

**Model PM5-CO**  
**Single or Dual Input**  
**Conductivity/Resistivity/ppm**  
**Panel Mount Display/Controller**  
**Quick Reference Guide**

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# 1 Introduction

This quick reference guide contains basic information for the installation and operation of the single or dual input PM5 Conductivity /Resistivity/ppm Monitor. The complete instruction manual for this instrument can be downloaded from [www.aicpl.com.au](http://www.aicpl.com.au).

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

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

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

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

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

## 1.1 Setup function access levels

Each setup function is assigned a default access level number from 1 to CAL. Three access methods are available. For two of these access levels the user can choose the required access level and then add or remove up to 16 functions to this access level. Level 1 access is by default empty but functions can be allocated to this level if required. For example if relay 1 high alarm and relay 1 hysteresis were the only functions required for regular access then these could both be allocated to

level 1 and access method 1 or 2 below set to allow access to level 1.

The default access levels are shown in the following function table. Refer to the main “Operation and Instruction Manual” for a full table showing function numbers.

## 1.2 Selecting and altering access levels

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

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

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

The access levels available are:

**None** - no access to functions

**1** - access to functions allocated to level 1

**2** - access to functions allocated to level 2

**3** - access to functions allocated to level 3

**4** - access to functions allocated to level 4

**5** - access to functions allocated to level 5

**6** - access to functions allocated to level 6

**CAL** - access to all normal operation functions

## 1.3 Accessing setup functions

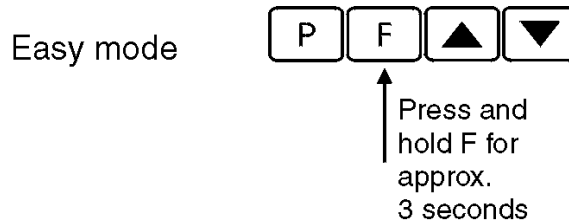
The setup functions allow adjustment of the instruments operation functions. There are five different ways of accessing setup functions. Each mode allows a selection of access levels i.e. allows some choice of which functions are accessible.

As a summary the methods available are:

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

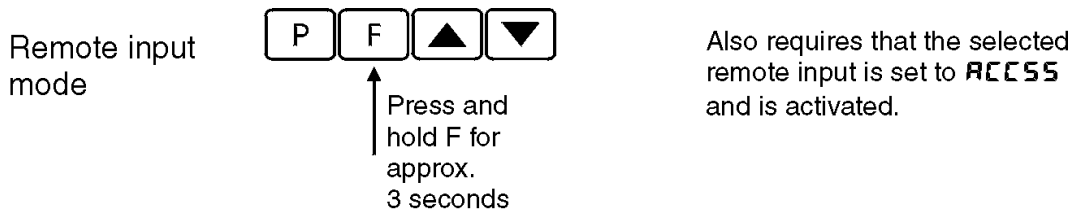
These modes are explained in more detail below.

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



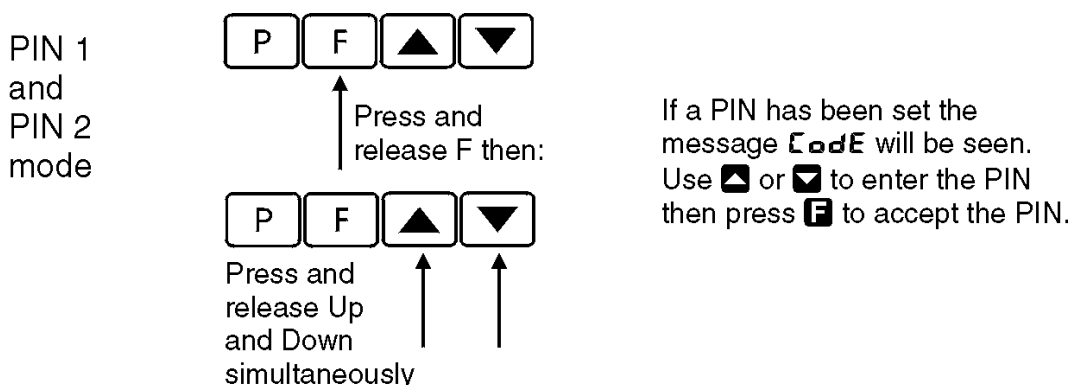
- Remote input mode** - Allows access to the level set by the **REMOTELEVEL** function in the **ACCS** menu. By default the Easy access is set to **CAL** level allowing access to all setup functions.

The remote input mode uses the same access method as the Easy mode but also requires that one of the available remote inputs is set to **ACCESS** and that the selected remote input is activated i.e. shorted to GND. The default access for this level is **NONE** so the access level will need to be changed if access via this method is required.



- PIN 1 mode** - Allows access to the level set by the **USR1LEVEL** function in the **ACCS** menu.

The PIN 1 mode requires the **F** button is pressed and released then within 2 seconds press the **▲** and **▼** buttons at the same time. The PIN can be set via the **PINCODE** function in the **ACCS** menu. A **USR1LEVEL** setting of **0** disables the PIN which means that there is no need to enter the PIN. If the **USR1LEVEL** function has been set to a number other than **NONE** then the first function seen when entering via PIN 1 mode will be the function **CODE**. When this function is seen the PIN value set at the **USR1LEVEL** function must be entered via the **▲** or **▼** pushbuttons followed by pressing **F** to accept the PIN before the user can progress to the setup functions.

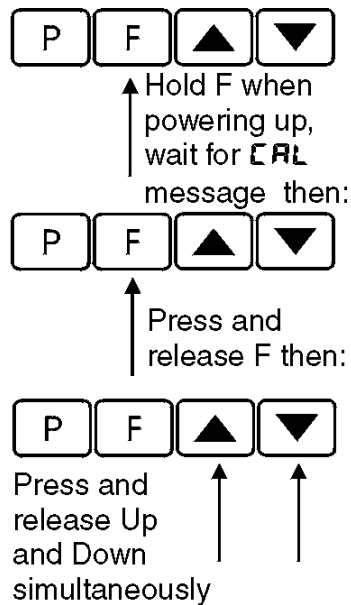


- **PIN 2 mode** - Allows access to the level set by the **USR.2LEVEL** function in the **ACCESS** menu.

This method uses the same access method as PIN 1 mode above. A **PIN.2CODE** setting of **NONE** disables the PIN. If the **USR.1LEVEL** or a **USR.2LEVEL** function has been set to a number other than **NONE** then the first function seen when entering via PIN 1/PIN2 mode will be the function **CODE**. When this function is seen the PIN value set at the **USR.1LEVEL** function can be entered for access to the level set at the **PIN.1ACCESS** function or enter the **USR.2LEVEL** PIN to gain access to the level set at the **PIN.2ACCESS** function. A correct code will allow access to the functions at the selected level. An incorrect code will result in the **FUNC End** message being seen indicating that access to setup functions has been refused and the display will return to normal measurement mode.

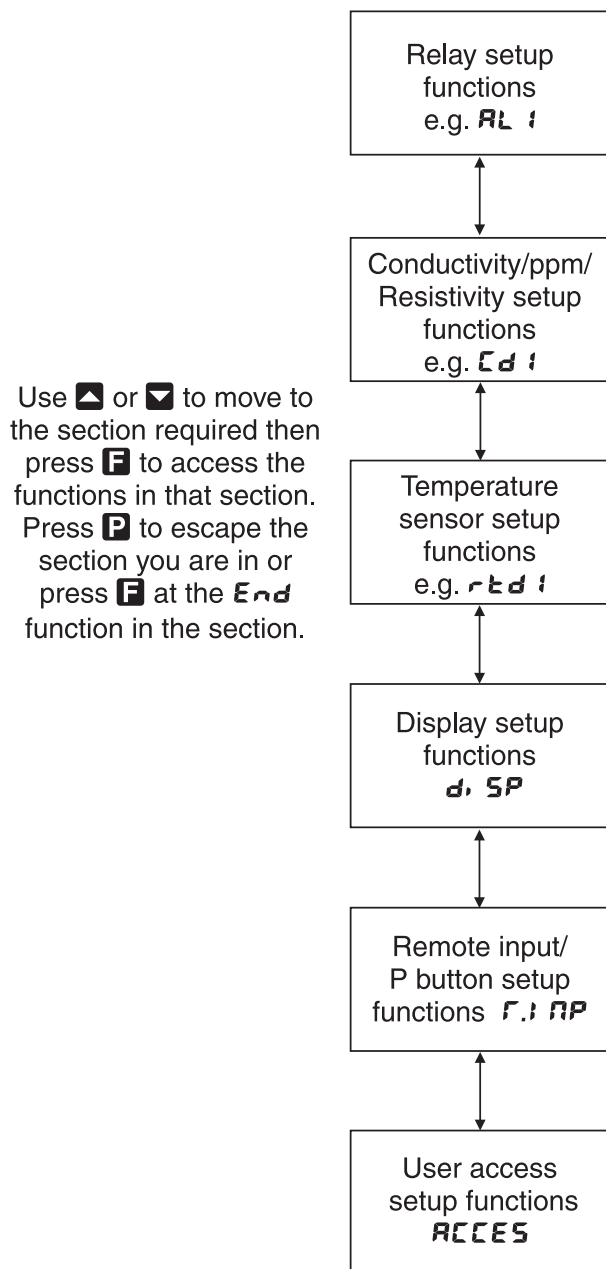
- **Super Cal mode** - This method can be used to gain access to all functions. If a PIN has been set and forgotten use this method to access the PIN functions to check the settings. To access via Super Cal mode with the instrument switched off hold in the **F** button whilst the instrument powers up.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

Super Cal mode

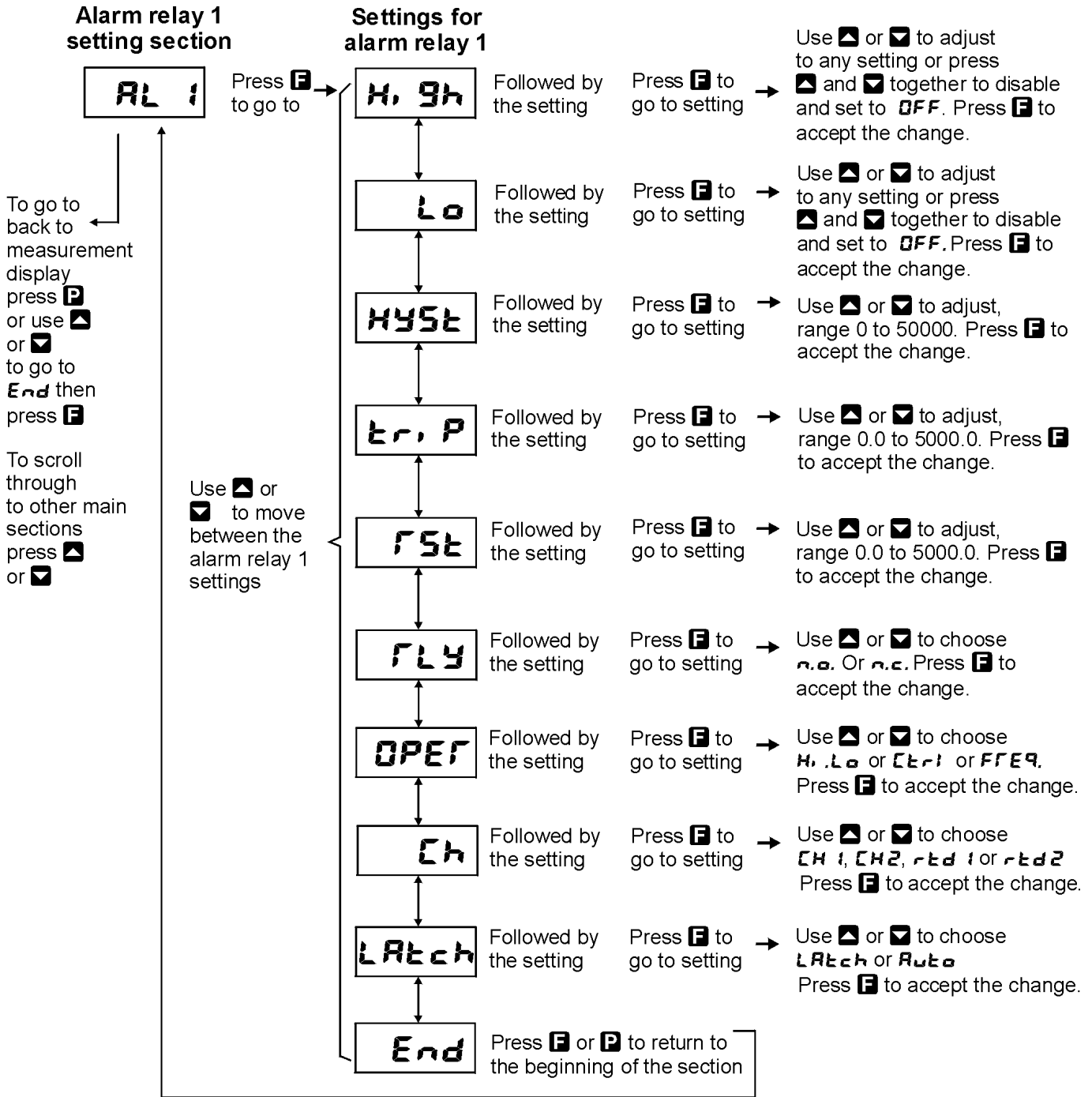


The setup functions are organised in blocks or sections e.g. all the settings for relay 1 are in the **RL 1** section. Once access to setup functions has been gained use the **▲** and **▼** buttons to select the section required then press **F** to enter this section and again use the **▲** and **▼**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

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



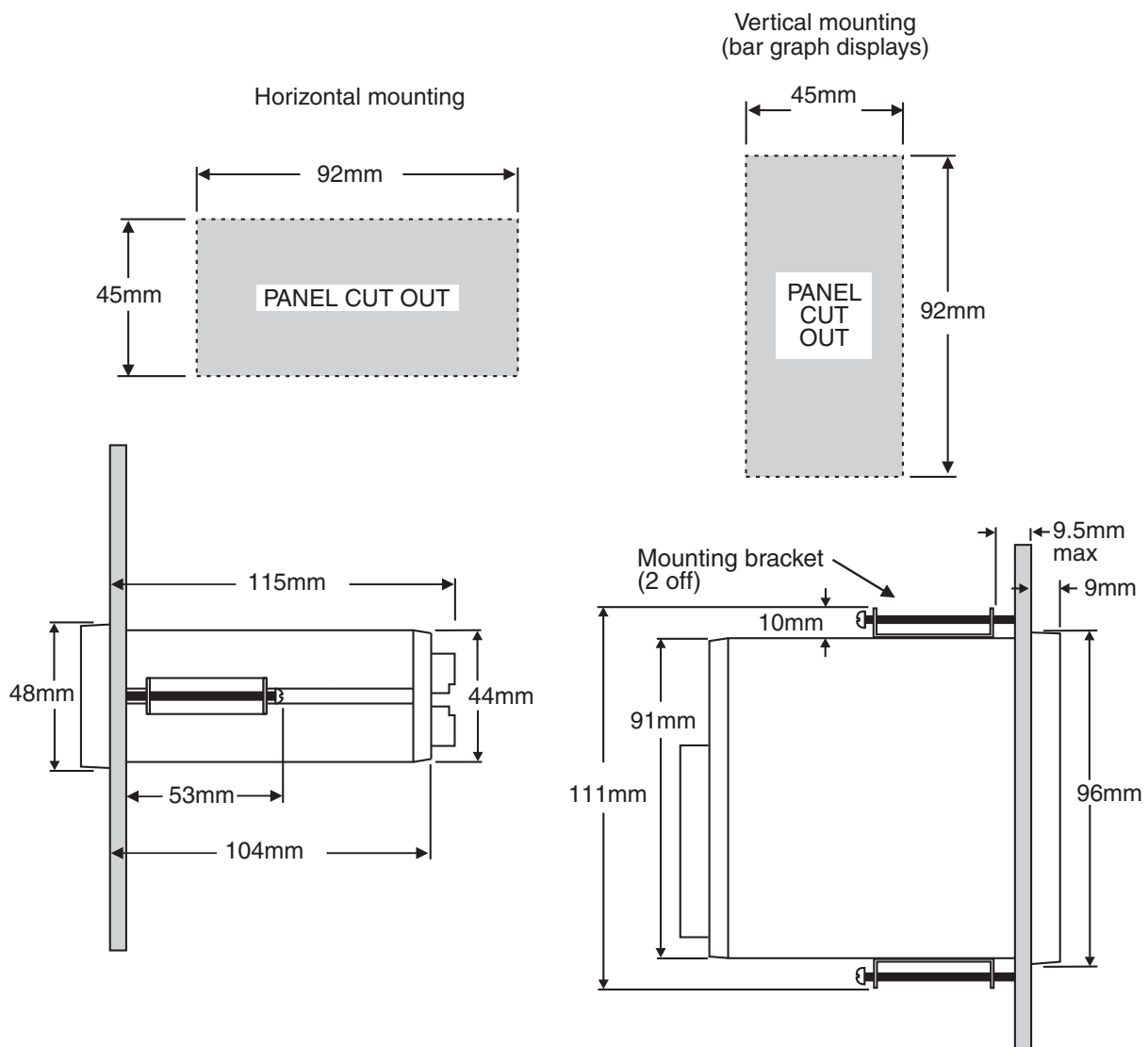
The example in the flowchart below shows the method using alarm relay 1 setup function.



## 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

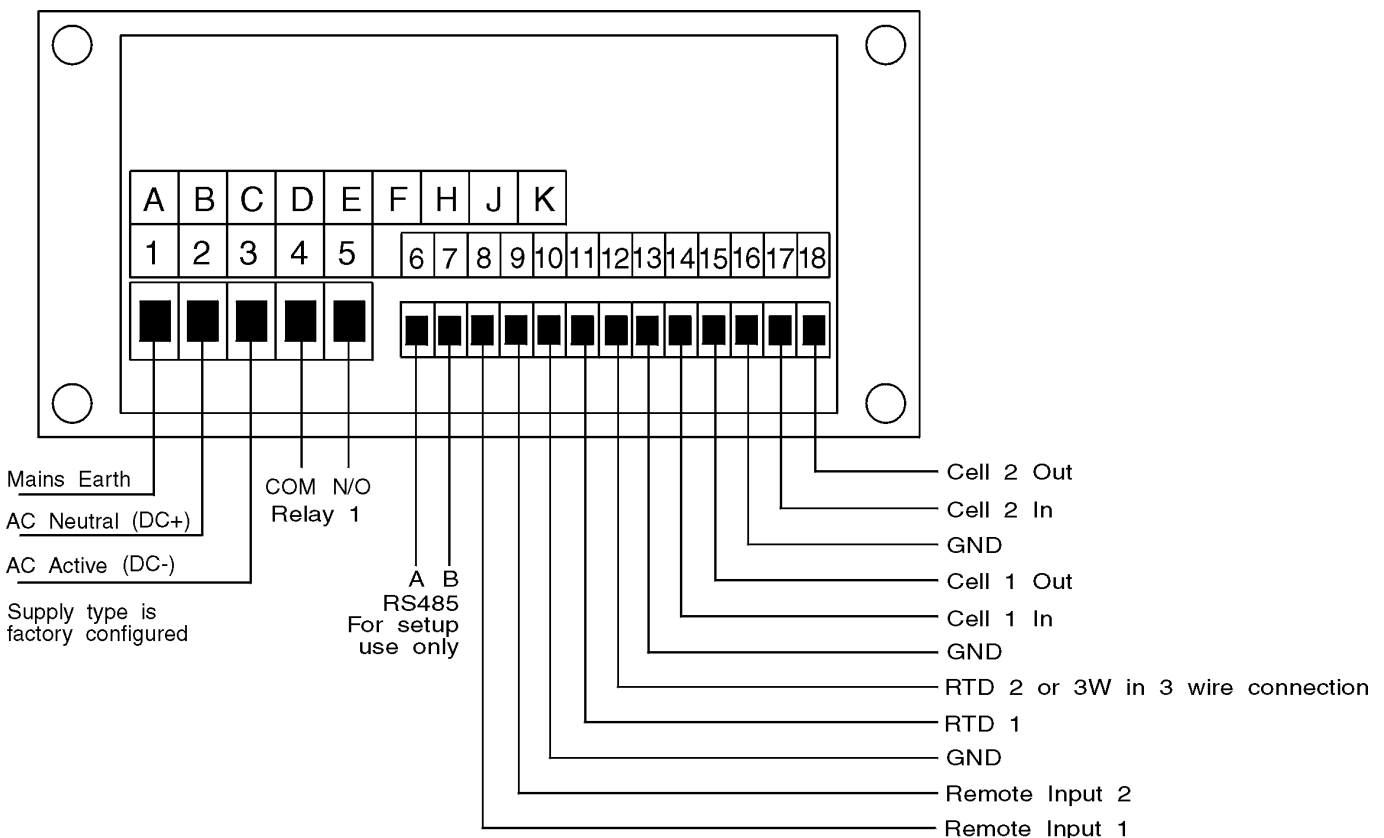
The PM5 Panel Meter is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing.

The plug in, screw type, terminal blocks allow for wires of up to 2.5mm<sup>2</sup> for power, relays and optional outputs and 1.5mm<sup>2</sup> for sensor and other wiring to be fitted. Connect the wires to the appropriate terminals as indicated below. Refer to connection details provided in this chapter to confirm proper selection of voltage, polarity and input type before applying power to the instrument.


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

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

### Rear panel connections



### Instrument label (example)

 AMALGAMATED INSTRUMENT CO PTY LTD 5/28 LEIGHTON PLACE HORNSBY 2077 NSW AUSTRALIA PH 02 9476 2244 FAX 02 9476 2902	
1 MAINS EARTH	
2 240 VAC NEUTRAL	
3 240 VAC ACTIVE	
4 RELAY 1	COM
5 RELAY 2	N/O
6 RS485 A	
7 RS485 B	
8 REMOTE INPUT 1	
9 REMOTE INPUT 2	
10 GND	
11 RTD 1	
12 RTD 2 OR RTD1 3W	
13 GND	
14 CELL 1	IN
15 CELL 1	OUT
16 GND	
17 CELL 2	IN
18 CELL 2	OUT
PMS-C0-240-5E	SERIAL No. : XXXXX-XXX

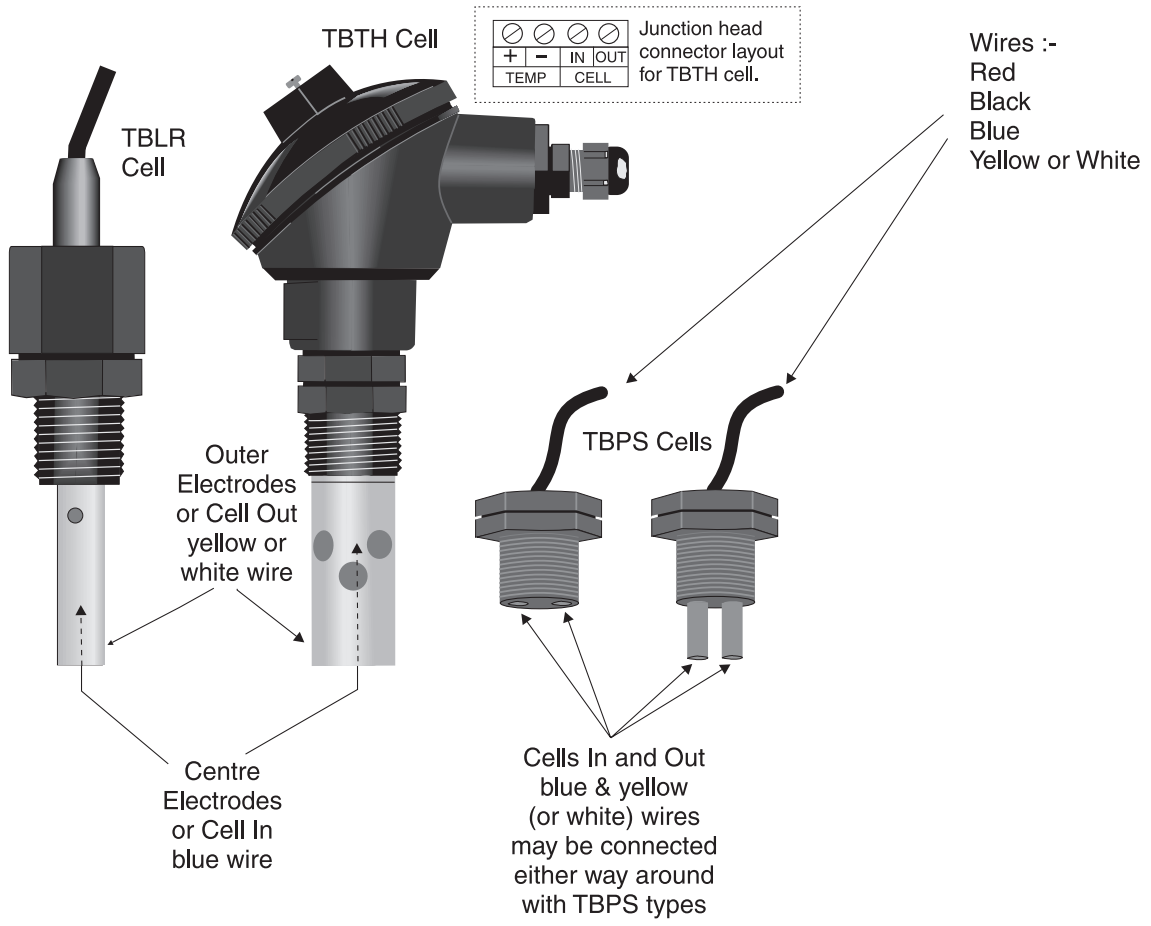
### 3.2 Electrical connection examples

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

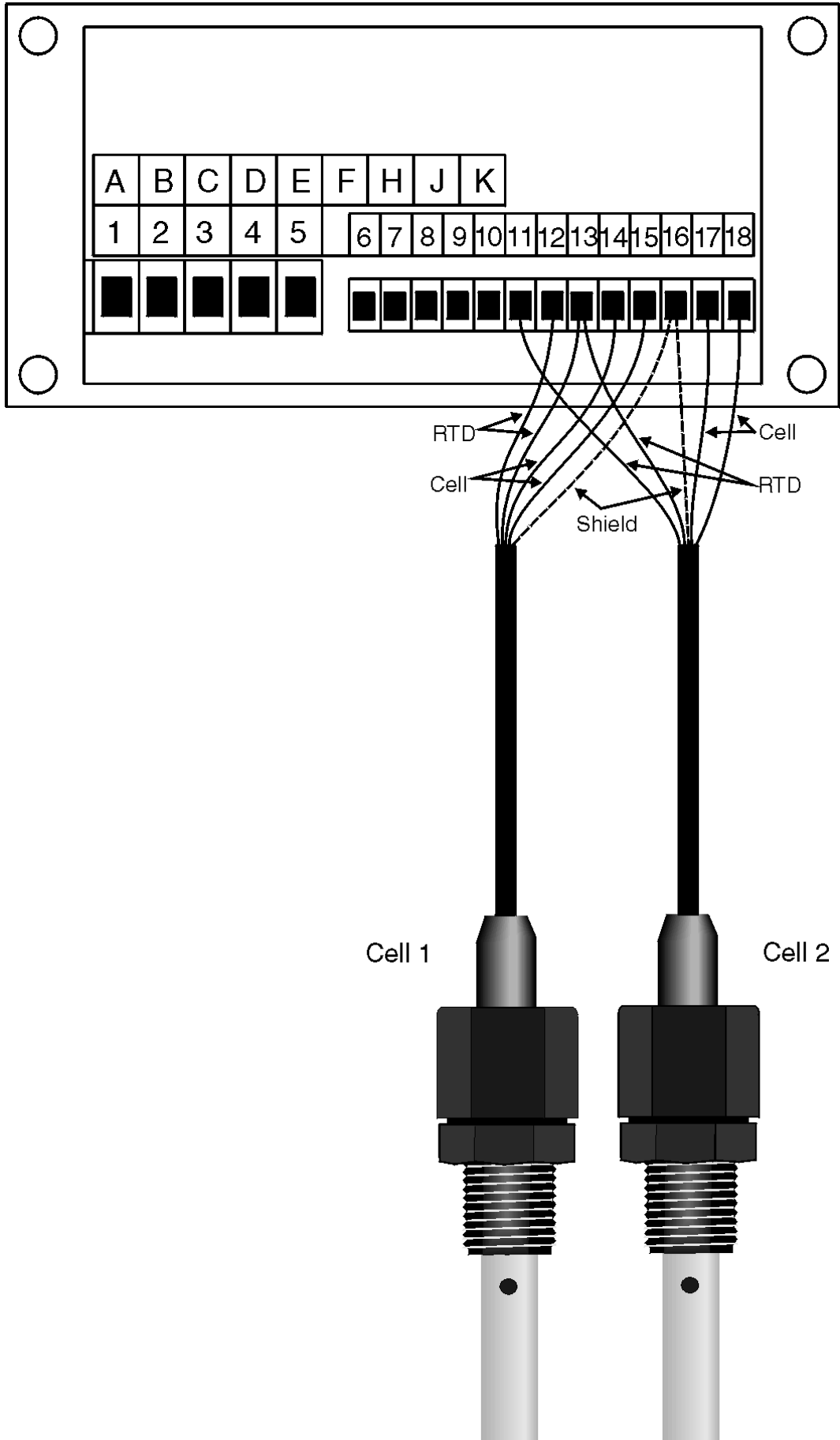
**Conductivity/Resistivity/ppm Cells** - Ensure that the **PFBE CASE** function has been correctly set for probe type. AIC cells with temperature compensation sensors are all wired with Red, Black, Blue and Yellow (or White on older models) inner core cable. See the note below for details of TBPS cells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

The wiring connections are as below.

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

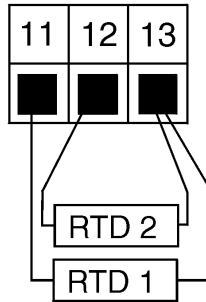


### 3.3 Conductivity cell and temperature sensor wiring example

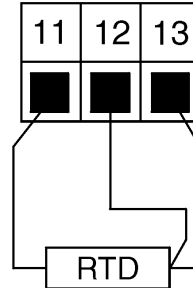


### 3.4 Temperature sensor - in most cases the temperature sensor is housed in the conductivity cell

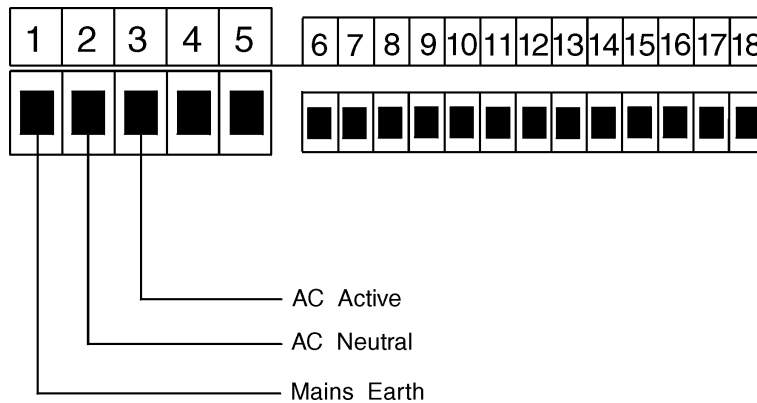
100Ω and 1000Ω RTDs  
2 Wire configuration  
for one or two  
temperature sensors



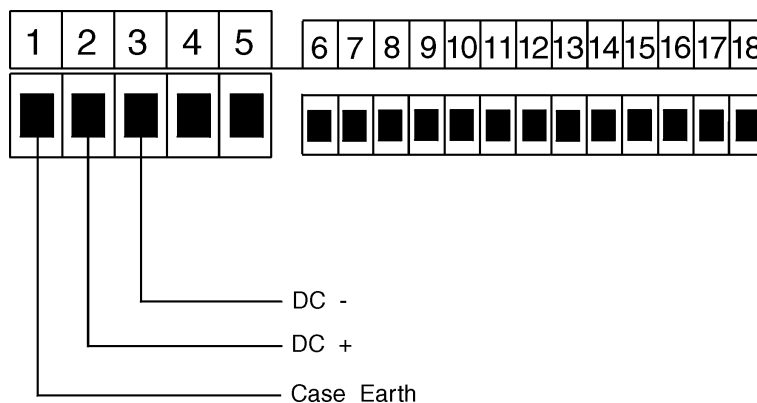
100Ω and 1000Ω RTDs  
3 Wire configuration.  
Single sensor only.



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

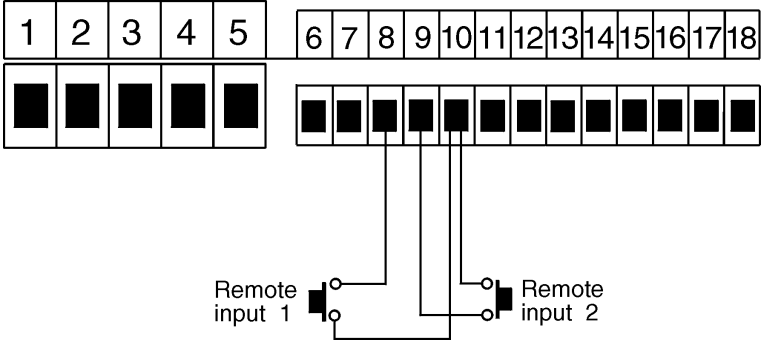


### 3.6 DC power connections (12 to 48VDC) - supply type is factory configured, check before connecting



### 3.7 Remote input connections

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



## 4 Function tables - summary of setup functions

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

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

### 4.1 Alarm relay function table

Display	Function	Range	Default	Your record	Access level
<b>AL x</b> <b>H, 9h</b>	High setpoint value for designated alarm relay <i>x</i>	Any display value or <b>OFF</b>	<b>OFF</b>	See 4.14	<b>2</b>
<b>AL x</b> <b>Lo</b>	Low setpoint value for designated alarm relay <i>x</i>	Any display value or <b>OFF</b>	<b>OFF</b>	See 4.14	<b>2</b>
<b>AL x</b> <b>HYSb</b>	Hysteresis value for the designated alarm relay <i>x</i> .	<b>0</b> to <b>50000</b>	<b>10</b>	See 4.14	<b>3</b>
<b>AL x</b> <b>tr, P</b>	Trip time delay for the designated alarm relay <i>x</i> .	<b>0</b> to <b>5000.0</b>	<b>0</b>	See 4.14	<b>3</b>
<b>AL x</b> <b>rSt</b>	Reset time delay for the designated alarm relay <i>x</i> .	<b>0</b> to <b>5000.0</b>	<b>0</b>	See 4.14	<b>3</b>
<b>AL x</b> <b>FLY</b>	Alarm relay <i>x</i> action to normally open (de-energised) or normally closed (energised)	<b>n.o</b> or <b>n.c</b>	<b>n.o</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>tFAL L</b>	Alarm trailing or setpoint mode	<b>SEt.P</b> or <b>tL 1</b> etc.	<b>SEt.P</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>OPER</b>	Alarm relay operating mode	<b>H, .Lo, ctri</b> or <b>FFe9</b>	<b>H, .Lo</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>Ch</b>	Alarm relay operation input selection	<b>CH 1, CH2,</b> <b>rtd 1</b> or <b>rtd 2</b>	<b>CH 1</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>LAtch</b>	Alarm relay latching operation	<b>Auto</b> or <b>LAtch</b>	<b>Auto</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>SPAN</b>	Relay PI control span	Any display value	<b>100</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>SEtP</b>	Relay PI control setpoint	Any display value	<b>1000</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>P.9</b>	Relay PI control proportional gain value	<b>-32.768</b> to <b>32.767</b>	<b>0.0 10</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>I.9</b>	Relay PI control integral gain value	<b>-32.768</b> to <b>32.767</b>	<b>0.000</b>	See 4.14	<b>4</b>
<b>AL x</b> <b>I.H</b>	Relay PI control integral high limit value	<b>0.0</b> to <b>100.0</b>	<b>100.0</b>	See 4.14	<b>4</b>

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

<b>AL x I.L</b>	Relay PI control integral low limit value	<b>0.0 to 100.0</b>	<b>100.0</b>	See 4.14	<b>4</b>
<b>AL x b, AS</b>	Relay PI control bias	<b>0.0 to 100.0</b>	<b>50.0</b>	See 4.14	<b>4</b>
<b>AL x duty SECS</b>	Relay PI control duty cycle	<b>0.0 to 5000.0</b>	<b>0.0</b>	See 4.14	<b>4</b>
<b>AL x on SECS</b>	Relay PI frequency control “on” time	<b>0.0 to 5000.0</b>	<b>0.0</b>	See 4.14	<b>4</b>

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

## 4.2 Digital output function table

Display	Function	Range	Default	Your record	Access level
<b>d.Out i nPut</b>	Channel for digital retransmission (*Optional)	<b>CH 1, CH 2, rtd 1, rtd 2 or Pcnt</b>	<b>CH 1</b>		<b>CAL</b>
<b>d.Out O.Put</b>	Output mode for digital retransmission (*Optional)	<b>b, n2, b, n, b.5CL or bcd</b>	<b>b, n2</b>		<b>CAL</b>
<b>d.Out Pol</b>	Output polarity for digital retransmission (*Optional)	<b>Lo or Hi, 9h</b>	<b>Lo</b>		<b>CAL</b>
<b>d.Out bcd OFSt</b>	Offset for BCD retransmission (*Optional)	<b>0, 1, 2 or 3</b>	<b>0</b>		<b>CAL</b>
<b>d.Out Lo</b>	Low value for scaled binary retransmission (*Optional)	Any display value	<b>0</b>		<b>4</b>
<b>d.Out Hi, 9h</b>	High value for scaled binary retransmission (*Optional)	Any display value	<b>0</b>		<b>4</b>
<b>d.Out E.Out</b>	Excitation voltage on binary retransmission output (*Optional)	<b>5 or 24</b>	<b>5</b>		<b>CAL</b>

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

## 4.3 Analog output 1 function table

Display	Function	Range	Default	Your record	Access level
<b>FO 1 OutPt</b>	Output selection for analog output 1 (*Optional)	<b>20mA, 10V or 10V</b>	<b>20mA</b>		<b>CAL</b>
<b>FO 1 i nPut</b>	Input selection for analog output 1 (*Optional)	<b>CH 1, CH 2, rtd 1 or rtd 2</b>	<b>CH 1</b>		<b>CAL</b>

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

<b>F01 P.Ct1</b>	Analog output 1 PI control on or off (*Optional)	<b>NO</b> or <b>YES</b>	<b>NO</b>		<b>CAL</b>
<b>F01 Lo</b>	Analog output 1 option low display value (*Optional)	Any display value	<b>0</b>		<b>4</b>
<b>F01 Hi, 9h</b>	Analog output option high display value (*Optional)	Any display value	<b>1000</b>		<b>4</b>
<b>F01 Lo9</b>	Linear or logarithmic analog output selection (*Optional)	<b>Lin</b> or <b>Log</b>	<b>Lin</b>		<b>5</b>
<b>F01 SEtP</b>	Analog output 1 PI control setpoint (*Optional)	Any display value	<b>0</b>		<b>2</b>
<b>F01 SPAn</b>	Analog output 1 PI control span (*Optional)	Any display value	<b>1000</b>		<b>4</b>
<b>F01 P.9</b>	Analog output 1 PI control proportional gain (*Optional)	<b>-32.768</b> to <b>32.767</b>	<b>1.000</b>		<b>4</b>
<b>F01 I.9</b>	Analog output 1 PI control integral gain (*Optional)	<b>-32.768</b> to <b>32.767</b>	<b>0.000</b>		<b>4</b>
<b>F01 I.H</b>	Analog output 1 PI control integral high limit (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>1.000</b>		<b>1.H</b>
<b>F01 I.L</b>	Analog output 1 PI control integral low limit (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>1.000</b>		<b>4</b>
<b>F01 b. AS</b>	Analog output 1 PI control bias (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>0.500</b>		<b>4</b>

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

#### 4.4 Analog output 2 function table

Display	Function	Range	Default	Your record	Access level
<b>F02 OutPt</b>	Output selection for analog output 2 (*Optional)	<b>20mA</b> , <b>10V</b> or <b>10V</b>	<b>20mA</b>		<b>CAL</b>
<b>F02 InPt</b>	Input selection for analog output 2 (*Optional)	<b>CH1</b> , <b>CH2</b> , <b>rtd 1</b> or <b>rtd 2</b>	<b>CH1</b>		<b>CAL</b>
<b>F02 P.Ct1</b>	Analog output 2 PI control on or off (*Optional)	<b>NO</b> or <b>YES</b>	<b>NO</b>		<b>CAL</b>
<b>F02 Lo</b>	Analog output 2 option low display value (*Optional)	Any display value	<b>0</b>		<b>4</b>
<b>F02 Hi, 9h</b>	Analog output option high display value (*Optional)	Any display value	<b>1000</b>		<b>4</b>
<b>F02 Lo9</b>	Linear or logarithmic analog output selection (*Optional)	<b>Lin</b> or <b>Log</b>	<b>Lin</b>		<b>5</b>
<b>F02 SEtP</b>	Analog output 2 PI control setpoint (*Optional)	Any display value	<b>0</b>		<b>2</b>

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

<b>FO2 SPAN</b>	Analog output 2 PI control span (*Optional)	Any display value	<b>1000</b>		<b>4</b>
<b>FO2 P.9</b>	Analog output 2 PI control proportional gain (*Optional)	<b>-32.768</b> to <b>32.767</b>	<b>1.000</b>		<b>4</b>
<b>FO2 I.9</b>	Analog output 2 PI control integral gain (*Optional)	<b>-32.768</b> to <b>32.767</b>	<b>0.000</b>		<b>4</b>
<b>FO2 I.H</b>	Analog output 2 PI control integral high limit (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>1.000</b>		<b>1.H</b>
<b>FO2 I.L</b>	Analog output 2 PI control integral low limit (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>1.000</b>		<b>4</b>
<b>FO2 b. AS</b>	Analog output 2 PI control bias (*Optional)	<b>0.0</b> to <b>100.0</b>	<b>0.500</b>		<b>4</b>

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

#### 4.5 Bargraph display function table

Display	Function	Range	Default	Your record	Access level
<b>bAr9 Ch</b>	Bargraph channel	<b>CH1, CH2,</b> <b>rtd1</b> or <b>rtd2</b>	<b>CH1</b>		<b>CAL</b>
<b>bAr9 TYPE</b>	Bargraph type	<b>bAr, S.dot,</b> <b>d.dot.</b> <b>c.bAr</b> or <b>r.dot</b>	<b>bAr</b>		<b>CAL</b>
<b>bAr9 Lo</b>	Bargraph low value	Any display value	<b>0</b>		<b>CAL</b>
<b>bAr9 Hi</b>	Bargraph high value	Any display value	<b>1000</b>		<b>CAL</b>

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

#### 4.6 Conductivity channel 1 setup function table

Display	Function	Range	Default	Your record	Access level
<b>Ed1 Ed.Ch</b>	Set number of input channels	<b>1</b> or <b>2</b>	<b>1</b>		<b>5</b>
<b>Ed1 dCPE</b>	Decimal point for channel 1	<b>0, 0.1, 0.02</b> or <b>0.003</b>	<b>0</b>		<b>5</b>
<b>Ed1 drnd</b>	Display rounding for channel one	<b>1</b> to <b>5000</b>	<b>1</b>		<b>5</b>
<b>Ed1 Filter</b>	Digital filter for channel 1	<b>0</b> to <b>8</b>	<b>3</b>		<b>5</b>

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

<b>Ed 1 UNIT</b>	Conductivity measuring units for channel 1	<b>uS.cñ, uS.ñ, ñS.cñ or ñS.ñ</b>	<b>uS.cñ</b>		<b>S</b>
<b>Ed 1 SENS</b>	Cell type for channel 1	<b>CELL or COI</b>	<b>CELL</b>		<b>S</b>
<b>Ed 1 FREQ</b>	Drive frequency for channel 1	<b>100, 150, 200, 250, 300, 350 or 400</b>	<b>100</b>		<b>S</b>
<b>Ed 1 SLPE</b>	Solution temperature compensation slope for channel 1	<b>-6.00 to 0.00</b>	<b>-2.00</b>		<b>S</b>
<b>Ed 1 SOL</b>	Solution temperature compensation reference for channel 1	<b>-40.0 to 150.0</b>	<b>25.0</b>		<b>S</b>
<b>Ed 1 PFBE</b>	Cell K factor for channel 1	<b>0.0 1.0.05. 0.1 0.5. 1.0. 2.0.5.0. 10. 20.50 or 100</b>	<b>0.1</b>		<b>S</b>
<b>Ed 1 H.I on</b>	Hydrogen Ion compensation for channel 1	<b>OFF or On</b>	<b>OFF</b>		<b>S</b>
<b>Ed 1 PPM FACT</b>	PPM conversion factor for input 1	<b>0.200 to 2.000</b>	<b>0.560</b>		<b>S</b>
<b>Ed 1 Pcnt FEJ</b>	Percent rejection display enable	<b>OFF or On</b>	<b>OFF</b>		<b>S</b>
<b>Ed 1 U.CAL</b>	Conductivity uncalibration for channel 1	n/a	n/a		<b>CAL</b>
<b>Ed 1 NULL</b>	Conductivity null calibration for channel 1	n/a	n/a		<b>CAL</b>
<b>Ed 1 CAL 1</b>	First point conductivity calibration for channel 1	n/a	n/a		<b>CAL</b>
<b>Ed 1 CAL 2</b>	Second point conductivity calibration for channel 1	n/a	n/a		<b>CAL</b>

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

#### 4.7 Conductivity channel 2 setup function table

Display	Function	Range	Default	Your record	Access level
<b>Ed 2 dCPE</b>	Decimal point for channel 2	<b>0, 0.1, 0.02 or 0.003</b>	<b>0</b>		<b>S</b>

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

<b>Ed2 drnd</b>	Display rounding for channel 2	<b>1 to 5000</b>	<b>1</b>		<b>S</b>
<b>Ed2 Filt</b>	Digital filter for channel 2	<b>0 to 8</b>	<b>3</b>		<b>S</b>
<b>Ed2 unit</b>	Conductivity measuring units for channel 2	<b>µS.cm, µS.ñ, ñS.cm or ñS.ñ</b>	<b>µS.cm</b>		<b>S</b>
<b>Ed2 SENS</b>	Cell type for channel 2	<b>CELL or cell</b>	<b>CELL</b>		<b>S</b>
<b>Ed2 FREQ</b>	Drive frequency for channel 2	<b>100, 150, 200, 250, 300, 350 or 400</b>	<b>100</b>		<b>S</b>
<b>Ed2 SLPE</b>	Solution temperature compensation slope for channel 2	<b>-6.00 to 0.00</b>	<b>-2.00</b>		<b>S</b>
<b>Ed2 SOL</b>	Solution temperature compensation reference for channel 2	<b>-40.0 to 150.0</b>	<b>25.0</b>		<b>S</b>
<b>Ed2 PFbE</b>	Cell K factor for channel 2	<b>0.0 1.0 05. 0.1 0.5. 1.0. 2.0. 5.0. 10. 20. 50 or 100</b>	<b>0.1</b>		<b>S</b>
<b>Ed2 H.ion</b>	Hydrogen Ion compensation for channel 2	<b>OFF or On</b>	<b>OFF</b>		<b>S</b>
<b>Ed2 PPM FACT</b>	PPM conversion factor for input 2	<b>0.200 to 2.000</b>	<b>0.560</b>		<b>S</b>
<b>Ed2 U.CAL</b>	Conductivity uncalibration for channel 2	n/a	n/a		<b>CAL</b>
<b>Ed2 NULL</b>	Conductivity null calibration for channel 2	n/a	n/a		<b>CAL</b>
<b>Ed2 CAL 1</b>	First point conductivity calibration for channel 2	n/a	n/a		<b>CAL</b>
<b>Ed2 CAL 2</b>	Second point conductivity calibration for channel 2	n/a	n/a		<b>CAL</b>

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

#### 4.8 Temperature sensor 1 function table

Display	Function	Range	Default	Your record	Access level
<b>rtd 1 INPt</b>	Temperature sensor configuration	<b>rtd3, rtd2 or 2rtd</b>	<b>rtd3</b>		<b>CAL</b>

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

<b>rt d 1 t y p e</b>	Temperature sensor type for channel 1	<b>100, 1000 or NONE</b>	<b>100</b>		<b>CAL</b>
<b>rt d 1 d e f °C</b>	Manual temperature setting for input 1	<b>-40.0 to 200.0</b>	<b>25.0</b>		<b>2</b>
<b>rt d 1 U.CAL</b>	Temperature uncalibration for input 1	<b>No or YES</b>	<b>No</b>		<b>CAL</b>
<b>rt d 1 O B O O</b>	First calibration point for temperature input 1	n/a	n/a		<b>CAL</b>
<b>rt d 1 C A L 2</b>	Second calibration point for temperature input 1	n/a	n/a		<b>CAL</b>

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

#### 4.9 Temperature sensor 2 function table

Display	Function	Range	Default	Your record	Access level
<b>rt d 2 t y p e</b>	Temperature sensor type for channel 2	<b>100, 1000 or NONE</b>	<b>100</b>		<b>CAL</b>
<b>rt d 2 d e f °C</b>	Manual temperature setting for input 2	<b>-40.0 to 200.0</b>	<b>25.0</b>		<b>2</b>
<b>rt d 2 U.CAL</b>	Temperature uncalibration for input 2	<b>No or YES</b>	<b>No</b>		<b>CAL</b>
<b>rt d 2 C A L 1</b>	First calibration point for temperature input 2	n/a	n/a		<b>CAL</b>
<b>rt d 2 C A L 2</b>	Second calibration point for temperature input 2	n/a	n/a		<b>CAL</b>

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

#### 4.10 Display function table

Display	Function	Range	Default	Your record	Access level
<b>d, SP d F i t</b>	Default display	<b>CH 1, CH 2, rt d 1, rt d 2 to Pcnt</b>	<b>CH 1</b>		<b>1</b>
<b>d, SP b r g t</b>	Display brightness	<b>1 to 16</b>	<b>3</b>		<b>3</b>
<b>d, SP d u l l</b>	Dimmed display brightness	<b>0 to 16</b>	<b>3</b>		<b>3</b>

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

#### 4.11 P button and remote inputs function table

Display	Function	Range	Default	Your record	Access level
<i>F.I NP</i> <i>P.but</i>	Front P button operation mode	<i>NONE .P.H. .</i> <i>P.Lo.H. .Lo</i> or <i>AL.Ac</i>	<i>NONE</i>		<b>3</b>
<i>F.I NP</i> <i>F.I N. 1</i>	Remote input 1 operation mode	<i>NONE .</i> <i>P.Hol d.</i> <i>d.Hol d.</i> <i>P.H. .P.Lo .</i> <i>H. .Lo .AL.Ac</i> or <i>ACCESS</i>	<i>NONE</i>		<i>F.I N. 1</i>
<i>F.I NP</i> <i>F.I N. 2</i>	Remote input 2 operation mode	<i>NONE .</i> <i>P.Hol d.</i> <i>d.Hol d.</i> <i>P.H. .P.Lo .</i> <i>H. .Lo .AL.Ac</i> or <i>ACCESS</i>	<i>NONE</i>		<b>3</b>

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

## 4.12 Access control function table

Display	Function	Range	Default	Your record	Access level
<b>ACCESS EASY LEVEL</b>	Easy access mode	<i>None</i> , 1, 2, 3, 4, 5, 6 or <i>CAL</i>	<i>None</i>		<i>CAL</i>
<b>ACCESS Fingerprint LEVEL</b>	Remote input access mode	<i>None</i> , 1, 2, 3, 4, 5, 6 or <i>CAL</i>	<i>None</i>		<i>CAL</i>
<b>ACCESS USr.1 Pin</b>	PIN code 1	0 to 50000	0		<i>CAL</i>
<b>ACCESS USr.1 LEVEL</b>	PIN code 1 access level	<i>None</i> , 1, 2, 3, 4, 5, 6 or <i>CAL</i>	0		<i>CAL</i>
<b>ACCESS USr.2 Pin</b>	PIN code 2	0 to 50000	0		<i>CAL</i>
<b>ACCESS USr.2 LEVEL</b>	PIN code 2 access level	<i>None</i> , 1, 2, 3, 4, 5, 6 or <i>CAL</i>	0		<i>CAL</i>
<b>ACCESS Fn.1 Code</b>	User assignable access function 1	000 to FFFF hex.	000		<i>CAL</i>
<b>ACCESS Fn.1 LEVEL</b>	User assignable access 1 level value	<i>digit</i> , 1, 2, 3, 4, 5, 6, <i>CAL</i> or <i>None</i>	<i>digit</i>		<i>CAL</i>
<b>ACCESS Fn.2 Code</b>	User assignable access function 2	000 to FFFF hex.	000		<i>CAL</i>
<b>ACCESS Fn.2 LEVEL</b>	User assignable access 2 level value	<i>digit</i> , 1, 2, 3, 4, 5, 6, <i>CAL</i> or <i>None</i>	<i>digit</i>		<i>CAL</i>
<b>ACCESS Fn.3 Code</b>	User assignable access function 3	000 to FFFF hex.	000		<i>CAL</i>
<b>ACCESS Fn.3 LEVEL</b>	User assignable access 3 level value	<i>digit</i> , 1, 2, 3, 4, 5, 6, <i>CAL</i> or <i>None</i>	<i>digit</i>		<i>CAL</i>
<b>ACCESS Fn.4 Code</b>	User assignable access function 4	000 to FFFF hex.	000		<i>CAL</i>
<b>ACCESS Fn.4 LEVEL</b>	User assignable access 4 level value	<i>digit</i> , 1, 2, 3, 4, 5, 6, <i>CAL</i> or <i>None</i>	<i>digit</i>		<i>CAL</i>

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

### 4.13 Serial communications function table

Display	Function	Range	Default	Your record	Access level
<b>SERi OPER</b>	Serial operation mode (*Optional)	<b>None . Cont . Poli or R.buS</b>	<b>None</b>		<b>CAL</b>
<b>SERi bAud</b>	Serial baud rate (*Optional)	<b>1200 . 2400 . 4800 . 9600 . 19200 . 38400 . 57600 or 115200</b>	<b>9600</b>		<b>CAL</b>
<b>SERi Prty</b>	Serial parity (*Optional)	<b>None . EvEn or Odd</b>	<b>None</b>		<b>CAL</b>
<b>SERi Unit Addr</b>	Serial address (*Optional)	<b>1 to 255</b>	<b>1</b>		<b>CAL</b>

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

### 4.14 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>H. 9h</b>							
<b>Lo</b>							
<b>HYSL</b>							
<b>tr. P</b>							
<b>rSt</b>							
<b>rLY</b>							
<b>Ch</b>							
<b>LAtch</b>							
<b>OPER</b>			n/a	n/a	n/a	n/a	n/a
<b>SPAN</b>			n/a	n/a	n/a	n/a	n/a
<b>SEtP</b>			n/a	n/a	n/a	n/a	n/a
<b>P.9</b>			n/a	n/a	n/a	n/a	n/a
<b>i.9</b>			n/a	n/a	n/a	n/a	n/a
<b>i.H</b>			n/a	n/a	n/a	n/a	n/a
<b>i.L</b>			n/a	n/a	n/a	n/a	n/a
<b>b. AS</b>			n/a	n/a	n/a	n/a	n/a
<b>duTYSECS</b>			n/a	n/a	n/a	n/a	n/a
<b>onSECS</b>			n/a	n/a	n/a	n/a	n/a

## 5 Calibration

### 5.1 Introduction

A null calibration feature (see **NULL**) allows the probe to be referenced to the instrument at a zero conductivity level. A null calibration should be undertaken before a single or two point calibration to ensure that the probe and instrument are matched. Before calibrating the instrument it is also important to ensure that the correct cell constant has been chosen. The **CAL 1** function together with the **NULL** function sets the calibration slope, the **CAL 2** calibration function can be used to compensate for head resistance when long cable lengths are used.

When using a temperature probe temperature calibration is carried out with the **0800** and **CAL 2** functions, ensure that the correct temperature probe type has been selected (see **TYPE**). If a temperature compensation sensor is used it is essential that the temperature input is reading correctly before performing a conductivity calibration. If necessary calibrate the temperature input before the conductivity input.

### 5.2 Conductivity/Resistivity/ppm Calibration Null

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

1. If calibration problems have been experienced for either temperature or conductivity then prior to calibration uncalibrate the display using the temperature or conductivity **U.CAL** function. Uncalibrating the display returns the calibration settings to factory default values and clears any incorrect calibration attempts which may be stored in memory.
2. If a temperature compensation sensor is used check that the temperature reading is correct and calibrate the temperature reading if necessary, see “Temperature Calibration Null” and “Temperature Calibration” sections in this chapter. Also check that the **SLOPE** function is correctly set. If no temperature sensor is being used check that the **TYPE** is set to **NONE** and that the **DEF °C** function is set to the required default temperature.
3. Using pure water clean the cell to be nulled, dry the cell and place in air.
4. Enter the setup functions and step through the functions until the channel to be null is reached e.g. **CD 1**. Press **F** to access the channel setup and then press and release the **▲** pushbutton until **NULL** is displayed.
5. Press **F** the display will show the message **No**. Use the **▲** or **▼** pushbutton to toggle this to **YES** then press **F** to accept this. The display will show a value which should be zero or very close to zero.
6. Press **F**, the display will show **CAL End** indicating that the selected channel has been successfully nulled.

### 5.3 Conductivity/Resistivity/ppm Calibration

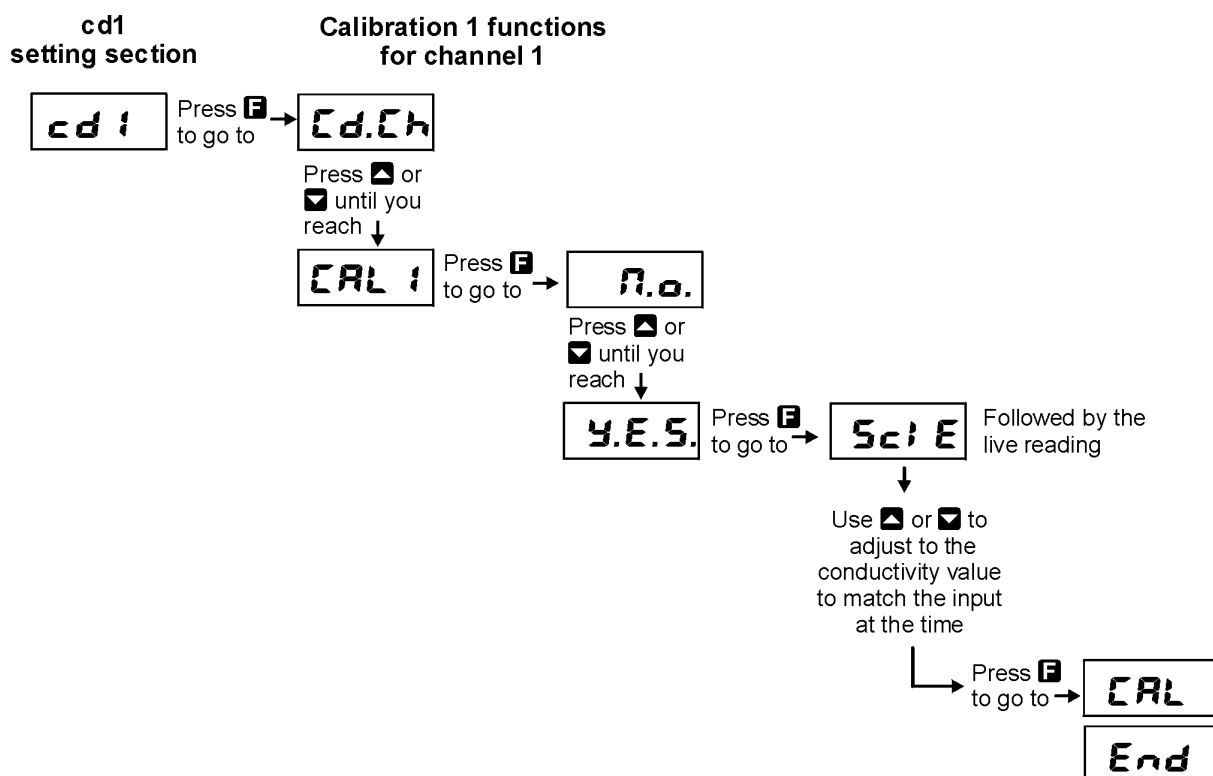
After performing the null calibration as previously described place the required probe in a solution of known conductivity/resistivity (for resistivity calibration ensure that the calibration solution

resistivity is not above  $1M\Omega$ ) and that the solution is within the measuring range of the cell. Follow the procedure below.

### First calibration point

1. Enter the setup functions and step through the functions until the channel to be calibrated is reached e.g. **cd 1**. Press **F** to access the channel setup and then press and release the **▲** pushbutton until **CAL 1** is displayed.
2. Press **F** the display will show the message **n.o.**. Use the **▲** or **▼** pushbutton to toggle this to **YES** then press **F** to accept this. The display will show the **CAL 1** followed by a value which should be close to the value of the calibration solution. Allow the reading to stabilise (typically 20 – 30 seconds).
3. Press and release **F**, the display will show the message (channel number e.g. **cd 1**) followed by **CAL 1 ScI E** followed by a value.
4. Use the **▲** or **▼** pushbutton to adjust the displayed value to that of the calibration solution then press **F** to accept the new calibration scaling.
5. Press and release **F**, the display will show **CAL End** to indicate that the calibration scaling has been accepted..

**Channel 1 calibration point 1 flow chart** Note: The cell must be placed in a known conductivity solution and the conductivity reading and temperature reading allowed to stabilise prior to following these steps.

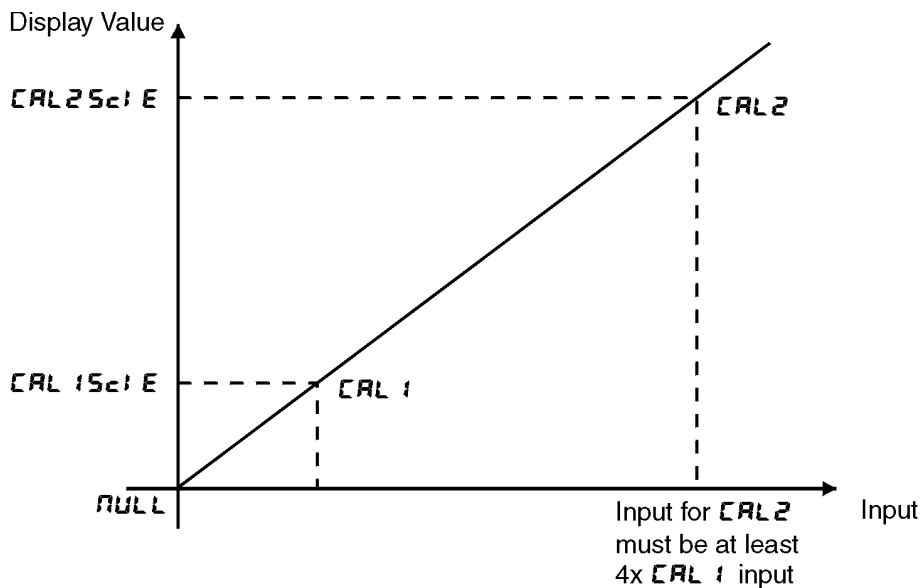


### Second calibration point

If required a second point, **CAL2** may now be undertaken. The second calibration point is normally used only to compensate for head resistance when long cell cables are used or to improve linearity when measuring over a wide conductivity range. In many installations the second point is not required. If the second point is required follow the sequence below.

1. Clean the probe in pure water then insert into a second solution of known conductivity/resistivity/ppm (the second solution must be at least 4x higher (or 10x lower for resistivity or 4x ppm higher) in value from the first solution, see note below if it is not possible to have a 4x difference (or 10x difference for resistivity or 4x ppm) in the process you are using).
2. At the **CAL2** function press **F** then use the **▲** or **▼** pushbutton to select **YES** and press **F**. The display will show the the live conductivity reading from the cell. Allow time for this reading to stabilise (typically 20 – 30 seconds).
3. Press and release **F**, the display will show a value with **cd 1** (or **cd 2** if cell 2 is being calibrated) **CAL2 Sc! E** flashing every few seconds.
4. Adjust the value displayed to the known solution value using the **▲** and **▼** pushbuttons.
5. Press and release **F**, the display will show **CAL End** to indicate that the second calibration point has been accepted.

Note: If the range you are using does not allow for a 4x difference (or 10x difference for resistivity or 4x 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.



## 5.4 Conductivity/Resistivity/ppm Uncalibration

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

1. Enter the setup functions and step through the functions until the channel to be calibrated is reached e.g. **cd 1**. Press **F** to access the channel setup and then press and release the **▲** pushbutton until **U.CAL** is displayed.
2. Press **F** the display will show the message **No**. Use the **▲** or **▼** pushbutton to toggle this to **YES** then press **F** to accept this. The display will show the message **UCAL End** to indicate that the uncalibration is complete.

## 5.5 Temperature Calibration

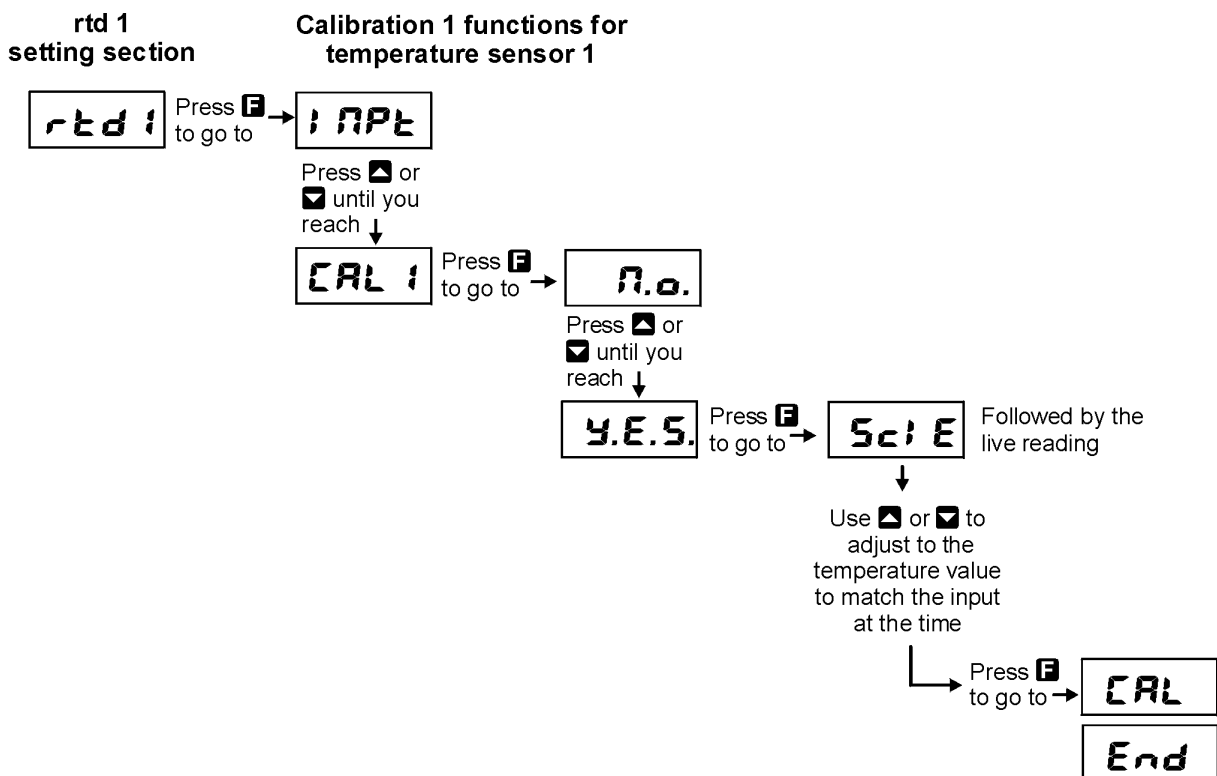
A two point calibration is provided for temperature sensors. The two point calibration requires that the sensor is allowed to stabilise at two known temperatures. Ideally the temperatures chosen should span the normal temperature measurement range of the process being measured. A minimum difference of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

The calibration procedure is as follows:

### First calibration point

1. Place the sensor to be calibrated at a known low temperature and allow 5 minutes to stabilise.
2. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. `rtd 1`. Press **F** to access the channel setup and then press and release the **▲** pushbutton until `CAL 1` is displayed.
3. Press **F** the display will show the message `n.o.` Use the **▲** or **▼** pushbutton to toggle this to `y.e.s.` then press **F** to accept this. The display will show the temperature. When the temperature is stable press **F**.
4. The display will show the message `ScI E` followed by a value. Use the **▲** or **▼** pushbuttons to adjust the value to the known low temperature value. Then press **F** to accept this.
5. The display will show the message `CAL End` to indicate that the first calibration point has been accepted.

### Channel 1 temperature calibration point 1 flow chart



### Second calibration point

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

2. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. **F t d 1**. Press **F** to access the channel setup and then press and release the **▲** pushbutton until **1** is displayed.
3. Press **F** the display will show the message **No**. Use the **▲** or **▼** pushbutton to toggle this to **YES** then press **F** to accept this. The display will show the temperature. When the temperature is stable press **F**.
4. The display will show the message **ScI E** followed by a value. Use the **▲** or **▼** pushbuttons to adjust the value to the known low temperature value. Then press **F** to accept this.
5. The display will show the message **CAL End** to indicate that the second calibration point has been accepted.

## 5.6 Temperature Uncalibration

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

1. Enter the setup functions and step through the functions until the temperature channel to be calibrated is reached e.g. **F t d 1**. Press **F** to access the channel setup and then press and release the **▲** pushbutton until **1** is displayed.
2. Press **F** the display will show the message **No**. Use the **▲** or **▼** pushbutton to toggle this to **YES** then press **F** to accept this. The display will show the message **UCAL End** to indicate that the uncalibration is complete.

## 5.7 Standard ppm conversion factors

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

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

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

Standard solution	Use	Suggested <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

## 6 Specifications

### 6.1 Technical Specifications

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

### 6.2 Output Options

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

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

### 6.3 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		

## 7 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.