Model PM5-CO
Single or Dual Input
Conductivity/Resistivity/ppm
Panel Mount Display/Controller
Operation and Instruction Manual

Table of Contents

1 Introduction

This manual contains information for the installation and operation of the single or dual input PM5 Conductivity /Resistivity/TDS (PPM) Monitor. The PM5-CO may be configured to accept an input from a range of conductivity cells with cell constants ranging from K=0.01 to K=100. The ranges over which the PM5 can measure for available cell K factors are shown in the table below.

Cell Range Guide				
Cell K factor	**uS/cm**	**uS/m**	**mS/cm**	mS/m
K=0.01	0 – 125 @ 25^{o}C	0 – 12,500 @ 25^{o}C	0 – 0.125 @ 25^{o}C	0 – 12.5 @ 25^{o}C
K=0.05	0 – 625 @ 25^{o}C	0 – 62,500 @ 25^{o}C	0 – 0.625 @ 25^{o}C	0 – 62.5 @ 25^{o}C
K=0.1	0 – 1,250 @ 25^{o}C	0 – 125,000 @ 25^{o}C	0 – 1.25 @ 25^{o}C	0 – 125 @ 25^{o}C
K=0.5	10 – 6,250 @ 25^{o}C	1000 – 625,000 @ 25^{o}C	0.01 – 6.25 @ 25^{o}C	1 – 625 @ 25^{o}C
K=1.0	10 – 12,500 @ 25^{o}C	–	0.01 – 12.5 @ 25^{o}C	1 – 1,250 @ 25^{o}C
K=2.0	20 – 25,000 @ 25^{o}C	–	0.02 – 25 @ 25^{o}C	2 – 2,500 @ 25^{o}C
K=5.0	50 – 62,500 @ 25^{o}C	–	0.05 – 62.5 @ 25^{o}C	5 – 6,250 @ 25^{o}C
K=10.0	100 – 125,000 @ 25^{o}C	–	0.1 – 125 @ 25^{o}C	10 – 12,500 @ 25^{o}C
K=20.0	200 – 250,000 @ 25^{o}C	–	0.2 – 250 @ 25^{o}C	20 – 25,000 @ 25^{o}C
K=50.0	500 – 625,000 @ 25^{o}C	–	0.5 – 625 @ 25^{o}C	50 – 62,500 @ 25^{o}C
K=100.0	–	–	1.0 – 1250 @ 25^{o}C	100 – 125,000 @ 25^{o}C

Inputs are provided for one two or 3 wire or two 2 wire temperature sensors for automatic temperature compensation. The PM5 can accept 100Ω RTD (Pt100) or 1000Ω RTD (Pt1000) type temperature sensors for automatic temperature compensation or the temperature can be manually set. The default display can be set to either resistivity, conductivity, ppm or percent rejection. The display will toggle between temperature/conductivity or temperature/resistivity or temperature/ppm or temperature/percent rejection indication by pressing either the ▲ or ▼ button. The conductivity display units can be set to show either milliSiemens per metre, milliSiemens per centimetre, microSiemens per metre or microSiemens per centimetre. The resistivity display is in MΩ. The TDS display is in PPM.

The default display can be set to either resistivity or conductivity, the display will toggle between channel 1, channel 2, percent rejection and temperature indication by pressing either the ▲ or ▼ button. The default display is channel 1, the instrument will revert to this display after switch on and will automatically revert to channel 1 after approx. 1 minute if the display has been toggled to a different value. When a display other than channel 1 is viewed a message will flash approximately every 8 seconds to indicate what value is being displayed e.g. Ch2 will flash prior to channel 2 reading, Pcnt prior to percent rejection and °C prior to the temperature. The conductivity display units can be set to show either milliSiemens per metre, milliSiemens per centimetre, microSiemens per metre or microSiemens per centimetre. The resistivity display is in MΩ. The percent rejection display requires that channel 2 is the inlet channel and channel 1 is the outlet channel.

Calibration, setpoint and other set up functions are easily achieved by push buttons (located at the rear panel and/or front panel depending on model). A standard inbuilt relay provides an alarm/control function, additional relays, retransmission and DC output voltage may also be provided. Unless otherwise specified at the time of order, your PM5 has been factory set to a standard configuration. Like all other PM5 series instruments the configuration and calibration are easily changed by the user.

Full electrical isolation between power supply, conductivity/resistivity cell and retransmission output is provided by the PM5, thereby eliminating grounding and common voltage problems. This isolation feature makes the PM5 ideal for interfacing to computers, PLCs and other data acquisition devices.

The PM5 series of Panel Mount Monitors are designed for high reliability in industrial applications. The high brightness LED display provides good visibility, even in areas with high ambient light levels. The high contrast LCD displays provide good visibility and are ideal for battery powered applications. LED models are available in 4 digit (20mm), 5 digit (14.2mm) with keypad, 6 digit (14.2mm) with keypad, and 20 segment bar graph with 5 digit (7.6mm) versions. LCD models are available in 4 digit (12.7mm) and 6 digit (12.7mm) versions.

1.1 Selecting and altering access levels

This subsection details the use "access levels". Access levels can be used to obtain easy access to functions which are regularly required and to limit access to functions which are not required or which restricted access is required. These access level settings can be ignored if no restrictions to access are required and no easy access to selected functions is required.

Each setup function has a default access level allocated to it, for example the relay 1 high alarm function **AL 1H, 9H** is allocated a default level of 2. There is a facility for the user to change the access levels for a limited number of functions to make them either easier to access or harder to access as required, see the **Fn. 1CodE** function.

There are different ways of accessing setup functions, these are explained in the following section. Each mode allows a selection of access levels i.e. allows some choice of which functions are accessible.

The access levels available are:

None - no access to functions
1 - access to functions allocated to level 1
2 - access to functions allocated to level 2
3 - access to functions allocated to level 3
4 - access to functions allocated to level 4
5 - access to functions allocated to level 5
6 - access to functions allocated to level 6
CAL - access to all normal operation functions

1.2 Accessing setup functions

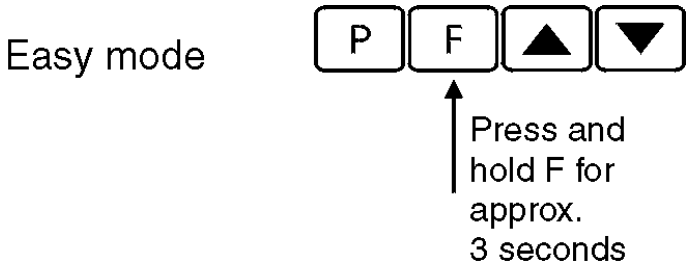
The setup functions allow adjustment of the instruments operation functions. There are five different ways of accessing setup functions. Each mode allows a selection of access levels i.e. allows some choice of which functions are accessible.

As as summary the methods available are:

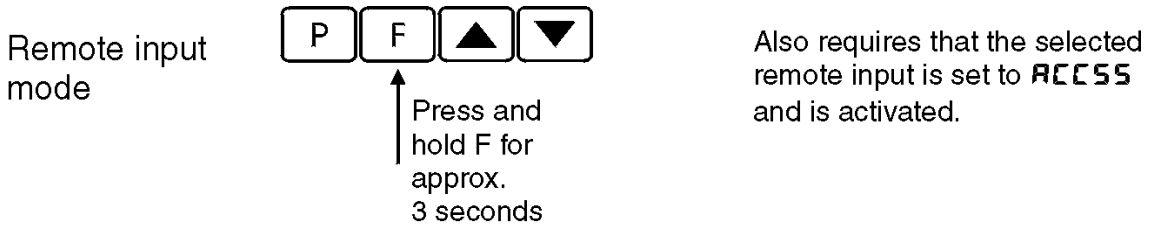
- **Easy mode** - this is the easiest access mode simply requiring the F button to be pressed for 3 seconds. This mode would normally be used to gain access to functions which require frequent adjustment.
- **Remote input mode** - this uses the Easy method of access but also requires the use of a remote input switch.
- **PIN 1 mode** - this method allows a PIN to be set with access via PIN entry.
- **PIN 2 mode** - this method also requires a PIN and would generally be use to allow a higher access level than the first PIN.
- **Super Cal mode** - this method requires a power up procedure and will allow access to all functions.

These modes are explained in more detail below.

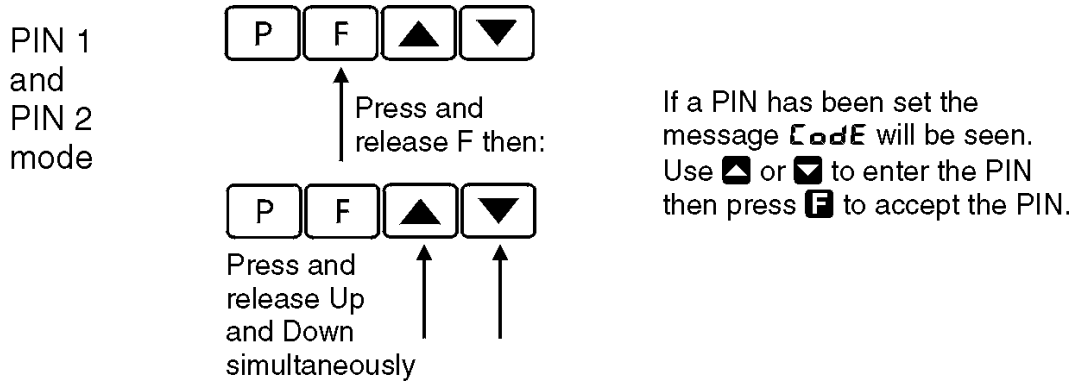
- **Easy mode** - Allows access to the level set by the **EASY LEVEL** function in the **ACCES** menu. By default the Easy access is set to **NONE** which blocks access to all setup functions. To allow access to functions using this method choose the access level required at the **EASY LEVEL** function.
  The Easy mode simply requires that the F button is held pressed until the message **FUNC** is seen followed by the first function message, this should take approximately 3 seconds. If the message **FUNC End** or no response is seen at this point it means that the access level has been set to **NONE**. The default access for this level is **NONE** so the access level will need to be changed if access via this method is required.



- **Remote input mode** - Allows access to the level set by the **r.i nPt LEVEL** function in the **ACCES** menu. By default the Remote input access is set to **CAL** level allowing access to all setup functions.
  The remote input mode uses the same access method as the Easy mode but also requires that one of the available remote inputs is set to **ACCSS** and that the selected remote input is activated i.e. shorted to GND. The default access for this level is **NONE** so the access level will need to be changed if access via this method is required.



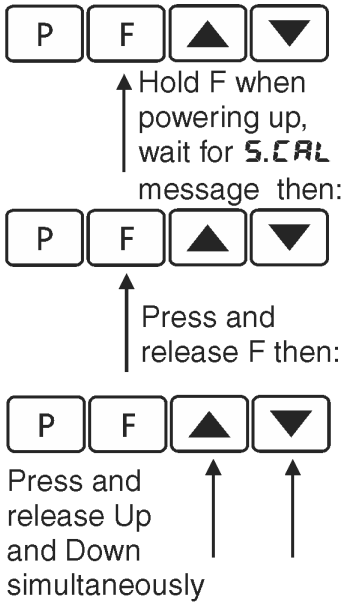
- **PIN 1 mode** - Allows access to the level set by the USr. 1 LEUEL function in the ACCES menu.
  The PIN 1 mode requires the F button is pressed and released then within 2 seconds press the ▲ and ▼ buttons at the same time. The PIN can be set via the USr. 1 P1 n function in the ACCES menu. A USr. 1 LEUEL setting of 0 disables the PIN which means that there is no need to enter the PIN. If the USr. 1 LEUEL function has been set to a number other than nonE then the first function seen when entering via PIN 1 mode will be the function CodE. When this function is seen the PIN value set at the USr. 1 P1 n function must be entered via the ▲ or ▼ pushbuttons followed by pressing F to accept the PIN before the user can progress to the setup functions.



- **PIN 2 mode** - Allows access to the level set by the USr.2 LEUEL function in the ACCES menu.
  This method uses the same access method as PIN 1 mode above. A USr.2 P1 n setting of 0 disables the PIN. If the USr. 1 LEUEL or a USr.2 P1 n function has been set to a number other than 0 then the first function seen when entering via PIN 1/PIN2 mode will be the function CodE. When this function is seen the PIN value set at the USr. 1 P1 n function can be entered for access to the level set at the USr. 1 LEUEL function or enter the USr.2 P1 n PIN to gain access to the level set at the USr.2 LEUEL function. A correct code will allow access to the functions at the selected level. An incorrect code will result in the FUNC End message being seen indicating that access to setup functions has been refused and the display will return to normal measurement mode.

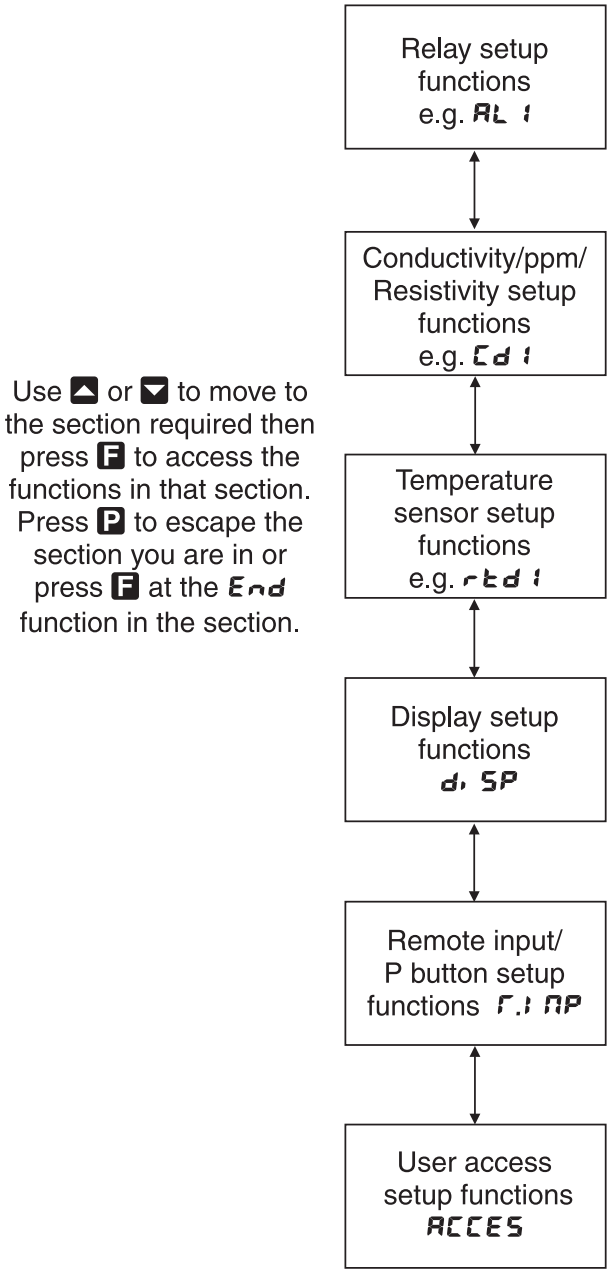
- **Super Cal mode** - This method can be used to gain access to all functions. If a PIN has been set and forgotten use this method to access the PIN functions to check the settings. To access via Super Cal mode with the instrument switched off hold in the F button whilst the instrument powers up. Keep the button pressed until the S.CAL message is seen, you can then release the F button. Next press and release F then within 2 seconds press and release the ▲ and ▼ pushbuttons simultaneously.

Super Cal mode

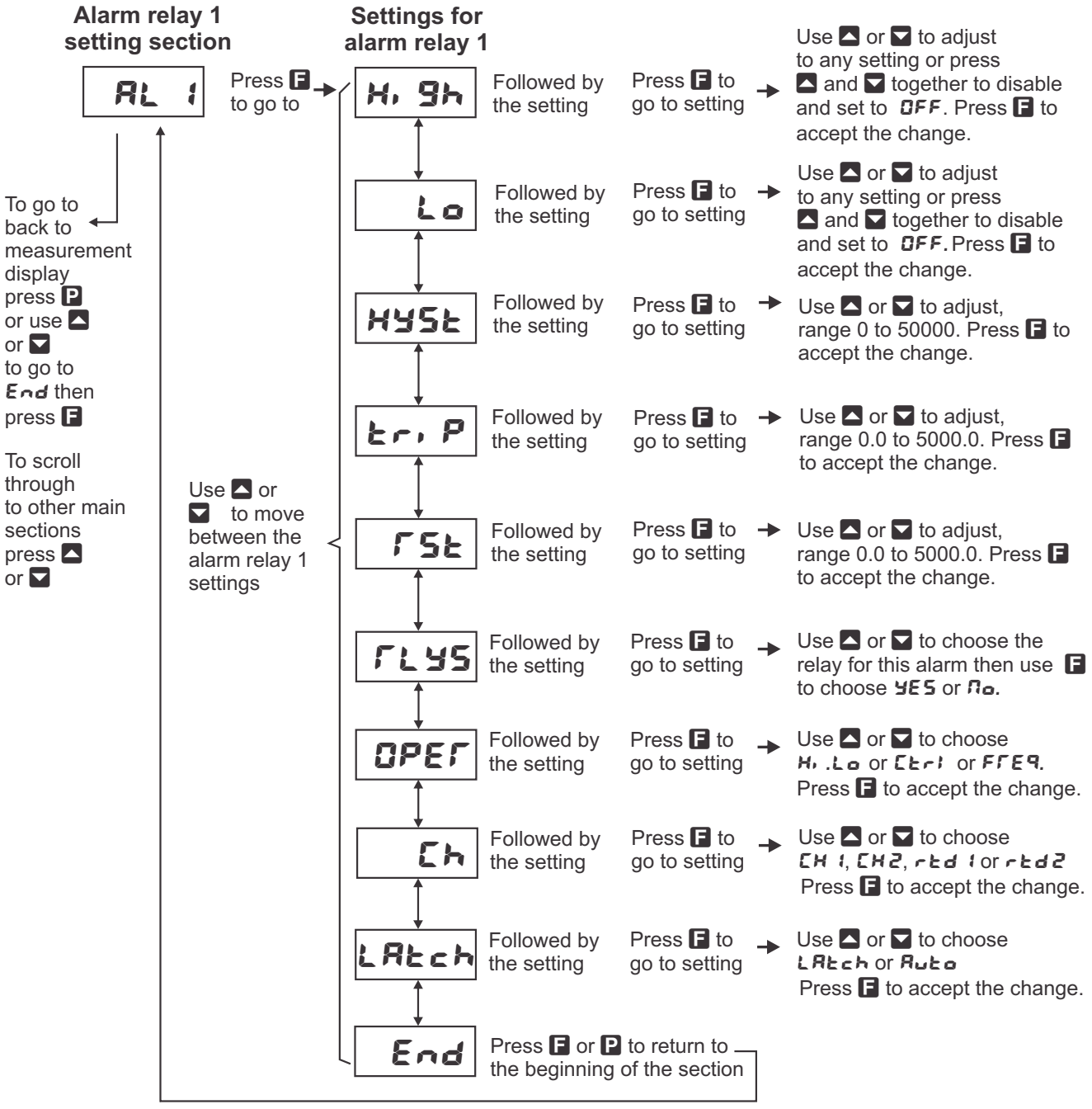


The setup functions are organised in blocks or sections e.g. all the settings for relay 1 are in the **RL 1** section. Once access to setup functions has been gained use the ▲ and ▼ buttons to select the section required then press **F** to enter this section and again us the ▲ and ▼ buttons to select the required function for alteration and press **F** to allow alteration of this function.

Typical sections for a basic instrument are illustrated below. In any particular instrument additional sections may appear depending on the part number and any optional outputs fitted.



The example in the flowchart below shows the method using alarm relay 1 setup function.



1.3 Conductivity measurement general information

The instrument measures conductivity by placing an AC voltage across the two conductive surfaces (electrodes) of the conductivity cell and measuring the resulting AC current passing through the solution. For a given cell the AC current will increase as the conductivity of the solution increases. Any external voltage's present in the solution where the cell is located may cause inaccuracy and possibly instability in the reading. Typical sources of external voltages are level sensors and badly earthed electrical equipment such as pumps which have contact with the solution. The amount of AC current produced by the cell depends on the conductivity of the solution, the area of the cell electrodes and the distance between the electrodes. Any deposits which coat the cell will reduce the surface area available and therefore cause inaccurate readings. If cells are likely to become coated in use they will either have to be regularly cleaned or a non contact (inductive) type cell used. The use of non contact cells is not covered in this manual.

If resistivity, ppm or percent are selected for viewing then the instrument simply measures conductivity using a conventional conductivity cell and converts this reading into the required display units. For ppm readings the conversion factor must be manually entered.

Cell K factor - The instrument can only supply a given current range through the solution being measured therefore a cell designed for use with pure water will not be suitable for use in measuring very high conductivity since the instrument will not be capable of providing sufficient current for stable measurement at both extremes. This instrument requires that the resistance of the solution be 80Ω or higher for accurate measurement. To overcome this problem cells with different sensitivity levels are manufactured and this sensitivity level is known as the K factor. A cell with a higher K factor will use less current in a given solution than a cell with a lower K factor. See the table at the beginning of this chapter for typical measuring ranges for common K factor cells. The correct K factor cell should be chosen to suit the range required for measurement.

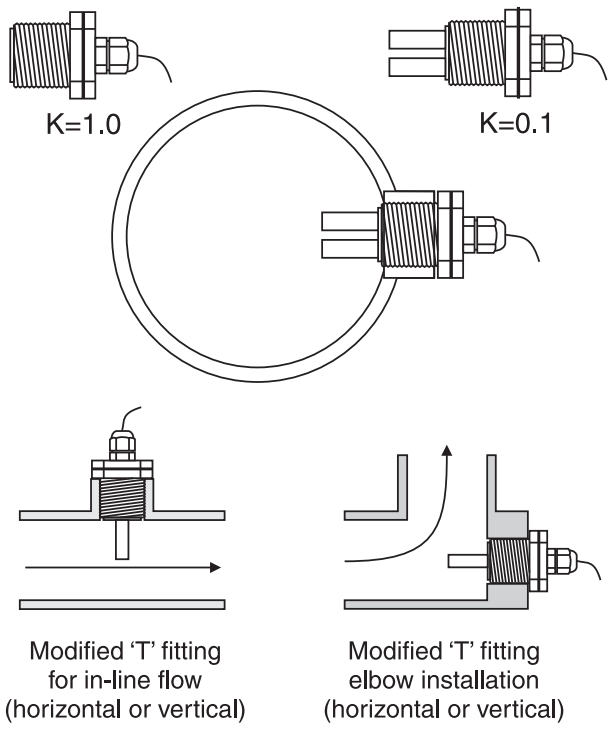
Temperature compensation - Since conductivity changes with temperature the conductivity value displayed is referenced to a given temperature, usually 25^{o}C. This means that the value being seen on the display is not necessarily the actual conductivity of the solution at that time but is the conductivity value which would be seen if the solution temperature was 25^{o}C. If 25^{o}C is not the required reference temperature i.e. if it is required to view what the conductivity reading would be at a different temperature then the required temperature value can be set at the **Ch 1 SOL** and **Ch2 SOL** functions.

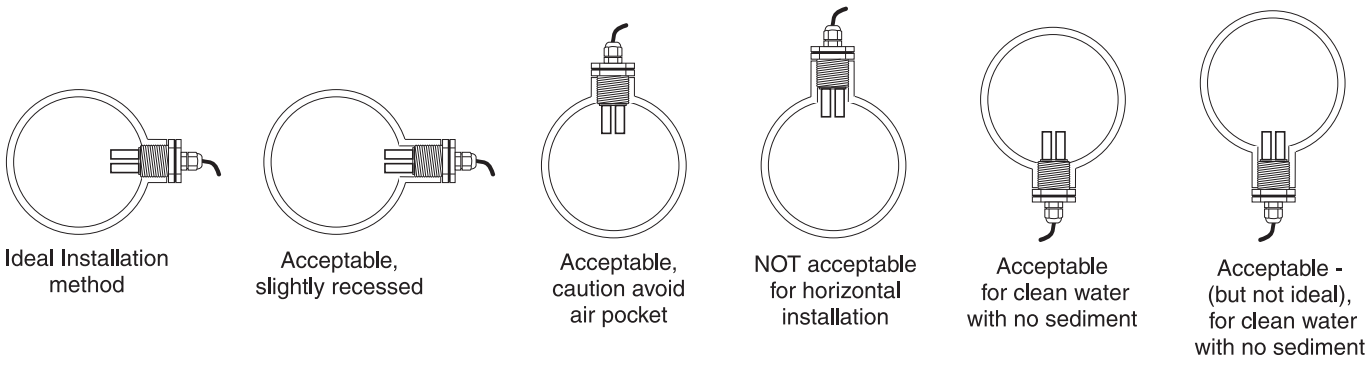
This instrument allows for either manual or automatic temperature compensation. If no temperature sensor is used with the cell then the known temperature of the solution can be entered at the **dEF °C** function. If a temperature sensor is used the the reading obtained from this sensor can be used to automatically compensate for temperature changes in the solution. For process solutions whose temperature varies by more than a few degrees automatic temperature compensation is essential for accurate readings. For example water varies its conductivity at the rate of 2%/^{o}C.

1.4 Cell Installation

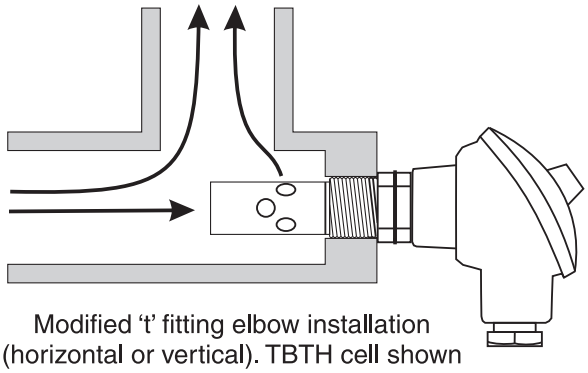
When installing conductivity cells it is important to locate the cell in a position where the pipe is always completely full. The cell electrodes must be in complete contact with the water sample. If air is trapped around the cell electrode it will cause errors in the measurement. If oil, grease or any insulating material is allowed to build up on the electrode surface measurement errors will also occur.

TBPS cells are suitable for installation into non metallic pipework. Ideally the cell should be installed from the side of the fitting. This method is less likely to be subjected to trapped air. The "T" fitting should be modified to allow the face of the cell to be flush with the inside of the fitting or pipe wall. It is acceptable for the cell to be slightly recessed when the cell is installed from the side of the fitting. Alternatively a 3/4" BSP hole may be drilled/threaded into the side of a fitting such as an existing elbow or "T" fitting. It is acceptable to install the cell from the top or bottom of the pipe or fitting provided care is taken to prevent air pockets or build up of sediment. In applications where the pipe diameter is less than 50mm the reduced sample volume around the cell electrodes may affect the accuracy of the reading. In these applications in-line calibration correction is recommended. For installation into the side wall of a tank, vessel etc. the information above applies.

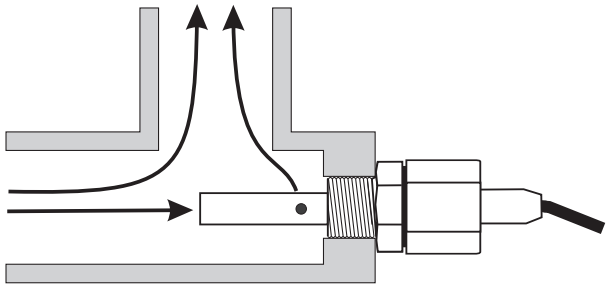




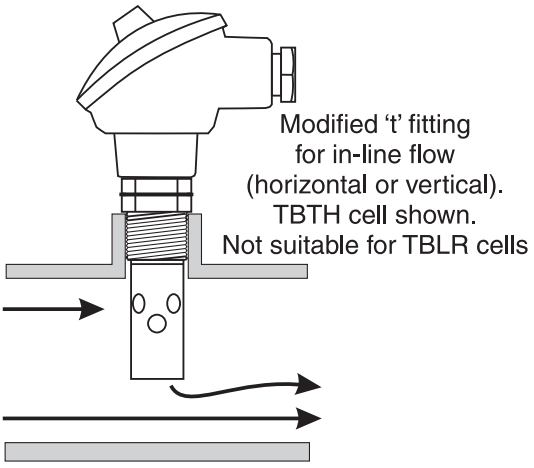
TBLR and P-CS41 cells are suitable for installation into metallic and non metallic pipework. The cell measurement is made on the inside of the cell body ensuring it is virtually unaffected by the surrounding sample or volume. The cell may be mounted in a horizontal or vertical position and is usually installed into a modified "T" fitting. The cell will provide a reliable and stable reading as long as there is a flow through the cell. Ideally the cell should be installed into an elbow installation with the flow entering the cell at the base opening and exiting from the holes around the perimeter. This method will provide a fast response. These cells are also suitable for installation into sample flow lines. These are usually installed in a flow bypass or a sample to waste arrangement. Sample line measurement usually provides a slower response, but has the advantage of allowing the cell to be removed without disturbing the process.



Modified 't' fitting elbow installation (horizontal or vertical). TBTH cell shown



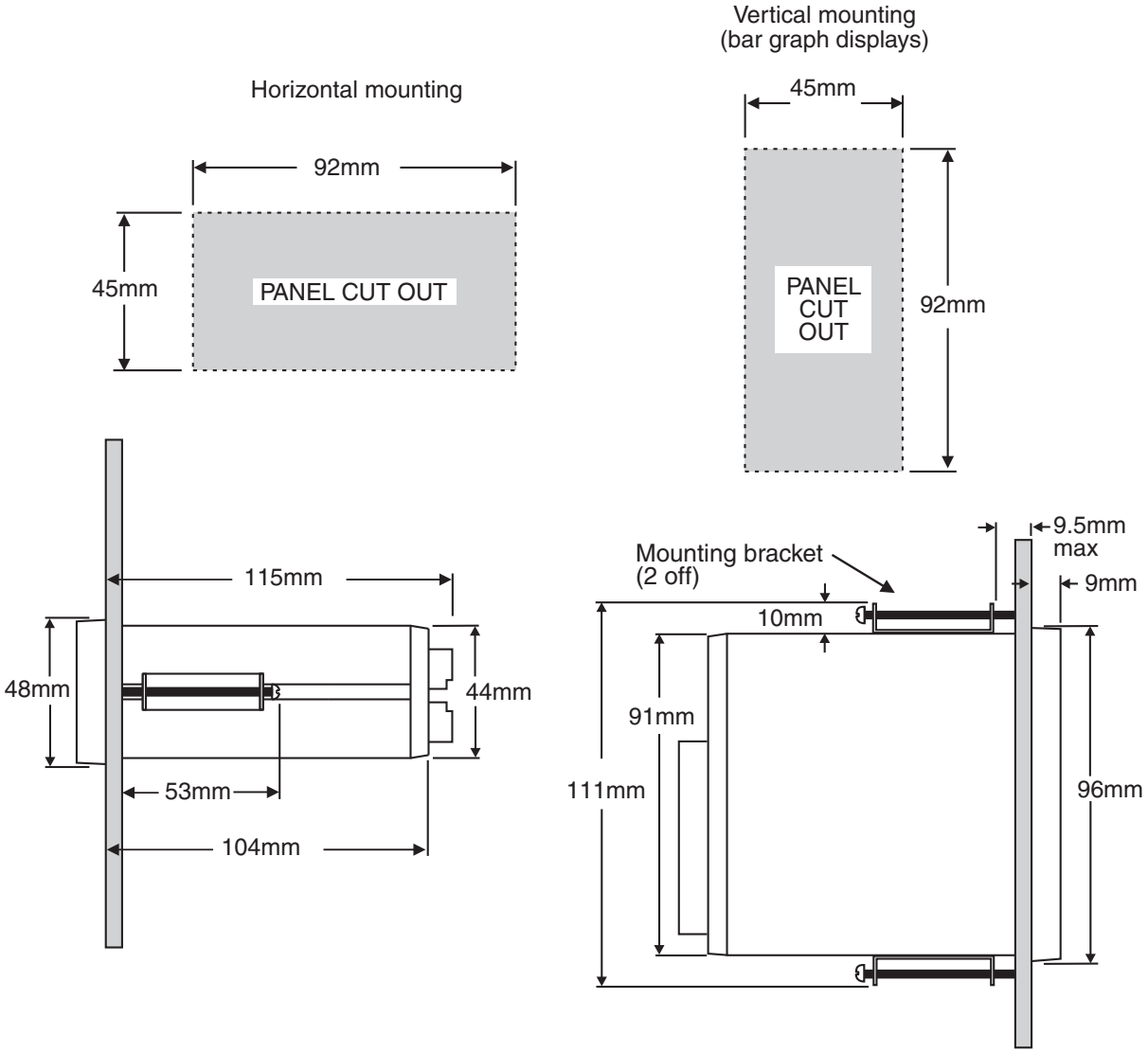
Modified 't' fitting elbow installation (horizontal or vertical). TBLR cell shown



2 Mechanical Installation

Choose a mounting position as far away as possible from sources of electrical noise such as motors, generators, fluorescent lights, high voltage cables/bus bars etc. An IP67 access cover which may be installed on the panel and surrounds is available as an option to be used when mounting the instrument in damp/dusty positions. A wall mount case is available, as an option, for situations in which panel mounting is either not available or not appropriate. A portable carry case is also available, as an option, for panel mount instruments.

Prepare a panel cut out of 45mm x 92mm +1 mm / – 0 mm (see diagram below). Insert the instrument into the cut out from the front of the panel. From the rear of the instrument fit the two mounting brackets into the recess provided (see diagram below). Whilst holding the bracket in place, tighten the securing screws being careful not to over-tighten, as this may damage the instrument. Hint: use the elastic band provided to hold the mounting bracket in place whilst tightening securing screws.



3 Electrical installation

3.1 Electrical installation

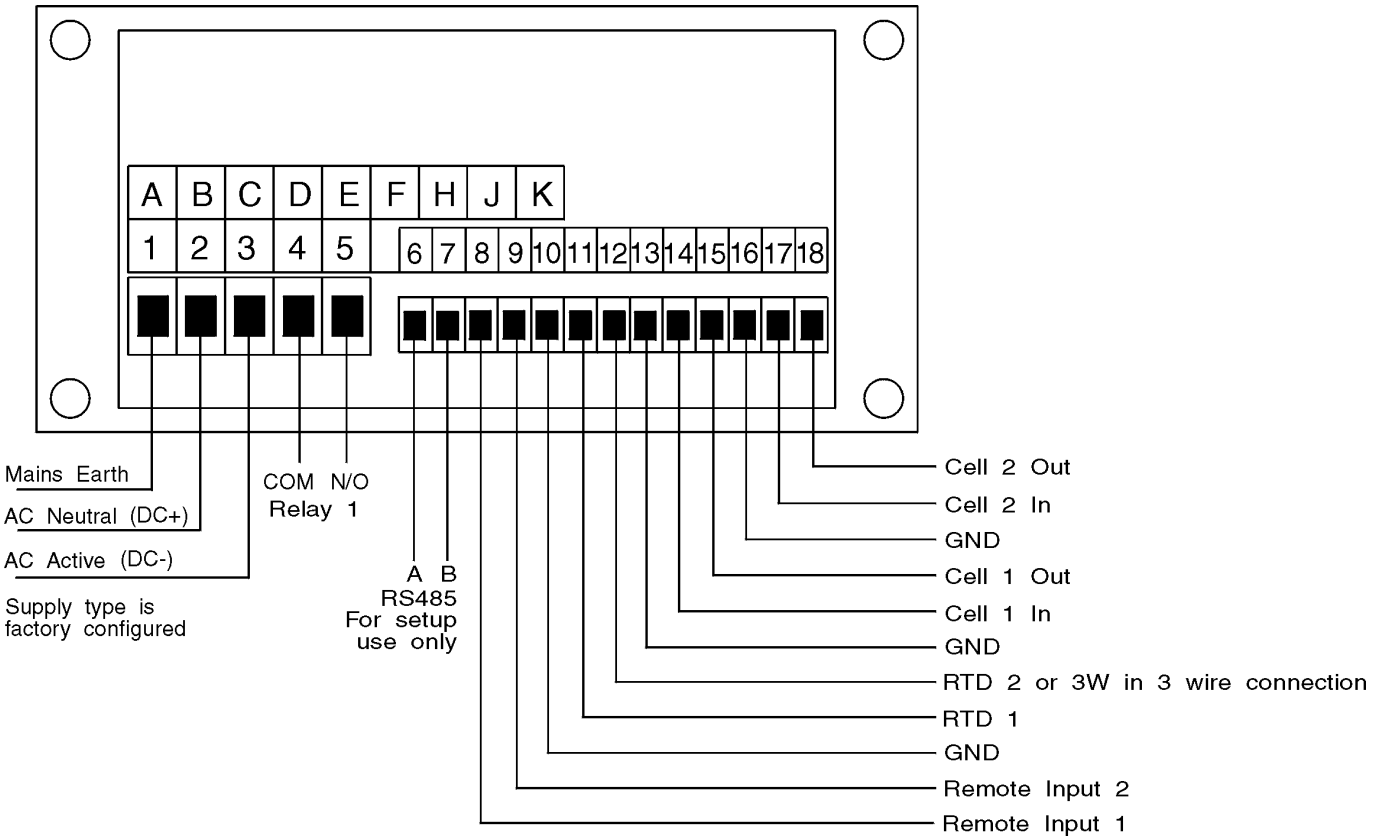
The PM5 Panel Meter is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing.

The plug in, screw type, terminal blocks allow for wires of up to 2.5mm^2 for power, relays and optional outputs and 1mm^2 for sensor and other wiring to be fitted. Connect the wires to the appropriate terminals as indicated below. Refer to connection details provided in this chapter to confirm proper selection of voltage, polarity and input type before applying power to the instrument.

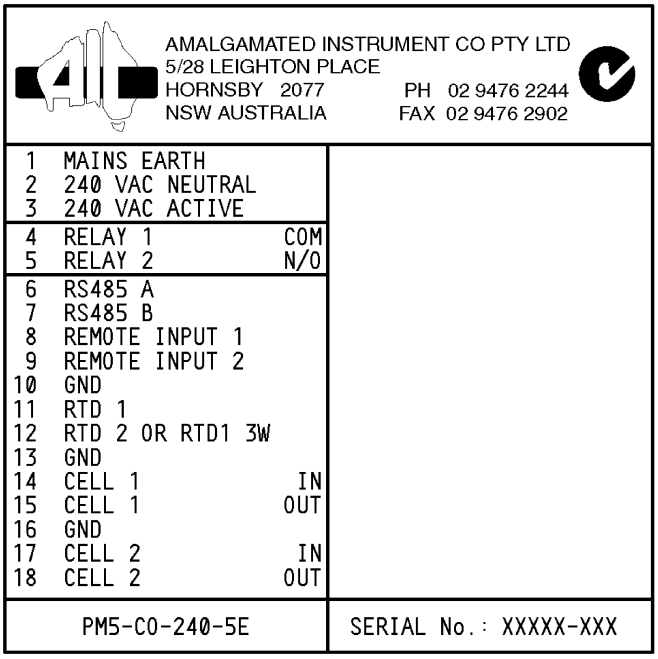
When power is applied the instrument will cycle through a display sequence indicating the software version and other status information, this indicates that the instrument is functioning. Acknowledgement of correct operation may be obtained by applying an appropriate input to the instrument and observing the reading. The use of screened cable is recommended for signal inputs.

For connection details of optional outputs refer to the separate "PM5 Panel Meter Optional Output Addendum" booklet supplied when options are fitted.

Rear panel connections



Instrument label (example)



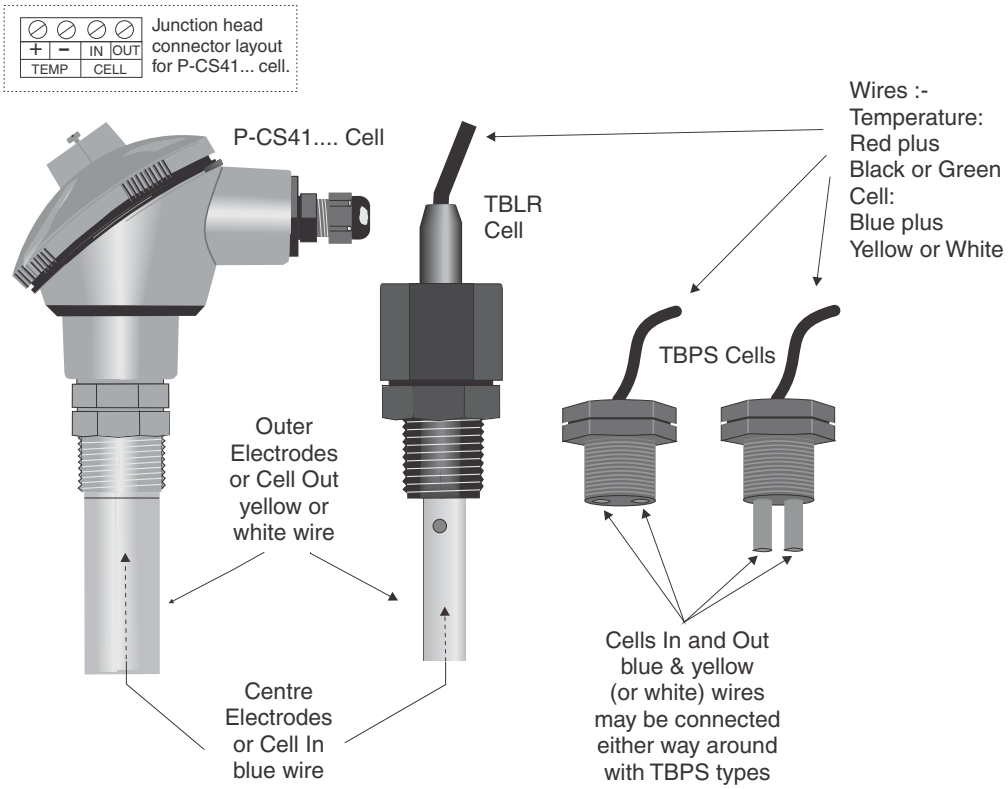
3.2 Electrical connection examples

If output options are fitted refer to the "PM5 Panel Meter Optional Output Addendum" booklet for connection details.

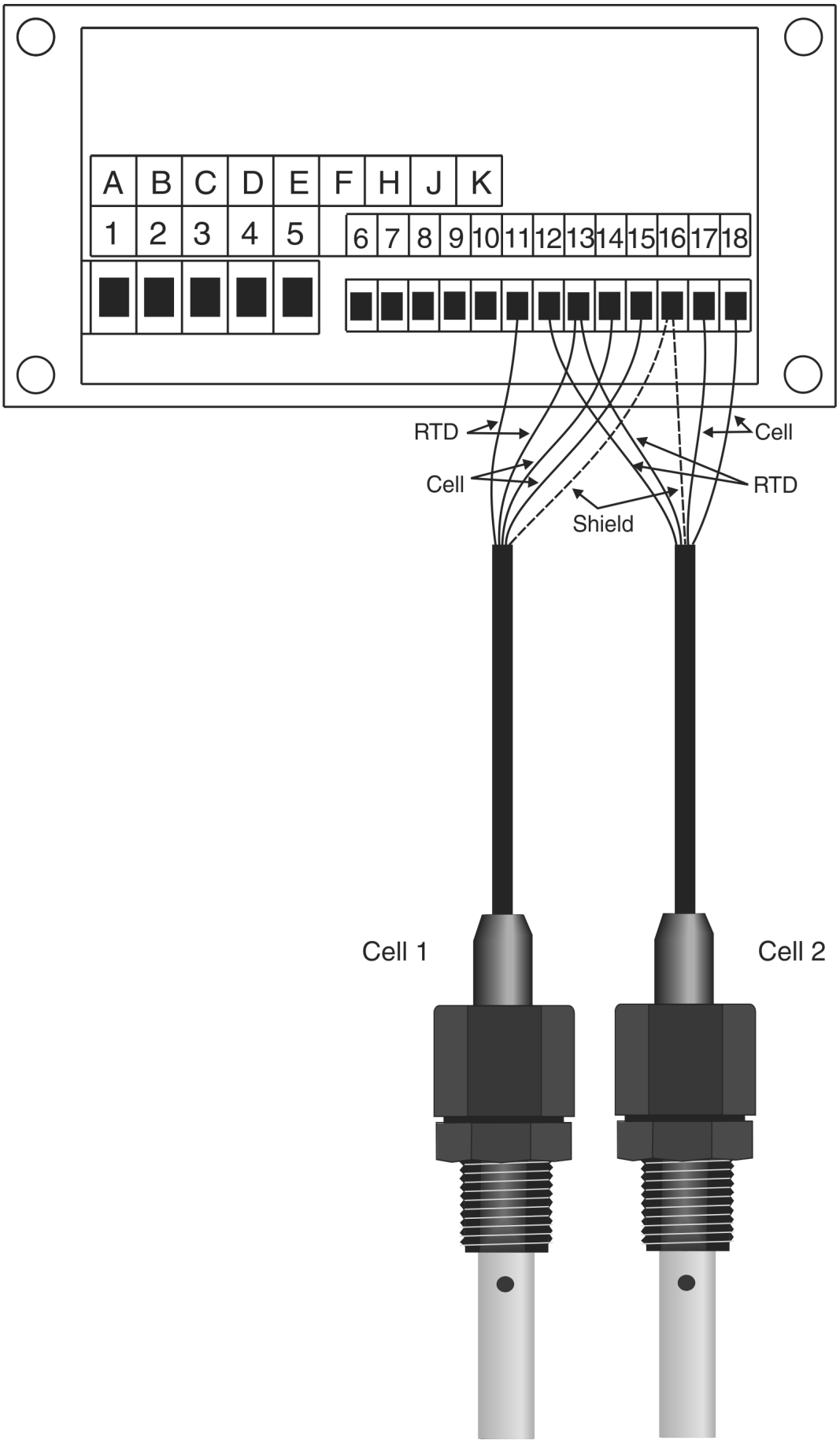
Conductivity/Resistivity/ppm Cells - Ensure that the **PrbE CnSt** function has been correctly set for probe type. AIC cells with temperature compensation sensors are all wired with Red, Black, Blue and Yellow (or White on older models) inner core cable. See the note below for details of TBPS cells without temperature compensation sensors.

The wiring connections are as below.

Cell wiring colour codes		
	AIC cells	**SDI cells**
Cell in	Blue	Black
Cell out	Yellow (or White)	White
Temperature +	Red	Red
Temperature -	Green (or Black)	Green
Shield	n/a	Clear


+
–
IN
OUT
TEMP
CELL
Junction head connector layout for P-CS41... cell.
P-CS41.... Cell
TBLR Cell
Wires :-
Temperature:
Red plus
Black or Green
Cell:
Blue plus
Yellow or White
TBPS Cells
Outer Electrodes or Cell Out yellow or white wire
Centre Electrodes or Cell In blue wire
Cells In and Out blue & yellow (or white) wires may be connected either way around with TBPS types

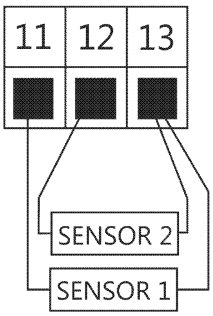
3.3 Conductivity cell and temperature sensor wiring example



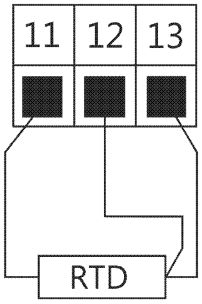
3.4 Temperature sensor - in most cases the temperature sensor is housed in the conductivity cell

If only one temperature sensor input is used then this temperature input will be used as the temperature compensation value for both channels. If two temperature sensor inputs are used then temperature sensor 1 will be allocated to cell 1 and temperature sensor 2 will be allocated to cell 2.

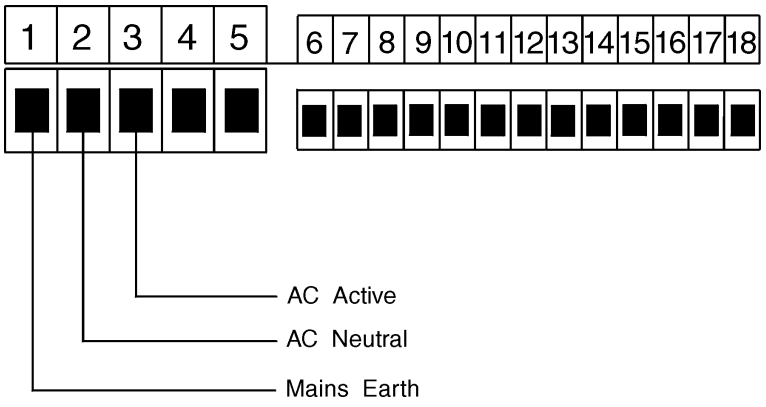
100Ω or 1000Ω RTDs
or 100Ω thermistor
2 Wire configuration
for one or two
temperature sensors



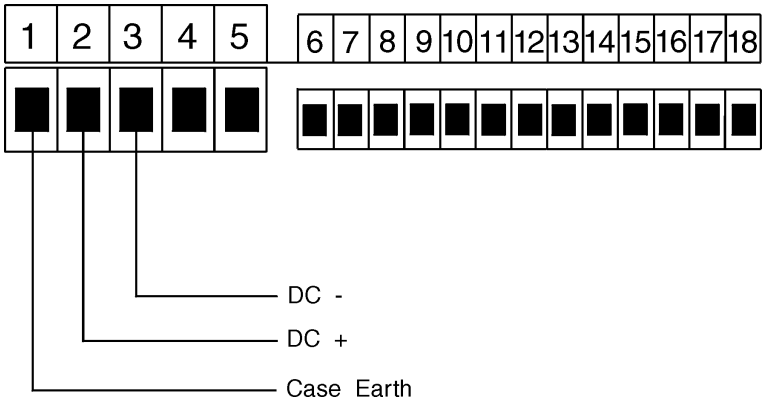
100Ω and 1000Ω RTDs
3 Wire configuration.
Single sensor only.



3.5 AC power connections - supply type is factory configured, check before connecting

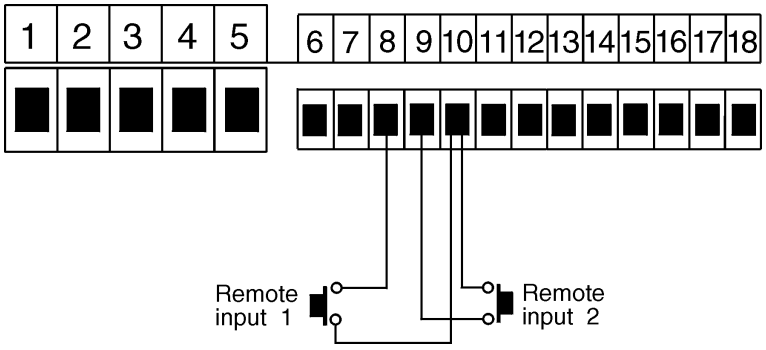


3.6 DC power connections (12 to 48VDC) - supply type is factory configured, check before connecting



3.7 Remote input connections

Use latching or momentary switches/relays depending on remote input function requirements. Input is not isolated and must use voltage free input only.



4 Function tables - summary of setup functions

Note: the order in which the functions appear on the display may not be exactly as shown below. The availability and order of functions is determined by choice of function settings and options fitted.

Functions in this first table are available in **FUNC** or **CAL** mode.

4.1 Alarm relay function table

Display	Function	Range	Default	Your record	Ref/Page
AL 1 to **AL 8** **Hi 9h**	High setpoint value for designated alarm	Any display value or **OFF**	**OFF**	See 4.15	5.1 / 33
AL 1 to **AL 8** **Lo**	Low setpoint value for designated alarm	Any display value or **OFF**	**OFF**	See 4.15	5.2 / 34
AL 1 to **AL 8** **HYSt**	Hysteresis value for the designated alarm	**0** to **50000**	**10**	See 4.15	5.3 / 35
AL 1 to **AL 8** **trI P**	Trip time delay for the designated alarm relay x.	**0** to **5000.0** secs	**0.0**	See 4.15	5.4 / 36
AL 1 to **AL 8** **rSt**	Reset time delay for the designated alarm relay x.	**0** to **5000.0** secs	**0.0**	See 4.15	5.5 / 36
AL 1 to **AL2** **SPAN**	Relay PI control span	Any display value	**1000**	See 4.15	5.6 / 37
AL 1 to **AL2** **SEtP**	Relay PI control setpoint	Any display value	**1000**	See 4.15	5.7 / 37
AL 1 to **AL2** **P.9**	Relay PI control proportional gain value	Any display value	**0.0 10**	See 4.15	5.8 / 37
AL 1 to **AL2** **I .9**	Relay PI control integral gain value	Any display value	**0.000**	See 4.15	5.9 / 37
AL 1 to **AL2** **I .H**	Relay PI control integral high limit value	**0** to **100.0** %	**100.0**	See 4.15	5.10 / 38
AL 1 to **AL2** **I .L**	Relay PI control integral low limit value	**0** to **100.0** %	**100.0**	See 4.15	5.11 / 38

(*__Optional__)—this function will only be accessible if the relevant option is fitted

AL 1 to AL2 bi AS	Relay PI control bias	0 to 100.0 %	50.0	See 4.15	5.12 / 38
AL 1 to AL2 duty SECS	Relay PI control duty cycle	0 to 5000.0 secs	0.0	See 4.15	5.13 / 38
AL 1 to AL2 on SECS	Relay PI frequency control "on" time	0 to 5000.0 secs	0.0	See 4.15	5.14 / 39
AL 1 to AL8 rLYS	Relay selection On or OFF	On or OFF	OFF	See 4.15	5.15 / 39
AL 1 to AL8 trAi L	Alarm trailing or setpoint mode	SEt.P, tL 1, tL 2, tL 3, tL 4, tL 5, tL 6, tL 7	SEt.P	See 4.15	5.16 / 39
AL 1 to AL8 OPEr	Alarm relay operating mode	Hi .Lo, Ctrl , FFE9	Hi .Lo	See 4.15	5.17 / 40
AL 1 to AL8 Ch	Alarm relay operation input selection	CH 1, CH2, rtd 1, rtd2	CH 1	See 4.15	5.18 / 41
AL 1 to AL8 LAtch	Alarm relay latching operation	Auto, LAtch	Auto	See 4.15	5.19 / 41

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.2 Relay function table

Display	Function	Range	Default	Your record	Ref/Page
rLY 1 to rLY7 rLY	Alarm relay x action to normally open (de-energised) or normally closed (energised)	n.o, n.c	n.o	See 4.15	5.20 / 42
rLY 1 to rLY7 AcK	Relay acknowledge	OFF or On	OFF	See 4.15	5.21 / 42
rLY 1 to rLY7 bool	Alarm relay Boolean logic operation	Or, And	Or	See 4.15	5.22 / 42

4.3 Digital output function table

Display	Function	Range	Default	Your record	Ref/Page
d.Out InPut	Channel for digital retransmission (*Optional)	CH1.CH2. rtd1.rtd2 or Pcnt	CH1		5.23 / 43
d.Out O.Put	Output mode for digital retransmission (*Optional)	bin2.bin. b.SCL or bcd	bin2		5.24 / 43
d.Out Pol	Output polarity for digital retransmission (*Optional)	Lo or Hi.9h	Lo		5.25 / 44
d.Out bcd OFSt	Offset for BCD retransmission (*Optional)	0. 1.2 or 3	0		5.26 / 44
d.Out Lo	Low value for scaled binary retransmission (*Optional)	Any display value	0		5.27 / 44
d.Out Hi.9h	High value for scaled binary retransmission (*Optional)	Any display value	0		5.28 / 45
d.Out E.Out	Excitation voltage on binary retransmission output (*Optional)	5 or 24	5		5.29 / 45

(***Optional**)—this function will only be accessible if the relevant option is fitted

4.4 Analog output 1 function table

Display	Function	Range	Default	Your record	Ref/Page
rO 1 OutPt	Output selection for analog output 1. Not seen if output is fixed at 4-20mA (*Optional)	4-20, 0-1.0, 0-10	4-20		5.30 / 46
rO 1 InPut	Input selection for analog output 1 (*Optional)	CH 1, CH2, rtd 1, rtd2	CH 1		5.31 / 46
rO 1 P.Ctl	Analog output 1 PI control on or off (*Optional)	no or YES	no		5.32 / 47
rO 1 SEtP	Analog output 1 PI control setpoint (*Optional)	Any display value	0		5.33 / 47
rO 1 SPAn	Analog output 1 PI control span (*Optional)	Any display value	1000		5.34 / 48
rO 1 P.g	Analog output 1 PI control proportional gain (*Optional)	Any display value	1.000		5.35 / 48
rO 1 I.g	Analog output 1 PI control integral gain (*Optional)	Any display value	0.000		5.36 / 48
rO 1 I.H	Analog output 1 PI control integral high limit (*Optional)	0 to 100.0 %	1.000		5.37 / 49
rO 1 I.L	Analog output 1 PI control integral low limit (*Optional)	0 to 100.0 %	1.000		5.38 / 49
rO 1 bi AS	Analog output 1 PI control bias (*Optional)	0 to 100.0 %	50.0		5.39 / 50
rO 1 Lo	Analog output 1 option low display value (*Optional)	Any display value	0		5.40 / 50
rO 1 Hi 9h	Analog output option high display value (*Optional)	Any display value	1000		5.41 / 50
rO 1 Log	Linear or logarithmic analog output selection (*Optional)	Lin, Log	Lin		5.42 / 51

(***Optional**)—this function will only be accessible if the relevant option is fitted

4.5 Analog output 2 function table

Display	Function	Range	Default	Your record	Ref/Page
rO2 OutPt	Output selection for analog output 2. Not seen if output is fixed at 4-20mA (*Optional)	4-20, 0-1.0 or 0-10	4-20		5.43 / 51
rO2 InPut	Input selection for analog output 2 (*Optional)	CH 1, CH2, rtd 1 or rtd 2	CH 1		5.44 / 52

(***Optional**)—this function will only be accessible if the relevant option is fitted

r02 P.Ctl	Analog output 2 PI control on or off (*Optional)	no or YES	no		5.45 / 52
r02 Lo	Analog output 2 option low display value (*Optional)	Any display value	0		5.46 / 52
r02 Hi.Sh	Analog output option high display value (*Optional)	Any display value	1000		5.47 / 53
r02 LoG	Linear or logarithmic analog output selection (*Optional)	Lin or LoG	Lin		5.48 / 53
r02 SEtP	Analog output 2 PI control setpoint (*Optional)	Any display value	0		5.49 / 53
r02 SPAn	Analog output 2 PI control span (*Optional)	Any display value	1000		5.50 / 54
r02 P.G	Analog output 2 PI control proportional gain (*Optional)	-32.768 to 32.767	1.000		5.51 / 54
r02 I.G	Analog output 2 PI control integral gain (*Optional)	-32.768 to 32.767	0.000		5.52 / 54
r02 I.H	Analog output 2 PI control integral high limit (*Optional)	0.0 to 100.0	1.000		5.53 / 54
r02 I.L	Analog output 2 PI control integral low limit (*Optional)	0.0 to 100.0	1.000		5.54 / 55
r02 bIAS	Analog output 2 PI control bias (*Optional)	0.0 to 100.0	50.0		5.55 / 55

(***Optional**)—this function will only be accessible if the relevant option is fitted

4.6 Bargraph display function table

Display	Function	Range	Default	Your record	Ref/Page
bAr9 Ch	Bargraph channel	CH 1, CH2, rtd 1 or rtd2	CH 1		5.56 / 55
bAr9 tYPE	Bargraph type	bAr, S.dot, d.dot. c.bAr or r.dot	bAr		5.57 / 56
bAr9 Lo	Bargraph low value	Any display value	0		5.58 / 56
bAr9 Hi	Bargraph high value	Any display value	1000		5.59 / 57

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.7 Conductivity channel 1 setup function table

Display	Function	Range	Default	Your record	Ref/Page
Cd 1 Cd.Ch	Set number of input channels	1 or 2	1		5.60 / 57
Cd 1 dCPt	Decimal point for channel 1	0, 0. 1, 0.02 or 0.003	0		5.61 / 58
Cd 1 drnd	Display rounding for channel one	1 to 5000 units	1		5.62 / 58
Cd 1 FiLr	Digital filter for channel 1	0 to 8	3		5.63 / 58
Cd 1 uni t	Conductivity measuring units for channel 1	uS.cm, uS.m, mS.cm, mS.m, TESt, PPm or Pcnt	uS.cm		5.64 / 59
Cd 1 SEnS	Cell type for channel 1	CELL or coil	CELL		5.65 / 59
Cd 1 FrEq	Drive frequency for channel 1	100, 150, 200, 250, 300, 350 or 400	100		5.66 / 60
Cd 1 SLOPE	Solution temperature compensation slope for channel 1	-6.00 to 0.00	-2.00		5.67 / 60
Cd 1 SOL	Solution temperature compensation reference for channel 1	-40.0 to 150.0	25.0		5.68 / 61

(*__Optional__)—this function will only be accessible if the relevant option is fitted

Cd 1 PrObE	Cell K factor for channel 1	0.01.0.05. 0.1.0.5. 1.0. 2.0.5.0. 10. 20.50 or 100	0.1		5.69 / 61
Cd 1 H.I on	Hydrogen Ion compensation for channel 1	oFF or On	oFF		5.70 / 61
Cd 1 PPM FACt	PPM conversion factor for input 1	0.200 to 2.000	0.560		5.71 / 62
Cd 1 Pcnt rEJ	Percent rejection display enable	OFF or On	OFF		5.72 / 62
Cd 1 U.CAL	Conductivity uncalibration for channel 1	n/a	n/a		5.73 / 63
Cd 1 nULL	Conductivity null calibration for channel 1	n/a	n/a		5.74 / 63
Cd 1 CAL 1	First point conductivity calibration for channel 1	n/a	n/a		5.75 / 63
Cd 1 CAL2	Second point conductivity calibration for channel 1	n/a	n/a		5.76 / 64

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.8 Conductivity channel 2 setup function table

Display	Function	Range	Default	Your record	Ref/Page
Cd2 dCPt	Decimal point for channel 2	0, 0.1, 0.02 or 0.003	0		5.77 / 64
Cd2 drnd	Display rounding for channel 2	1 to 5000 units	1		5.78 / 64
Cd2 FiLtr	Digital filter for channel 2	0 to 8	3		5.79 / 65
Cd2 unit	Conductivity measuring units for channel 2	uS.cm, uS.m, mS.cm, mS.m, TESt, PPm or Pcnt	uS.cm		5.80 / 65
Cd2 SENS	Cell type for channel 2	CELL or coil	CELL		5.81 / 65
Cd2 FrEq	Drive frequency for channel 2	100, 150, 200, 250, 300, 350 or 400	100		5.82 / 66
Cd2 SLOPE	Solution temperature compensation slope for channel 2	-6.00 to 0.00	-2.00		5.83 / 66
Cd2 SOL	Solution temperature compensation reference for channel 2	-40.0 to 150.0	25.0		5.84 / 66
Cd2 PrObE	Cell K factor for channel 2	0.01.0.05. 0.1.0.5. 1.0. 2.0.5.0. 10. 20.50 or 100	0.1		5.85 / 66
Cd2 H.Ion	Hydrogen Ion compensation for channel 2	oFF or On	oFF		5.86 / 67
Cd2 PPm FACt	PPM conversion factor for input 2	0.200 to 2.000	0.560		5.87 / 67
Cd2 U.CAL	Conductivity uncalibration for channel 2	n/a	n/a		5.88 / 67
Cd2 nULL	Conductivity null calibration for channel 2	n/a	n/a		5.89 / 68
Cd2 CAL 1	First point conductivity calibration for channel 2	n/a	n/a		5.90 / 68
Cd2 CAL2	Second point conductivity calibration for channel 2	n/a	n/a		5.91 / 68

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.9 Temperature sensor 1 function table

Display	Function	Range	Default	Your record	Ref/Page
rtd1 InPt	Temperature sensor configuration	rtd3, rtd2 or 2rt2	rtd3		5.92 / 69
rtd1 tYPE	Temperature sensor type for channel 1	100, 1000, t 100 or NONE	100		5.93 / 69
rtd1 dEF °C	Manual temperature setting for input 1	-40.0 to 200.0	25.0		5.94 / 70
rtd1 U.CAL	Temperature uncalibration for input 1	No or YES	No		5.95 / 70
rtd1 CAL 1	First calibration point for temperature input 1	n/a	n/a		5.96 / 70
rtd1 CAL2	Second calibration point for temperature input 1	n/a	n/a		5.97 / 71

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.10 Temperature sensor 2 function table

Display	Function	Range	Default	Your record	Ref/Page
rtd2 tYPE	Temperature sensor type for channel 2	100, 1000, t 100 or NONE	100		5.98 / 71
rtd2 dEF °C	Manual temperature setting for input 2	-40.0 to 200.0	25.0		5.99 / 71
rtd2 U.CAL	Temperature uncalibration for input 2	No or YES	No		5.100 / 72
rtd2 CAL 1	First calibration point for temperature input 2	n/a	n/a		5.101 / 72
rtd2 CAL2	Second calibration point for temperature input 2	n/a	n/a		5.102 / 72

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.11 Display function table

Display	Function	Range	Default	Your record	Ref/Page
d. SP br9t	Display brightness	1 to 16	16		5.104 / 73
d. SP dul 1	Dimmed display brighness	0 to 16	2		5.105 / 73

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.12 P button and remote inputs function table

Display	Function	Range	Default	Your record	Ref/Page
r.1 nP P.but	Front P button operation mode	nONE, P.H., P.Lo, H., Lo or AL.Ac	nONE		5.106 / 74
r.1 nP r.1 n. 1	Remote input 1 operation mode	nONE, P.Hol d, d.Hol d, P.H., P.Lo, H., Lo, AL.Ac, ACCSS or dul 1	nONE		5.107 / 74
r.1 nP r.1 n.2	Remote input 2 operation mode	nONE, P.Hol d, d.Hol d, P.H., P.Lo, H., Lo, AL.Ac, ACCSS or dul 1	nONE		5.108 / 75

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.13 Access control function table

Display	Function	Range	Default	Your record	Ref/Page
ACCES EASY LEVEL	Easy access mode	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.109 / 75
ACCES r.1 nPt LEVEL	Remote input access mode	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.110 / 76

(*__Optional__)—this function will only be accessible if the relevant option is fitted

ACCES USr.1 P.n	PIN code 1	0 to 50000	0		5.111 / 76
ACCES USr.1 LEVEL	PIN code 1 access level	NONE, 1, 2, 3, 4, 5, 6, CAL	NONE		5.112 / 76
ACCES USr.2 P.n	PIN code 2	0 to 50000	0		5.113 / 77
ACCES USr.2 LEVEL	PIN code 2 access level	NONE, 1, 2, 3, 4, 5, 6, CAL	NONE		5.114 / 77
ACCES Fn.1 CodE	User assignable access function 1	0000 to FFFF hex.	0000		5.115 / 78
ACCES Fn.1 LEVEL	User assignable access 1 level value	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFLt		5.116 / 78
ACCES Fn.2 CodE	User assignable access function 2	0000 to FFFF hex.	0000		5.117 / 78
ACCES Fn.2 LEVEL	User assignable access 2 level value	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFLt		5.118 / 79
ACCES Fn.3 CodE	User assignable access function 3	0000 to FFFF hex.	0000		5.119 / 79
ACCES Fn.3 LEVEL	User assignable access 3 level value	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFLt		5.120 / 79
ACCES Fn.4 CodE	User assignable access function 4	0000 to FFFF hex.	0000		5.121 / 80
ACCES Fn.4 LEVEL	User assignable access 4 level value	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFLt		5.122 / 80

(*__Optional__)—this function will only be accessible if the relevant option is fitted

4.14 Serial communciations function table

Display	Function	Range	Default	Your record	Ref/Page
SEr1 OPEr	Serial operation mode (*Optional)	nonE, Cont, Poll, A.buS, dISP or M.buS	nonE		5.123 / 80
SEr1 bAud	Serial baud rate (*Optional)	1200, 2400, 4800, 9600, 19.2, 38.4, 57.6, 115.2	9600		5.124 / 81
SEr1 PrtY	Serial parity (*Optional)	8N, 8E, 8O, 7E, 7O	8N		5.125 / 81
SEr1 Unit Addr	Serial address (*Optional)	1 to 127	1		5.126 / 81

(*Optional)—this function will only be accessible if the relevant option is fitted

4.15 Relay table

Record your relay settings in the table below

Display	Alarm 1	Alarm 2	Alarm 3	Alarm 4	Alarm 5	Alarm 6	Alarm 7	Alarm 8
HI 9h								
Lo								
HYSt								
tr1P								
rSt								
SPAN			n/a	n/a	n/a	n/a	n/a	n/a
SEtP			n/a	n/a	n/a	n/a	n/a	n/a
P.9			n/a	n/a	n/a	n/a	n/a	n/a
1.9			n/a	n/a	n/a	n/a	n/a	n/a
1.H			n/a	n/a	n/a	n/a	n/a	n/a
1.L			n/a	n/a	n/a	n/a	n/a	n/a
bIAS			n/a	n/a	n/a	n/a	n/a	n/a
duty SECS			n/a	n/a	n/a	n/a	n/a	n/a
on SECS			n/a	n/a	n/a	n/a	n/a	n/a
rLYS								
trAIL								
OPEr								
Ch								
LAtch								

Record which relays are allocated to which alarms and other relay settings in the table below

Display	Relay 1	Relay 2	Relay 3	Relay 4	Relay 5	Relay 6	Relay 7
Alarm 1							
Alarm 2							
Alarm 3							
Alarm 4							
Alarm 5							
Alarm 6							
Alarm 7							
Alarm 8							
FLY							
AcK							
bool							

5 Explanation of functions

The setup and calibration functions are configured through a push button sequence. The three push buttons located at the front of the instrument are used to alter settings. The access modes available are detailed in section 1.2, starting on page 5.

Explanation of Functions

5.1 Alarm relay high setpoint

Section:	AL 1 to AL 8
Display:	Hi SH
Range:	Any display value or OFF
Default Value:	OFF
Default Access Level	2
Function number	4000 to 4007

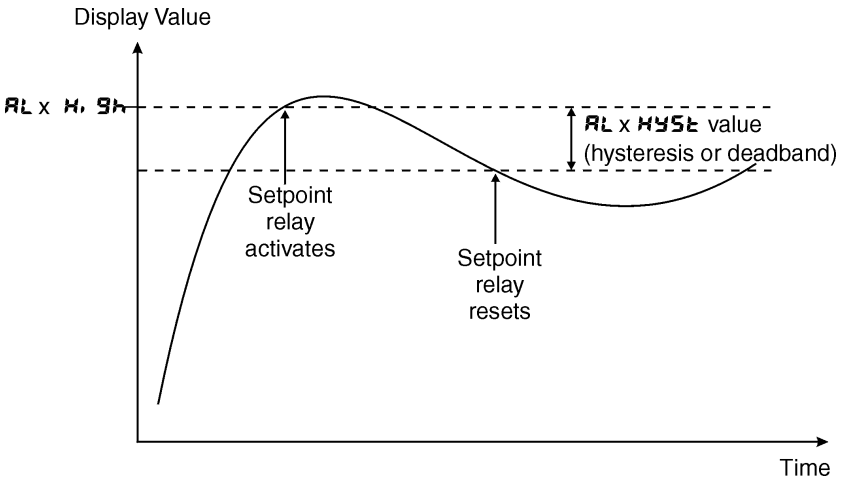
Displays and sets the high setpoint value for the designated alarm. Use this high setpoint function if an alarm operation is required when the display value becomes equal to or greater than the required setpoint value.

To set the high alarm value go to the Hi SH function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection. The high alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the alarm is allocated both a low and high setpoint then the alarm will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the alarm will reset is controlled by the HYSt function. The relay or relays to be used with this alarm can be selected (set to on or off) at the rLYS function for each alarm.

Overlapping alarms - if the Hi SH value is set lower than the Lo value then the alarm will activate in the band between the two values.

If the display has annunciator leds for the alarm then the annunciator will initially flash in alarm condition, if the alarm is acknowledged by pressing the F button the annunciator will be solidly lit until the display moves out of alarm condition.

Example:
If Hi SH under AL 1 is set to 100 then alarm 1 will activate when the display value is 100 or higher. Any relay allocated to this alarm will also activate.



5.2 Alarm relay low setpoint

Section:	AL 1 to AL 8
Display:	Lo
Range:	Any display value or OFF
Default Value:	OFF
Default Access Level	2
Function number	40 10 to 40 17

Displays and sets the low setpoint value for the designated alarm.

Use this low setpoint function if a relay operation is required when the display value becomes equal to or less than the required setpoint value.

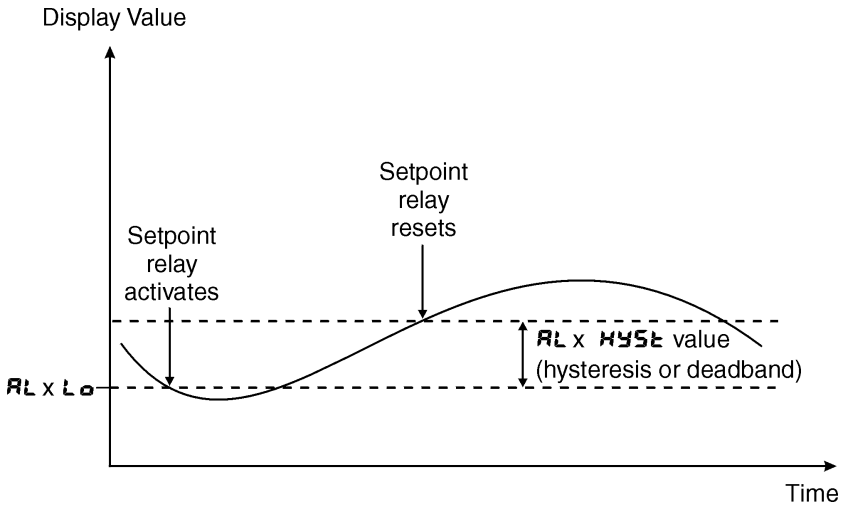
To set the low alarm value press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

The low alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the alarm is allocated both a low and high setpoint then the alarm will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the alarm will reset is controlled by the Hysteresis function. The relay or relays to be used with this alarm can be selected (set to on or off) at the FLYS function for each alarm.

If the display has annunciator leds for the alarm then the annunciator will initially flash in alarm condition, if the alarm is acknowledged by pressing the F button the annunciator will be solidly lit until the display moves out of alarm condition.

Overlapping alarms - if the HI SP value is set lower than the Lo value then the alarm will activate in the band between the two values.

Example:
If Lo under AL 1 is set to 10 then relay 1 will activate when the display value is 10 or less. Any relay allocated to this alarm will also activate



5.3 Alarm hysteresis (deadband)

Section:	AL 1 to AL 8
Display:	HYST
Range:	0 to 50000
Default Value:	10
Default Access Level	3
Function number	4020 to 4027

Displays and sets the alarm hysteresis limit for the designated alarm. To set a alarm hysteresis value go to the function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value. The hysteresis value is common to both high and low setpoint values. The hysteresis value may be used to prevent too frequent operation of the alarm and associated relays when the measured value is rising and falling around setpoint value. e.g. if HYST under AL 1 is set to zero the alarm will activate when the display value reaches the alarm setpoint (for high alarm) and will reset when the display value falls below the setpoint, this can result in repeated on/off switching of relays at around the setpoint value.

The hysteresis setting operates as follows: In the high alarm mode, once the alarm is activated the input must fall below the setpoint value minus the hysteresis value to reset the alarm. e.g. if Hi SH under AL 1 is to 50.0 and HYST is set to 3.0 then the setpoint alarm will activate once the display value goes to 50.0 or above and will reset when the display value goes below 47.0 i.e. at 46.9 or below. In the low alarm mode, once the alarm is activated the input must rise above the setpoint value plus the hysteresis value to reset the alarm. e.g. if Lo is to 20.0 and HYST is set to 10.0 then the alarm will activate when the display value falls to 20.0 or below and will reset when the display value goes above 30.0 i.e at 30.1 or above.

To set the hysteresis value go to the HYST function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection. The hysteresis units are expressed in displayed engineering units.

Example: If Hi SH is set to 100 and HYST is set to 10 then alarm 1 will activate when the display value is 100 or higher and will reset at a display value of 89 or lower.

5.4 Alarm relay trip time

Section:	AL 1 to AL 8
Display:	trP
Range:	0 to 5000.0 secs
Default Value:	0.0
Default Access Level	3
Function number	4040 to 4047

Displays and sets the alarm trip time in seconds. The trip time is common for both alarm high and low setpoint values. The trip time provides a time delay before the alarm relay will activate when an alarm condition is present. The alarm condition must be present continuously for the whole trip time period before the alarm will activate. If the input moves out of alarm condition during this period the timer will reset and the full time delay will be restored. This trip time delay is useful for preventing an alarm trip due to short non critical deviations from setpoint. The trip time is selectable over 0 to 50000 seconds.

To set the trip time value go to the trP function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

Example: If trP is set to 5 seconds then the display must indicate an alarm value for a full 5 seconds before the relay will activate.

5.5 Alarm relay reset time

Section:	AL 1 to AL 8
Display:	rSt
Range:	0 to 5000.0 secs
Default Value:	0.0
Default Access Level	3
Function number	4050 to 4057

Displays and sets the alarm reset delay time in seconds. The reset time is common for both alarm high and low setpoint values. With the alarm condition is removed the alarm relay will stay in its alarm condition for the time selected as the reset time. If the input moves back into alarm condition during this period the timer will reset and the full time delay will be restored. The reset time is selectable over 0 to 50000 seconds.

To set the reset time value go to the rSt function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

Example: If rSt is set to 10 seconds then the resetting of alarm relay will be delayed by 10 seconds.

5.6 Relay PI control span

Section:	**AL 1** to **AL2**
Display:	**SPAN**
Range:	Any display value
Default Value:	**1000**
Default Access Level	**4**
Function number	**4290** to **4297**

Allows setting of the control span, refer to "Setting up the relay PI control" chapter.

5.7 Relay PI control setpoint

Section:	**AL 1** to **AL2**
Display:	**SEtP**
Range:	Any display value
Default Value:	**1000**
Default Access Level	**4**
Function number	**4200** to **4207**

Allows setting of the control setpoint, refer to "Setting up the relay PI control" chapter.

5.8 Relay PI control proportional gain value

Section:	**AL 1** to **AL2**
Display:	**P.9**
Range:	Any display value
Default Value:	**0.0 10**
Default Access Level	**4**
Function number	**42 10** to **42 17**

Allow the relay PI control proportional gain to be set, refer to "Setting up the relay PI control" chapter.

5.9 Relay PI control integral gain value

Section:	**AL 1** to **AL2**
Display:	**I .9**
Range:	Any display value
Default Value:	**0.000**
Default Access Level	**4**
Function number	**4220** to **4227**

Allow the relay PI control integral gain to be set, refer to "Setting up the relay PI control" chapter.

5.10 Relay PI control integral high limit value

Section:	**AL 1** to **AL2**
Display:	**1.H**
Range:	**0** to **100.0** %
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4240** to **4247**

Allow the relay PI control integral high limit to be set, refer to "Setting up the relay PI control" chapter.

5.11 Relay PI control integral low limit value

Section:	**AL 1** to **AL2**
Display:	**1.L**
Range:	**0** to **100.0** %
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4250** to **4257**

Allow the relay PI control integral low limit to be set, refer to "Setting up the relay PI control" chapter.

5.12 Relay PI control bias

Section:	**AL 1** to **AL2**
Display:	**bi AS**
Range:	**0** to **100.0** %
Default Value:	**50.0**
Default Access Level	**4**
Function number	**4260** to **4267**

Allow the relay PI control bias to be set, refer to "Setting up the relay PI control" chapter.

5.13 Relay PI control duty cycle

Section:	**AL 1** to **AL2**
Display:	**duty SECS**
Range:	**0** to **5000.0** secs
Default Value:	**0.0**
Default Access Level	**4**
Function number	**4270** to **4277**

Allows the relay PI control duty cycle to be set, refer to "Setting up the relay PI control" chap-

ter.

5.14 Relay PI frequency control “on” time

Section:	AL 1 to AL2
Display:	on SECS
Range:	0 to 5000.0 secs
Default Value:	0.0
Default Access Level	4
Function number	4280 to 4287

Allows the relay PI frequency control “on” time to be set, refer to “Setting up the relay PI control” chapter.

5.15 Relay selection

Section:	AL 1 to AL 8
Display:	rLYS
Range:	On or OFF
Default Value:	OFF
Default Access Level	4
Function number	4330 to 4337

Allows a relay to be allocated to an alarm. For example if a high alarm value has been selected at the AL 1 rLYS function this alarm could be allocated to relay 3 by selecting rLY3 On at this function. Press the F button to enter this function then use the ▲ or ▼ pushbuttons to choose the required relay then press the F button to toggle to On or OFF as required.

5.16 Alarm trailing or setpoint mode

Section:	AL 1 to AL 8
Display:	trAI L
Range:	SEt.P, tL 1, tL 2, tL 3, tL 4, tL 5, tL 6, tL 7
Default Value:	SEt.P
Default Access Level	4
Function number	4060 to 4067

This function will not be seen unless extra optional relays are fitted. Each alarm relay, except relay 1, may be programmed to operate with an independent setpoint value (SEt.P selected) or may be linked to operate at a fixed difference to another relay setpoint, known as trailing operation. The operation is as follows:

- Relay 1 (AL 1) is always independent.
- Relay 2 (AL2) may be independent or may be linked to relay 1 (tL 1).
- Relay 3 (AL3) may be independent or may be linked to relay 1 (tL 1) or relay 2 (tL 2).

- Relay 4 (**RL4**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**) or relay 3 (**tL3**).
- Relay 5 (**RL5**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**) or relay 4 (**tL4**).
- Relay 6 (**RL6**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**), relay 4 (**tL4**) or relay 5 (**tL5**).
- Relay 7 (**RL7**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**), relay 4 (**tL4**), relay 5 (**tL5**) or relay 6 (**tL6**).

The operation of each alarm is selectable by selecting, for example, (Relay 4) **RL4 SEt.P** = Relay 4 normal setpoint or **RL4 tL 1** = Relay 4 trailing relay 1 or **RL4 tL2** = Relay 4 trailing relay 2 or **RL4 tL3** = Relay 4 trailing relay 3. For trailing set points the setpoint value is entered as the difference from the setpoint being trailed.

If the trailing setpoint is to operate ahead of the prime setpoint then the value is entered as a positive number and if operating behind the prime setpoint then the value is entered as a negative number.

Notes: do not use trailing alarms for mixed input types or channels e.g. do not set relay 2 to trail relay 1 if relay 1 is set to operate from the Channel 1 conductivity input and relay 2 is set to operate from a temperature input. Similarly trailing alarms will not operate if the relays chosen are set to operate from different conductivity channels. If a high (**RL** *x* **Hi 9h**) trailing alarm is set then this will only follow the high alarm setting of the relay it is set to trail. Similarly a low alarm will only trail a low alarm of the relay it is set to trail. It is possible to use trailing alarms with both high and low alarm settings used for each relay.

Example 1 - High alarm: With Relay 2 set to trail relay 1, if **RL 1 Hi 9h** is set to **1000** and **RL2 Hi 9h** is set to **50** then relay 1 will activate at **1000** and relay 2 will activate at **1050** (i.e. 1000 + 50). If relay 2 had been set at **-50** then Relay 2 would activate at **950** (i.e. 1000 – 50) or above.

Example 2 - Low alarm: With Relay 2 set to trail relay 1, if **RL 1 Lo** is set to **600** and **RL2 Lo** is set to **200** then relay 1 will activate at **600** and relay 2 will activate at **800** (i.e. 600 + 200). If relay 2 had been set at **-200** then Relay 2 would activate at **400** (i.e. 600 – 200) or below.

5.17 Alarm relay operating mode

Section:	**RL 1** to **RL8**
Display:	**OPEr**
Range:	**Hi .Lo**, **Ctrl** , **FFEQ**
Default Value:	**Hi .Lo**
Default Access Level	**4**
Function number	**4 160** to **4 167**

Sets the operating mode for the selected relay, refer to “Setting up the relay PI control” chapter.

5.18 Alarm relay operation input selection

Section:	AL 1 to AL 8
Display:	Ch
Range:	CH 1, CH2, rtd 1, rtd2
Default Value:	CH 1
Default Access Level	4
Function number	4070 to 4077

Sets the input from which the selected alarm relay will operate. Selections available are:
CH 1 - relay operates from the channel 1 input
CH2 - relay operates from the channel 2 input
rtd 1 - temperature sensor 1 input
rtd2 - temperature sensor 2 input

To set the alarm relay input selection go to the function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required selection then press F to accept this selection.

5.19 Alarm relay latching operation

Section:	AL 1 to AL 8
Display:	LAtch
Range:	Auto, LAtch
Default Value:	Auto
Default Access Level	4
Function number	4 170 to 4 177

Allows selection of alarm latching operation. If set to Auto the alarm relays will not latch i.e. they will automatically reset when the display moves out of alarm condition. If set to LAtch the relay will latch and will not reset until the display value is out of alarm condition and either the F button is pressed to clear the latch condition or if power is removed. The relay hysteresis, trip time and reset time settings still apply to latching relays.

In latching mode the alarm annunciator (5 digit display type only) will flash when the display goes into alarm condition. If the display goes out of alarm condition without being acknowledged the flashing period will change to give a longer "off" time. If the alarm is acknowledged by pressing the F button then the annunciator will change from flashing to solidly lit. Once the alarm has been acknowledged the relay will be free to reset once the display value moves out of alarm condition.

5.20 Alarm relay normally open/closed

Section:	rLy 1 to rLy 7
Display:	rLy
Range:	n.o, n.c
Default Value:	n.o
Default Access Level	4
Function number	4030 to 4036

Displays and sets the setpoint alarm relay x action to normally open (de-energised) or normally closed (energised), when no alarm condition is present. Since the relay will always open when power is removed a normally closed alarm is often used to provide a power failure alarm indication. To set the alarm relay for normally open or closed go to the rLy 1 to rLy 7 rLy function and use the ▲ or ▼ push buttons to set the required operation then press F to accept this selection.
Example:
If set to A In.o alarm relay 1 will be open circuit when the display is outside alarm condition and will be closed (short circuit across COM and N/O terminals) when the display is in alarm condition.

5.21 Relay acknowledge

Section:	rLy 1 to rLy 7
Display:	AcK
Range:	OFF or On
Default Value:	OFF
Default Access Level	4
Function number	4320 to 4326

If the AcK is set to On the operator can acknowledge the alarm whilst still in alarm condition allowing the relay to reset straight away. This is not affected by the alarm being set to either latching or auto reset mode. The acknowledge can be made by pressing the front F button, if available. The front P button and/or a remote input can also be programmed to be used in acknowledging the alarm.

5.22 Alarm relay Boolean logic operation

Section:	rLy 1 to rLy 7
Display:	bool
Range:	Or, And
Default Value:	Or
Default Access Level	4
Function number	43 10 to 43 16

This function allows a Boolean logic AND (And) or OR (Or) function to be applied to alarms. If two or more alarms use the same relay and that relay is set to operate as an OR operation then this effectively puts the alarms in parallel. If two or more alarms use the same relay that relay is set to operate on an AND operation then this effectively puts the alarms in series.

Examples: 1. If alarms 1, 2 and 3 all use relay 1 and relay 1 is set for **Or** operation then relay 1 will activate if the display value for the selected channels for these alarms causes either alarm 1 or alarm 2 or alarm 3 to go into alarm condition. i.e. relay 1 will activate if any of the alarms is in alarm condition.

2. If alarms 1, 2 and 3 all use relay 1 and relay 1 is set for **And** operation then relay 1 will activate if the display value for the selected channels for these alarms causes alarm 1 and alarm 2 and alarm 3 to go into alarm condition. i.e. all 3 alarms must be in alarm condition for relay 1 to activate.

5.23 Channel for digital retransmission

Section:	**d.Out**
Display:	**1 nPut**
Range:	**CH 1**, **CH2**, **rtd 1**, **rtd2** or **Pcnt**
Default Value:	**CH 1**
Default Access Level	**4**
Function number	**4685**

Allows selection of which value is to be retransmitted via the optional binary/BCD output. Choices for an instrument with 2 channels and 2 temperature sensors enabled are:

- **CH 1** - channel 1 value will be retransmitted.
- **CH2** - channel 2 value will be retransmitted.
- **rtd 1** - temperature sensor 1 value will be retransmitted.
- **rtd2** - temperature sensor 2 value will be retransmitted.
- **Pcnt** - percent rejection value will be retransmitted.

5.24 Output mode for digital retransmission

Section:	**d.Out**
Display:	**O.Put**
Range:	**bin2**, **bin**, **b.SCL** or **bcd**
Default Value:	**bin2**
Default Access Level	**4**
Function number	**4680**

Allow selection of the output mode for optional digital retransmission. Selections available are: **bin2** (signed binary) i.e. -32767 to 32767, **bin** (unsigned binary) i.e. 0 to 65535, **b.SCL** (scaled binary, see **d.Out Lo** and **d.OUt Hi 9H**), **bcd** (binary coded decimal) i.e. up to four BCD numbers, see also **bcdOFSt**.

5.25 Output polarity for digital retransmission

Section:	d.Out
Display:	Pol
Range:	Lo or Hi, 9h
Default Value:	Lo
Default Access Level	4
Function number	4681

Allow selection of the output polarity for optional digital retransmission. Selections available are: Lo (active low i.e. logic 1 = 0V and logic 0 = +V output) or Hi, 9h (active high i.e. logic 1 = +V and logic 0 = 0V output).

5.26 Offset for BCD retransmission

Section:	d.Out
Display:	bcd OFSt
Range:	0, 1,2 or 3
Default Value:	0
Default Access Level	4
Function number	4682

When the optional 16 bit digital output is in BCD retransmission mode i.e. the O.Put function is set to bcd the maximum number of digits which can be retransmitted as a BCD value is 4. The bcd OFSt function allows either all 4 digits to be retransmitted or allows the least siginificant bit or bits to be ignored and not retransmitted. For example if the value on the display is 1234 and bcd OFSt function is set to 0 then the value 1234 will be sent as four BCD numbers from the digital output. If the bcd OFSt function is changed to 1 then the value 123 will be retransmitted.

5.27 Low value for scaled binary retransmission

Section:	d.Out
Display:	Lo
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4683

When the optional 16 bit digital output is in scaled binary retransmission mode i.e. the O.Put function is set to b.SCL the scaling for the retransmission will operate needs to be set. See formula and examples in the Hi, 9h function which follows.

5.28 High value for scaled binary retransmission

Section:	d.Out
Display:	Hi 9h
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4684

When the optional 16 bit digital output is in scaled binary retransmission mode i.e. the O.Put function is set to b.SCL the scaling for the retransmission will operate needs to be set. The Lo sets the low level and the Hi 9h sets the high level.

The value retransmitted can be calculated from the formula below:

$$\text{Binary value retransmitted} = (\text{Display value - Lo}) \times \frac{65535}{\text{Hi 9h}}$$

Note that rounding on the output can occur.

Examples:

Display value	Lo	Hi 9h	Retransmitted value
20	0	65535	20
20	0	32767	40
20	4	65535	16
20	4	16384	64

5.29 Excitation voltage on binary retransmission output

Section:	d.Out
Display:	E.Out
Range:	5 or 24
Default Value:	5
Default Access Level	4
Function number	4686

When the optional 16 bit digital output is fitted with an optional excitation voltage (across terminals C and D) supply it is possible through this function to select either 5VDC (5) or 24VDC (24) as the excitation supply voltage. Excitation voltages are approximate.

5.30 Output selection for analog output 1

Section:	rO 1
Display:	OutPt
Range:	4-20, 0-1.0, 0-10
Default Value:	4-20
Default Access Level	4
Function number	4140

Seen only when 16 bit analog retransmission option with choice of outputs is fitted. If the 4-20mA only output is fitted then this function will not be seen. Sets the output type for the 16 bit analog output. Choices are:

- 4-20 for 4 to 20mA output
- 0-1.0 for 0 to 1VDC output
- 0-10 for 0 to 10VDC output

To set the selection go to the OutPt function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.31 Input selection for analog output 1

Section:	rO 1
Display:	1 nPut
Range:	CH 1, CH2, rtd 1, rtd2
Default Value:	CH 1
Default Access Level	4
Function number	43E0

Seen only when analog retransmission option fitted. Sets the input from which the first analog output will operate. Selections available are:
CH 1 output operates from value of channel 1
CH2 output operates from value of channel 2 (only available if 2 channels selected)
rtd 1 output operates from value of temperature input 1
rtd2 output operates from value of temperature input 2 (only available if 2 temperature sensors selected)

To set the selection go to the 1 nPut function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.32 Analog output 1 PI control on or off

Section:	rO 1
Display:	P.Ct1
Range:	no or YES
Default Value:	no
Default Access Level	4
Function number	4600

Allows selection of retransmission (no) or PI control analog output (YES). If set to no then the analog output will operate as a retransmission output using the limits set at the Lo and Hi SH functions. If set to YES then the analog output will operate as a PI control output and the PI control functions will appear.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the selection go to the P.Ct1 function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to select the required setting then press F to accept this selection.

5.33 Analog output 1 PI control setpoint

Section:	rO 1
Display:	SEtP
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	46 10

Allows selection of the PI control setpoint.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the selection go to the SEtP function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.34 Analog output 1 PI control span

Section:	rO 1
Display:	SPAn
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	4618

Allows selection of the PI control span.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the SPAn function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.35 Analog output 1 PI control proportional gain

Section:	rO 1
Display:	P.9
Range:	Any display value
Default Value:	1.000
Default Access Level	4
Function number	4620

Allows selection of the PI control proportional gain.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the P.9 function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.36 Analog output 1 PI control integral gain

Section:	rO 1
Display:	I.9
Range:	Any display value
Default Value:	0.000
Default Access Level	4
Function number	4628

Allows selection of the PI control integral gain.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the **I.9** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.37 Analog output 1 PI control integral high limit

Section:	**rO 1**
Display:	**I.H**
Range:	**0** to **100.0** %
Default Value:	**1.000**
Default Access Level	**4**
Function number	**4638**

Allows selection of the PI control integral high limit.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the **I.H** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.38 Analog output 1 PI control integral low limit

Section:	**rO 1**
Display:	**I.L**
Range:	**0** to **100.0** %
Default Value:	**1.000**
Default Access Level	**4**
Function number	**4640**

Allows selection of the PI control integral low limit.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the **I.L** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.39 Analog output 1 PI control bias

Section:	rO 1
Display:	b, AS
Range:	0 to 100.0 %
Default Value:	50.0
Default Access Level	4
Function number	4648

Allows selection of the PI control bias.

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details. Refer to the addendum "Analog PI control output" chapter for a full description of the analog PI control functions.

To set the value go to the b, AS function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.40 Analog output 1 option low value

Section:	rO 1
Display:	Lo
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4 120

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details.

Displays and sets the analog retransmission output low value (4mA or 0V) in displayed engineering units. To set the selection go to the Lo function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

Example: If it is required to retransmit 4mA when the display indicates 0 then select 0 in this function using the ▲ or ▼ button.

5.41 Analog output option high value

Section:	rO 1
Display:	H, 9h
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	4 130

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details.

Displays and sets the analog retransmission output high display value (20mA, 1V or 10V) in displayed engineering units.

To set the value go to the **Hi SH** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

Example: If it is required to retransmit 20mA when the display indicates **50** then select **50** in this function using the ▲ or ▼ button.

5.42 Linear or logarithmic analog output selection

Section:	**r01**
Display:	**Log**
Range:	**Lin**, **Log**
Default Value:	**Lin**
Default Access Level	**4**
Function number	**4 150**

Seen only when analog retransmission option fitted. Refer to the separate "PM5 Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details.

Selects linear (**Lin**) or logarithmic (**Log**) output for the first analog output. If logarithmic output is chosen the number of decades will be automatically calculated based on the **Lo** and **Hi SH** values set.

To set the selection go to the **Log** function, press **F** and when you see the decimal points flash use the ▲ or ▼ push buttons to select the required setting then press **F** to accept this selection.

5.43 Output selection for analog output 2

Section:	**r02**
Display:	**OutPt**
Range:	**4-20**, **0- 1.0** or **0- 10**
Default Value:	**4-20**
Default Access Level	**4**
Function number	**4 141**

Seen only when dual 16 bit analog retransmission option fitted. Sets the output type for the 16 bit analog output. Choices are:

4-20 for 4 to 20mA output

0- 1.0 for 0 to 1VDC output

0- 10 for 0 to 10VDC output

To set the selection go to the **OutPt** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.44 Input selection for analog output 2

Section:	rO2
Display:	InPut
Range:	CH1, CH2, rtd1 or rtd2
Default Value:	CH1
Default Access Level	4
Function number	43E1

Seen only when dual analog retransmission option fitted. Sets the input from which the second analog output will operate. See function for further details.

5.45 Analog output 2 PI control on or off

Section:	rO2
Display:	P.Ct1
Range:	no or YES
Default Value:	no
Default Access Level	4
Function number	4601

Allows selection of retransmission (no) or PI control analog output (YES). See function rO1 P.Ct1 for further details.

5.46 Analog output 2 option low value

Section:	rO2
Display:	Lo
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4121

Seen only when dual analog retransmission option fitted. See function rO1 Lo for further details.

5.47 Analog output option 2 high value

Section:	rO2
Display:	Hi 9h
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	4131

Seen only when dual analog retransmission option fitted. See function rO1 Hi 9h for further details.

5.48 Linear or logarithmic analog output 2 selection

Section:	rO2
Display:	Lo9
Range:	Lin or Lo9
Default Value:	Lin
Default Access Level	4
Function number	4151

Seen only when dual analog retransmission option fitted. See function for further details.

5.49 Analog output 2 PI control setpoint

Section:	rO2
Display:	SEtP
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4611

Allows selection of the PI control setpoint.

Seen only when dual analog retransmission option fitted. See function rO1 SEtP for further details.

5.50 Analog output 2 PI control span

Section:	rO2
Display:	SPAn
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	4619

Allows selection of the PI control span for analog output 2. See function rO1 SPAn for further details.

5.51 Analog output 2 PI control proportional gain

Section:	rO2
Display:	P.9
Range:	-32.768 to 32.767
Default Value:	1.000
Default Access Level	4
Function number	4621

Allows selection of the PI control proportional gain. See function rO1 P.9 for further details.

5.52 Analog output 2 PI control integral gain

Section:	rO2
Display:	I.9
Range:	-32.768 to 32.767
Default Value:	0.000
Default Access Level	4
Function number	4629

Allows selection of the PI control integral gain. See function rO1 I.9 for further details.

5.53 Analog output 2 PI control integral high limit

Section:	rO2
Display:	I.H
Range:	0.0 to 100.0
Default Value:	1.000
Default Access Level	I.H
Function number	4639

Allows selection of the PI control integral high limit. See function rO1 I.H for further details.

5.54 Analog output 2 PI control integral low limit

Section:	r02
Display:	1.L
Range:	0.0 to 100.0
Default Value:	1.000
Default Access Level	4
Function number	4641

Allows selection of the PI control integral low limit. See function r011.L for further details.

5.55 Analog output 2 PI control bias

Section:	r02
Display:	bi AS
Range:	0.0 to 100.0
Default Value:	50.0
Default Access Level	4
Function number	4649

Allows selection of the PI control bias. See function r01bi AS for further details.

5.56 Bargraph channel

Section:	bArG
Display:	Ch
Range:	CH1, CH2, rtd1 or rtd2
Default Value:	CH1
Default Access Level	4
Function number	43F6

Seen only in bargraph display instruments. Displays and sets the channel/input type for the bargraph display to operate from. Choices are:

- CH1 - bargraph shows conductivity channel 1 value
- CH2 - bargraph shows conductivity channel 2 value
- rtd1 - bargraph shows temperature sensor 1 value
- rtd2 - bargraph shows temperature sensor 2 value

To set bargraph channel go to the bArG Ch function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required choice then press F to accept this selection.

5.57 Bargraph type

Section:	bAr9
Display:	tYPE
Range:	bAr, S.dot, d.dot. c.bAr or r.dot
Default Value:	bAr
Default Access Level	4
Function number	43F0

Seen only in bargraph display instruments. Displays and sets the bargraph display type Choices are:

- **bAr** - conventional solid bargraph display i.e. all LEDs illuminated when at full scale.
- **S.dot** - single dot display. A single segment will be lit to indicate the input readings position on the scale.
- **d.dot** - double dot display. Two segments will be lit to indicate the input reading position on the scale. The reading should be taken from the middle of the two segments.
- **c.bAr** - centre bar display. The display will be a solid bargraph but will have its zero point in the middle of the display. If the seven segment display value is positive the bargraph will rise. If the seven segment display value is negative then the bargraph will fall.
- **r.dot** -modulus or wrap around single dot bargraph. This mode of operation allows the bargraph to wrap around the limits set by the **bAr9 Lo** and **bAr9 Hi** functions by dividing the 7 segment display by the modulus (the modulus is the difference between 0 and **bAr9 Hi**) and displaying the remainder. For example if **bAr9 Lo** is set to 0 and **bAr9 Hi** is set to 10 then in other bargaph modes when the 7 segment display reads a value such as 25 the bargraph would be stuck at the high limit of its travel since it cannot go beyond 10. In **r.dot** mode the display will wrap around at 10 then continue up the bar again and will be at the midpoint of the bargraph when the 7 segment display shows 25 (as it would for a 7 segment display of 15, 35, etc.). In this example for a 7 segment display of 25 the value of 25 is divided by the modulus value of 10 in this example and the remainder displayed i.e. 10 goes into 25 twice with the remainder of 5 and so a bargaph position of 5 is displayed.

To set bargraph type go to the **bAr9 tYPE** function, press **F** and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required choice then press **F** to accept this selection.

5.58 Bargraph low value

Section:	bAr9
Display:	Lo
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	43F2

Seen only in bargraph display instruments. Displays and sets the bar graph low value i.e. the value on the 7 segment display at which the bargraph will start to rise. This may be independently

set anywhere within the display range of the instrument. Note: The bAr9 Lo and bAr9 Hi settings are referenced from the 7 segment display readings, not the bargraph scale values. The bargraph scale may scaled differently to the 7 segment display. For example the bargraph scale may be indicating percentage whilst the 7 segment display is indicating actual process units. To set bargraph low level go to the bAr9 Lo function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value.

5.59 Bargraph high value

Section:	bAr9
Display:	Hi
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	43F4

Seen only in bargraph display instruments. Displays and sets the bar graph high value i.e. the value on the 7 segment display at which the bargraph will reach its maximum indication. This may be independently set anywhere within the display range of the instrument. Note: The bAr9 Lo and bAr9 Hi settings are referenced from the 7 segment display readings, not the bargraph scale values. The bargraph scale may scaled differently to the 7 segment display. For example the bargraph scale may be indicating percentage whilst the 7 segment display is indicating actual process units. To set bargraph low level go to the bAr9 Hi function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value.

5.60 Set number of input channels

Section:	Cd 1
Display:	Cd.Ch
Range:	1 or 2
Default Value:	1
Default Access Level	CAL
Function number	48d0

Allows selection of one or two conductivity cell inputs. If one input is chosen the functions for input 2 will not be seen.

5.61 Decimal point for channel 1

Section:	CA 1
Display:	dCPt
Range:	0, 0.1, 0.02 or 0.003
Default Value:	0
Default Access Level	CAL
Function number	4100

Displays and sets the decimal point for channel 1. To set the decimal point value go to the dCPt function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection. The display will indicate as follows: 0 (no decimal point), 0.1 (1 decimal place), 0.02 (2 decimal places) or 0.003 (3 decimal places).

5.62 Display rounding for channel one

Section:	CA 1
Display:	drnd
Range:	1 to 5000 units
Default Value:	1
Default Access Level	CAL
Function number	43b0

Displays and sets the display rounding value for channel 1. This value may be set to 1 - 5000 displayed units. Display rounding is useful for reducing the instrument resolution without loss of accuracy in applications where it is undesirable to display to a fine tolerance. To set the display rounding value go to the drnd function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

Example: If set to 10 the channel 1 display values will change in multiples of 10 only i.e. display moves from 10 to 20 to 30 etc.

5.63 Digital filter for channel 1

Section:	CA 1
Display:	FiLtr
Range:	0 to 8
Default Value:	3
Default Access Level	CAL
Function number	43C0

Displays and sets the digital filter value for channel 1. Digital filtering uses a weighted average method of determining the display value and is used for reducing display value variation due to short term interference. The digital filter range is selectable from 0 to 8, where 0 = none and 8 = most filtering. Note that the higher the filter setting the longer the display may take to reach its final value when the input is changed, similarly the relay operation and any output options will be slowed down when the filter setting is increased. To set the filter go to the FiLtr function, press

F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.64 Conductivity measuring units for channel 1

Section:	Cd 1
Display:	uni t
Range:	uS.cm, uS.m, mS.cm, mS.m, rESt, PPM or Pcnt
Default Value:	uS.cm
Default Access Level	CAL
Function number	4380

Selects the conductivity measuring units for channel 1 input. Choices available are:

- uS.cm to display in microSiemens per centimetre (uS/cm)
- uS.m to display in microSiemens per metre (uS/m)
- mS.cm to display in milliSiemens per centimetre (mS/cm)
- mS.m to display in milliSiemens per metre (mS/m)
- rESt to display resistivity in MΩ
- PPM to display in parts per million using the PPM FACt value, see section 5.71
- Pcnt to display % by weight of sodium chloride (NaCl)

Note that if the conductivity display units are changed the instrument must be recalibrated.

To set the display units go to the uni t function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required units then press F to accept this selection.

5.65 Cell type for channel 1

Section:	Cd 1
Display:	SENS
Range:	CELL or coil
Default Value:	CELL
Default Access Level	CAL
Function number	48d1

Allows selection of either conventional (CELL conductivity cell or toroidal type (coil) conductivity cell. If (coil) is selected the FrEQ does not function as a higher frequency will automatically be used.

5.66 Drive frequency for channel 1

Section:	Cd 1
Display:	FrEq
Range:	100, 150, 200, 250, 300, 350 or 400
Default Value:	100
Default Access Level	CAL
Function number	48d4

Selects the drive frequency in Hz for the AC excitation output for channel 1. Default setting of 100 is suitable for most applications but if difficulties are encountered other frequencies can be tried. Higher frequencies can be used if the process solution being measured is causing problems with electrolysis at the cell. To set the frequency go to the FrEq function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required frequency then press F to accept this selection.

5.67 Solution temperature compensation slope for channel 1

Section:	Cd 1
Display:	SLOPE
Range:	-6.00 to 0.00
Default Value:	-2.00
Default Access Level	CAL
Function number	48dC

Displays and sets the solution slope for channel 1, variable from -6.00 to 0.00. The solution slope gives the temperature coefficient of the solution measured as a % per ^{o}C (this figure is needed since each individual solutions conductivity/resistivity will vary differently with temperature) . A typical value is -2% per ^{o}C for water. Enter the solution value, if known, if the solution slope is not known then it can be obtained as follows:

1. Set the slope setting to 0.00
2. Place the cell into a sample of the process solution. Measure the temperature of the solution or alter the temperature to a desired level, this temperature is shown as T1 in the formula below. Allow the reading to stabilise and note the reading.
3. Bring the solution up to a higher temperature and allow the reading to stabilise, again note the reading.
4. Use the formula below to calculate the solution slope.

$$Slope = \left(\frac{Conductivity\,or\,Resistivity\,at\,T1}{Conductivity\,or\,Resistivity\,at\,T2} - 1 \right)^{\left(\frac{1}{T2-T1}\right)} \times 100$$

5. Enter the result as the solution slope.

To set the slope go to the SLOPE function, press F and when you see a digit of the value flash flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.68 Solution temperature compensation reference for channel 1

Section:	Cd 1
Display:	SOL
Range:	-40.0 to 150.0
Default Value:	25.0
Default Access Level	CAL
Function number	48E0

Displays and sets the solution temperature (T1) for channel 1 to be used with the solution slope function above for automatic temperature compensation calculation. The default value is set at 25°C as this is the standard reference temperature for conductivity measurement. If this value is changed the conductivity readings obtained will be the value compensated to the new temperature selected. e.g. if changed to 30°C the display will compensate to show conductivity at 30°C no matter what the solution temperature actually is.

To set the reference value go to the function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.69 Cell K factor for channel 1

Section:	Cd 1
Display:	PROBE
Range:	0.01 . 0.05 . 0.1 . 0.5 . 1.0 . 2.0 . 5.0 . 10 . 20 . 50 or 100
Default Value:	0.1
Default Access Level	CAL
Function number	48E4

Displays and sets the probe cell constant (K factor) for channel 1. See chapter 1 for measurement ranges for common K factors. Set this function to match the K factor of the cell being used. To set the K factor go to the PROBE function, press F and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.70 Hydrogen Ion compensation for channel 1

Section:	Cd 1
Display:	H.I on
Range:	oFF or On
Default Value:	oFF
Default Access Level	CAL
Function number	48E8

Allows automatic hydrogen ion compensation to be turned off or on. When measuring high purity water solutions (1uS/cm or less) compensation needs to be made for hydrogen ions as well as temperature. When set to on the instrument compensates for conductivity due to the H+ and OH- solvent ions which become prevalent at low conductivity. These ions have an effect on water conductivity/resistivity since they have different temperature compensation curves to water. When

set to **on** the a dry cell will give a display reading of 0.05uS/cm (if 2 decimal point places are selected).

5.71 PPM conversion factor for input 1

Section:	**Cd 1**
Display:	**PPM FACt**
Range:	**0.200** to **2.000**
Default Value:	**0.560**
Default Access Level	**CAL**
Function number	**48EC**

The **PPM FACt** (ppm factor) function value is used with the input from the cell to calculate the ppm value of the solution concerned. The displayed ppm figure is calculated from: ppm = conductivity (uS/cm) times **PPM FACt**. The factor will vary with the composition and concentration of the solution being measured. Suggested ppm factors for four standard solutions are given below. The suggested factors are based on conductivities of approx. 14,000 uS/cm at 25oC. For example the default setting for the instrument is 0.560 which is a figure used for NaCl (sodium chloride solution or salt water).

Standard solution	Use	Suggested **PPM FACt** value
NaCl	Salt water and dairy products	0.560
442 (40% sodium sulphate, 40% sodium bicarbonate, 20% sodium chloride)	General fresh water e.g. rivers, lakes and reverse osmosis water	0.860
KCL	Can be used in applications a NaCl standard is used but KCL is normally used as a conductivity standard rather than ppm standard	0.580
CaCO3	Boiler and cooling tower water	0.480

5.72 Percent rejection display enable

Section:	**Cd 1**
Display:	**Pcnt rEJ**
Range:	**OFF** or **On**
Default Value:	**OFF**
Default Access Level	**CAL**
Function number	**48F0**

The percent rejection figure is valid only for a 2 input conductivity measurement. When this

function is set to **On** the percent rejection figure can be viewed in normal measurement display via the ▲ or ▼ pushbuttons.

$$Percent\,Rejection = \left(\frac{inlet\,PPM - outlet\,PPM}{inlet\,PPM}\right) \times 100\%$$

Where the inlet PPM is the Channel 2 conductivity times the Channel 2 PPM factor and the outlet PPM is the Channel 1 conductivity times the Channel 1 PPM factor.

5.73 Conductivity uncalibration for channel 1

Section:	**Cd 1**
Display:	**U.CAL**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**0620**

Reset (uncalibrate) calibration for cell 1. The uncalibration process resets the calibration to factory default settings. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.74 Conductivity null calibration for channel 1

Section:	**Cd 1**
Display:	**NULL**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**0600**

Null calibration for conductivity cell 1. The null calibration is carried out with the cell dry and in air. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.75 First point conductivity calibration for channel 1

Section:	**Cd 1**
Display:	**CAL 1**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**0600**

The first calibration point can be used with the **NULL** function to perform a basic 2 point calibration. It can also be used with the **CAL2** function to perform an additional calibration to

compensate for head resistance in long cable runs. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.76 Second point conductivity calibration for channel 1

Section:	**Cd 1**
Display:	**CAL2**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**06 10**

The second calibration point can be used with the **CAL 1** function to compensate for head resistance in long cable runs. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.77 Decimal point for channel 2

Section:	**Cd2**
Display:	**dCPt**
Range:	**0**, **0.1**, **0.02** or **0.003**
Default Value:	**0**
Default Access Level	**CAL**
Function number	**4 10 1**

Displays and sets the decimal point for channel 2. Refer to **Cd 1 dCPt** for further details.

5.78 Display rounding for channel 2

Section:	**Cd2**
Display:	**drnd**
Range:	**1** to **5000** units
Default Value:	**1**
Default Access Level	**CAL**
Function number	**436 1**

Displays and sets the display rounding value for channel 2. Refer to **Cd 1 drnd** for further details.

5.79 Digital filter for channel 2

Section:	**Cd2**
Display:	**FiLtr**
Range:	**0** to **8**
Default Value:	**3**
Default Access Level	**CAL**
Function number	**43C1**

Displays and sets the digital filter value for channel 2. Refer to **Cd1FiLtr** for further details.

5.80 Conductivity measuring units for channel 2

Section:	**Cd2**
Display:	**uniT**
Range:	**uS.cm**, **uS.m**, **mS.cm**, **mS.m**, **TEST**, **PPM** or **Pcnt**
Default Value:	**uS.cm**
Default Access Level	**CAL**
Function number	**43A1**

Selects the conductivity measuring units for channel 2 input. Refer to **Cd1uniT** for further details.

5.81 Cell type for channel 2

Section:	**Cd2**
Display:	**SENS**
Range:	**CELL** or **coil**
Default Value:	**CELL**
Default Access Level	**CAL**
Function number	**48d2**

Allows selection of either conventional (**CELL** conductivity cell or toroidal type (**coil**) conductivity cell. If (**coil**) is selected the **FrEQ** does not function as a higher frequency will automatically be used.

5.82 Drive frequency for channel 2

Section:	Cd2
Display:	FrEq
Range:	100, 150, 200, 250, 300, 350 or 400
Default Value:	100
Default Access Level	CAL
Function number	48d5

Selects the drive frequency in Hz for the AC excitation output for channel 2. Refer to **Cd 1 FrEq** for further details.

5.83 Solution temperature compensation slope for channel 2

Section:	Cd2
Display:	SLOPE
Range:	-6.00 to 0.00
Default Value:	-2.00
Default Access Level	CAL
Function number	48dd

Displays and sets the solution slope for channel 2. Refer to **Cd 1 SLOPE** for further details.

5.84 Solution temperature compensation reference for channel 2

Section:	Cd2
Display:	SOL
Range:	-40.0 to 150.0
Default Value:	25.0
Default Access Level	CAL
Function number	48E 1

Displays and sets the solution temperature (T1) for channel 2. Refer to **Cd 1 SOL** for further details.

5.85 Cell K factor for channel 2

Section:	Cd2
Display:	PrObE
Range:	0.01, 0.05, 0.1, 0.5, 1.0, 2.0, 5.0, 10, 20, 50 or 100
Default Value:	0.1
Default Access Level	CAL
Function number	48E5

Displays and sets the probe cell constant (K factor) for channel 2. Refer to **Cd 1 PrObE** for

further details.

5.86 Hydrogen Ion compensation for channel 2

Section:	**Cd2**
Display:	**H.I on**
Range:	**oFF** or **On**
Default Value:	**oFF**
Default Access Level	**CAL**
Function number	**48E8 to 48E9**

Allows automatic hydrogen ion compensation to be turned off or on. Refer to **Cd 1 H.I on** for further details.

5.87 PPM conversion factor for input 2

Section:	**Cd2**
Display:	**PPM FACt**
Range:	**0.200** to **2.000**
Default Value:	**0.560**
Default Access Level	**CAL**
Function number	**48Ed**

Sets the ppm factor for input 2. See **Cd 1 PPM FACt** for further details.

5.88 Conductivity uncalibration for channel 2

Section:	**Cd2**
Display:	**U.CAL**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**0b21**

Reset (uncalibrate) calibration for cell 2. The uncalibration process resets the calibration to factory default settings. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.89 Conductivity null calibration for channel 2

Section:	**Cd2**
Display:	**NULL**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**060 1**

Null calibration for conductivity cell 2. The null calibration is carried out with the cell dry and in air. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.90 First point conductivity calibration for channel 2

Section:	**Cd2**
Display:	**CAL 1**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**060 1**

The first calibration point can be used with the **NULL** function to perform a basic 2 point calibration. It can also be used with the **CAL2** function to perform an additional calibration to compensate for head resistance in long cable runs. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.91 Second point conductivity calibration for channel 2

Section:	**Cd2**
Display:	**CAL2**
Range:	n/a
Default Value:	n/a
Default Access Level	**4**
Function number	**06 11**

The second calibration point can be used with the **CAL 1** function to compensate for head resistance in long cable runs. Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.92 Temperature sensor configuration

Section:	rtd 1
Display:	1 nPt
Range:	rtd3, rtd2 or 2rt2
Default Value:	rtd3
Default Access Level	CAL
Function number	4800

Allows selection of the temperature sensor configuration. Choices are:

rtd3 - allows a single 3 wire temperature sensor input for channel 1 (and channel 2 if 2 channels selected).
rtd2 - allows a single 2 wire temperature sensor input for channel 1 (and channel 2 if 2 channels selected).
2rt2 - allows a 2 wire temperature sensor input for channel 1 plus a separate 2 wire temperature sensor input for channel 2.

If two input channels are selected but only one temperature sensor then the temperature reading from this one sensor will be applied to both channels for temperature compensation. If two temperature sensors are selected then temperature sensor input 1 will be used to provide temperature compensation to channel 1 and temperature sensor input 2 will be used to provide temperature compensation to channel 2. To set the configuration go to the **1 nPt** function, press **F** and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required selection then press **F** to accept this selection.

5.93 Temperature sensor type for channel 1

Section:	rtd 1
Display:	tYPE
Range:	100, 1000, t 100 or NONE
Default Value:	100
Default Access Level	CAL
Function number	4804

Allows selection of the temperature sensor type for channel 1. Choices are:
100 - Pt100 RTD
1000 - Pt1000 RTD
t 100 - 100Ω ntc thermistor
NONE - No temperature sensor used.

To set the sensor type go to the **tYPE** function, press **F** and when you see the decimal points flash use the ▲ or ▼ push buttons to set the required selection then press **F** to accept this selection. See also the **1 nPt** function which allows selection of single 2 or 3 wire or dual 2 wire type sensors. The 100Ω thermistor setting is suitable for 2 wire connection only.

5.94 Manual temperature setting for input 1

Section:	rtd 1
Display:	dEF °C
Range:	-40.0 to 200.0
Default Value:	25.0
Default Access Level	CAL
Function number	4808

Allows a manual temperature setting when no temperature sensor is used i.e. when TYPE is set to NONE.

To set the default temperature go to the dEF °C function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.95 Temperature uncalibration for input 1

Section:	rtd 1
Display:	U.CAL
Range:	no or YES
Default Value:	no
Default Access Level	4
Function number	0620

Allows the temperature calibration to be cleared and set back to factory default calibration.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.96 First calibration point for temperature input 1

Section:	rtd 1
Display:	CAL 1
Range:	n/a
Default Value:	n/a
Default Access Level	4
Function number	0600

The CAL 1 function is used together with the CAL2 function to calibrate the temperature input.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.97 Second calibration point for temperature input 1

Section:	rtd1
Display:	CAL2
Range:	n/a
Default Value:	n/a
Default Access Level	4
Function number	0610

The CAL2 function is used together with the CAL 1 function to calibrate the temperature input.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.98 Temperature sensor type for channel 2

Section:	rtd2
Display:	tYPE
Range:	100, 1000, t 100 or NONE
Default Value:	100
Default Access Level	CAL
Function number	4805

Allows selection of the temperature sensor type for channel 2. Refer to rtd 1 tYPE for further details.

5.99 Manual temperature setting for input 2

Section:	rtd2
Display:	dEF °C
Range:	-40.0 to 200.0
Default Value:	25.0
Default Access Level	CAL
Function number	4809

Allows a manual temperature setting when no temperature sensor is used. Refer to rtd 1 dEF °C for further details.

5.100 Temperature uncalibration for input 2

Section:	rtd2
Display:	U.CAL
Range:	no or YES
Default Value:	no
Default Access Level	4
Function number	0621

Allows the temperature calibration to be cleared and set back to factory default calibration.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.101 First calibration point for temperature input 2

Section:	rtd2
Display:	CAL 1
Range:	n/a
Default Value:	n/a
Default Access Level	4
Function number	0601

The CAL 1 function is used together with the CAL2 function to calibrate the temperature input.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.102 Second calibration point for temperature input 2

Section:	rtd2
Display:	CAL2
Range:	n/a
Default Value:	n/a
Default Access Level	4
Function number	0611

The CAL2 function is used together with the CAL 1 function to calibrate the temperature input.

Refer to the Calibration chapter page 83 for full details of the calibration procedure.

5.103 Default display

Section:	d, SP
Display:	dFlt
Range:	CH1, CH2, rtd1, rtd2 to Pcnt
Default Value:	CH1
Default Access Level	4
Function number	4438

This function allows setting of the default display. Selections available are: Channel 1 (CH1), Channel 2 (
lcvCH2), Temperature input 1 (rtd1), Temperature input 2 rtd2) or percent rejection (Pcnt. Only displays which have been enabled can be chosen e.g. you cannot choose percent rejection if the percent rejection function is set to OFF. The display will always return to the default display even if toggled to another display. If toggled to another display the display type will flash e.g. rtd 2 once every 8 seconds prior to the value. After approx. 30 seconds of selecting a non default value the display will return to the default display and the input type will not flash for this display.

5.104 Display brighness

Section:	d, SP
Display:	brgt
Range:	1 to 16
Default Value:	16
Default Access Level	2
Function number	22Fb

Displays and sets the dulled digital display brightness. The display brightness is selectable from 1 to 16, where 1 = lowest intensity and 15 = highest intensity. This function is useful for improving the display readability in dark areas or to reduce the power consumption of the instrument. See also the dul1 function.

To set brightness level go to the brgt function press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

5.105 Dimmed display brighness

Section:	d, SP
Display:	dul1
Range:	0 to 16
Default Value:	2
Default Access Level	2
Function number	22EC

Displays and sets the level for remote input brightness switching. When a remote input is set to dul1 the remote input can be used to switch between the display brightness level set by the brgt function and the dimmed display brightness set by the dul1 function. The display dull

level is selectable from 0 to 16, where 0 = lowest intensity and 16 = highest intensity. This function is useful in reducing glare when the display needs to be viewed in both light and dark ambient light levels.

5.106 Front P button operation mode

Section:	F.1 nP
Display:	P.but
Range:	nonE, P.Hi, P.Lo, Hi, Lo or AL.Ac
Default Value:	nonE
Default Access Level	4
Function number	4720

Sets the operation mode for front P button. Functions available are identical to the same functions used in the F.1 n. 1 function.

5.107 Remote input 1 operation mode

Section:	F.1 nP
Display:	F.1 n. 1
Range:	nonE, P.Hold, d.Hold, P.Hi, P.Lo, Hi, Lo, AL.Ac, ACCSS or dul 1
Default Value:	nonE
Default Access Level	4
Function number	4721

Sets the operation mode for remote input 1 terminal at the rear of the instrument. Choices are as follows:

- nonE - If this option is selected then remote input 1 will have no function.
- P.Hold - peak hold. The display will show the peak value (highest positive value) only whilst the remote input terminals are short circuited i.e. the display value can rise but not fall whilst the input terminals are short circuited. The message P.HLd will appear briefly every 8 seconds whilst the input terminals are short circuited to indicate that the peak hold function is active.
- d.Hold - display hold. The display value will be held whilst the remote input terminals are short circuited. The message d.HLd will appear briefly every 8 seconds whilst the input terminals are short circuited to indicate that the display hold function is active.
- P.Hi - peak memory. The peak value stored in memory will be displayed if the remote input terminals are short circuited, if the short circuit is momentary then the display will return to normal measurement after 20 seconds. If the short circuit is held for 2 to 3 seconds or the power is removed from the instrument then the memory will be reset.
- P.Lo - valley memory. The minimum value stored in memory will be displayed. Otherwise operates in the same manner as the P.Hi function described above.

- **Hi Lo** - toggle between **Hi** and **Lo** displays. This function allows the remote input to be used to toggle between peak and valley memory displays. The first operation of the remote input will cause the peak memory value to be displayed, the next operation will give a valley memory display. **P.Hi** or **P.Lo** will flash before each display to give an indication of display type.
- **AL.Ac** - alarm acknowledge. Allows the remote input to be used to acknowledge a latching alarm. See the function.
- **ACCSS** - remote input access. Allows the remote input to be used for access control purposes. See the function.
- **dull** - remote input brightness switching. When this mode is selected the display brightness will be switch from the brightness level set at the **d. SP brgt** to the brightness level set at the **d. SP dull** function. This function is generally used to switch between daylight and night time viewing brightness requirements thereby avoiding glare when light levels are low.

5.108 Remote input 2 operation mode

Section:	**r.i nP**
Display:	**r.i n.2**
Range:	**none**, **P.Hold**, **d.Hold**, **d.P.Hi**, **P.Lo**, **Hi**, **Lo**, **AL.Ac**, **ACCSS** or **dull**
Default Value:	**none**
Default Access Level	**4**
Function number	**4722**

Sets the operation mode for remote input 2. Functions are identical to the **r.i n. 1** function but uses the rear remote input 2 terminal. If a **r.i n.2** function is selected ensure it is not the same as that selected at **r.i n. 1**.

5.109 Easy access mode

Section:	**ACCES**
Display:	**EASY LEVEL**
Range:	**none**, **1**, **2**, **3**, **4**, **5**, **6**, **CAL**
Default Value:	**none**
Default Access Level	**5.CAL**
Function number	**0C00**

Allows choice of the access level available when using the easy access method. For example if this function is set to **3** then functions with levels 1, 2 and 3 can be viewed and changed when access to setup functions is made using this method. To access setup functions using the easy access method press and hold the **F** button until the message **FUNC** is seen followed by the first function message, this should take approximately 3 seconds. If the message **FUNC End** or no response is seen at this point it means that the access level has been set to **nonE** and that access to setup functions has been refused.

5.110 Remote input access mode

Section:	ACCES
Display:	r.I nPt LEVEL
Range:	nONE, 1, 2, 3, 4, 5, 6, CAL
Default Value:	nONE
Default Access Level	S.CAL
Function number	OC01

This function allows choice of the access level available when using the remote input access method. To access setup functions using the remote input access method one of the remote inputs must be set to ACCSS and the chosen remote input must be shorted to ground. Press and hold the F button until the message FUNC is seen followed by the first function message, this should take approximately 3 seconds. If the message FUNC End is seen at this point it means that the access level has been set to nonE.

5.111 PIN code 1

Section:	ACCES
Display:	USr.1 Pin
Range:	0 to 50000
Default Value:	0
Default Access Level	S.CAL
Function number	OC09

This function allows choice of the PIN code to be used for PIN code input access method. Associated with the PIN is an access level (see Pin.1AccS). If a PIN is not required leave the setting at 0. If a PIN other than 0 is chosen then this PIN must be entered to gain access to the the selected level.

To access setup functions using the PIN code input access method press then release the F button then within 2 seconds press the ▲ and ▼ buttons at the same time. The message FUNC is seen followed by the message CodE. If the message FUNC End is seen at this point it means that the access level has been set to nonE. Use the ▲ and ▼ buttons to enter the PIN then press F to accept the PIN and proceed to the setup functions.

5.112 PIN code 1 access level

Section:	ACCES
Display:	USr.1 LEVEL
Range:	nONE, 1, 2, 3, 4, 5, 6, CAL
Default Value:	nONE
Default Access Level	S.CAL
Function number	OC02

This function allows choice of the access level available when using the PIN code 1 input access method. To access setup functions using the PIN code 1 input access method press and hold the F button until the message FUNC is seen followed by the first function message, this should take

approximately 3 seconds. If the message FUNC End is seen at this point it means that the access level has been set to NonE.

5.113 PIN code 2

Section:	ACCES
Display:	USr.2 Pin
Range:	0 to 50000
Default Value:	0
Default Access Level	S.CAL
Function number	0C0A

This function allows choice of a second PIN code to be used for PIN code input access method. Associated with the PIN is an access level (see Pin.2AccS). The second PIN would normally be used to allow a second person to have a higher access to setup functions via a different PIN. If a second PIN is not required leave the setting at 0. If a PIN other than 0 is chosen then this PIN must be entered to gain access to the the selected level.

To access setup functions using the PIN code input access method press then release the F button then within 2 seconds press the ▲ and ▼ buttons at the same time. The message FUNC is seen followed by the message CodE. If the message FUNC End is seen at this point it means that the access level has been set to NonE. Use the ▲ and ▼ buttons to enter the PIN then press F to accept the PIN and proceed to the setup functions. Ony one CodE message will appear even though there can be a second PIN. If the number entered into the CodE at this point is the PIN code 1 number then access will be granted to the functions allocated to the first PIN. If the PIN code 2 value is entered then access will be granted to the functions allocated to the second PIN.

5.114 PIN code 2 access level

Section:	ACCES
Display:	USr.2 LEVEL
Range:	NONE, 1, 2, 3, 4, 5, 6, CAL
Default Value:	NONE
Default Access Level	S.CAL
Function number	0C03

This function allows choice of the access level available when using the PIN code 2 input access method. To access setup functions using the PIN code 2 input access method press and hold the F button until the message FUNC is seen followed by the first function message, this should take approximately 3 seconds. If the message FUNC End is seen at this point it means that the access level has been set to NonE.

5.115 User assignable access 1 function number

Section:	ACCES
Display:	Fn. 1 CodE
Range:	0000 to FFFF hex.
Default Value:	0000
Default Access Level	S.CAL
Function number	OC 10

In addition to being assigned an access level each setup function is assigned an individual function number. This functions and the ones which follow (Fn.2 CodE etc.) can be used to alter the access level for particular functions. For example if the user wishes to change the access level of the channel 1 display units (function number 43A0) from level 5 to level 1 then the value 43A0 would be entered at this function and the value 3 would be entered at the function which follows. This would then enable the channel 1 display unit functions to be accessed at the lowest access level.

5.116 User assignable access 1 level value

Section:	ACCES
Display:	Fn. 1 LEVEL
Range:	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL
Default Value:	dFLt
Default Access Level	S.CAL
Function number	OC40

Allows a new access level for the function with the number set in the function to be chosen. If dFLt is chosen then the level reverts back to the original default level.

5.117 User assignable access 2 function number

Section:	ACCES
Display:	Fn.2 CodE
Range:	0000 to FFFF hex.
Default Value:	0000
Default Access Level	S.CAL
Function number	OC 11

This function allows as second function access change and operates in the same manner as . Enter the function number required and then enter the new access level at the function which follows.

5.118 User assignable access 2 level value

Section:	ACCES
Display:	Fn.2 LEVEL
Range:	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL
Default Value:	dFlt
Default Access Level	S.CAL
Function number	OC41

Allows a new access level for the function with the number set in the function to be chosen. If dFlt is chosen then the level reverts back to the original default level.

5.119 User assignable access 3 function number

Section:	ACCES
Display:	Fn.3 CodE
Range:	0000 to FFFF hex.
Default Value:	0000
Default Access Level	S.CAL
Function number	OC 12

This function allows as third function access change and operates in the same manner as . Enter the function number required and then enter the new access level at the function which follows.

5.120 User assignable access 3 level value

Section:	ACCES
Display:	Fn.3 LEVEL
Range:	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL
Default Value:	dFlt
Default Access Level	S.CAL
Function number	OC42

Allows a new access level for the function with the number set in the function to be chosen. If dFlt is chosen then the level reverts back to the original default level.

5.121 User assignable access 4 function number

Section:	ACCES
Display:	Fn.4 CodE
Range:	0000 to FFFF hex.
Default Value:	0000
Default Access Level	S.CAL
Function number	0C 13

This function allows as fourth function access change and operates in the same manner as . Enter the function number required and then enter the new access level at the function which follows.

5.122 User assignable access 4 level value

Section:	ACCES
Display:	Fn.4 LEVEL
Range:	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL
Default Value:	dFlt
Default Access Level	S.CAL
Function number	0C43

Allows a new access level for the function with the number set in the function to be chosen. If dFlt is chosen then the level reverts back to the original default level.

5.123 Serial operation mode

Section:	SEr1
Display:	OPEr
Range:	nonE, Cont, Poll, A.buS, dISP or ñ.buS
Default Value:	nonE
Default Access Level	4
Function number	4480

Allows selection of the operating mode to be used for serial RS232 or RS485 communications. See the "PM5 Panel Meter Optional Output Addendum" Choices are:

- nonE - no serial comms. required.
- Cont - sends ASCII form of display data at a rate typically 90% of the sample rate.
- Poll - controlled by computer or PLC etc. as host. The host sends command via RS232/485 and instrument responds as requested.
- A.buS - this is a special communications mode used with Windows compatible optional PC download software. Refer to the user manual supplied with this optional software.

- **di SP** - sends image data from the display without conversion to ASCII. This mode should only be used when the serial output is connected to another display from the same manufacturer.
- **Modbus** - Modbus RTU.

5.124 Serial baud rate

Section:	**SEri**
Display:	**bAud**
Range:	**1200**, **2400**, **4800**, **9600**, **19.2**, **38.4**, **57.6**, **115.2**
Default Value:	**9600**
Default Access Level	**4**
Function number	**4484**

Allows the baud rate to be set for serial communications. Choices are:

1200.2400.4800.9600.19200.38400.57600 or **115200**

5.125 Serial parity

Section:	**SEri**
Display:	**Prty**
Range:	**8N**, **8E**, **8O**, **7E**, **7O**
Default Value:	**8N**
Default Access Level	**4**
Function number	**4482**

Allows selection of the parity check. The parity check selected should match that of the device it is being communicated with.

5.126 Serial address

Section:	**SEri**
Display:	**Unit Addr**
Range:	**1** to **127**
Default Value:	**1**
Default Access Level	**4**
Function number	**0430**

Allows selection of the unit address when the operation is set for **POLL** mode. The unit address is offset by 32(DECIMAL) to avoid clashing with ACSII special characters, therefore 42 (DECIMAL) or 2A (HEX) would be unit address 10.

Error Messages

- **CAL FAIL** - Calibration error, this can be seen during conductivity, resistivity or temperature calibration.

  This indicates that the calibration attempt has failed and can be seen at the null calibration or first or second calibration point. This error most usually occurs when there is not enough change in conductivity/resistivity/temperature level between calibration points (if the change is less than 5 percent of the sensor range the error message may be seen). If a null calibration is attempted when the measured conductivity is not close to zero then the same error message will be seen.

  If this message is seen at only one calibration point then try proceed with the second point. If the second point is successful then try the first point again. If the error message is seen at both points then see below.

  For conductivity/resistivity uncalibrate and check the reading with at least one known value solution. If the reading is not close to the known value there is no point in trying to calibrate, check the cell, the cell wiring and settings. If then reading is close to the known value then try calibration again with a higher conductivity or lower resistivity solution and ensure than null calibration was correctly carried out.

  For temperature uncalibrate and check the reading on the display at a know temperature. If the reading is not close to the known temperature there is no point in trying to calibrate, check the temperature sensor resistance, the wiring of the temperature input and settings. If the reading is close try calibration again after checking all temperature settings and ensuring that there is a significant change in temperature between calibration points.

- **-d.or-**- Display overrange. This indicates that the positive value to be displayed has too many digits to be displayed e.g. you cannot display 199999 on a 5 digit display.

- **-d.ur-**- Display underrange. This indicates that the negative value to be displayed has too many digits to be displayed e.g. you cannot display -2999 on a 4 digit display.

- **-or-** - overrange message - This error message is seen if the input signal is above the range of the sensor or the measuring range of the display for that sensor e.g. above 200 degrees C for a temperature display.

- **-ur-** - underrange message - This indicates that the input is below the range expected for that input. e.g. below -40 degrees C for a temperature display.

- **Int FF02** - this message indicates that the power has been cycled on and off too quickly i.e. switched off then on again quickly. The display will normally recover from this on its own and proceed to normal operation.

Note: It is essential in conductivity measurement that the resistance across the cell is always greater than 80Ω. If the resistance is less than this then it may be necessary to use a cell with a higher cell constant. The resistance at any given conductivity level can be found from the formula:

$$Resistance\,(Ohms) = \frac{1}{Conductivity\,/cm} \times K\,factor$$

6 Calibration

6.1 Introduction

A null calibration feature (see NULL) allows the probe to be referenced to the instrument at a zero conductivity level. A null calibration should be undertaken before a single or two point calibration to ensure that the probe and instrument are matched. Before calibrating the instrument it is also important to ensure that the correct cell constant has been chosen. The CAL 1 function together with the NULL function sets the calibration slope, the CAL2 calibration function can used to compensate for head resistance when long cable lengths are used.

When using a temperature probe temperature calibration is carried out with the CAL 1 and CAL2 functions, ensure that the correct temperature probe type has been selected (see tYPE). If a temperature compensation sensor is used it is essential that the temperature input is reading correctly before performing a conductivity calibration. If necessary calibrate the temperature input before the conductivity input.

6.2 Conductivity/Resistivity/ppm Calibration Null

Null calibration allows the cell to be referenced to the meter. The instrument should be nulled as the first calibration point. For resistivity the display should be set to read conductivity and a conductivity null and calibration carried out then the display can be switched back to read resistivity. Calibrating or nulling with the display set to read resistivity is not possible. To null the instrument the following procedure should be followed.

1. If calibration problems have been experienced for either temperature or conductivity then prior to calibration uncalibrate the display using the temperature or conductivity U.CAL function. Uncalibrating the display returns the calibration settings to factory default values and clears any incorrect calibration attempts which may be stored in memory.

2. If a temperature compensation sensor is used check that the temperature reading is correct and calibrate the temperature reading if necessary, see "Temperature Calibration" sections in this chapter. Also check that the SLOPE function is correctly set. If no temperature sensor is being used check that the tYPE is set to NONE and that the dEF °C function is set to the required default temperature.

3. Using pure water clean the cell to be nulled, dry the cell and place in air.

4. Enter the setup functions and step through the functions until the channel to be null is reached e.g. Cd 1. Press F to access the channel setup and then press and release the ▲ pushbutton until NULL is displayed.

5. Press F the display will show the message no. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show a value which should be zero or very close to zero.

6. Press F, the display will show CAL End indicating that the selected channel has been successfully nulled.

6.3 Conductivity/Resistivity/ppm Calibration

After performing the null calibration as previously described place the required probe in a solution of known conductivity or PPM and that the solution is within the measuring range of the cell. For resistivity calibration the display should be set to read conductivity and a conductivity calibration carried out then the display can be switched back to read resistivity. Calibrating with the display set to read resistivity is not possible.

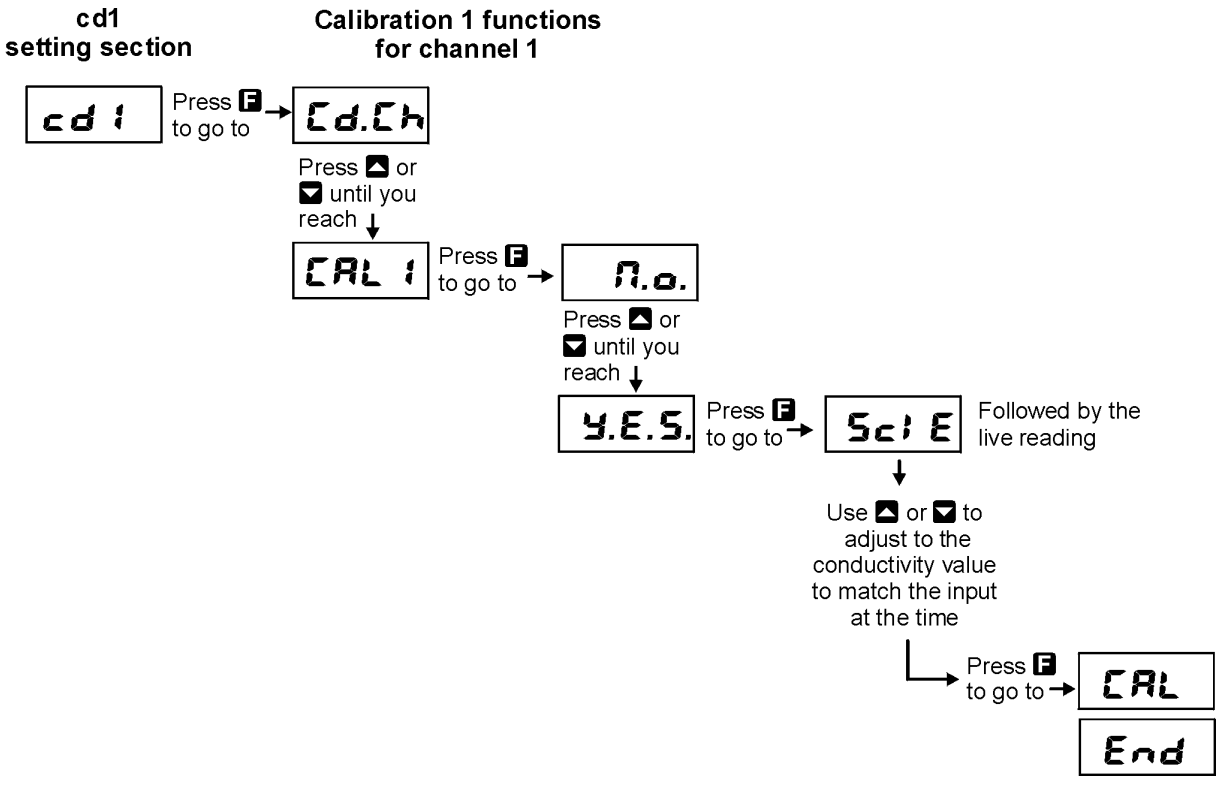
Follow the procedure below.

First calibration point

1. Enter the setup functions and step through the functions until the channel to be calibrated is reached e.g. **Cd 1**. Press **F** to access the channel setup and then press and release the ▲ pushbutton until **CAL 1** is displayed.
2. Press **F** the display will show the message **no**. Use the ▲ or ▼ pushbutton to toggle this to **YES** then press **F** to accept this. The display will show the **CAL 1** followed by a value which should be close to the value of the calibration solution. Allow the reading to stabilise (typically 20 – 30 seconds).
3. Press and release **F**, the display will show the message (channel number e.g. **Cd 1**) followed by **CAL 1 Sc1 E** followed by a value.
4. Use the ▲ or ▼ pushbutton to adjust the displayed value to that of the calibration solution then press **F** to accept the new calibration scaling.
5. Press and release **F**, the display will show **CAL End** to indicate that the calibration scaling has been accepted..

Channel 1 calibration point 1 flow chart

Note: The cell must be placed in a known conductivity solution and the conductivity reading and temperature reading allowed to stabilise prior to following these steps.

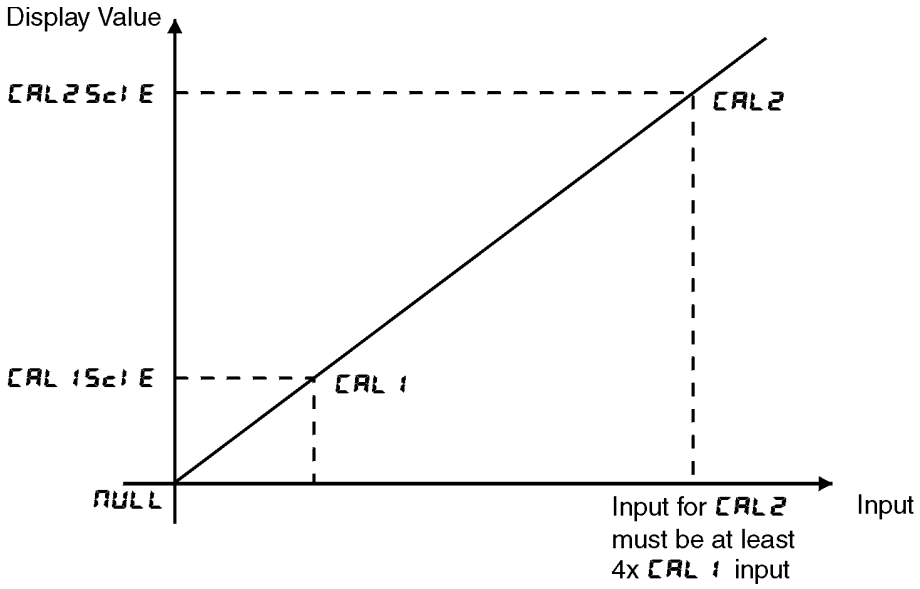


Second calibration point

If required a second point, CAL 2 may now be undertaken. The second calibration point is normally used only to compensate for head resistance when long cell cables are used or to improve linearity when measuring over a wide conductivity range. In many installations the second point is not required. If the second point is required follow the sequence below.

1. Clean the probe in pure water then insert into a second solution of known conductivity/resistivity/ppm (the second solution must be at least 2.5x higher (or 10x lower for resistivity or 2.5x ppm higher) in value from the first solution, see note below if it is not possible to have a 2.5x difference (or 10x difference for resistivity or 2.5x ppm) in the process you are using).
2. At the CAL 2 function press F then use the ▲ or ▼ pushbutton to select YES and press F. The display will show the the live conductivity reading from the cell. Allow time for this reading to stabilise (typically 20 – 30 seconds).
3. Press and release F, the display will show a value with cd 1 (orcd2 if cell 2 is being calibrated) CAL 2 Sc1 E flashing every few seconds.
4. Adjust the value displayed to the known solution value using the ▲ and ▼ pushbuttons.
5. Press and release F, the display will show CAL End to indicate that the second calibration point has been accepted.

Note: If the range you are using does not allow for a 2.5x difference (or 10x difference for resistivity or 2.5x ppm) between CAL 1 and CAL 2 then you should use the Null Calibration and CAL 1 only. The solution used for CAL 1 should be as close as possible to the highest value you will be using.



6.4 Conductivity/Resistivity/ppm Uncalibration

This function sets the instrument calibration back to the factory calibrated value. Uncalibration is used as a reset when an error exists due to incorrect calibration. The uncalibration procedure is as follows:

1. Enter the setup functions and step through the functions until the channel to be calibrated is reached e.g. Cd 1. Press F to access the channel setup and then press and release the ▲ pushbutton until U.CAL is displayed.

2. Press F the display will show the message no. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show the message UCAL End to indicate that the uncalibration is complete.

6.5 Temperature Calibration

A two point calibration is provided for temperature sensors. The two point calibration requires that the sensor is allowed to stabilise at two known temperatures. Ideally the temperatures chosen should span the normal temperature measurement range of the process being measured. A minimum difference of 25 degrees C between temperature calibration points is recommended.

The calibration procedure is as follows:

First calibration point

1. Place the sensor to be calibrated at a known low temperature and allow 5 minutes to stabilise.

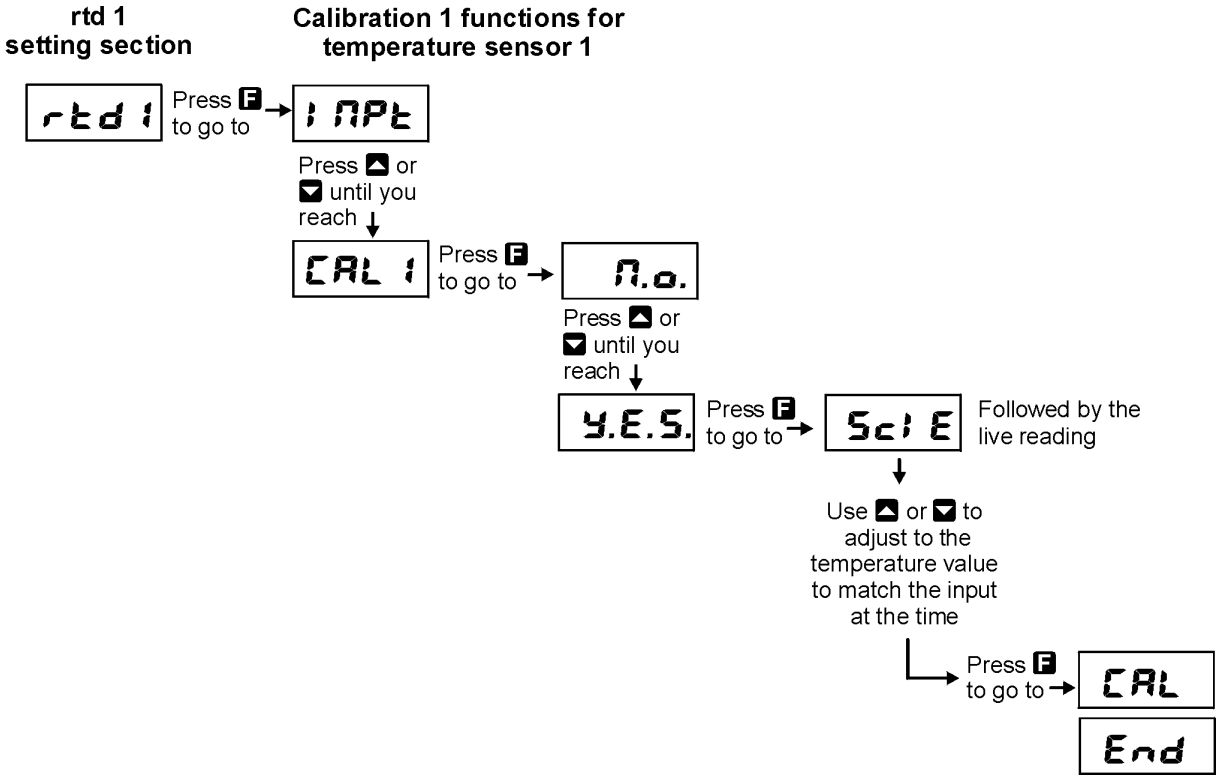
2. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. rtd 1. Press F to access the channel setup and then press and release the ▲ pushbutton until CAL 1 is displayed.

3. Press F the display will show the message no. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show the temperature. When the temperature is stable press F.

4. The display will show the message Sc1 E followed by a value. Use the ▲ or ▼ pushbuttons to adjust the value to the known low temperature value. Then press F to accept this.

5. The display will show the message CAL End to indicate that the first calibration point has been accepted.

Channel 1 temperature calibration point 1 flow chart



Second calibration point

1. Once the first calibration point has been completed place the sensor in a second temperature environment and allow 5 minutes for the temperature to stabilise.

2. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. rtd 1. Press F to access the channel setup and then press and release the ▲ pushbutton until is displayed.

3. Press F the display will show the message no. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show the temperature. When the temperature is stable press F.

4. The display will show the message Sc1 E followed by a value. Use the ▲ or ▼ pushbuttons to adjust the value to the known low temperature value. Then press F to accept this.

5. The display will show the message CAL End to indicate that the second calibration point has been accepted.

6.6 Temperature Uncalibration

This function sets the instrument calibration back to the factory calibrated value. Uncalibration is used as a reset when an error exists due to incorrect calibration. The uncalibration procedure is as follows:

1. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. rtd 1. Press F to access the channel setup and then press and release the ▲ pushbutton until is displayed.

2. Press F the display will show the message No. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show the message UCAL End to indicate that the uncalibration is complete.

6.7 Standard ppm conversion factors

The PPMFACt (ppm factor) function value is used with the input from the cell to calculate the ppm value of the solution concerned. The displayed ppm figure is calculated from:

$$ppm = conductivity\,(uS/cm) \times PPmFACt$$

The factor will vary with the composition and concentration of the solution being measured. Suggested ppm factors for four standard solutions are given below. The suggested factors are based on conductivities of approx. 14,000 uS/cm at 25°C. For example the default setting for the instrument is 0.560 which is a figure used for NaCl (sodium chloride solution or salt water).

Standard solution	**Use**	**Suggested PPMFACt value**
NaCl	Salt water and dairy products	0.560
442 (40% sodium sulphate, 40% sodium bicarbonate, 20% sodium chloride)	General fresh water e.g. rivers, lakes and reverse osmosis water	0.860
KCL	Can be used in applications a NaCl standard is used but is normally used as a conductivity standard rather than ppm standard	0.580
CaCO3	Boiler and cooling tower water	0.480

7 Setting up the relay PI controller

The Relay Proportional + Integral Controller can be made to operate in either pulse width control or frequency control mode via the function. The best results are usually achieved by initially configuring as a "Proportional Only" controller and then introducing the Integral functions when stable results are obtained.

The function allows three choices of operating mode for the chosen relay, namely Hi .Lo, ctrl or FrEq. If Hi .Lo is selected the chosen relay will operate as a setpoint relay whose operation is controlled by the , etc. settings and the PI control settings will not be seen.

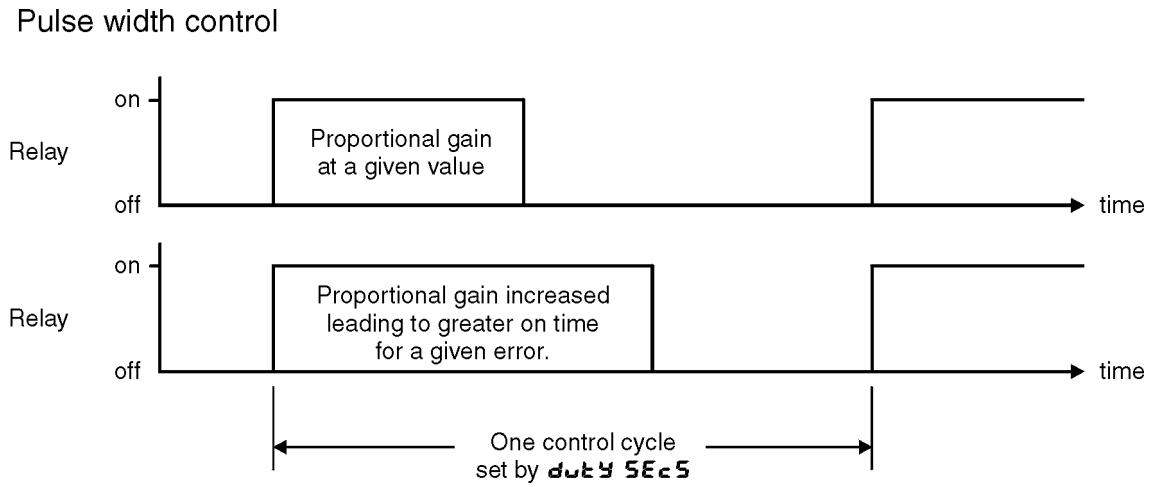
If ctrl is selected then the chosen relay will operate in pulse width control mode. If FrEq is selected then the chosen relay will operate in frequency control mode.

Pulse width control - operates by controlling the on to off time ratio of the relay. In a typical application this would be used to control the length of time for which a dosing pump is switched on during a control cycle i.e. the pump or other device will continuously operate for the length of time the relay is activated and will stop operating when the relay is de-activated.

Frequency control - operates by changing the rate at which the relay switches on and off. In a typical control application the frequency control operation is particularly suited for use when one shot dosing is used i.e. the pump or other device puts out a fixed dosing quantity for every pulse received.

7.1 Relay pulse width modulation control mode

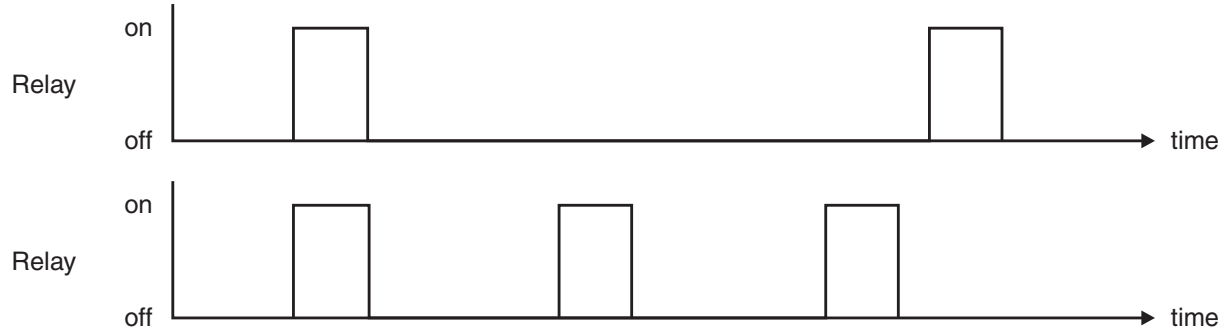
To use pulse width modulation control ctrl must be selected at the function.



7.2 Relay frequency modulation control mode

To use frequency PI control FrEq must be selected at the OPEr function. In frequency modulation mode the relay on time is fixed, see function on SECS. The duty cycle time can also be set. The control program will vary the actual off time to suit the error seen between the setpoint and the measured temperature at the time. For example if extra dosing is needed to reach the setpoint then the off time will be reduced resulting in more on pulses per period of time i.e. the frequency of the pulses is controlled to allow the setpoint to be maintained.

Frequency control - pulse frequency varies according to settings and control requirement



PI control functions and setup procedure

7.3 Alarm relay operating mode

Section:	AL *x*
Display:	OPEr
Range:	Hi.Lo, ctrl or FrEq
Default Value:	Hi.Lo
Default Access Level	4
Function number	4160 to 4166

Sets the operating mode for the selected relay; Choices are:

- Hi.Lo will cause the relay to operate in on/off mode using the setting in the and functions.
- ctrl will cause the relay to operate in pulse width PI control output mode.
- FrEq will cause the relay to operate in frequency PI control output mode.

7.4 Relay PI control span

Section:	AL *x*
Display:	SPAn
Range:	Any display value
Default Value:	100
Default Access Level	4
Function number	4290 to 4296

The function of the control span is to define the limit to which the PI control values will relate. The control span value will be common to all control relays i.e. if more than one control relay output is being used then each of these relays operates from the same control span setting. The span value defines the range over which the input must change to cause a 100% change in the control output when the proportional gain is set to 1.000. This function affects the overall gain of the controller and is normally set to the process value limits that the controller requires for normal operation. For example if the control setpoint () is 70 and the is 20 and is set to 1.000 then an error of 20 from the setpoint will cause a 100% change in proportional control output. For example with at 70, at 20, at 1.000 and at 0.0 a display reading of 50 or lower (minus) the control output will be at 100% i.e. the relay will be on continuously. The control output will then gradually adjust the on/off time as the display value reaches the setpoint.

7.5 Relay PI control setpoint

Section:	**RL** *x*
Display:	**SEtP**
Range:	Any display value
Default Value:	**1000**
Default Access Level	**4**
Function number	**4200** to **4206**

The control setpoint is set to the value in measurement units required for the control process. The controller will attempt to vary the control output to keep the process variable at the setpoint.

7.6 Relay PI control proportional gain value

Section:	**RL** *x*
Display:	**P.9**
Range:	**-32.768** to **32.767**
Default Value:	**0.0 10**
Default Access Level	**4**
Function number	**42 10** to **42 16**

The proportional value will determine the degree to which the controller will respond when there is a difference (error) between the measured value and the process control setpoint. If the proportional gain is increased then for a given error the relay on time will be increased (or decreased if the error is on the other side of the setpoint). The proportional gain action can be reversed by setting a negative gain i.e. with a negative gain the on time will reduce as the error increases. With a proportional gain of 1.000 and an error of 10 or more (with control span set at 10) the controller will increase the frequency by 100% if possible. With a proportional gain of 0.500 an error of 10 or more (with control span set at 10) will cause the controller to increase the frequency by 50%, if possible. Too much proportional gain will result in instability due to excessive overshoot of the setpoint. Too little proportional gain will lead to a slow response.

This table shows the effect on the pulse width on changing proportional gain and bias with the following settings: = 2.0, duty secs = 1.0, i.9 = 0.000			
	P.9	bi AS	**Effect on relay operation**
7.0	1.000	0.0	Reading of 5.0 or below - relay permanently on. Reading of 5.0 to 7.0 - relay pulses with off time increasing as value approaches 7.0. Reading 7.0 or above - relay permanently off.
7.0	1.000	100.0	Reading of 7.0 or below - relay permanently on. Reading of 7.0 to 9.0 - relay pulses with off time increasing as value approaches 9.0. Reading 9.0 or above - relay permanently off.
7.0	1.000	50.0	Reading of 6.0 or below - relay permanently on. Reading of 6.0 to 7.0 - relay pulses with off time increasing as value approaches 7.0. Reading 7.0 - relay pulses at 50% on and 50% off. Reading 7.0 to 8.0 - relay pulses with off time increasing as value approaches 8.0. Reading 8.0 or above - relay permanently off.
7.0	0.500	50.0	Reading 5.0 or below - relay permanently on. Reading 5.0 to 7.0 - relay pulses with off time increasing as value approaches 7.0. Reading 7.0 - relay pulses at 50% on and 50% off. Reading 7.0 to 9.0 - relay pulses with off time increasing as value approaches 9.0. Reading 9.0 or above - relay permanently off.
7.0	- 1.000	50.0	Reading of 6.0 or below - relay permanently off. Reading of 6.0 to 7.0 - relay pulses with on time increasing as value approaches 7.0. Reading 7.0 - relay pulses 50% on and 50% off. Reading 7.0 to 8.0 - relay pulses with on time increasing as value approaches 8.0. Reading 8.0 or above - relay permanently on.

7.7 Relay PI control integral gain value

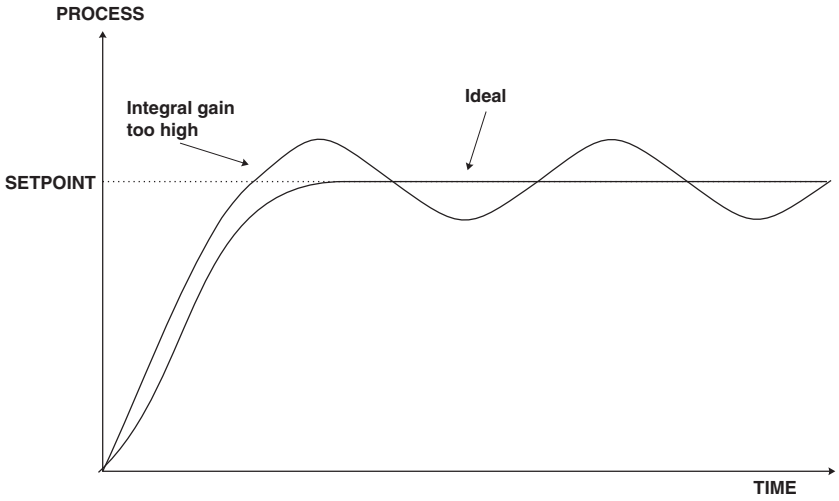
Section:	AL x
Display:	I .9
Range:	-32.768 to 32.767
Default Value:	0.000
Default Access Level	4
Function number	4220 to 4226

Note: the range value may be restricted if the number of display digits does not allow viewing of the full range.

The Integral action will attempt to correct for any offset which the proportional control action is unable to correct (e.g. errors caused by changes in the process load). When the integral gain is correctly adjusted the control output is varied to maintain control by keeping the process variable at the same value as the control setpoint. Since the integral gain is time based the output will gradually increase if the error does not decrease i.e. if the measured value remains constant and there is an error (a difference between the measured value and the setpoint) then the frequency will be increased compared to the previous frequency output. The higher the proportional gain, the greater the degree by which the on to off ratio will be affected i.e. the response will be greater at higher integral gain settings. With an integral gain of 1.000 an error of 1.0 or more with control span set at 1.0 will cause the integral action to try to correct at the rate of 100% minute. With an integral gain of 0.200 an error of 1.0 or more will cause the integral action to try to correct at the rate of 20% per minute. Too high an integral gain will result in instability. To low an integral gain will slow down the time taken to reach the setpoint. The optimum setting will depend on the lag time of the process and the other control settings. Start with a low figure (e.g. 0.200) and increase until a satisfactory response time is reached. The integral gain figure has units of gain/minute. The integral action can be reversed by setting a negative gain figure, note that the sign of the integral gain must match the sign of the proportional gain. The integral control output follows the formula:

$$Integral\,control\,output = \frac{error \times Ig \times time\,(seconds)}{60} + previous\,integral\,control\,output$$

Where Ig is the integral gain set via the function.



7.8 Relay PI control integral high limit value

Section:	**RL** x
Display:	**I .H**
Range:	**0.0** to **100.0**
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4220** to **4246**

The maximum limit can be used to reduce overshoot of the control setpoint when the control output is increasing i.e. rising above the setpoint. Other than this the limit operates in the same manner as the low limit described in the following function.

7.9 Relay PI control integral low limit value

Section:	**RL** x
Display:	**I .L**
Range:	**0.0** to **100.0**
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4220** to **4246**

The low limit can be used to reduce overshoot of the control setpoint when the control output is being reduced i.e. falling below the setpoint. The low limit reduces the available output swing by a percentage of the maximum output. Without a limit the integral output can be very large at the time the setpoint is reached and a large overshoot of the will then result. Settings available are from 0.0 to 100.0 (%). If the limit setting is too high then overshoot will result. If the setting is too low then the integral output can be limited to such an extent that the setpoint cannot be maintained. Start with a low value such as 20.0 and increase or decrease the value until a satisfactory result is obtained.

The advantage of using separate low and high limits is that in many applications the response is very one directional e.g. the system may respond very quickly to a heat input but may cool down at a much slower rate. Separate high and low limit settings allow independent limiting of the integral control swing below and above the setpoint so a smaller minimum limit can be set to limit swings below the setpoint to compensate for the slower cooling time. The minimum and maximum limits are used in conjunction with the output bias setting to maintain the control process setpoint value. For example with a **bI AS** set at 50%, minimum limit set at 20% and a maximum limit of 30% the actual bias when the process is at the setpoint may be anywhere between 30% and 80% i.e. Integral control is being used to alter the bias setting in order to maintain the process at the setpoint. In this case the minimum term will allow the bias to drop to a value between 50% and 30% in order to maintain the setpoint. The maximum term will allow the bias point to rise to a value between 50% and 80% in order to maintain the setpoint.

7.10 Relay PI control bias

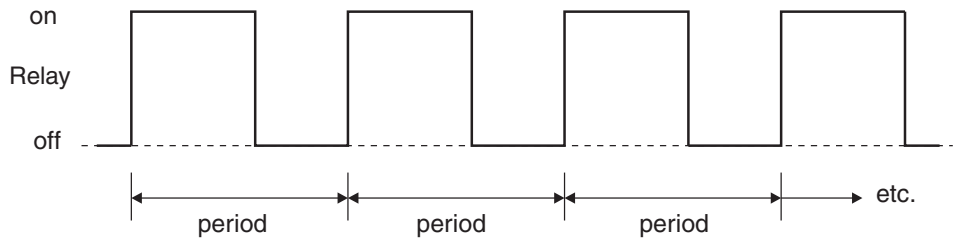
Section:	**AL** x
Display:	**b, AS**
Range:	**0.0** to **100.0**
Default Value:	**50.0**
Default Access Level	**4**
Function number	**4260** to **4266**

The control bias sets the ideal steady state output required once the setpoint is reached. Settings are in % from 0.0 to 100.0. When set at 0.0 the relay will be de-activated for the entire control period when the measured input is at the setpoint (depending on proportional and integral gain settings). If set at 50.0 then the relay operation frequency will on for 50% and off for 50% of the duty cycle time when the measured input is at the setpoint. If set at 100.0 then the relay will activated for the whole time whilst the measured input is at the setpoint.

7.11 Relay PI control duty cycle

Section:	**AL** x
Display:	**duty SECS**
Range:	**0.0** to **5000.0**
Default Value:	**0.0**
Default Access Level	**4**
Function number	**4270** to **4276**

Displays and sets the control duty cycle (period) from **0.0** to **5000.0** seconds. The control period sets the total time for each on/off cycle. This time should be set as long as possible to reduce wear of the control relay and the controlling device.



7.12 Relay PI frequency control "on" time

Section:	**AL** x
Display:	**on SECS**
Range:	**0.0** to **5000.0**
Default Value:	**0.0**
Default Access Level	**4**
Function number	**4280** to **4286**

Displays and sets the control pulse width ("on" time) from **0.0** to **5000.0** seconds. If set to 0.0 the relay will be disabled. The duration should be long enough to ensure that the device being

controlled receives an acceptable on pulse.

7.13 Setting up the PI pulse width controller

Settings in the procedure below are intended as a basic guide to setting up the controller where there required settings are not known.

1. Set the function to **ctrl** .
2. Set the control setpoint to the required setting.
3. Set the control span to the required setting.
4. Set the proportional gain to an arbitrary value e.g. **0.500**.
5. Set the integral gain to **0.000** (i.e. off).
6. Set the low and high integral and limits to an arbitrary value e.g. **20.00**.
7. Set the bias to **50.0**.
8. Set the cycle period to **20** seconds.

Initialise the control system and monitor the control results. If the original settings causes process oscillations then gradually decrease the proportional gain until the oscillations decrease to an acceptable steady cycle. If the original settings do not cause process oscillations then gradually increase the proportional gain until a steady process cycling is observed.

Once the steady cycling state is achieved note the difference between the display value and the control setpoint value. Gradually increase or decrease the bias value until the displayed value matches (or cycles about) the control setpoint value.

Gradually increase the integral gain until the process begins to oscillate. Then reduce the integral gain slightly to regain the control without this added oscillation.

Create a step change to the process conditions and observe the control results. It may be necessary to fine tune the settings and use integral limits to obtain optimum results.

Set up sequence	**Symptom**	**Solution**
Proportional gain	Slow response	Increase proportional gain
Proportional gain	High overshoot or oscillation	Decrease proportional gain
Proportional bias	Process above or below setpoint	Increase or decrease bias as required
Integral gain	Slow response	Increase integral gain
Integral gain	Instability or oscillations	Decrease integral gain

This table shows the effect on the output frequency on changing proportional gain and bias with the following settings: = 2.0, = 1.0, = 0.000			
			Effect on relay operation
7.0	1.000	0.0	Reading of 5.0 or below - relay pulses at maximum frequency. Reading of 5.0 to 7.0 - relay pulses with frequency decreasing as value approaches 7.0. Reading 7.0 or above - relay permanently off.
7.0	1.000	100.0	Reading of 7.0 or below - relay pulses at maximum frequency. Reading of 7.0 to 9.0 - relay pulses with frequency decreasing as value approaches 9.0. Reading 9.0 or above - relay permanently off.
7.0	1.000	50.0	Reading of 6.0 or below - relay pulses at maximum frequency. Reading of 6.0 to 8.0 - relay pulses with frequency decreasing as value approaches 8.0. (period increased by 50% at 7.0 compared to minimum period e.g. if minimum period is 4 seconds the period at 7.0 will be 6 seconds) Reading 8.0 or above - relay permanently off.
7.0	0.500	50.0	Reading 5.0 or below - relay pulses at maximum frequency. Reading 5.0 to 9.0 - relay pulses with frequency decreasing as value approaches 9.0. (period increased by 50% at 7.0 compared to minimum period e.g. if minimum period is 4 seconds the period at 7.0 will be 6 seconds) Reading 9.0 or above - relay permanently off.
7.0	- 1.000	50.0	Reading of 6.0 or below - relay permanently off. Reading of 6.0 to 8.0 - relay pulses with frequency decreasing as value approaches 8.0. (period increased by 50% at 7.0 compared to minimum period e.g. if minimum period is 4 seconds the period at 7.0 will be 6 seconds) Reading 8.0 or above - relay pulses at maximum frequency.

7.14 Setting up the PI frequency controller

Settings in the procedure below are intended as a basic guide to setting up the controller where there required settings are not known.

1. Set the function to FREQ.
2. Set the control setpoint to the required setting.
3. Set the control span to the required setting.
4. Set the proportional gain to an arbitrary value e.g. 0.500.
5. Set the integral gain to 0.000 (i.e. off).
6. Set the low and high integral and limits to an arbitrary value e.g. 20.00.

7. Set the bias to **50.0**.
8. Set the cycle period to **20** seconds.
9. Set the relay on time to an arbitrary value e.g. **1.0**

Initialise the control system and monitor the control results. If the original settings causes process oscillations then gradually decrease the proportional gain until the oscillations decrease to an acceptable steady cycle. If the original settings do not cause process oscillations then gradually increase the proportional gain until a steady process cycling is observed.

Once the steady cycling state is achieved note the difference between the display value and the control setpoint value. Gradually increase or decrease the bias value until the displayed value matches (or cycles about) the control setpoint value.

Gradually increase the integral gain until the process begins to oscillate. Then reduce the integral gain slightly to regain the control without this added oscillation.

Create a step change to the process conditions and observe the control results. It may be necessary to fine tune the settings and use integral limits to obtain optimum results.

Set up sequence	**Symptom**	**Solution**
Proportional gain	Slow response	Increase proportional gain
Proportional gain	High overshoot or oscillation	Decrease proportional gain
Proportional bias	Process above or below setpoint	Increase or decrease bias as required
Integral gain	Slow response	Increase integral gain
Integral gain	Instability or oscillations	Decrease integral gain

8 Specifications

8.1 Technical Specifications

Input:	One or two conductivity cells (K=0.01, 0.05, 0.1, 0.5, 1.0, 2.0, 5.0, 10, 20, 50 or 100) or toroidal conductivity cells
Temperature Input:	1 x 3 wire or 2 x 2 wire 100Ω RTD or 1000Ω RTD or 100Ω NTC thermistors (100D–5 type) or manually set
Measuring Range:	(K = 0.01) 0 to 125uS/cm (K = 0.1) 0 to 1250uS/cm (K = 1.0) 10 to 12,500uS/cm (K = 10.0) 100 to 125,000uS/cm Selectable measuring units uS/cm, uS/m, mS/cm, mS/m, MΩ and PPM Temperature: -40 to 200^{o}C (automatic) or -40 to 150^{o}C (manually set)
Accuracy:	Better than 1% of full scale
Sample Rate:	1 per sec for single channel. 1 sample every 5 seconds for dual channel
Ambient Temperature:	LED -10 to 60^{o}C, LCD -10 to 50^{o}C
Humidity:	5 to 95% non condensing
Display:	LED Models 4 digit 20mm, 5 digit 14.2mm + status LEDs + 4 way keypad. 6 digit 14.2mm + 4 way keypad. LED Bar Graph 20 segment bar + 5 digit 7.6mm LED plus relay status LEDs LCD and 4 digit LED displays are available for computer or remote keypad only setup and calibration
Power Supply:	AC 240V, 110V, 48V, 32V or 24V 50/60Hz or DC isolated wide range 12 to 48V. Note: supply type is factory configured
Power Consumption:	AC supply 4 VA max, DC supply typically 160mA at 12V, 80mA at 24V (basic model with no output options)
Output (standard):	1 x relay, Form A rated 5A at 240VAC resistive load
Relay Action:	Programmable N.O. or N.C. On/off alarm/control or PI control (pulse width or frequency)

8.2 Output Options

Extra Relays:	1, 2, or 3 extra relays (form A, 3A @ 240VAC) First extra relay configurable for alarm or PI control 6 extra relays (form A, 2A @ 240VAC) 5 extra relays (form A, 2A @ 240VAC) available only with serial retransmission
Analog Retransmission:	Isolated 12 bit 4-20mA output only single or dual channel or 16 bit single or dual channel 4-20mA, 0 to 1V or 0 to 10V analog output options 4 to 20mA output can drive into 800Ω load maximum Analog output 1 can be set for PI control, linear or logarithmic Analog output 2 can be set for linear or logarithmic output
Serial Communications:	RS232 or RS485 or Ethernet
Digital output:	16 bit NPN or PNP (factory configured) binary of BCD

Output options are available in certain combinations e.g. Analog output plus extra relay, contact supplier for details.

8.3 Physical Characteristics

Bezel Size:	DIN 48mm x 96mm x 10mm Case Size: 44mm x 91mm x 120mm behind face of panel
Panel Cut Out:	45mm x 92mm +1mm and -0mm
Connections:	Plug in screw terminals (max 1.5mm wire)
Weight:	400 gms Basic model, 450 gms with option card

9 Guarantee and service

The product supplied with this manual is guaranteed against faulty workmanship for a period of two years from the date of dispatch.

Our obligation assumed under this guarantee is limited to the replacement of parts which, by our examination, are proved to be defective and have not been misused, carelessly handled, defaced or damaged due to incorrect installation. This guarantee is VOID where the unit has been opened, tampered with or if repairs have been made or attempted by anyone except an authorised representative of the manufacturing company.

Products for attention under guarantee (unless otherwise agreed) must be returned to the manufacturer freight paid and, if accepted for free repair, will be returned to the customers address in Australia free of charge.

When returning the product for service or repair a full description of the fault and the mode of operation used when the product failed must be given. In any event the manufacturer has no other obligation or liability beyond replacement or repair of this product.

Modifications may be made to any existing or future models of the unit as it may deem necessary without incurring any obligation to incorporate such modifications in units previously sold or to which this guarantee may relate.

This product is designed and manufactured in Australia.