM .OP	ALARM OUTPUT			This is a read only value which indicates the alarm output On or Off. The totalised value can be a positive number or a negative number. If the number is positive the alarm occurs when Total > Alarm Setpoint If the number is negative the alarm occurs when Total < Alarm Setpoint	Conf R/O L3 R/O
		OFF	0	Off	
		On	1	On	
RUN	RUN	no	0	Totaliser not running. See note below	Conf R/W
		YES	1	Select to run the totaliser	L3 R/W
HOLD	HOLD	no	0	Totaliser not in hold. See note below	Conf R/W
		YES	1	Holds the totaliser at its current value	L3 R/W
RESET	RESET	no	0	Totaliser not in reset	Conf R/W
		YES	1	Resets the totaliser	L3 R/W

Note: The Run & Hold parameters are designed to be wired to (for example) digital inputs. Run must be 'on' and Hold must be 'off' for the totaliser to operate.

8 Input Analogue MUX List (AN.Sw)

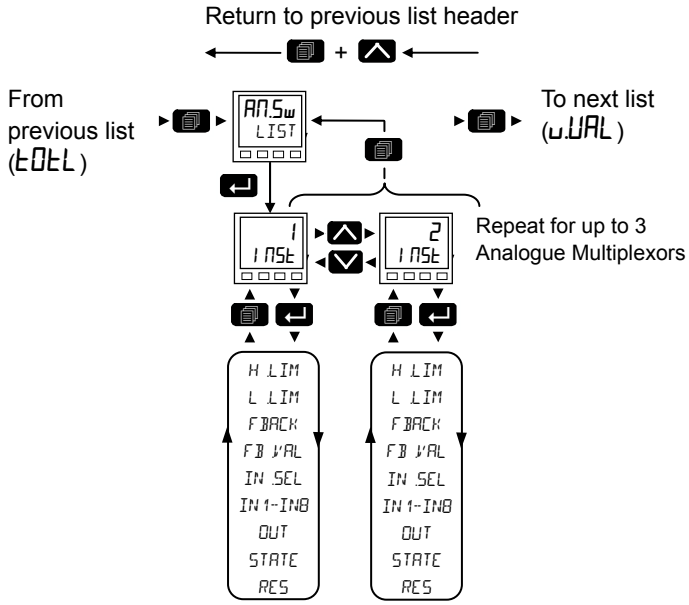
The Analogue Multiplexor list is only available if the Toolkit option has been ordered.

There are 3 instances of 8 Input Analogue Multiplexor (Switch).

The eight Input analogue multiplexors may be used to switch one of eight inputs to an output. It is usual to wire inputs to a source within the controller which selects that input at the appropriate time or event.

Access to the 8 Input Analogue Multiplexor parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.

The following parameters are available.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
H LIM	HIGH LIMIT	9999.0		The high limit for all inputs and the fall back value. Range Low Limit to Max 32-bit floating point value (decimal point depends on resolution). **Default: 9999**	Conf R/W
L LIM	LOW LIMIT	-999.0		The low limit for all inputs and the fall back value. Range Min 32-bit floating point value to High Limit (decimal point depends on resolution). **Default: -999**	Conf R/W

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
FBACK	FALLBACK STRATEGY			The state of the Output and Status parameters when either input is bad or operation cannot be completed. This parameter could be used in conjunction with fallback value..	Conf R/W
		C.bAd	0	Clip Bad. If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Good'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value **Default: C.bad**	
		C.Gd	1	Clip Good. If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the appropriate limit, and 'Status' is set to 'Bad'. If the input signal is within the limits, but its status is bad, the output is set to the 'Fallback' value.	
		F.bAd	2	Fall Bad. If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Bad'.	
		F.Gd	3	Fall Good. If the input value is above 'High Limit' or below 'Low Limit', then the output value is set to the 'Fallback' value, and the 'Status' is set to 'Good'	
		u.bAd	4	Upscale. If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'High Limit'.	
		d.bAd	6	Downscale. If the input status is bad, or if the input signal is above 'High Limit' or below 'Low Limit', the output value is set to the 'Low Limit'.	
FB VAL	FALLBACK VALUE	0.0		Used (in accordance with Fallback Strategy) to define the output value when fallback strategy is active. Range Low Limit to High Limit (decimal point depends on resolution)	Conf R/W
IN SEL	INPUT SELECTION	In1 to InB		Input values (normally wired to an input source). **Default: In1**	Conf R/W L3 R/W
IN1	INPUT 1	0.0	1	To input values if not wired. Range Min 32-bit floating point value to Max 32-bit floating point value.	Conf R/W L3 R/W
IN2	INPUT 2	0.0	2		
IN3	INPUT 3	0.0	3		
IN4	INPUT 4	0.0	4		
IN5	INPUT 5	0.0	5		
IN6	INPUT 6	0.0	6		
IN7	INPUT 7	0.0	7		
IN8	INPUT 8	0.0	8		
OUT	OUTPUT			Indicates the analogue value of the output between high and low limits	R/O
STATE	STATUS			Used in conjunction with Fallback to indicate the status of the operation. Typically, status is used to flag the status of the operation and used in conjunction with fallback strategy. May be used as an interlock for other operations. See section "Status" on page 96 for a list of enumerated values.	R/O
RES	RESOLUTION			Indicates the resolution of the output. The resolution of the output is taken from the selected input. If the selected input is not wired, or if its status is 'bad' then the resolution will be set to 1dp	R/O
		nnnnn	0	No decimal places **Default: nnnnn**	
		nnnn.n	1	One decimal place	
		nnn.nn	2	Two decimal places	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	

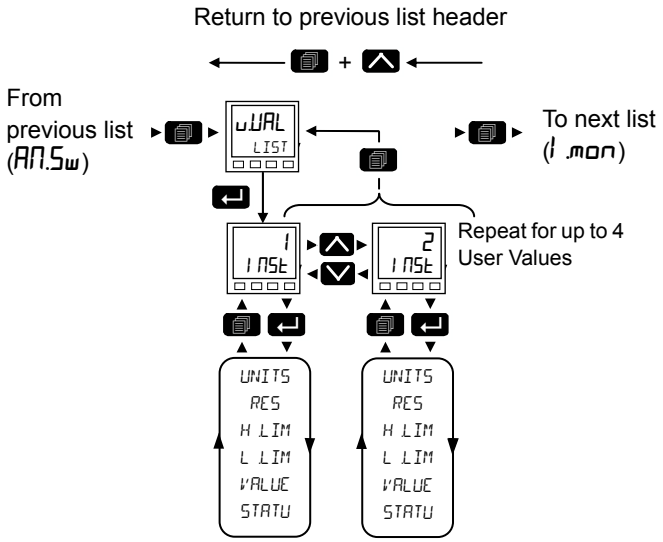
User Value List (uVAL)

User Values are only available if the Toolkit option has been ordered.

User values are registers provided for use in calculations. They may be used as constants in equations or temporary storage in extended calculations.

There are 4 instances of User Values.

Access to the User Value parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
UNITS	UNITS			See section "Units" on page 95 for a list of units used throughout	Conf
RES	RESOLUTION	nnnnn	0	User value resolution.	Conf
		nnnn.n	1	One decimal place	
		nnn.nn	2	Two decimal places **Default: nnn.nn**	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	
H LIM	HIGH LIMIT	9999.0		The high limit may be set for each user value to help prevent the value being set to an out-of-bounds value. Range Low Limit to Max 32-bit floating point value (decimal point depends on resolution). **Default: 99999**	L3 and Conf
L LIM	LOW LIMIT	-999.0		The low limit of the user value may be set to help prevent the user value from being edited to an illegal value. This is important if the user value is to be used as a setpoint. Range Min 32-bit floating point value to High Limit (decimal point depends on resolution). **Default: -99999**	L3 and Conf
VALUE	VALUE			To set the value within the range limits. See note below.	L3 and Conf
STATU	STATUS			Can be used to force a good or bad status onto a user value. This is useful for testing status inheritance and fallback strategies. See note below. See section "Status" on page 96 for a list of enumerated values.	L3 and Conf

Note: If 'Value' parameter is wired but 'Status' parameter is not wired, then, instead of being used to force the Status, it will indicate the status of the value which is inherited from the wired connection to the 'Value' parameter.

Input Monitor List (I mon)

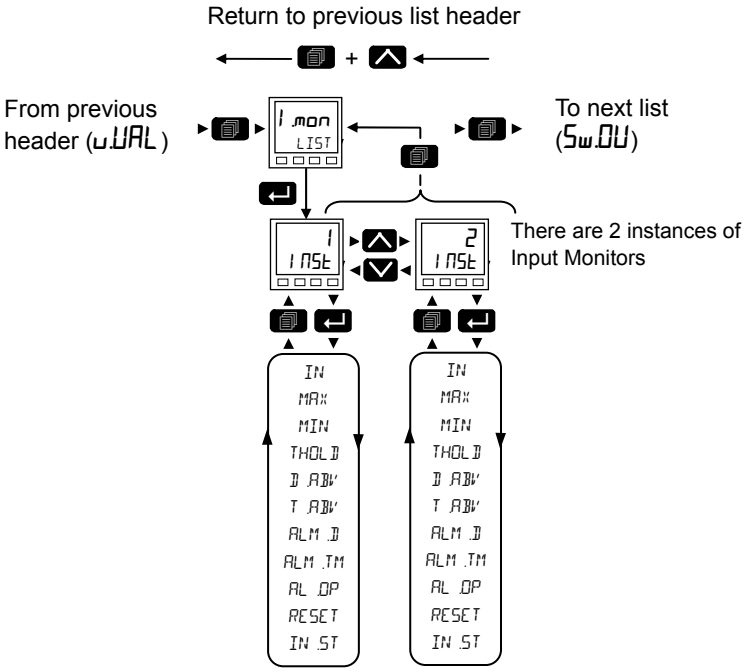
The Input Monitor list is only available if the Toolkit option has been ordered.

The input monitor may be wired to any variable in the controller. It then provides three functions:-

1. Maximum detect
2. Minimum detect
3. Time above threshold

There are 2 instances of the Input Monitor.

Access to the Input Monitor parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
IN	INPUT	0.0		Monitored input value	Conf R/W L3 RW
MAX	MAXIMUM	0.0		This function continuously monitors the input value. If the value is higher than the previously recorded maximum, it becomes the new maximum. This value is retained following a power outage.	R/O
MIN	MINIMUM	0.0		This function continuously monitors the input value. If the value is lower than the previously recorded minimum, it becomes the new minimum. This value is retained following a power outage.	R/O
THOLD	THRESHOLD			The input timer accumulates the time the input PV spends above this trigger value. **Default: 1.0**	Conf R/W L3 RW
D ABV	DAYS ABOVE	0		Accumulated days the input has spent above threshold since the last reset. Days is an integer count of the 24 hour periods only. The Days value should be combined with the Time value to make the total time above threshold.	R/O
T ABV	TIME ABOVE	00:00		Accumulated time above the timer threshold since last reset. The time value accumulates from 00:00.0 to 23:59.59. Overflows are added to the days value.	R/O

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
ALM.D	ALARM DAYS	0		Days threshold for the monitors time alarm. Used in combination with the TimeAbove parameter. The AlmOut is set to true if the inputs accumulated time above threshold is higher than the timer high parameters. **Default: 0**	Conf R/W L3 RW
ALM.TM	ALARM TIME	00:00		Time threshold for the monitors time alarm. Used in combination with the AlmDay parameter. The AlmOut is set to true if the inputs accumulated time above threshold is higher than the timer high parameters. **Default: 0**	Conf R/W L3 RW
AL.OP	ALARM OUTPUT	OFF	0		R/O
		On	1	Set true if the accumulated time that the input spends above the threshold value is higher than the alarm setpoint.	
RESET	RESET	No	0	**Default: No**	Conf R/W L3 RW
		YES	1	Resets the Max and Min values and resets the time above threshold to zero.	
IN.ST	INPUT STATUS			Displays the status of the input. See section "Status" on page 96 for a list of enumerated values.	R/O

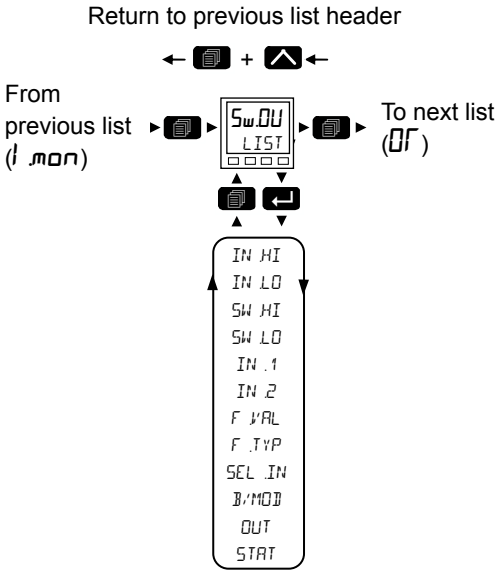
Switchover List (SwOU)

The Switchover list is only available if the Toolkit option has been ordered.

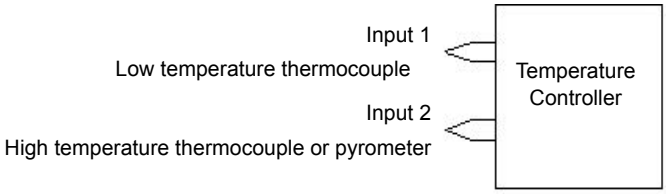
This facility is commonly used in temperature applications which operate over a wide range of temperatures. For example, a thermocouple may be used to control at lower temperatures and a pyrometer then controls at very high temperatures. Alternatively two thermocouples of different types may be used.

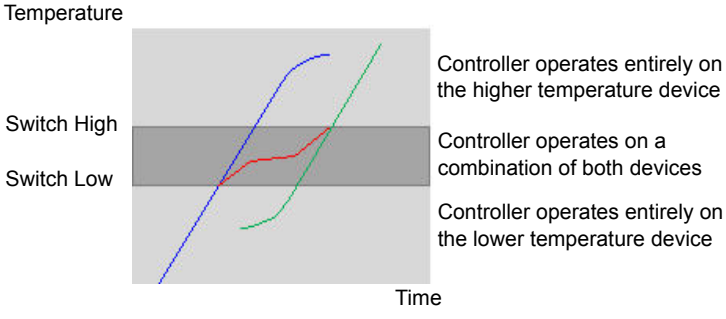
The diagram below shows a process heating over time with boundaries which define the switching points between the two devices. The higher boundary is normally set towards the top end of the thermocouple range and this is determined by the ‘Switch Hi’ parameter. The lower boundary is set towards the lower end of the pyrometer (or second thermocouple) range using the parameter ‘Switch Lo’. The controller calculates a smooth transition between the two devices.

Access to the Switchover parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



From this list you can configure the switchover function block. This is only appears if the function has been enabled.





Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
IN HI	INPUT HIGH	9999.0		Sets the high limit for the switch high. It is the highest reading from input 2 because input 2 is the high range input sensor. **Default: 9999.0**	Conf R/W L3 R/W
IN LO	INPUT LOW	-999.0		Sets the low limit for the switch low. It is the lowest reading from input 1 since input 1 is the low range input sensor. **Default: -999.0**	Conf R/W L3 R/W
SW HI	SWITCH HIGH	0.0		Defines the higher boundary of the switchover region	Conf R/W L3 R/W
SW LO	SWITCH LOW	0.0		Defines the lower boundary of the switchover region	Conf R/W L3 R/W
IN.1	INPUT 1	0.0		The first input value. This is taken from the low range sensor.	Conf R/W L3 R/W
IN 2	INPUT 2	0.0		The second input value. This is taken from the high range sensor.	Conf R/W L3 R/W
F VAL	FALLBACK VALUE	0.0		Defines (in accordance with Fallback Type) the output value when fallback strategy is active. Range between Input High and Input Low	Conf R/W L3 R/W
F.TYP	FALLBACK TYPE	c.bAd	0	Clip Bad The measurement is clipped to the limit it has exceeded and its status is set to BAD, such that any function block using this measurement can operate it's own fallback strategy. For example the control loop may hold its output. **Default: c.bad**	L3 R/O
		c.Gd	1	Clip Good The measurement is clipped to the limit it has exceeded and its status is set to GOOD, such that any function block using this measurement may continue to calculate and not employ its own fallback strategy.	
		F.bAd	2	Fallback Bad The measurement will adopt the configured fallback value. Which has been set by the user. In addition the status of the measured value will be set to BAD, such that any function block using this measurement can operate it's own fallback strategy. For example the control loop may hold its output.	
		F.Gd	3	Fallback Good The measurement will adopt the configured fallback value. Which has been set by the user. In addition the status of the measured value will be set to GOOD, such that any function block using this measurement may continue to calculate and not employ its own fallback strategy.	
		u.bAd	4	Up Scale The measurement will be forced to adopt its high limit, this is like having a resistive pull up on an input circuit. In addition the status of the measurement is set to BAD, such that any function block using this measurement can operate its own fallback strategy. For example the control loop may hold its output.	
		d.bAd	6	Down Scale The measurement will be forced to adopt it's low limit, this is like having a resistive pull down on an input circuit. In addition the status of the measurement is set to BAD, such that any function block using this measurement can operate its own fallback strategy. For example the control loop may hold its output.	
SEL.IN	SELECTED INPUT	in2	0	Indicates which input is currently selected.	R/O
		in1	1		
		both	2		
B MOD	BAD MODE			The action taken if the selected input is BAD.	L3 R/O
		S.Gd	0	If the currently selected input is BAD the output will assume the value of the other input if it is GOOD	
		S.bAd	1	If selected input is BAD the output is BAD	
OUT	OUTPUT			The process variable produced from the 2 input measurements.	R/O
STAT	STATUS			The status of the input block. See section "Status" on page 96 for a list of enumerated values.	R/O

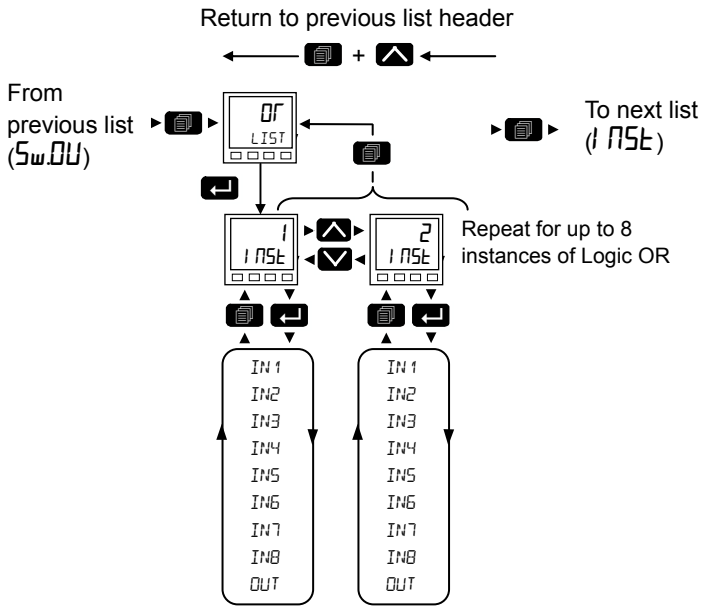
Logic OR List (OR)

The Logic OR function block allows multiple parameters to be wired to a single Boolean parameter without the need to enable toolkit blocks for the LGC2 or LGC8 'OR' functionality.

There are 8 Logic OR blocks available.

Each block consists of 8 inputs which are OR'd together into one output. It may be used, for example, to take the outputs from a number of alarm blocks and OR them together to operate a single general alarm output.

Access to the Logic OR parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.

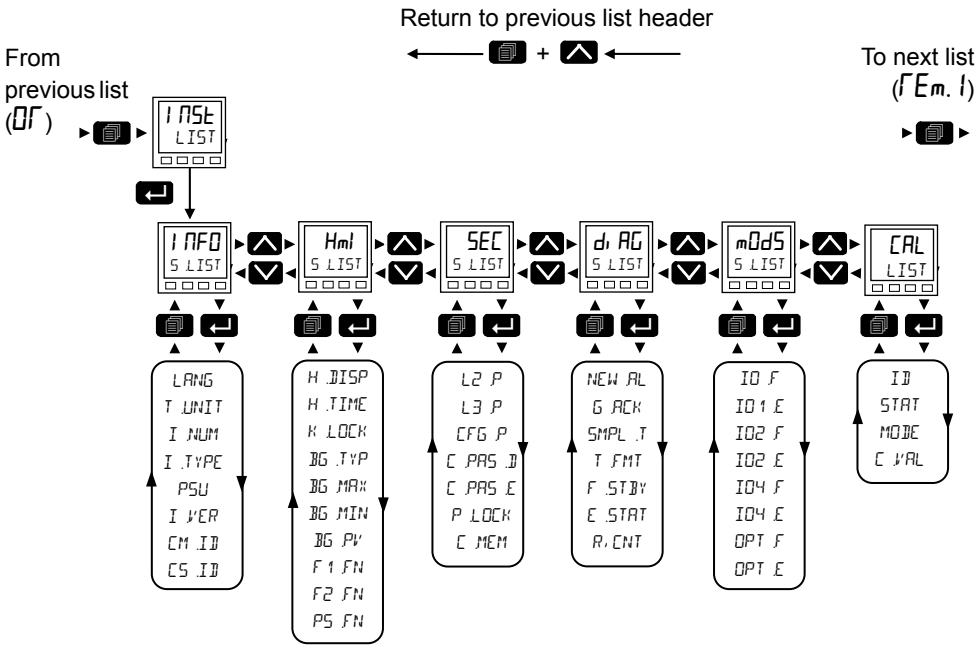


Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
IN 1	INPUT 1	OFF	0	Input 1 to the OR block	R/O
		On	1		
IN 2	INPUT 2	OFF	0	Input 2 to the OR block	
		On	1		
IN 3	INPUT 3	OFF	0	Input 3 to the OR block	
		On	1		
IN 4	INPUT 4	OFF	0	Input 4 to the OR block	
		On	1		
IN 5	INPUT 5	OFF	0	Input 5 to the OR block	
		On	1		
IN 6	INPUT 6	OFF	0	Input 6 to the OR block	
		On	1		
IN 7	INPUT 7	OFF	0	Input 7 to the OR block	
		On	1		
IN 8	INPUT 8	OFF	0	Input 8 to the OR block	
		On	1		
OUT	OUTPUT	OFF	0	Output result	
		On	1		

Instrument List (I nSt)

This list contains five sub-lists: Information (I nFO), HMI (Hmi), Security (SEC), Diagnostics (di AG), Modules (mOdS), Calibration (CAL).

Access to the Instrument parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Information Sub-List (INFO)

From this list you can read and adjust information such as Instrument Language, Temperature Units, Customer ID, etc, as shown in the following table.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
LANG	LANGUAGE	EN	0	English **Default: English**	Config RW
		FR	1	French	
		dE	2	German	
		IT	3	Italian	
		ES	4	Spanish	
T UNIT	TEMP UNITS	dEG.C	0	Sets the temperature units (°C). When temperature units is changed, those parameters which are flagged as having a temperature type (Absolute or relative) will have their values converted to reflect the new temperature units. **Default: deg.C**	Config RW L3 RO
		dEG.F	1	Sets the temperature units (°F).	
		K	2	Sets the temperature units (K).	
I NUM	INSTRUMENT NUMBER			Unique instrument serial number	RO
I TYPE	TYPE	3016	0	Instrument type EPC3016 1/16 DIN	RO
		3008	1	Instrument type EPC3008 ⅛ DIN	
		3004	2	Instrument type EPC3004 ¼ DIN	
	Native Type			Comms parameter. Used by iTools.	
PSU	PSU TYPE	HU	0	100 to 230Vac +/- 15% voltage PSU option	RO
		LU	1	24Vac/dc voltage PSU option	
I VER	VERSION			Firmware version number	RO
	Native version			Comms parameter. Used by iTools.	
CM ID	COMPANY ID	1280		Eurotherm CNOMO identifier	RO
CS ID	CUSTOMER ID			A non-volatile value for customer use: it has no effect on the instrument functionality. **Default: 0**	Config RW Lev 3 RO

Display Functionality Sub-List (Hml)

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
H.DISP	HOME DISPLAY			This configures which parameters are shown in the HOME display for Levels 1 and 2.	Conf R/W L3 R/W
		PV.SP	0	The HOME display will show Loop PV, Setpoint when in Auto mode and Output power when in Manual mode **Default: PV.SP**	
		PV.Pt	1	The HOME display will show Loop PV and program time left	
		LPV	2	The HOME display will show Loop PV only	
		PV 1	3	The HOME display will show Analogue input 1 PV1 only	
		PV.PS	4	The HOME display will show PV and the currently running program number and segment number	
		PV 1.2	5	The HOME display will show Analogue input 1 PV1 and PV2	
		PV2	6	The HOME display will show PV2	
VAL.3	HOME DISPLAY 3RD VALUE			An extra parameter value may be displayed on the home display. If the Home Display is set to LPV/SP, LPV/Time Left or PV1/PV2 the 1/8 and 1/4 DIN displays will display the parameter value on the 3rd line. The 1/16 DIN display will not show the parameter value. If the Home Display parameter is set to display only LPV, PV1 or PV2, then, the value of this parameter will be displayed on the second line. This parameter is typically wired from the parameter which is to be displayed.	Conf R/W
H.TIME	HOME TIMEOUT	0 to 60		Configures the timeout period (in seconds) for the home page - a value of 0 disables the Home Page Timeout. Range 0 to 60s **Default: 60**	
K.LOCK	KEYLOCK	OFF	0	Front panel buttons are active (normal operation) **Default: Off**	
		On	1	Lock the front panel buttons	
BG.TYP	BARGRAPH TYPE			Select the type of bargraph to be displayed	Conf R/W L3 R/W
		L2r	0	Left to Right. Minimum value is on the left, maximum value is on the right. The bar starts at the minimum value and extends to the right, to the current value. **Default: Left to right**	
		CEnt	1	Centred. Minimum value is on the left, maximum value is on the right. The bar starts at the midpoint between maximum and minimum and extends either left or right, to the current value.	
BG.MAX	BARGRAPH MAX	1000		Scaling for maximum on the bar graph. Bargraph Max and Bargraph Min can be wired as shown in the example in section "Example 4: To Configure a Bargraph" on page 196. **Default: 1000**	Conf R/W L3 R/W
BG.MIN	BARGRAPH MIN	0		Scaling for minimum on the bar graph **Default: 0**	
BG.PV	BARGRAPH PV			The current value being displayed on the bar graph	RO
F1.FN	F1 FUNCTION	A-m	1	To configure the F1 function button. Not available in EPC3016. **Default: Loop Auto/Manual**	Conf R/W
F2.FN	F2 FUNCTION	P.Hld	12	To configure the F2 function button. Not available in EPC3016. **Default: Programmer Run/Hold**	Conf R/W
PS.FN	PAGE + SCROLL FUNCTION	A.Ack	2	To configure the action when the Page + Scroll buttons are pressed together. **Default: Alarm acknowledge**	Conf R/W

Functionality of the F1 and F2 and Page + Scroll buttons

The functionality of the above three function buttons can be configured from the following list:

Function	Mnemonic	Value	Description
None	nonE	0	
Auto/Manual select	A-m	1	Put Loop into Auto or Manual mode
Alarm acknowledge	A.Ack	2	Acknowledge all active alarms
Segment advance	P.Adv	3	Advance program by one segment
SP1/SP2 select	SP.SEL	4	Select SP1 or SP2
RSP select	S.rSP	5	Remote or Local auto mode
Loop track	L.trk	6	Put the Loop into Track mode
SP rate limit disable	SP.rL	7	Enable/Disable the Sepoint Rate Limits
Recipe select	S.rEC	8	Switch between recipe 1 and 2
PID set select	S.PId	9	Switch between PID set 1 and 2
Tune enable	tunE	10	Start the auto-tune process
Standby enable	E.Sby	11	Put instrument into standby mode
Program Run/Hold	P.HLd	12	Switches the Programmer between Run and Hold mode
Program Run/Reset	P.rSt	13	Switches the Programmer between Run and Reset mode
Probe clean	2.CLn	14	Start a clean of the zirconia probe. Only applies if the application is Carbon Potential.

Security Sub-List (SEC)

The security list sets up security settings as listed in the following table:

Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
L2 P	L2 PASSWORD	2		The passcode that will be required to place the instrument into HMI level 2. Note: a value of 0 will disable the need to enter a passcode to enter level2. **Default: 2**	Conf R/W
L3 P	L3 PASSWORD	3		The passcode that will be required to place the instrument into HMI level 3. Note: a value of 0 will disable the need to enter a passcode to enter level 3. **Default: 3**	Conf R/W
CFG P	CONF PASSWORD	4		The passcode that will be required to place the instrument into HMI configuration mode. Note: a value of 0 will disable the need to enter a passcode to enter configuration level. **Default: 4**	Conf R/W
C PAS D	CPASS DEFAULT NOTIFICATION	YES	1	Enable a notification if the Comms Config passcode has not been changed from its default value.	Conf R/W
		No	0	Disable the comms config default passcode notification	
C PAS E	CPASS EXPIRY DAYS	90		The number of days after which the comms configuration passcode will expire generating a notification message. This is to inform the user that the passcode needs changing. It should be noted that a value of 0 will disable the expiry feature. **Default: 90**	Conf R/W
P LOCK	PASSCODE LOCK TIME	00:30		After 3 invalid attempts to login, the passcode entry mechanism will be locked out for the period set. This lockout time affects all access level passcodes and the comms config passcode. Note: A value of 0 will disable the lockout mechanism. The lock can be cleared by entering a higher level. **Default: 30 minutes**	Conf R/W
C MEM		YES	1	See CAUTION table below	
		No	0		
IM				Instrument mode	Comms parameter
Maxim				Maximum instrument mode	
CommsConfigPasscode				The configured passcode that will be required to place the instrument into comms configuration mode. See also section "Comms Config Level Passcode" on page 18. **Default: 1234567890**	
CommsPasscode		Yes	1	Enter the configured comms config passcode to gain access to the comms configuration mode.	
		No	0	**Default: No**	
ConfigAccess				Indication that comms configuration mode can be accessed	
FeaturePasscode1				Enter the new feature passcode supplied by Eurotherm to enable your selected features	
FeaturePasscode2				Enter the new feature passcode supplied by Eurotherm to enable your selected features	

⚠ CAUTION

CLEAR MEMORY PARAMETER

The clear memory parameter will force all parameters to be set to their factory default values. This will cause all values previously set by the user to be lost and it should, therefore, only be used in exceptional circumstances. This parameter is only available if the CFG.P parameter has been set to 9999.

Failure to follow these instructions can result in injury or equipment damage.

Diagnostics Sub-List (di AG)

The diagnostics list provides general diagnostic information as shown in the following table:

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
NEW AL	NEW ALARM	OFF	0		Conf R/O L3 R/O
		On	1	This shows ON when a process alarm (see Alarm List) becomes active and remains on until the alarm has become inactive (and acknowledged depending upon the latching strategy of the alarm).	
G ACK	GLOBAL ACK	no	0		Conf R/W L3 R/W
		YES	1	A rising edge will acknowledge all active process alarms (see the Alarm List).	
SMPL T	SAMPLE TIME			Indicates the sample period (in seconds). This is the period between each execution cycle.	Conf R/O L3 R/O
T FMT	TIME FORMAT	mSEC	0	Sets the resolution of time parameters on the config comms channel when read/written via scaled integer comms **Default: msec**	Conf R/W L3 R/W
		SEC	1		
		mIn	2		
		HOUr	3		
F STBY	FORCE STANDBY MODE	no	0	**Default: No**	Conf R/W L3 R/W
		YES	1	Sets the instrument into Standby Mode (see "Standby" on page 67).	
E STAT	EXECUTION STATUS			Indicates the status of the execution engine. This parameter can be used to determine if the instrument execution is running, in standby or starting up.	Conf R/O L3 R/O
		run	0	Running	
		StbY	1	Standby	
		St.UP	2	Start up	
R CNT	RESET COUNTER			This indicates the number of times the instrument has reset due to a power cycle, exit from configuration mode, exit from quick start, or an unexpected software reset. The count value can be reset by writing a value of 0. **Default: 0**	Conf R/W L3 R/W
V LINE				Line voltage measurement, not available on low voltage instruments.	Conf R/O L3 R/O

Parameter Mnemonic / Parameter Name Press ↵ to select in turn	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
				Comms only parameters
InstStatusWord			Instrument Status Word. This is a 16-bit bitmapped parameter that provides instrument status information. It is mapped as shown in the next section.	
AlarmStatusWord			Alarm Status Word. This is a16-bit bitmapped parameter that provides alarm status information. It is mapped as shown in the following section.	
NotificationStatus			Notifications Status Word. This is a 16-bit bitmapped parameter that provides instrument notification status information. It is mapped as shown in the following section.	
StandbyCondStatus			Standby Conditions Status Word (include the bit map table)	
L2PassUnsuccess			Number of HMI Level 2 unsuccessful login attempts since the last successful login	
L2PassSuccess			Number of HMI Level 2 successful logins	
L3PassUnsuccess			Number of HMI Level 3 unsuccessful login attempts since the last successful login	
L3PassSuccess			Number of HMI Level 3 successful logins	
CfgPassUnsuccess			Number of HMI Configuration Mode unsuccessful login attempts since the last successful login	
CfgPassSuccess			Number of HMI Configuration Mode successful logins	
CommsPassUnsuccess			Number of Communications Configuration Mode unsuccessful login attempts since the last successful login	
CommsPassSuccess			Number of Communications Configuration Mode successful logins	

Instrument Status Word Bitmap

Bit Number	Description
0	Alarm 1 State (0=Off, 1=On)
1	Alarm 2 State (0=Off, 1=On)
2	Alarm 3 State (0=Off, 1=On)
3	Alarm 4 State (0=Off, 1=On)
4	Manual Mode (0=Auto, 1=Manual)
5	Global (PV1 or PV2) Sensor Break (0=Off, 1=On)
6	Loop Break (0=Good closed loop, 1=Open loop)
7	CT Load Alarm (0=Off, 1=On)
8	Auto Tune (0=Off, 1=On)
9	Program End (0=No, 1=Yes)
10	PV1 out of range (0=No, 1=Yes)
11	CT Over Current Alarm (0=Off, 1=On)
12	New Alarm (0=No, 1=Yes)
13	Programmer Running (0=No, 1=Yes)
14	PV2 out of range (0=No, 1=Yes)
15	CT Leak Alarm (0=Off, 1=On)

Alarm Status Word Bitmap

Bit Number	Description
0	Alarm 1 in active region (0=No,1=Yes)
1	Alarm 1 not acknowledged (0=No,1=Yes)
2	Alarm 2 in active region (0=No,1=Yes)
3	Alarm 1 not acknowledged (0=No,1=Yes)
4	Alarm 3 in active region (0=No,1=Yes)
5	Alarm 3 not acknowledged (0=No,1=Yes)
6	Alarm 4 in active region (0=No,1=Yes)
7	Alarm 4 not acknowledged (0=No,1=Yes)
8	Alarm 5 in active region (0=No,1=Yes)
9	Alarm 5 not acknowledged (0=No,1=Yes)
10	Alarm 6 in active region (0=No,1=Yes)
11	Alarm 6 not acknowledged (0=No,1=Yes)
12	Reserved
13	CT Load Alarm (0=No, 1=Yes)
14	CT Leak Alarm (0=No, 1=Yes)
15	CT Over Current Alarm (0=No, 1=Yes)

Notification Status Word Bitmap

Bit Number	Description
0	Default passcode not changed
1	Passcode has expired
2	HMI level 2 access locked out
3	HMI level 3 access locked out
4	HMI configuration access locked out
5	Comms configuration access locked out
6	Control loop in demo mode
7	Control loop in auto tune mode
8	Comms in configuration mode
9	Loop Autotune requested, but cannot run
10	Reserved
11	Reserved
12	Reserved
13	Reserved
14	Reserved
15	Reserved

Standby Status Word Bitmap

Bit Number	Description
0	Invalid RAM image of NVOL
1	NVOL parameter database load/store was unsuccessful
2	NVOL region load/store was unsuccessful
3	Option NVOL load/store was unsuccessful
4	Factory Calibration not detected
5	Unexpected CPU condition
6	Hardware Ident Unknown
7	Fitted hardware differs from expected hardware
8	Unexpected Keyboard condition during startup
9	Instrument powered down, in config mode
10	Recipe load was unsuccessful
11	Reserved
12	Reserved
13	Reserved
14	Reserved
15	Reserved

Modules Sub-List (mOdS)

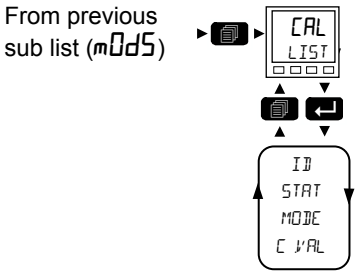
This list provides information about the modules fitted in the controller as shown in the following table:

Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
IO1 F	IO1 FITTED	NonE	0	The module type that is actually fitted in IO1	Conf R/O
		LIO	1		
		rELY	2		
		SSr	3		
		dC.OP	4		
IO1 E	IO1 EXPECTED	as above		The module type that is expected in IO1	Conf R/W
IO2 F	IO2 FITTED	as above		The module type that is actually fitted in IO2	Conf R/O
IO2 E	IO2 EXPECTED	as above		The module type that is expected in IO2	Conf R/W
IO4 F	IO4 FITTED	as above		The module type that is actually fitted in IO4	Conf R/O
IO4 E	IO4 EXPECTED	as above		The module type that is expected in IO4	Conf R/W
OPT F	OPTION FITTED			The module type that is actually fitted in the options slot	Conf R/O
		NONE	0	None - EPC3004 and EPC3008	
		AI .dB	1	Eight digital input - EPC3004 and EPC3008	
		ENEt	2	Ethernet - EPC3004 and EPC3008	
		NONE	10	None - EPC3016	
		rSP	11	Remote SP - EPC3016	
		C.232	12	EIA232 - EPC3016	
		C.485	13	EIA485 - EPC3016	
		C.422	14	EIA422 - EPC3016	
		ENEt	15	Ethernet -EPC3016	
OPT E	OPTION EXPECTED	as above		The module type that is expected in the options slot	Conf R/W

Calibration Sub-List (CAL)

Calibration information and instructions for User Calibration are given in "User Calibration" on page 278.

Access to the Calibration parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



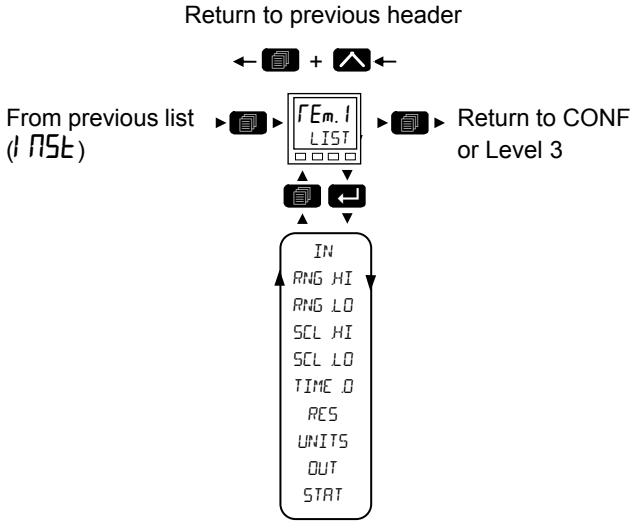
The calibration list provides user calibration status information and a means of input and output calibration.

Parameter Mnemonic Press ↵ to select in turn	Parameter Name	Value Press ▲ or ▼ to change values (if read/write, R/W)		Description	Access
ID	ID	AI.1	0	Analogue input 1	Conf R/W L3 R/W
		AI.2	1	Analogue input 2	
		dC.1	2	Analogue output 1	
		dC.2	3	Analogue output 2	
		dC.3	4	Analogue output 3	
		CT	5	Current transformer	
		r.mA	6	Remote setpoint milli-amps	
		rSPU	7	Remote setpoint Volts	
STAT	STATUS	FACt	0	Factory	R/O
		Adjd	1	Adjusted	
MODE	MODE	IdLE	0	Idle	Conf R/W L3 R/W
		StrT	1	Start calibration	
		U.SUC	2	Unsuccessful	
		Lo	3	Low calibration point	
		SEtL	4	Set low point	
		di SC	5	Discard calibration	
		Hi	6	High calibration point	
		SEtH	7	Set high point	
		di SC	8	Discard calibration	
		Adjd	9	Adjusted	
		di SC	10	Discard calibration	
C VAL	CAL VALUE			This parameter only appears if MODE is equal to Low and High calibration point. For input user calibration this is the value the input is expected to be at the point of calibration. For output user calibration this is the externally measured output value at the point of calibration.	Conf R/W L3 R/W

Remote Input List (rEm. 1)

This list configures the remote input as shown in the following table.

Access to the Remote Input parameter list is summarised below. The full Navigation Diagram is shown in section "Navigation Diagram" on page 82.



Parameter Mnemonic	Parameter Name	Value		Description	Access
Press ↵ to select in turn		Press ^ or v to change values (if read/write, R/W)			
IN	REMOTE INPUT			This parameter can be written to via a remote master, or by the Remote Setpoint Module (if fitted). The Modbus address is 277 if being written to by an external master.	Conf R/W L3 R/W
RNG HI	RANGE HIGH			Maximum value of the input **Default: 100**	Conf R/W L3 R/O
RNG LO	RANGE LOW			Minimum value of the input **Default: 0**	Conf R/W L3 R/O
SCL HI	SCALE HIGH			The maximum value of the scaled output PV **Default: 100**	Conf R/W L3 R/O
SCL LO	SCALE LO			The minimum value of the scaled output PV **Default: 0**	Conf R/W L3 R/O
TIME.O	TIMEOUT			This is the period in which the input has to be written to (in seconds). If this period is exceeded the output PV status will be set to Bad. If this period is set to 0, the timeout strategy is disabled. **Default: 1s**	Conf R/W L3 R/O
RES	RESOLUTION	nnnnn	0	Resolution of the input /output. No decimal places	Conf R/W L3 R/O
		nnnn.n	1	One decimal place **Default: nnnn.n**	
		nnn.nn	2	Two decimal places	
		nn.nnn	3	Three decimal places	
		n.nnnn	4	Four decimal places	
UNITS	UNITS			See section "Units" on page 95 for a list of units used throughout **Default: AbsTemp**	
OUT	PV			The output PV that has been linearly scaled Range High to Scale High and Range Low to Scale Low.	Conf R/O
STAT	STATUS			Status of the output PV. See section "Status" on page 96 for a list of enumerated values.	Conf R/O

Q Code List

These are the Quick Start Code function block parameters which are available via comms. They are the Quick Codes shown on the HMI when the instrument starts-up. They can be seen in iTools but there is no separate list on the controller HMI.

Parameter Name Press ↵ to select in turn	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
Quick Start Code Set 1				Comms only
Application			Defines the application	
	None	0	No application configured. The controller has no soft wiring	
	PID heat only	1	PID heat only controller	
	PID heat/cool	2	PID heat/cool controller	
	VPU heat only	3	Valve position heat only controller	
	Carbon potential	4	Carbon potential controller	
	Dew point control	5	Dew point controller	
Input 1 Sensor Type			Defines the type of the input sensor connected to input 1	
	X	0	Use Default	
	B	1	Type B	
	J	2	Type J	
	K	3	Type K	
	L	4	Type L	
	N	5	Type N	
	R	6	Type R	
	S	7	Type S	
	T	8	Type T	
	Pt100	20	PT100	
	Pt1000	21	PT1000	
	80mV	30	0-80mV	
	10V	31	0-10V	
	20mA	32	0-20mA	
	4-20mA	33	4-20mA	
Input 1 Range			Defines the range of the input 1	
	X	0	Use Default	
	1	1	0-100°C	
	2	2	0-200°C	
	3	3	0-400°C	
	4	4	0-600°C	
	5	5	0-800°C	
	6	6	0-1000°C	
	7	7	0-1200°C	
	8	8	0-1300°C	
	9	9	0-1600°C	
	A	10	0-1800°C	
	F	11	Full Range	
Input 2 Sensor Type			Defines the type of the input sensor connected to input 2. The enumerated values are the same for Input 1 Type above with the following addition available on input 2 only	
	HiZ	40	High Impedance (Zirconia)	
Input 2 Range			Defines the range of the input 2. The enumerated values are the same for Input 1 range.	

Parameter Name Press ↵ to select in turn	Value Press ^ or v to change values (if read/write, R/W)		Description	Access
Quick Start Code Set 2				Comms only
CT input	Not used	0	Defines the range of the current transformer input	
	10A	1	10 Amps	
	25A	2	25 Amps	
	50A	5	50 Amps	
	100A	6	100 Amps	
	1000A	7	1000 Amps	
Digital input A	Not used	0	Defines the functionality of digital input A	
	Alarm acknowledge	1		
	Loop Auto/Manual	2		
	Programmer Run/Hold	3		
	Keylock	4		
	Setpoint Select	5		
	Programmer Run/Reset	6		
	Loop Remote/Local	7		
	Recipe Select	8		
	Loop Track	9		
Digital input B			Defines the functionality of digital input B. The enumerated values are the same as for Input A above.	
D1-D8	Not used	0	Digital inputs 1 to 8. (See also "Quick Codes DIO" on page 63).	
	Config1	1		
	Config2	2		
	Config3	3		
	Config4	4		
	Config5	5		
	Config6	6		
	Config7	7		
	Config8	8		
	Config9	9		
Temperature units	Default	0	Default temperature units	
	Celsius	1	Degrees Celsius	
	Fahrenheit	2	Degrees Fahrenheit	
	Kelvin	3	Kelvin	
Save and exit	NoExit	0	Do not exit quick start mode	
	Save	1	Save quick start settings	
	Discard	2	Discard quick start settings	

Configuration Using iTools

What's in this Chapter

This chapter describes how to configure the controller using iTools.

This chapter describes those feature which are specific to the EPC series controllers. iTools is generally described in the iTools Help Manual Part No. HA028838 which can be obtained from www.eurotherm.co.uk.

What is iTools?

iTools is a configuration and monitoring package which can be used to edit, store and 'clone' complete controller configurations. It is a free downloadable package available from www.eurotherm.co.uk.

iTools can be used to configure all the functions of the controller already described in this manual. It is also possible using iTools to configure additional functions such as Customised Messages, Recipe Storage and Download and Parameter Promotion. These features are described in this chapter.

What is an IDM?

The Instrument Descriptor Module (IDM) is a Windows file that is used by iTools to determine the properties of a specific device. Each version of a device requires its own IDM file. This is normally included with the iTools software and allows iTools to recognize the software version of your instrument.

To Load an IDM

In the unlikely event that the build of your instrument is a non-standard, it may be necessary for you to obtain the IDM from the Eurotherm web site www.eurotherm.co.uk. The file will be of the format IDxxx_v106.exe, where IDxxx is the instrument and v--- is the software version number of the instrument.

Having downloaded the new IDM installer, ensure all of iTools and the iTools OPC Server have been stopped. Then launch the installer and follow the instructions to complete the IDM installation onto your system.

Once installed, start iTools as usual. If the installation was successful, the new device details should be listed under the "New" dialog under the appropriate tab.

Connecting a PC to the Controller

This may been done using the configuration CPI clip, the Fixed Communications port (EPC3004/EPC3008) or by Option Comms modules (if fitted).

Using the Configuration Clip

A Configuration Clip is available with iTools by quoting USB in the iTools ordering code. Alternatively, it may be ordered with the controller by quoting EPCACC/USBCONF in the Accessory Order Code. The clip can be fitted into the side of a controller as shown and has a USB interface to a PC.

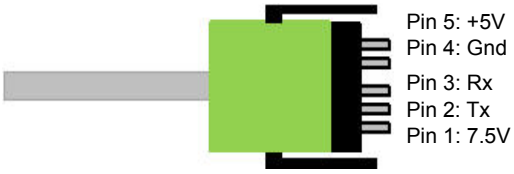
Connecting via the Configuration Clip offers the simplest and quickest method of establishing communications to the controller, as it provides easy access whatever configuration the controller is set to.

Ensure that the controller is powered down before the clip is attached.

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



Note: In some cases it may be preferable to have the configuration clip connected but not power the instrument from the USB port. For example, when the controller is powered by the standard Low Voltage (24Vdc) or Mains (110Vac -240Vac) and iTools is connected to monitor, configure or clone it. The power can be disconnected by removing Pins 1 & 5 in the following diagram.



Note: An existing earlier version of this clip with a serial interface to a PC may also be used.

Using the Communications Port

Connect the controller to the EIA485 serial communications port of the PC shown in "EIA485 Wiring" on page 52.

Using Option Comms

In EPC3016, if the relevant options board is fitted, the controller may be connected using EIA232, EIA422 or Ethernet as shown in "Digital Communications Connections" on page 51.

In EPC3008 and EPC3004, if the relevant options board is fitted, the controller may be connected using the Ethernet connector, see "Ethernet Wiring" on page 53.

Note: Ensure that the Comms block in the controller is suitably configured - i.e. in the Comm/Main Sub List the Protocol parameter is configured to "m.tCP" (MODBUS/TCP), and in the Comm/Network Sub List the IP Mode parameter is correctly set (STAT/dHCP - depending on whether there is a DHCP server).

Also, to enable iTools to automatically Discover the controller, ensure that the Auto Discovery parameter found in the Comm/Network Sub List is turned to ‘On’.

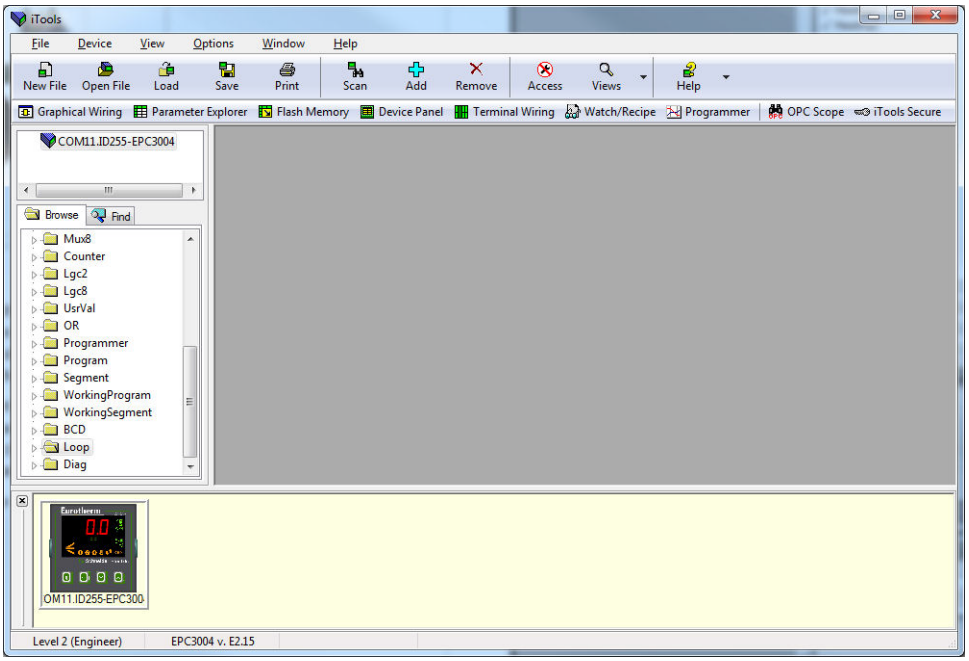
Refer to sections "Main Sub List (mAIN)" on page 141 and "Network Sub List (nWrk)" on page 142.

Starting iTools

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

When the controller is detected a screen view similar to the one shown below will be displayed. The browser on the left shows the List Headers. To display parameters within a list double click the Header or select 'Parameter Explorer'. Click on a list header to display parameters associated with this list.

The controller view may be turned on or off using the 'View' menu and selecting 'Panel Views'. This view mimics the connected controller HMI. The buttons are active which means that the controller can be operated directly from these buttons in exactly the same way as the connected instrument.



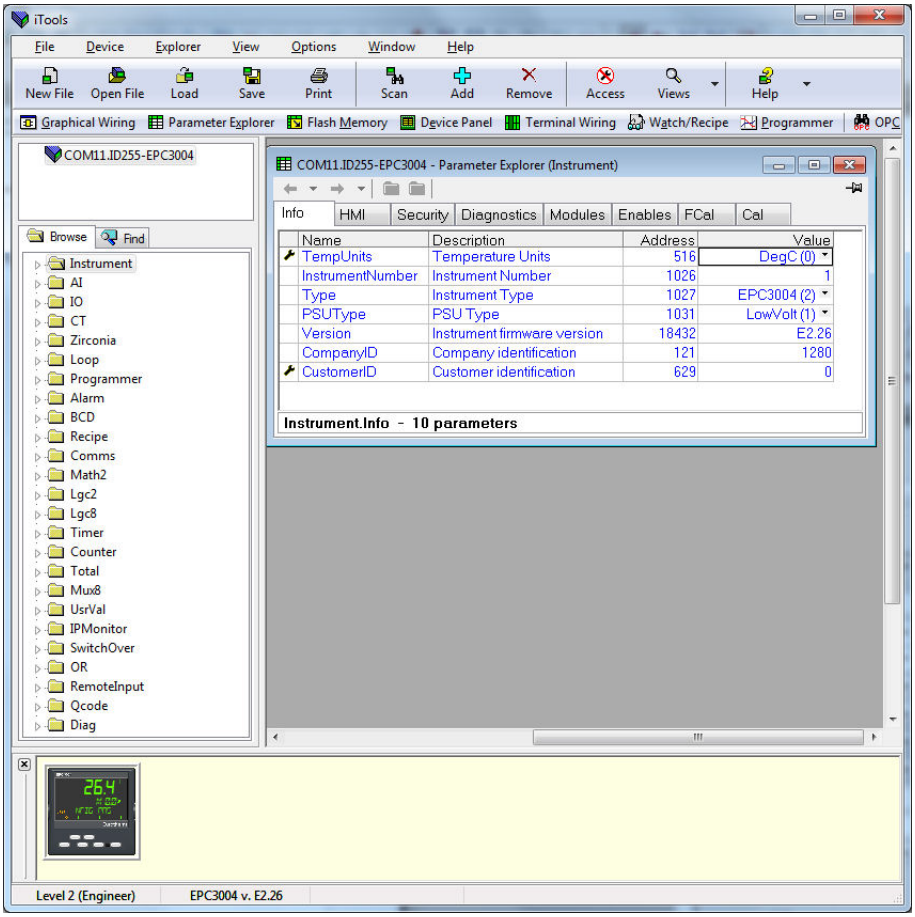
The controller may be configured using the Browser view above. The following pages show a number of examples of how to configure various functions.

It is assumed that the user is generally familiar with iTools and has a general understanding of Windows.

If the controller uses Ethernet comms, iTools needs to be set up to communicate with the controller. This is described in "Ethernet Protocol" on page 273.

The 'Browser' List

Parameters are available under list headings in the same way as in the controller Level 3 or Configuration level.



Double click on a heading to display parameters associated with the selected heading in the right hand side of the iTools view.

Parameters coloured blue are read only in the selected operator level.

To put the controller into Configuration level, click on 

. You may be prompted to enter the Comms passcode. If connected via the CPI clip, no Comms passcode will be required.

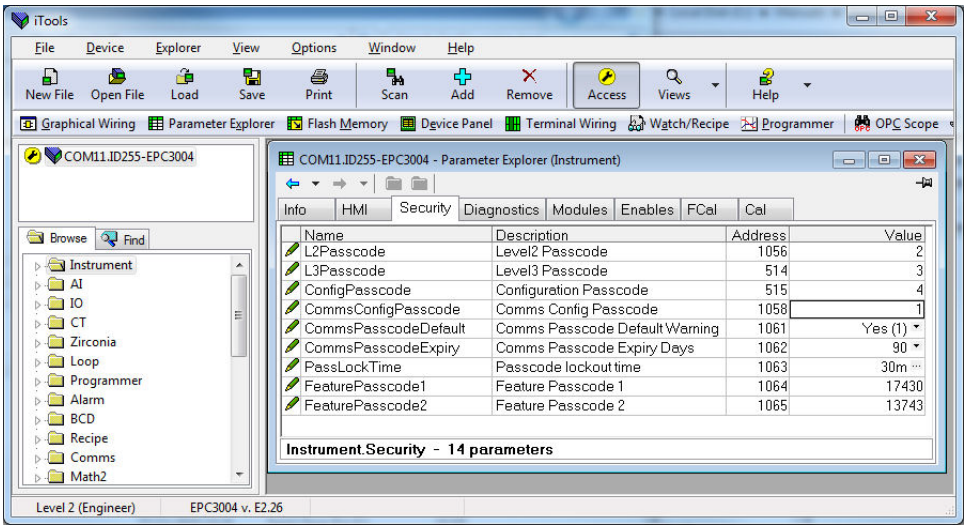
Parameters shown in black may be adjusted within pre set limits. Enumerated parameters are selected from a drop down list and analogue parameters may be adjusted by typing in the new value.

The actual controller HMI may be displayed in the top or bottom section of the iTools display as shown. The controller may be operated from this view. The controller HMI may also be displayed by pressing ‘Device Panel’ in the menu bar.

Instrument List

The Instrument List is the first list shown in the Browser section of iTools. It allows further features which are not available in the instrument HMI to be set. In particular Security related features including the Comms Config Passcode.

This passcode has a default value of 1234567890 and should be changed to help prevent unauthorised configuration access via comms. If this password is not changed a scrolling message ‘USING DEFAULT COMMS CONFIG PASSWORD’ will be shown when the controller is in operator level as described in "Operator Levels" on page 69.



To change the Comms Config Passcode, click on the value and enter a new value.

Note: The 'Using Default Comms Config Passcode' notification can be disabled by setting the Instrument.Security.CommsPasscodeDefault parameter to ‘No’. However, this is not recommended as it could potentially allow unauthorised access to the instrument configuration.

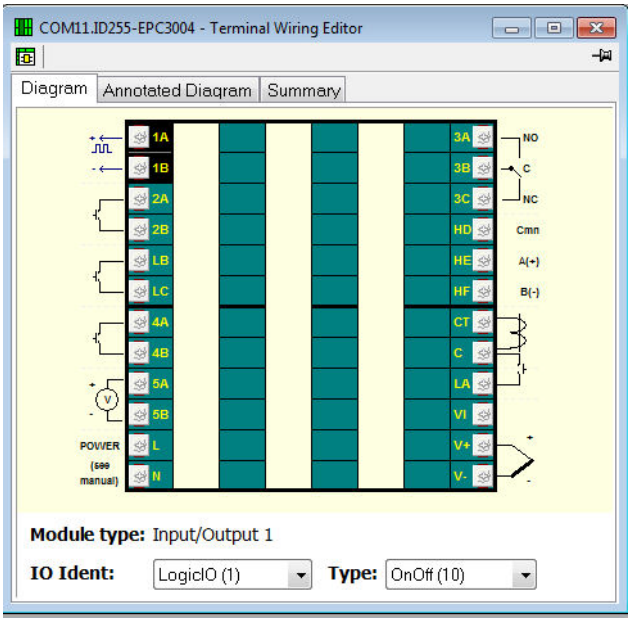
The parameter ‘Comms Passcode Expiry Days’ defaults to 90 days. This parameter sets the number of days after which the comms configuration passcode will expire. This will generate a message informing the user that the passcode needs changing.

The 'COMMS CONFIG PASSCODE EXPIRED' notification appears as a scrolling message in the display if passcode expires but can be disabled by setting Instrument.Security.CommsPasscodeExpiry to ‘0’.

Note: However, this is not recommended as it potentially could lead to unauthorised access to the instrument's configuration.

Terminal Wiring

Press ‘Terminal Wiring’ on the menu bar



From this view click on a set of terminals. In the ‘IO Ident’ drop down select an IO type. The diagram of the type of IO will be shown against the chosen terminal set.

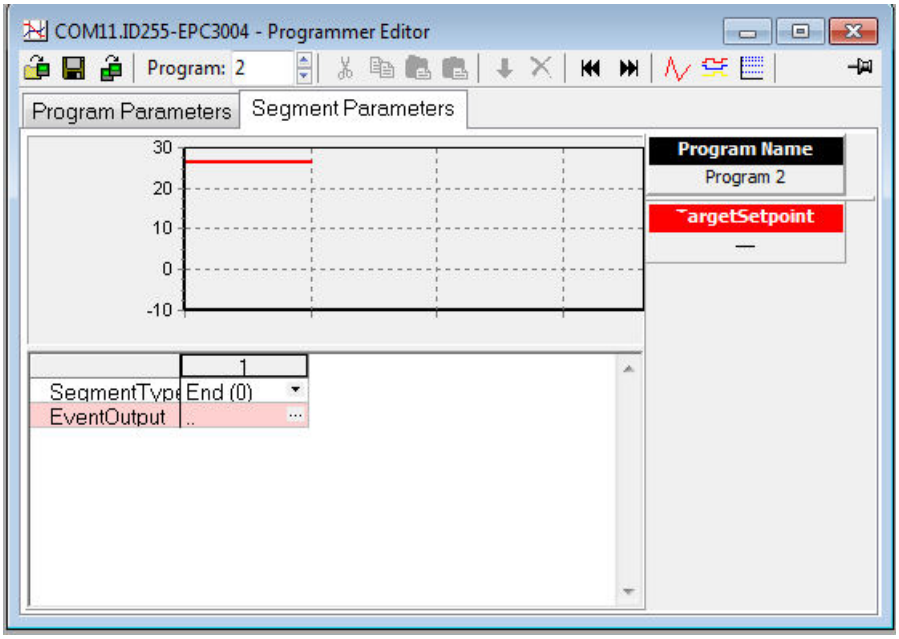
An Annotated Diagram and Summary of wiring can also be viewed.

Programmer

Stored Programs may be set up, run, held or reset in the controller using iTools. Alternatively, they may be set up using the controller HMI as described in "To Set-up a Program" on page 238.

To Set up a Stored Program Using iTools

Press ‘Programmer’ in the menu bar.



Up to 10 stored programs can be configured. By default, a stored program will consist of just an End segment as shown above.

To add segments change the segment type of the End segment to the desired segment type using the segment type drop down menu. The end segment will now have moved along to the right. Note that changes to the program will be automatically written to the controller.

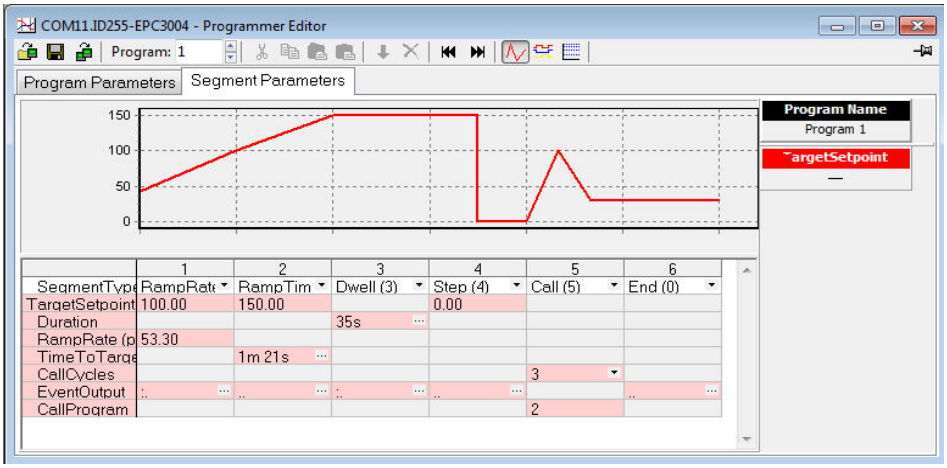
Menu options are shown in the bar above the graph and are also available as a pop up by right clicking in the segment table. They are from left to right:



Highlight a segment by clicking into the top of the list (1, 2, 3, 4, etc)

- Cut : Removes the segment and places it into the clipboard
- Copy: Copies the segment and places it into the clipboard
- Paste: The copied segment will be pasted to the right of a selected segment
- Paste Over: Replaces the selected segment with the copied segment
- Insert: Inserts copied segments to the right of the selected segment
- Delete: Removes the selected segment

The following diagram shows a stored program (Program 1) of 5 segments plus an End segment. Segment 5 calls another stored program (in this case program 2 consisting of a ramp up and a ramp down) to repeat 3 times before the program ends. Segment types are described in the Programmer chapter, "Segments" on page 228.



⚠ CAUTION

CALL SEGMENTS

If a call segment is selected the controller will default to calling the next program number. This may not necessarily the correct program so you must ensure that the correct call program number is selected manually.

Failure to follow these instructions can result in injury or equipment damage.

Event Outputs

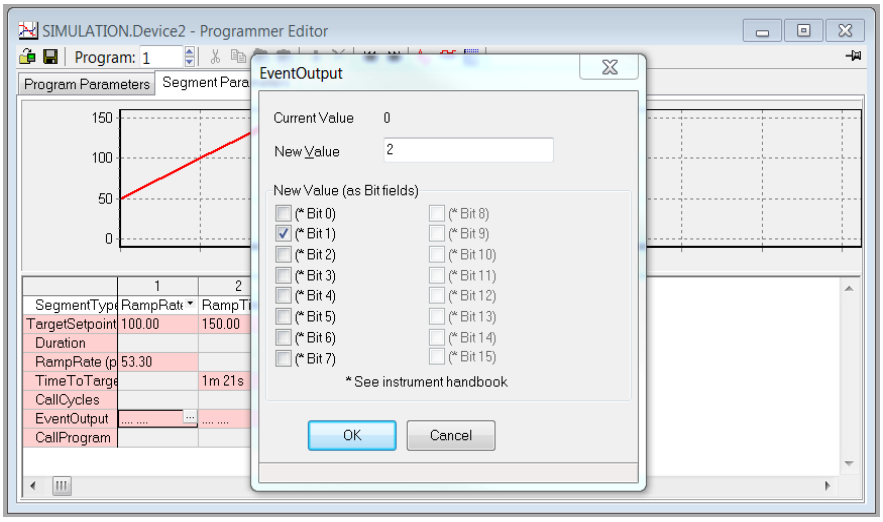
Up to 8 event outputs may be enabled using Programmer.Setup.MaxEvents parameter in the iTools browser.

If more than one event is configured ‘EventOutput’ is shown as an ellipsis, see the diagram above.

If no events are configured then ‘EventOutput’ is not shown in the list.

If one event is configured, ‘EventOutput’ allows the event to be turned on or off directly.

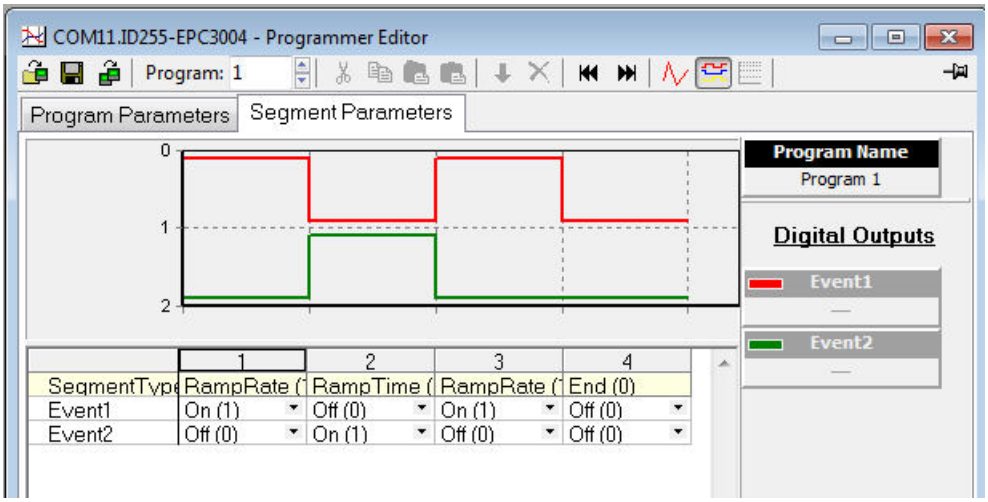
Click on the ellipsis to display a bit map:



Tick bit 0 to turn on event 1 in the selected segment.

Tick bit 1 to turn on event 2 in the selected segment.

Alternatively, click on ‘Digital Event Outputs’ (Ctrl+D)  to turn the events On or Off directly in each segment including the End segment.



The above view shows 2 events configured.

Events may be indication only or may be soft wired to digital output blocks to operate external devices. This is explained in section "Graphical Wiring" on page 194.

To Save and Load Stored Programs

On many occasions processes may be similar to one another in a particular production unit. It is often useful, therefore, to save and copy an existing stored program into another program location in iTools. Such a program may be re-named, modified and saved as required. Note that a full-featured Programmer contains 10 stored programs and each program will need to be saved individually.

To Save a Program

1. In the Programmer Editor, select the stored program number to be saved using the program selector.
2. There are two ways to save a program. In the Programmer Editor click on "Save current program to file (Ctrl+S)". Alternatively, in the main menu click on Programmer and from the drop down list press "Save current program to file (Ctrl+S)".

Do not confuse this with 

on the toolbar.

To Load a Previously Saved Program

1. In the Programmer Editor, select the stored program number where the saved program is to be loaded using the program selector.
2. There are two ways to load a program. In the Programmer Editor click on "Load Program (Ctrl+L)". Alternatively, in the main menu click on Programmer and from the drop down list press "Load...(Ctrl+L)".

Do not confuse this with 

on the toolbar.

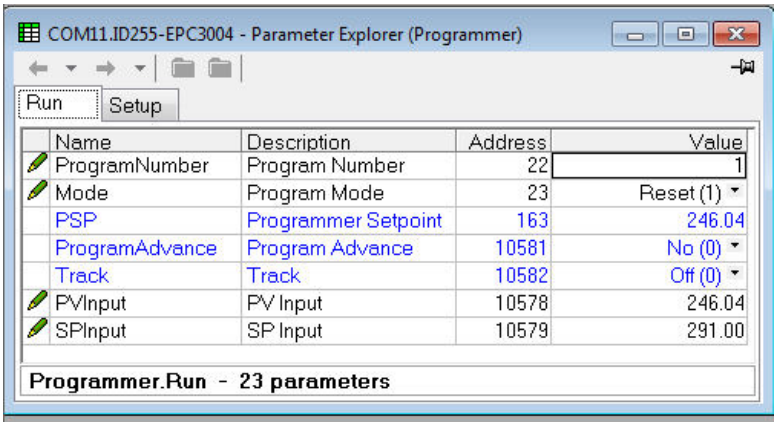
Note: If an attempt is made to load a program which contains a Call segment into the last stored program (e.g. program 10) iTools will prohibit the action and report a message as follows:

‘Unable to load: Program 10' (the last program) cannot contain a call segment'.

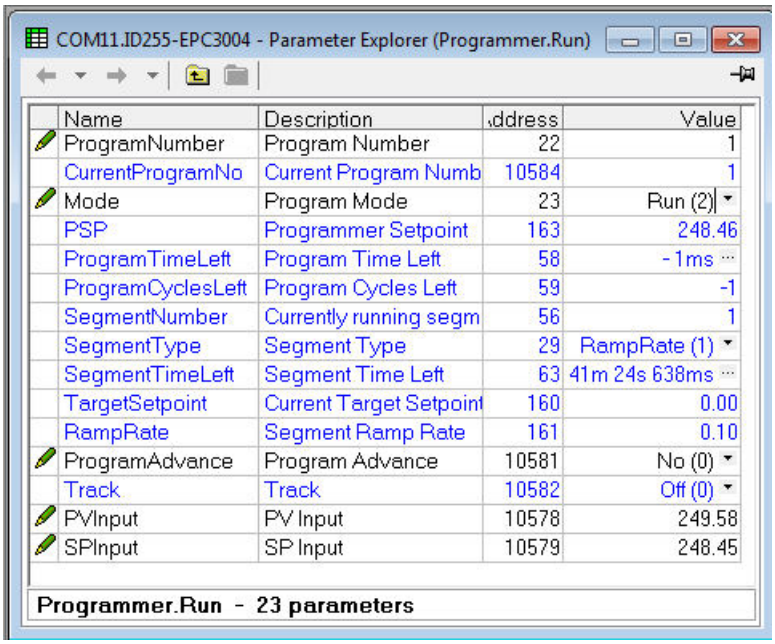
Note: A 1x8 or 1x25 programmer cannot contain any call segments.

To Run, Reset and Hold a Program

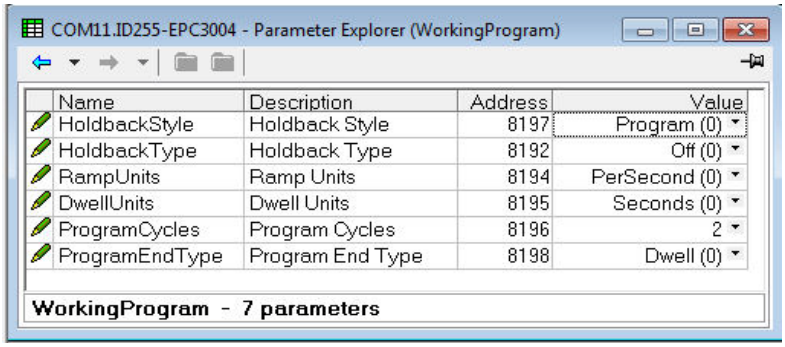
In the browser view, open the Program Run list



To run a stored program make sure that the controller is in Operator mode. Select the stored program number of the program to run and select Run(2) from the Mode parameter drop down enumeration. The program may also be put into Hold or Reset from the mode Parameter.



When one of the stored programs (Program 1 to 10) is run, the stored program parameters are copied into the working program. The Working Program and Working Segment parameters are then made available to the user for monitoring and/or editing.

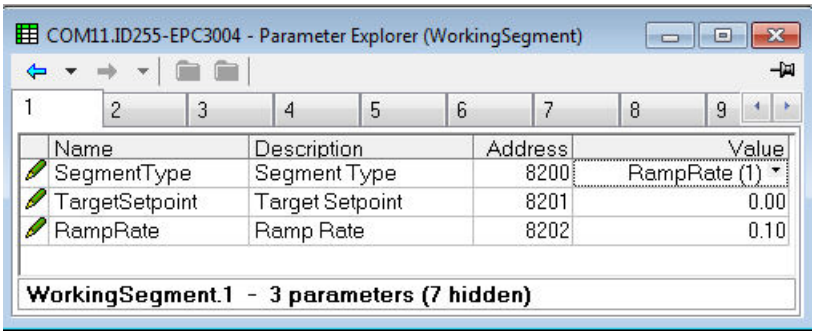


The programmer loads each segment from the working program before it is run. If the programmer is currently running segment 2 of the working program and working segment 3 is edited, then the changes will be executed when working segment 3 is run. If working segment 1 is edited, then the changes will be executed in the next program cycle, (assuming there are any program cycles left). However, if the running program completes or is reset and then run again, the stored program will be copied to the working program thereby overwriting any changes made to the working program. The working program can also be overwritten as a result of running another program or calling another program as a subroutine.

Stored programs are always available and configurable via the HMI and iTools even when a program is currently running. Working program parameters, however, are only available and configurable via HMI and iTools when a program is not in reset.

Note: For a running program set for Continuous cycles (using the ProgramCycles parameter in the Programmer Parameters tab) the 'Program Time Left' parameter shows 'CONt' in the controller HMI. In iTools this is shown as −1. Similarly, in iTools the Program Cycles Left parameter shows -1 but the controller HMI shows CONt. If the program cycles is set to repeat for a set number of times, then the 'Program Time Left' parameter and the Program Cycles Left parameter will count down in both iTools and the controller HMI.

The Working Program provides the user read/write access to the program parameters of the currently running program (which can be the main program or a subroutine resulting from a call segment).



The Working Segment provides the user read/write access to the segment parameters of the currently running program (which can be the main program or a subroutine resulting from a call segment).

Graphical Wiring

Graphical wiring provides a means of connecting function blocks together to produce a unique process. If the controller has been ordered or configured using the Quick Codes for a particular application then an example of the application has already been produced and is intended as a starting point for the user to modify as required.

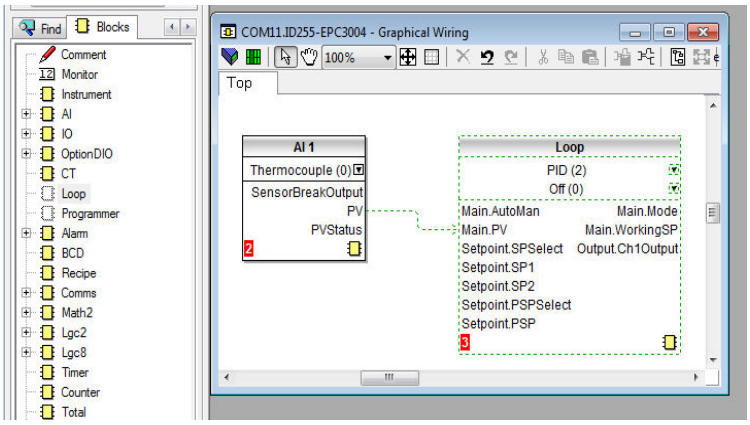
Press ‘Graphical Wiring’ on the menu bar.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

This operation will require the controller to enter configuration mode. Ensure that the controller is not connected to an active process.

Failure to follow these instructions can result in injury or equipment damage.



A list of function blocks is shown in the left hand side. Blocks are dragged and dropped from the list into the Graphical Wiring section on the right.

They are ‘soft wired’ together to produce the application. The above example shows the Analogue Input 1 block wired to the PV input of the loop. This is produced by clicking on the ‘PV’ parameter of the Analogue Input block and dragging to the ‘Main PV’ parameter of the Loop block. It is important to note that the value of a wired parameter cannot be manually changed since it takes on the value of the parameter it is wired from. The blocks and wires are shown dotted until the controller is updated using the ‘Download Wiring to Instrument’ button in the top left corner of the Graphical Wiring section.

For a full description of graphical wiring, please refer to the iTools User Manual HA028838.

50 wires are available as standard, with 200 wires available if the Toolkit option has been ordered.

If a controller is ordered or configured for a specific application it will already have the wiring in place. This is shown in the examples following the section "Applications" on page 199. Application specific wiring is intended as a starting point which can be modified by the user to suit a particular process.

If the controller is ordered unconfigured it will be necessary for the user to wire the function blocks to suit the particular application.

Some examples of graphical wiring are shown in the following sections.

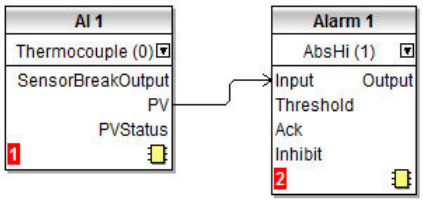
Example 1: To Wire an Alarm

Unless specifically produced in an application, any alarm which is required must be wired by the user.

The example below shows an absolute high alarm monitoring the Process Variable.

This is a ‘soft’ alarm in that it does not operate a physical output.

1. Drag and drop an alarm function block into the graphical wiring editor
2. Drag and drop an analogue input block into the graphical wiring editor
3. Click on ‘PV’ of the input block and drag a wire to ‘input’ of the alarm block
4. At this stage the wire is shown dotted and it must be transferred to the controller by clicking the ‘Download Wiring to Instrument’ button in the top left hand corner of the Graphical Wiring view

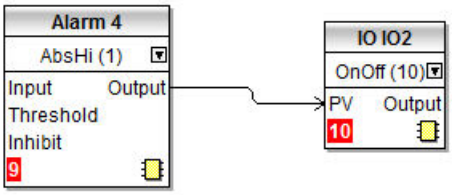


Example 2: To Connect an Alarm to a Physical Output

To make a soft alarm operate an output it must be ‘wired’.

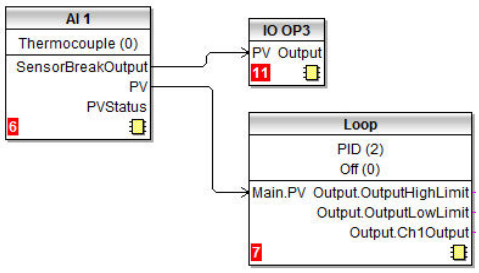
1. Drag and drop an alarm function block into the graphical wiring editor.
2. Drag and drop an output block into the graphical wiring editor.
3. Click on the ‘Output’ of the Alarm block and drag the wire to the ‘PV’ input of the output block
4. At this stage the wire is shown dotted and it must be transferred to the controller by clicking the ‘Download Wiring to Instrument’ button

The example shown below uses Alarm 4 and IO2 (configured for On/Off output).



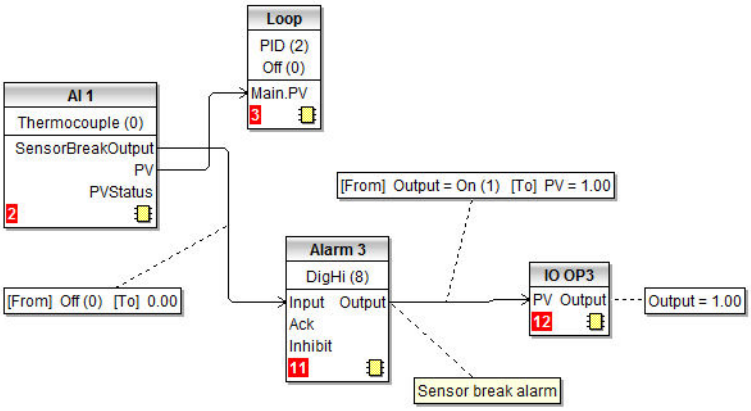
Example 3: To Wire Sensor Break

If a sensor condition is required to operate an output it must be wired as shown in the example below.



Sensor Break Alarm with Latching

In the above example a sensor break alarm has no latching ability. If latching is required the sensor break output can be wired to an alarm function block configured as a digital alarm which can be configured for auto or manual latching. A wiring example is shown below:



Example 4: To Configure a Bargraph

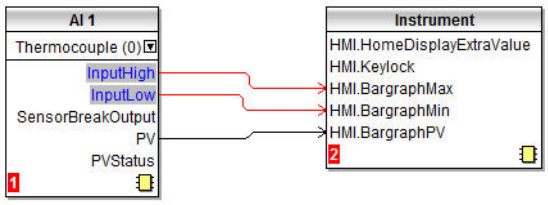
In this example the bargraph will be wired to the PV input connected to Analogue Input 1.

1. Drag and drop the ‘Instrument’ function block into the graphical wiring editor.
2. Drag and drop an ‘AI1’ block into the graphical wiring editor
3. Click on the ‘PV’ of the AI1 block and drag the wire to the ‘HMI.BargraphPV’ in the Instrument block

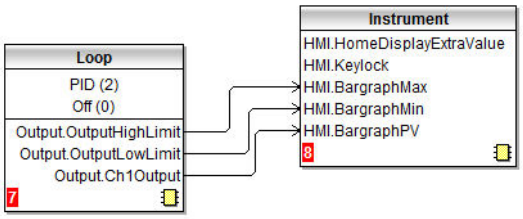
To apply limits to the bargraph:

4. In the AI1 function block click to open the list of parameters. Then click to show all connections.
5. Drag InputHigh to HMI.BargraphMax in the Instrument block
6. Drag InputLow to HMI.BargraphMin in the Instrument block

7. Click the ‘Download Wiring to Instrument’ button

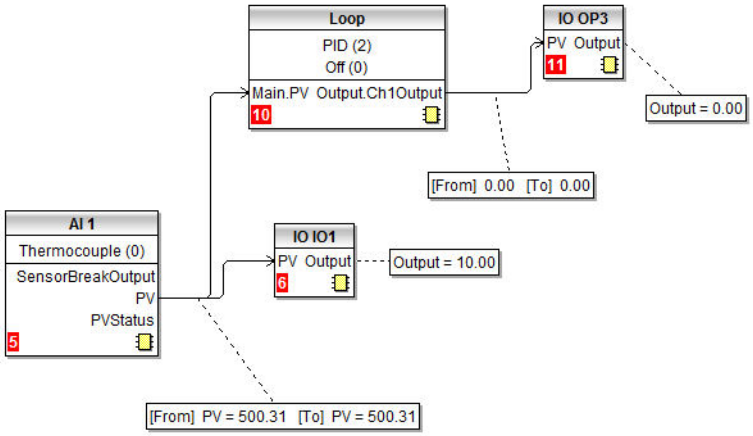


The above example will cause the bargraph to display the PV from AI1. Another typical requirement is for the bargraph to show the output demand value. This may be wired in a similar way by wiring the channel output to the HMI.BargraphPV as shown below.

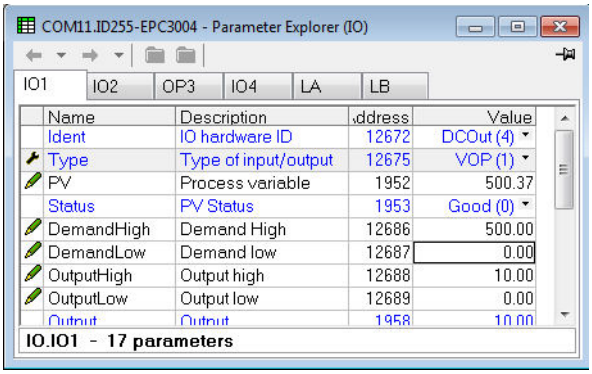


Example 5: To Wire a Retransmission Output

In this example Analogue Output 1 (IO1) is required to read 0 volts for a PV input of 0.0 and 10 volts for a PV of 500.0



The diagram shows a simple loop where the control output is connected to Output 3 and the PV is wired to Analogue Output 1 configured for 0 - 10V.



In the IO1 settings adjust Demand Low to 0.0 and Demand High to 500.0.

The Output High and Output Low parameters may be adjusted to limit the analogue output if required. For example, set OutputHigh to 8.0V and OutputLow to 1.0V. The retransmission will then read 1.0V for a PV of 0.0 and 8.0V for a PV of 500.0.

Applications

The controller is supplied with a number of pre-configured applications as shown in the following sections. These are further described in supplements to this manual and may be found in www.eurotherm.co.uk. They are:

HA033033 EPC3000 Temperature Control Applications

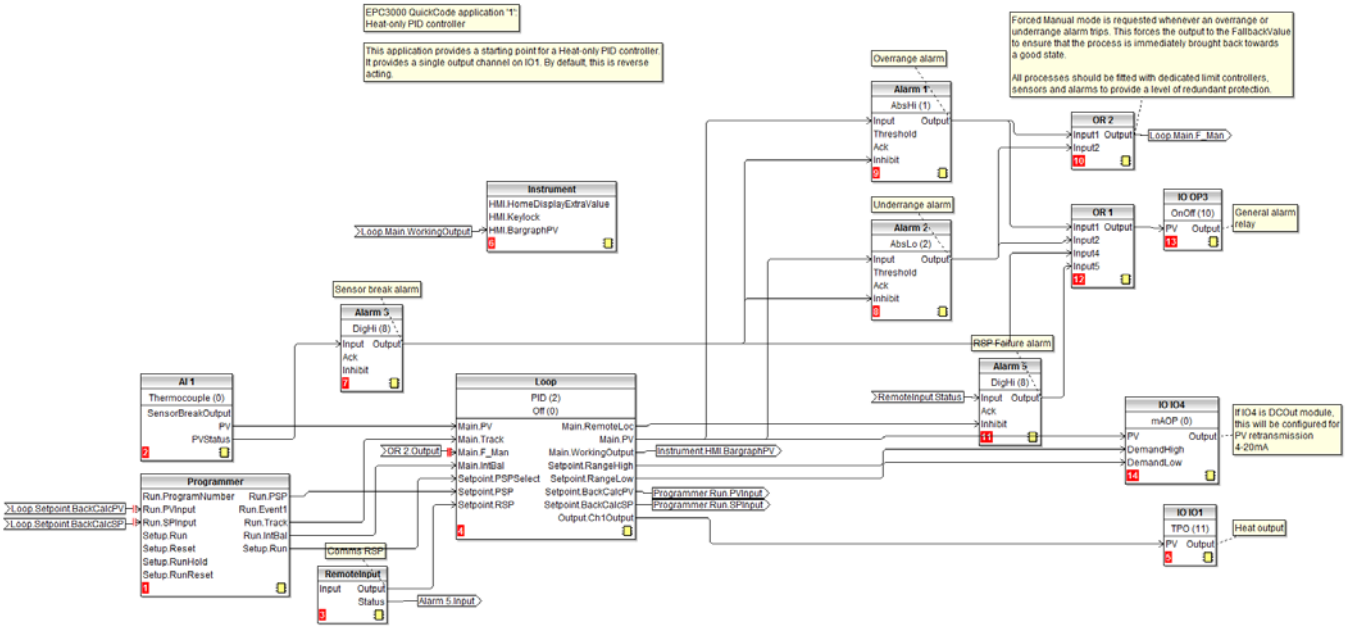
HA032987 EPC3000 Carbon Potential Control Supplement

HA032994 EPC3000 Dew Point Control Supplement

Heat Only Controller

The diagram below shows the graphical wiring which is pre-loaded into the controller if the single heat only loop controller application Quick Code 1 (value 1) is configured.

It provides a starting point for a heat only PID controller which the user can modify to suit a particular process.



In this example, the sensor input is a thermocouple connected to the main analogue input.

A programmer block provides the PSP setpoint to the loop.

A remote setpoint is available the value of which can be written over comms using Modbus address 277. When the loop is in remote auto mode, the RSP must be written to at least every second. If updates stop then an alarm will trip and the loop will fallback to forced local auto.

There are four alarms configured:

- Alarm 1 trips when the PV exceeds an absolute high threshold
- Alarm 2 trips when the PV exceeds an absolute low threshold

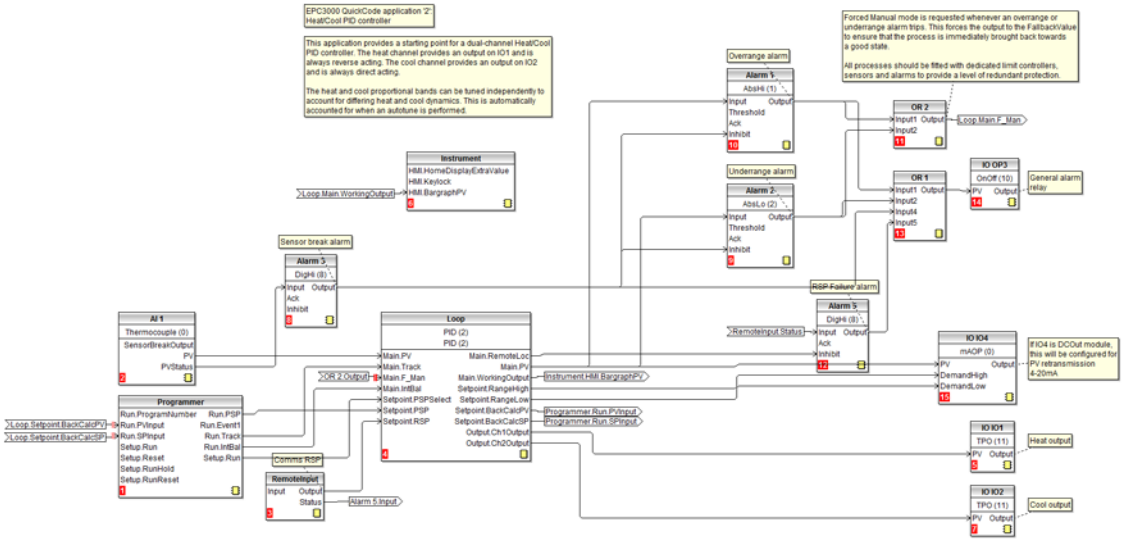
  These are OR'd together to provide an out of range alarm. When either of these alarms trip the controller is placed into 'Forced Manual' mode. This sets the output to the 'Fallback Value' to ensure that the process is immediately returned to a good state.
- Alarm 5 is a digital high alarm wired to the Remote Input Status
- Alarm 3 is a digital alarm providing sensor break alarm

These four alarms are OR’d to provide a general alarm which is outputted via OP3. IO4 can provide a 4-20mA retransmission signal only if configured with a DC voltage output, otherwise it remains unconnected. IO1 is the heat control output.

Quick codes QC2B and QC2C are used to configure the programmer Run/Hold and Reset functions respectively.

Heat/Cool Controller

The graphical wiring for the Heat/Cool Controller Quick Code 1 (value 2) is shown below:



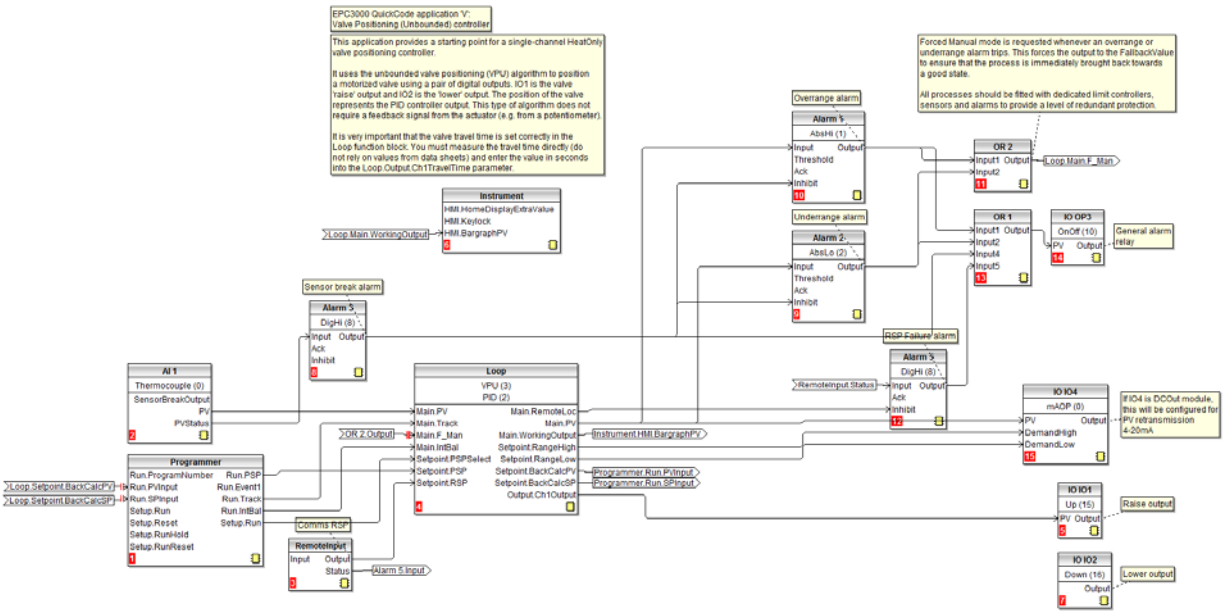
This is the same as the heat only controller but with the addition of IO2 connected to the cool output.

It provides a starting point for a heat/cool PID controller which the user can modify to suit a particular process.

An example of the physical wiring of a heat/cool controller is shown in "Heat/Cool Controller" on page 54.

Valve Position Heat Only Controller

The graphical wiring for the heat only VPU controller Quick Code 1 (value V) is shown below.



This is the same as a heat only controller except that IO1 and IO2 are configured for valve raise and valve lower respectively.

It provides a starting point for a heat only PID controller for motor valve control which the user can modify to suit a particular process.

Flash Memory Editor

The Flash Memory Editor edits any device data that needs to be saved to the device flash memory in addition to the OPC parameter editing mechanism used for most configuration editing.

The data that requires this is as follows:

1. Promote Parameters
2. User Message Table
3. Recipe Definition and Recipe data sets

All these sets of data are presented on a series of tabs as shown in the following views.

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Any changes made to the controllers flash memory require the controller to enter configuration mode. The controller will not control the process when in configuration mode. Ensure that the controller is not connected to an active process when in configuration mode.

Failure to follow these instructions can result in injury or equipment damage.

Parameter Promotion

Parameters which are available in Level 1 and Level 2 may be configured to suit the preferences of a particular user.

The name for each parameter can be changed (maximum 5 characters + '.').

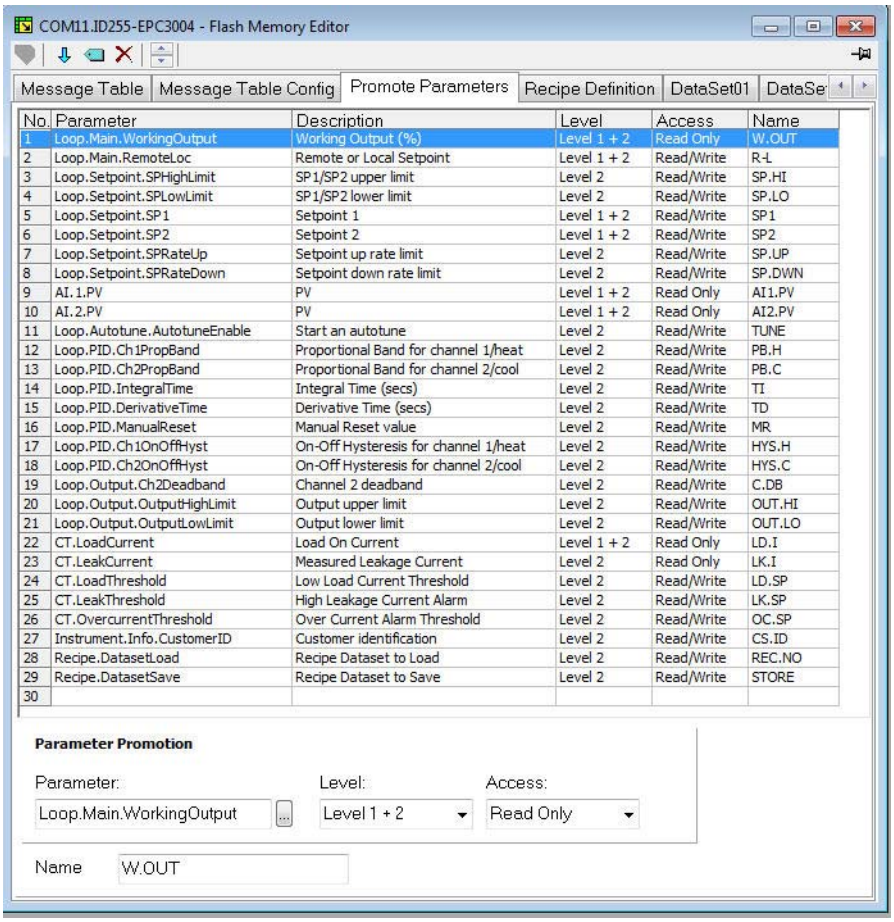
⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

It is strongly recommended that parameters to be promoted should be given user defined names. This is because some parameters, such as alarm thresholds, have the same default name. This is described in section "User Defined Messages" on page 205

Failure to follow these instructions can result in injury or equipment damage.

Select ‘Flash Memory’ followed by ‘Promote Parameters’.



No.	Parameter	Description	Level	Access	Name
1	Loop.Main.WorkingOutput	Working Output (%)	Level 1 + 2	Read Only	W.OUT
2	Loop.Main.RemoteLoc	Remote or Local Setpoint	Level 1 + 2	Read/Write	R-L
3	Loop.Setpoint.SPHighLimit	SP1/SP2 upper limit	Level 2	Read/Write	SP.HI
4	Loop.Setpoint.SPLowLimit	SP1/SP2 lower limit	Level 2	Read/Write	SP.LO
5	Loop.Setpoint.SP1	Setpoint 1	Level 1 + 2	Read/Write	SP1
6	Loop.Setpoint.SP2	Setpoint 2	Level 1 + 2	Read/Write	SP2
7	Loop.Setpoint.SPRateUp	Setpoint up rate limit	Level 2	Read/Write	SP.UP
8	Loop.Setpoint.SPRateDown	Setpoint down rate limit	Level 2	Read/Write	SP.DWN
9	AI.1.PV	PV	Level 1 + 2	Read Only	AI1.PV
10	AI.2.PV	PV	Level 1 + 2	Read Only	AI2.PV
11	Loop.Autotune.AutotuneEnable	Start an autotune	Level 2	Read/Write	TUNE
12	Loop.PID.Ch1PropBand	Proportional Band for channel 1/heat	Level 2	Read/Write	PB.H
13	Loop.PID.Ch2PropBand	Proportional Band for channel 2/cool	Level 2	Read/Write	PB.C
14	Loop.PID.IntegralTime	Integral Time (secs)	Level 2	Read/Write	TI
15	Loop.PID.DerivativeTime	Derivative Time (secs)	Level 2	Read/Write	TD
16	Loop.PID.ManualReset	Manual Reset value	Level 2	Read/Write	MR
17	Loop.PID.Ch1OnOffHyst	On-Off Hysteresis for channel 1/heat	Level 2	Read/Write	HYS.H
18	Loop.PID.Ch2OnOffHyst	On-Off Hysteresis for channel 2/cool	Level 2	Read/Write	HYS.C
19	Loop.Output.Ch2Deadband	Channel 2 deadband	Level 2	Read/Write	C.DB
20	Loop.Output.OutputHighLimit	Output upper limit	Level 2	Read/Write	OUT.HI
21	Loop.Output.OutputLowLimit	Output lower limit	Level 2	Read/Write	OUT.LO
22	CT.LoadCurrent	Load On Current	Level 1 + 2	Read Only	LD.I
23	CT.LeakCurrent	Measured Leakage Current	Level 2	Read Only	LK.I
24	CT.LoadThreshold	Low Load Current Threshold	Level 2	Read/Write	LD.SP
25	CT.LeakThreshold	High Leakage Current Alarm	Level 2	Read/Write	LK.SP
26	CT.OvercurrentThreshold	Over Current Alarm Threshold	Level 2	Read/Write	OC.SP
27	Instrument.Info.CustomerID	Customer identification	Level 2	Read/Write	CS.ID
28	Recipe.DatasetLoad	Recipe Dataset to Load	Level 2	Read/Write	REC.NO
29	Recipe.DatasetSave	Recipe Dataset to Save	Level 2	Read/Write	STORE
30					

The list shows the parameters which are available in Levels 1 & 2, Level 2 only and whether they are Read Only or Read/Write.

To change the level select the parameter. In the ‘Level’ drop down select ‘Level 1 + 2’ or ‘Level 2’.

In the Access drop down select ‘Read Only’ or ‘Read/Write’.

Parameters can be added to or removed from the list as follows:

To add a parameter to the list click in the list where you want the item to appear then right click and select ‘Insert Item’. A pop up box will appear from which the required parameter can be selected. To remove a parameter from the list, right click on the parameter and select ‘Remove Item’.

Alternatively, highlight the blank line at the end of the list or at the point in the list where the item is to appear (in the above example, line 30).

Press the ellipsis in the ‘Parameter’ drop down. This will open the full list of parameters from which the new parameter can be chosen.

After changes have been made, press the "Download" button  which is located in the top left hand corner of the Flash Memory Editor view.

In order for the controller to be updated it needs to be put into configuration mode. A confirmation message will be shown asking if you wish to proceed.

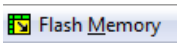
Changes will not be saved unless the Download button is pressed.

User Defined Messages

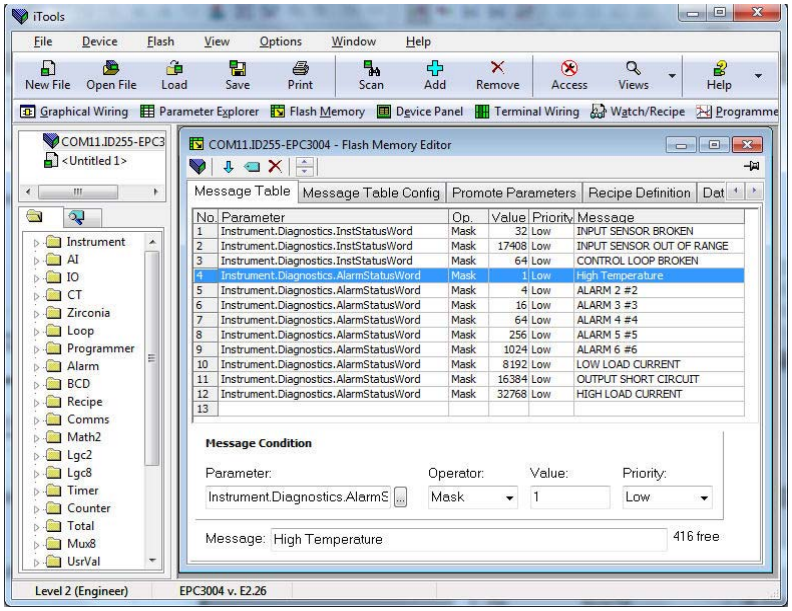
Process messages which scroll in the controller display may be customised. Default user messages are overridden if an application is selected via Quick Codes.

Example 1: To Customise Alarm 1 Message

In this example the alarm 1 message will read ‘HIGH TEMPERATURE’.

1. Press the Flash Memory 

option from the menu bar.
2. Select and press the ‘Message Table’ tab
3. Select Parameter ‘ALARM1 #1’



4. In the ‘Message’ area change ‘Message’ to HIGH TEMPERATURE
5. Press ‘Update Device Flash Memory’ button to download the new message into the controller. To update the controller it needs to be put into configuration mode. A confirmation message will be shown asking if you wish to proceed.

Note: # is a mechanism which allows values from parameters to be displayed in accordance with the table below:

Escape code	Inserted text
#1	Alarm 1 type (None, High, Low, Deviation High, etc)
#2	Alarm 2 type (None, High, Low, Deviation High, etc)
#3	Alarm 3 type (None, High, Low, Deviation High, etc)
#4	Alarm 4 type (None, High, Low, Deviation High, etc)
#5	Alarm 5 type (None, High, Low, Deviation High, etc)
#6	Alarm 6 type (None, High, Low, Deviation High, etc)
#T	PV value
#U	PV2 value
#O	Active output power value
#S	Working setpoint
#L	CT leak current
#I	CT load current
#C	Custom ID
#M*nnnn*	Parameter Mnemonic, where nnnn = parameter modbus address in Hex
##	Displays a single # character

Example 2: To Add Further Parameters

By default iTools shows 12 parameters which can have customised messages. This default message table is overridden if an application has been selected via quick codes.

The user can add further parameters and messages as follows:

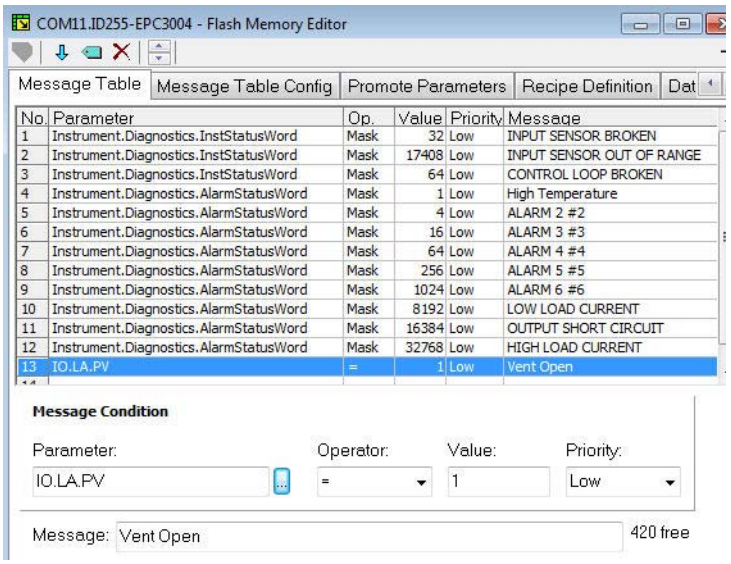
Either double click in the next available parameter or click on the ellipsis button.

This opens a list of all available parameters.

In this example the message ‘VENT OPEN’ will be applied to the LA digital input.

1. Select IO.LA.PV
2. Type the required message into the ‘Message’ Area
3. Press the ‘Update Flash Memory’ button to download the message to the controller. To update the controller it needs to be put into configuration mode. A confirmation message will be shown asking if you wish to proceed.

When Digital Input LA is activated the scrolling message ‘VENT OPEN’ will now be displayed in the controller display.



In the ‘Operator’ drop down it is possible to select:

= equals the ‘Value’

<> is greater or less than the ‘Value’

> is greater than the ‘Value’

< is less than the ‘Value’

Mask is generally used to activate a message for a number of parameters when using a bitmap field.

Recipes

A recipe is a list of parameters whose values can be captured and stored in a dataset which can then be loaded at any time to restore the recipe parameters, thus providing a means of altering the configuration of an instrument in a single operation even in operator mode. Recipes can be set up and loaded using iTools or in the controller itself, see "To Save Recipes" on page 139.

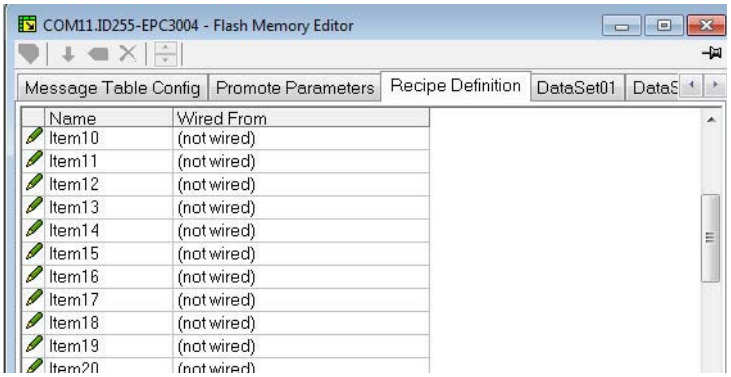
A maximum of 5 datasets are supported, referenced by name, and defaulted to be the dataset number i.e. 1…5

By default each dataset consists of 40 parameters which must be populated by the user, see "Recipe List (RECP)" on page 137. A recipe can take a snapshot of the current values and store these into a recipe dataset.

Each dataset can be given a name using iTools configuration software.

Recipe Definitions

Select ‘Flash Memory’ followed by ‘Recipe Definitions’.



The Recipe Definition table contains a set of 40 parameters. Not all 40 parameters need to be wired.

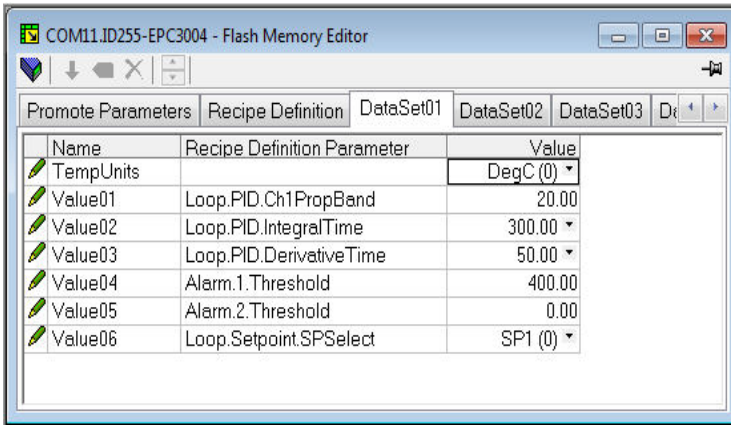
The Recipe Definition tab allows the user to produce a customised list.

To add parameters:

1. Double click in the next empty item
2. This opens the parameter list to choose from
3. Adding a parameter to the list will automatically populate the 5 datasets with the current value of the added parameter

Data Sets

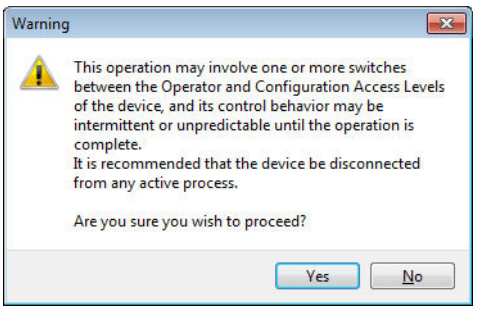
Up to 5 DataSets are available each being a recipe for a particular batch or process.



To Save the Data Set

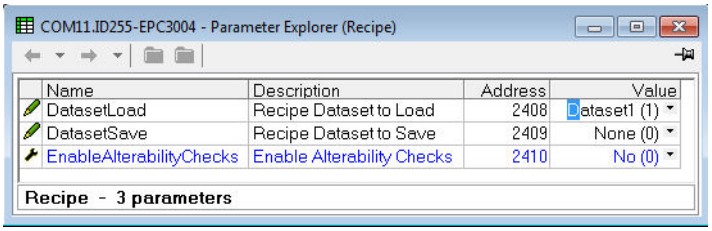
1. Set up the required values in the selected data set—see the example above
2. Press Enter
3. Press the ‘Update device flash memory’ (Ctrl+F)’ button in the top left of the Flash Memory Editor display to update the controller. This sets the values into all five of the controller datasets. (Note: saving in the controller will save the current values into one dataset).

Since this operation may involve one or more switches between Operator Level and Configuration Level it is recommended that the controller is disconnected from the process. A warning message is shown.



To Load a Data Set

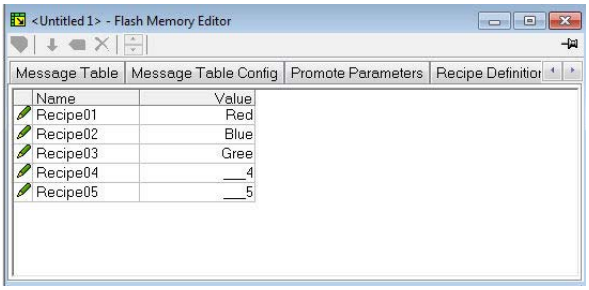
1. In the browser list select ‘Recipe’



2. Select the required Dataset

Recipe Names

This tab simply allows a name to be assigned to each of the 5 Recipe data sets. This name will be shown in the controller display.



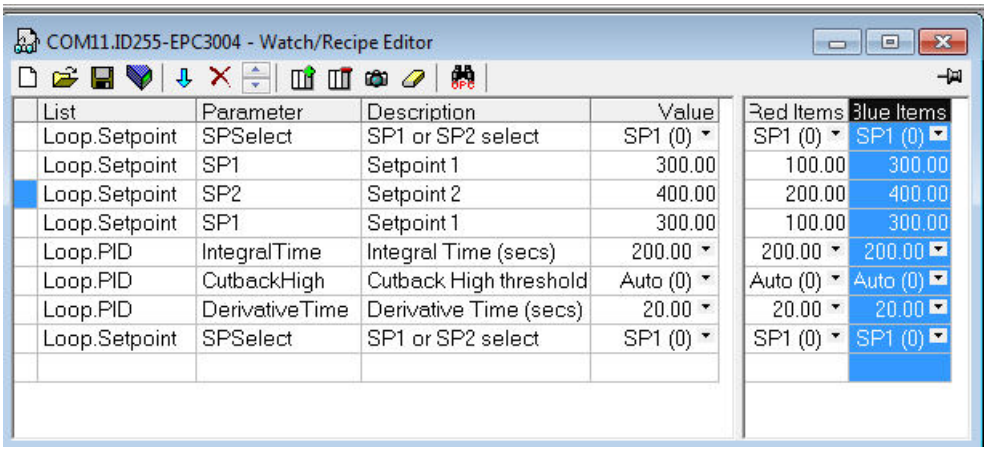
Watch Recipe Editor

Click on the Watch/Recipe tool button, by selecting 'Watch/Recipe' in the Views menu, or via the shortcut (Alt+A). The window is in two parts: the left part contains the watch list; the right-hand part contains a data set, initially empty and unnamed.

Watch Recipes are run from iTools, and are not stored or run from the device, i.e. iTools must be running and connected to a specific device.

The window is used:

1. To monitor a so-called 'watch list' of parameter values. The watch list can contain parameters from many different lists within the same device.
2. To create 'data sets' of parameter values which can be selected and downloaded to the device, in the sequence defined by the recipe. The same parameter may be used more than once in a recipe.



Creating a Watch List

After opening the window parameters can be added to it as described below. Parameters can be added only from the device to which the Watch/Recipe window relates (that is, parameters from more than one device cannot be placed in one Watch list). The values of the parameters update in real time, allowing the user to monitor, simultaneously, a number of parameters which might otherwise be unrelated.

Adding Parameters To The Watch List

1. Parameters can be clicked and dragged into the watch list grid from elsewhere in iTools (for example: the main browse tree, the Parameter Explorer window, the Graphical Wiring Editor (if applicable)). The parameter is placed either in the empty row at the bottom of the list, or 'on top' of an existing parameter, in which case it is inserted above this parameter in the list, the remaining parameters moving down one place.
2. Parameters can be dragged from one position in the list to another. In such a case, a copy of the parameter is produced: the source parameter remains in place. Parameters can be also be copied by using the 'Copy Parameter' item in the Recipe or right mouse-click menu, or by using the short cut (Ctrl+C). Data set values are not included in the copy.

3. The 'Insert item...' tool button , the 'Insert Parameter' Recipe menu item or the shortcut <Insert> can be used to open a browse window from which a parameter can be selected. The selected parameter is inserted above the currently active parameter.
4. A parameter can be 'copied' from (for example) the Graphical Wiring Editor and subsequently 'pasted' into the watch list using the 'Paste Parameter 'item in the Recipe menu, or the right mouse click context menu (short cut = Ctrl+V).

Creating a Data Set

All the parameters required for the recipe should be added to the watch list, described above.

Once this has been done, if the empty data set is selected (by clicking on the column header), the 'Snapshot' tool button (Ctrl+A) can be used to fill the data set with the current values. Alternatively, the 'Snapshot Values' item in the Recipe or context (right click) menu or the shortcut + can be used to fill the data set.

Individual data values can now be edited by typing directly into the grid cells. Data values can be left blank or cleared, in which case, when the recipe is downloaded, no value will be written for those values. Data values can be cleared by deleting all the characters in the field, then, either moving to a new cell, or typing <Enter>.

The set is called 'Set 1' by default. The name can be edited by using the 'Rename Data Set...' item in the Recipe or right mouse-click menu, or by using the shortcut (Ctrl+R).

New data sets can be added and edited in the same way, by using the 'Create a new empty....' tool button (Ctrl+W), or by selecting the 'New Data Set' item in the Recipe or right mouse-click menu, or by using the shortcut +

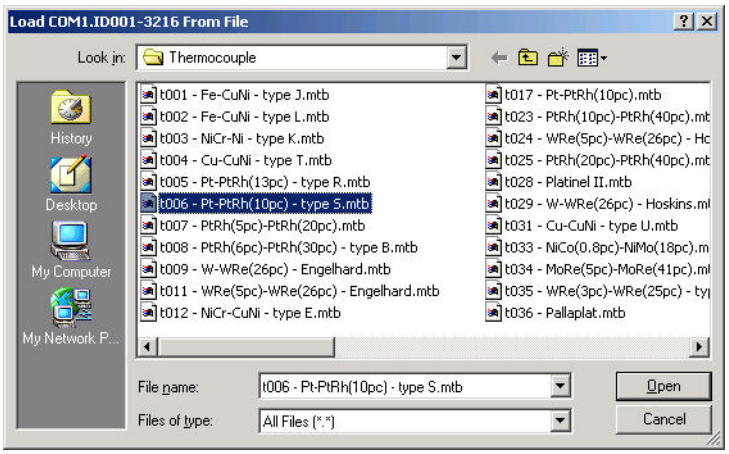
Once all the data sets required for the Recipe have been created, and saved, they can be downloaded to the device, one at a time, using the download tool (Ctrl+D), or equivalent Recipe/context menu item.

To Load a Custom Linearisation Table

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

1. Press 

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



In this example a Pt-PTRh(10%) thermocouple has been loaded into the controller.

The controller will display the linearisation table downloaded:- 

Cloning

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in death, serious injury or equipment damage

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

Save to File

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

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

To Clone a New Controller

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

From the File menu select 'Load Values From File' or select 'Load' from the toolbar. Choose the required file and follow the instruction. The configuration of the original controller will now be transferred to the new controller.

Clone Load Unsuccessful

A Message Log is produced during the cloning process. The log may show a message such as 'Cloning of device completed with 1 unsuccessful entry'. This can be caused by writing a parameter using iTools which is outside of the resolution of a parameter. For example, the parameter Filter Time Constant is stored in the controller to one decimal place (1.6 seconds by default). If it is entered as an IEEE float value, using iTools, as, say, 1.66 it will be rounded up in the controller to 1.7 seconds. Under these circumstances it is possible that 'Clone Load Unsuccessful' can occur because iTools expects a value of 1.66 and the instrument contains 1.7. Values should, therefore, be entered, when using iTools, within the resolution of the parameter.

This cannot happen from values entered via the front panel but only if entered over communications

Cold Start

⚠ CAUTION

COLD START

A cold start of the controller must only be carried out under exceptional circumstances as it will erase ALL previous settings and return the controller to its original state.

A controller must not be connected to any equipment when performing a cold start.

Failure to follow these instructions can result in injury or equipment damage.

In the Instrument Security list set the HMI Configuration Passcode to 9999. The parameter 'Clear Memory' will become available. Set this to Yes. The controller restart, resulting in the quickcode setup screen on the HMI.

Alarms

What's in this Chapter

- This chapter provides a description of alarm types used in the controllers.
- Definitions of alarm parameters

What are Alarms?

For the purposes of this section alarms alert an operator when a pre-set threshold, determined by the user as applicable to his particular process, has been exceeded.

Unless they have been produced in a particular application, in EPC3000 series, there are no specific alarms. It is then necessary to wire alarm blocks using iTools (see "Graphical Wiring" on page 194.

They are indicated by flashing the red  beacon in the display. The green PV value will also turn red. If using the default user messages, a message will scroll indicating which alarm is active. The scrolling message may be customised using iTools (see "User Defined Messages" on page 205).

Alarms may also switch an output, usually a relay, to allow external devices to be activated when an alarm is active (see "Example 2: To Connect an Alarm to a Physical Output" on page 195).

Up to 6 process related alarms can be configured in all models.

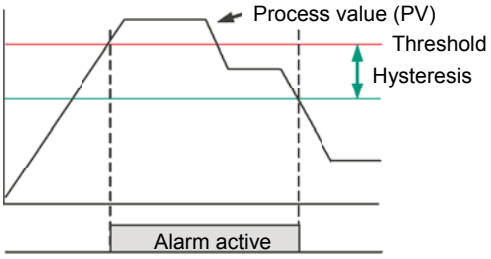
Alarms can also be configured as 'Events'. If an alarm has been configured as an event, when it is active it will not be annunciated on the HMI or in the Instrument Alarm Status Word. Events may be used to operate an output.

Alarm Types

There are 4 distinct types of alarm; Absolute, Deviation, Rate of Change and Digital. These are split into the following 9 alarm types. The descriptions for these 9 alarm types are for the algorithms only, blocking and latching is applied separately, after the active/working state has been determined (See "Blocking" on page 222).

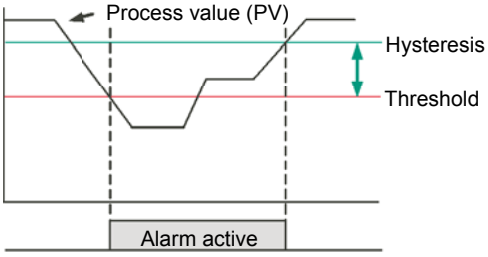
Absolute High

The Absolute High alarm is active when the input is greater than the threshold. It remains active until the input falls below the threshold minus the hysteresis value



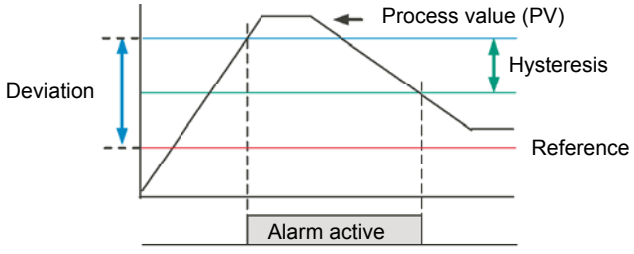
Absolute Low

The Absolute Low alarm is active when the input is less than the threshold. It remains active until the input increases above the threshold plus the hysteresis value.



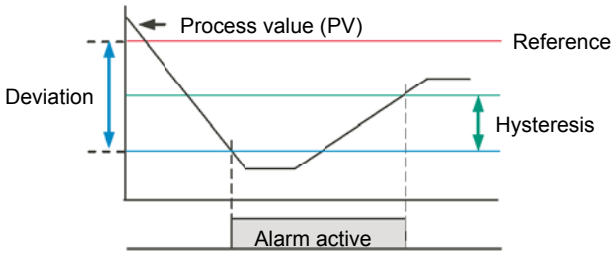
Deviation High

The alarm is triggered when the input becomes higher than the reference by the amount of the deviation. It remains active until the input falls below the hysteresis value.



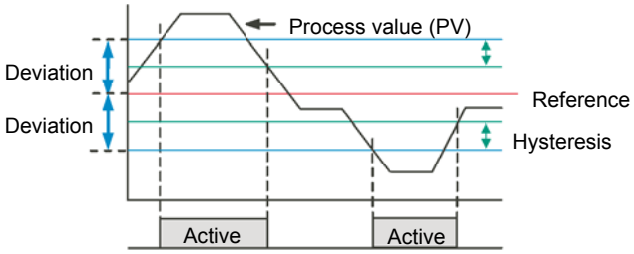
Deviation Low

The alarm is triggered when the input becomes lower than the reference by the amount of the deviation. It remains active until the input increases above the hysteresis value.



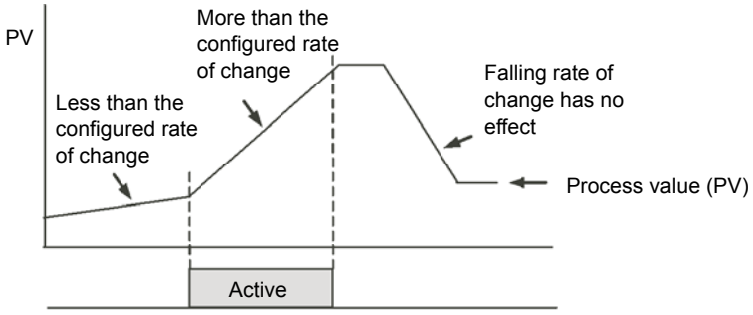
Deviation Band

The Deviation Band alarm is a combination of Deviation High and Deviation Low alarms. The alarm will be active when the input goes outside the deviation band i.e. is greater than the reference plus the deviation OR is less than the reference minus the deviation. It remains active until the input returns to within the reference value, plus/minus the deviation, minus/plus the hysteresis value.



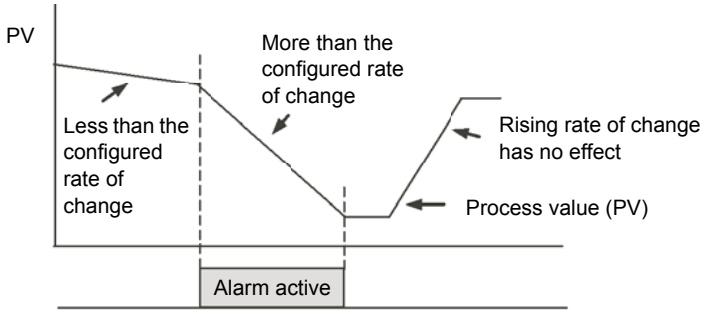
Rising Rate of Change

The Rising Rate of Change alarm sets the alarm active when the rate at which the input increases exceeds the configured maximum rate of change (per change time). It will remain active until the rising rate of the input falls below the configured rate of change



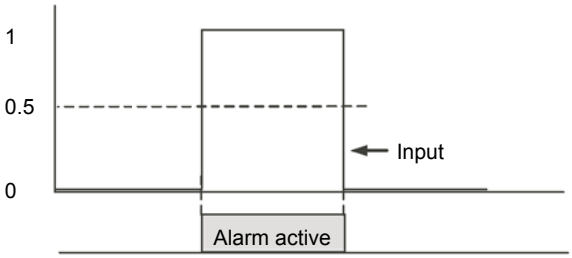
Falling Rate of Change

The Falling Rate of Change alarm sets the alarm active when the rate at which the input decreases exceeds the configured maximum rate of change (per change time). It will remain active until the falling rate of the input falls below the configured rate of change



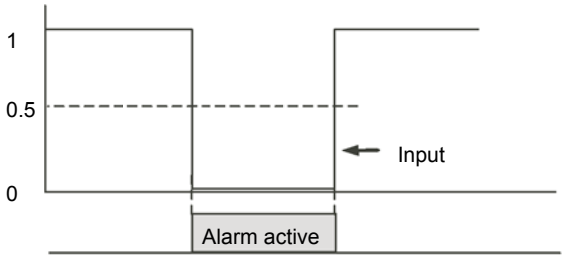
Digital High

The Digital High alarm is effectively an Absolute High alarm with a fixed threshold of 0.5 and 0 hysteresis. It sets the alarm to active when the input is greater than 0.5 (HIGH/TRUE for a digital/boolean input).



Digital Low

The Digital Low alarm is effectively an Absolute Low alarm with a fixed threshold of 0.5 and 0 hysteresis. It sets the alarm to active when the input is less than 0.5 (LOW/FALSE for a digital/boolean input).

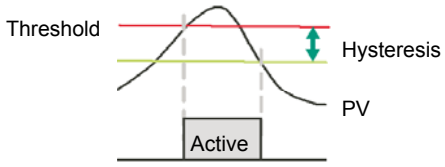


Sensor Break

If the process sensor becomes open circuit an alarm can be generated. The chosen application may already do this, but, if not it must be wired. This is shown in section "Example 3: To Wire Sensor Break" on page 196.

Hysteresis

Hysteresis helps to prevent an alarm output from oscillating (rapidly switching between active and non active) due to electrical ‘noise’ on the monitored parameter. As illustrated in the diagram below, the alarm will become active as soon as the alarm condition has been met (that is, the monitored parameter crosses the threshold value), however, it will only become inactive when the monitored parameter has gone into the region defined by the hysteresis amount.

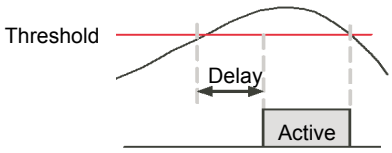


Hysteresis can be disabled by setting a value of 0.0, this is the default value.

Hysteresis is supported for the following analogue alarm types: AbsHi, AbsLo, DevHi, DevLo, DevBand.

Delay

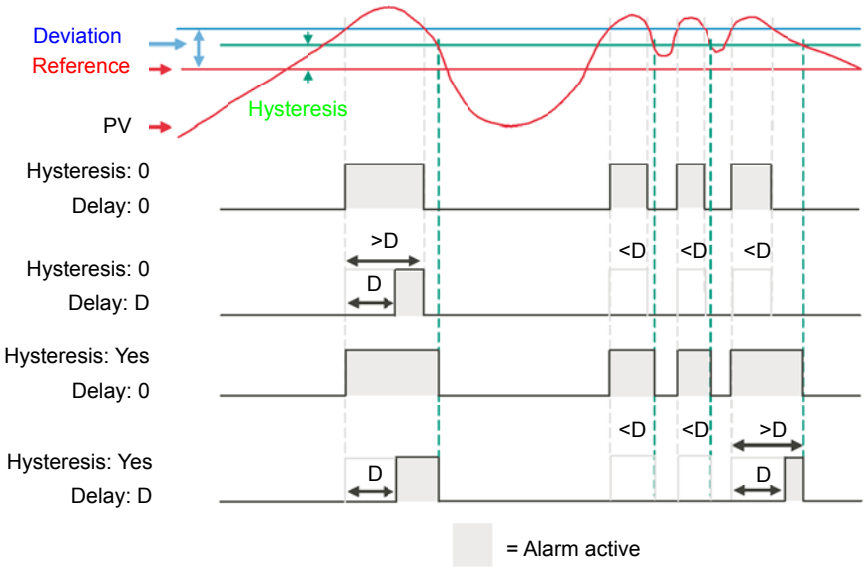
Alarm Delay is supported for all alarm types. This is a small delay between sensing the alarm condition and acting upon it. If in the time between the two, the measured value returns to below the threshold, then the alarm will not be activated and the delay timer is reset.



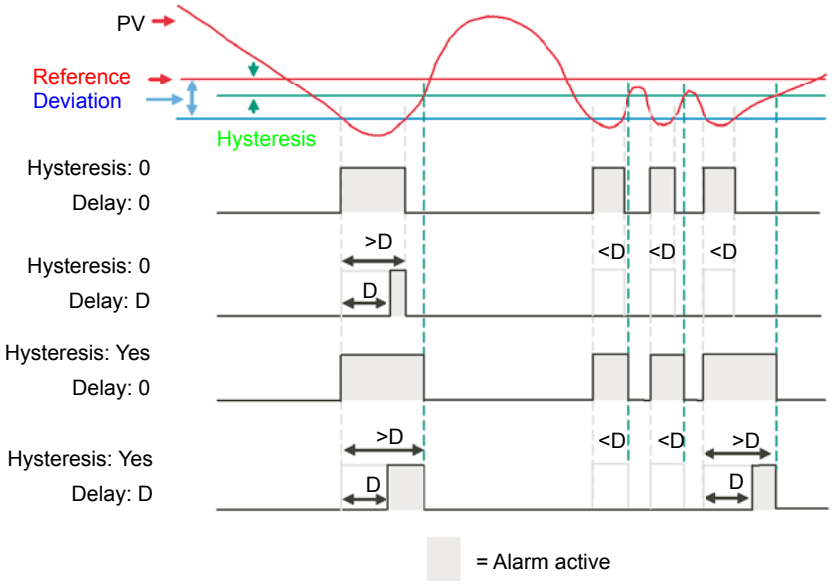
Effects of Delay and Hysteresis

The following diagrams show the effect of delay on hysteresis (for a very out of control process!)

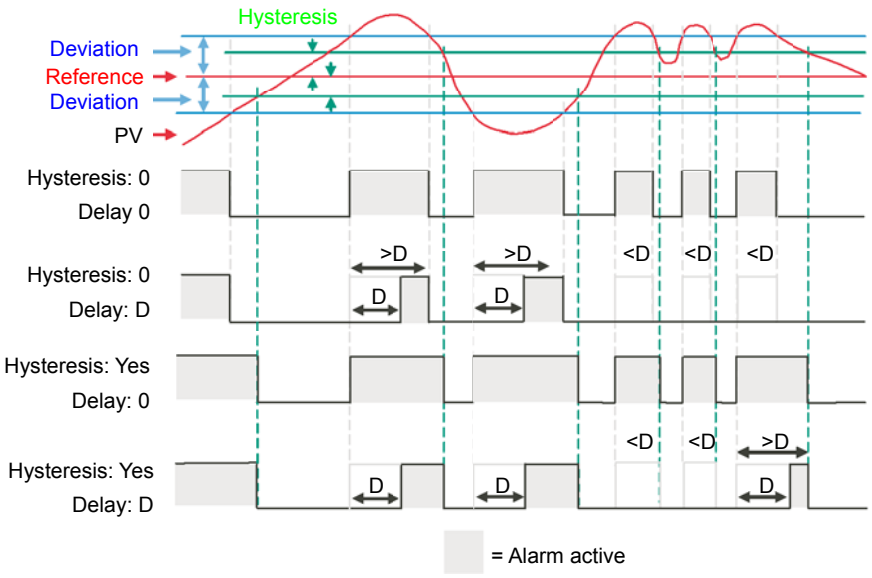
Deviation High



Deviation Low



Deviation Band



Inhibit

Inhibit helps to prevent an alarm from activating when the Alarm Inhibit input is held High. Alarm Inhibit is supported for all alarm types.

Standby Inhibit

Standby inhibit helps to prevent an alarm from activating when the instrument is in Standby "Standby" on page 67. This includes when the instrument is in configuration mode. Alarm Standby Inhibit is supported for all alarm types.

Latching

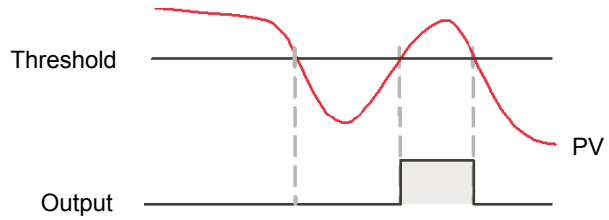
Alarm latching is used to hold the alarm condition active once an alarm has been detected.

The following latching types are supported for all alarm types:

Type	Description
None	No latching methodology i.e. when the alarm condition is removed the alarm will become inactive without being acknowledged.
Auto	The alarm will remain active until the alarm condition has been removed and the alarm has been acknowledged. The alarm can be acknowledged **at any time** after the alarm has become active.
Manual	The alarm will remain active until the alarm condition has been removed and the alarm has been acknowledged. The alarm can only be acknowledged **after** the alarm condition has been removed.
Event	Same as a non-latching alarm except the alarm is used as a trigger and therefore will not be displayed.

Blocking

Blocking stops an alarm from being activated until the value of the monitored parameter (for example PV) has first achieved the desired working state. It is typically used to ignore start-up conditions which are not representative of running conditions. Blocking of alarms is supported for all alarm types.



Blocking will be enforced after a power-cycle or after exit from configuration depending upon the latching status of the alarm as follows:

- For a non-latching alarm or an event alarm, blocking will be enforced.
- For an auto-latching alarm, blocking will be enforced only if the alarm had been acknowledged prior to the power cycle or exit from configuration level.
- For a manual-latching alarm, blocking will not be enforced.
- Blocking will be enforced for a Deviation alarm if the reference value is changed. It should be noted that if the reference value is wired from an electrically 'noisy' input then blocking should be disabled otherwise the alarm will continually be blocked.
- Blocking will be enforced, regardless of current active state and latching method, if the alarm is inhibited (either inhibit or standby inhibit).

To Set Alarm Threshold

The levels at which absolute high and absolute low process alarms operate are adjusted by the THRESHOLD parameter, THLD, found, by default, in Level 3 or Configuration Level.

It is also possible to 'promote' the threshold parameters to Levels 1 and 2 using iTools (see "Parameter Promotion" on page 203).

Select the appropriate operating level as described in "Operator Levels" on page 69.

Press  until the required alarm threshold is shown.

Press  or  to raise or lower the alarm threshold.

Alarm Indication

If any alarm is active and not acknowledged, the red  beacon will flash and the scrolling message will show the alarm number and its type, for example ALARM 1 ABSH. When any alarm is active and not acknowledged then the PV value on the top line will be red.

If more than one alarm is present each alarm message is scrolled in turn.

The alarm beacon will only turn off when all alarms are not active and have been acknowledged (if required).

Any output (usually a relay) attached to an alarm will operate and its corresponding beacon will be lit. To attach an output to an alarm see "Example 2: To Connect an Alarm to a Physical Output" on page 195.

It is normal to configure the relay to be de-energised in alarm so that an alarm can be indicated externally if power to the controller is removed.

To Acknowledge an Alarm

When on the Home page, by default press and together. This is true unless the functionality of these buttons has been changed using the PS.Fn parameter, see "Display Functionality Sub-List (Hmi)" on page 169.

If the alarm is still active the beacon will go steady but the scrolling message still shows.

There are other ways in which an alarm can be acknowledged:

1. In Level 3 or Configuration level select the list header which applies to the alarm then scroll to the parameter ACK - ACKNOWLEDGE. Then press or to YES. This reverts to no as soon as the command is confirmed.
2. The ACK parameter can be 'promoted' to levels 1 or 2 using iTools in which case it appears in the chosen operator list. See "Parameter Promotion" on page 203.
3. F1 or F2 function keys can be configured to alarm acknowledge. See "Display Functionality Sub-List (Hmi)" on page 169.
4. A digital input can be wired using iTools to alarm acknowledge. The procedure is the same as described in section "Example 2: To Connect an Alarm to a Physical Output" on page 195.
5. Use the "Global Ack" parameter in the instrument block to acknowledge all alarms.

The action which takes place depends on the latching type of the alarm configured. The following table shows a step by step action which takes place in the controller:

nonE	Non latching	A non latching alarm will reset itself when the alarm condition is removed. If it is still present when acknowledged the beacon illuminates constantly, the scrolling alarm messages remain and the output remains active.	
Auto	Automatic	An auto latching alarm requires acknowledgement before it is reset. The acknowledgement can occur BEFORE the condition causing the alarm is removed. An example of the action for Alarm 1 attached to OP3 is described below:	
		Alarm occurs	will flash. The top row changes to red. A scrolling message will be displayed. Output 3 is active and beacon 3 is ON.
		Acknowledge (the alarm is still present)	is constant. The scrolling message remains. Output 3 is active and Beacon 3 is ON.
		Alarm condition is removed.	All conditions are reset.
		Alarm occurs	will flash. The top row changes to red. A scrolling message will be displayed. Output 3 is active and beacon 3 is ON.
		Alarm 1 condition is removed	No change from the above.
		Acknowledge (the alarm condition has been removed)	The alarm indication and output are reset

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. An example of the action for Alarm 1 attached to OP3 is described below:	
		Alarm occurs	 will flash. The top row changes to red. A scrolling message will be displayed. Output 3 is active and Beacon 3 is ON.
		Acknowledge (the alarm is still present)	No change from above
		Alarm condition is removed	No change from above
		Acknowledge (the alarm condition has been removed)	The alarm indication and output are reset
Event	Event	No alarm indication and no latching. An example of the action for Alarm 1 attached to OP3 is described below:	
		Alarm occurs	Beacon 3 is ON. Output 3 is active
		Acknowledge (the condition is still present)	No change from above
		Alarm 1 condition is removed.	The output is reset.

By default alarms are configured as non-latching, de-energised during an alarm.

It is possible to mix alarms between any of the latching types listed above. Each alarm configured will behave independently.

A ‘Global Alarm Acknowledge’ parameter is available by default in Level 3 in the ‘Instrument - Diagnostics’ list. This may be wired in the same way as other parameters (for example, to a digital input) and is used to acknowledge all alarms.

Alarms Advanced

Behaviour of Alarms after a Power Cycle

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

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

For a non-latching alarm, blocking, if configured, will be re-instated. If blocking is not configured the active alarm will remain ‘active’. If the alarm condition has returned to within the threshold value during the down time, then the alarm will return ‘inactive’.

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

For a manual-latching alarm, blocking will not be re-instated and the active alarm will remain ‘active’. If the alarm condition has returned to within the threshold value during the downtime, then the alarm will return ‘inactive but not acknowledged’. If the alarm was ‘inactive but not acknowledged’ prior to the power cycle the alarm will return ‘inactive but not acknowledged’.

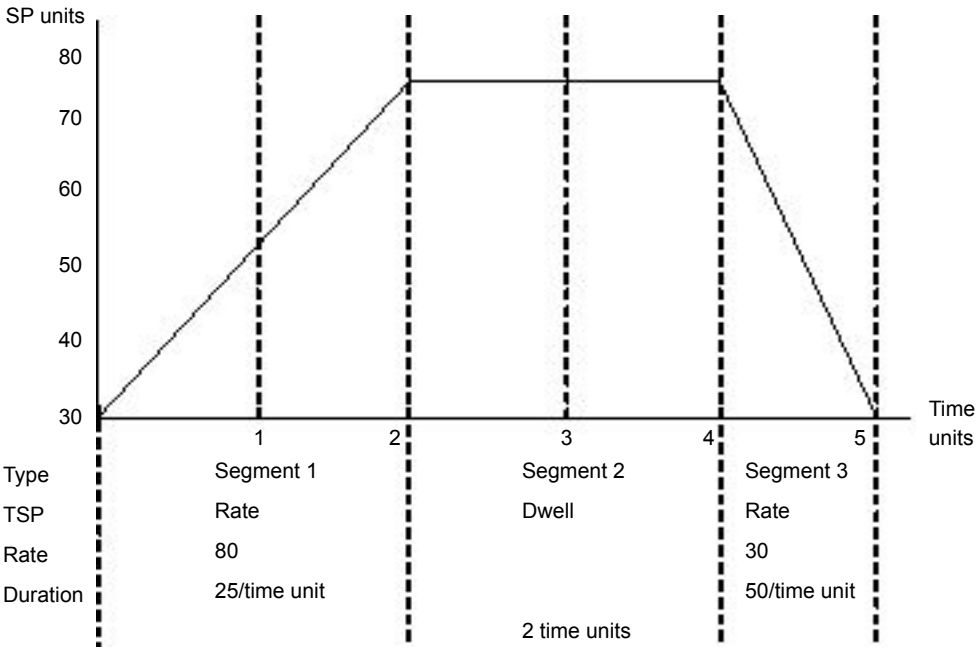
Programmer

What's in this Chapter

This chapter describes the functionality of a setpoint programmer

What is a Programmer?

A programmer provides a means of being able to vary the setpoint in a controlled manner over a set period of time. This varying setpoint can then be used in the control process.



The example above shows a simple three segment program in which the programmer setpoint (PSP) increases at a controlled rate of 25/time unit to a value of 80. It then dwells at that setpoint for 2 time units before decreasing to 30 at a controlled rate of 50/time unit.

The programmer in the EPC range is a single channel programmer and can be ordered in three different options. These are:

- Basic Programmer (1x8 configurable segments, no event output)
- Single Full Functionality Program (1x24 configurable segments with up to 8 event outputs)
- Multiple Full Functionality Programs (10x24 configurable segments with up to 8 event outputs)
- An additional End segment is provided which may also have EventOutputs configured if supported.

Programs

A program is a sequence of varying setpoints which executes with reference to time. Up to a maximum of 10 programs are supported, the actual number of programs is set via Feature Passcodes (see "Security Sub-List (SEC)" on page 171). Program options are:

None, 1x8 configurable segments, 1x24 configurable segments10x24 configurable segments.

Programs are identifiable by a program number i.e. 1…10.

Segments

A segment is a single step within a program, typically it has a specified target setpoint and either a duration to maintain that setpoint, or a ramp rate (or time) to achieve that setpoint, however other segment types instruct the programmer to perform additional tasks.

Up to 24 configurable segments are supported, plus a fixed end segment, in each program. Each segment (in a program) is identifiable by a segment number i.e. 1…25.

The following types of segments are supported:

Time To Target

A time to target segment is specified by a target setpoint and a time in which to achieve the ramp to target setpoint.

Dwell

A dwell segment specifies how long the setpoint is to be maintained

Step

A step segment causes the programmer setpoint to change to the target setpoint in a single execution cycle.

Note: the step will occur immediately followed by a 1 second dwell period to allow event outputs to be set.

Call

A call segment allows the main program to call another program as a subroutine. The number of times the program is called is configurable, 1…9999 or continuous.

Note: A program can only call other programs which have a program number greater than itself, this helps to prevent cyclic programs from being created.

This segment type is only available if multiple programs are enabled via Feature Passcodes and the program is not the last program i.e. Program 10. All configurable segments (1–24) can be configured as a call segment.

⚠ CAUTION

CALL SEGMENTS

If a call segment is selected the controller will default to calling the next program number. This may not necessarily be the correct program so you must ensure that the correct call program number is selected manually.

Failure to follow these instructions can result in injury or equipment damage.

End

An end segment is the very last segment in a program and using the Program.ProgramEndType parameter, the user can specify the programmer behaviour when the program ends, as follows:

- Dwell—the programmer setpoint (PSP) is maintained indefinitely and event outputs remain at the states configured for the End segment.
- Reset—the program is reset and the programmer setpoint (PSP) will servo either to PVInput value or SPInput value as configured by the Programmer.Setup.ServoTo parameter. The event outputs will return to the states specified by the Programmer.Setup.ResetEventOP parameter..
- Track - the programmer setpoint (PSP) is maintained indefinitely and event outputs remain at the states configured for the End segment. If the Programmer is wired to the Loop, the Loop will be forced into Track mode

Note: The 1st end segment will terminate the program in the configured manner if there no more program cycles left to run.

Standard Functionality

The EPC3000 process controller supports the following standard functionality:

Recovery Strategy

The recovery strategy after an instrument reset or a power outage can be configured to be:

Ramp Back—the programmer setpoint will servo (jump to) the input Process Value (PV), and ramp to the target set-point at the rate prior to the power outage.

Reset—the programmer will reset the program.

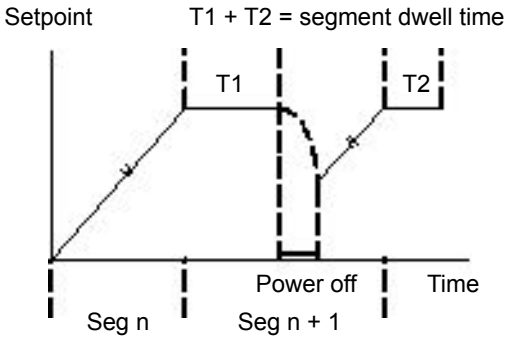
Continue—the programmer setpoint will return immediately to its last value prior to the reset and the program will continue to run.

This is shown diagrammatically in the following sections.

Ramp back (Power outage during Dwell segments.)

If the interrupted segment was a Dwell, then the ramp rate will be determined by the previous ramp segment.

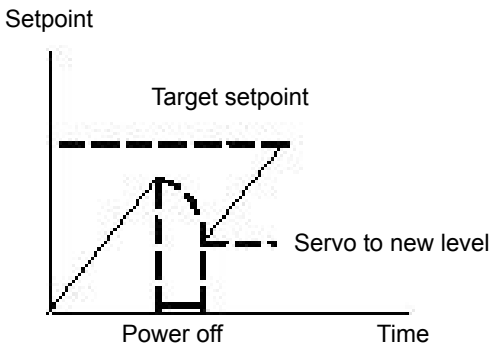
On achieving the Dwell setpoint, the dwell will continue from the point at which the power was interrupted.



If a previous ramp segment does not exist, i.e. the first segment of a program is a dwell, then the Dwell will continue at the "servo to PV" setpoint.

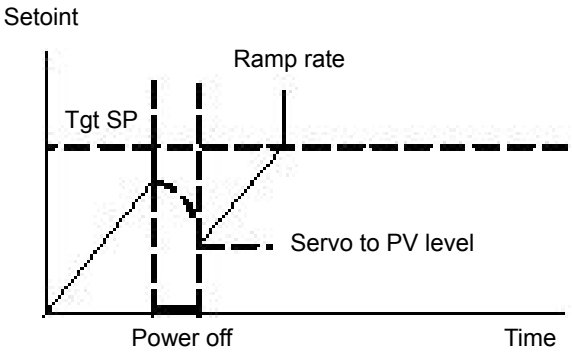
Ramp back (Power outage during Ramp segments)

If the interrupted segment was a ramp, then the programmer will servo the programmer setpoint to the PV, then ramp towards the target setpoint at the previous ramp rate. Previous ramp rate is the ramp rate at power outage.



Ramp back (Power outage during Time-to-target segments)

If the programmer was defined as a Time-to-Target programmer then when the power is returned the previous ramp rate will be recovered. The Time remaining will be recalculated. The rule is to maintain RAMP RATE, but alter TIME REMAINING.



Sensor Break Recovery

If the recovery strategy is set to Reset, then, upon sensor break of the PV input, the program will be reset. If the recovery strategy is other than Reset, then the program will be placed in Hold. When the PV input goes out of sensor break, the programmer will apply the recovery strategy described above.

Holdback

When the PV deviates from the Programmer Setpoint (PSP) by more than a specified amount the program will temporally hold until the PV returns to within the specified deviation.

Holdback Style configures Holdback to operate over the entire program or on a per segment basis (mutually exclusive).

Holdback Type may be set to Off, Low, High or Band.

- Off: Holdback disabled.
- Low: Active if PV < (PSP − Holdback Value)
- High: Active if PV > (PSP + Holdback Value)
- Band: Active if (PV < (PSP − Holdback Value)) OR (PV > (PSP + Holdback Value))

Servo To PV/SP

The programmer can be set to servo (jump to) the PV input or the Setpoint input at the start of a program.

Event Outputs

Up to 8 digital 'event' outputs can be configured for each segment within a program. These event outputs will remain at their configured value for the entire duration of the segment.

Digital Inputs

The following digital inputs are supported:

- Run - start the current program on the rising edge of this input.
- Hold - hold the current program whilst this input is High.
- Reset - current program is in reset whilst this input signal is High.
- Run/Hold - This is a dual action input. A rising edge will run the current program, but hold the current running program whilst the input is Low.
- Run/Reset - This is a dual action input. A rising edge starts the current program, but reset the current program whilst input is Low.
- Advance - a rising edge initiates the following sequence of actions:
  - go to the end of the current segment
  - set the programmer setpoint to the target setpoint
  - start the next segment.

Program Cycles

A program can be configured to repeat 1…9999 times or run continuously.

Configuration Mode Reset

It is not permissible to run a program whilst the instrument is in configuration mode. If a program is running and the instrument is placed into configuration mode (either by comms or HMI) the running program will be reset.

Program Selection

When multiple programs are configured, selecting the program to be run is done by setting the Programmer.ProgramNumber parameter to the required program number. This selection can be performed via the HMI or Comms.

It is often convenient to use a BCD switch physically connected to digital inputs as shown in the "Example BCD Switch Wiring" on page 50.

The program selected can then be run using Mode parameter or any of the Run digital input parameters, i.e., Run, RunHold or RunReset digital input.

Rules for Program Creation / Editing

It is possible to create and edit a stored program, i.e., Programs 1-10, (via Comms or the HMI) when the programmer is in RUN, HOLD or RESET mode, with the changes being retained.

When running one of the stored programs it will first be copied into the 'working' program which will then be run. It is NOT be possible to edit the working program when the programmer is in RESET, but it can be edited when the programmer is in RUN or HOLD, however, the changes will be overwritten when a different program is loaded to be run. Edits to the working program will not change the stored programs. The working program will be overwritten when the next stored program is copied into it, either as a result of running a new program or calling another program as a subroutine.

A Programmer Run list is provided (both via Comms and HMI) which can edit a copy of the working program segment that is currently running when the programmer is in HOLD mode, however the changes will be overwritten when the next segment is loaded and run.

The minimum operator access level at which programs can be created/edited can be configured as Level 1, Level 2 or Level 3.

Program & Segment Times

Segment Time Left is always available whilst a program is running.

The Programmer will attempt to calculate Program Time left when the program is running or when the working program is edited while the program is on Hold. If the calculation takes too long, it will be aborted and the Program Time Left parameter will not be available.

Resolution

When read/written via scaled integer comms, the units of the following segment parameters can be configured as follows:

- Segment.Duration (sec/min/hour) configured by Program.DwellUnitsTime (sec/min/hour)
- Segment.TimeToTarget (sec/min/hour) configured by Program.RampUnits
- Segment.RampRate (per sec/per min/per hour) configured by Program.RampUnits

In addition, when read/written via scaled integer comms, it is possible to configure the units for the following time remaining parameters:

- Programmer.Run.ProgramTimeLeft (sec/min/hour) configured by Programmer.Setup.Resolution
- Programmer.Run.SegmentTimeLeft (sec/min/hour) configured by Programmer.Setup.Resolution (sec/min/hour)

On the HMI, time-based parameters are displayed, depending on their configured units, as follows:

- sec - MM:SS
- min - HH:MM
- hour- HHH.H

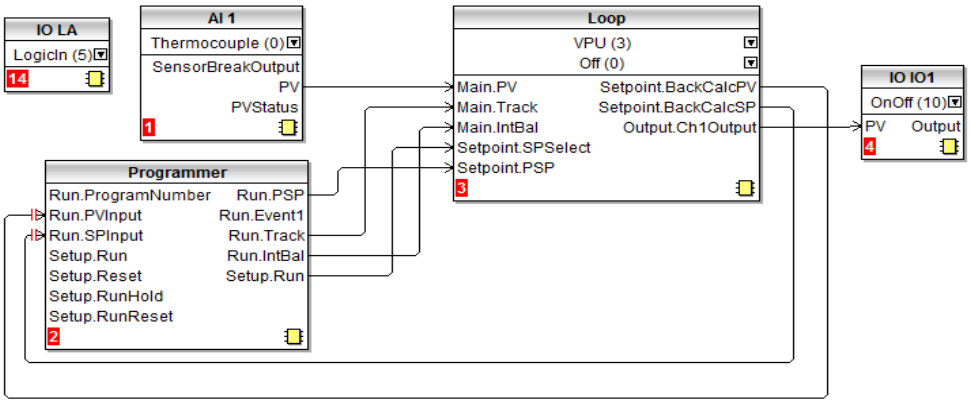
Times are stored as 32-bit integer millisecond values, and as such times will be capped at 500hrs i.e. 1,800,000,000ms. When a program exceeds this value, program time left will remain at 500hrs until such time that the accumulative segment times is 500hrs or less.

Programmer Time Base Accuracy

The programmer timebase accuracy is dependent upon the timebase accuracy of the microcontroller which is specified as <+/-50ppm between the temperature range -40 to +85 degrees C. This equates to a worst case of +/-4.3s in 24hrs.

Typical Loop to Programmer Graphical Wiring

The figure below shows a simple soft wiring diagram for a programmer.



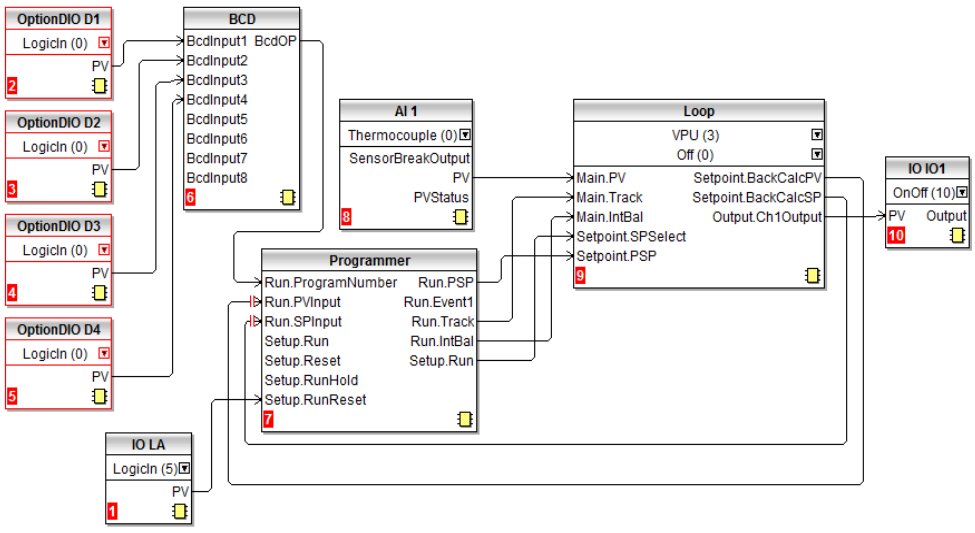
Soft wiring is carried out using iTools and is described in section "Graphical Wiring" on page 194.

In the figure a thermocouple is connected to Analogue Input AI1. The PV output from AI1 provides the input to the control loop. The setpoint for the control loop is provided by the programmer block using the parameter Run.PSP. The programmer will run when the Setup.Run parameter changes to true. In this example the LA digital input may be used to Run/Reset the programmer from an external source.

Integral balance is required so that there is no sudden change of output when the programmer is operated.

The loop heat output is connected to output IO1.

As previously mentioned program selection can be wired to a BCD switch. An example of the soft wiring for this for EPC3008 or EPC3004 using a four or eight digital input option is shown in the diagram below.



Communications

Programs can be configured and run via Modbus and EI-Bisync communications.

The Modbus parameter addresses and EI-Bisync Mnemonics for the programmer parameters, program parameters, and the segment parameters (for the 1st 16 segments) are compatible with the 2400 series controllers.

Note: In the 2400 series controllers, (and therefore in the EPC3000 process controller to allow compatibility), several parameters within segments are mutually exclusive and are accessed via comms using the same Modbus Address and EI-Bisync Mnemonic.

Modbus Address Ranges

2400 Compatible - Program General Data & Segments 1…16 Parameters

Area	Base Address - Decimal	Base address - HEX
Program 0 (Currently running program)	8192	2000
Program 1	8328	2088
Program 2	8464	2110
Program 3	8600	2198
Program 4	8736	2220
Program 5	8872	22A8
Program 6	9008	2330
Program 7	9144	23B8
Program 8	9280	2440
Program 9	9416	24C8
Program 10	9552	2550
Non-compatible - Segments 17…26 & Additional Programmer Parameters		
Area	Base Address - Decimal	Base address - HEX
Program 0	9688	25D8
Program 1	9768	2628
Program 2	9848	2678
Program 3	9928	26C8
Program 4	10008	2718
Program 5	10088	2768
Program 6	10168	27B8
Program 7	10248	2808
Program 8	10328	2858
Program 9	10408	28A8
Program 10	10488	28F8
Programmer (additional parameters)	10568 - 11007	2948 - 2AFF

EI-Bisync Mnemonics

EI-Bisync Mnemonics: *n* is dependent upon segment number i.e.

Segment 1, n is 1	Segment 2, n is 2	Segment 3, n is 3	Segment 4, n is 4
Segment 5, n is 5	Segment 6, n is 6	Segment 7, n is 7	Segment 8, n is 8
Segment 9, n is 9	Segment 10, n is :	Segment 11, n is ;	Segment 12, n is <
Segment 13, n is =	Segment 14, n is >	Segment 15, n is ?	Segment 16, n is @

It should be noted that Ei-Bisync is intended for 2400 series controller compatibility only and as such it is not extended to include mnemonics for segments 17–25.

To Set-up a Program

By default programs can be set up and run via the controller HMI in Operator Level 2 or higher. Access levels can be configured using Edit access and Run access parameters, refer to "Programmer List (PROG)" on page 125.

For the purposes of this example, it is assumed that parameters in the PROGRAMMER LIST (PROG) have been set up and the HMI is in Operator Level 2.

Operation	Action	Display	Notes
Select PROGRAM SETUP List	1. Press until P.SEt is shown 2. Press to enter 3. Press or to select the program number	1 P NUM	Up to 10 programs may be selected.
Select the Holdback style	4. Press 5. Press or to select the style	PROG HB STY	Prog = Holdback is applied to the whole program. SEGm = Holdback is applied separately to each segment
Select Holdback type	6. Press 7. Press or to select the Holdback type	LOw HB TYP	Low - in Holdback when PV < (PSP - Holdback value) High - in Holdback when PV > (PSP + Holdback value) Band - in Holdback when (PV < (PSP +/- Holdback Value)) OR (PV > (PSP + Holdback Value)) Off - No Holdback
Set Holdback value	8. Press 9. Press or to select the Holdback value	10.0 HB VAL	The program will hold if the low deviation is greater than 10.0 and PSP > PV.
Set Ramp Units	10. Press 11. Press or to select the Ramp units	P.SEC RAMP U	Per second Per minute Per hour
Set Dwell units	12. Press 13. Press or to select the Dwell units	P.SEC DWEL U	secs/ mins/ hrs
Set the number of times the program is to repeat	14. Press 15. Press or to select the number of cycles	1 P CYC	1 = The program will execute once Cont = the program will repeat continuously.
Set the action at the end of a program	16. Press 17. Press or to select the End action	dwEL P END	DweL = dwell at the last setpoint Rset = reset Trak = dwell at the last setpoint but also places the loop in Track mode provided Loop is wired to Programmer

Operation	Action	Display	Notes
Set up the first segment	18. Press ↵ 19. Press ∧ or ∨ to select the segment number		Segment number 1
Set up the segment type	20. Press ↵ 21. Press ∧ or ∨ to select the Segment type		Can be configured to Ramp rate, Ramp time, Dwell, Step, End or Call segments (for multiple-program Programmers with Program number < 10). These are described earlier in this section.
The parameters which follow depend on the type of segment set but will include: Target Setpoint, Ramp Rate for Rate type segments. Target Setpoint, Time to target for Time type segments Duration for Dwell type segments Target Setpoint for Step type segments Call Program number and Call Cycles for Call type segments Event Outputs will be shown at the end of each segment if Programmer.Setup.MaxEvents > 0 When the currently selected segment has been set up the next parameter will automatically choose the next segment number.			
Set up the end segment	22. Press ↵		The last segment is an end type

The previous example shows how to configure a stored program (Program 1). When a program is running, the working program parameters will become available and can be configured in the same manner.

To Run/Hold the Program

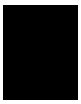
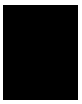
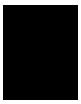
Assuming the program has been set up as described above, from the HOME display

1. Press to PROGRAMMER list (PROG)
2. Press to select the Program number
3. Press again to PROGRAM MODE
4. Press or to select run or HOLd

Alternatively, press a function key if configured as Program Run/Hold or Program Run/Reset or activate a digital input, configured as Run, Hold, Run/Hold and Run/Reset.

The status of the program is shown by the HMI crow's foot indicator 

The current status of the program is displayed as follows:

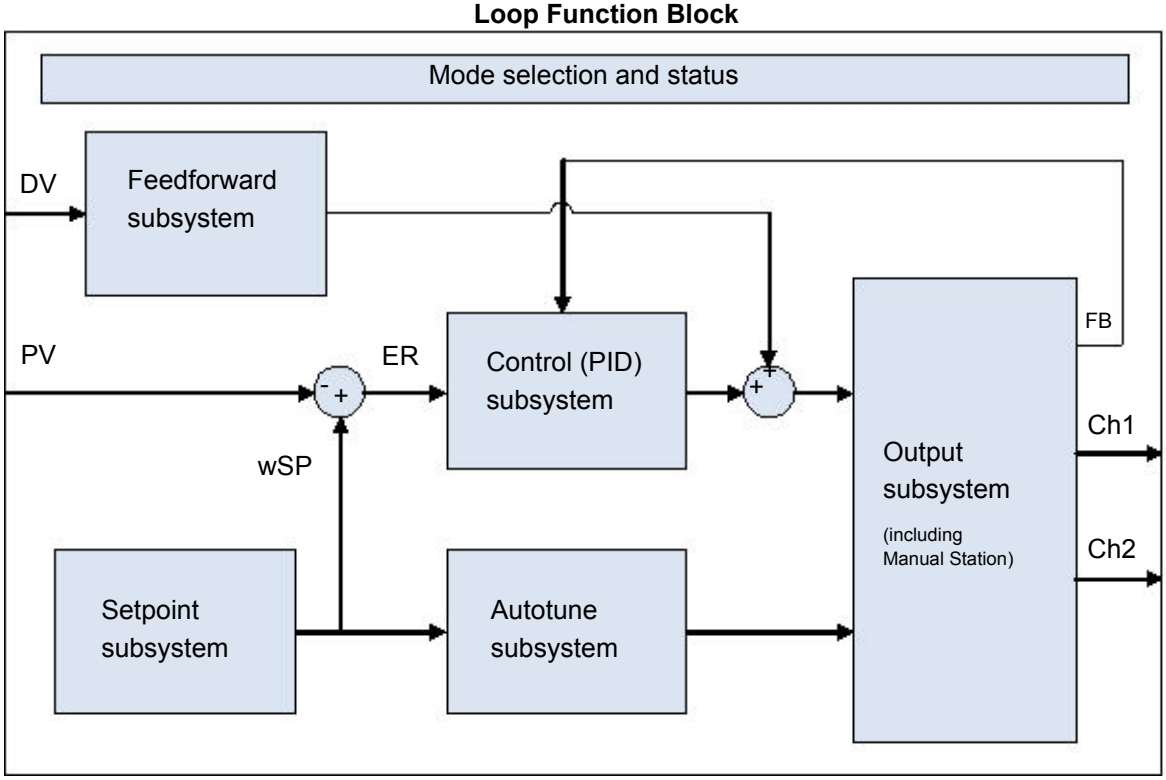
State	Ramp/Step Up	Dwell	Ramp/Step Down
Reset			
Run			
Hold/Holdback	 Flashing (1 second period 66% duty cycle)	 Flashing (1 second period 66% duty cycle)	 Flashing (1 second period 66% duty cycle)
Complete (Dwell End)	Not applicable	 Flashing (2 seconds period 66% duty cycle)	Not applicable

Control

The ‘Loop’ function block contains and coordinates the various control and output algorithms. The diagram below shows the top-level structure of the Loop function block for a heat only or heat/cool temperature controller.

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). The controller calculates an output value to call for heating or cooling so that the difference between set and measured temperature is minimised. 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 deliver the demanded heating (or cooling). This, in turn. is detected by the temperature sensor. This is referred to as the control loop or closed loop control.

Loop Function Block



Types of Control

Three types of control loop may be configured. These are PID control, On/Off control, or control of motorised valves

PID Control

PID, also referred to as 'Three Term Control', is an algorithm which continuously adjusts the output, according to a set of rules, to compensate for changes in the process variable. It provides more stable control but the parameters need to be set up to match the characteristics of the process under control.

The three terms are:

Proportional term PB

Integral term TI

Derivative term TD

The Eurotherm PID algorithm is based upon an ISA type algorithm in its positional (non-incremental) form.The output from the controller is the sum of the contributions from these three terms.The simplified Laplace transform is:

OP/ER = (100/PB) (1 + 1/sTI + sTD)

The combined output is a function of the magnitude and duration of the error signal, and the rate of change of the process value.

It is possible to turn off integral and derivative terms and control on proportional only (P), proportional plus integral (PI) or proportional plus derivative (PD).

An example of where PI control might be used i.e. D is turned off, is process plants (flows, pressures, liquid levels), which are inherently turbulent and noisy, causing valves to fluctuate wildly.

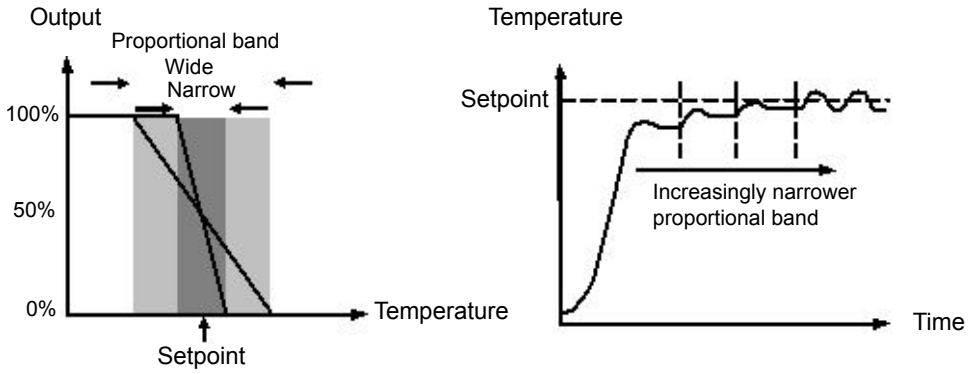
PD control may be used, for example, on servo mechanisms.

In addition to the three terms described above, there are other parameters which determine how well the control loop performs. These include High and Low Cutback and Manual Reset and are described in detail in subsequent sections.

Proportional Term 'PB'

The proportional term, or gain, delivers an output which is proportional to the size of the difference between SP and PV. It is the range over which the output power is continuously adjustable in a linear fashion from 0% to 100% (for a heat only controller). Below the proportional band the output is full on (100%), above the proportional band the output is full off (0%) as shown in the diagram below.

The width of the proportional band determines the magnitude of the response to the error. If it too narrow (high gain) the system oscillates by being over responsive. If it is too wide (low gain) the control is sluggish. The ideal situation is when the proportional band is as narrow as possible without causing oscillation.



The diagram also shows the effect of narrowing proportional band to the point of oscillation. A wide proportional band results in straight line control but with an appreciable initial error between setpoint and actual temperature. As the band is narrowed the temperature gets closer to setpoint until finally becoming unstable.

The proportional band can be specified in engineering units or in percent of span (RangeHigh – RangeLow). Engineering Units is recommended for its ease of use.

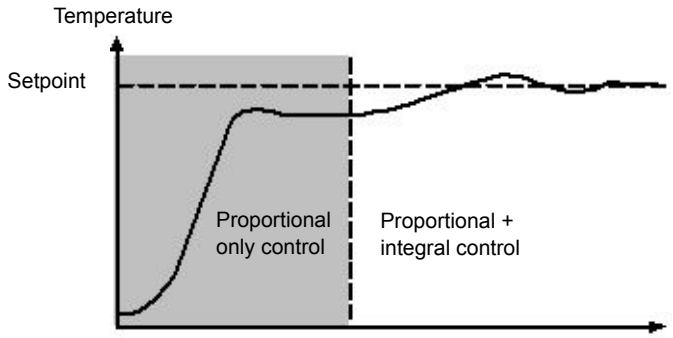
Previous controllers had the parameter Relative Cool Gain (R2G) to adjust the cool proportional band relative to the heat. This has been replaced by separate proportional bands for Channel 1 (Heat) and Channel 2 (Cool).

Integral Term 'TI'

In a proportional only controller, a difference between setpoint and PV must exist for the controller to deliver power. Integral is used to reduce this to a zero steady state control.

The integral term slowly shifts the output level as a result of a difference between setpoint and measured value. If the measured value is below setpoint the integral action gradually increases the output in an attempt to correct the difference. If it is above setpoint integral action gradually decreases the output or increases the cooling power to correct the difference.

The diagram below shows the result of introducing integral action.



The units for integral are measured in time. The longer the integral time constant, the more slowly the output is shifted and results in a sluggish response. Too small an integral time will cause the process to overshoot and even oscillate. The integral action may be disabled by setting its value to Off(0), in which case manual reset will be made available.

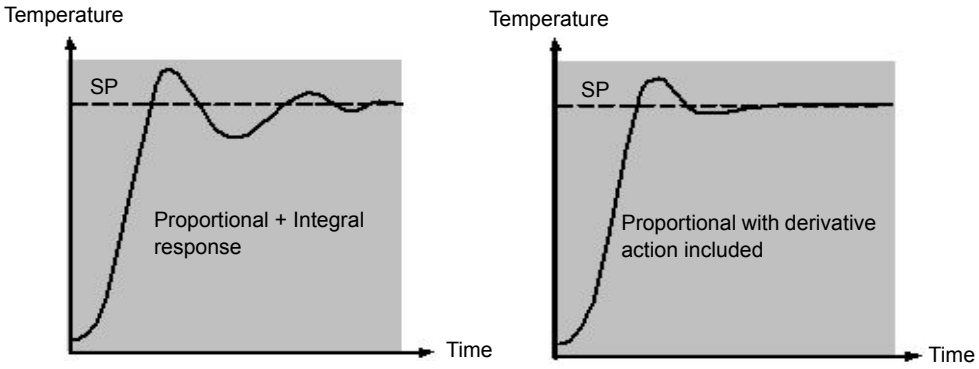
The integral time is always specified in seconds. In US nomenclature, the integral time is equivalent to ‘seconds per repeat’.

Integral Hold

When the IntegralHold parameter is turned on, the output value contained in the integrator will be frozen. It will be maintained even through mode changes. This can sometimes be useful e.g. in a cascade to stop the master integral winding up when the slave is saturated.

Derivative Term 'TD'

Derivative action, or rate, provides a sudden shift in output as a result of a rapid change in error. If the measured value falls quickly derivative provides a large change in output in an attempt to correct the perturbation before it goes too far. It is most beneficial in recovering from small perturbations.



The derivative modifies the output to reduce the rate of change of the difference. It reacts to changes in the PV by changing the output to remove the transient. Increasing the derivative time will reduce the settling time of the loop after a transient change.

Derivative is often mistakenly associated with overshoot inhibition rather than transient response. In fact, derivative should not be used to curb overshoot on start up since this will inevitably affect the steady state performance of the system. Overshoot inhibition is best left to the approach control parameters, High and Low Cutback, described below.

Derivative is generally used to increase the stability of the loop, however, there are situations where derivative may be the cause of instability. For example, if the PV is electrically noisy, then derivative can amplify that electrical noise and cause excessive output changes, in these situations it is often better to disable the derivative and re-tune the loop.

Derivative time is always specified in seconds. Derivative action can be turned off by setting the derivative time to Off(0).

Derivative on PV or Error (SP - PV)

By default, derivative action is applied to the PV only and not to the error (SP - PV). This helps to prevent large derivative kicks when the setpoint is changed.

If required, derivative can be switched to error using the DerivativeType parameter. This is not usually recommended but can, for example, reduce overshoot at the end of SP ramps.

Manual Reset (PD Control)

In a full three-term controller (that is, a PID controller), the integral term automatically removes the steady state error from the setpoint. Turn off the integral term to set the controller to PD. 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.

This value must be set manually in order to remove the steady state error.

Cutback

Cutback is a system of approach control for process start-up and for large setpoint changes. It allows the response to be tuned independently of the PID controller, thereby allowing optimum performance for both large and small setpoint changes and disturbances. It is available for all control types except OnOff.

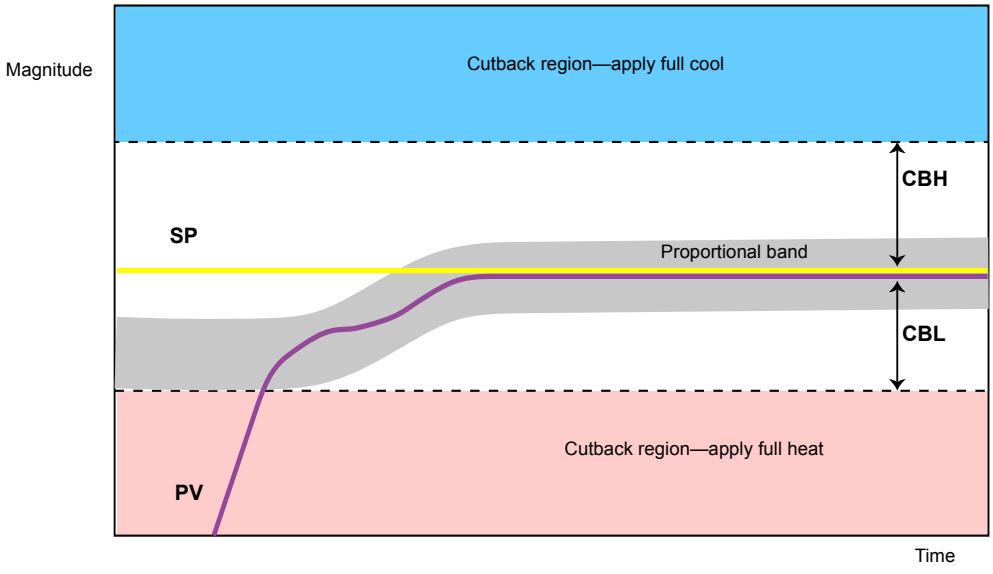
The cutback high and low thresholds, CBH and CBL, define two regions above and below the working setpoint. They are specified in the same units as the proportional band. Operation can be explained in three rules:

1. When the PV is more than *CBL* units *below* WSP, *maximum* output is always applied.
2. When the PV is more than *CBH* units *above* WSP, *minimum* output is always applied.
3. When the PV exits a cutback region, the output is returned *bumplessly* to the PID algorithm.

The effect of rule 1 and 2 is to bring the PV towards the WSP as rapidly as possible whenever there exists a significant deviation, just as an experienced operator might do manually.

The effect of 3 is to allow the PID algorithm to immediately start 'cutting back' the power from maximum or minimum when the PV passes the cutback threshold. Remember that, due to 1 and 2, the PV should be moving rapidly towards WSP, and it is this that causes the PID algorithm to start cutting back the output.

By default, CBH and CBL are set to *Auto (0)*, which means that they are automatically taken to be 3 times the proportional band. This is a reasonable starting point for most processes, but rise time to setpoint on start-up or large setpoint changes may be improved by tuning them manually.



Note: Because cutback is a type of non-linear controller, a set of CBH and CBL values that are tuned for one particular operating point may not be satisfactory for another operating point. It is always advisable therefore not to try to tune the cutback values *too* tightly, or otherwise to use gain scheduling to schedule different values of CBH and CBL at different operating points. All the PID tuning parameters can be gain scheduled.

Reverse/Direct Action

For single-channel loops, the concept of reverse and direct action is important.

The ControlAction parameter should be set appropriately:

1. If an increase in control output causes a corresponding increase in PV, such as in a heating process, then set ControlAction to Reverse.
2. If an increase in control output causes a corresponding decrease in PV, such as in a refrigeration process, then set ControlAction to Direct.

The ControlAction parameter is not available for split-range configurations, where channel 1 is always reverse acting and channel 2 is always direct acting.

Loop Break

The loop is considered to be broken if the PV does not respond to a change in the output. An alarm may be initiated but in EPC3000 series this must be explicitly wired using the 'LoopBreak' parameter. 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, two parameters under diagnostics are used to determine if the loop is broken, 'Loop Break Time' and 'Loop Break Delta PV'.

If the control loop is broken, the output will tend to wind up and eventually hit a limit.

Once the output is at the limit, the loop break detection algorithm will monitor the PV. If the PV has not moved by a specified amount (LoopBreakDeltaPV) in twice the specified time (LoopBreakTime), then a loop break will be flagged.

Motorised Valve Positioning Control

Valve Positioning control is used for ‘three-step’ motorised valve actuators that are driven with a digital ‘raise’ and ‘lower’ signal. A common example is a valve modulating the firing rate of a gas-fired furnace or oven. Some valves are already fitted with positioners, in which case these algorithms are not suitable and PID should be used.

The EPC series contains the Boundless (VPU) (or Unbounded) algorithm which does not require a feedback potentiometer.

This type of valve has an inherent travel time – that is the time needed to slew from end-stop to end-stop. This time should be measured as accurately as possible in both directions and the average entered into the appropriate travel time parameter.

Boundless (VPU)

The Valve Positioner boundless (VPU) algorithm operates *without knowledge* of the actual valve position. Therefore, it *does not* require a potentiometer on the valve.

VPU contains a special incremental form of the PID algorithm. It uses the valve itself as an accumulator, to ‘add up’ the increments calculated by the algorithm. Because of this special formulation, it can be treated as a positional algorithm, just like PID itself.

It contains a simple software model of the valve, based on the entered Travel Time, which estimates the valve position (the Working Output). It is important to realise that this estimation is just that, and that over time, particularly long cycles, the displayed Working Output and the real valve position may be completely different. This has no effect on control performance—it is purely a display problem. This model is also used in non-auto modes such as Manual.

With VPU, it is important that the valve travel time is measured and set as accurately as possible. This helps to ensure that the tuning parameters retain their real physical meanings and also helps to ensure proper autotuning, which may otherwise give an unsatisfactory tune. Motor travel time is defined as valve fully open - valve fully closed - it is not necessarily the time printed on the motor since, if mechanical stops have been set on the motor, the travel time of the actual valve may be different

Motorised Valve Control in Manual mode

When manual is selected, the algorithm predicts where the valve will move to based on the value of the manual power.The manual output is set as normal, and the controller will position the valve according to the internal estimated position.

Every time the valve is driven to its end stops the estimated and real positions will tend to realign themselves.

Parameters shown in this section are relevant to the subject being described. Further information is available in the Configuration chapter.

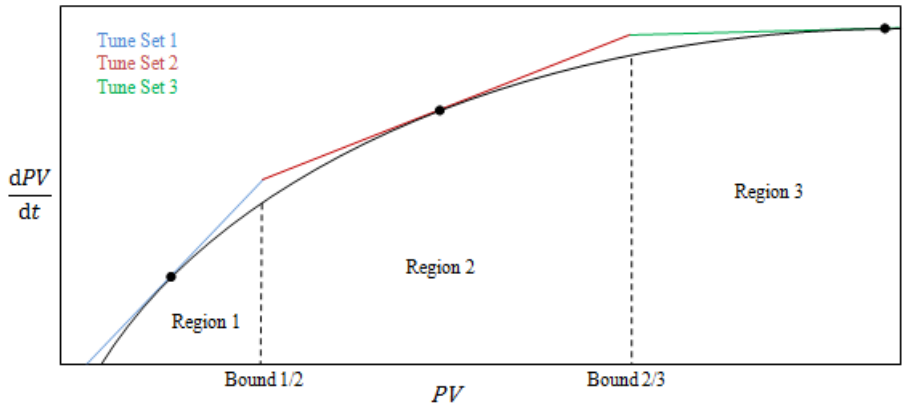
Gain scheduling

Some processes exhibit non-linear dynamics. For example, a heat treatment furnace may behave quite differently at low temperatures than at high temperatures. This is commonly due to the effects of radiant heat transfer, which start to appear above about 700°C. This is illustrated in the diagram below.

It is often unfeasible, then, for a single set of PID tuning constants to perform well over the entire process operating range. To combat this, several sets of tuning constants can be used and 'scheduled' according to the process operating point.

Each set of constants is called a 'gain set' or a 'tune set'. The gain scheduler selects the active gain set by comparing the value of the Scheduling Variable (SV) against a set of boundaries.

An integral balance is issued whenever the active gain set changes. This helps to prevent discontinuities ('bumps') in the controller output.



On-Off Control

Each of the two control channels can be configured for On-Off control. This is a simple type of control often found in basic thermostats.

The control algorithm takes the form of a simple hysteretic relay.

For channel 1 (heat):

1. When PV > WSP, OP = 0%
2. When *PV* < (*WSP* – *Ch1OnOffHyst*), OP = 100%

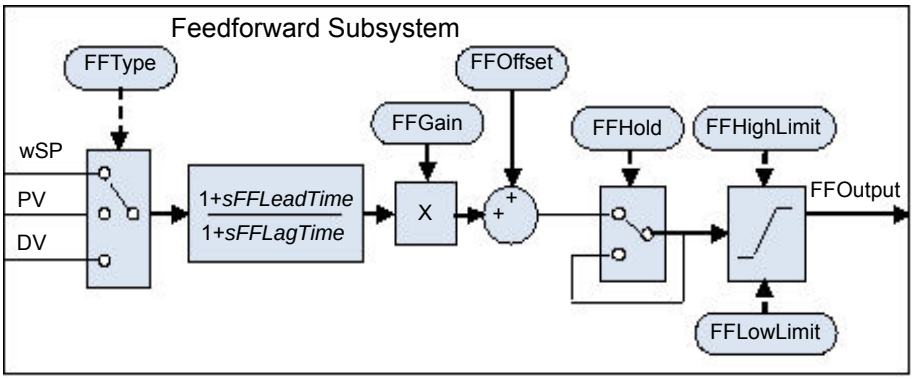
For channel 2 (cool):

1. When *PV* > (*WSP* + *Ch2OnOffHyst*), OP = 100%
2. When *PV* < *WSP*, OP = 0%

This form of control will lead to oscillation about setpoint but it is by far the easier to tune. The hysteresis should be set according to the trade-off between oscillation amplitude and actuator switching frequency. The two hysteresis values can be gain scheduled.

Feedforward

The block diagram for the feedforward subsystem structure is shown below.



The Loop incorporates a feedforward controller in addition to the normal feedback (PID) controller; it is capable of static or dynamic feedforward compensation. Broadly, there are three common uses for feedforward in these instruments and are described in turn below.

Disturbance feedforward

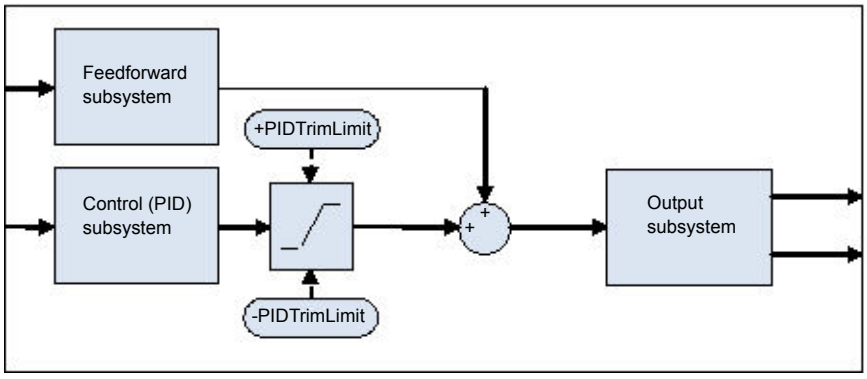
A disadvantage of a feedback (PID) controller is that it responds only to deviations between PV and SP. By the time a PID controller first starts to react to a process disturbance, it is already too late and the disturbance is in progress; all that can be done is to try to minimise the extent of the disruption as much as possible.

Feedforward control is often used to overcome this disadvantage. It uses a measurement of the disturbance variable itself and *a priori* knowledge of the process to predict the controller output that will exactly counter the disturbance *before* it has a chance to affect the PV.

Feedforward on its own also has a major disadvantage. It is an open-loop strategy that relies entirely on a model of the process. Modelling error, uncertainty and process variation all help to prevent zero tracking error being achieved in practice. Further, the feedforward controller can only respond to disturbances that are explicitly measured and modelled.

To counter the relative disadvantages, the Loop combines both types of control in an arrangement known as “Feedforward with Feedback Trim”. The Feedforward controller gives the principal control output and the Feedback controller can trim this output appropriately to give zero tracking error.

The diagram below shows the feedforward with feedback trim structure.



A symmetrical trim limit is provided around the PID component such that the influence of the feedback trim can be restricted.

Setpoint feedforward

Setpoint feedforward is arguably the type most often seen in instrument applications. A signal that is proportional to the working setpoint is fed-forward directly to the controller output. The most common scenario is dead-time dominant processes.

Dead times are common in process control. Flow lines, packaging lines, food processing lines and similar can all involve some amount of transport delay; that is to say that there is a finite period of time between an actuation being made by the final control element and a change being observed by the sensor.

Where this time delay is large with respect to other process dynamics, stable feedback control becomes increasingly difficult. A solution to this is often to detune the gain of the controller. Whilst this may well achieve stability, it also results in a sluggish system response to setpoint changes.

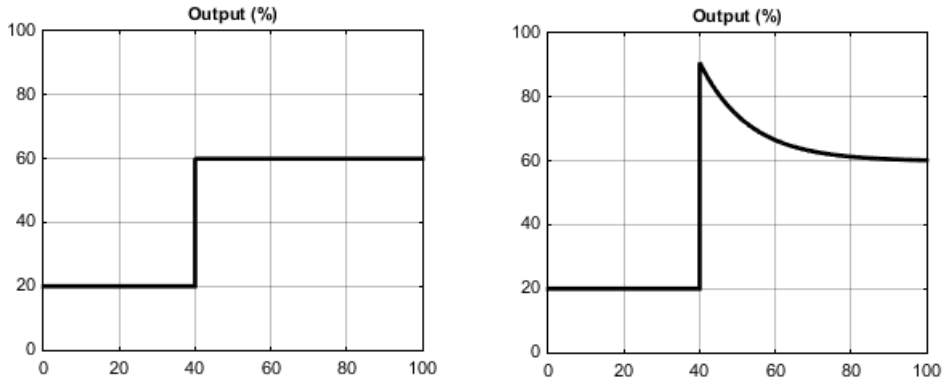
The ‘Feedforward with Feedback Trim’ arrangement shown above can be used to significantly improve the situation. The feedforward controller immediately gives an output value close to the final value and the PID controller can then trim this to give zero tracking error. The maximum amount of trim can be limited to help prevent the PID component having too much influence.

First, obtain the static characteristics of the plant. This can be achieved by putting the controller into Manual and, at a number of output values, record the final stead-state PV. Determine values of Gain and Bias that approximate the relationship, such that *OP = Gain*PV + Bias*.

If required, dynamic compensation can be used to change the feedforward output response. For example, it may speed things up even more if the output gives an initial kick *in excess* of its final value before settling back down. A lead compensation can achieve this as discussed later.

Static or dynamic compensation

An example of Feedforward output response to SPchange with Static (left) and Dynamic (right) compensation is shown below.

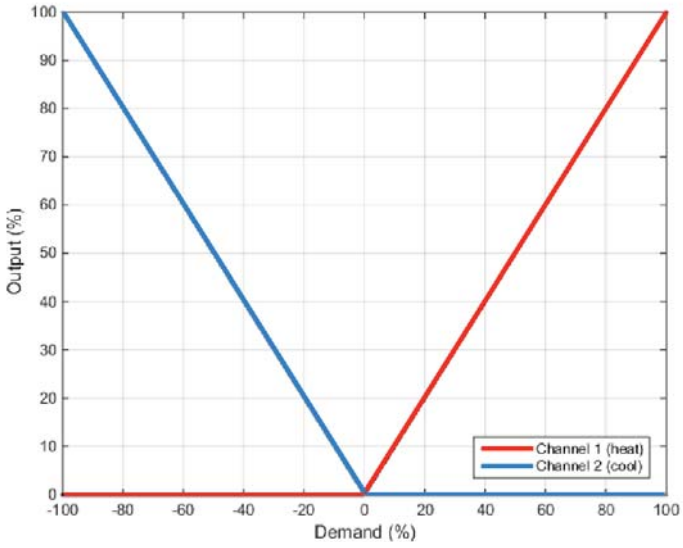


Split Range (heat/cool)

Inherent in the Loop is the concept of split-range for heat/cool.

Each Loop has a single setpoint and single PV, but can have *two* outputs. These two outputs operate in opposite directions. For example, consider a chamber with both a heater and a chiller. Both of these actuators are used to influence the temperature (the 'process variable', PV), but they operate in different directions: increasing heat output causes increasing PV, whereas increasing chiller output causes decreasing PV. Another example might be a gas carburising furnace where the atmosphere is either enriched with methane (channel 1) or diluted with air (channel 2).

The way that the loop implements this is to allow the control output to extend over the span −100 to +100%. In this way, the range is split so that 0 to +100% is output on channel 1 (heat) and −100 to 0% is output on channel 2 (cool). The diagram below shows Split Range Outputs (Heat/Cool)



In addition, the loop allows each of the two channels to use different control types. The available control algorithm types are:

1. PID with an absolute output.
2. PID with valve positioning (without measured position and VPU).
3. Hysteretic On-Off ('bang-bang') control.

For example, a process may have an electrical heater on channel 1, controlled with the PID algorithm, whereas the flow of coolant through a jacket is modulated by a valve which is controlled by the VPU algorithm on channel 2. Transfer between the different algorithms is handled automatically.

In addition, different actuator gains are handled by having a separate proportional band for each channel.

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.

Non-linear cooling

The loop provides a set of curves that can be applied to the cooling (ch2) output. These can be used to compensate for cooling non-linearities thereby making the process 'look' linear to the PID algorithm. Curves for *Oil, Fan* and *Water* cooling are provided.

Curves are always scaled to fit between 0 and the output low limit. Tuning the curve to the process is an important step in commissioning and can be achieved by adjusting the output low limit. The low limit should be set to the point at which the cooling effect is maximum, before it starts to drop off again.

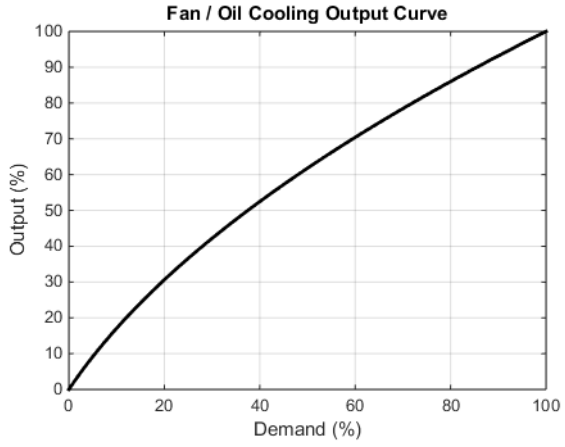
Be aware that any output rate limiting is applied to the output *before* non-linear cooling. Therefore, the actual controller output may change faster than any configured rate limit, but the power being delivered to the process will move at the correct rate, provided the curve has been correctly applied.

Air or Oil cooling

At low temperatures, the rate of heat transfer from one body to another can be considered linear and is proportional to the temperature difference between them. In other words, as the cooling media heats up, the rate of heat transfer slows down. So far, this is linear.

The non-linearity arises when a *flow* of cooling media is introduced. The higher the rate of flow (mass transfer), the less time a given 'unit' of media is in contact with the process and so the greater the average rate of heat transfer.

The air and oil characteristic is shown in the diagram below.

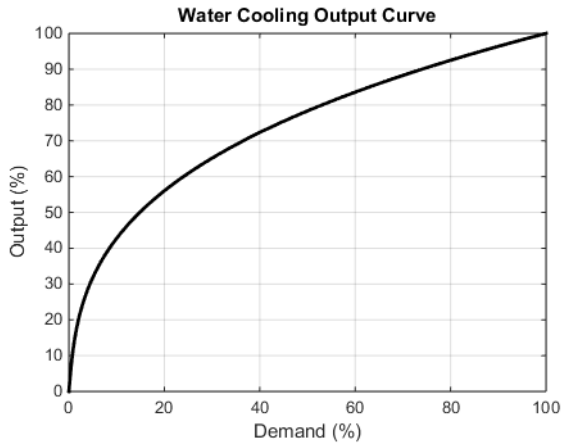


Evaporative Water cooling

Vaporising water requires about five times as much energy as is required to raise its temperature from 0–100°C. This difference represents a large non-linearity, where at low cooling demands, the principal cooling effect is evaporative, but at higher cooling demands only the first few pulses of water flash off to steam.

To compound this, the mass transfer non-linearity described above for oil and air cooling is also true for water cooling.

Evaporative water cooling is often used in plastics extruder barrels and so this feature is ideal for that application. The evaporative water cooling characteristic is shown below.

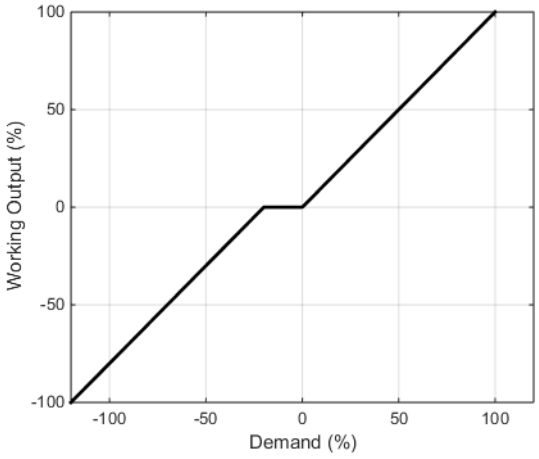


Channel 2 (heat/cool) Deadband

The channel 2 deadband introduces a gap between the point at which channel 1 switches off and the point at which channel 2 switches on, and vice versa. This is sometimes used to help prevent small and fleeting demands for cooling during normal process operation.

For a PID control channel, the deadband is specified in % output. For example, if the deadband is set to 10%, then the PID algorithm must demand −10% before ch2 will begin to switch on.

For an On/Off control channel, the deadband is specified in % of hysteresis. The diagram shows heat/cool with 20% deadband.



Bumpless Transfer

Where possible, the transfer to an Auto control mode from a non-Auto control mode will be ‘bumpless’. This means that the transition will go smoothly without large discontinuities.

Bumpless transfer relies on there being an integral term in the control algorithm to ‘balance out’ the step change. For this reason, it is sometimes called an ‘integral balance’.

The *IntBal* parameter allows the external application to request an integral balance. This is often useful if it is known that a step change in PV is to occur, for example a compensation factor has just changed in an oxygen probe calculation. The integral balance will help to prevent any proportional or derivative kick, instead allowing the output to be smoothly adjusted under integral action.

Sensor Break

‘Sensor Break’ is an instrument condition that occurs when the input sensor is broken or out of range. The Loop reacts to this condition by putting itself in Forced Manual mode (see above description). The type of transfer when entering Forced Manual, when the PV status is not good, can be selected using the *PVBadTransfer* parameter. The options are:

- Enter Forced Manual mode with the output set to the Fallback Value.
- Enter Forced Manual mode with the output held at the last good value (typically a value from about one second ago).

Operating Modes

The Loop has a number of possible operating modes. It is quite possible for several modes to be requested by the application at once. The active mode is therefore determined by a priority model, whereby the mode with the highest priority will always win.

For details of the modes and their priorities, refer to "Loop - Main Sub-list" on page 107.

Start-up and Recovery

Proper start up is an important consideration and varies depending on the process. The Loop recovery strategy is followed under any of the following circumstances:

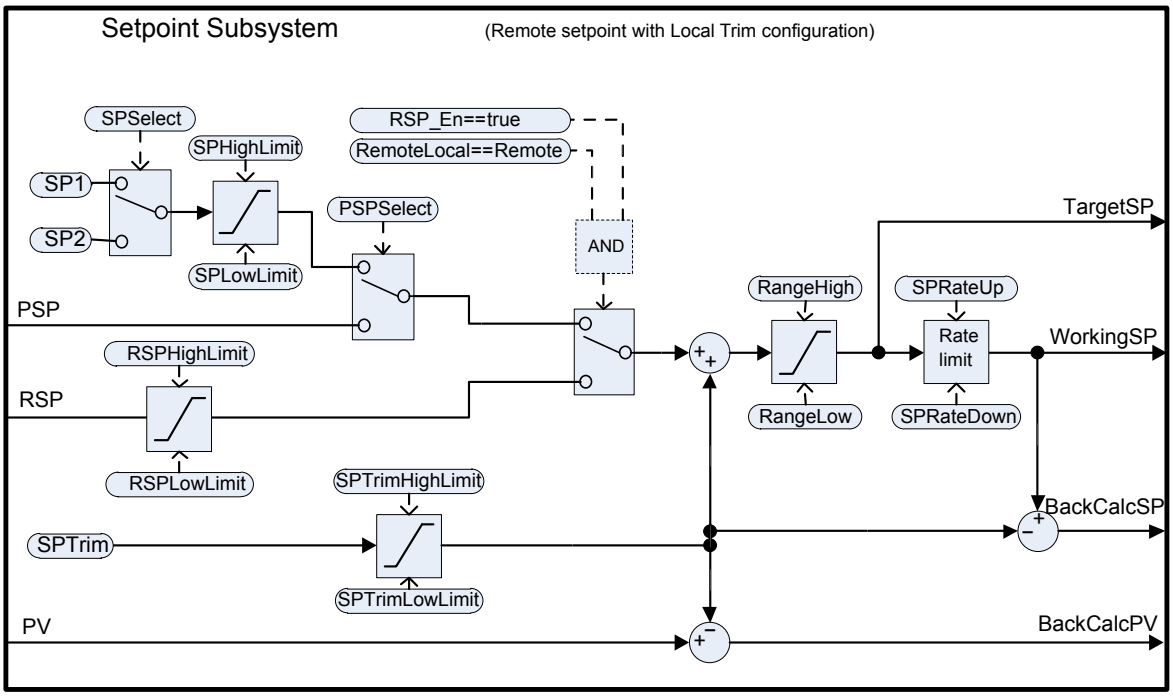
- Upon instrument start-up, after a power cycle, power outage event or power disruption
- Upon exit from Instrument Configuration or Standby conditions.
- Upon exit from Forced Manual (F_MAN) mode to a lower priority mode (e.g. when the PV recovers from a bad status or an alarm condition goes away).

The strategy to follow is configured by the *RecoveryMode* parameter. The two available options are:

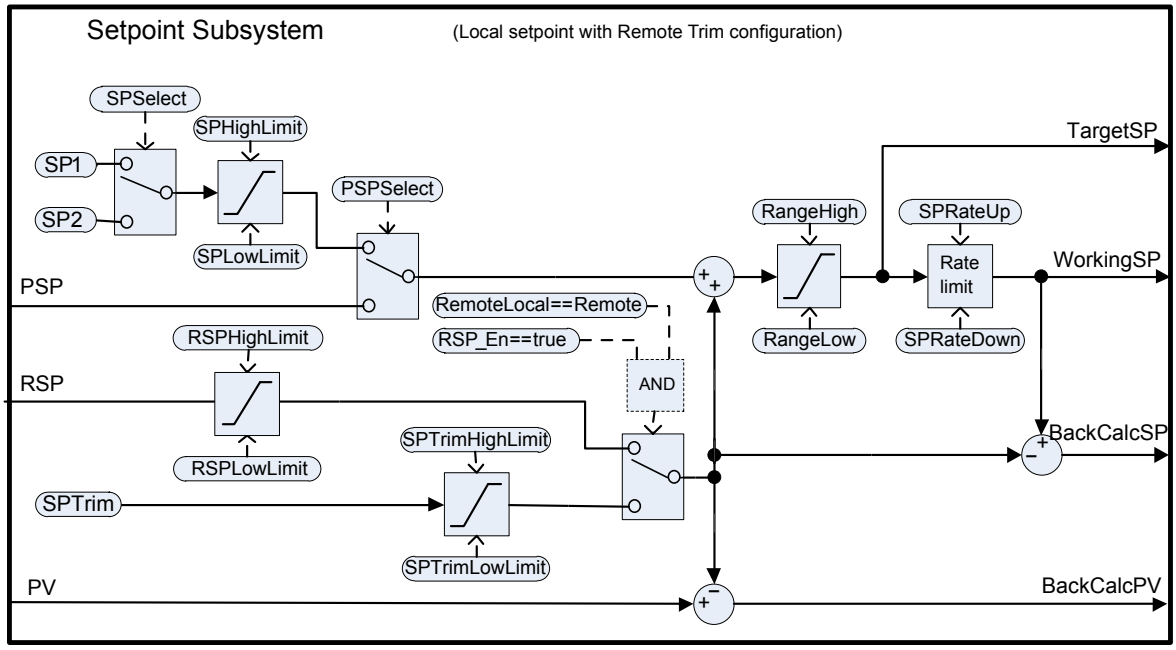
1. Last mode with last output
   The loop will return to Auto or Manual mode, whichever was last active. The working output will be initialized to the last used output value.
2. Manual mode with fallback output
   The loop will always enter Manual mode. The initial output will be the configured Fallback Value, unless recovering from Forced Manual where the transfer will be bumpless.

Setpoint subsystem

The diagrams below show Setpoint function block. The first shows the ‘Remote Setpoint with local trim’ configuration.



The second diagram shows Setpoint subsystem in the ‘Local Setpoint with remote trim’ configuration.



The setpoint subsystem resolves and generates the working setpoint for the control algorithms. The working setpoint can ultimately come from several different sources, programmer, local or remote, have local or remote trims applied, and be limited and rate limited.

Remote/Local Setpoint Source Selection

The RemoteLocal parameter selects between the remote or local setpoint source.

The SPSource parameter reports which source is currently active. The three values are:

- Local – the local setpoint source is active.
- Remote – the remote setpoint source is active.
- F_Local – the remote setpoint source has been selected but it cannot become active. The local setpoint source is active until the exceptional condition is resolved.

In order for the remote setpoint source to become active, the following conditions need to be fulfilled:

1. The RemoteLocal parameter has been set to ‘Remote’.
2. The RSP_En input is true.
3. The status of the RSP input is Good.

Local Setpoint Selection

There are three local setpoint sources: the two operator setpoints, SP1 and SP2; and the programme setpoint, PSP. For selection parameters and priorities, refer to the above diagram.

Remote Setpoint

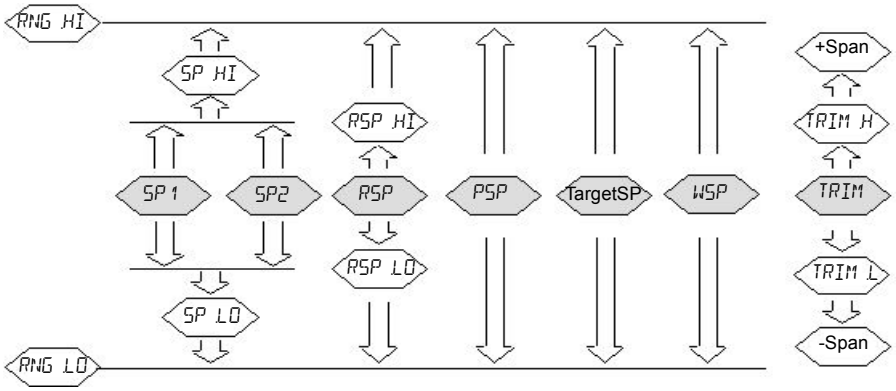
RSP is the remote setpoint source. It can be configured by the *RSPType* parameter in one of two ways:

1. Remote setpoint (RSP) with a local trim (SPTrim).
   For example, in a continuous oven with several temperature zones, the master controller can transmit its setpoint to each slave’s RSP, and then a local trim can be applied in each slave to achieve the desired temperature gradient through the oven.
2. Local setpoint (SP1, SP2 or PSP) with a remote trim (RSP).
   For example, in a combustion air/fuel ratio application where the ratio set-point is fixed, but a remote controller analyses the excess oxygen in the flue gases and is allowed to trim the ratio within a given band.

The remote setpoint is always limited by the RSPHighLimit and RSPLowLimit parameters.

Setpoint limits

The various setpoint parameters are subjected to limits according to the diagram below. Some of the limits themselves are also subjected to limits.



The *Span* is taken to be the value given by (*RangeHigh* – *RangeLow*).

Note: Whilst it is possible to set the RSP Limits outside the Range Limits, the RSP value will still be clipped to the Range Limits.

Setpoint Rate Limit

Rate limits can be applied to the final setpoint value. This can sometimes be useful to help prevent sudden step changes in controller output, and therefore help to prevent damage to the process or product.

Asymmetric rate limits are available. That is to say that the increasing rate limit can be set independently of the decreasing rate limit. This is often useful, for example in a reactor application whereby a sudden increase in flow should be reduced so that an exothermic event does not overwhelm the cooling control loop. On the other hand, a sudden decrease in flow should be permitted.

The setpoint rate limits may be set in units per hour, per minute or per second, according to the SPRateUnits parameter.

Note: When transitioning into an automatic control mode from a non-automatic control mode such as manual, the WSP will be set equal to the PV whenever a rate limit is set. It will then move towards the target setpoint from there at the configured rate.

In addition, if the SPRateServo parameter is enabled, the WSP will be set equal to the PV whenever the Target SP is changed and will then move towards the target from there. This only applies in Auto (including the transition to Auto) when SP1 or SP2 is active. It does not apply when using a remote or program setpoint.

Target SP

The Target SP is the setpoint value immediately prior to rate limiting (the Working SP is the value immediately after it). In many instruments it is possible to write to the Target SP directly. The effect of this is to trigger a back-calculation, which takes into account the trim value (either a local or remote trim), and then to write the back-calculated value to the selected setpoint source. This is so that the calculated Target SP on the next execution is equal to the entered value.

This usefully allows the target setpoint to be set to a desired value immediately, without having to manually make the calculations and determine which setpoint source is active.

Writing to the TargetSP is not possible when a remote setpoint is active.

Tracking

There are three setpoint tracking modes available. They can each be turned on by enabling the appropriate parameter.

1. SP1/SP2 tracks PV
   Whilst the mode is MANUAL, whichever of SP1 or SP2 is active will track the PV (less the trim). This is so that the operating point is maintained whenever the mode is changed to Auto.
2. SP1/SP2 tracks PSP
   Whilst PSPSelect is enabled, whichever of SP1 or SP2 is active will track the PSP. This is so that the operating point is maintained when the programmer is reset and PSPSelect goes false.
3. SP1/SP2/SPTrim tracks RSP
   When the RSP is active and acting as a Remote Setpoint, whichever of SP1 or SP2 is active will track RSP. If RSP is acting as a Remote Trim, then it is SPTrim that will track RSP. This is so that the operating point is maintained if the setpoint is switched to local.

Back-calculated SP and PV

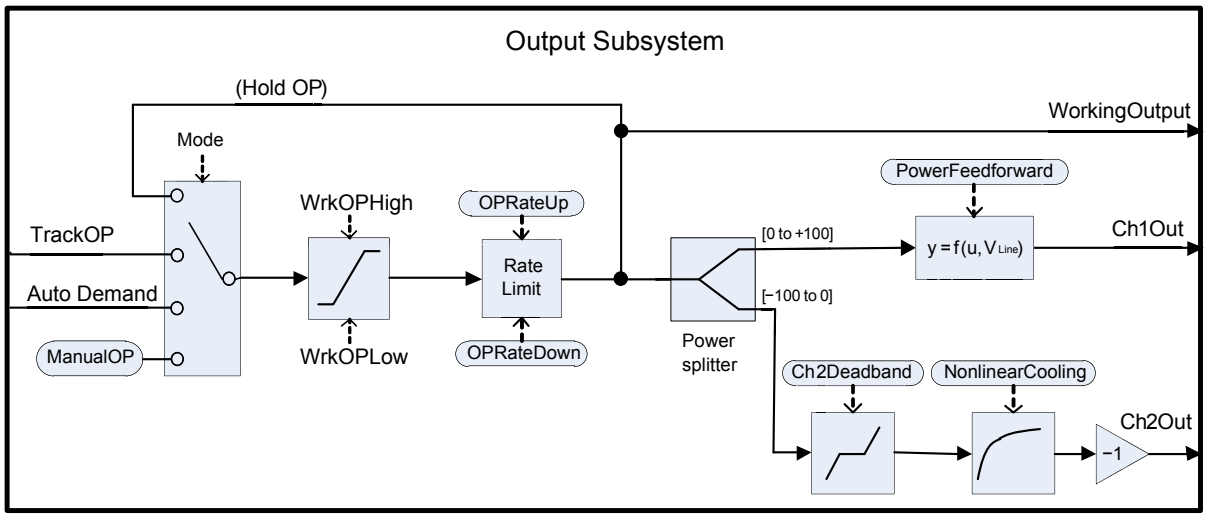
Back-calculated versions of WSP and PV are provided as outputs. These are simply WSP/PV minus the active trim value. These outputs are given so that an external setpoint source (such as a setpoint programmer or a cascade master) can track their output to them as necessary, thus helping to prevent bumps on mode changes and switchovers.

Setpoint Integral Balance

When the SPIntBal parameter is enabled, the setpoint subsystem will issue an integral balance request to the PID/VPU algorithms whenever a step change in SP1 or SP2 occurs. This will cause any proportional or derivative kick to be suppressed and the PV will move smoothly to the new setpoint with the integral as the driving force and with minimum overshoot. The effect is the same as what is sometimes called ‘proportional and derivative on PV’ instead of error, but only applies to step changes in SP1 or SP2 and on transition to local setpoint from remote.

Output Subsystem

The diagram shows the block diagram of the Output subsystem.



Output selection (including Manual Station)

The source of the output demand is resolved according to which controller mode is active. In HOLD, the previous Working Output is held. In TRACK, the output demand is taken from TrackOP. In MANUAL and F_MAN, the output is taken from ManualOP. In other modes, the output is taken from the control subsystems output.

Output Limiting

The resolved demand is subject to position limiting. There are several different sources of position limits:

- The master limits, *OutputHighLimit* and *OutputLowLimit*
- The active gain scheduled limits: *OutputHigh(n)* and *OutputLow(n)*
- The remote limits, *RemoteOPHigh* and *RemoteOPLow*
- The tune limits (only during auto-tuning), *TuneOutputHigh* and *TuneOutputLow*

The most restrictive limits always take priority. That is to say, the minimum of the upper limits and the maximum of the lower limits are used. These become the working output limits, *WrkOPHigh* and *WrkOPLow.*

The output limits are always applied in Auto modes. In non-Auto modes such as Manual, the *FallbackValue* may override a limit if that limit would help prevent the *FallbackValue* being achieved. For example, if the *OutputLowLimit* is 20% and the *FallbackValue* is 0%, then in Auto the working low limit will be 20%, while in Manual it will be 0%.

The remote output limits are only applied in Auto mode.

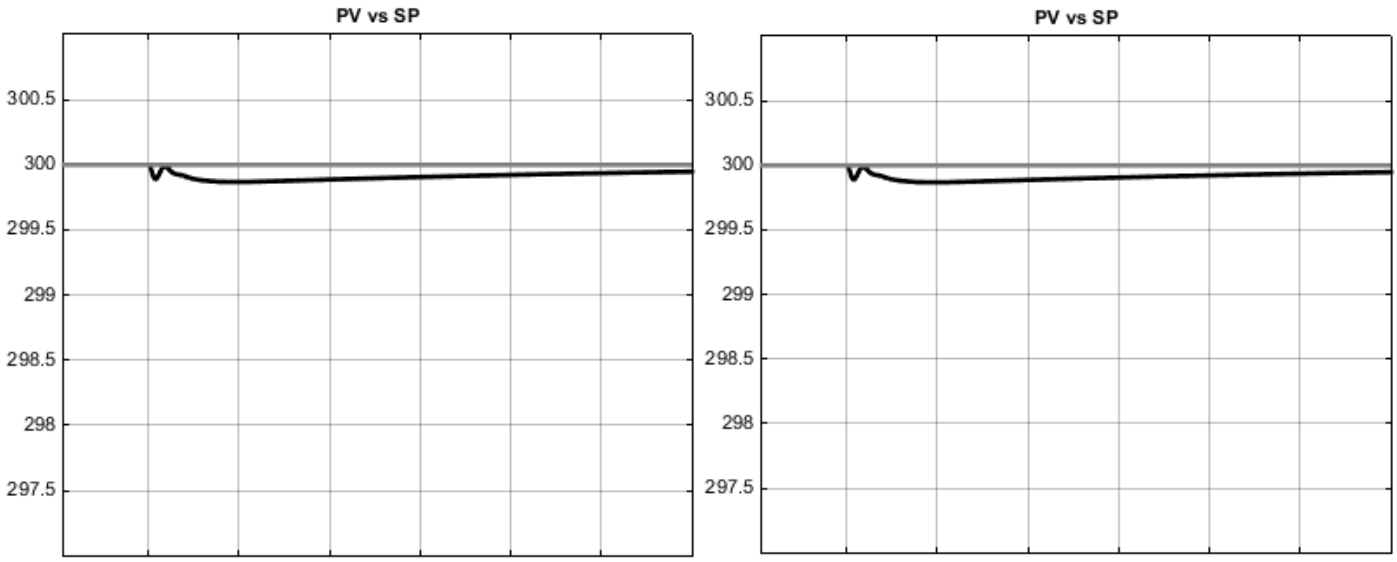
Rate limiting

The working output can be rate limited by setting the two parameters, *OPRateUp* and *OPRateDown*. They are always specified in % per second. Output rate limiting is only available for PID control channels and should be used only where necessary since it can significantly degrade process performance.

Power feedforward (line voltage compensation)

Power Feedforward is a feature that compensates for fluctuations in mains supply voltage. This can be useful for processes being heated by an electrical heater, where the heater is driven by the controller directly (e.g. via a relay or SSR).

Any fluctuation in line voltage can be immediately compensated for by adjusting the output power appropriately, thereby attenuating any resultant deviation in PV. Its effectiveness is illustrated below:



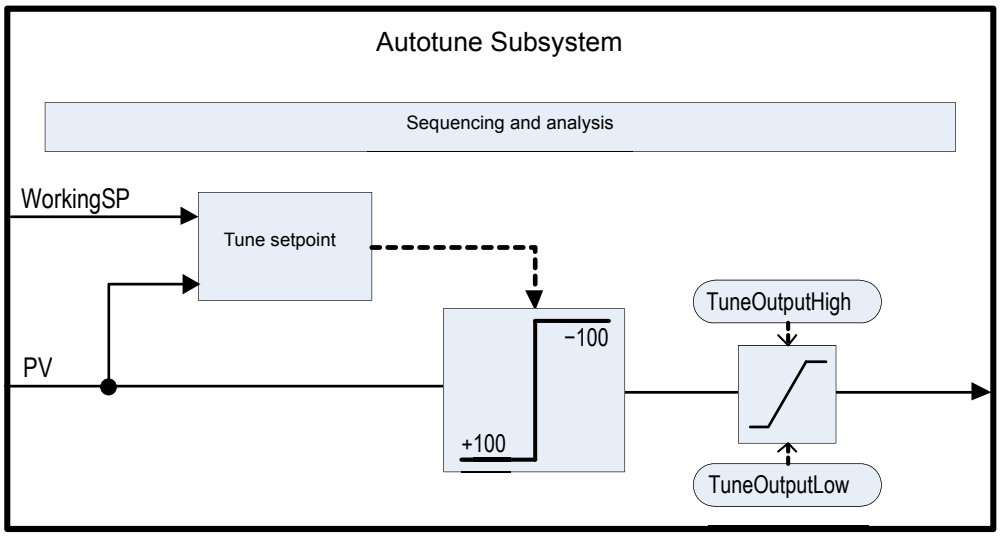
Here, it can be seen that enabling power feedforward has greatly reduced the magnitude of the process disturbance. However, the smaller disturbance persists for a longer period of time.

Power Feedforward is usually available in mid-range instruments but only where they are fitted with a ‘high volts’ power supply option. The controller measures its own power supply input to determine the heater voltage, therefore, it should be powered from the same supply as the heater itself. It should *not* be enabled if an intelligent power controller is driving the heater, since the power controller will itself provide compensation.

When enabled, power feedforward is applied to the heat channel (channel 1) only and is active while the controller is in Auto mode. It has no effect in other operating modes.

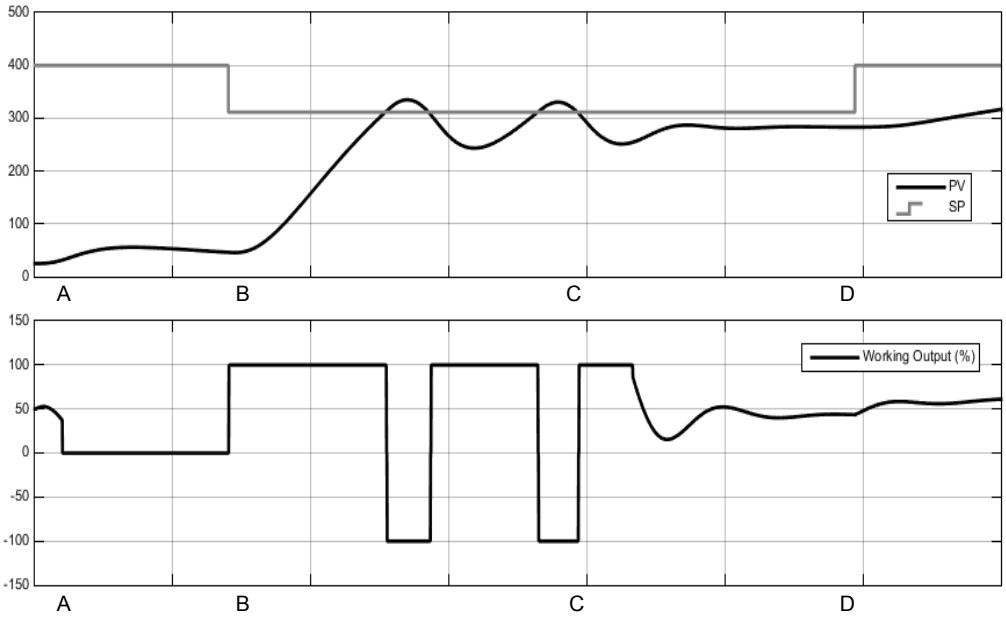
Autotuning

The diagram below shows a simplified structure of a relay-based Autotuner.



The function block contains sophisticated autotuning algorithms that can tune the controller to the process. They work by performing experiments on the plant, by inducing perturbations, and observing and analysing the response. The autotuning sequence is described in detail below.

The diagram shows an example of heat/cool Autotune with ‘alternative’ CH2 Tune Type.



Time	Description
A	**Autotune Begins** Setting the *AutotuneEnable* parameter to On and the controller mode to Auto will cause the autotune to begin. Before starting an autotune, you should turn off the PID terms that you do not want to use. For example, setting TD to Off will disable derivative action and the autotuner will therefore tune for a PI controller. If you do not want any integral, set TI to Off and the autotuner will tune for a PD controller. If the cutback thresholds, CBH and CBL, are set to Auto then the autotuner will not attempt to tune them. An autotune may be triggered at any time, but it will not begin until the mode goes to Auto. If autotune is triggered but the controller is not in Auto mode the scrolling message AUTOTUNE TRIGGERED BUT CANNOT RUN is displayed. In this case put the controller into Auto mode, the message AUTOTUNE ACTIVE will be displayed and the controller will begin the autotune process. Similarly, autotune will abort if the mode is changed away from Auto at any time during the tune, including reasons such as sensor status is bad. In this case it will be necessary to start autotune again. Note that the PID tuning constants will be written to whichever gain set is active when tuning completes.
A to B	**Initial Delay** This period always persists for precisely one minute. If the PV is already at the WSP then the working output will be frozen. Otherwise, the output is set to 0 and the process is allowed to drift while some initial measurements are made. The target setpoint may be changed during this initial delay, but not after it. You should set the target setpoint to the operating point at which you would like to tune. Care should be taken in setting the setpoint, to help to ensure that oscillations of the process will not damage the process or load. For some processes, it may be necessary to use a setpoint for tuning purposes that is below the normal operating point.
B	**Calculate Tune Setpoint** Once the initial delay has elapsed, the tune setpoint is determined. It is calculated by: If PV = Target SP: Tune SP = Target SP If PV < Target SP: Tune SP = PV + 0.75(Target SP – PV) If PV > Target SP: Tune SP = PV − 0.75(PV – Target SP) Once determined, this tune setpoint will be used for the duration of the autotune and any changes to the target setpoint will be ignored until the autotune has completed. If you wish to change the tuning setpoint, abort and restart the autotune.

Time	Description
B to C	**Relay Experiment** The autotuner will now insert a relay into the closed-loop. This establishes the limit-cycle oscillations in PV. The relay operates such that: If PV > SP: OP = minimum If PV < SP: OP = maximum The minimum and maximum outputs are determined by the various limits. There is also a small amount of hysteresis, not described, around the relay switching point to help prevent electrical noise from causing nuisance switching. The number of oscillations required before moving to the next stage depends on the controller configuration: If either channel is configured for VPU, or OnOff control, or if output rate limiting is enabled, then the 'Fourier' autotune algorithm will run. This requires three cycles of oscillation. If only PID is configured and there is no output rate limiting, then the 'PID' autotune algorithm will run. Only two cycles of oscillation are required. There will be an additional half-cycle of oscillation at the beginning of this stage if the initial PV is above the SP. Once the required number of cycles is achieved, the algorithm moves to the next stage.
C to D	**Relative Channel 2 Tuning Experiment** This stage is only used for dual-channel heat/cool configurations. For heat-only or cool-only, it is skipped. The purpose of this stage is to determine the relative gain between channel 1 and channel 2. This is used to set the correct proportional bands. For example, in a heat/cool process, the heater and the chiller are typically not equally rated, e.g. the heater might be capable of putting much more energy into the process in a given period of time than the chiller is capable of removing. This non-linearity needs accounting for and the purpose of this additional experiment is to collect the necessary information to make that correction. The type of experiment that is used can be selected with the Ch2TuneType parameter: The *Standard* experiment is the default and gives good results for most processes. It will put the process into an additional cycle of oscillation but instead of applying minimum output, it will apply 0 output and allow the PV to drift. This option is not available if TuneAlgo is Fourier. The *Alternative* experiment is recommended for processes that do not exhibit significant losses—for example, a very well-lagged tank or oven. It attempts to control the PV to the SP and collects data about the process input required to do so. The length of this stage is equivalent to between 1.5 and 2 oscillation cycles. The *KeepRatio* option should only be selected when the relative gain of the two channels is well known. It causes this stage to be skipped and instead the existing proportional band ratio will be maintained. So, for example, if you know that the heating channel will deliver a maximum of 20kW and the cooling channel will deliver a maximum of -10kW, then setting the proportional bands such that the ratio Ch2PB/Ch1PB = 2 before autotuning will allow the correct ratio to be maintained.

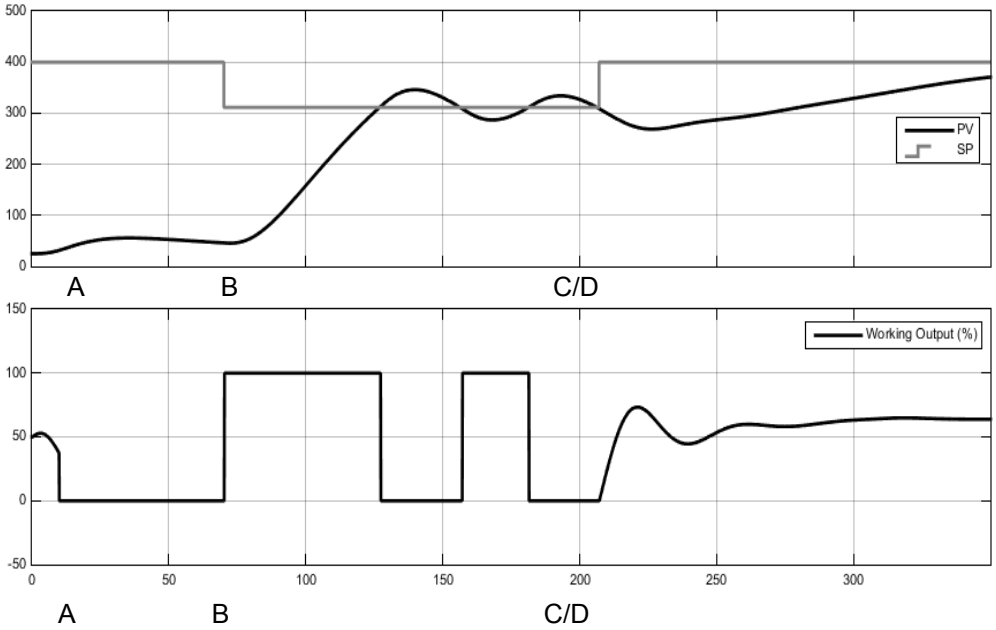
Time	Description
D	**Analysis and Completion** The autotune experiments are now complete. Finally, some analysis will be performed on the collected data and the controller tuning constants will be chosen and written to whichever gain set is active. This analysis may take a number of seconds, typically less than 15, during which the output will be frozen. After the tune has completed, the working setpoint is released and can be modified in the usual manner. Authority over the output is returned bumplessly to the control algorithms.

Notes:

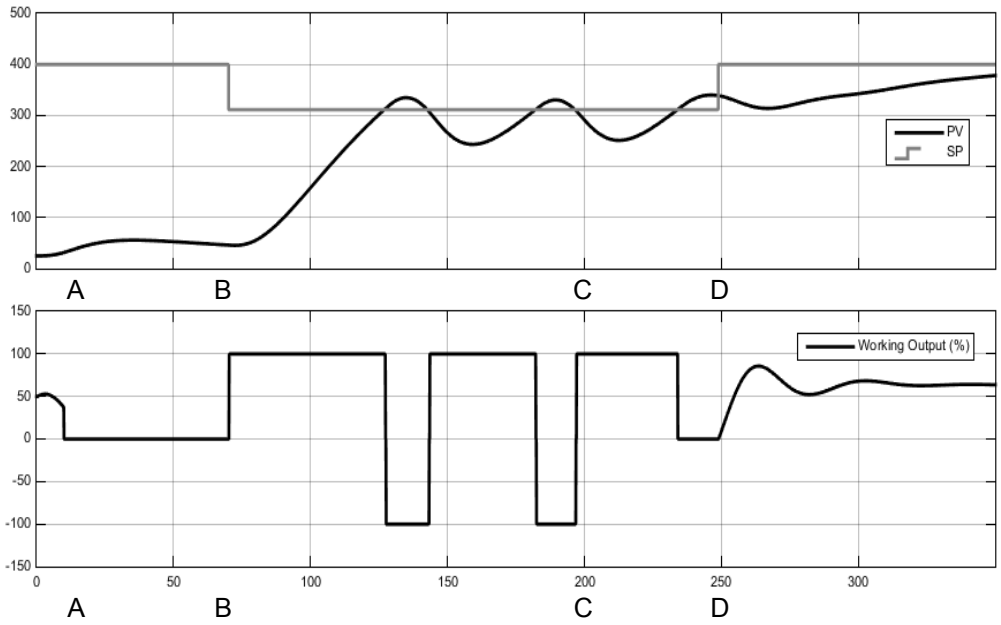
- If any stage of the autotune sequence exceeds two hours in duration, the sequence will timeout and be aborted. The StageTime parameter counts up the time in each stage.
- Channels configured for OnOff control cannot be autotuned but they will be exercised during the experiments if the opposite channel is not OnOff.
- For VPU channels, it is important that the associated Travel Time parameter is set as accurately as possible before commencing the autotune.
- Carbon Potential loops, which have a setpoint in the range 0–2.0% (and other loops with small setpoint ranges), cannot be autotuned if the proportional band type is set to ‘Engineering Units’. For these loops, proportional band type should be set to ‘Percent’ and the RangeHigh and RangeLow set correctly. This allows autotune to work.

A number of further examples under different conditions are pictured below.

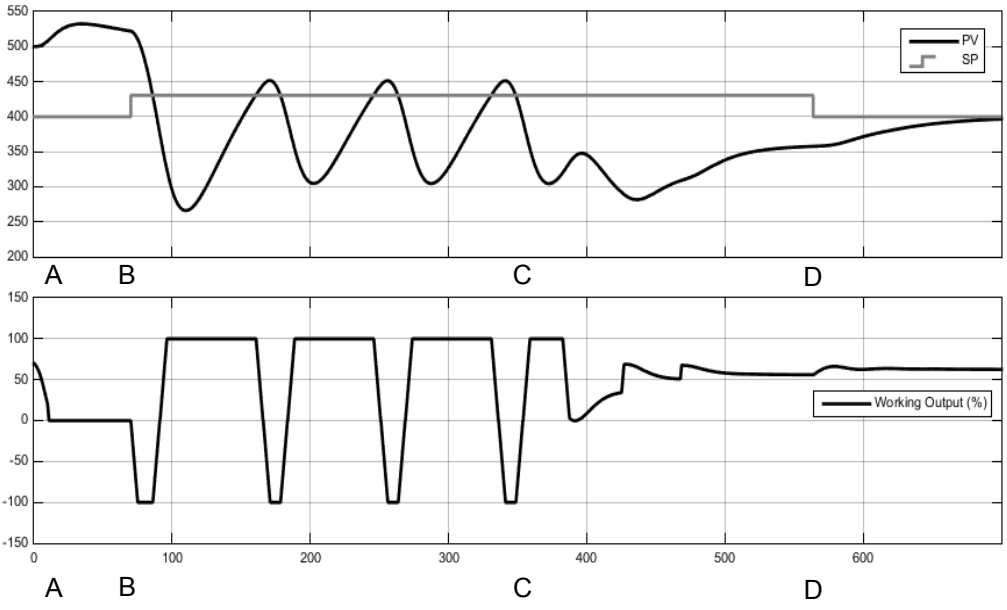
The first shows an example Heat-only Autotune



The second example shows Heat/Cool Autotune with ‘Standard’ Ch2 tune type



The third shows an example of Heat/Cool Autotune from above with output rate limiting.



Autotuning multiple zones

Autotune relies completely on the principle of cause and effect. It perturbs the process and then watches for what the effect will be. It is therefore essential that all external influences and disturbances are minimised as much as possible during an autotune.

When autotuning a process that has multiple interacting loops, for example a furnace with multiple temperature zones, each loop should be autotuned separately. They *should not* under any circumstances be autotuned at the same time, since the algorithms will not be able to ascertain what cause produced what effect. The procedure below should be followed:

1. Place all loops in manual and set the outputs to the approximate steady state value for the desired operating point. Allow the process to settle.
2. Enable autotune on a *single zone.* Allow the tune to complete.
3. After the zone has finished autotuning, allow it to settle out in auto and then place it back into manual.
4. Repeat steps 2 and 3 for each zone.

Digital Communications

Digital Communications (or 'comms' for short) allows the controller to communicate with a PC or a networked computer system or any type of communications master using the protocols supplied. Connections to the PC are shown in "Digital Communications Connections" on page 51. A data communication protocol defines the rules and structure of messages used by all devices on a network for data exchange. Communications can be used for many purposes - SCADA packages; PLCs; data logging for archiving and plant diagnostic purposes; cloning for saving instrument set ups for future expansion of the plant or to allow a controller to be replaced by a spare.

Modbus RTU

MODBUS (JBUS) Protocol defines a digital communication network to have only one MASTER and one or more SLAVE devices. Either a single or multi-drop network is possible. All message transactions are initiated by the MASTER. Eurotherm instruments communicate using the Modbus RTU binary protocol.

The JBUS protocol is identical in most respects to Modbus protocol - the main difference being that Modbus uses a 0-based register addressing whereas JBUS uses 1-based register addressing.

The list of Modbus addresses is available in iTools by opening the browser list.

A full description of the Modbus protocol can be found on www.modbus.org.

EI-Bisynch Protocol

EI-Bisynch is a proprietary Eurotherm protocol based on the ANSI X3.28-2.5 A4 standard for message framing. It is included in the EPC3000 series as an EI-Bisynch slave so that it can replace earlier instruments such as 2000 series. Despite its name, it is an ASCII based asynchronous protocol. Data is transferred using 7 data bits, even parity, 1 stop bit.

EI-Bisynch identifies parameters within an instrument using (usually) two letter abbreviations for a given parameter, for example, PV for Process Variable, OP for Output, SP for Setpoint, and so on.

The list of supported parameters is given in "Appendix EI-Bisync Parameters" on page 298.

Further information is available for both protocols in the Series Communications Handbook part no. HA026230. This may be accessed via www.eurotherm.co.uk.

Baud Rate

The baud rate of a communications network specifies the speed that data is transferred between instrument and master. A baud rate of 9600 equates to 9600 Bits per second. Since a single character requires 8 bits of data plus start, stop, and optional parity, up to 11 bits per byte may be transmitted. 9600 baud equates approximately to 1000 Bytes per second. 4800 baud is half the speed - approx. 500 Bytes per second.

In calculating the speed of communications in your system it is often the Latency between a message being sent and a reply being started that dominates the speed of the network.

For example, if a message consists of 10 characters (10msec at 9600 Baud) and the reply consists of 10 characters, then the transmission time would be 20 msec. However, if the Latency is 20msec, then the transmission time has become 40msec.

Parity

Parity is a method of ensuring that the data transferred between devices has not been corrupted.

Parity ensures that every single byte in the received message contains the same number of ones or zeros when it was received as when it was transmitted.

In industrial protocols, there are usually layers of checking to ensure that the first byte transmitted is good. Modbus protocol applies a CRC (Cyclic Redundancy Check) to the data to ensure that the package is correct.

Communication Address

On a network of instruments a comms address is used to identify a particular instrument. Each instrument on a network should have a unique comms address. Address 255 is reserved for the configuration port.

Comms Delay

In some systems it is necessary to introduce a delay between the instrument receiving a message and sending its reply. This is sometimes necessary if the line transceivers require an extended time to switch to tristate.

EI-Bisynch Limitations

In the case of the detection of read or write message failures the instrument will respond with the following single character replies:

Write message failure detected: 0x15 (Negative Acknowledge or NAK).

Read message failure detected: 0x04 (End of transmission or EOT).

iTools will display a generic notification "Failed to write data to device" or "Failed to read data from device".

The actual reason for the error is saved in the mnemonic "EE". This special mnemonic may then be read to give the status of the last communications transaction. It is a hex format parameter, whose value corresponds to the following status and errors:

EE Mnemonic value	Description
0	No error
1	Invalid mnemonic
2	Parameter is read only
7	Incorrect message
8	Limit error

Further information on EI-Bisynch may be found in the 2000 Series Communications manual part number HA026230 available from www.eurotherm.co.uk.

Ethernet Protocol

MAC address display

Each Ethernet module contains a unique MAC address, normally presented as a 12 digit hexadecimal number in the format "aa-bb-cc-dd-ee-ff".

In the EPC3000 instruments MAC addresses are shown as 6 separate decimal values in the "COMMS" list. MAC1 shows the first pair of digits (example "170"), MAC2 shows the second pair of digits and so on.

The MAC address is only available for communications port with Ethernet interfaces. It can be found in the Option Comms list shown in section "Network Sub List (nWrk)" on page 142.

IP Mode Settings

It will generally be necessary to consult with your network administrator to determine if the IP addresses, Subnet mask and Default gateway for the instruments should be static or dynamically allocated by a DHCP server.

For instruments with Static IP mode, network configuration must be entered manually on the Comms.Option.Network IP address, Subnet mask and Default gateway parameters.

Network Connection

The RJ45 connector is used to connect to the instrument's Ethernet interface to a 100BaseT or 10BaseT switch/hub using standard CAT5 cable. The Ethernet interface on the instrument is auto-switching so specific cross-over cables are not required.

Dynamic IP Addressing

Within the "Option Comms" list of the instrument set the "IP Mode" parameter to "DHCP". Once connected to the network and powered, the instrument will acquire its "IP address", "Subnet Mask" and "Default gateway" from the DHCP Server and display this information within a few seconds.

If DHCP is active but the DHCP server cannot be contacted the IP address will remain at 0.0.0.0 and no Ethernet communications will be possible.

If a valid DHCP IP address lease expires and the server is not contactable then the address will revert to 0.0.0.0 and no Ethernet communication will be possible.

Static IP Addressing

Within the "Comms.Option.Network" list of the instrument ensure the "IP Mode" parameter is set to "Static", then set the IP address and Subnet Mask and Default gateway as required (and defined by your network administrator).

See section "Network Sub List (nWrk)" on page 142.

Broadcast Storm Protection

Broadcast Storm Protection discards all broadcast packets if the broadcast rate climbs too high. Broadcast Storm and Ethernet Rate Protection are intended to favour maintaining the control strategy in certain high traffic network environments.

The diagnostic parameters Broadcast Storm and Rate Protection, see section "Network Sub List (nWrk)" on page 142, which indicates when the protection is active.

Ethernet Rate Protection

Certain excessive network loads on embedded products have the potential to impact processor availability to the point that useful control is compromised and the product restarts as there is no longer CPU to service the device watchdog.

The EPC3000 series controllers incorporate an Ethernet Rate Protection algorithm which will de-prioritise Ethernet comms in very heavy traffic environments so that the control strategy continues and the instrument does not watchdog reset.

Additional information

The "Comms.Option.Network" list also includes configuration settings for "Default Gateway", these parameters will be set automatically when DHCP IP mode is used. When static IP mode is used these settings are only required if the instrument needs to communicate across subnets - see your network administrator for the required setting.

Bonjour

Bonjour™ is an implementation of Zeroconf, which allows a plug 'n' play type feel to instrument connectivity by providing a method of auto discovery of a device on an Ethernet network and therefore negates the need for network configuration by the user. It is used to provide an easy route for Ethernet connectivity configuration in the EPC3000 range.

Bonjour™ is released under a terms-of-limited-use license by Apple.

Note: For cybersecurity reasons, the Bonjour™ service is disabled by default, as it makes it easier for a malicious user to discover and access the controller via the network. To turn on Bonjour™ auto-discovery, use the *AUTO DISCOVERY* parameter as follows.

Auto discovery

The ’AutoDiscovery’ flag set to True (On) implements Bonjour™, which means it is not necessary to add the EPC3000 IP address to the iTools control panel applet.

To turn on AutoDiscovery

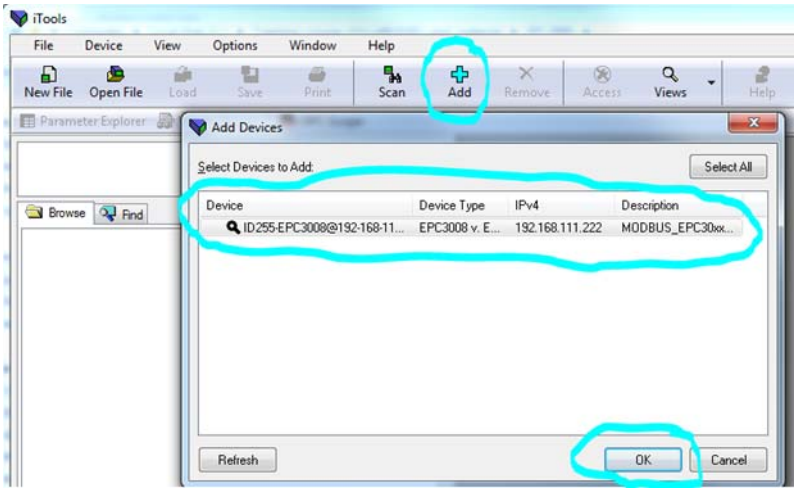
Using the controller buttons: Page , Scroll , Up , Down

1. Enter Configuration level as described in section "To Enter Configuration Level" on page 84.
2. Press the Page button until Comm is shown
3. Press the Scroll button. If F.Com is shown press the Up button to select O.Com (Optional communications)
4. Press the Scroll button. mAI n will be displayed
5. Press the Scroll button again to show EtH (Ethernet)
6. Press the Scroll button again. If nonE is shown use the UP button to select m.tCP (Modbus TCP)
7. Press the Page button to return to mAI n
8. Press the Up button to show nwFr
9. Continue to press the Scroll button until A .DISC is shown
10. Press the Up or Down button to select On

Note: Make sure that the controller and PC are on the same subnet. At this point it is possible to communicate with iTools but you must exit configuration level first to apply configuration changes.

11. Exit configuration level and wait for a few seconds for iTools (version V9.72 or later) to receive the controller broadcasts.

In iTools select 'Add' from the title bar, the controller will appear in the list of devices connected via Ethernet. The EPC3000 will not appear in the list if it is in Configuration Mode.



To turn on DHCP

12. From 10 above, continue to press the scroll button until IP MD (IP MODE) is shown
13. Press the Up or Down button to select dHCP

The instrument will receive its address from the network

To set up an IP address for Ethernet via the front panel

If Auto Discovery or DHCP is not used the IP address, Subnet mask and Default gateway addresses can be set up manually (the MAC addresses are set up in production and are read only).

The default IP address is 192.168.111.222 and the default subnet mask is 255.255.255.0

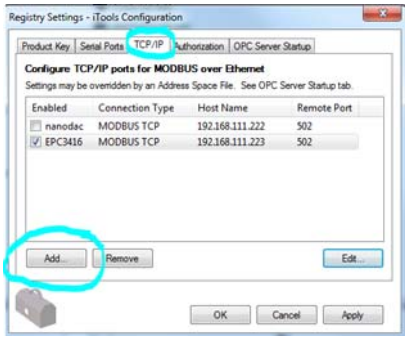
14. From 13 above press the Scroll button to scroll through the Ethernet options. The Up and Down buttons allow the values to be altered
15. Scroll through IP.A1, IP.A2, IP.A3, and IP.A4 to set each part of the IP address, e.g. IP.A1 = 192, IP.A2 = 168, IP.A3 = 111, IP.A4 = 222
16. The Subnet mask and Default gateway can be set in a similar way except the MAC address which is read only

iTools Setup

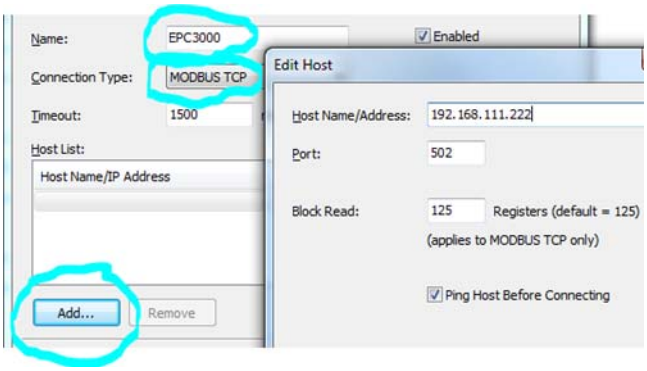
iTools configuration package, version V9.72 or later, may be used to configure Ethernet communications. If AutoDiscovery and DHCP is not used iTools must be set up for Ethernet as described in the following instructions.

To include a Host Name/Address within the iTools scan:-

1. Ensure iTools is NOT running before taking the following steps
2. Within Windows, open 'Control Panel'
3. In control panel select 'iTools'
4. Within the iTools configuration settings select the 'TCP/IP' tab
5. Click the 'Add' button to add a new connection



6. Click the 'Add' button to add the host name (details from your network administrator) or IP address of the instrument in the 'Host Name/ Address' section



The name you enter is your choice – the example shows EPC3000. Ensure that no duplicate IP address entries are enabled at the same time.

The controller default address is 192.168.111.222; subnet mask 255.255.255.0. Ensure that the PC IP address is in the same range as the controller.

7. Click 'OK' to confirm the new Host Name/IP Address you have entered
8. Click 'OK' to confirm the new TCP/IP port you have entered
9. The TCP/IP port configured within the TCP/IP tab of the iTools control panel settings should now be seen

iTools is now ready to communicate with an instrument at the Host Name/IP Address configured.

User Calibration

The controller is calibrated during manufacture using traceable standards for every input range. It is, therefore, not necessary to calibrate the controller when changing ranges. Furthermore, the use of a continuous automatic zero correction of the input ensures that the calibration of the instrument is optimised during normal operation.

To comply with statutory procedures such as the Heat Treatment Specification AMS2750, the calibration of the instrument can be verified and re-calibrated if considered necessary in accordance with the instructions given in this chapter.

For example AMS2750 states:- "Instructions for calibration and recalibration of "field test instrumentation" and "control monitoring and recording instrumentation" as defined by the NADCAP Aerospace Material Specification for pyrometry AMS2750D clause 3.2.5 (3.2.5.3 and sub clauses)" Including Instruction for the application and removal of offsets defined in clause 3.2.4.

User calibration allows the controller to be calibrated at any part of its range (not just span and zero) or to allow for fixed known measuring offsets such as sensor tolerances.

Factory calibration is stored within the controller and can be returned to at any time.

In some cases it is only required to calibrate the controller itself, however, it is often necessary to compensate for tolerances in the sensor and its connections as well. This is particularly true for temperature measurement which uses, typically, thermocouple or PRT sensors. In the latter case this may be done using an ice cell or hot bath or dry block calibrator. The different methods are described in the following sections

Controller only Calibration

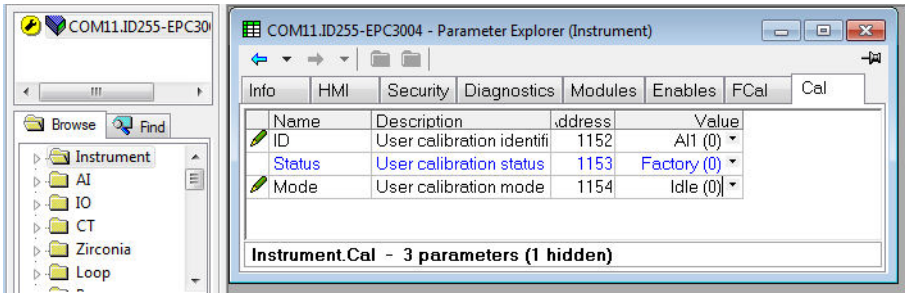
To Calibrate the Analogue Input

This can be done through the HMI or using iTools. The following points should be observed:

- Place the controller into Operator Level 3 (or Configuration level)
- Allow at least 10 minutes for the controller to settle after switching on
- Connect the input of the controller to a milli-volt source. If the controller is configured for thermocouple ensure that the millivolt source is set to the correct CJC compensation for the thermocouple in use and that the correct compensating cable is used.
- If the input to be calibrated is mV, mA or volts the measurement will be linear mV, mA or volts. If it is configured for thermocouple or RTD the measurement will be in degrees in accordance with the instrument configuration.

Using iTools

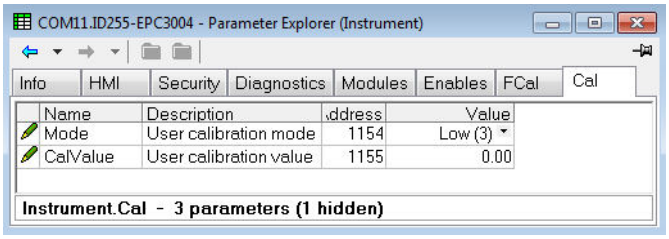
Open the Instrument list and select the Cal tab.



Status will show 'Factory' if user calibration has not been carried out before.

To Start User Calibration

Click the 'Mode' parameter and select 'Start'.



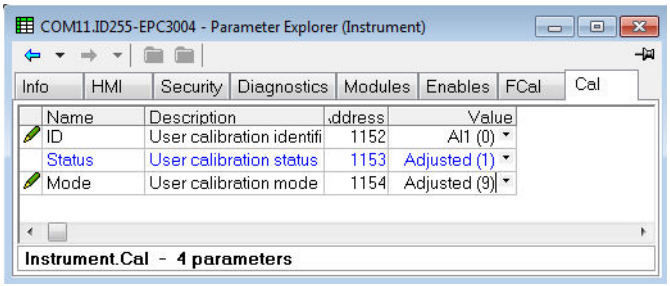
The Mode will change to 'Low'

1. In 'CalValue' enter a value which represents the low reading required on the controller display, in this case 0.00
2. Set the mV source to 0.00mV. If the input is a thermocouple make sure that the mV source is set to compensate for the type of thermocouple configured. It is not necessary to calibrate for other thermocouple types.
3. In 'Mode' select 'SetLow'. This will calibrate the controller to the selected input mV (0.00). Discard will return to Factory calibration.

The 'Mode' will change to 'High'

1. In 'CalValue' enter a value which represents the high reading required on the controller display, in this case 300.00
2. Set the mV source to the correct input level. If the input is a thermocouple this will be the mV equivalent to 300.00^{O}C. It is not necessary to calibrate for other thermocouple types.
3. In 'Mode' select 'SetHigh'. This will calibrate the controller to the selected input mV. Discard will return to Factory calibration.

The ’Status’ and ’Mode’ will show ’Adjusted’ which indicates that the controller has been calibrated by the user.



It may be found useful to open the AI1 browser list when carrying out the calibration since the PV can be read directly during the calibration procedure. This also allows the input measurement settling to be viewed during the calibration process.

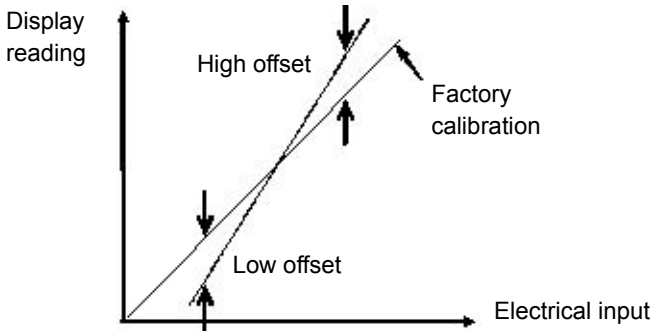
Note: If, at the end of a calibration process, the calibration has been unsuccessful the Status will return to Factory and the Mode will show ’Unsuccessful’ (U .SUC)

To Return to Factory Calibration

In ’Mode’ drop down select ’Discard’.

Two Point Offset

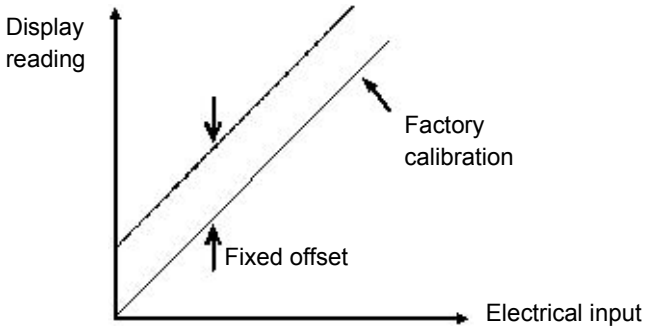
A two point offset enables the controller display to be offset by different amounts at the low end of the scale and at the high end of the scale. The basic calibration of the controller is unaffected but the two point offset provides a compensation for sensor or inter-connection errors. The diagrams below show that a line is drawn between the low and high offsets values. Any readings above and below the calibration points will be an extension of this line. For this reason it is good practice to calibrate with the two points as far apart as possible.



The procedure is exactly the same as shown in the previous section. For the minimum input set the 'CalValue' to the reading required on the controller display as shown in the Low offset in the diagram above.

Similarly, for the maximum input set the 'CalValue' to the reading required on the controller display as shown in the High offset in the above diagram.

Note: A 'PvOffset' parameter is available in the Analogue Input list which provides a fixed value to be added to or subtracted from the process variable. This is not part of the User Calibration procedure but 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:-



Using the Controller HMI

The procedure is the same as using iTools. Observe the precautions listed in "To Calibrate the Analogue Input" on page 278.

The example below shows a step by step procedure using the controller HMI. In this example a two point offset is applied

Operation	Action	Display	Notes
In Level 3 or Configuration level select the Instrument List then CAL S LIST			
Select the Analogue input AI.1	1. Press ↵ to until the Mode parameter is displayed		If the MODE shows 'AdJ.d' (adjusted) select 'diSC' (discard). This returns the controller to Factory Calibration.
Select Start	2. Press ∧ or ∨ to select		The display will change to Lo 
Set the mV source to the input value representing the required offset. In this example +1.80mV			
Enter the value of the reading required on the controller display for an input of 1.80mV	3. Press ↵ to scroll to C VAL 4. Press ∧ or ∨ to enter the value		In this example the controller display will read 0.00 for an input of +1.80 mV
Scroll back to Lo	5. Press ↵ Scroll back to Lo 6. Press ∧ or ∨ to SEt.L		The low calibration point will be entered and the display will change to Hi 
Set the mV source to 17.327. This is the offset value (+1.00mv) at which a type J thermocouple is required to read 300.0 (in this example).			
Enter the value of the reading required on the controller display for an input of 17.327mV.	7. Press ↵ to scroll to C VAL 8. Press ∧ or ∨ to enter the value		The display will read 300.0OC for an input of 17.327mv (an offset of +1.000 mV)
Scroll back to Hi	9. Press ↵ Scroll back to Hi 10. Press ∧ or ∨ to SEt.H		The high calibration will be entered and the display will changeAdJ.d. showing that the controller has been calibrated by the user 
To return to Factory calibration select diSc (discard) in place of Adj.d. If the calibration is unsuccessful the controller will revert to Factory Cal.			

Calibration using a Dry Block or Equivalent

A dry block, ice cell or hot bath are heated or cooled to a specific temperature and accurately maintained at that temperature. Calibration is a comparison between two devices. The first device is the unit to be calibrated, often called the unit under test. The second device is the standard, which has a known accuracy. Using the standard as a guide, the unit under test is adjusted until both units display the same results while exposed to the same temperature. Using this method the tolerance of the temperature sensor, CJC, etc is included in the calibration.

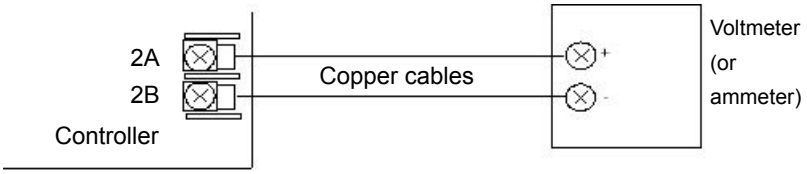
The procedure is essentially the same as that already described but the millivolt source is replaced by the temperature sensor under test.

To Calibrate a Voltage or Current Analogue Output

Using the Controller HMI

The procedure is generally the same as for the Analogue input except it requires the output to be connected to a voltage or current meter.

In this example the output to be calibrated is OP2.



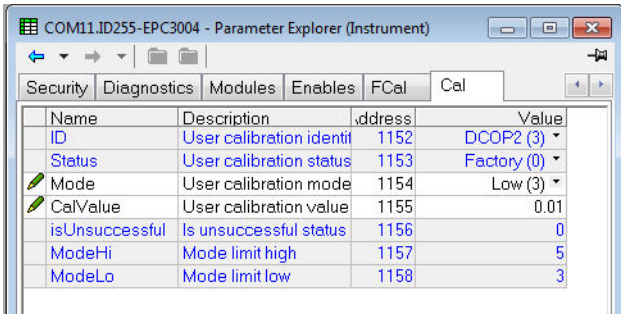
Operation	Action	Display	Notes
In Level 3 or Configuration level select the Instrument List then CAL S LIST		CAL S LIST	
Select the Analogue output dC.1 (2 or 3)	1. Press ↵ until the Mode parameter is displayed	IdLE MODE	If MODE shows 'AdJ.d' (adjusted) select 'diSC' (discard). This returns the controller to Factory Cal.
Select Start	2. Press ∧ or ∨ to select	Strt MODE	The display will change to Lo Lo MODE
Read the DC output on the meter. For a voltage output, this should read 2.00 volts. (For a mA output this should read 4.00mA). If, for example, the voltage reading is 1.90V, enter this value - the instrument works out the difference as part of the calibration process.			
Enter the meter reading e.g. 1.9V	3. Press ↵ to scroll to C.VAL 4. Press ∧ or ∨ to enter the value	1.9 C.VAL	In this example the user calibrated output will output 2V instead of 1.9V
Scroll back to Lo	5. Press ↵ Scroll back to Lo 6. Press ∧ or ∨ to SEt.L	SEt.L MODE	The low calibration point will be entered and the display will change to Hi Hi MODE
As above read the DC output on the meter. For a voltage output, this should read 10.00 volts. (For a mA output this should read 20.00mA). If the voltage reading is 9.80V, enter this value into the C.VAL parameter as shown below.			
Enter the meter reading e.g. 9.80V	7. Press ↵ to scroll to C.VAL 8. Press ∧ or ∨ to enter the value	9.8 C.VAL	In this example the user calibrated output will output 10V instead of 9.8V
Scroll back to Hi	9. Press ↵ Scroll back to Hi 10. Press ∧ or ∨ to SEt.H	SEt.Hi MODE	The high calibration will be entered and the display will changeAdJ.d. AdJ.d MODE
To return to Factory calibration select diSc (discard) in place of Adj.d. If the calibration is unsuccessful the controller will revert to Factory Cal.			

Using iTools

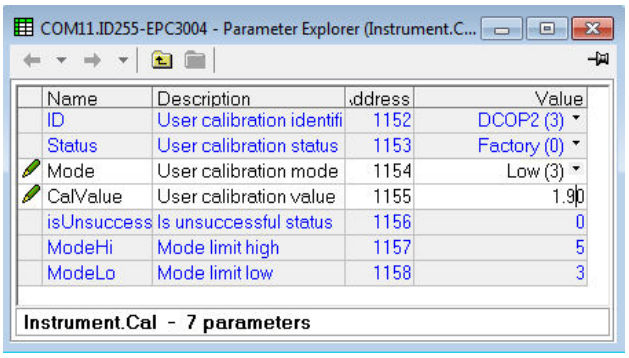
Open the Instrument list and select the Cal tab.

Assuming that user calibration has not been carried out before the Status will show Factory.

In 'Mode' select 'Start'. The Mode parameter will change to 'Low'.



1. Read the DC output on the meter. For a voltage output, this should read 2.00 volts. (For a mA output this should read 4.00mA). If the voltage reading is 1.90V, enter this value, into the C.VAL parameter as shown below.



2. Change 'Mode' to 'SetLo'. The new cal value will be stored and the 'Mode' will change to 'High'.

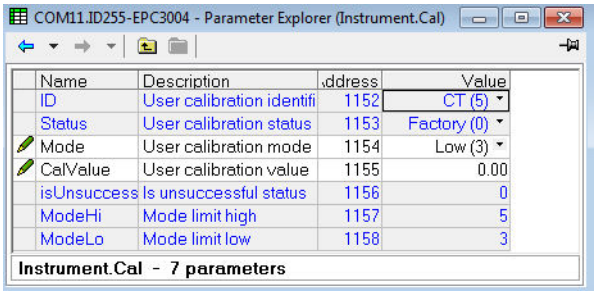
Repeat Step 1 above for the High Calibration point entering the required meter reading for the high calibration point.

The 'Mode' parameter will now show 'Adjusted' signifying that calibration has been adjusted by the user.

To Calibrate the Current Transformer

The procedure is similar to the calibration of the Analogue Input as described in section "Using iTools" on page 279

1. Connect a current source to the current transformer terminals C and CT
2. In the 'Instrument Cal' list. set the ID to CT



3. Adjust the 'Mode' parameter to 'Low'.
4. Inject a current from the current source, for example, 35mA.
5. Enter 35.00 into the 'CalValue' parameter
6. Adjust the 'Mode' parameter to 'SetLow'.
7. The CT low calibration point will be stored and the 'Mode' parameter will change to 'High'
8. Inject a current from the current source, for example, 70mA.
9. Enter 70.00 into the 'CalValue' parameter
10. Adjust the 'Mode' parameter to 'SetHigh'.
11. On successful calibration the 'Mode' parameter will change to 'Adjusted' as in the previous examples.

Notification Messages

Notification messages indicate specific conditions within the controller or connected devices.

The following messages can be displayed depending upon value, notifications, or standby conditions:

Note: Scrolling messages can be customised using iTools, (see "User Defined Messages" on page 205) so they may not be identical to those shown in the table below.

Mnemonic	Scrolling Message	Description of notification / unexpected condition	Possible Solutions
HHHH	--	Parameter value is greater than the maximum display limit	
LLLL	--	Parameter value less than the minimum display limit	
S.brk	INPUT SENSOR BROKEN	If the sensor becomes open circuit a message in the upper display which alternates between S.brk and bAd. The controller will be placed into Manual mode. The lower display will scroll the message 'Input Sensor Broken'. This message can be customised using iTools. The actual message is defined in default message table. The Sensor Break Output parameter can be wired to a process alarm to provide latching strategies.	Typical reasons for this alarm may be caused by the connections between the instrument and the sensor becoming disconnected or a detected break of the sensor itself. Change the sensor and check the wiring and connections.
S.rNG O.rNG	INPUT SENSOR OUT OF RANGE	A sensor is out of range. If the PV input value rises above 5% of the input range, alarm messages will be shown. O.RNG (over range in green) will alternate with S.RNG (sensor out of range in red) and the controller will be put into Manual mode. A scrolling message, as defined in default message table, will also appear.	Reconfigure the Range High parameter in the Analogue Input list in accordance with the application requirements.
S.rNG u.rNG	INPUT SENSOR OUT OF RANGE	A sensor is out of range. If the PV input value falls below 5% of the input range, alarm messages will be shown. u.RNG (under range in green) will alternate with S.RNG (sensor out of range in red) and the controller will be put into Manual mode. A scrolling message as defined in default message table will also appear,.	Reconfigure the Range Low parameter in the Analogue Input list in accordance with the application requirements.
tUnE	--	Control loop auto tune has timed out and did not complete.	Retry tune or clear by entering and exiting configuration level.
	USING DEFAULT COMMS CONFIG PASSCODE	The instrument contains user comms (fixed and/or option) and the 'Comms Config Passcode' has not been changed from its default value.	Change the Config Passcode in the Instrument/Security list.
	COMMS CONFIG PASSCODE EXPIRED	The instrument contains user comms (fixed and/or option) and the 'Comms Config Passcode' has expired	
	HMI LEVEL 2 LOCKED. TOO MANY INCORRECT PASSCODE ATTEMPTS	HMI Level 2 access has been locked due to too many incorrect passcode entries.	Enter level 3 or config to clear the lock, or wait for the timeout period to expire.
	HMI LEVEL 3 LOCKED. TOO MANY INCORRECT PASSCODE ATTEMPTS	HMI Level 3 access has been locked due to too many incorrect passcode entries.	Enter config level to clear the lock, or wait for the timeout period to expire.

	HMI CONF LEVEL LOCKED. TOO MANY INCORRECT PASSCODE ATTEMPTS	HMI Config access has been locked due to too many incorrect passcode entries.	Use config clip to connect and reset the timer to 0, to clear, then back to the required timeout period. Or wait for the timeout period to expire.
	COMMS CONF LEVEL LOCKED. TOO MANY INCORRECT PASSCODE ATTEMPTS	Comms Config access has been locked due to too many incorrect passcode entries.	
	LOOP DEMO MODE	Control loop is in demo mode (controlling a simulated load)	
	AUTO TUNE ACTIVE	Control loop auto tune is active	
	AUTOTUNE TRIGGERED BUT CANNOT RUN	Control loop auto tune requested but can not run.	Put the loop into auto.
	COMMS CONFIG ACTIVE	The instrument is in config mode via comms. This will typically be displayed if the controller has been put into configuration mode using iTools.	Disconnect the comms source or take the controller out of config mode (if using iTools).
OFF		Channel is Off	
HwE		Detected hardware error	
rnG		Input Ranging	
OFLw		Input Overflow	
bAd		Bad Input	
HwC		Hardware Exceeded	
NdAt		The PV has no data	
rAm.S	INVALID RAM IMAGE OF NVOL	Periodic check of non-volatile memory has detected a corruption . This condition places the instrument in standby mode.	Clear by going in and out of config mode. If problem persists, return to factory
OPt.S	OPTION NVOL LOAD OR STORE WAS UNSUCCESSFUL	Option Board Non-Volatile Memory load or store was unsuccessful.	Return unit to factory.
PA.S	NVOL PARAMETER DATABASE LOAD OR STORE WAS UNSUCCESSFUL	Option Board Non-Volatile Memory load or store was unsuccessful.	Return unit to factory.
rEG.S	NVOL REGION LOAD OR STORE WAS UNSUCCESSFUL	Option Board Non-Volatile Memory load or store was unsuccessful.	Return unit to factory.
CAL.S	FACTORY CALIBRATION NOT DETECTED	AI or IO module has lost, or gone out of calibration.	Return to factory for calibration.
CPu.S	UNEXPECTED CPU CONDITION	Unexpected internal CPU fuse settings.	Return unit to factory.
Id.S	HARDWARE IDENT UNKNOWN	Unsupported hardware detected.	Return unit to factory
Hwd.S	FITTED HARDWARE DIFFERS FROM EXPECTED HARDWARE	Detected hardware does not match the expected hardware.	Clear by ensuring the expected hardware matches the fitted hardware in Instrument.Modules parameter list.
trEY.S	UNEXPECTED KEYBOARD CONDITION	Unexpected keyboard condition detected at startup.	Clear by power cycling. If problem persists, return to factory
P.CnF	POWERED DOWN WHILST IN CONFIG MODE	The instrument lost power while in config mode	Clear by entering and exiting config mode
rEC.S	INCOMPLETE RECIPE LOAD	If the recipe load cannot be completed for any reason (values are invalid or out of range), the instrument will be half configured. The instrument will go into Standby	Enter config mode and re-enter Operator Level to clear the message

Technical Specification

General

Controller Function	Single loop panel mount PID controller range with Autotune, ON/OFF, Valve Positioning (no slidewire required). Zirconia Probe Atmosphere Control. Single loop profile/program up to 10 profiles of 24 segments. Mains and 24V VDC options.
Measurement Inputs	1 or 2 inputs. Accuracy ±0.1% reading (refer to detailed specification)
PID Control	2 PID sets are available (Separate proportional band for heat and cool). Enhanced Autotuning control with cutback to minimize overshoot and oscillation. Fast reacting precision control to setpoint changes or after process disturbances. Enhanced Valve Positioning (unbounded) algorithm. Gain scheduling allows PID selection for a wide range of operating situations, including deviation from setpoint, absolute temperature, output level and others. Mains voltage monitoring for feedforward. PV and SP feedforward functions.
Program/Profiler	Up to 10 profiles of 24 steps. Options for 1x8, 1x24 and 10x24. Holdback (“guaranteed soak”, event outputs, time to target, ramp rate, dwell, step and call segment types. Communications compatible with Eurotherm 2400 programmer. Additional timer functions available.
User function block wiring	Optional Totaliser, Math, Logic and multiplexing, BCD conversion, Counter/Timer and many other special function blocks available including Zirconia and Switchover.
Additional Functions	Digital and analog retransmission functions. CT Input - Monitor partial load failure, load short and open circuit; Dual input functions including switchover, redundant sensor, average, min, max, Zirconia. Six freely configurable alarms with manual, automatic, non-latching and event types plus alarm delay function and blocking. Alarms may be inhibited in standby. Five recipes with 40 freely selectable parameters switchable from front panel or digital input. Scrolling parameter help and user messages displayed on event. USB Backup lead and free configuration software.
Backup and Configuration Tools	Free Eurotherm iTools software for backup and configuration. USB Backup lead available for convenient desktop configuration and back up; powers the instrument with or without a sleeve. iTools connects also using Ethernet and serial Modbus RTU.
Ethernet	Certified to Achilles® Communications Robustness Testing Level 1

Environmental specifications, standards, approvals and certifications

Operating Temperature		0℃ to 55℃
Storage Temperature		−20℃ to 70℃
Operating/storage humidity		5% to 90%, non-condensing
Atmosphere		Non-corrosive, non-explosive
Altitude		< 2000 Metres
Vibration / Shock		EN61131-2 (5 to 11.9Hz @ 7mm peak to peak displacement, 11.9-150Hz @ 2g, 0.5 octave min.) EN60068-2-6 Test FC, Vibration. EN60068-2-27 Test Ea and guidance, Shock.
Front of panel sealing protection		Standard bezel: EN60529 IP65, UL50E Type 12 (equivalent to NEMA12). Washdown bezel: EN60529 IP66, UL50E Type 4X (indoor use) (equivalent to NEMA4X)
Rear of panel protection		EN60529 IP10
Flammability of plastic materials		UL746C-V0
Electromagnetic compatibility (EMC)	Emissions	HV PSU units to EN61326-1 Class B – Light industrial LV PSU units to EN61326-1 Class A – Heavy industrial
	Immunity	BS EN61326-1 Industrial
Approvals and certification	Europe	CE (EN61326), RoHS (EN50581), REACH, WEEE, EN14597 pending
	USA, Canada	UL, cUL
	Russia	EAC (CUTR) pending
	China	RoHS, CCC: Exempt (Product not listed in catalogue of products subject to China Compulsory Certification)
	Global	When subject to the necessary field calibration, EPC3000 series controllers manufactured by Eurotherm are suitable for use in Nadcap applications in all furnace classes, as defined in AMS2750E clause 3.3.1. Meets accuracy requirements of CQI-9 Achilles® Level 1 CRT Cyber Security Assessment Schneider Electric Green Premium
Electrical safety		EN61010-1: 2010 and UL 61010-1: 2012. Pollution Degree 2 Insulation Category II

Mechanical

Dimensions

Dimensions given as width × height.

EPC3004 ¼ DIN	Cut out	92 mm × 92 mm (-0.0 +0.8) 3.62 inch × 3.62 inch (-0.00 +0.03)
	Front panel	96 mm × 96 mm (+1 mm) 3.78 inch × 3.78 inch (+0.05 inch)
EPC3008 ⅛ DIN	Cut out	45 mm (-0.0 +0.6) × 92 mm (-0.0 +0.8) 1.77 inch (-0.00 +0.02) × 3.62 inch (-0.00 +0.03)
	Front panel	48 mm x 96 mm (+1 mm) 1.89 inch x 3.78 inch (+0.04 inch)
EPC3016 1/16 DIN	Cut out	45 mm × 45 mm (-0.0 +0.6) 1.77 inch × 1.77 inch (-0.00 +0.02)
	Front panel	48 mm × 48 mm (+1 mm) 1.89 inch × 1.89 inch (+0.04 inch)

Depth behind panel (all controllers) 90 mm (3.54 inch)
Depth Total (all controllers) 101 mm (3.97 inch)

Weight

EPC3004	420 grams; 14.81oz
EPC3008	350 grams; 12.34oz
EPC3016	250 grams; 8.81oz

Input and Outputs

I/O and communication types

I/O and Comms	EPC3016	EPC3008/3004
Analogue inputs	1 universal input 20Hz 1 auxilliary input 4-20mA, 0-10V 4Hz (option)	1 or 2 (option) universal input 20Hz
Optional I/O modules: Form A relay output Logic I/O DC analog output TRIAC output	Up to 2, freely selectable:	Up to 3, freely selectable:
Form C relay output	1	1
Contact closure logic input	1 (option)	2
Logic I/O (open collector)	-	4 or 8 (option)
Current transformer	1 (option)	1
24V transmitter PSU	-	1
Communications	1 of the following options: RS485, RS422, or RS232 with either - Modbus RTU slave - EI Bisynch (available with serial comms) Ethernet Modbus TCP (option)	2 of the following options: RS485 with either - Modbus RTU slave - EI Bisynch (option) Ethernet ModbusTCP (option)

I/O specifications

Input types	Thermocouples, PT100/PT1000 RTD, 4-20mA, 0-20mA, 10V, 2V, 0.8V, 80mV, 40mV, Zirconia (Oxygen Probe), Pyrometers. Accuracy ±0.1% reading. When subject to the necessary field calibration, “Control, Monitoring and Recording Instruments” manufactured by Eurotherm are suitable for use in Nadcap applications in all furnace classes as defined in AMS2750E clause 3.3.1.
Sample time	Process Inputs: 50ms (20Hz) Thermocouple: 62.5ms (16Hz) RTD: Automatic cycle time selection 100ms (10Hz)
Mains rejection	Series mode rejection: 48-62Hz >80dB Common mode rejection: > 150dB
Sensor break	AC sensor break, detected within 3 seconds worst case
Input filtering	Filter time constant = OFF to 60 seconds
User calibration	User 2-point input adjust (offset/gradient), transducer scaling
Thermocouple	K, J, N, R, S, B, L, T as standard plus 2 downloadable custom curves Linearisation accuracy CJ Calibration: <±1.0C at 25C ambient. CJ Ambient rejection ratio: better than 40:1 from 25C ambient CJ automatic (internal), variable (external fixed 0, 45, 50ºC) CJ external (measured) for 3004/3008 only

Inputs and outputs

Input ranges		**40mV**	**80mV**	**mA**	**0.8V**	**2V**	**10V**	**RTD (PT100/ PT1000)**
Range	Min	-40mV	-80mV	-32mA	-800mV	-2V	-10V	18.5Ω/185Ω (-200ºC)
	Max	+40mV	+80mV	+32mA	+800mV	+2V	+10V	400Ω /4000Ω (850ºC)
Thermal stability from 25ºC ambient		±0.4µV/ºC ±13ppm/ºC	±0.4µV/ºC ±13ppm/ºC	±0.16µA/ºC ±113ppm/ºC	±0.4µV/ºC ±13ppm/ºC	±0.4µV/ºC ±13ppm/ºC	±0.8µV/ºC ±70ppm/ºC	±10mºC/ºC ±25ppm/ºC
Resolution		1.0µV unfiltered	1.6µV	0.6µA	16µV	41µV	250µV	50mºC
Measurement noise (pk to pk with 1.6s input filter		0.8µV	3.2µV	1.3µA	32µV	82µV	250µV	50mºC
Linearity accuracy (best fit straight line)		0.003%	0.003%	0.003%	0.003%	0.003%	0.007%	0.033%
Calibration accuracy at 25ºC ambient		±4.6µV ±0.053%	±7.5µV ±0.052%	±3µA ±1.052%	±75µV ±0.052%	±420µV ±0.044%	±1.5mV ±0.063%	±310mºC ±0.023%
Input resistance		100 MΩ	100 MΩ	2.49Ω (1% shunt)	100 MΩ	100 MΩ	57 kΩ	
Bulb current								Bulb current 190µA/180µA

Remote (Aux) analogue input (EPC3016 only)

Range	0 to 10V and 4 to 20mA. Max ranges -1V to 11V and 3.36mA to 20.96mA
Accuracy	<±0.25% of reading ± 1LSD, 14 Bits
Sample Rate	4Hz (250ms)
Functions	Remote setpoint input. Auxiliary analogue input.
Mains Rejection	48-62Hz > -120dB Common Mode > -90db Series Mode
Thermal Stability	100ppm (typical) < 150ppm (worst case)
Input Impedance	Voltage 223kΩ. Current 2.49Ω

Current transformer

Input range	0mA to 50mA rms 48 to 62Hz
Burden resistor	10Ω burden resistor fitted inside the controller
Measurement Scaling	10, 25, 50 or 100 Amps
Calibration accuracy	<1% of reading (typical), <4 % of reading (worst case)
Input Functions	Partial load failure. SSR Open or Short Circuit. Other functions including power usage totalisation using soft wiring.

Contact closure inputs

Thresholds	Open > 600Ω, Closed < 300Ω
Input functions	Auto/Manual select, SP2 select, Integral Hold/Control inhibit/Program run functions/Keylock/Recipe, Select/PID, select/BCD Bit/Autotune enable/Standby/PV Select plus other functions using soft wiring

Logic I/O modules

Output Rating	ON 12V DC 44mA max. Minimum control cycle time 50mS (auto)
Output Functions	Time proportioned heat, Time proportioned cool. SSR Drive Alarm and event outputs, interlock outputs, other functions using soft wiring.
Contact Closure (input)	Open > 500Ω, Closed < 150Ω
Input Functions	Auto/Manual select, SP2 select, Integral Hold, Control inhibit, Program run functions, Keylock, Recipe select, PID select, BCD Bit, Autotune enable, Standby, PV Select plus other functions using soft wiring.

Logic I/O open collector type (EPC3008/3004)

Output Rating	15V to 35V DC
Output limit	Maximum current sinking 40mA
Output Functions	Alarm and event outputs, interlock outputs, other functions using soft wiring. Cannot be used as a control output.
Voltage sensing input	OFF < 1V, ON > 4V. Max 35V, Min -1V
Contact Closure (input)	OFF > 28KΩ, ON < 100Ω
Input Functions	Auto/Manual select, SP2 select, Integral hold, Control inhibit, Program run functions, Keylock, Recipe select, PID select, BCD bit, Autotune enable, Standby, PV select plus other functions available using soft wiring.

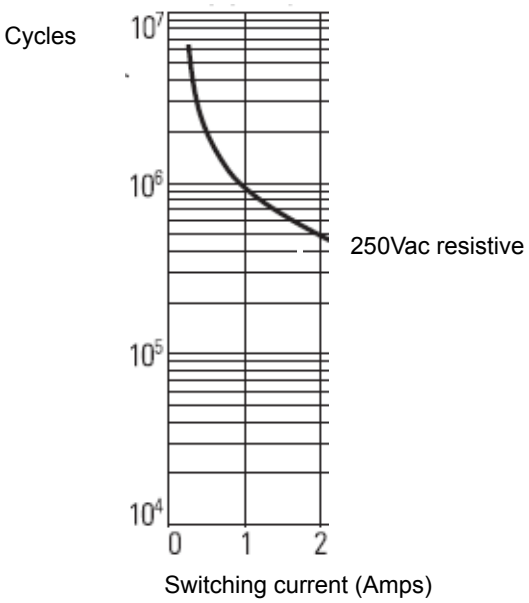
Relays (form A modules and form C fixed built in)

Types	Form A (normally open) Form C (changeover)
Output Functions	Time proportioned heat, time proportioned cool. SSR Drive. Direct Valve raise/lower. Alarm and event outputs, interlock outputs, other functions using soft wiring
Rating	Min 100mA @ 12V, Max 2A :@ 264V AC resistive. External Snubber recommended.

Relay Electrical Endurance

The number of operations which the relays are expected to endure is limited in accordance with the graph shown below. Typically at a load of 2A, 250Vac resistive this is 500,000 operations.

Electrical Endurance



Triac module

Rating	Min 40mA, 30V RMS, Max 0.75A :@ 264V AC resistive
Output Functions	Time proportioned heat, time proportioned cool. SSR drive. Alarm and event outputs, interlock outputs, other functions using soft wiring.
Surge Rating	Max current surge 30A (<10mS). Max continuous operating voltage 540V peak, 385V RMS. Max surge voltage 800V peak, 565V RMS (< 10mS)

Isolated DC output module

	Current Output	Voltage output
Range	0-20mA	0-10V
Load resistance	<550Ω	>450Ω
Calibration accuracy	< ±(0.5% of reading + 100uA offset)	Calibration accuracy: < ±(0.5% of reading + 50mV offset)
Resolution	13.5 Bits resolution	13.5 Bits resolution
Output Functions	SCR/Power control drive. Proportional valve. Retransmission to chart recorder or other instrumentation. Other functions using soft wiring.	

Power supply and transmitter power supply

Controller supply voltage	100-230Vac +/- 15%, 48 to 62Hz or 24Vac +10/-15%, 48 to 62Hz 24Vdc +20/-15%, max 5% ripple voltage.
PSU Rating	EPC3016 6W EPC3008/3004 9W
Power Measurement	Only available in 100-230Vac powered instruments. Measures direct from power supply (no additional connections. Uncalibrated. Electrical noise 0.5V filtered, used by the PID function for power feedforward.
Transmitter PSU	24Vdc. 2 to 28mA load. Isolated from system (300V AC double isolation) (EPC3008/3004 only)

Communications

Ethernet	Shielded grounded RJ45 Jack supporting 10/100BASE-T auto sensing. Fixed IP address or DHCP.
Serial	RS485 Half duplex RS422/RS232 Full duplex Baud rates 9600, 19200 Modbus RTU 8 data bits, odd/even/no parity selectable. EI-Bisynch 7 data bits even parity fixed.

Operator interface

Type	High Visibility LCD with backlight. Flat “washdown” membrane bezel with superior panel sealing, or sculpted bezel with fully tactile keys
Keyboard	100,000 Operations typical
Main PV	EPC3016 4 Digits, 3DP, EPC3008 4.5 Digits, 4DP. EPC3004 5 Digits, 4DP. Green/Red Bicolor (Red in alarm)
Second Line	5 Character 16 segment text or numeric
Third Line (EPC3004/3008 only)	16 Segment scrolling text or numeric display
Text Character Sets	Roman, Simplified Cyrillic
Additional Display Functions	Program status “crowsfoot” indicator Output indicators Alarm indication Units Bar graph (EPC3004/3008 only) Communications activity indicator
HMI Functions	Configurable display contents Configurable scroll lists for operator/supervisor Configurable scrolling event messages Passcode level protection with lockout period Two Programmable function keys (EPC3004/3008 only)

Appendix EI-Bisync Parameters

The following table lists the EIBisync parameters which are supported by EPC3000 series controllers.

Parameter	Mnemonics
Loop.Main.PV	PV
Loop.OP.ManualOP	OP
Loop.Main.TargetSP	SL
Loop.Main.AutoMan	mA
CurrentTransformer.LoadCurrent	LI
Instrument.Info.CustomerID	ID
Loop.Main.WorkingSP	SP
Loop.Main.WorkingOutput	OO
Loop.OP.ManualOP	VM
Loop.Main.WorkingOutput	VP
Programmer.Run.ProgramNumber	PN
Programmer.Run.ProgramMode	PC
Programmer.Run.ProgramSetpoint	PS
Programmer.Run.ProgramCyclesLeft	CL
Programmer.Run.SegmentNumber	SN
Programmer.Run.SegmentType	CS
Programmer.Run.SegmentTimeLeft	TS
Programmer.Run.TargetSetpoint	CT
Programmer.Run.RampRate	CR
Programmer.Run.ProgramTimeLeft	TP
Programmer.Run.Event1	z1
Programmer.Run.Event2	z2
Programmer.Run.Event3	z3
Programmer.Run.Event4	z4
Programmer.Run.Event5	z5
Programmer.Run.Event6	z6
Programmer.Run.Event7	z7
Programmer.Run.Event8	z8
Alarm.1.Threshold	A1
Alarm.2.Threshold	A2
Alarm.3.Threshold	A3
Alarm.4.Threshold	A4
Alarm.1.Hysteresis	n5
Alarm.2.Hysteresis	n6
Alarm.3.Hysteresis	n7
Alarm.4.Hysteresis	n8
Loop.Diags.LoopBreakTime	lt
Loop.Atune.AutotuneEnable	AT
Loop.PID.Boundary	GS
Loop.PID.ActiveSet	Gn
Loop.PID.Ch1PropBand	XP
Loop.PID.IntegralTime	TI
Loop.PID.DerivativeTime	TD
Loop.PID.ManualReset	MR
Loop.PID.CutbackHigh	HB
Loop.PID.CutbackLow	LB

Parameter	Mnemonics
Loop.PID.Ch2PropBand	RG
Loop.PID.Ch1PropBand2	P2
Loop.PID.IntegralTime2	I2
Loop.PID.DerivativeTime2	D2
Loop.PID.ManualReset2	M2
Loop.PID.CutbackHigh2	hb
Loop.PID.CutbackLow2	lb
Loop.PID.Ch2PropBand2	G2
Loop.FF.FFGain	FP
Loop.FF.FFOffset	FO
Loop.FF.PIDTrimLimit	FD
Loop.PID.Ch1OnOffHyst	HH
Loop.PID.Ch2OnOffHyst	hc
Loop.OP.Ch2Deadband	HC
Loop.OP.SafeValue	BO
Loop.OP.Ch1TravelTime	TT
Loop.OP.SafeValue	VS
Loop.SP.SPSelect	SS
Loop.Main.RemoteLoc	rE
Loop.SP.SP1	S1
Loop.SP.SP2	S2
Loop.SP.RSP	uq
Loop.SP.RSP	ur
Loop.SP.SPTrim	LT
Loop.SP.SPLowLimit	LS
Loop.SP.SPHighLimit	HS
Loop.SP.SPLowLimit	L2
Loop.SP.SPHighLimit	H2
Loop.SP.SPTrimLowLimit	TL
Loop.SP.SPTrimHighLimit	TH
Loop.SP.SPRateUp	RR
AI.1.MVIn	VA
AI.2.MVIn	VD
AI.1.CJCTemp	t5
AI.2.CJCTemp	t6
AI.1.PV	QY
AI.2.PV	QZ
Loop.OP.OutputLowLimit	LO
Loop.OP.OutputHighLimit	HO
Loop.OP.RemoteOPLow	RC
Loop.OP.RemoteOPHigh	RH
Loop.OP.OPRateUp	OR
Loop.OP.ManualStepValue	FM
IO.1.CycleTime	CH
IO.1.MinOnTime	MH
IO.2.CycleTime	C2
IO.2.MinOnTime	MC
Loop.OP.SafeValue	BP
Instrument.HMI.HomeDisplay	WC
Loop.Main.WorkingOutput	WO
Loop.FF.FFOutput	FN
Loop.Diags.ProportionalOP	Xp
Loop.Diags.IntegralOP	xI
Loop.Diags.DerivativeOP	xD

Parameter	Mnemonics
Loop.OP.Ch1Output	Vv
RemoteInput.input	RI
Loop.Diags.Deviation	ER
Instrument.Info.NativeVersion	V0 (HEX Format)
Instrument.Info.NativeType	II (HEX Format)
Instrument.Security.InstrumentMode	IM
Programmer.Set.EditProgram	EP
Loop.Main.Hold	FC
AI.1.SensorBreakOutput	sb
Loop.Diags.LoopBreak	Lb
Loop.Main.IntegralHold	IH
Instrument.Diagnostics.GlobalAck	AK
Loop.SP.SPRateDone	Rc
Instrument.HMI.Keylock	DK
RemoteInput.RemStatus	RF
AI.2. SensorBreakOutput	IF
Loop.SP.RangeHigh	QL
Loop.SP.RangeLow	QM
Instrument.Diagnostics.InstrumentStatus	SO (HEX Format)
Loop.Setup.Ch1ControlType	Q0
Loop.Setup.ControlAction	CA
Loop.OP.NonLinearCooling	Q9
Loop.Setup.DerivativeType	Qe
Loop.OP.PowerFeedforward	Pe
Loop.FF.FFType	QO
Loop.OP.SafeValue	QP
Loop.OP.ManualStepValue	QR
BCD.BcdOP	BF
Loop.PID.GainScheduler	QW
Instrument.Info.TemperatureUnits	Q1
Loop.SP.SPTracksRSP	QE
Loop.SP.SPTracksPV	QF
Loop.SP.SPTracksPSP	QG
Loop.SP.SPRateUnits	QJ
Loop.SP.RSPType	QA
*WorkingProgram.HoldbackType	$0
*WorkingProgram.HoldbackValue	s0
*WorkingProgram.RampUnits	d0
*WorkingProgram.DwellUnits	p0
*WorkingProgram.ProgramCycles	o0
*WorkingSegment.1.SegmentType	$1
*WorkingSegment.1.TargetSetpoint	s1
*WorkingSegment.1.Duration/RampRate/RampTime	d1
*WorkingSegment.1.CallProgramNo/WorkingProgram.ProgramEndType	p1
*WorkingSegment.1.EventOutput	o1 (HEX Format)
*WorkingSegment.2.SegmentType	$2
*WorkingSegment.2.TargetSetpoint	s2
*WorkingSegment.2.Duration/RampRate/RampTime	d2
*WorkingSegment.2.CallProgramNo/WorkingProgram.ProgramEndType	p2
*WorkingSegment.2.EventOutput	o2 (HEX Format)
*WorkingSegment.3.SegmentType	$3
*WorkingSegment.3.TargetSetpoint	s3
*WorkingSegment.3.Duration/RampRate/RampTime	d3
*WorkingSegment.3.CallProgramNo/WorkingProgram.ProgramEndType	p3

Parameter	Mnemonics
*WorkingSegment.3.EventOutput	o3 (HEX Format)
*WorkingSegment.4.SegmentType	$4
*WorkingSegment.4.TargetSetpoint	s4
*WorkingSegment.4.Duration/RampRate/RampTime	d4
*WorkingSegment.4.CallProgramNo/WorkingProgram.ProgramEndType	p4
*WorkingSegment.4.EventOutput	o4 (HEX Format)
*WorkingSegment.5.SegmentType	$5
*WorkingSegment.5.TargetSetpoint	s5
*WorkingSegment.5.Duration/RampRate/RampTime	d5
*WorkingSegment.5.CallProgramNo/WorkingProgram.ProgramEndType	p5
*WorkingSegment.5.EventOutput	o5 (HEX Format)
*WorkingSegment.6.SegmentType	$6
*WorkingSegment.6.TargetSetpoint	s6
*WorkingSegment.6.Duration/RampRate/RampTime	d6
*WorkingSegment.6.CallProgramNo/WorkingProgram.ProgramEndType	p6
*WorkingSegment.6.EventOutput	o6 (HEX Format)
*WorkingSegment.7.SegmentType	$7
*WorkingSegment.7.TargetSetpoint	s7
*WorkingSegment.7.Duration/RampRate/RampTime	d7
*WorkingSegment.7.CallProgramNo/WorkingProgram.ProgramEndType	p7
*WorkingSegment.7.EventOutput	o7 (HEX Format)
*WorkingSegment.8.SegmentType	$8
*WorkingSegment.8.TargetSetpoint	s8
*WorkingSegment.8.Duration/RampRate/RampTime	d8
*WorkingSegment.8.CallProgramNo/WorkingProgram.ProgramEndType	p8
*WorkingSegment.8.EventOutput	o8 (HEX Format)
*WorkingSegment.9.SegmentType	$9
*WorkingSegment.9.TargetSetpoint	s9
*WorkingSegment.9.Duration/RampRate/RampTime	d9
*WorkingSegment.9.CallProgramNo/WorkingProgram.ProgramEndType	p9
*WorkingSegment.9.EventOutput	o9 (HEX Format)
*WorkingSegment.10.SegmentType	$:
*WorkingSegment.10.TargetSetpoint	s:
*WorkingSegment.10.Duration/RampRate/RampTime	d:
*WorkingSegment.10.CallProgramNo/WorkingProgram.ProgramEndType	p:
*WorkingSegment.10.EventOutput	o: (HEX Format)
*WorkingSegment.11.SegmentType	$;
*WorkingSegment.11.TargetSetpoint	s;
*WorkingSegment.11.Duration/RampRate/RampTime	d;
*WorkingSegment.11.CallProgramNo/WorkingProgram.ProgramEndType	p;
*WorkingSegment.11.EventOutput	o; (HEX Format)
*WorkingSegment.12.SegmentType	$<
*WorkingSegment.12.TargetSetpoint	s<
*WorkingSegment.12.Duration/RampRate/RampTime	d<
*WorkingSegment.12.CallProgramNo/WorkingProgram.ProgramEndType	p<
*WorkingSegment.12.EventOutput	o< (HEX Format)
*WorkingSegment.13.SegmentType	$=
*WorkingSegment.13.TargetSetpoint	s=
*WorkingSegment.13.Duration/RampRate/RampTime	d=
*WorkingSegment.13.CallProgramNo/WorkingProgram.ProgramEndType	p=
*WorkingSegment.13.EventOutput	o= (HEX Format)
*WorkingSegment.14.SegmentType	$>
*WorkingSegment.14.TargetSetpoint	s>
*WorkingSegment.14.Duration/RampRate/RampTime	d>

Parameter	Mnemonics
*WorkingSegment.14.CallProgramNo/WorkingProgram.ProgramEndType	p>
*WorkingSegment.14.EventOutput	o> (HEX Format)
*WorkingSegment.15.SegmentType	$?
*WorkingSegment.15.TargetSetpoint	s?
*WorkingSegment.15.Duration/RampRate/RampTime	d?
*WorkingSegment.15.CallProgramNo/WorkingProgram.ProgramEndType	p?
*WorkingSegment.15.EventOutput	o? (HEX Format)
*WorkingSegment.16.SegmentType	$@
*WorkingSegment.16.TargetSetpoint	s@
*WorkingSegment.16.Duration/RampRate/RampTime	d@
*WorkingSegment.16.CallProgramNo/WorkingProgram.ProgramEndType	p@
*WorkingSegment.16.EventOutput	o@ (HEX Format)

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