Model RM4-CO
Conductivity/Resistivity/ppm
DIN Rail Mount Display/Controller
Operation and Instruction Manual

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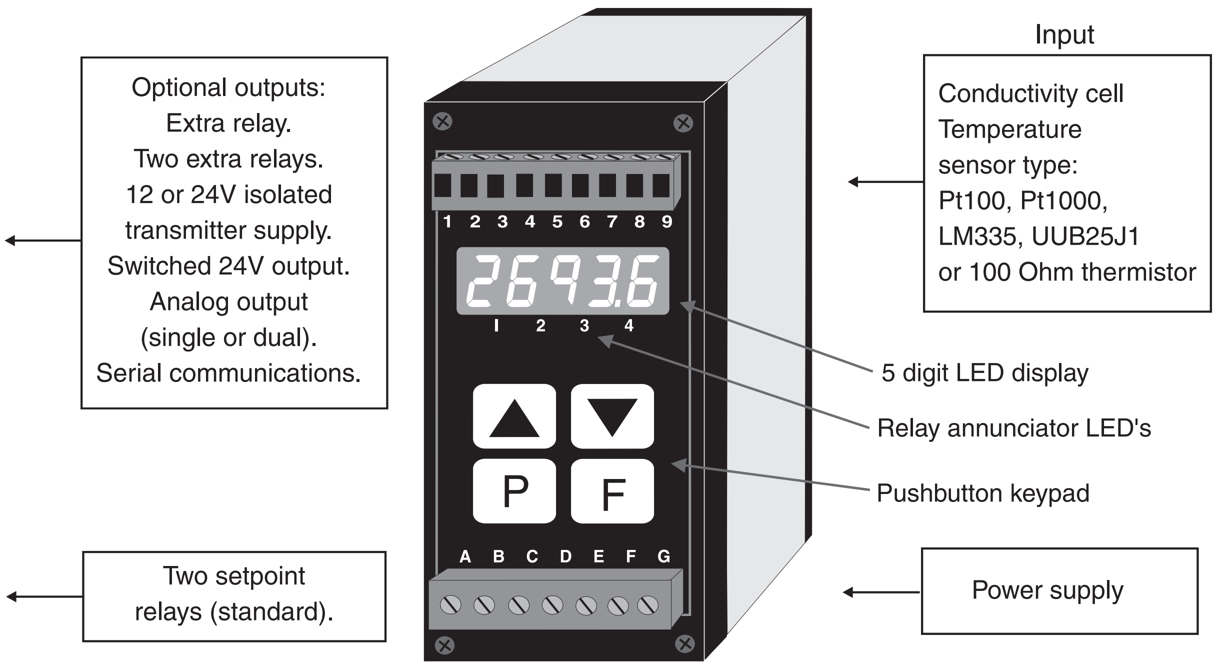
1 Introduction

This manual contains information for the installation and operation of the RM4 Conductivity /Resistivity/ppm Monitor. The RM4-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. Note that the RM4-CO can only display 5 digits so mS/cm or mS/m ranges may have to be used at higher conductivities.

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

A second input is provided for a temperature sensor to be used for automatic temperature compensation. The RM4-CO can accept 100Ω RTD (Pt100), 1000Ω RTD (Pt1000), 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 using the push buttons. Two standard inbuilt relays are provided for alarm/control, 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 RM4 has been factory set to a standard configuration. Like all other RM4 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 RM4, thereby eliminating grounding and common voltage problems. This isolation feature makes the RM4 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.

The RM4 series of DIN Rail 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. A feature of the RM4 is the programmable display brightness function. This allows the unit to be operated in low display brightness to reduce power consumption and improve readability in darker areas. To reduce power consumption in normal use the display can be programmed to automatically blank after a set time. When the display has blanked it can be returned to normal brightness by pressing any of the front pushbuttons and it will also return to normal brightness if a relay becomes activated.

1.1 Output options

- Third relay rated 0.5A resistive 30VAC or DC. May be configures as form A or C if the third relay is the only option fitted
- Fourth relay rated 0.5A resistive 30VAC or DC, form A
- Isolated analog retransmission (12 or 16 bit versions available) configurable for 4–20mA, 0–1V or 0–10V. The analog output is configurable for retransmission or PI control

- Dual isolated analog retransmission (12 bit) configurable for 4–20mA, 0–1V or 0–10V. The first analog output is configurable for retransmission or PI control
- Isolated RS485 or RS232 serial communications (ASCII (8 bit) or Modbus RTU)
- 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 80Ω or higher for accurate measurement. To overcome this problem cells with different sensitivity levels are manufactured and this sensitivity level is known as the K factor. A cell with a higher K factor will use less current in a given solution than a cell with a lower K factor. See the table at the beginning of this chapter for typical measuring ranges for common K factor cells. The correct K factor cell should be chosen to suit the range required for measurement.

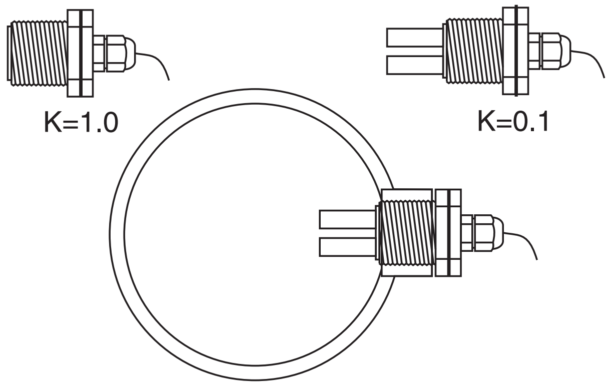
Temperature compensation - Since conductivity changes with temperature the conductivity value displayed is referenced to a given temperature, usually 25^{o}C. This means that the value being seen on the display is not necessarily the actual conductivity of the solution at that time but is the conductivity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

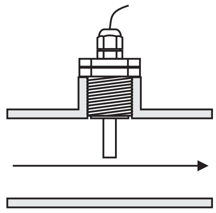
This instrument allows for either manual or automatic temperature compensation. If no temperature sensor is used with the cell then the known temperature of the solution can be entered at the **dEF °C** function. If a temperature sensor is used the the reading obtained from this sensor can be used to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

1.3 Cell Installation

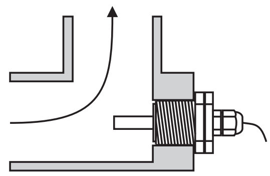
When installing conductivity cells it is important to locate the cell in a position where the pipe is always completely full. The cell electrodes must be in complete contact with the water sample. If air is trapped around the cell electrode it will cause errors in the measurement. If oil, grease or any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

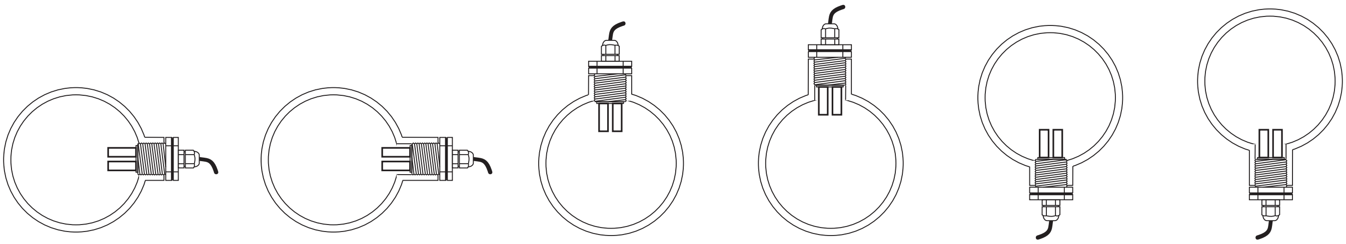




Modified ‘T’ fitting
for in-line flow
(horizontal or vertical)

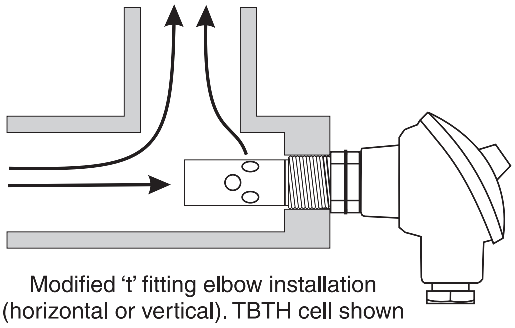


Modified ‘T’ fitting
elbow installation
(horizontal or vertical)

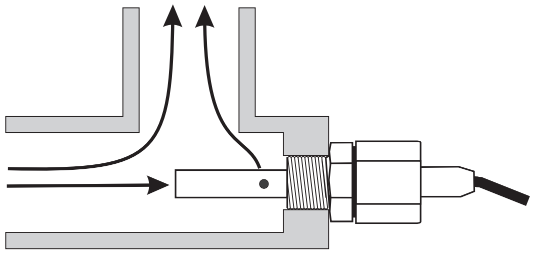


Ideal Installation method | Acceptable, slightly recessed | Acceptable, caution avoid air pocket | NOT acceptable for horizontal installation | Acceptable for clean water with no sediment | Acceptable - (but not ideal), for clean water with no sediment

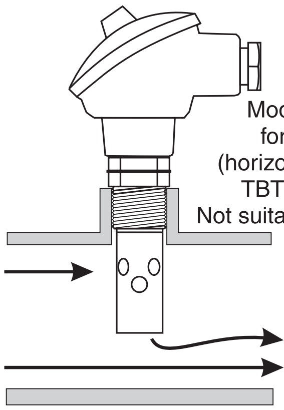
TBLR, TBTH and TBTHHT cells are suitable for installation into metallic and non metallic pipework. The cell measurement is made on the inside of the cell body ensuring it is virtually unaffected by the surrounding sample or volume. The cell may be mounted in a horizontal or vertical position and is usually 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.



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



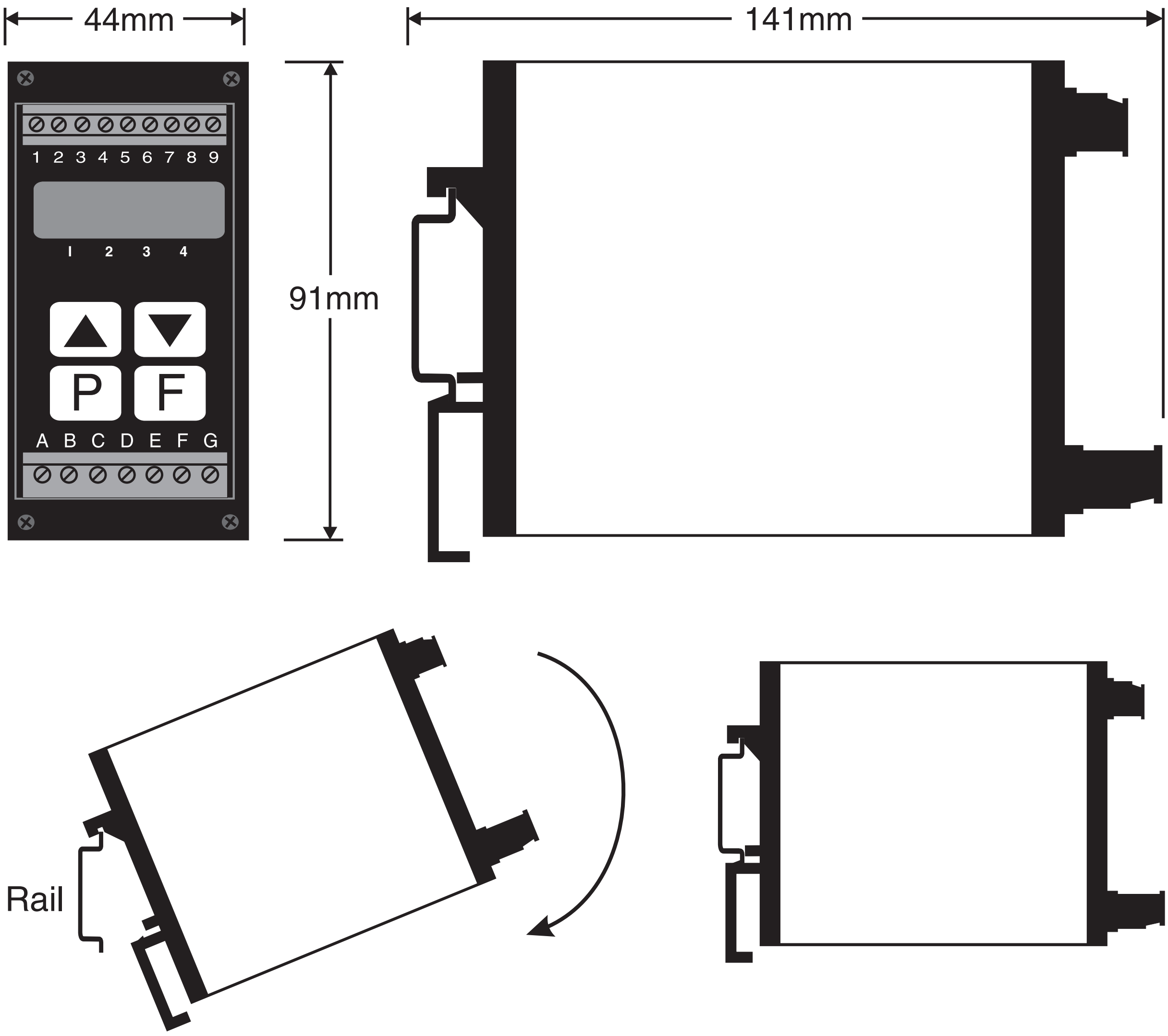
Modified 't' fitting elbow installation
(horizontal or vertical). TBLR cell shown



Modified 't' fitting
for in-line flow
(horizontal or vertical).
TBTH cell shown.
Not suitable for TBLR cells

2 Mechanical installation

The instrument is designed for DIN rail mounting. The instrument clips on to 35mm DIN standard rails (EN50022). Cut the DIN rail to length and install where required. To install the instrument simply clip onto the rail as shown below. To remove the instrument lever the lower arm downwards using a broad bladed screwdriver to pull the clip away from the DIN rail.



3 Electrical installation

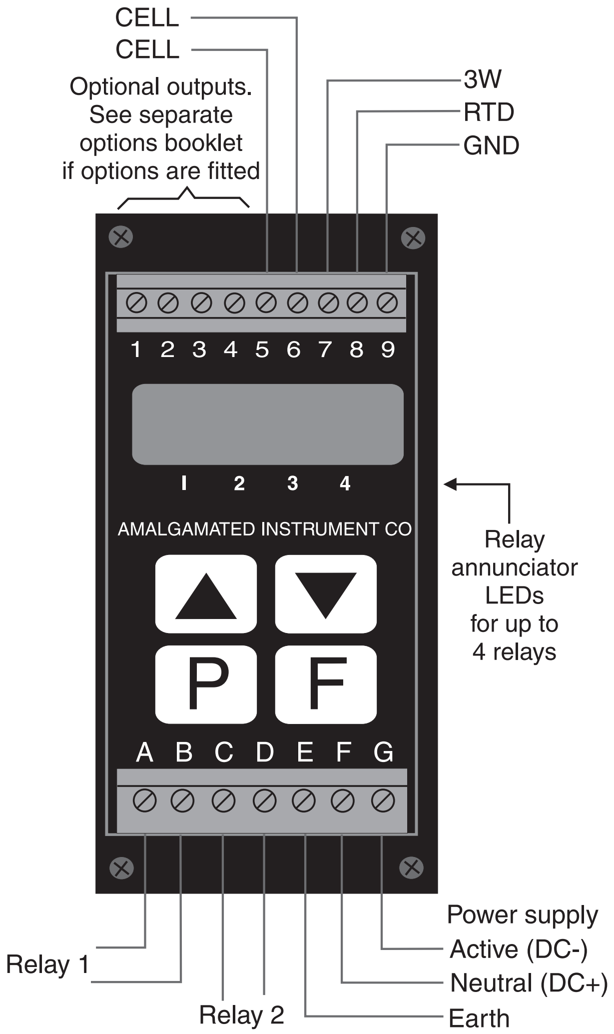
3.1 Electrical installation

The RM4 Meter is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing.

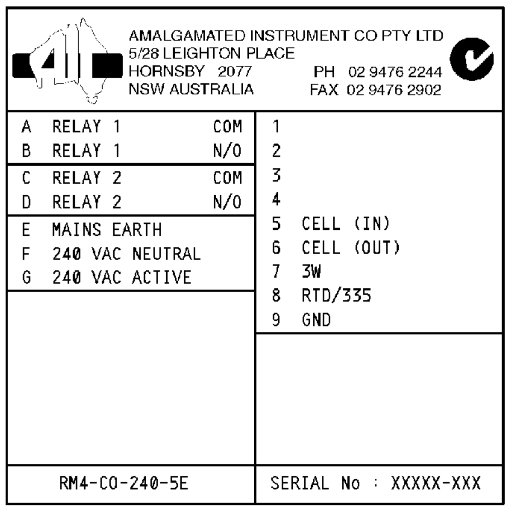
The plug in, screw type, terminal blocks allow for wires of up to 2.5mm^2 to be fitted. Connect the wires to the appropriate terminals as indicated below. Refer to connection details provided in this chapter to confirm proper selection of voltage, polarity and input type before applying power to the 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 "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when options are fitted.



Instrument label (example)

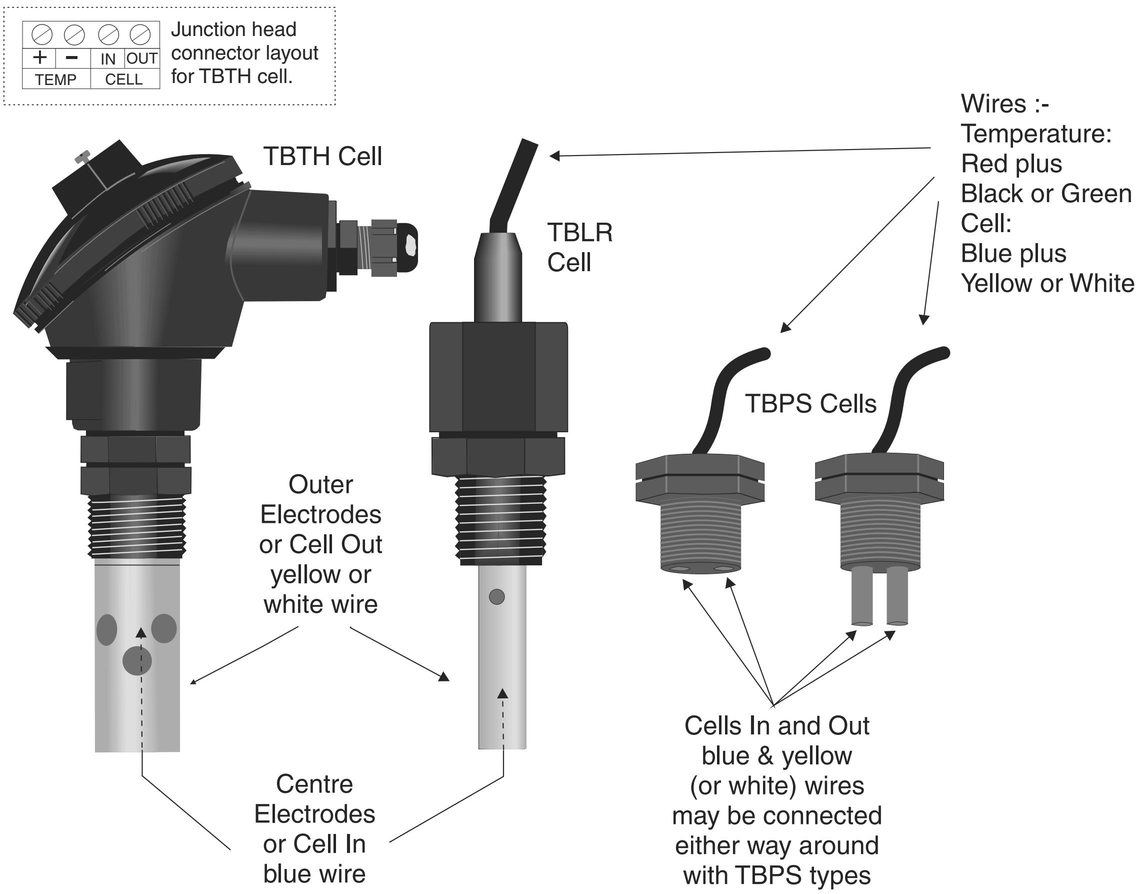


3.2 Electrical connection examples

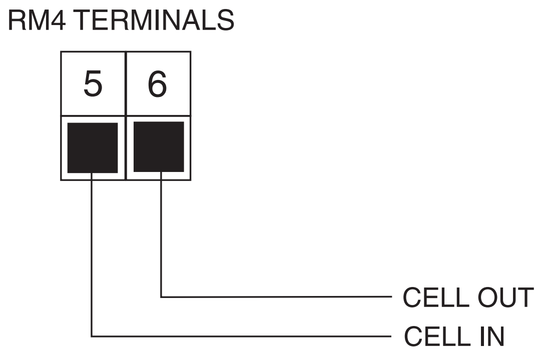
If output options are fitted refer to the "RM4 DIN Rail Meter Optional Output Addendum" booklet for connection details.

Conductivity/Resistivity/ppm Cells - The cell is connected to terminals 5 and 6. Terminal 5 is the input connection i.e. the current input from the cell. Terminal 6 is the output connection. If using a centre core type cell the centre core wire should be connected to Terminal 5. Ensure that the **PrbE CnSt** function has been correctly set for probe type. A.I.C. cells with temperature compensation sensors are all wired with Red, Black, Blue and Yellow (or White on older models) inner core cable. See the note below for details of TBPS cells without temperature compensation sensors. The wiring connections are as below.

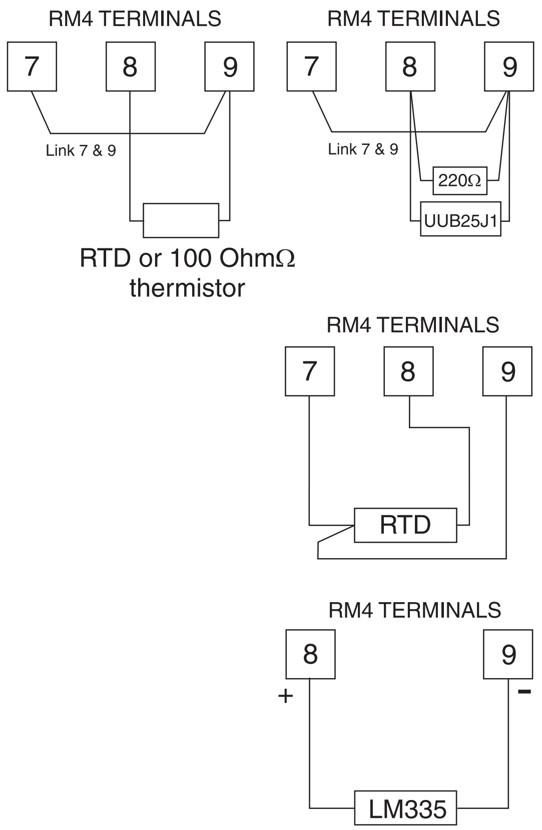
Cell wiring colour codes		
	AIC cells	**SDI cells**
Cell in	Blue	Black
Cell out	Yellow (or White)	White
Temperature +	Red	Red
Temperature -	Green (or Black)	Green
Shield	n/a	Clear



Conductivity cell wiring - Ensure correct K factor is set at the PrbE CnSt function.

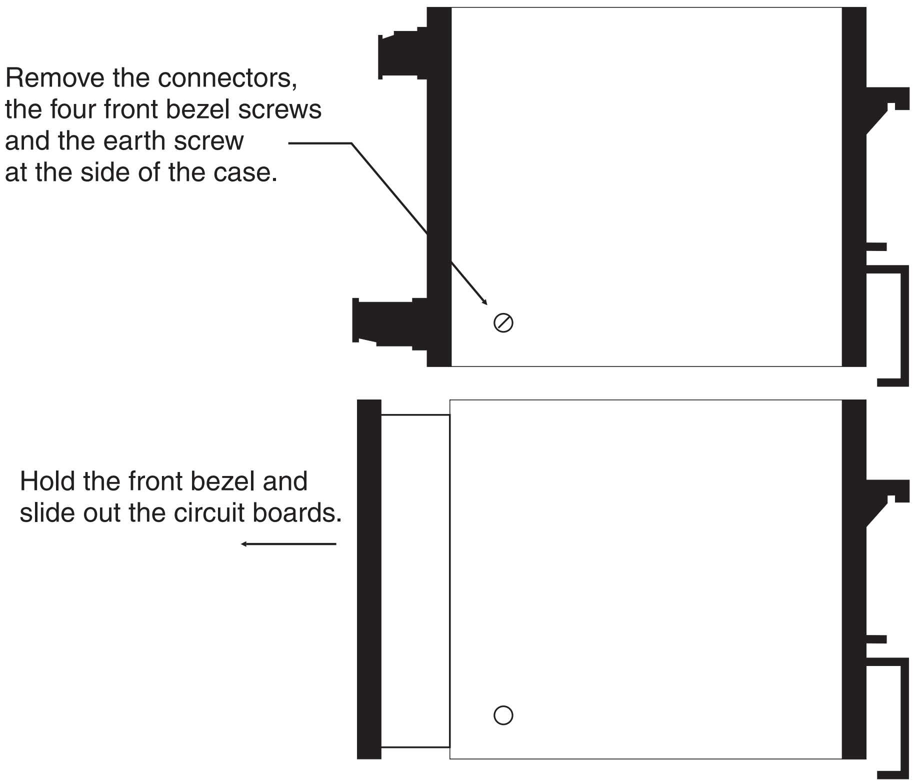


Temperature sensor wiring - 2 or 3 wire RTD (Pt100 or Pt1000) sensors, 100Ω thermistor or UU25J1 thermistor types can be accepted. Wiring for these sensors is shown below. Ensure that links for the temperature probe are set and that the °C tYPE function is set to the appropriate type.



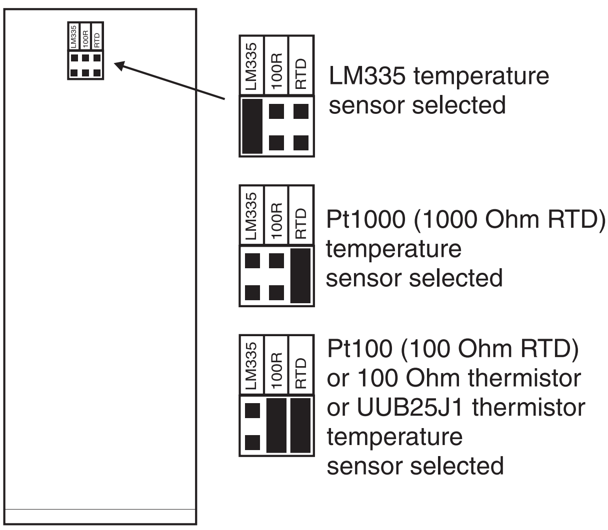
3.3 Configuring the output board

If changes to the link settings are required on the option board the circuit board will need to be removed from the case. Remove the circuit board from the case following the instructions below.



3.4 Temperature 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 sensor 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
AxLo	Low setpoint value for designated alarm relay x	Any display value or OFF	OFF	See 4.1	5.1 / 19
AxHi	High setpoint value for designated alarm relay x	Any display value or OFF	OFF	See 4.1	5.2 / 19
AxHY	Hysteresis value for the designated alarm relay x.	0 to 9999	10	See 4.1	5.3 / 20
A$x$tt	Trip time delay for the designated alarm relay x.	0 to 9999	0	See 4.1	5.4 / 21
A$x$rt	Reset time delay for the designated alarm relay x.	0 to 9999	0	See 4.1	5.5 / 21
Axn.o or Axn.c	Alarm relay x action to normally open (de-energised) or normally closed (energised)	Axn.o or Axn.c	Axn.o	See 4.1	5.6 / 21
brGt	Display brightness level	1 to 15	15		5.7 / 22
duLL	Automatic brightness switching	0 to 15	1		5.8 / 22
d.oFF SECS	Auto display dimming timer	0 to 9999	0		5.9 / 22
rEC_	Analog output option low display value (*Optional)	Any display value	0		5.10 / 23
rEC‾	Analog output option high display value (*Optional)	Any display value	1000		5.11 / 23
rEC_ Ch2	Second analog output option low display value (*Optional)	Any display value	0		5.12 / 23
rEC‾ Ch2	Second analog output option high display value (*Optional)	Any display value	1000		5.13 / 23

(***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
drnd	Display rounding	1 to 5000	1		5.14 / 24
dCPt	Decimal point	0, 0.1 etc.	0		5.15 / 24
FLtr	Digital filter	0 to 8	2		5.16 / 24
dOSE PErd	Special dosing mode operation	0 to 600	0		5.17 / 25
°C tYPE	Temperature sensor type	nOnE, 100, 1000, L335, t 100 or 25J1	nOnE		5.18 / 25
dEF °C	Default temperature value	0.0 to 200.0	25.0		5.19 / 25
SOL SLPE	Solution temperature compensation slope	-6.00 to 0.00	-2.00		5.20 / 26
SOL °C	Solution temperature compensation reference	0.0 to 100.0	25.0		5.21 / 26
PrbE CnSt	Cell K factor	0.01, 0.05, 0.1, 0.5, 1.0, 2.0, 5.0, 10, 50 or 100	0.1		5.22 / 26
H.OFF or H.On	Hydrogen ion compensation	H.OFF or H.On	H.OFF		5.23 / 27
CAL nULL	Display null calibration	n/a	n/a		5.24 / 27
CAL 1	First live input calibration scaling point	Any display value	n/a		5.25 / 27
CAL2	Second live input calibration scaling point	Any display value	n/a		5.26 / 27
°C nULL	Temperature null calibration	n/a	n/a		5.27 / 27
CAL °C	Temperature calibration	n/a	n/a		5.28 / 28
cond unit	Conductivity measuring units	uS.cm, uS.m, mS.cm or mS.m	uS.cm		5.29 / 28
UCAL cond	Conductivity uncalibration	n/a	n/a		5.30 / 28
UCAL rESt	Resistivity uncalibration	n/a	n/a		5.31 / 28
UCAL PPm	ppm uncalibration	n/a	n/a		5.32 / 29

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

UCAL Pcnt	Percentage uncalibration	n/a	n/a		5.33 / 29
UCAL °C	Temperature uncalibration	n/a	n/a		5.34 / 29
PPM FACt	ppm conversion factor	0.200 to 2.000	0.560		5.35 / 29
SEt di SP	Set display type	cond, rESt, PPM or Pcnt	cond		5.36 / 30
rEc ctrl	Analog output PI control (*Optional)	on or OFF	OFF		5.37 / 30
Pbut	**P** button function (for instruments with front **P** button)	NONE, Hi, Lo or Hi Lo	NONE		5.38 / 30
ACCS	Access mode	OFF, EASY, NONE or ALL	OFF		5.39 / 31
SPAC	Setpoint access mode (*Optional)	A1, A1-2 etc.	A1		5.40 / 31
A1, A2 etc.	Alarm relay operation mode	cond, rESt, PPM, Pcnt, °C or dOSE	cond	See 4.1	5.41 / 31
rEC	Analog output mode (*Optional)	cond, rESt, PPM, Pcnt or °C	cond		5.42 / 32
rEC2	Second analog output mode (*Optional)	cond, rESt, PPM, Pcnt or °C	cond		5.43 / 32
rEC	Analog output logarithmic or linear mode (*Optional)	Lin, Log1, Log2, Log3, Log4 or Log5	Lin		5.44 / 33
rEC Lo	Analog output logarithmic start point (*Optional)	0.001, 0.01, 0.1, 1.0 or 10.0	0.001		5.45 / 34
rEC2	Second analog output logarithmic or linear mode (*Optional)	Lin, Log1, Log2, Log3, Log4 or Log5	Lin		5.46 / 34
rEC2 Lo	Second analog output logarithmic start point (*Optional)	0.001, 0.01, 0.1, 1.0 or 10.0	0.001		5.47 / 34
bAUd rAtE	Baud rate for serial communications (*Optional)	300, 600, 1200, 2400, 4800, 9600, 19.2 or 38.4	9600		5.48 / 34

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

PrtY	Parity for serial communications (*Optional)	NONE.EVEN or odd	NONE		5.49 / 35
O.Put	Output for serial communications (*Optional)	dISP.Cont, POLL, A.buS or m.buS	Cont		5.50 / 35
Addr	Instrument address for serial communications (*Optional)	0 to 31	0		5.51 / 35

(***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
AxLo				
AxHi				
AxHY				
A$x$tt				
A$x$rt				
Axn.o or Axn.c				
A1.A2 etc.				

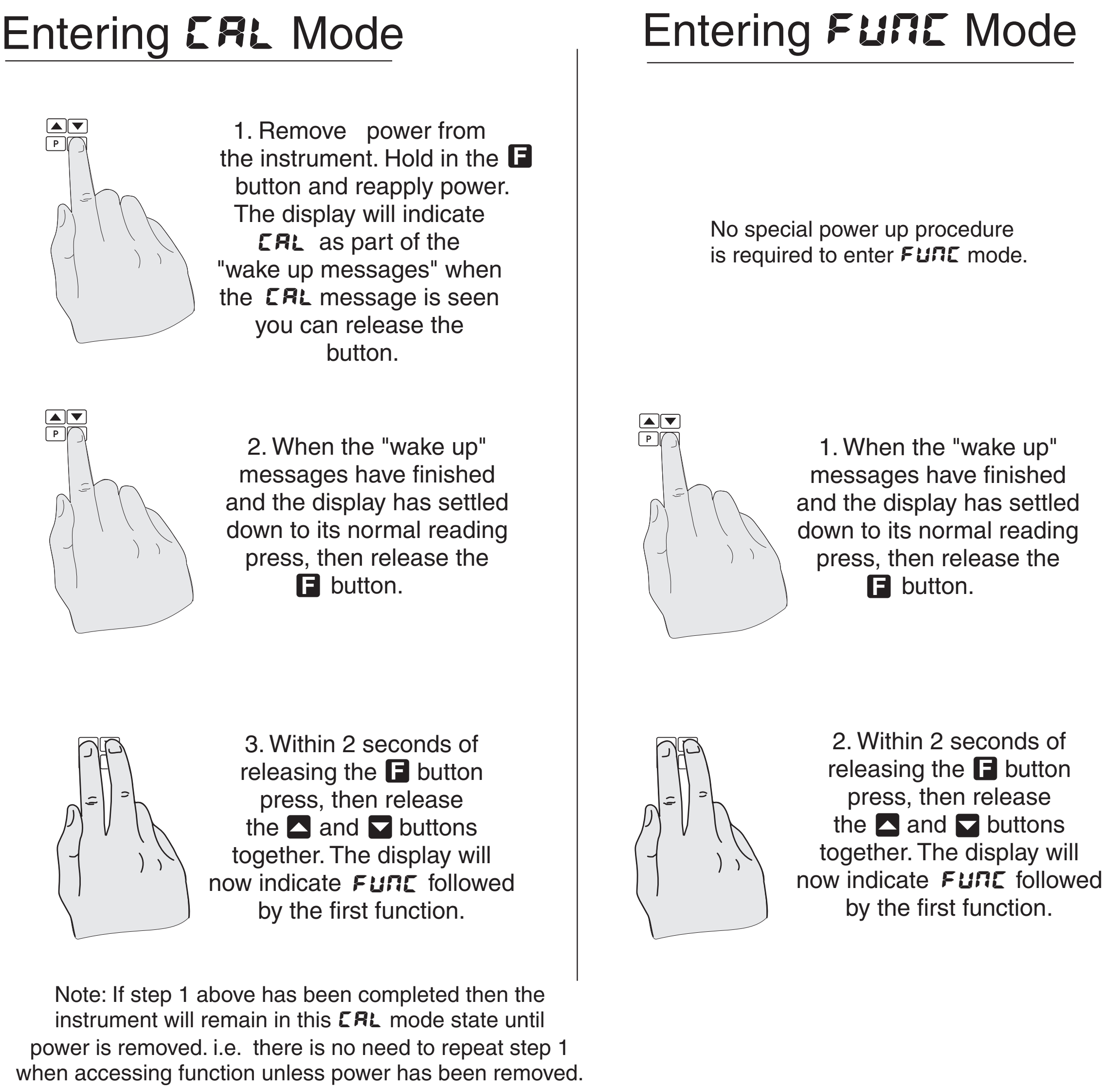
5 Explanation of functions

The RM4 setup and calibration functions are configured through a push button sequence. The push buttons located at the front of the instrument are used to alter settings. Two basic access modes are available:

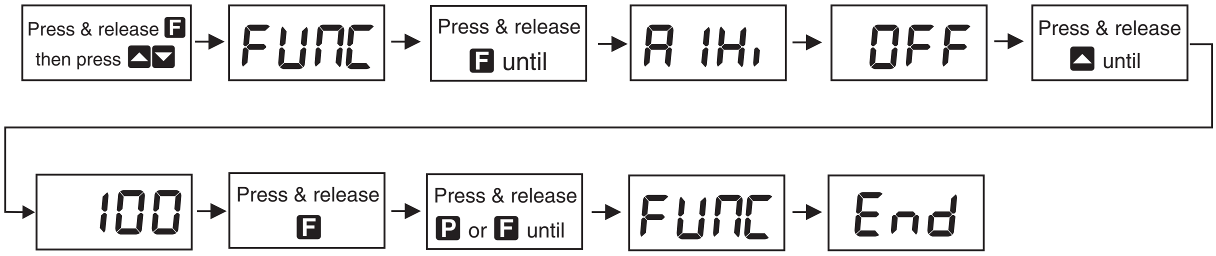
FUNC mode (simple push button sequence) allows access to commonly set up functions such as alarm setpoints.

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

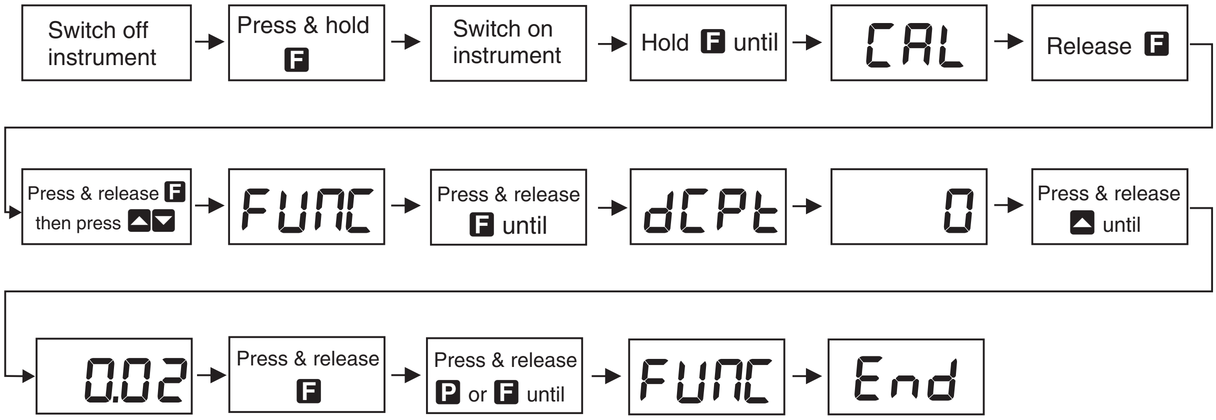
Once CAL or FUNC mode has been entered you can step through the functions, by pressing and releasing the F push button, until the required function is reached. Changes to functions are made by pressing the or push button (in some cases both simultaneously) when the required function is reached. See the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



Example: Entering FUNC mode to change alarm 1 high function A1Hi 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 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 r.inP 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 A1-2 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.

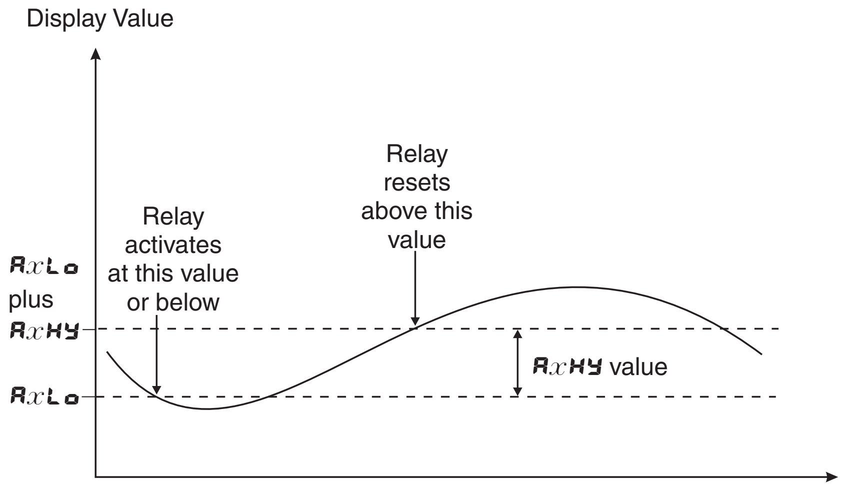
Explanation of Functions

5.1 Alarm relay low setpoint

Display: AxLo
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. A1Lo 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 AxLo function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value. The low alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the 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 AxHY function.

Example:
If A1Lo is set to 10 then relay 1 will activate when the display value is 10 or less.



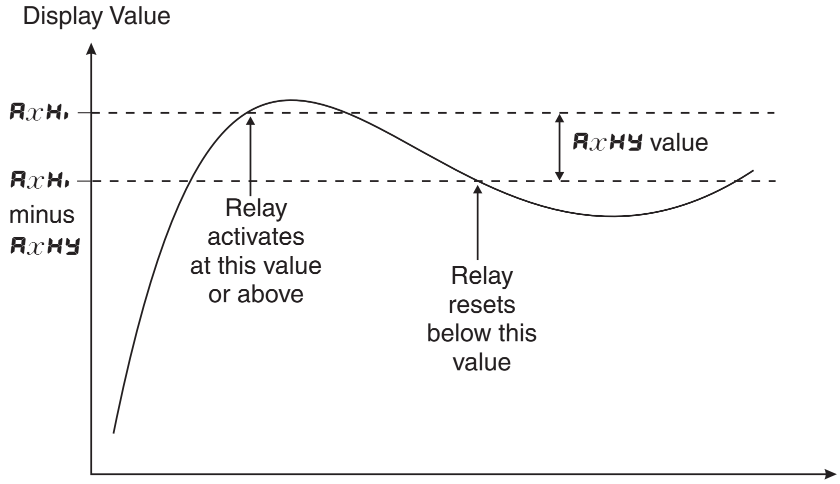
Alarm low operation with hysteresis

5.2 Alarm relay high setpoint

Display: AxHi
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. A1Hi 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 AxHi function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value. The high alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the 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 AxHY function.

Example:
If A1Hi is set to 100 then relay 1 will activate when the display value is 100 or higher.



Alarm high operation with hysteresis

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. A1HY 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 A1HY 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 A1Hi is set to 50.0 and A1HY 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 A1Lo is to 20.0 and A1HY 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 A1Hi is set to 100 and A1HY 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: A$x$tt
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 A$x$tt function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value.

Example: If A1tt 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: A$x$rt
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 A$x$rt function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value.

Example: If A1rt 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 A1n.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 Display brightness

Display: br9t

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 br9t function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value.

5.8 Automatic brightness switching

Display: duLL

Range: 0 to 15

Default Value: 1

Displays and sets the level for automatic brightness switching. To set dull level go to the duLL function and use the ▲ or ▼ push buttons to set the value required then press F to accept this value. The d.oFF SECS function (automatic display blanking or dulling) will cause the duLL function to appear if the d.oFF SECS function is enabled i.e. set to any value other than 0. When the d.oFF SECS time is reached the display brightness will change from the level set at the br9t function to the level set at the duLL function. The brightness will automatically return to the br9t level if any of the front pushbuttons are pressed or if an alarm relay is activated. This function is useful in battery powered applications in that it can be used to reduce current consumption by dimming the display when the display is not being viewed.

5.9 Auto display dimming timer

Display: d.oFF SECS

Range: 0 to 9999

Default Value: 0

This function allows a time to be set after which the display brightness (set by the br9t function) will automatically be set to the level set at the duLL function. The auto dimming feature can be used to reduce power consumption. The function can be set to any value between 0 and 9999 seconds. A setting of 0 disables the auto dimming. The display brightness can be restored by pressing any of the instruments front push buttons. The display brightness will also be restored whilst one or more alarm relays is activated. In normal display mode (i.e. not in CAL mode) there is a 2 minute delay period after the instrument is switched on during which the automatic display dimming will not operate. If any of the front pusbuttons are pressed during this period this 2 minute delay will be canceled.

5.10 Analog output option low value

Display: rEC_
Range: Any display value
Default Value: 0

Seen only when analog retransmission option fitted. Refer to the separate "RM4 Din Rail 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 rEC_ 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.

5.11 Analog output option high value

Display: rEC‾
Range: Any display value
Default Value: 1000

Seen only when analog retransmission option fitted. Refer to the separate "RM4 Din Rail 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 rEC‾ 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 20mA when the display indicates 50 then select 50 in this function using the ▲ or ▼ button.

5.12 Second analog output option low value

Display: rEC_ Ch2
Range: Any display value
Default Value: 0

See rEC_ function 5.10 for description of operation.

5.13 Second analog output option high value

Display: rEC‾ Ch2
Range: Any display value
Default Value: 1000

See rEC‾ function 5.11 for description of operation.

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

5.14 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.

5.15 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.

5.16 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.

5.17 Special "blowdown" dosing mode operation

Display: dOSE PErd
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 A1 is set to dOSE. Refer to the A1,A2 etc. function for a description of operation of this special mode.

5.18 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.

5.19 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.

5.20 Solution temperature compensation slope

Display: SOL SLPE
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 ^{o}C (this figure is needed since each individual solutions conductivity/resistivity will vary differently with temperature) . A typical value is -2% per ^{o}C for water. Enter the solution value, if known, if the solution slope is not known then it can be obtained as follows:

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

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

5. Enter the result as the solution slope.

5.21 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^{o}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^{o}C the display will compensate to show conductivity at 30^{o}C no matter what the solution temperature actually is.

5.22 Cell K factor

Display: PrbE CNSt
Range: 0.01, 0.05, 0.1, 0.5, 1.0, 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.

5.23 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^+ and OH^- solvent ions which become prevalent at low conductivity. These ions have an effect on water conductivity/resistivity since they have different temperature compensation curves to water. When set to H.ON the a dry cell will give a display reading of 0.05uS/cm (if 2 decimal point places are selected).

5.24 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.

5.25 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

5.26 Second calibration scaling point

Display: CAL2

Range: Any display value

Default Value: n/a

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

5.27 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.

5.28 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.

5.29 Conductivity measuring units

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

Selects the conductivity measuring units to be displayed, seen only if SEt diSP set to cond. Choices available are:

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

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

5.30 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 diSP 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.

5.31 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 diSP 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.

5.32 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.

5.33 Percentage uncalibration

Display: UCAL Pcnt
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 Pcnt. 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.

5.34 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.

5.35 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.

5.36 Set display type

Display: SEt dI SP
Range: cond, rESt, PPm or Pcnt
Default Value: cond

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

5.37 Analog output PI control

Display: rEc ctrl
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.SPN, C_PG , C_Po , C.I G, CI L.H, CI L.L and rEC SPAC. These functions are not detailed in this manual. Refer to the separate RM4 Din Rail Meter Optional Output Addendum booklet for description of the analog PI control functions and wiring details.

5.38 P button function

Display: Pbut
Range: NONE, HI , Lo or HI Lo
Default Value: NONE

P button function - The P button may be set to operate one of the following selections:

- NONE - P has no operation.
- HI - Peak memory. This function allows the P to be used to view and reset the peak memory. The peak memory is the maximum positive display value (conductivity/resistivity or ppm) achieved since the peak memory was last reset. To view the peak memory press the P momentarily, the display will show the indicator PHI followed by the peak reading. This peak reading will be retained on the display for approximately 20 seconds before returning to "live" display readings, alternatively the display can be forced to return to "live" measurement by pressing the F. To reset the peak memory hold the P pressed for 3 seconds or remove power to the display.
- Lo - Valley memory. Operates in the same manner as the HI function above but operates on the lowest value in memory. The indicator PLo will be seen prior to the valley memory value.
- HI Lo - Peak/valley memory. Operates in the same manner as the HI and Lo memories but allows toggling between high and low values i.e. press once momentarily to view peak

high and again momentarily to view peak low.

5.39 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" section. 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.

5.40 Setpoint access mode

Display: SPAC
Range: A 1, A 1-2 etc.
Default Value: A 1

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:
A 1 - Allows setpoint access to alarm 1 only.
A 1-2 - Allows setpoint access to alarms 1 and 2 only.
A 1-3 - Allows setpoint access to alarms 1, 2 and 3 etc. up to the maximum number of relays fitted.
Note: Only the setpoints which have been given a value will be accessible e.g. if A 1Hi is set to OFF then there will be no access to the A 1Hi function when SPAC is used.

5.41 Alarm relay operation mode

Display: A 1, A2 etc.
Range: cond, rESt, PPm, 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, rESt for resistivity, PPm for PPm , 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 PPm depending on which is selected at the SEt di SP function) by pressing the [up] or [down] pushbutton. The alarm will still function on the selected mode even if the display is not in that mode. e.g. if A 1 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 **A2Hi** 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 PErd** function. At the end of the time period relay 1 will de activate.
- 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 PErd** function when relay 2 resets.

Two functions are used with this special mode. The special functions are:
A 1 - this should be set to **dOSE** for blowdown operation. Note the usual relay 1 functions such as **A 1Lo**, **A 1Hi** etc. will not be seen if **A 1** is set to **dOSE**.
dOSE PErd - sets the relay 1 timer period in minutes and can be set from 0 to 600 minutes. The **dOSE PErd** function will only be seen when **A 1** is set to **dOSE**.

5.42 Analog output mode

Display:	**rEC**
Range:	**cond**.**rESt**.**PPm**.**Pcnt** or **°C**
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, **PPm** for **PPm**, or **Pcnt** for sodium chloride % or **°C** 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 °C** 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.

5.43 Second analog output mode

Display:	**rEC2**
Range:	**cond**.**rESt**.**PPm**.**Pcnt** or **°C**
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 %

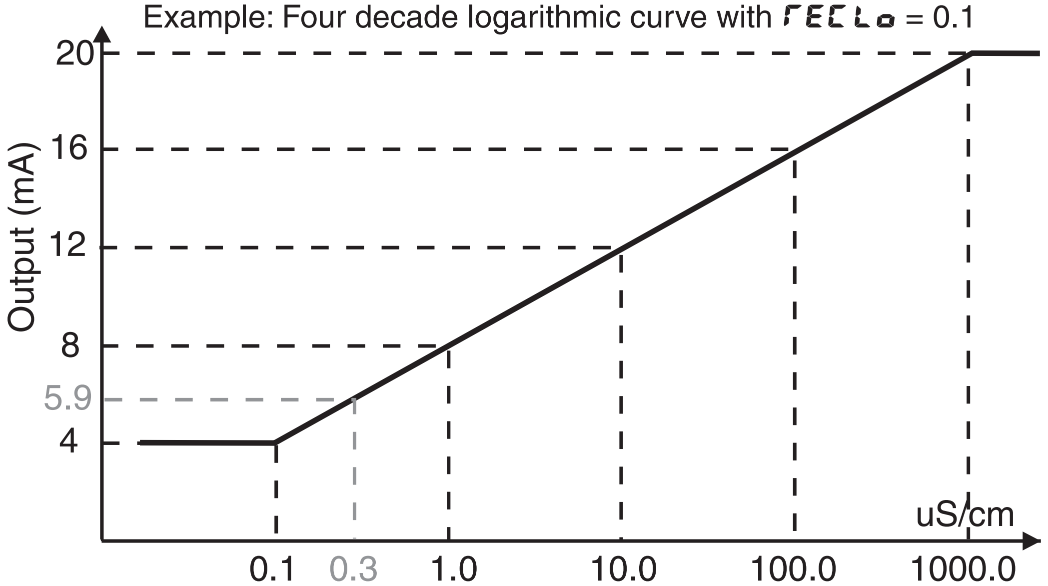
by weight, temperature values. Note only the mode selected at the **SEt OPEr** function or the temperature can be selected. Select **cond** for conductivity, **rESt** for resistivity, **PPm** for **PPm** , or **Pcnt** for sodium chloride % or **°C** for temperature. Set the **rEC_** and **rEC‾** functions 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 °C** 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.

5.44 Analog output logarithmic or linear mode

Display:	**rEC**
Range:	**Lin**, **Log1**, **Log2**, **Log3**, **Log4** or **Log5**
Default Value:	**Lin**

Analog output linear or logarithmic mode - seen only when the analog output option is fitted and not applicable unless **rECctrL** is set to **OFF**. Choose **Lin** for a linear output whose limits are set by the **rEC_** and **rEC‾** functions. Choose **Log1** for a logarithmic output with 1 decade, **Log2** for a logarithmic output with 2 decades etc. up to **Log5** for 5 decades. See below for an example.

Example: Four decade logarithmic curve with **rEC Lo** = 0.1



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:

mA output = final mA value for that decade - ($\log_{10}$ 1.0 - $\log_{10}$ 0.3) x (mA change per decade)

mA output = 8 - ($\log_{10}$1.0 - $\log_{10}$0.3) x (4)

mA output = 8 - (0- -0.523) x (4)

mA output at 0.3uS/cm = 5.9mA

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:

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

5.45 Analog output logarithmic start point

Display: rEC Lo
Range: 0.001, 0.01, 0.1, 1.0 or 10.0
Default Value: 0.001

Analog retransmission logarithmic output low starting point - Seen only when the analog retransmission option is fitted and not applicable unless rEC 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 0.001, 0.01, 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 Log3 is selected at the rEC function the analog output will be spread over 3 decades of measurement. If 0.1 is chosen as the low starting point at the rEC Lo 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

5.46 Second analog output logarithmic or linear mode

Display: rEC2
Range: Lin, Log1, Log2, Log3, Log4 or Log5
Default Value: Lin

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

5.47 Second analog output logarithmic start point

Display: rEC2Lo
Range: 0.001, 0.01, 0.1, 1.0 or 10.0
Default Value: 0.001

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

5.48 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 "RM4 Din Rail 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.

5.49 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 "RM4 Din Rail 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.

5.50 Output mode for optional serial communications

Display: O.Put
Range: di SP, Cont, POLL, A.buS or m.buS
Default Value: Cont

Set serial interface mode - seen only with serial output option. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when optional outputs are fitted. Allows user to select the serial interface operation as follows:

di 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.

A.buS - is a special communications mode used with Windows compatible optional PC download software. Refer to the user manual supplied with this optional software.

m.buS - Modbus RTU protocol.

5.51 Instrument address for optional serial communications

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

Set unit address for polled (POLL) or m.buS mode (0 to 31) - seen only with serial output option. Refer to the separate "RM4 Din Rail 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. if RS485 is available. 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. Do not use address 0 in m.buS mode.

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 CAL2 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 19.

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.

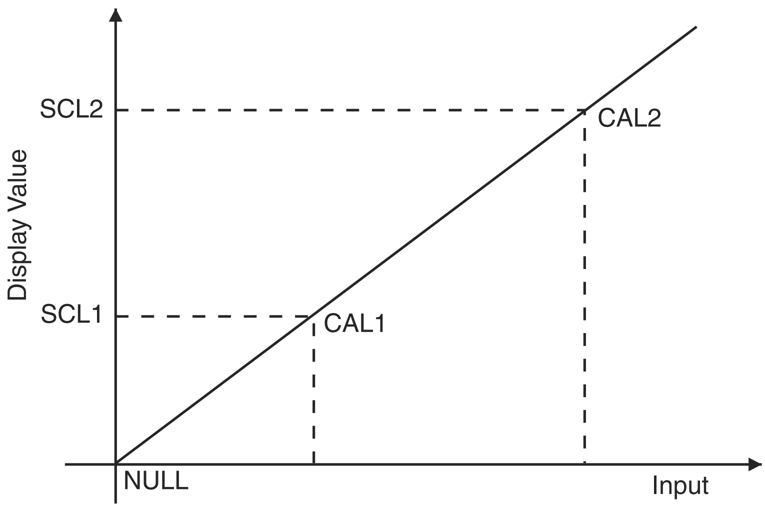
5. Press F, the display will show NULL End. When the instrument returns to normal measure mode the reading from the probe in air will be zero. If any other message is seen refer to section 6.13.

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 1MΩ) 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 require. 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.



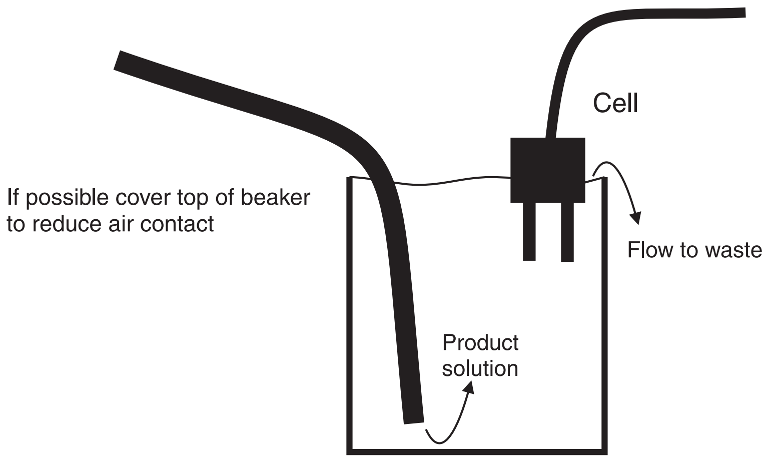
6.5 Low conductivity/high resistivity calibration

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 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 resitivity solutions is required the instrument should be set to display conductivity rather than resistivity using the **SEt dI 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 resitivity null calibration value is too close to high resitivity solution values. The conversion formula is:

$$Resistivity \; = (\frac{1}{Conductivity/cm}) \; \times \; Kfactor$$

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

$$Resistivity \; = (\frac{1}{0.006^{-6}}) \times \; 0.1 \; = \; 16.67 \, MOhms$$



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 1End** 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 rESt** 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:

$$Conductivity/cm = (\frac{1}{resistivity}) \times Kfactor$$

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:

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

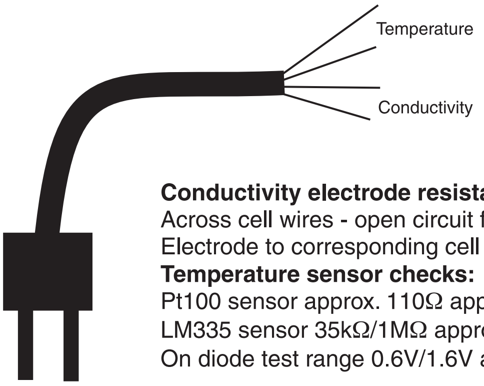
The factor will vary with the composition and concentration of the solution being measured. Suggested ppm factors for four standard solutions are given below. The suggested factors are based on conductivities of approx. 14,000 uS/cm at 25°C. For example the default setting for the instrument is 0.560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

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

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 OFSt 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.
- **nOACCS** - No access to functions. This message indicates that the attempt to enter **FUnC** mode has failed due to entry being blocked by the **ACCS** 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.
- **CAL2 Err** - Calibration point 2 error. See **CAL 1Err**.
- **CAL2 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 ERR** - Calibration point 2 gain error. See **CAL GAIN ERR**.
- **CAL2 REST ERR** - 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:

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

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.

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

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 (Pt100), 1000Ω RTD (Pt1000), LM335, 100Ω thermistor, UU25J1 thermistor or manually set
Measuring Range:	Conductivity uS/cm, mS/cm, mS/m or uS/m ranges selectable. Range depends on cell sensitivity (K factor), see page 3. Resistivity up to 18MΩ Temperature -40 to 120^{o}C
Accuracy:	Better 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^{o}C, LCD -10 to 50^{o}C
Humidity:	5 to 95% non condensing
Display:	LED 5 digit 7.6mm with alarm annunciator LEDs
Power Supply:	AC 240V, 110V 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, consult supplier typical 80mA at 24VDC, 160mA at 12VDC (depends on sensor and options)
Output (standard):	1 x relay, Form, A rated 5A resistive
Relay Action:	Programmable N.O. or N.C.

7.2 Optional outputs

Third relay:	Rated 0.5A resistive 30VAC or DC May be configured as form A or form C if the third relay is the only option fitted
Fourth relay:	Rated 0.5A resistive 30VAC or DC, form A
Analog output:	Isolated 4 to 20mA, 0 to 1V or 0 to 10V link selectable 12 or 16 bit versions available (4-20mA will drive into resistive loads of up to 800Ω) The analog output is configurable for retransmission or PI control Dual analog version also available, two isolated analog output channels 12 bit. The first analog output is configurable for retransmission or PI control
Serial communications:	Isolated RS232, RS485 or RS422 (ASCII or Modbus RTU)

Some combinations of optional outputs are available e.g. analog output plus extra relay. Consult supplier for available combinations.

7.3 Physical characteristics

Case size:	44mm(w) x 91mm(h) x 141mm(d)
Connections:	Plug in screw terminals (max. 2.5mm^2 wire for power and relays, max. 1.5mm^2 wire for load cell and options)
Weight:	470 gms basic model, 500 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 product is designed and manufactured in Australia.