

**Model PM4-CO**  
**Conductivity/Resistivity/ppm**  
**DIN Rail Mount Display/Controller**  
**Operation and Instruction Manual**

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# 1 Introduction

This manual contains information for the installation and operation of the PM4 Conductivity /Resistivity/ppm Monitor. The PM4-CO is a general purpose auto ranging monitor which may be configured to accept an input from a range of conductivity cells with cell constants ranging from K=0.01 to K=100. Ranges and typical cell 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°C	0 – 12,500 @ 25°C	0 – 0.125 @ 25°C	0 – 12.5 @ 25°C
K=0.1	0 – 1,250 @ 25°C	0 – 125,000 @ 25°C	0 – 1.25 @ 25°C	0 – 125 @ 25°C
K=1.0	10 – 12,500 @ 25°C	–	0.01 – 12.5 @ 25°C	1 – 1,250 @ 25°C
K=2.0	20 – 25,000 @ 25°C	–	0.02 – 25 @ 25°C	2 – 2,500 @ 25°C
K=10.0	100 – 125,000 @ 25°C	–	0.1 – 125 @ 25°C	10 – 12,500 @ 25°C
K=20.0	200 – 250,000 @ 25°C	–	0.2 – 250 @ 25°C	20 – 25,000 @ 25°C

A second input is provided for a temperature sensor for automatic temperature compensation. The PM4 can accept 100Ω RTD, 1000Ω RTD, LM335 or 100Ω thermistor or UU25J1 thermistor type temperature sensors. The default display can be set to either resistivity, conductivity, ppm or % by weight of Sodium Chloride. The display will toggle between temperature/conductivity or temperature/resistivity or temperature/ppm or temperature/%NaCl 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.

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. A special “blowdown” relay operation is available for units fitted with 2 relays.

Unless otherwise specified at the time of order, your PM4 has been factory set to a standard configuration. Like all other PM4 series instruments the configuration and calibration are easily changed by the user. Initial changes may require dismantling the instrument to alter PCB links, other changes are made by push button functions.

Full electrical isolation between power supply, conductivity/resistivity cell and retransmission output is provided by the PM4, thereby eliminating grounding and common voltage problems. This isolation feature makes the PM4 ideal for interfacing to computers, PLCs and other data acquisition devices. The single analog output option allows the choice of temperature or main display (conductivity or resistivity, %NaCl or PPM) output. The dual analog option allows both temperature and main display to be retransmitted. Analog outputs can be set for linear or logarithmic (up to 5 decades) output. Analog output 1 can alternatively be set for PI control operation.

The PM4 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 Output options

- 1, 3 or 6 extra relays (first optional relay can be set for simple on/off alarm/control or PI control using pulse width or frequency control)
- Isolated analog retransmission (single or dual analog outputs) configurable for 4–20mA, 0–1V or 0–10V. Analog retransmission can be set for linear operation or logarithmic operation using 1 to 5 decades. The first analog output is configurable for retransmission or PI control
- Isolated RS485 or RS232 serial communications (ASCII)
- Isolated Digital output - binary or BCD up to 16 bit, NPN or PNP output types available
- Optional outputs are available in certain combinations e.g. Extra relay plus RS232

## 1.2 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  $80\Omega$  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  $25^{\circ}\text{C}$ . 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  $25^{\circ}\text{C}$ . If  $25^{\circ}\text{C}$  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 **SOL °C** function.

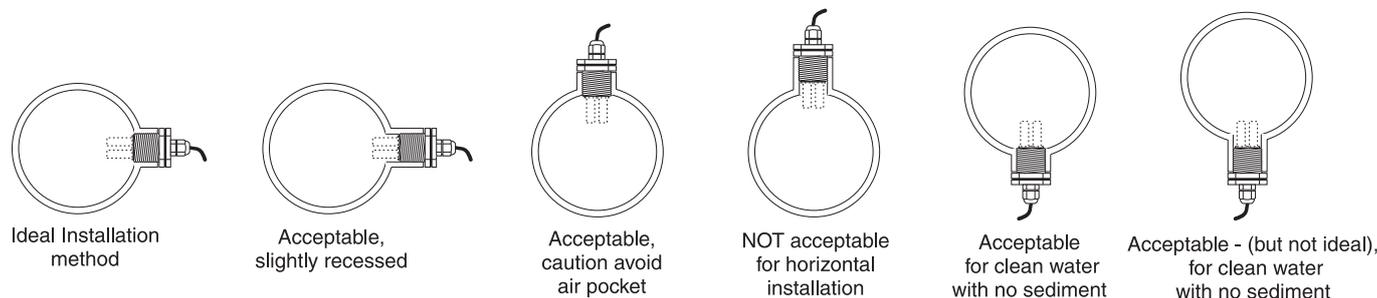
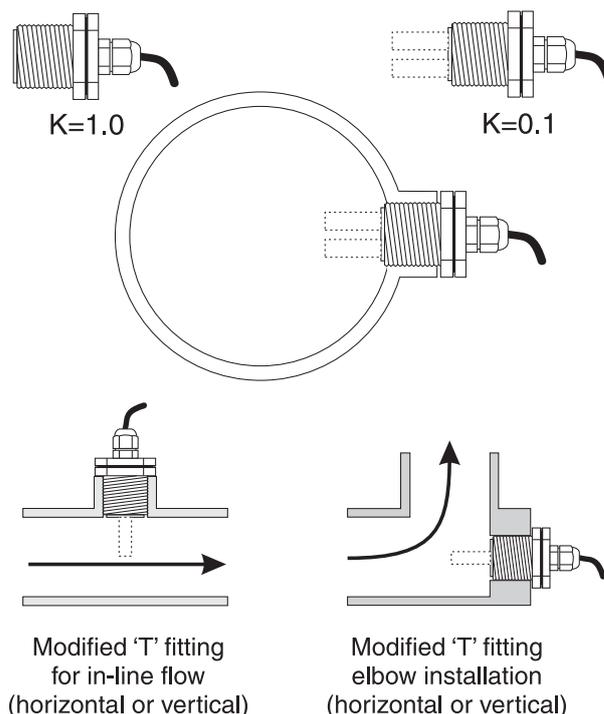
This instrument allows for either manual or automatic temperature compensation. If no temperature sensor is used with the cell then the known temperature of the solution can be entered at the **DEF °C** function. If a temperature sensor is used the the reading obtained from this sensor can

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%/°C.

### 1.3 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, TBTH and TBTHHT 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. Alternatively the cell may be installed across the flow (not suitable for TBLR type cells or K=10.0 TBTH cells). This will provide a stable and accurate measurement, but the response time will be slower. In most applications this will not present a problem. 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.

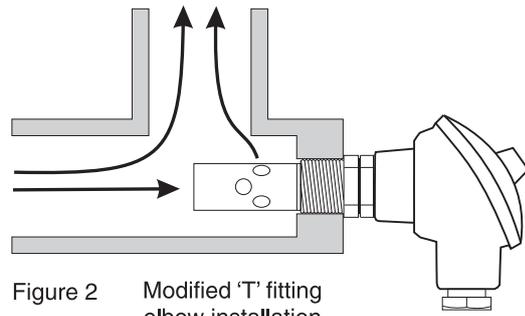


Figure 2 Modified 'T' fitting elbow installation (horizontal or vertical)

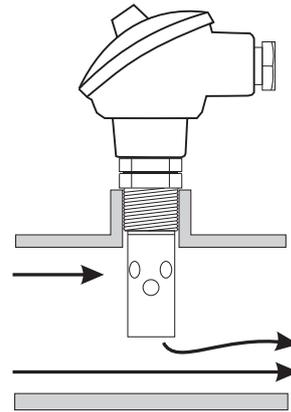
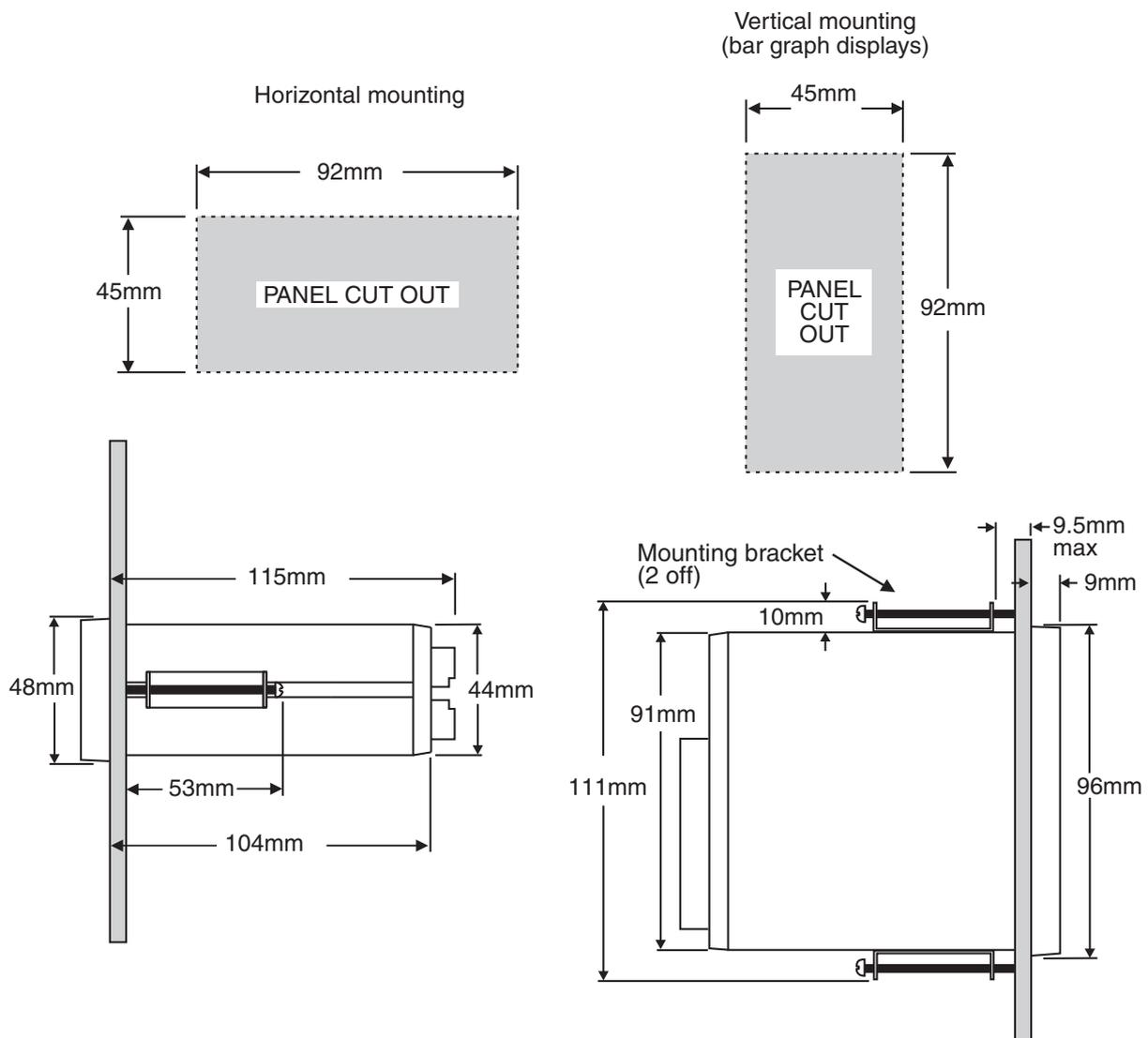


Figure 3 Modified 'T' fitting for in-line flow (horizontal or vertical). TBTH cells only, not suitable for TBLR cells.

## 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 IP65 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

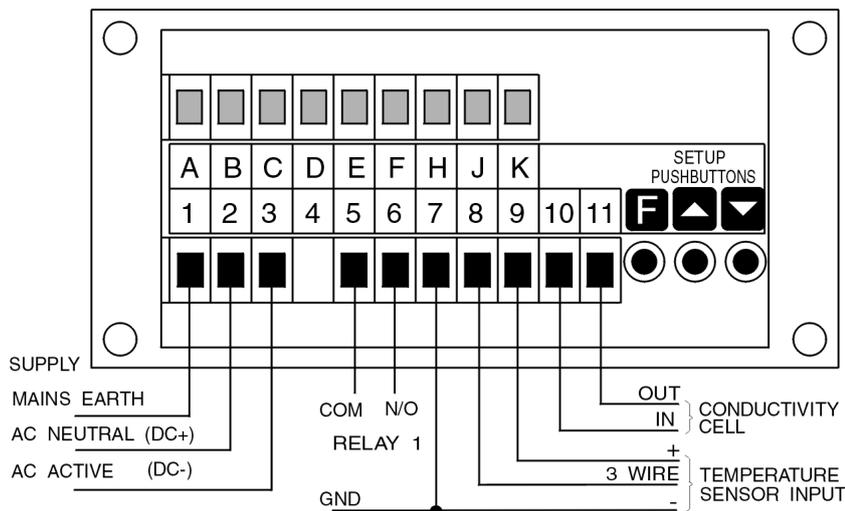
## 3.1 Electrical installation

The PM4 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<sup>2</sup> 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 “PM4 Panel Meter Optional Output Addendum” booklet supplied when options are fitted.



### Instrument label (example)

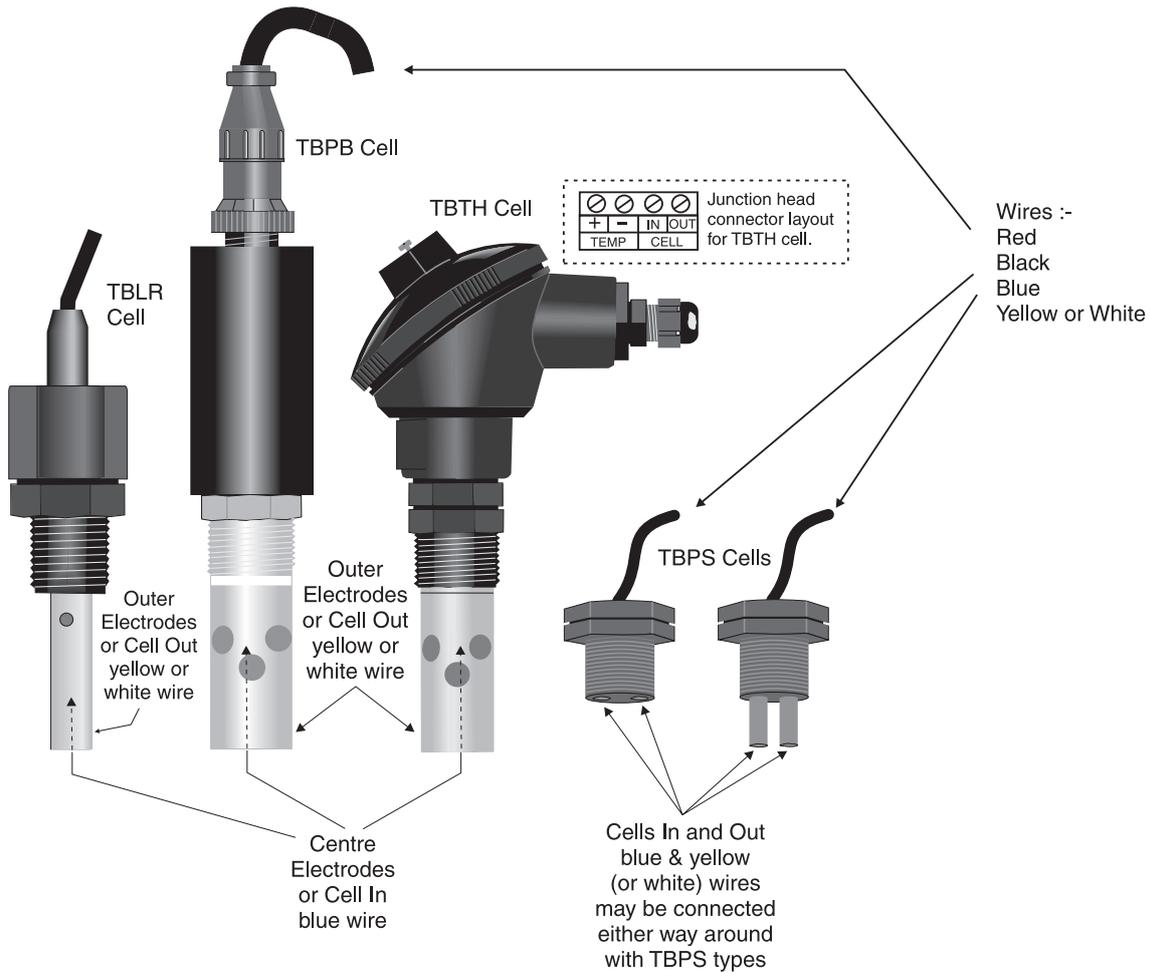
 <b>N1440</b>	
1	MAINS EARTH
2	240 VAC NEUTRAL
3	240 VAC ACTIVE
5	RELAY 1 COM
6	RELAY 1 N/O
7	RTD GROUND
8	RTD 3RD WIRE
9	RTD +VE
10	CONDUCTIVITY IN
11	CELL OUT
PM4-C0-240-5E	SERIAL No : XXXXX-XXX

### 3.2 Electrical connection examples

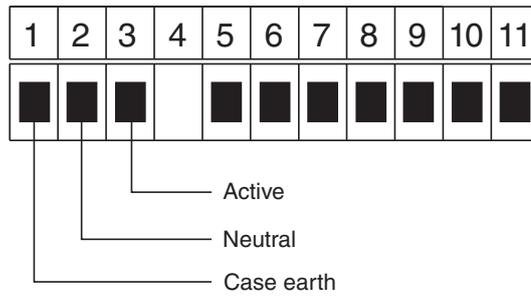
If output options are fitted refer to the "PM4 Panel Meter Optional Output Addendum" booklet for connection details.

**Conductivity/Resistivity/ppm Cells** - The cell is connected to pins 10 and 11 at the rear of the instrument. Terminal 10 is the input connection i.e. the current input from the cell. Terminal 11 is the output connection. If using a centre core type cell the centre core wire should be connected to Terminal 10. Ensure that the **PTBE/RS5t** 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.

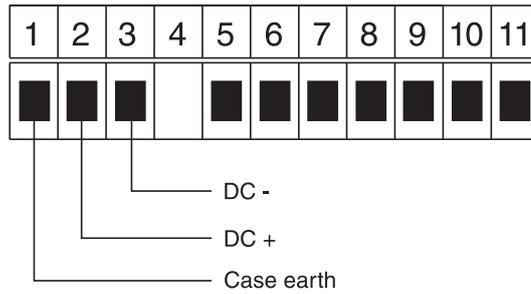
Cell wiring colour codes			
	Terminal	AIC cells	SDI cells
Cell in	10	Blue	Black
Cell out	11	Yellow (or White)	White
Temperature +	9	Red	Red
Temperature -	7	Black	Green
Shield	7	n/a	Clear



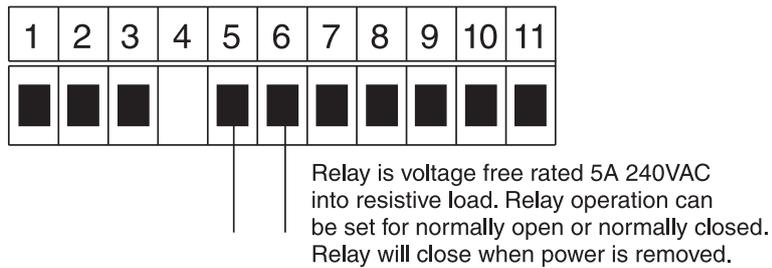
AC power connections - supply type is factory configured, check before connecting



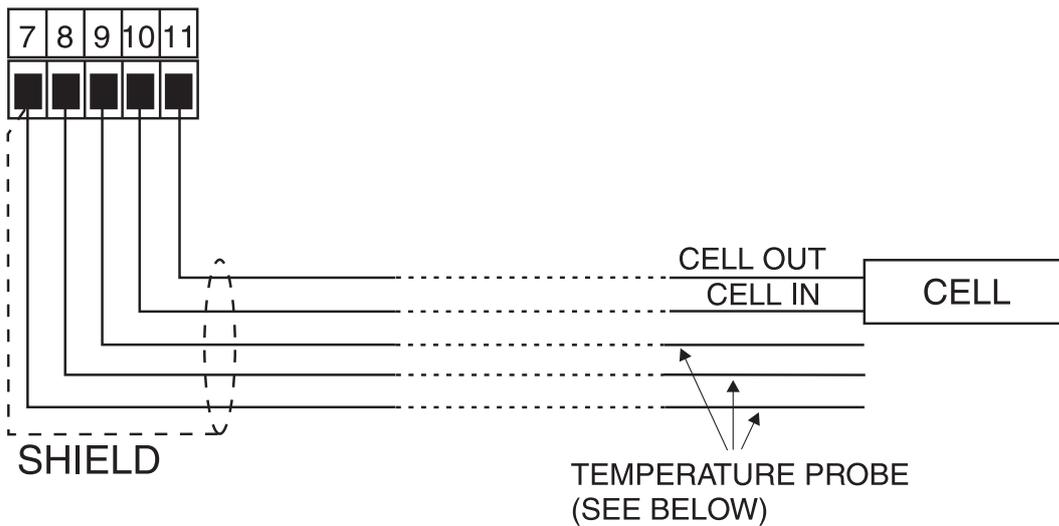
DC power connections (12 to 48VDC) - supply type is factory configured, check before connecting



Relay connections

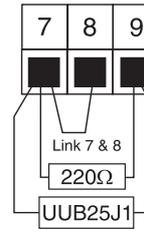
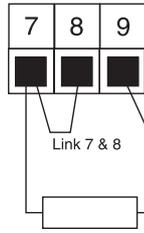


Conductivity and temperature wiring

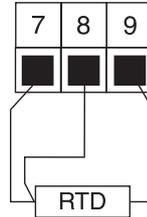


Temperature sensor - in most cases the temperature sensor is housed in the conductivity cell.

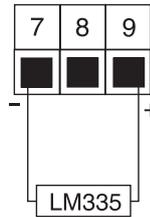
100Ω and 1000Ω RTDs  
2 Wire configuration or  
100Ω thermistor or  
UUB25J1 thermistor.  
Note: If using the UUB25J1  
a 220Ω resistor must be  
placed across terminals 7 & 9



100Ω and 1000Ω RTDs  
3 Wire configuration



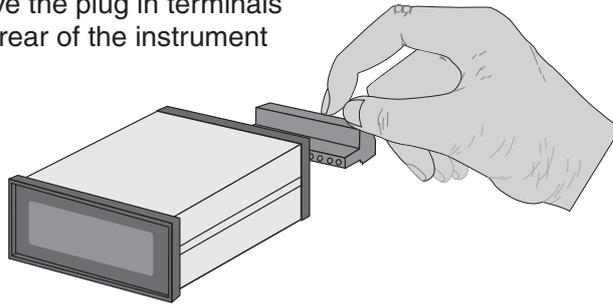
LM335 Temperature sensor



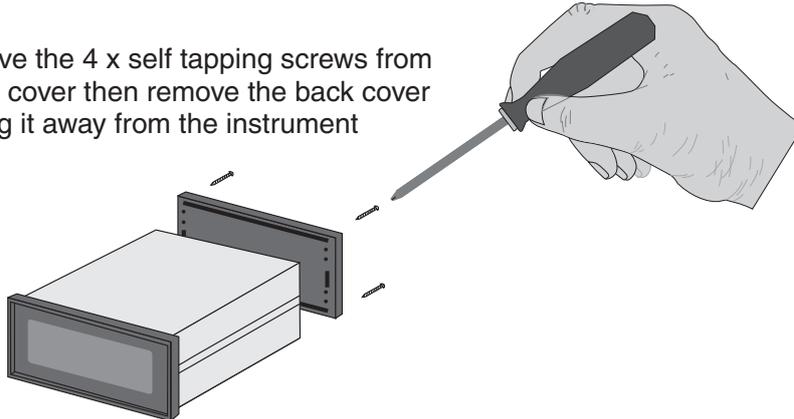
### 3.3 Input Output Configuration

If you need to alter the input or output configuration link settings proceed as follows:

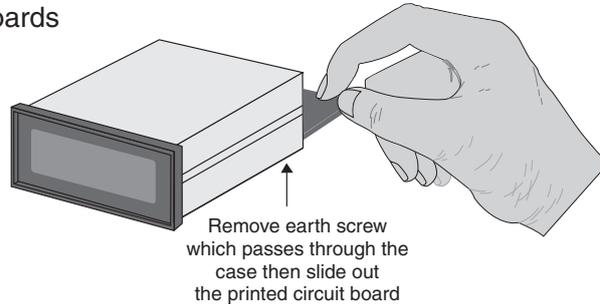
1. Remove the plug in terminals from the rear of the instrument



2. Remove the 4 x self tapping screws from the back cover then remove the back cover by pulling it away from the instrument



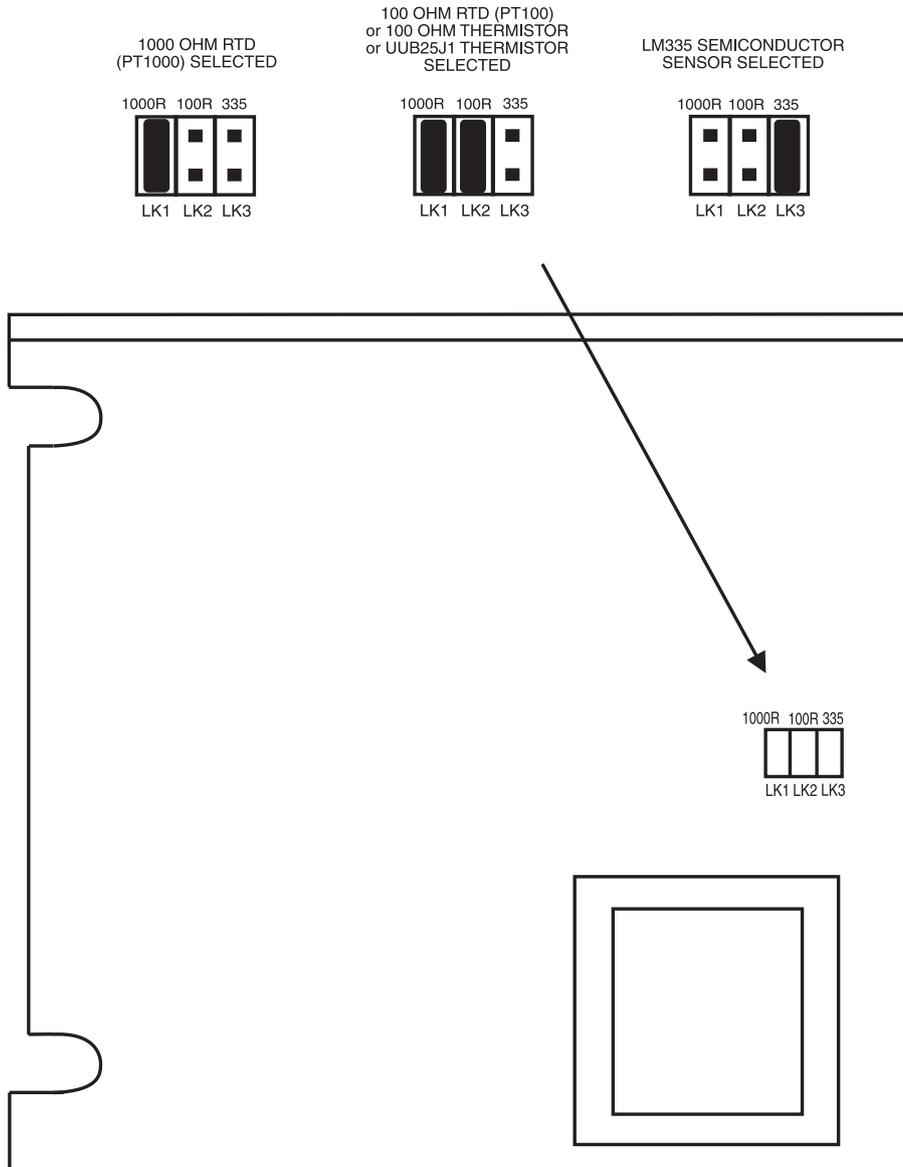
3. Remove the earth screw which passes through the underside of the case then slide out the board or boards



4. Configure the PCB links as required, see appropriate chapter
5. Slide PCB back into case
6. Replace the earth screw which passes through the case
7. Refit the back cover and fix with the self tapping screws
8. Plug the terminal strips back into the rear of the instrument

### 3.4 Input range link selection

Dismantle the instrument as described in section 3.3. Insert the links into the appropriate location on the pin header to suit the range required.



## 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.

Display	Function	Range	Default	Your record	Ref/Page
<b>RxLo</b>	Low setpoint value for designated alarm relay <i>x</i>	Any display value or <b>OFF</b>	<b>OFF</b>	See 4.1	5.1 / 20
<b>RxHi</b>	High setpoint value for designated alarm relay <i>x</i>	Any display value or <b>OFF</b>	<b>OFF</b>	See 4.1	5.2 / 20
<b>RxHy</b>	Hysteresis value for the designated alarm relay <i>x</i> .	<b>0</b> to <b>9999</b>	<b>10</b>	See 4.1	5.3 / 21
<b>Rxtt</b>	Trip time delay for the designated alarm relay <i>x</i> .	<b>0</b> to <b>9999</b>	<b>0</b>	See 4.1	5.4 / 22
<b>Rxrt</b>	Reset time delay for the designated alarm relay <i>x</i> .	<b>0</b> to <b>9999</b>	<b>0</b>	See 4.1	5.5 / 22
<b>Rxn.o</b> or <b>Rxn.c</b>	Alarm relay <i>x</i> action to normally open (de-energised) or normally closed (energised)	<b>Rxn.o</b> or <b>Rxn.c</b>	<b>Rxn.o</b>	See 4.1	5.6 / 22
<b>RxSP</b> or <b>Rxt 1</b> etc.	Relay operation independent setpoint or trailing setpoint (*Optional)	<b>RxSP</b> or <b>Rxt 1</b> etc.	<b>RxSP</b>	See 4.1	5.7 / 23
<b>brgt</b>	Display brightness level	<b>1</b> to <b>15</b>	<b>15</b>		5.8 / 23
<b>FEC-</b>	Analog output option low display value (*Optional)	Any display value	<b>0</b>		5.9 / 23
<b>FEC+</b>	Analog output option high display value (*Optional)	Any display value	<b>1000</b>		5.10 / 24
<b>FEC- Ch2</b>	Second analog output option low display value (*Optional)	Any display value	<b>0</b>		5.11 / 24
<b>FEC+ Ch2</b>	Second analog output option high display value (*Optional)	Any display value	<b>1000</b>		5.12 / 24
<b>bAr-</b>	Bargraph low value	Any display value	<b>0</b>		5.13 / 24
<b>bAr+</b>	Bargraph high value	Any display value	<b>1000</b>		5.14 / 25

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

Functions in this second table are available only in **CAL** mode or if **ACCS** is set to **ALL**

Display	Function	Range	Default	Your record	Ref/Page
<b>bAr tYPE</b>	Bargraph type for instruments with bargraph display	<b>bAr</b> , <b>S.dot</b> , <b>d.dot</b> , <b>C.bAr</b> or <b>r.dot</b>	<b>bAr</b>		5.15 / 25
<b>d9OP</b>	Digital output option mode (*Optional)	<b>bcd</b> , <b>b.SCL</b> , <b>b, n</b> or <b>b, n2</b>	<b>b, n2</b>		5.16 / 26
<b>d9.OP</b>	Digital output option polarity (*Optional)	<b>RI 0</b> or <b>RI,</b>	<b>RI 0</b>		5.17 / 26
<b>bcd StArT</b>	Digital output option BCD start position (*Optional)	<b>0</b> , <b>1</b> or <b>2</b>	<b>0</b>		5.18 / 26
<b>d, 9-</b>	Digital output option low value (*Optional)	Any display value	<b>0</b>		5.19 / 27
<b>d, 9+</b>	Digital output option high value (*Optional)	Any display value	<b>1000</b>		5.20 / 27
<b>drnd</b>	Display rounding	<b>1</b> to <b>5000</b>	<b>1</b>		5.21 / 27
<b>dCPt</b>	Decimal point	<b>0</b> , <b>0.1</b> etc.	<b>0</b>		5.22 / 27
<b>FLtR</b>	Digital filter	<b>0</b> to <b>8</b>	<b>2</b>		5.23 / 28
<b>dOSE PERd</b>	Special dosing mode operation	<b>0</b> to <b>600</b>	<b>0</b>		5.24 / 28
<b>°C tYPE</b>	Temperature sensor type	<b>NONE</b> , <b>100</b> , <b>1000.L335</b> , <b>t 100</b> or <b>25J1</b>	<b>NONE</b>		5.25 / 28
<b>dEF °C</b>	Default temperature value	<b>0.0</b> to <b>200.0</b>	<b>25.0</b>		5.26 / 29
<b>SOL SLPE</b>	Solution temperature compensation slope	<b>-6.00</b> to <b>0.00</b>	<b>-2.00</b>		5.27 / 29
<b>SOL °C</b>	Solution temperature compensation reference	<b>0.0</b> to <b>100.0</b>	<b>25.0</b>		5.28 / 29
<b>PFbE CAsE</b>	Cell K factor	<b>0.0</b> <b>1.0</b> <b>0.05</b> , <b>0.1</b> <b>0.5</b> <b>1.0</b> , <b>2.0</b> <b>5.0</b> <b>10</b> , <b>50</b> or <b>100</b>	<b>0.1</b>		5.29 / 30
<b>H.OFF or H.ON</b>	Hydrogen ion compensation	<b>H.OFF</b> or <b>H.ON</b>	<b>H.OFF</b>		5.30 / 30
<b>Ind PFbE</b>	Inductive cell selection	<b>on</b> or <b>OFF</b>	<b>OFF</b>		5.31 / 30
<b>CAL NULL</b>	Display null calibration	n/a	n/a		5.32 / 30
<b>CAL 1</b>	First live input calibration scaling point	Any display value	n/a		5.33 / 31

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

<b>CAL2</b>	Second live input calibration scaling point	Any display value	n/a		5.34 / 31
<b>°C NULL</b>	Temperature null calibration	n/a	n/a		5.35 / 31
<b>CAL °C</b>	Temperature calibration	n/a	n/a		5.36 / 31
<b>cond unit</b>	Conductivity measuring units	<b>µS.cm, µS.ñ, ñS.cm or ñS.ñ</b>	<b>µS.cm</b>		5.37 / 31
<b>UCAL cond</b>	Conductivity uncalibration	n/a	n/a		5.38 / 32
<b>UCAL RESL</b>	Resistivity uncalibration	n/a	n/a		5.39 / 32
<b>UCAL PPñ</b>	ppm uncalibration	n/a	n/a		5.40 / 32
<b>UCAL Pcnt</b>	Percentage uncalibration	n/a	n/a		5.41 / 32
<b>UCAL °C</b>	Temperature uncalibration	n/a	n/a		5.42 / 33
<b>PPñ FACT</b>	ppm conversion factor	<b>0.200 to 2.000</b>	<b>0.560</b>		5.43 / 33
<b>SEt diSP</b>	Set display type	<b>cond, RESL, PPñ or Pcnt</b>	<b>cond</b>		5.44 / 33
<b>rEc ctri</b>	Analog output PI control (*Optional)	<b>on or OFF</b>	<b>OFF</b>		5.45 / 33
<b>Pbut</b>	<b>P</b> button function (for instruments with front <b>P</b> button)	<b>NONE, Hi, Lo, Hi, Lo, bARE, ZERO, P.SET</b>	<b>NONE</b>		5.46 / 34
<b>ACCS</b>	Access mode	<b>OFF, EASY, NONE or ALL</b>	<b>OFF</b>		5.47 / 34
<b>SPAC</b>	Setpoint access mode (*Optional)	<b>A1, A1-2 etc.</b>	<b>A1</b>		5.48 / 34
<b>A1, A2 etc.</b>	Alarm relay operation mode	<b>cond, RESL, PPñ, Pcnt, °C or dOSE</b>	<b>cond</b>	See 4.1	5.49 / 35
<b>BAR</b>	Bargraph display mode (*Optional)	<b>cond, RESL, PPñ, Pcnt or °C</b>	<b>cond</b>		5.50 / 35
<b>FEc</b>	Analog output mode (*Optional)	<b>cond, RESL, PPñ, Pcnt or °C</b>	<b>cond</b>		5.51 / 36

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

<b>FEC2</b>	Second analog output mode (*Optional)	<b>cond.FESt . PPn.Pent</b> or <b>oC</b>	<b>cond</b>		5.52 / 36
<b>FEC</b>	Analog output logarithmic or linear mode (*Optional)	<b>L, n.Lo91 . Lo92.Lo93 . Lo94</b> or <b>Lo95</b>	<b>L, n</b>		5.53 / 37
<b>FEC Lo</b>	Analog output logarithmic start point (*Optional)	<b>0.00 1.0.0 1 . 0. 1. 1.0</b> or <b>10.0</b>	<b>0.00 1</b>		5.54 / 37
<b>FEC2</b>	Second analog output logarithmic or linear mode (*Optional)	<b>L, n.Lo91 . Lo92.Lo93 . Lo94</b> or <b>Lo95</b>	<b>L, n</b>		5.55 / 38
<b>FEC2 Lo</b>	Second analog output logarithmic start point (*Optional)	<b>0.00 1.0.0 1 . 0. 1. 1.0</b> or <b>10.0</b>	<b>0.00 1</b>		5.56 / 38
<b>BAUD RATE</b>	Baud rate for serial communications (*Optional)	<b>300.600 . 1200.2400 . 4800.9600 . 19.2</b> or <b>38.4</b>	<b>9600</b>		5.57 / 38
<b>Prty</b>	Parity for serial communications (*Optional)	<b>NONE .EVEN</b> or <b>odd</b>	<b>NONE</b>		5.58 / 38
<b>Output</b>	Output for serial communications (*Optional)	<b>di SP.Cont . POLL, R.buS</b> or <b>ā.buS</b>	<b>Cont</b>		5.59 / 39
<b>Addr</b>	Instrument address for serial communications (*Optional)	<b>0 to 3 1</b>	<b>0</b>		5.60 / 39

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

## 4.1 Relay table

Record your relay settings in the table below

Display	Relay 1	Relay 2	Relay 3	Relay 4	Relay 5	Relay 6	Relay 7
<b>AxLo</b>							
<b>AxH,</b>							
<b>AxHY</b>							
<b>Axtt</b>							
<b>Axrt</b>							
<b>Axn.o</b> or <b>Axn.c</b>							
<b>AxSP</b> or <b>Axt 1</b> etc.	n/a						
<b>A 1.A2</b> etc.							

## 5 Explanation of functions

The PM4 setup and calibration functions are configured through a push button sequence. The three push buttons located at the rear of the instrument (also at the front on some display options) are used to alter settings. Two basic access modes are available:

**FUNC** mode (simple push button sequence) allows access to commonly set up functions such as alarm setpoints.

**CAL** mode (power up sequence plus push button sequence) allows access to all functions including calibration parameters.

Once **CAL** or **FUNC** mode has been entered you can step through the functions, by pressing and releasing the **F** push button, until the required function is reached. Changes to functions are made by pressing the or push button (in some cases both simultaneously) when the required function is reached. See the flow chart example on the following page.

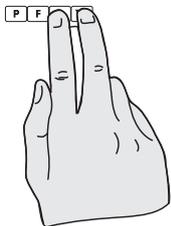
### Entering **CAL** Mode



1. Remove power from the instrument. Hold in the **F** button and reapply power. The display will briefly indicate **CAL** as part of the "wake up messages" when the **CAL** message is seen you can release the button. Move to step 2 below.



2. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button. Move to step 3 below.



3. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

Note: If step 1 above has been completed then the instrument will remain in this **CAL** mode state until power is removed. i.e. there is no need to repeat step 1 when accessing function unless power has been removed.

### Entering **FUNC** Mode

No special power up procedure is required to enter **FUNC** mode.

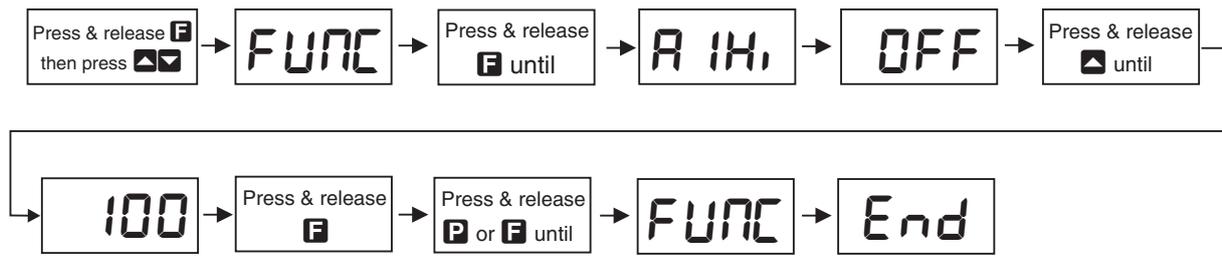


1. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button.

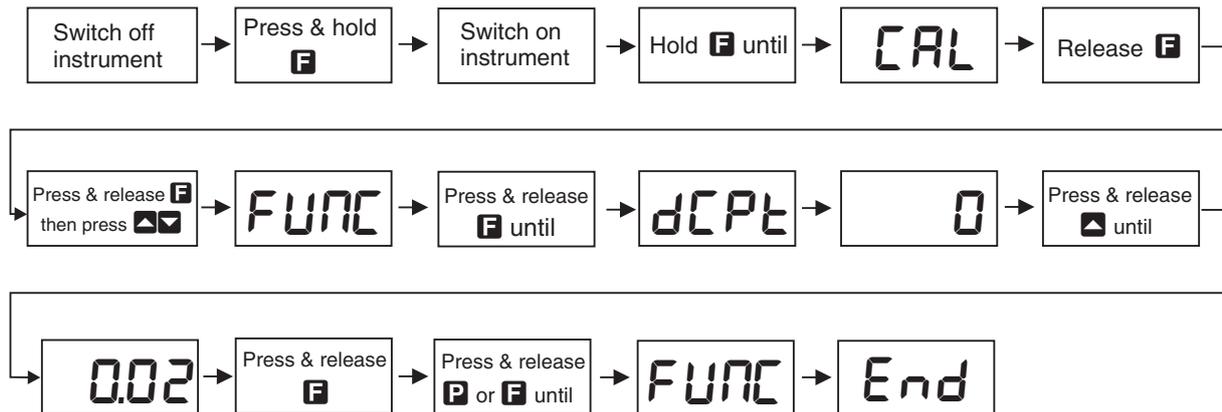


2. Within 2 seconds of releasing the **F** button press, then release the **▲** and **▼** buttons together. The display will now indicate **FUNC** followed by the first function.

Example: Entering **FUNC** mode to change alarm 1 high function **A 1H**, from **OFF** to **100**



Example: Entering **CAL** mode to change decimal point function **dCPT** from **0** to **0.02**



### Easy alarm relay adjustment access facility

The display has an easy alarm access facility which allows access to the alarm setpoints simply by pressing the **F** button at the front or rear of the instrument. The first setpoint will then appear and changes to this setpoint may be made to this setpoint via the **▲** or **▼** buttons. Press the **F** button to accept any changes or to move on to the next setpoint. Note: this easy access also functions in the same manner for the PI control setpoint (relay and/or analog PI output) if PI control is available. The instrument must be set in the manner described below to allow the easy access facility to work:

1. The **PI NP** function must be set to **SPAC** or the **ACCS** function must be set to **EASY**.
2. At least one alarm must have a setpoint, nothing will happen if all the alarm setpoints are set to **OFF**.
3. The **SPAC** function must be set to allow access to the relays required e.g. if set to **A 1-2** then the easy access will work only with alarm relays 1 and 2 even if more relays are fitted.
4. The instrument must be in normal measure mode i.e. if the instrument is powered up so that it is in **CAL** mode then the easy access will not function. If in doubt remove power from the instrument, wait for a few seconds then apply power again.
5. If the easy access facility is used then the only way to view or alter any other function settings is to power up via **CAL** mode i.e. there is no entry to **FUNC** mode functions unless the instrument is powered up in **CAL** mode.

# Explanation of Functions

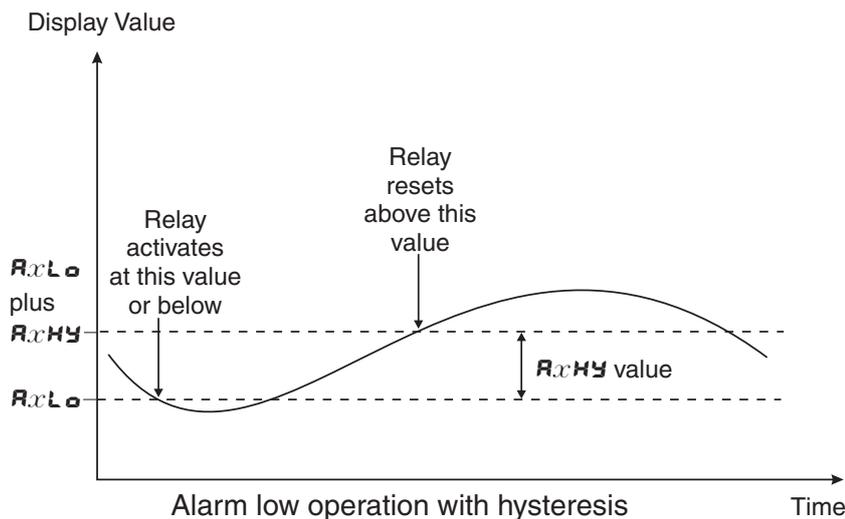
## 5.1 Alarm relay low setpoint

**Display:**  $RxLo$   
**Range:** Any display value or **OFF**  
**Default Value:** **OFF**

Displays and sets the low setpoint value for the designated alarm relay  $x$ . Note  $x$  will be replaced by the relay number when displayed e.g.  $R1Lo$  for relay 1. Use this low setpoint function if a relay operation is required when the display value becomes equal to or less than the low setpoint value. To set a low alarm value go to the  $RxLo$  function and use the  $\blacktriangle$  or  $\blacktriangledown$  push buttons to set the value required then press **F** to accept this value. The low alarm setpoint may be disabled by pressing the  $\blacktriangle$  and  $\blacktriangledown$  push buttons simultaneously. When the alarm is disabled the display will indicate **OFF**. If the relay is allocated both a low and high setpoint then the relay will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the relay will reset is controlled by the  $RxHy$  function.

### Example:

If  $R1Lo$  is set to **10** then relay 1 will activate when the display value is 10 or less.



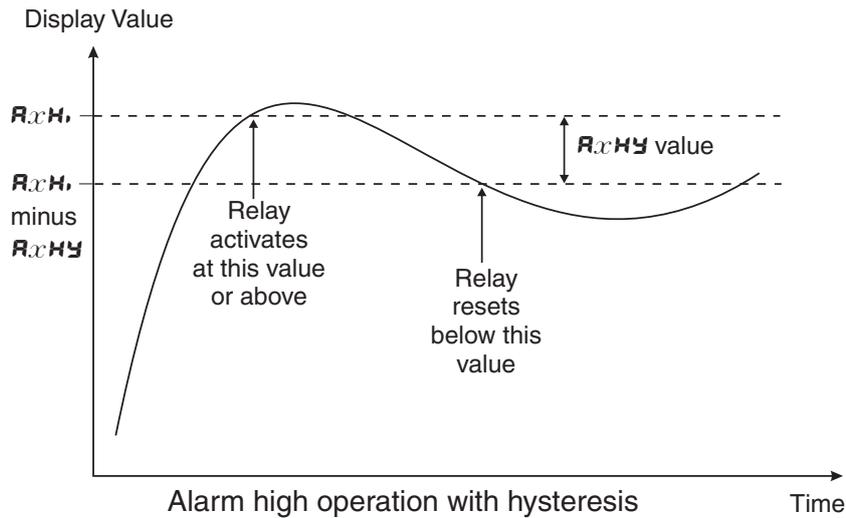
## 5.2 Alarm relay high setpoint

**Display:**  $RxH$   
**Range:** Any display value or **OFF**  
**Default Value:** **OFF**

Displays and sets the high setpoint value for the designated alarm relay  $x$ . Note  $x$  will be replaced by the relay number when displayed e.g.  $R1H$  for relay 1. Use this high setpoint function if a relay operation is required when the display value becomes equal to or more than the low setpoint value. To set a high alarm value go to the  $RxH$  function and use the  $\blacktriangle$  or  $\blacktriangledown$  push buttons to set the value required then press **F** to accept this value. The high alarm setpoint may be disabled by pressing the  $\blacktriangle$  and  $\blacktriangledown$  push buttons simultaneously. When the alarm is disabled the display will indicate **OFF**. If the relay is allocated both a low and high setpoint then the relay will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the relay will reset is controlled by the  $RxHy$  function.

**Example:**

If **A 1H** is set to **100** then relay 1 will activate when the display value is **100** or higher.



### 5.3 Alarm relay hysteresis (deadband)

- Display: **AxHY**
- Range: **0** to **9999**
- Default Value: **10**

Displays and sets the alarm relay hysteresis limit for the designated relay *x*. Note *x* will be replaced by the relay number when displayed e.g. **A 1HY** for relay 1. To set a relay hysteresis value go to the **AxHY** 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 relay when the measured value is rising and falling around setpoint value. e.g. if **A 1HY** 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 the relay 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 **A 1H** is to **50.0** and **A 1HY** is set to **3.0** then the setpoint output relay 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 **A 1Lo** is to **20.0** and **A 1HY** is set to **10.0** then the alarm output relay 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. The hysteresis units are expressed in displayed engineering units.

**Example:** If **A 1H** is set to **100** and **A 1HY** is set to **10** then relay 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

**Display:** **Ax.t.t**  
**Range:** **0 to 9999**  
**Default Value:** **0**

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 **9999** seconds. To set a trip time value go to the **Ax.t.t** function and use the **▲** or **▼** push buttons to set the value required then press **F** to accept this value.

**Example:** If **A 1.t.t** is set to **5** seconds then the display must indicate an alarm value for a full 5 seconds before relay 1 will activate.

## 5.5 Alarm relay reset time

**Display:** **Ax.r.t**  
**Range:** **0 to 9999**  
**Default Value:** **0**

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 **9999** seconds. To set a reset time value go to the **Ax.r.t** function and use the **▲** or **▼** push buttons to set the value required then press **F** to accept this value.

**Example:** If **A 1.r.t** is set to **10** seconds then the resetting of alarm relay 1 will be delayed by 10 seconds.

## 5.6 Alarm relay normally open/closed

**Display:** **Axn.o** or **Axn.c**  
**Range:** **Axn.o** or **Axn.c**  
**Default Value:** **Axn.o**

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 **Axn.o** or **Axn.c** function and use the **▲** or **▼** push buttons to set the required operation then press **F** to accept this selection. **Example:** If set to **A 1.n.o** alarm relay 1 will be open circuit when the display is outside alarm condition and will be closed (short circuit across terminals) when the display is in alarm condition.

## 5.7 Alarm relay setpoint or trailing operation

Display: **RxSP** or **Rxt i** etc.

Range: **RxSP** or **Rxt i** etc.

Default Value: **RxSP**

Relay operation independent setpoint or trailing setpoint, 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 or may be linked to operate at a fixed difference to another relay setpoint, known as trailing operation. The operation is as follows:

Alarm 1 (**R1**) is always independent. Alarm 2 (**R2**) may be independent or may be linked to Alarm 1. Alarm 3 (**R3**) may be independent or may be linked to Alarm 1 or Alarm 2. Alarm 4 (**R4**) may be independent or may be linked to Alarm 1, Alarm 2 or Alarm 3. The operation of each alarm is selectable by selecting, for example, (Alarm 4) **R4.SP** = Alarm 4 normal setpoint or **R4.t 1** = Alarm 4 trailing Alarm 1 or **R4.t 2** = Alarm 4 trailing Alarm 2 or **R4.t 3** = Alarm 4 trailing Alarm 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.

**Example:** With Alarm 2 set to trail alarm 1, if **R1H** is set to **1000** and **R2H** is set to **50** then Alarm 1 will activate at **1000** and alarm 2 will activate at **1050** (i.e. 1000 + 50). If Alarm 2 had been set at **-50** then alarm 2 would activate at **950** (i.e. 1000 - 50).

## 5.8 Display brightness

Display: **br 9t**

Range: **1** to **15**

Default Value: **15**

Displays and sets the digital display brightness. The display brightness is selectable from **1** to **15**, 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. To set brightness level go to the **br 9t** function and use the **▲** or **▼** push buttons to set the value required then press **F** to accept this value.

## 5.9 Analog output option low value

Display: **FEE -**

Range: Any display value

Default Value: **0**

Seen only when analog retransmission option fitted. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted for wiring details and link settings. Displays and sets the analog retransmission (4–20mA, 0–1V or 0–10V, link selectable) output low value (4mA or 0V) in displayed engineering units. To set the analog output low value go to the **FEE -** function and 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.

## 5.10 Analog output option high value

**Display:** ***F E C ^***  
**Range:** Any display value  
**Default Value:** ***1000***

Seen only when analog retransmission option fitted. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted for wiring details and link settings. Displays and sets the analog retransmission (4–20mA, 0–1V or 0–10V, link selectable) output high display value (20mA, 1V or 10V) in displayed engineering units. To set the analog output high value go to the ***F E C ^*** function and use the  or  push buttons to set the required value then press  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.

## 5.11 Second analog output option low value

**Display:** ***F E C \_ C h 2***  
**Range:** Any display value  
**Default Value:** ***0***

See ***F E C \_*** function 5.9 for description of operation.

## 5.12 Second analog output option high value

**Display:** ***F E C ^ C h 2***  
**Range:** Any display value  
**Default Value:** ***1000***

See ***F E C ^*** function 5.10 for description of operation.

## 5.13 Bargraph low value

**Display:** ***b A r \_***  
**Range:** Any display value  
**Default Value:** ***0***

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 ***b A r \_*** and ***b A r ^*** settings are referenced from the 7 segment display readings, not the bargraph scale values. The bargraph scale may be scaled differently to the 7 segment display. For example the bargraph scale may be indicating percentage fill of a tank whilst the 7 segment display is indicating actual process units. To set bargraph low level go to the ***b A r \_*** function and use the  or  push buttons to set the value required then press  to accept this value.

## 5.14 Bargraph high value

Display: **BAR<sup>~</sup>**  
Range: Any display value  
Default Value: **1000**

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 (e.g. all LEDs illuminated). May be independently set anywhere within the display range of the instrument. To set bargraph high level go to the **BAR<sup>~</sup>** function and use the **▲** or **▼** push buttons to set the value required then press **F** to accept this value.

Functions in this second table are available only in **CAL** mode or if **ACCS** is set to **ALL**

## 5.15 Bargraph type for instruments with bargraph display

Display: **BAR TYPE**  
Range: **BAR**, **S.dot**, **d.dot**, **C.BAR** or **r.dot**  
Default Value: **BAR**

Bar graph display operation mode - seen only in vertical or circular bargraph display instruments. Allows selection of bargraph operation mode. Choices available are:

- **BAR** - conventional solid bargraph display i.e. all LEDs illuminated when at full scale. When scaling the display use the **BAR<sub>-</sub>** and **BAR<sup>~</sup>** functions e.g. **BAR<sub>-</sub> = 0** and **BAR<sup>~</sup> = 100** will give a bargraph with no segments lit at a 7 segment display reading of **0** and all segments lit with a 7 segment display reading of **100**.
- **S.dot** - single dot display. A single segment will be lit to indicate the input readings position on the scale. When scaling the display use the **BAR<sub>-</sub>** and **BAR<sup>~</sup>** functions e.g. **BAR<sub>-</sub> = 0** and **BAR<sup>~</sup> = 100** will give a bargraph with the bottom segment lit at a 7 segment display reading of **0** and the top segment lit with a 7 segment display reading of **100**. Note: this could also be set up as a centre zero single dot display by entering a negative value and positive value. e.g. **BAR<sub>-</sub> = -100**, **BAR<sup>~</sup> = 100**.
- **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. When scaling the display use the **BAR<sub>-</sub>** and **BAR<sup>~</sup>** functions e.g. **BAR<sub>-</sub> = 0** and **BAR<sup>~</sup> = 100** will give a bargraph with the bottom two segments lit at a 7 segment display reading of **0** and the top two segments lit with a 7 segment display reading of **100**. Note: this could also be set up as a centre zero double dot display by entering a negative value and positive value. e.g. **BAR<sub>-</sub> = -100**, **BAR<sup>~</sup> = 100**.
- **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. When scaling the display use the **BAR<sub>-</sub>** and **BAR<sup>~</sup>** functions e.g. **BAR<sub>-</sub> = 0** and **BAR<sup>~</sup> = 100** will give a bargraph with all the bottom half segments lit at a 7 segment display reading of **-100** and all the top segments lit with a 7 segment display reading of **100**.
- **r.dot** - modulus or wrap around single dot bargraph. This mode of operation allows the bargraph to wrap around the limits set by the **BAR<sub>-</sub>** and **BAR<sup>~</sup>** functions by dividing

the 7 segment display by the modulus (the modulus is the difference between 0 and  $\text{bAR}^-$ ) and displaying the remainder. For example if  $\text{bAR}^-$  is set to **0** and  $\text{bAR}^-$  is set to **10** then in other bargraph 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 bargraph position of 5 is displayed. This mode will operate on both vertical and circular bargraph type displays.

## 5.16 Digital output option mode

Display: **d90P**  
 Range: **bcd**, **b.SCL**, **b,n** or **b,n2**  
 Default Value: **b,n2**

Seen only with the 16 bit digital output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted. Selections available are: **b,n2** (signed binary) i.e. -32767 to 32767, **b,n** (unsigned binary) i.e. 0 to 65535, **b.SCL** (scaled binary, see **d,9-** and **d,9-** below), **bcd** (binary coded decimal) i.e. up to four BCD numbers.

## 5.17 Digital output option polarity

Display: **d9.OP**  
 Range: **Al 0** or **AH,**  
 Default Value: **Al 0**

Seen only with the 16 bit digital output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted. Selections available are: **Al 0** (active low i.e. logic 1 = 0V output, logic 0 = +V output) or **AH,** (active high i.e. logic 1 = +V output, logic 0 = 0V output).

## 5.18 Digital output option BCD start position

Display: **bcd Start**  
 Range: **0**, **1** or **2**  
 Default Value: **0**

Seen only with the 16 bit digital output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted. This function affects BCD mode only and determines the number of digits to skip when outputting from the display. As the output is 16 bit it can output up to 4 BCD numbers. Select from **0** to number of display digits minus 4. e.g. for a 6 digit display you may select **0** to **2**, if **2** is selected then the four left most digits will be output, if set to **0** then the four right most digits will be output.

## 5.19 Digital output option low value

**Display:** **d, 9<sub>-</sub>**  
**Range:** Any display value  
**Default Value:** **0**

Seen only with the 16 bit digital output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted. Accepts any valid display value. Determines the low scaling point for the **b.5CL** mode and has no effect on other modes. See example which follows in 5.20.

## 5.20 Digital output option high value

**Display:** **d, 9<sup>-</sup>**  
**Range:** Any display value  
**Default Value:** **1000**

Seen only with the 16 bit digital output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when this option is fitted. Determines the high scaling point for the **b.5CL** mode and has no effect on other modes.

**Example:** If **d, 9<sub>-</sub>** is set to **0** and **d, 9<sup>-</sup>** is set to **65535** ( $2^{16} - 1$ ) then the retransmission will not be scaled i.e. a display of **2** will cause a retransmission of 2. If **d, 9<sup>-</sup>** is now changed to **32767** ( $2^{15} - 1$ ) then a display of **2** will cause a retransmission of 4 (note: rounding may occur on retransmission).

## 5.21 Display rounding

**Display:** **drnd**  
**Range:** **1** to **5000**  
**Default Value:** **1**

Displays and sets the display rounding value. 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 and use the  or  push buttons to set the required value then press **F** to accept this selection.

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

## 5.22 Decimal point

**Display:** **dCPt**  
**Range:** **0, 0.1** etc.  
**Default Value:** **0**

Displays and sets the decimal point. By pressing the  or  pushbutton at the **dCPt** function the decimal point position may be set. The display will indicate as follows: **0** (no decimal point),

**0.1** (1 decimal place), **0.02** (2 decimal places), **0.003** (3 decimal places) and **0.0004** for display with more than 4 digits. Note if the decimal point is altered the display will need to be recalibrated and alarm etc. settings checked.

## 5.23 Digital filter

Display: **FLTR**  
Range: **0** to **8**  
Default Value: **2**

Displays and sets the digital filter value. 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. Use **▲** or **▼** at the **FLTR** function to alter the filter level if required. 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 digital filter value go to the **FLTR** function and use the **▲** or **▼** push buttons to set the required value then press **F** to accept this selection.

## 5.24 Special “blowdown” dosing mode operation

Display: **DOSE PER d**  
Range: **0** to **600**  
Default Value: **0**

Special dosing operation mode - sets relay 1 operation period for special “blowdown” dosing pump operation mode. This function can be set from 0 to 600 seconds. This function will only be seen if function **R1** is set to **DOSE**. Refer to the **R1.R2** etc. function for a description of operation of this special mode.

## 5.25 Temperature sensor type

Display: **°C TYPE**  
Range: **NONE** , **100** , **1000** , **L335** , **t 100** or **25J1**  
Default Value: **NONE**

Temperature sensor type used, note see also electrical link settings in chapter 3. Choices available are:

- **NONE** - no temperature sensor used
- **100** - Pt100 temperature sensor used
- **1000** - Pt100 temperature sensor used
- **L335** - LM335 temperatures sensor used
- **t 100** - 100Ω thermistor sensor used
- **25J1** - UUB25J1 thermistor sensor used

Note that if **NONE** is selected then the temperature used for compensation and displayed will be that selected at the **DEF °C** function.

## 5.26 Default temperature value

Display: **DEF °C**  
Range: **0.0 to 200.0**  
Default Value: **25.0**

Displays and sets the default temperature for manual compensation when **°C TYPE** is set to **NONE**. If no temperature sensor is used set this function to the temperature required for temperature compensation calculation i.e. set this to the known temperature of the process solution.

## 5.27 Solution temperature compensation slope

Display: **SOL SLOPE**  
Range: **-6.00 to 0.00**  
Default Value: **-2.00**

Displays and sets the solution slope, variable from -6.00 to 0.00. The solution slope gives the temperature coefficient of the solution measured as a % per °C (this figure is needed since each individual solutions conductivity/resistivity will vary differently with temperature) . A typical value is -2% per °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.

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

5. Enter the result as the solution slope.

## 5.28 Solution temperature compensation reference

Display: **SOL °C**  
Range: **0.0 to 100.0**  
Default Value: **25.0**

Displays and sets the solution temperature (T1) 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.

## 5.29 Cell K factor

**Display:** **PTbE CnSt**  
**Range:** **0.0 1.0 0.5 1.0 5. 10 2.0 5.0 10 50** or **100**  
**Default Value:** **0.1**

Displays and sets the probe cell constant (K number) See chapter 1 for measurement ranges for common K factors. Set this function to match the K factor of the cell being used.

## 5.30 Hydrogen ion compensation

**Display:** **H.OFF** or **H.ON**  
**Range:** **H.OFF** or **H.ON**  
**Default Value:** **H.OFF**

Displays and sets the hydrogen ion compensation feature to either be on or off. 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 **H.ON** the instrument compensates for conductivity due to the H<sup>+</sup> and OH<sup>-</sup> 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 **H.ON** the a dry cell will give a display reading of 0.05uS/cm (if 2 decimal point places are selected).

## 5.31 Inductive cell selection

**Display:** **Ind PTbE**  
**Range:** **on** or **OFF**  
**Default Value:** **OFF**

Used to select whether or not a non contact inductive cell type is used. Set to **on** if a non contact cell is to be used. Note: non contact cells will only operate with the PM4-CO if the PM4-CO has been specially ordered for use with that particular model cell i.e. these types of cell will not work with standard model PM4-CO displays.

## 5.32 Display null calibration

**Display:** **CAL NULL**  
**Range:** n/a  
**Default Value:** n/a

This function allows the conductivity cell to be referenced to the instruments display value at zero conductivity. See section 6.3 for details.

### 5.33 First calibration scaling point

**Display:** **CAL 1**  
**Range:** Any display value  
**Default Value:** n/a

First scaling point for 2 point calibration scaling - See “Calibration” chapter, section

### 5.34 Second calibration scaling point

**Display:** **CAL 2**  
**Range:** Any display value  
**Default Value:** n/a

Second scaling point for 2 point calibration scaling - See “Calibration” chapter, section

### 5.35 Temperature null calibration

**Display:** **°C NULL**  
**Range:** n/a  
**Default Value:** n/a

This function allows the temperature sensor output to be referenced to the instruments null value using short circuit input. See section 6.6 for details.

### 5.36 Temperature calibration

**Display:** **CAL °C**  
**Range:** n/a  
**Default Value:** n/a

This function is used to calibrate the temperature sensor. See section 6.7 for details.

### 5.37 Conductivity measuring units

**Display:** **cond unit**  
**Range:** **µS.cm, µS.m, mS.cm** or **mS.m**  
**Default Value:** **µS.cm**

Selects the conductivity measuring units to be displayed, seen only if **Set di SP** set to **cond**. Choices available are:

- **µS.cm** to display in microSiemens per centimetre (uS/cm)
- **µS.m** to display in microSiemens per metre (uS/m)
- **mS.cm** to display in milliSiemens per centimetre (mS/cm)

- **5.5** to display in milliSiemens per metre (mS/m)

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

### 5.38 Conductivity uncalibration

**Display:** **UCAL cond**

**Range:** n/a

**Default Value:** n/a

This function is used to set the conductivity calibration back to the factory calibration values and will be seen only if the **SEt dI SP** function is set to **cond**. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. See section 6.8 for details.

### 5.39 Resistivity uncalibration

**Display:** **UCAL RESt**

**Range:** n/a

**Default Value:** n/a

This function is used to set the resistivity calibration back to the factory calibration values and will be seen only if the **SEt dI SP** function is set to **RESt**. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. See section 6.8 for details.

### 5.40 ppm uncalibration

**Display:** **UCAL PPm**

**Range:** n/a

**Default Value:** n/a

This function is used to set the ppm calibration back to the factory calibration values and will be seen only if the **SEt dI SP** function is set to **PPm**. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. See section 6.8 for details.

### 5.41 Percentage uncalibration

**Display:** **UCAL Percnt**

**Range:** n/a

**Default Value:** n/a

This function is used to set the resistivity calibration back to the factory calibration values and will be seen only if the **SEt dI SP** function is set to **Percnt**. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. See section 6.8 for details.

## 5.42 Temperature uncalibration

Display: **UCAL °C**  
Range: n/a  
Default Value: n/a

This function is used to set the temperature calibration back to the factory calibration values. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. See section 6.9 for details.

## 5.43 ppm conversion factor

Display: **PPM FACT**  
Range: **0.200** to **2.000**  
Default Value: **0.560**

This function is used to display and sets the ppm conversion factor and will be seen only if the **SEt dI SP** function is set to **PPM**. See section 6.11 for details.

## 5.44 Set display type

Display: **SEt dI SP**  
Range: **cond**, **RESist**, **PPM** or **Pcent**  
Default Value: **cond**

This function is used to set the default display to either conductivity (**cond**) in the display units selected or resistivity (**RESist**) in MΩ or parts per million (**PPM**) or Sodium Chloride (NaCl) percentage by weight (**Pcent**). Select the default display required for measurement.

## 5.45 Analog output PI control

Display: **reCctri**  
Range: **on** or **OFF**  
Default Value: **OFF**

Analog output mode - seen only when analog output option is fitted. This function allows selection of **on** or **OFF** for PI control analog output. If set to **OFF** the analog output operates as a retransmission output and uses the functions described in this chapter. If set to **on** the analog output operates as a PI control output.

When this function is set to **on** the following associated functions will appear: **C.SET**, **C.SPAN**, **C\_PG**, **C\_P0**, **C\_I9**, **C\_I.L.H**, **C\_I.L.L** and **FEC SPAC**. These functions are not detailed in this manual. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet for description of the analog PI control functions and wiring details.

## 5.46 **P** button function

Display: **Pbut**  
Range: **NONE.H, .Lo.H, Lo.tARE.ZERO, P.SET**  
Default Value: **NONE**

**P** button function - a only applicable models with front panel **P** buttons. The **P** button may be set to operate some of functions also available via the remote input, see **F.I RP** below for a description of these functions. The **P** button is located at the front of 5 or 6 digit LED models and bargraph models. If both the remote input and **P** button function are operated simultaneously the **P** button will override the remote input. The functions below are as described in the **F.I RP** function below. Functions available are: **NONE.H, .Lo.H, Lo.tARE.ZERO, P.SET**. Note: To prevent accidental operation of the **P** button in the **tARE** or **ZERO** functions it is necessary to hold the button in for 2 seconds to perform the selected operation.

## 5.47 Access mode

Display: **ACCS**  
Range: **OFF.EASY.NONE** or **ALL**  
Default Value: **OFF**

Access mode - the access mode function **ACCS** has four possible settings namely **OFF.EASY.NONE** and **ALL**. If set to **OFF** the mode function has no effect on alarm relay operation. If set to **EASY** the “easy alarm access” mode will be activated. Refer to “Easy alarm relay adjustment access facility” page 19. If set to **NONE** there will be no access to any functions via **FUNC** mode, entry via **CAL** mode must be made to gain access to alarm and calibration functions. If set to **ALL** then access to all functions, including calibration functions, can be gained via **FUNC** mode.

## 5.48 Setpoint access mode

Display: **SPAC**  
Range: **R1,R1-2** etc.  
Default Value: **R1**

Setpoint access - seen only if more than 1 relay fitted. Sets the access via **FUNC** mode and “easy alarm access” mode to the alarm relay setpoints. The following choices are available:

**R1** - Allows setpoint access to alarm 1 only.

**R1-2** - Allows setpoint access to alarms 1 and 2 only.

**R1-3** - Allows setpoint access to alarms 1, 2 and 3 etc. up to the maximum number of relays fitted.

The remote input function (**F.I RP**) must be set to **SPAC** for this function to operate. Note: Only the setpoints which have been given a value will be accessible e.g. if **R1H** is set to **OFF** then there will be no access to the **R1H** function when **SPAC** is used.

## 5.49 Alarm relay operation mode

Display: **A1.A2** etc.  
Range: **cond.FESb.PPn.Pcnt.°C** or **dOSE**  
Default Value: **cond**

Alarm relay operation mode for relays 1, 2 etc. The alarms setpoints may be set to operate from either the conductivity, resistivity, ppm, sodium chloride % by weight, temperature values. Note apart from the special **dOSE** operation only the mode selected at the **SEt OPEr** function or the temperature can be selected. Select **cond** for conductivity, **FESb** for resistivity, **PPn** for **PPn**, or **Pcnt** for sodium chloride % or **°C** for temperature. A special “blowdown” (**dOSE**) dosing pump operation mode is also available and is described below. The display can toggle from displaying temperature (a **°C** indication will flash every 8 seconds when set to temperature) to displaying conductivity (or resistivity or **PPn** depending on which is selected at the **SEt d: SP** function) by pressing the **▲** or **▼** pushbutton. The alarm will still function on the selected mode even if the display is not in that mode. e.g. if **A1** is set to **°C** and the display is showing a conductivity reading then the alarm 1 will still operate if the sensed temperature goes above the alarm 1 high setpoint or below the alarm 1 low setpoint. Special blowdown dosing operation (**dOSE**) - this mode is for use only in special instruments fitted with 2 or more output relays. The purpose of the blowdown software is to provide an output to a dosing pump for a programmable time period. This timed dosing pump output occurs immediately after the high level conductivity alarm resets. This software operates in the following manner:

- Two relays are fitted, relay 1 is a timed dosing operation relay, relay 2 is used as a high conductivity alarm which is used to operate the blowdown valve.
- When the conductivity level becomes equal to or higher than the alarm 2 setpoint (set at the **A2H** function) relay 2 will activate opening the blowdown valve.
- When the conductivity level falls to below the alarm 2 setpoint minus the hysteresis value (set at **A2HY**) relay 2 will deactivate closing the blowdown valve.
- Relay 1 will now activate for a period of time set at the **dOSE PER d** function. At the end of the time period relay 1 will deactivate.
- If during the dosing period the conductivity should rise above the relay 2 setpoint then relay 2 will activate and relay 1 will immediately deactivate, cutting short the dosing time. The process will then start again with relay 1 being energised for the period of time set at the **dOSE PER d** function when relay 2 resets.

Two functions are used with this special mode. The special functions are:

**A1** - this should be set to **dOSE** for blowdown operation. Note the usual relay 1 functions such as **A1Lo**, **A1H**, etc. will not be seen if **A1** is set to **dOSE**.

**dOSE PER d** - sets the relay 1 timer period in minutes and can be set from 0 to 600 minutes. The **dOSE PER d** function will only be seen when **A1** is set to **dOSE**.

## 5.50 Bargraph display mode

Display: **BAR**  
Range: **cond.FESb.PPn.Pcnt** or **°C**  
Default Value: **cond**

Bargraph operation mode - seen only when the bargraph display type is fitted. The bargraph

may be set to operate from either the conductivity, resistivity, ppm, sodium chloride % by weight, temperature values. Note only the mode selected at the **SEt OPEr** function or the temperature can be selected. Select **cond** for conductivity, **rESt** for resistivity, **PPn** for **PPn** , or **Pcnt** for sodium chloride % or **oC** for temperature. Set the **bAr-** and **bAr^** functions to suit the output mode selected. Note: if set for conductivity, resistivity or ppm then the bargraph will go to full scale if the display goes to overrange (**-or-** displayed on the 7 segment display). If set for temperature an overrange display will cause the bargraph to revert to the default temperature set at the **dEF oC** function i.e. if required the default temperature can be set to a value which will give required bargraph display if an overrange, e.g. open circuit, occurs.

## 5.51 Analog output mode

Display: **rEC**  
Range: **cond.rESt.PPn.Pcnt** or **oC**  
Default Value: **cond**

Analog output mode - seen only when the analog output option is fitted. The analog output may be set to operate from either the conductivity, resistivity, ppm, sodium chloride % by weight, temperature values. Note only the mode selected at the **SEt OPEr** function or the temperature can be selected. Select **cond** for conductivity, **rESt** for resistivity, **PPn** for **PPn** , or **Pcnt** for sodium chloride % or **oC** for temperature. Set the **rEC-** and **rEC^** functions to suit the output mode selected. Note: if set for conductivity, resistivity or ppm then the output will go to full scale if the display goes to overrange (**-or-** displayed on the 7 segment display). If set for temperature an overrange display will cause the output to revert to that for the default temperature set at the **dEF oC** function i.e. if required the default temperature can be set to a value which will give required analog output if an overrange, e.g. open circuit, occurs.

## 5.52 Second analog output mode

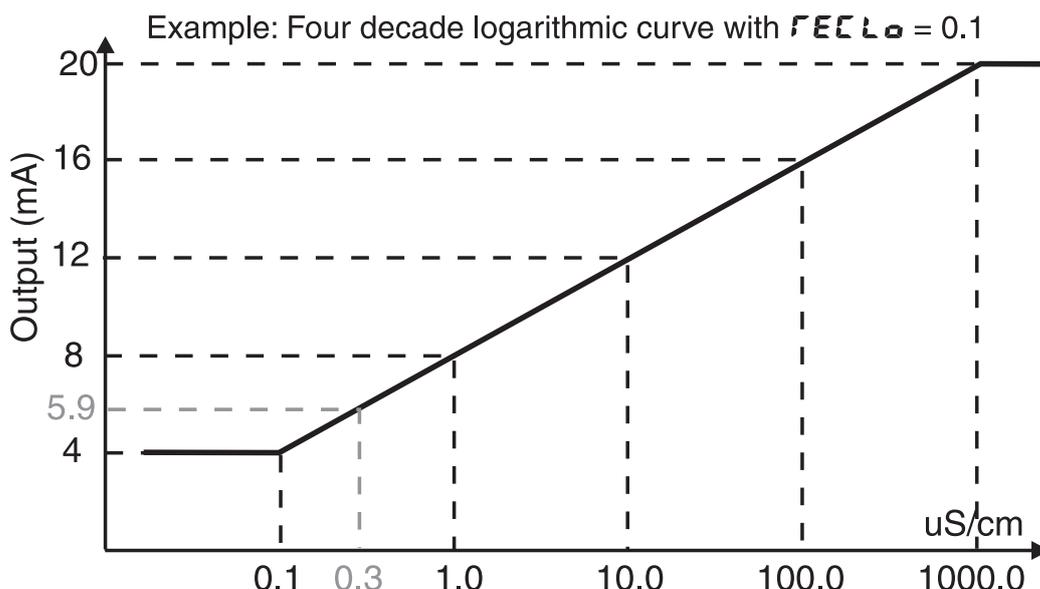
Display: **rEC2**  
Range: **cond.rESt.PPn.Pcnt** or **oC**  
Default Value: **cond**

Analog output mode - seen only when the dual analog output option is fitted. The second analog output may be set to operate from either the conductivity, resistivity, ppm, sodium chloride % by weight, temperature values. Note only the mode selected at the **SEt OPEr** function or the temperature can be selected. Select **cond** for conductivity, **rESt** for resistivity, **PPn** for **PPn** , or **Pcnt** for sodium chloride % or **oC** for temperature. Set the **rEC-** and **rEC^** functions to suit the output mode selected. Note: if set for conductivity, resistivity or ppm then the output will go to full scale if the display goes to overrange (**-or-** displayed on the 7 segment display). If set for temperature an overrange display will cause the output to revert to that for the default temperature set at the **dEF oC** function i.e. if required the default temperature can be set to a value which will give required analog output if an overrange, e.g. open circuit, occurs.

## 5.53 Analog output logarithmic or linear mode

Display: **FEC**  
 Range: **L, n, Lo9 1, Lo92, Lo93, Lo94** or **Lo95**  
 Default Value: **L, n**

Analog output linear or logarithmic mode - seen only when the analog output option is fitted and not applicable unless **FEC ctrl** is set to **OFF**. Choose **L, n** for a linear output whose limits are set by the **FEC<sub>+</sub>** and **FEC<sub>-</sub>** functions. Choose **Lo9 1** for a logarithmic output with 1 decade, **Lo92** for a logarithmic output with 2 decades etc. up to **Lo95** for 5 decades. See below for an example.



Example: The first decade runs from 0.1 to 1.0uS/cm. Because there are 4 decades in this example this gives a change of 4mA per decade. If the reading of 0.1uS/cm gives an output of 4mA and the reading of 1.0 uS/cm gives an output of 8mA then a reading of 0.3uS/cm will give an output of 5.9mA calculated from:

$$\begin{aligned} \text{mA output} &= \text{final mA value for that decade} - (\log_{10} 1.0 - \log_{10} 0.3) \times (\text{mA change per decade}) \\ \text{mA output} &= 8 - (\log_{10} 1.0 - \log_{10} 0.3) \times (4) \\ \text{mA output} &= 8 - (0 - -0.523) \times (4) \\ \text{mA output at } 0.3\text{uS/cm} &= 5.9\text{mA} \end{aligned}$$

i.e. the value is 52.3% below the end of decade value with 100% being 4mA.

Similarly the mA output at a display reading of 600.0uS/cm would be:

$$\text{mA output} = 20 - (\log_{10} 1000.0 - \log_{10} 600.0 \times 4) \times 4 = 19.1\text{mA}$$

## 5.54 Analog output logarithmic start point

Display: **FEC Lo**  
 Range: **0.00 1.00 1.0 1. 1.0** or **10.0**  
 Default Value: **0.00 1**

Analog retransmission logarithmic output low starting point - Seen only when the analog retransmission option is fitted and not applicable unless **FEC ctrl** is set to **OFF**. Sets the low starting point (4mA or 0V output) for the first decade of the logarithmic output. Choices available are **0.00 1.00 1.0 1. 1.0** or **10.0** display units. These are particularly written for optimum use with display units of uS/cm but they can be used with other conductivity ranges and, within the limits of the ranges available, in the resistivity, ppm and percent NaCl ranges.

**Example:** If **Lo93** is selected at the **FEC** function the analog output will be spread over 3 decades of measurement. If **0.1** is chosen as the low starting point at the **FECLo** function then the first decade of measurement will be from **0.1** to **1.0**, the second from **1.0** to **10.0** and the third from **10.0** to **100.0**. For a 4-20mA output the output for each decade would be as shown in the table below:

Display range	mA output range
0.1 to 1.0	4.0 to 9.3
1.0 to 10.0	9.3 to 14.6
10.0 to 100.0	14.6 to 20.0

## 5.55 Second analog output logarithmic or linear mode

Display: **FEC2**  
 Range: **Lin.Lo91.Lo92.Lo93.Lo94** or **Lo95**  
 Default Value: **Lin**

Second analog output linear or logarithmic mode - seen only when the dual analog output option is fitted and not applicable unless **FECctrl** is set to **OFF**. See **FEC** for a description.

## 5.56 Second analog output logarithmic start point

Display: **FEC2Lo**  
 Range: **0.00 1.0.0 1.0. 1. 1.0** or **10.0**  
 Default Value: **0.00 1**

Second analog retransmission logarithmic output low starting point - Seen only when the dual analog retransmission option is fitted and not applicable unless **FECctrl** is set to **OFF**. See **FECLo** for a description.

## 5.57 Baud rate for optional serial communications

Display: **BAUD RATE**  
 Range: **300.600. 1200.2400.4800.9600. 19.2** or **38.4**  
 Default Value: **9600**

Set baud rate - seen only with serial output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when optional outputs are fitted. Select from **300.600. 1200.2400.4800.9600. 19.2** or **38.4** baud. The baud rate should be set to match the device being communicated with.

## 5.58 Parity for optional serial communications

Display: **Prty**  
 Range: **NONE.EVEN** or **odd**  
 Default Value: **NONE**

Set parity - seen only with serial output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when optional outputs are fitted. Select parity check to

either **NONE**, **EVEN** or **odd**. The parity should be set to match the device being communicated with.

## 5.59 Output mode for optional serial communications

Display: **D.Pvt**  
Range: **d! SP.Cont.POLL, R.buS** or **ā.buS**  
Default Value: **Cont**

Set serial interface mode - seen only with serial output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when optional outputs are fitted. Allows user to select the serial interface operation as follows:

- d! SP** - sends image data from the display without conversion to ASCII.
- Cont** - sends 8 bit ASCII form of display data at a rate typically 90% of the sample rate.
- POLL** - controlled by computer or PLC as host. Host sends command via RS232/485 and instrument responds as requested.
- R.buS** - is a special communications mode used with Windows compatible optional PC download software. Refer to the user manual supplied with this optional software.
- ā.buS** - Modbus RTU protocol.

## 5.60 Instrument address for optional serial communications

Display: **Addr**  
Range: **0** to **31**  
Default Value: **0**

Set unit address for polled (**POLL**) mode (**0** to **31**) - seen only with serial output option. Refer to the separate “PM4 Panel Meter Optional Output Addendum” booklet supplied when optional outputs are fitted. Allows several units to operate on the same RS485 interface reporting on different areas etc. The host computer or PLC may poll each unit in turn supplying the appropriate address. The unit address ranges from 0 to 31 (DEC) but is offset by 32 (DEC) to avoid clashing with ASCII special function characters (such as <STX> and <CR>). Therefore 32 (DEC) or 20 (HEX) is address 0, 42 (DEC) or 2A (HEX) is address 10.

## 6 Calibration

### 6.1 Introduction

The instrument has provision for calibration slope and head resistance compensation conductivity/resistivity/ppm calibration. A null calibration feature (see **CAL 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** together with the **CAL NULL** function sets the calibration slope, the **CAL 2** reading is used to compensate for head resistance when long cable lengths are used. When using a temperature probe temperature calibration is carried out with the **°C NULL** and **CAL °C** functions, ensure that the correct temperature probe type has been selected (see **°C TYPE**) and that the appropriate links have been set (see Chapter 3).

### 6.2 Calibration Functions

To enter the calibration mode the instrument must be powered up and functions entered via **CAL** mode as illustrated in chapter 5 page 20.

### 6.3 Conductivity/Resistivity/ppm Calibration Null

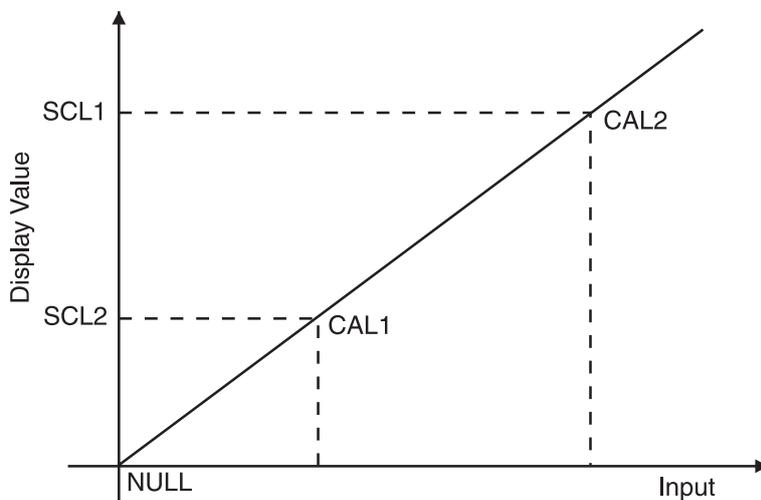
Null calibration allows the cell to be referenced to the meter. The instrument should be nulled before calibration. To null the instrument the following procedure should be followed.

1. If a temperature compensation sensor is used check that the temperature reading is correct and calibrate the temperature reading if necessary, see “Temperature Calibration Null” and “Temperature Calibration” sections in this chapter. Also check that the **SOL SLPE** function is correctly set. If no temperature sensor is being used check that the **SOL °C** function is set to the required default temperature.
2. Using pure water clean the cell to be nulled, dry the cell and place in air.
3. Enter the **CAL** mode and **FUNC** mode then step through the functions until **CAL NULL** is displayed.
4. Press **▲** and **▼** together, the display will show a reading (this reading will be taken as zero upon completion). Allow 20 seconds for the reading to stabilise.
5. Press **F**, the display will show **NULL End**. When the instrument returns to normal measure mode the reading from the probe in air will be zero. If any other message is seen refer to section 6.13.

### 6.4 Conductivity/Resistivity/ppm Calibration

After performing the null calibration as previously described place the required probe in a solution of known conductivity/resistivity (for resistivity calibration ensure that the calibration solution resistivity is not above 1M $\Omega$ ) or ppm. Follow the procedure below.

1. Enter the **CAL** mode as previously described and step through the instructions until **CAL 1** appears.
  2. Press **▲** and **▼** together, the display will show a value with **CAL 1** flashing every few seconds. Allow time for this reading to stabilise (typically 20 seconds).
  3. Press and release **F**, the display will show a value with **SCL 1** 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** followed by **CAL 2**. If any other message is seen (see “Error Messages” appendix) then the calibration will need to be repeated. If required a second point, **CAL 2** may now be taken. 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 move on to step 6, if this is not required simply press and release **F** until the **FUNC End** message is seen or press **P** to escape to normal measurement mode.
  6. Clean the probe in pure water then insert into a second solution of known conductivity/resistivity/ ppm (the second solution must be at least 500uS/cm higher (or 10x lower for resistivity or 500 ppm higher) in value from the first solution, see note below if it is not possible to have a 500uS/cm difference (or 10x difference for resistivity or 500 ppm) in the process you are using).
  7. Press **▲** and **▼** together, the display will show a value with **CAL 2** flashing every few seconds. Allow time for this reading to stabilise (typically 20 seconds).
  8. Press and release **F**, the display will show a value with **SCL 2** flashing every few seconds.
  9. Adjust the value displayed to the known solution value using the **▲** and **▼** pushbuttons.
  10. Press and release **F**, the display will show **CAL End** to indicate that calibration is complete.
- Note: If the range you are using does not allow for a 500uS/cm difference (or 10x difference for resistivity or 500 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.



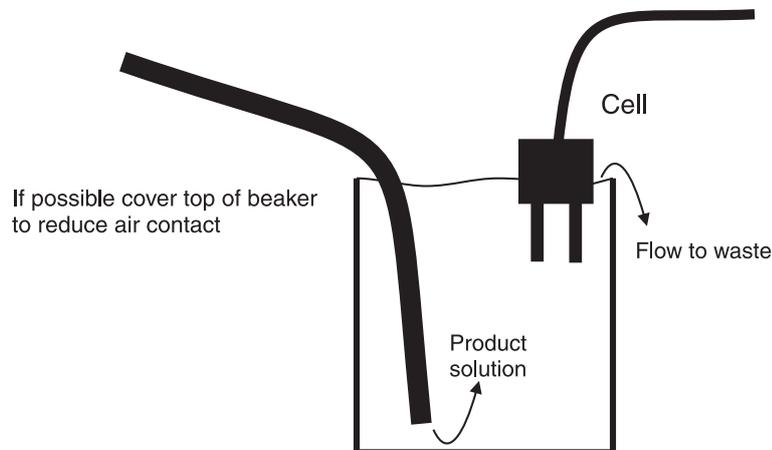
## 6.5 Low conductivity/high resistivity calibration

Low conductivity/high resistivity calibration difficulties often occur due to the fact that once a sample is exposed to air the conductivity will rise rapidly due to the absorption of carbon dioxide and other contaminants. Conductivity standard solutions of low conductivity can also be affected by exposure to air over a period of time. The installation conditions such as pipe diameter and material can affect the reading i.e. if the cell is calibrated outside its normal installation position the calibration may be inaccurate once the cell is installed due to the effect on conductivity paths in the pipe. Ideally calibration should take place with the cell in its normal measuring position and a calibration reference cell and display mounted close to this cell but not so close as to electrically interfere. If this is not possible and the cell has to be removed for calibration then the best way to avoid contamination is to put flowing product solution into the bottom of a container and allow it to flow over the side. The cell is then placed in the solution as shown in the diagram below. Note that when a resistivity display is required and calibration using high resistivity solutions is required the instrument should be set to display conductivity rather than resistivity using the **SEt d: SP** function. The calibration should then take place as a conductivity calibration and when calibrated the display set back to read resistivity. This procedure is necessary since the resistivity null calibration value is too close to high resistivity solution values. The conversion formula is:

$$\text{Resistivity} = \left( \frac{1}{\text{Conductivity/cm}} \right) \times K \text{ factor}$$

e.g. for 0.006 uS/cm conductivity and a K=0.1 cell

$$\text{Resistivity} = \left( \frac{1}{0.006^{-6}} \right) \times 0.1 = 16.67 \text{ MOhms}$$



## 6.6 Temperature Calibration Null

Note: the temperature sensor type should be selected, using the **°C TYPE** function, and appropriate internal links set, prior to calibration. The temperature null calibration function, **°C NULL**, allows the temperature input to be nulled or zeroed. This procedure only needs to be executed upon initial calibration or if the temperature probe is changed. Ensure that correct temperature probe has been selected under the **°C TYPE** function and that appropriate hardware links have been set for the probe type (see the “Hardware Configuration” chapter). Enter the calibration (**CAL**) mode and step through the functions until **°C NULL** is reached. Place a shorting wire across the temperature input terminals (terminals 7, 8 and 9). Press Both **▲** and **▼** together, a temperature value will be displayed then press the **F** button. The message **°C NULL End** should be displayed. If any other message is seen refer to the “Error Messages” appendix.

## 6.7 Temperature Calibration

The temperature calibration is a single point calibration. Place the temperature sensor in an accurately known temperature environment and allow to stabilise. Enter the calibration (**CAL**) mode and step through the functions by pressing the **F** button until the display shows **CAL °C**. Press the **▲** and **▼** simultaneously the display will show **CAL °C** followed by the live temperature reading. Press the **F** button, the display will now show **°C**. Now press the **▲** or **▼** button to set the correct temperature value then press the **F** button, the display will read **CAL End** indicating that the calibration is complete. If any other message is seen refer to section 6.13.

## 6.8 Conductivity/Resistivity/ppm Uncalibration

This function sets the instrument calibration back to the factory calibrated value. Uncalibrate is useful as a temporary measure when the probe is replaced and on the spot recalibration is difficult or when a calibrating error exists due to incorrect calibration. To enter the uncalibrate mode follow the procedure described above and step through the functions by pressing the **F** button until the display shows **UCAL cond** or **UCAL RES** or **UCAL PPM**. Press the **▲** and **▼** pushbuttons simultaneously the display will show **UCAL End** indicating that the calibration is cleared. If any other message is seen refer to section 6.13.

## 6.9 Temperature Uncalibration

This function sets the instrument calibration back to that of an ideal temperature sensor. Uncalibrate is useful as a temporary measure when the probe is replaced and on the spot recalibration is difficult or when a calibrating error exists due to incorrect calibration. To enter the uncalibrate mode follow the procedure described above and step through the functions by pressing the **F** button until the display shows **UCAL °C**. Press the **▲** and **▼** pushbuttons simultaneously the display will show **UCAL End** indicating that the calibration is cleared. If any other message is seen refer to section 6.13.

## 6.10 Equivalent resistance values

Equivalent resistance values The following table shows equivalent resistances for various conductivity levels and cell constants. If errors are encountered in the display value or if difficulties are encountered in calibration then an appropriate value resistor can be used in place of the cell to perform basic checks on the instrument operation. The value of resistance can be calculated from:

$$\text{Conductivity/cm} = \left( \frac{1}{\text{resistivity}} \right) \times K \text{ factor}$$

Some examples are shown in the table below.

Cell K Factor	mS/cm	uS/cm	uS/m	Substitute resistance
K=10.0	100	100,000	10,000,000	100Ω
K=10.0	10	10,000	1,000,000	1,000Ω
K=10.0	1	1,000	100,000	10,000Ω
K=1.0	10	10,000	1,000,000	100Ω
K=1.0	1	1,000	100,000	1,000Ω
K=1.0	0.1	100	10,000	10,000Ω
K=1.0	0.01	10	1,000	100,000Ω
K=0.1	1	1,000	100,000	10Ω
K=0.1	0.1	100	10,000	1,000Ω
K=0.1	0.01	10	1,000	10,000Ω
K=0.1	0.001	1	100	100,000Ω

## 6.11 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:

$$ppm = conductivity (uS/cm) \times PPmFACT$$

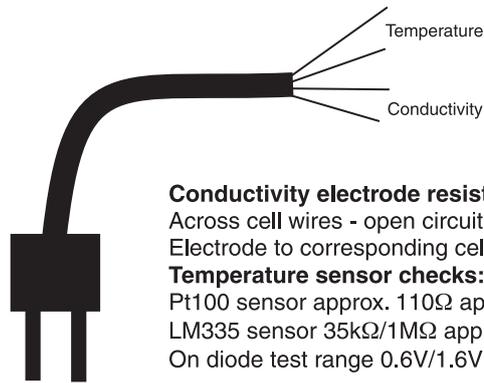
The factor will vary with the composition and concentration of the solution being measured. Suggested ppm factors for four standard solutions are given below. The suggested factors are based on conductivities of approx. 14,000 uS/cm at 25°C. For example the default setting for the instrument is 0.560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

Standard solution	Use	Suggested <b>PPmFACT</b> 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

### Returning to the normal measure mode

When the calibration procedure has been completed, it is advisable to return the instrument to the normal mode (where calibration functions cannot be tampered with). To return to the normal mode turn off power to the instrument, wait a few seconds and then restore power.

## 6.12 Resistance checks on the conductivity cell



### Conductivity electrode resistance checks:

Across cell wires - open circuit for clean, dry cell in air

Electrode to corresponding cell wire - low resistance (fraction of an Ohm)

### Temperature sensor checks:

Pt100 sensor approx. 110Ω approx. at 25°C, 100Ω at zero degrees.

LM335 sensor 35kΩ/1MΩ approx. depending on polarity.

On diode test range 0.6V/1.6V approx. depending on polarity.

## 6.13 Error messages

- **NULL ERR** - Null error. Reading too high when trying to null. Possible causes are wet or dirty cell or faulty cable.
- **°C NULL ERR** - Temperature null error. Over range reading from probe. Possible causes are incorrect link setting, incorrect probe type selected and faulty probe wire.
- **°C OFFSET ERR** - Temperature offset error. The offset required to null the temperature probe was too great. Check probe connections and link settings.
- **----** on temperature reading - This indicates either a faulty temperature sensor or that a temperature sensor type has been selected at the **°C TYPE** function and none is fitted.
- **°C SPAN ERR** - Temperature calibration span error. The temperature for calibration was outside the range allowed i.e. outside the -10°C to 200°C range. Check that correct temperature probe is selected and that correct links are selected.
- **°C GAIN ERR** - Temperature gain error. The temperature gain was more than 10% away from expected gain. Check probe selection and connection is correct, check for faulty probe.
- **NOACCESS** - No access to functions. This message indicates that the attempt to enter **FUNC** mode has failed due to entry being blocked by the **ACCESS** function being set to **NONE**. The only way to gain access to functions in this case is via **CAL** mode.
- **CAL 1 ERR** - Calibration point 1 error. The conductivity or resistivity input is too high, check for correct cell constant selection, check cell for short circuit.
- **CAL 1 SPAN ERR** - Calibration point 1 span error. The **CAL 1** conductivity/resistivity must be at least 5% away of the range of the cell from the null value. Try calibration again with a higher conductivity or lower resistivity solution, ensure than null calibration was correctly carried out.
- **CAL GAIN ERR** - Calibration gain error. The gain value after calibration was more than 10 times higher or lower than expected. Possible causes are incorrect calibration procedure, incorrect cell constant selection or faulty cell.
- **CAL 2 ERR** - Calibration point 2 error. See **CAL 1 ERR**.
- **CAL 2 SPAN ERR** - Calibration point 2 span error. The second calibration point must be at least 5 times greater than the **CAL 1** point and at least 500uS/cm or 10x less for resistivity. Increase the conductivity/resistivity of the solution to at least 500uS/cm or decrease the resistivity by at least 10x and try again or recalibrate **CAL 1** at a lower value.

- **CAL2 GAIN EFF** - Calibration point 2 gain error. See **CAL GAIN EFF**.
- **CAL2 RESIST EFF** - Calibration point 2 resistance error. Indicates that the calibration resistance constant has been calculated at either a negative value or a value greater than 20Ω (i.e. excessive lead resistance). Check cell connections and **CAL2** calibration procedure.

**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 e.g. it may be necessary to change from K=0.1 to K=1. The resistance at any given conductivity level can be found from the formula:

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

e.g. for a K=0.1 cell in a 2000 uS/cm solution the resistance is 50 Ohms (see below) which is not acceptable. Changing to a K=1 cell would result in an acceptable resistance of 500Ω.

$$Resistance = \frac{1}{2000 \times 10^{-6}} \times 0.1 = 50 \text{ Ohms}$$

## 7 Specifications

### 7.1 Technical Specifications

Input:	Conductivity cell (K=0.01, 0.05, 0.1, 0.5, 1.0, 2.0, 5.0, 10 or 100)
Temperature Input:	100Ω RTD, 1000Ω RTD, LM335, 100W thermistor, UU25J1 thermistor or manually set
Measuring Range:	0 to 9999 uS/cm, mS/cm or uS/m, 0 to 18MΩ and -40 to 120°C
Accuracy:	Less than 1% of full scale
Sample Rate:	1 per sec
A/D Converter:	20,000 count Dual Slope integrating
Microprocessor:	MC68HC11F1FN CMOS
Ambient Temperature:	LED -10 to 60°C, LCD -10 to 50°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 Models 4 digit 12.7mm, 6 digit 12.7mm
Power Supply:	AC 240V, 110V or 24V 50/60Hz or DC isolated wide range 12 to 48V. Special supply types 32VAC, 48VAC 50/60Hz or DC isolated 50 to 110V also available. Note: supply type is factory configured
Power Consumption:	AC supply 4 VA max, DC supply, consult supplier typical 80mA at 24VDC, 160mA at 12VDC (depends on display type and options)
Output (standard):	1 x relay, Form, A rated 5A resistive
Relay Action:	Programmable N.O. or N.C.

### 7.2 Output Options

Extra Relays:	Same specs as Relay 1. Up to 6 extra relays can be fitted.
Analog Retransmission:	Isolated 12 bit single or dual channel analog output options are available 4 to 20mA standard, 0 to 1V and 0 to 10V link selectable 4 to 20mA output can drive into 800Ω load maximum. Analog output 1 can be set for PI control, linear or logarithmic (1 to 5 decades) output. Analog output 2 can be set for linear or logarithmic (1 to 5 decades) output.
Serial Communications:	RS232 or RS485
Digital retransmission:	Isolated binary or BCD output up to 16 bit, NPN or PNP output versions.

### 7.3 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		

## 8 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 document is the property of the instrument manufacturer and may not be reproduced in whole or part without the written consent of the manufacturer.

This product is designed and manufactured in Australia.