Model PM5-PH
pH/ORP
Panel Mount Display/Controller
Operation and Instruction Manual

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1 Introduction

This manual contains information for the installation and operation of the PM5-PH Monitor. This instrument is a general purpose pH/Redox monitor which may be configured to accept an input from a standard pH electrode (E0=7), an electronic unity gain buffer amplifier or a standard Redox (ORP) electrode. The instrument is user configurable for use as a pH or Redox monitor. A second input is provided for a temperature sensor for automatic pH temperature compensation. The PM5 can accept Pt100 or Pt1000 RTD sensors or a default temperature can be manually set.

The pH/ORP input is isolated which can reduce or remove false readings which can occur when a potential difference exists between the process solution and ground i.e. there is a voltage between the solution and ground.

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). The ⏶ and ⏷ pushbuttons may be used to toggle the display between pH or ORP and solution temperature reading or default temperature if no external sensor is used. A standard inbuilt relay provides an alarm/control function, optional extra relays, retransmission (analog, serial or digital) and DC output voltage may also be provided. The PM5 is available with a 4, 5 or 6 digit display or combined bar graph/5 digit display to suit various applications. 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 is easily changed by the user. Full electrical isolation between power supply, input signal 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.

Standard outputs

- A standard inbuilt relay provides an alarm or control function (can be set for on or off alarm or control or PI control using pulse width or frequency control)

Output options

- 1, 3 or 6 extra relays (first optional relay can be set for simple on/off alarm/control or PI control using pulse width or frequency control)
- Isolated analog retransmission 12 bit, 4–20mA (single or dual analog outputs). Configurable for retransmission or PI control
- Isolated analog retransmission 16 bit (single or dual analog outputs) configurable for 4-20mA, 0-1V or 0-10V. Configurable for retransmission or PI control
- 12VDC (24V) isolated transmitter supply/excitation voltage (25mA max.)
- Isolated RS485 or RS232 serial communications (ASCII or Modbus RTU)
- Isolated Digital output - binary or BCD up to 16 bit, NPN or PNP output types available
- Ethernet communications
- Internal datalogger 8M Byte
- Isolated Optional outputs are available in certain combinations e.g. Extra relay plus RS232

1.1 Selecting and altering access levels

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

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

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

The access levels available are:

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

1.2 Accessing setup functions

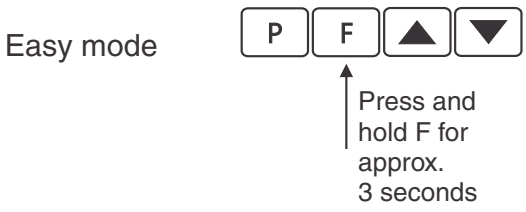
The setup functions allow adjustment of the instruments operation functions. There are five different ways of accessing setup functions. Each mode allows a selection of access levels i.e. allows some choice of which functions are accessible.

As as summary the methods available are:

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

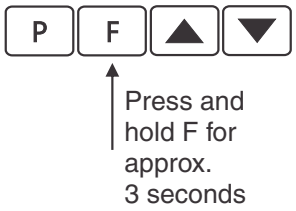
These modes are explained in more detail below.

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



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

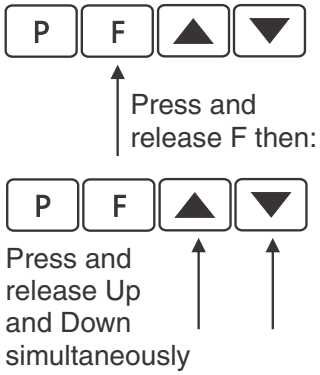
Remote input mode



Also requires that the selected remote input is set to ACCSS and is activated.

- **PIN 1 mode** - Allows access to the level set by the USr. 1 LEUEL function in the ACCES menu.
  The PIN 1 mode requires the F button is pressed and released then within 2 seconds press the ▲ and ▼ buttons at the same time. The PIN can be set via the USr. 1 P1n function in the ACCES menu. A USr. 1 LEUEL setting of 0 disables the PIN which means that there is no need to enter the PIN. If the USr. 1 LEUEL function has been set to a number other than nonE then the first function seen when entering via PIN 1 mode will be the function CodE. When this function is seen the PIN value set at the USr. 1 P1n 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 1 and PIN 2 mode

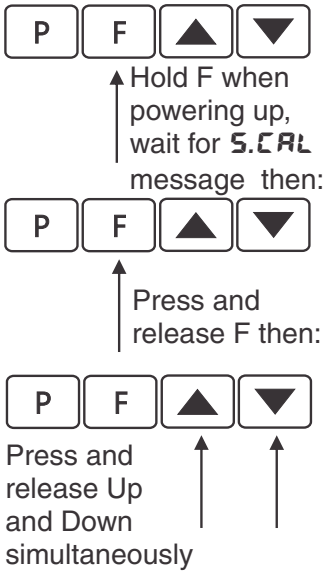


If a PIN has been set the message CodE will be seen. Use ▲ or ▼ to enter the PIN then press F to accept the PIN.

- **PIN 2 mode** - Allows access to the level set by the USr.2 LEUEL function in the ACCES menu.
  This method uses the same access method as PIN 1 mode above. A USr.2 P2n setting of 0 disables the PIN. If the USr. 1 LEUEL or a USr.2 P2n function has been set to a number other than 0 then the first function seen when entering via PIN 1/PIN2 mode will be the function CodE. When this function is seen the PIN value set at the USr. 1 P1n function can be entered for access to the level set at the USr. 1 LEUEL function or enter the USr.2 P2n PIN to gain access to the level set at the USr.2 LEUEL function. A correct code will allow access to the functions at the selected level. An incorrect code will result in the FUNC End message being seen indicating that access to setup functions has been refused and the display will return to normal measurement mode.

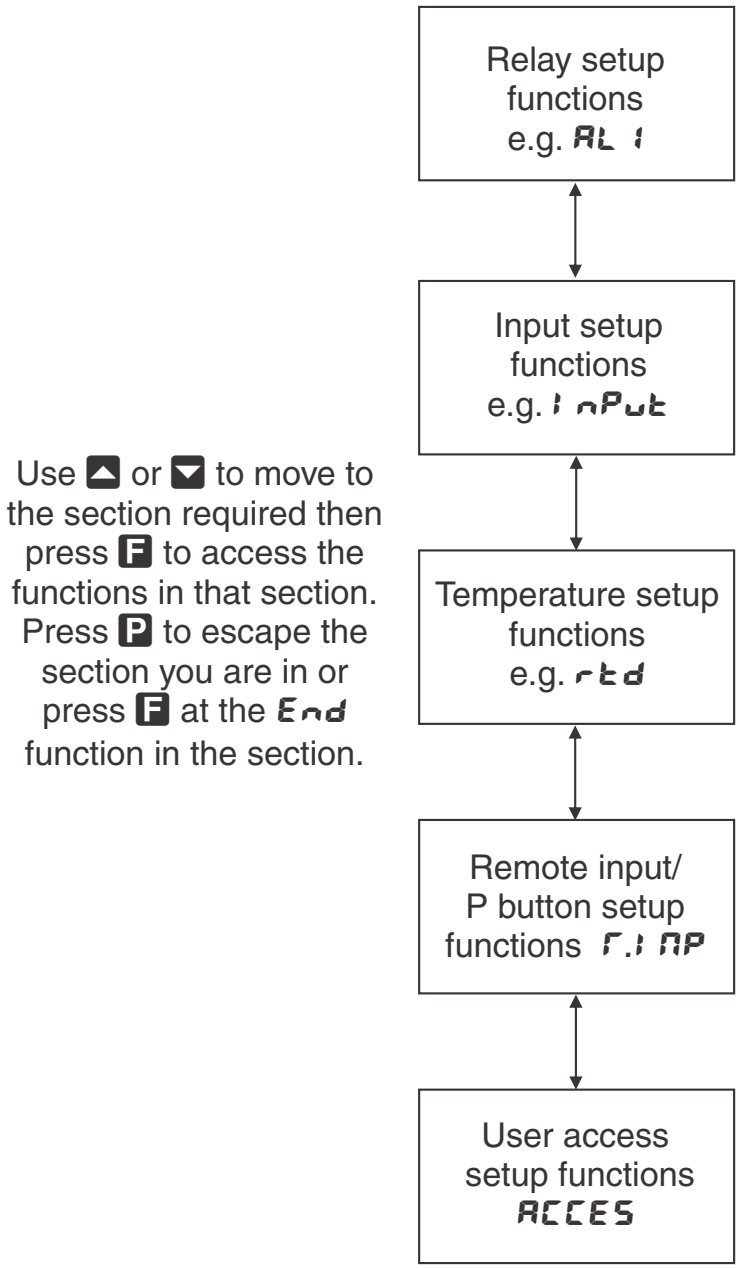
- **Super Cal mode** - This method can be used to gain access to all functions. If a PIN has been set and forgotten use this method to access the PIN functions to check the settings. To access via Super Cal mode with the instrument switched off hold in the F button whilst the instrument powers up. Keep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

Super Cal mode

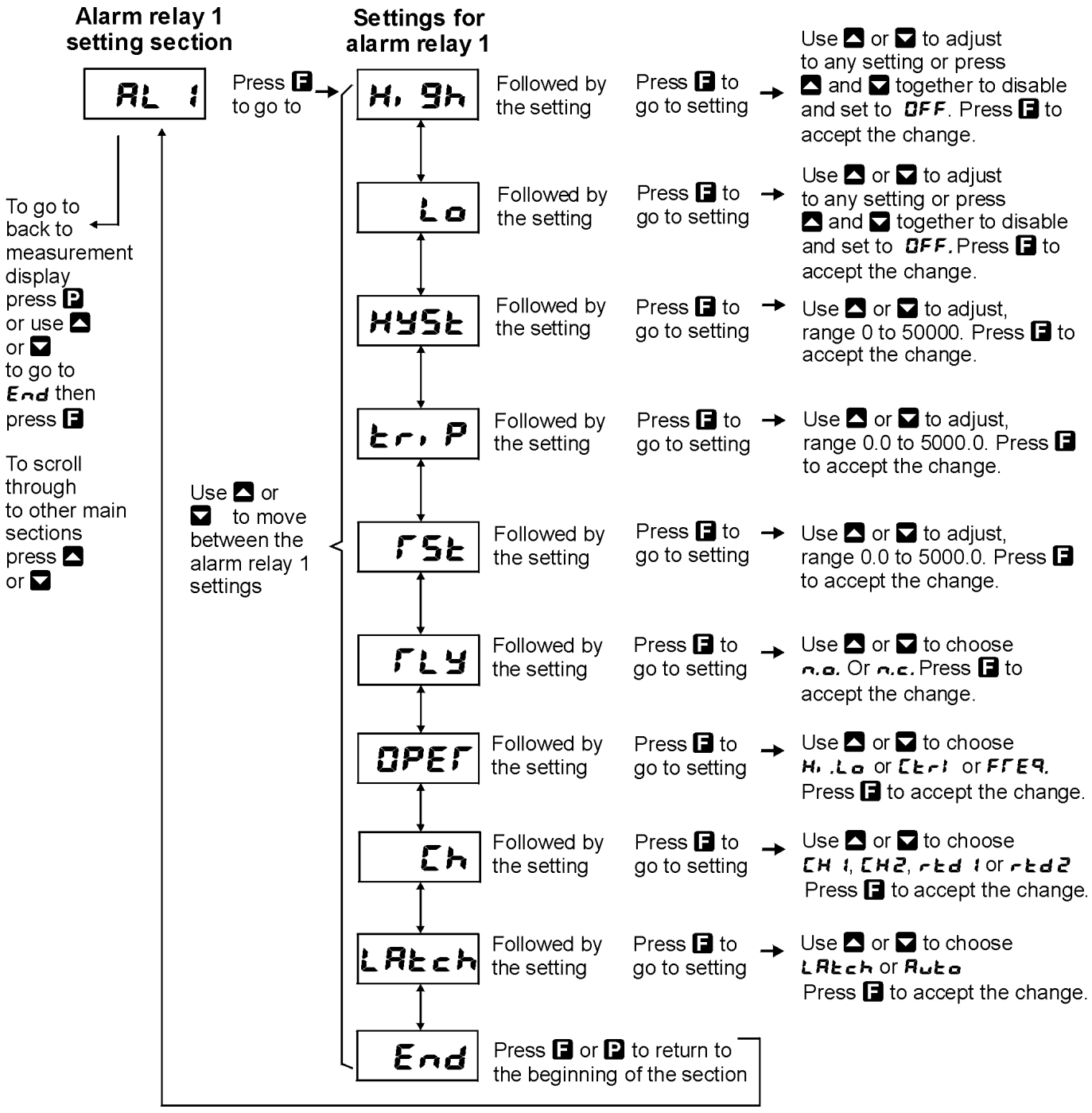


The setup functions are organised in blocks or sections e.g. all the settings for relay 1 are in the **AL 1** section. Once access to setup functions has been gained use the ▲ and ▼ buttons to select the section required then press **F** to enter this section and again us the ▲ and ▼ buttons to select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

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



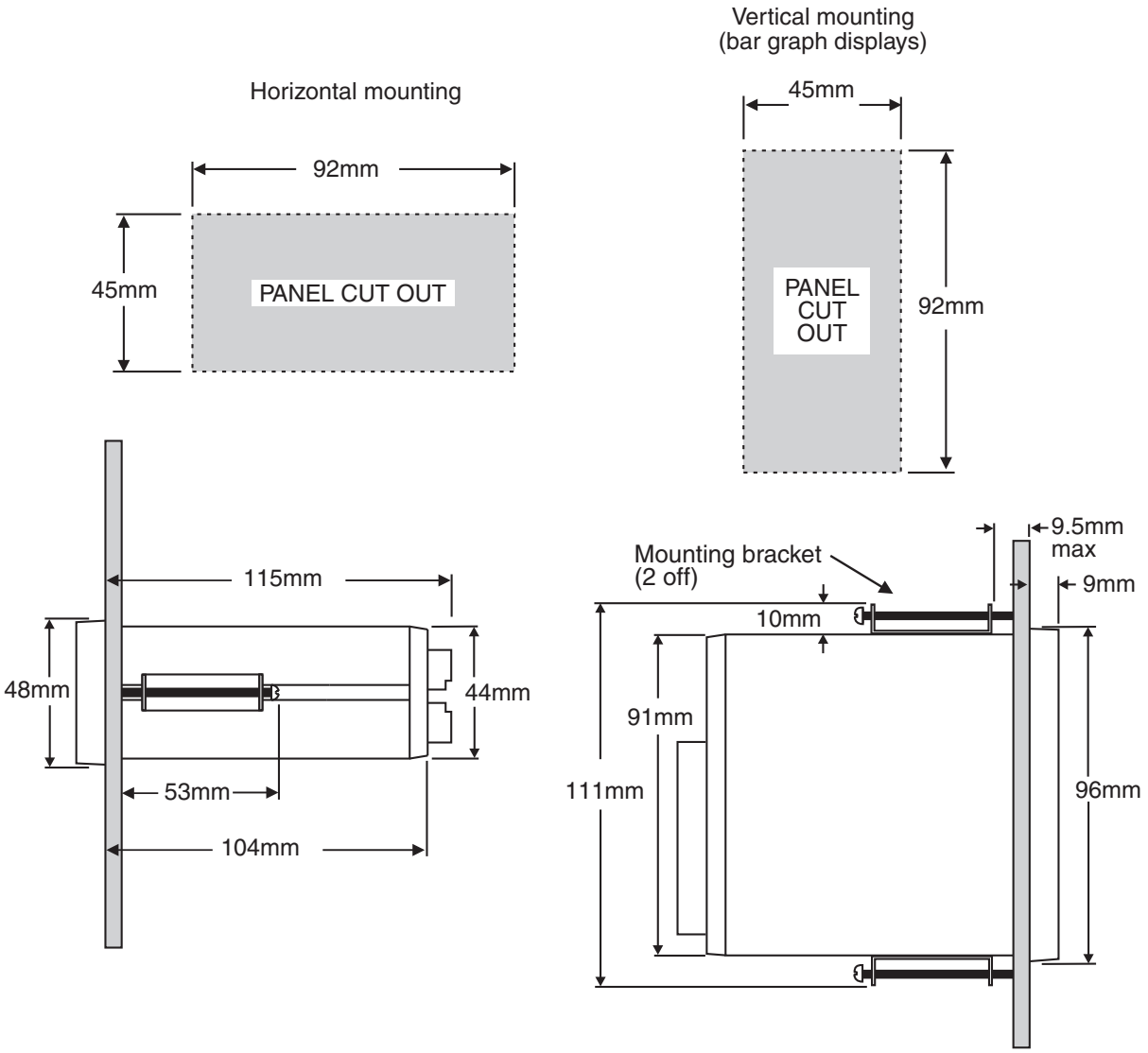
The example in the flowchart below shows the method using alarm relay 1 setup function (example only, actual functions seen may vary depending on software version).



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 or IP67 access cover which may be installed on the panel and surrounds is available as an option to be used when mounting the instrument in damp/dusty positions. A wall mount case is available, as an option, for situations in which panel mounting is either not available or not appropriate. A portable carry case is also available, as an option, for panel mount instruments.

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



3 Electrical installation

3.1 Electrical installation

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

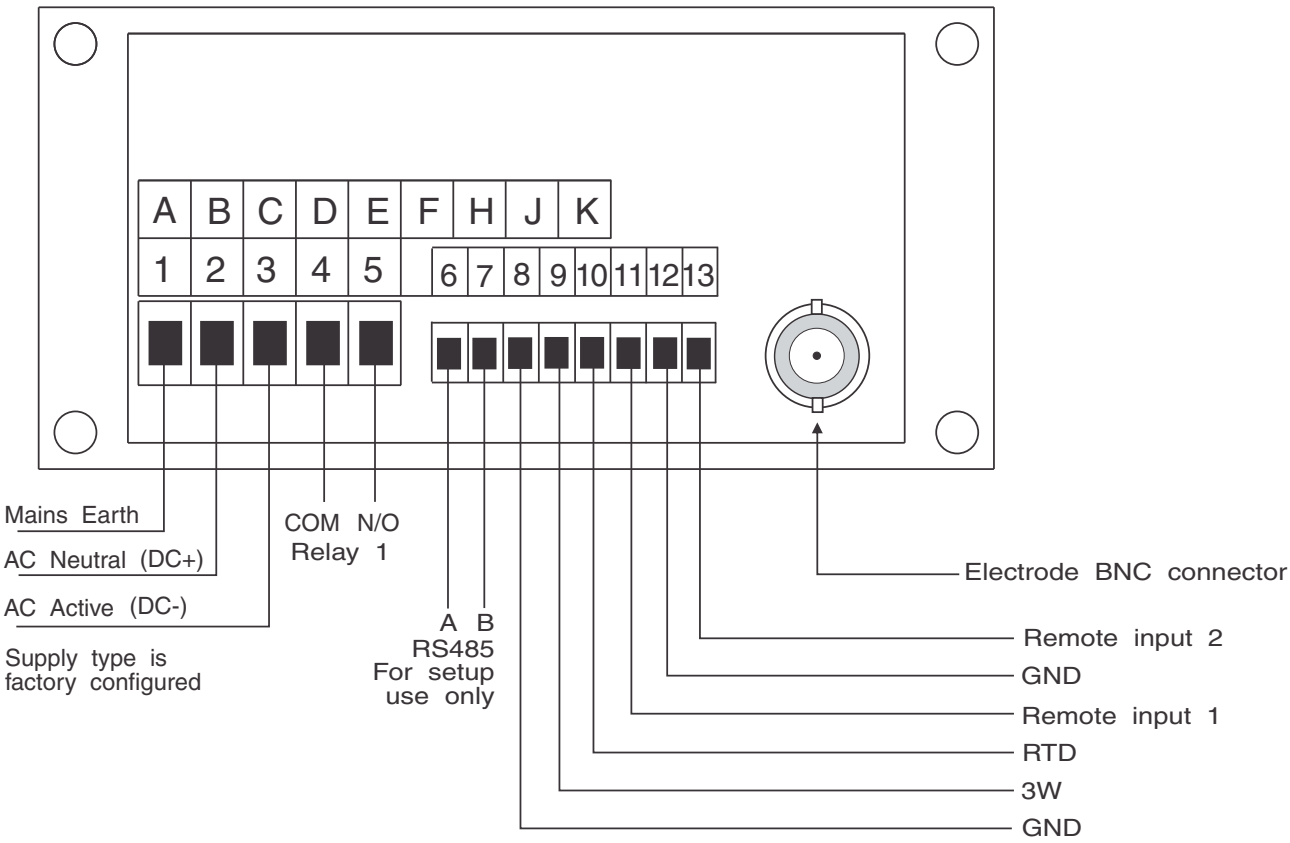
The plug in, screw type, terminal blocks allow for wires of up to 2.5mm^2 for power, relays and optional outputs and 1mm^2 for sensor and other wiring to be fitted. Connect the wires to the appropriate terminals as indicated below. Refer to connection details provided in this chapter to confirm proper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

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

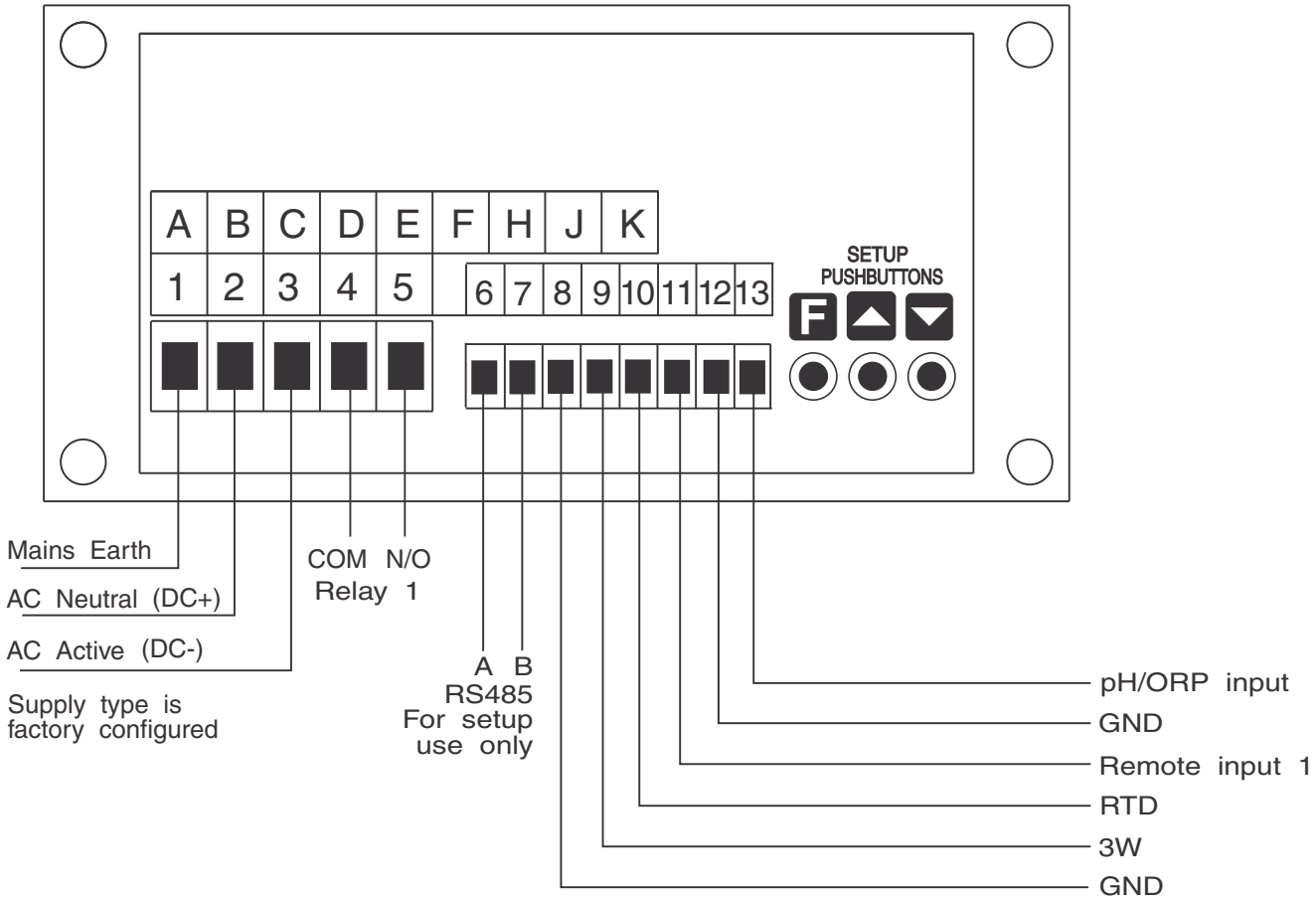
For connection details of optional outputs refer to the separate "PM5 Panel Meter Optional Output Addendum" booklet supplied when options are fitted.

Rear panel connections

Displays with BNC connector fitted (displays with front pushbuttons)

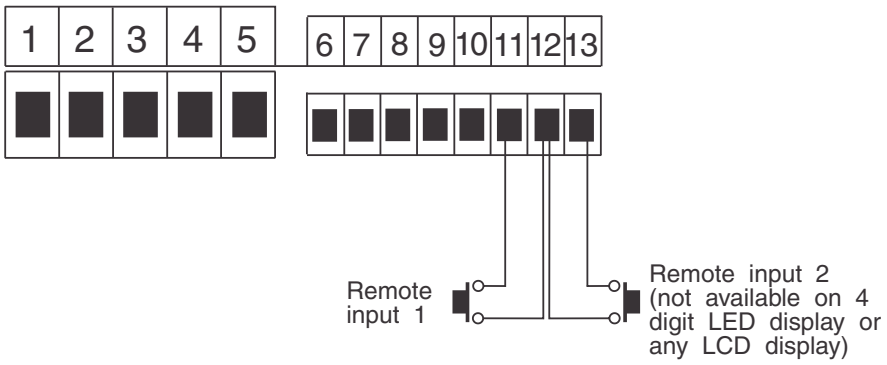


Displays without BNC connector (displays without front pushbuttons)



3.2 Remote/Digital input connections

Use latching or momentary switches/relays depending on remote input function requirements. Input is not isolated and can be configured for voltage free or up to 24V input (e.g. see **d.i n.1** **P.UP** function).

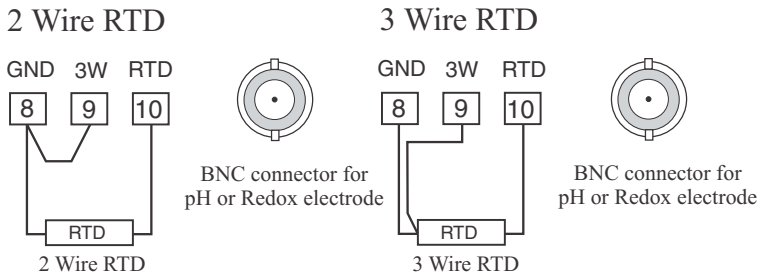


3.3 Optional output connections

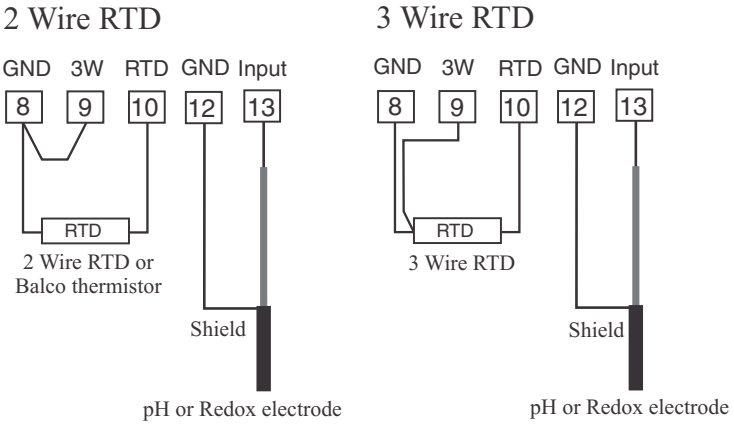
If output options are fitted refer to the "PM5 Panel Meter Optional Output Addendum" booklet for connection details.

3.4 Sensor connection examples

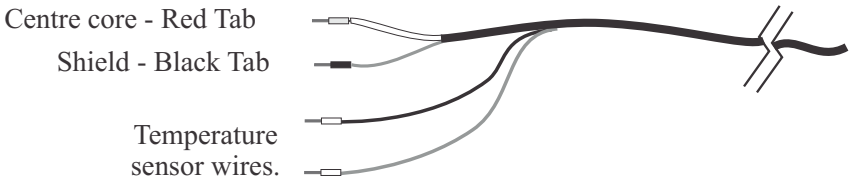
Rear sensor connection for panel meter fitted with BNC connector (any model with front pushbuttons)



Rear sensor connection for panel meter without BNC connector (4 digit LED or 4 or 6 digit LCD display)



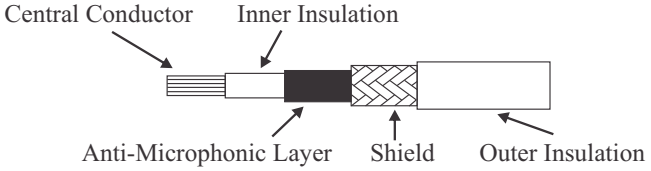
Termination of a typical pH electrode with temperature compensation for screw terminal connection



If dual temperature sensors are fitted then the colour code is:
Red & Black Pt100, Green & White Pt1000.

RTD temperature sensors are not polarised and therefore the wires may be placed either way around at the temperature input.

Note: If using low noise pH/Redox coaxial cable with an anti-microphonic layer ensure that this layer is removed from the exposed wiring. This layer is conductive and may cause a short circuit between the centre conductor and the cable shield resulting in an incorrect indication, usually this fault would be seen as a constant 7.00 pH or 0mV indication.



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.

4.1 Alarm relay function table

Display	Function	Range	Default	Your record	Ref/Page
AL 1 to AL 7 HI SH	High setpoint value for designated alarm	Any display value or OFF	OFF	See 4.12	5.1 / 23
AL 1 to AL 7 LO	Low setpoint value for designated alarm	Any display value or OFF	OFF	See 4.12	5.2 / 24
AL 1 to AL 7 HYST	Hysteresis value for the designated alarm	0 to 50000	10	See 4.12	5.3 / 25
AL 1 to AL 7 TR1 P	Trip time delay for the designated alarm relay x.	0.0 to 5000.0	0.0	See 4.12	5.4 / 26
AL 1 to AL 7 RST	Reset time delay for the designated alarm relay x.	0.0 to 5000.0	0.0	See 4.12	5.5 / 26
AL x SPAN	Relay PI control span	Any display value	100	See 4.12	5.6 / 27
AL x SETP	Relay PI control setpoint	Any display value	1000	See 4.12	5.7 / 27
AL x P.G	Relay PI control proportional gain value	Minimum display value to 32.767	0.0 10	See 4.12	5.8 / 27
AL x I.G	Relay PI control integral gain value	Minimum display value to 32.767	0.000	See 4.12	5.9 / 27
AL x I.H	Relay PI control integral high limit value	0.0 to 100.0	100.0	See 4.12	5.10 / 28
AL x I.L	Relay PI control integral low limit value	0.0 to 100.0	100.0	See 4.12	5.11 / 28
AL x BIAS	Relay PI control bias	0.0 to 100.0	50.0	See 4.12	5.12 / 28
AL x DUTY SECS	Relay PI control duty cycle	0.0 to 5000.0	0.0	See 4.12	5.13 / 28

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

AL *x* on SECS	Relay PI frequency control "on" time	0.0 to 5000.0	0.0	See 4.12	5.14 / 29
AL *x* rLY	Alarm relay *x* action to normally open (de-energised) or normally closed (energised)	n.o, n.c	n.o	See 4.12	5.15 / 29
AL *x* trAIL	Alarm trailing or setpoint mode	SEt.P, tL 1, tL 2, tL 3, tL 4, tL 5, tL 6	SEt.P	See 4.12	5.16 / 29
AL *x* OPEr	Alarm relay operating mode	Hi .Lo, Ctrl , FrEq	Hi .Lo	See 4.12	5.17 / 31
AL *x* Ch	Alarm relay operation input selection	PH, rtd	LIVE	See 4.12	5.18 / 31
AL *x* LAtch	Alarm relay latching operation	Auto, LAtch	Auto	See 4.12	5.19 / 31

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

4.2 Analog output 1 function table

Display	Function	Range	Default	Your record	Ref/Page
r0 1 OutPt	Output selection for analog output 1. Not seen if output is fixed at 4-20mA (*__Optional__)	4-20, 0- 1.0, 0- 10	4-20		5.20 / 32
r0 1 inPut	Input selection for analog output 1 (*__Optional__)	PH, ORP or rtd	PH		5.21 / 32
r0 1 P.Ctl	Analog output 1 PI control on or off (*__Optional__)	nO or YES	no		5.22 / 33
r0 1 SEtP	Analog output 1 PI control setpoint (*__Optional__)	Any display value	0		5.23 / 33
r0 1 SPAn	Analog output 1 PI control span (*__Optional__)	Any display value	1000		5.24 / 34
r0 1 P.G	Analog output 1 PI control proportional gain (*__Optional__)	Minimum display value to 32.767	1.000		5.25 / 34
r0 1 I .G	Analog output 1 PI control integral gain (*__Optional__)	Minimum display value to 32.767	0.000		5.26 / 34
r0 1 I .H	Analog output 1 PI control integral high limit (*__Optional__)	0.0 to 100.0	1.000		5.27 / 35
r0 1 I .L	Analog output 1 PI control integral low limit (*__Optional__)	0.0 to 100.0	1.000		5.28 / 35

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

r0 1 b. AS	Analog output 1 PI control bias (*Optional)	0.0 to 100.0	50.0		5.29 / 36
r0 1 Lo	Analog output 1 option low display value (*Optional)	Any display value	0		5.30 / 36
r0 1 H. 9h	Analog output option high display value (*Optional)	Any display value	1000		5.31 / 36

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

4.3 Analog output 2 function table

Display	Function	Range	Default	Your record	Ref/Page
r02 OutPt	Output selection for analog output 2 (*Optional)	4-20, 0- 1.0 or 0- 10	4-20		5.32 / 37
r02 InPut	Input selection for analog output 2 (*Optional)	PH, ORP or rtd	PH		5.33 / 37
r02 P.Ctl	Analog output 2 PI control on or off (*Optional)	no or YES	no		5.34 / 38
r02 SEtP	Analog output 2 PI control setpoint (*Optional)	Any display value	0		5.35 / 38
r02 SPAn	Analog output 2 PI control span (*Optional)	Any display value	1000		5.36 / 38
r02 P.G	Analog output 2 PI control proportional gain (*Optional)	-32.768 to 32.767	1.000		5.37 / 39
r02 I .G	Analog output 2 PI control integral gain (*Optional)	-32.768 to 32.767	0.000		5.38 / 39
r02 I .H	Analog output 2 PI control integral high limit (*Optional)	0.0 to 100.0	1.000		5.39 / 39
r02 I .L	Analog output 2 PI control integral low limit (*Optional)	0.0 to 100.0	1.000		5.40 / 39
r02 bi AS	Analog output 2 PI control bias (*Optional)	0.0 to 100.0	50.0		5.41 / 40
r02 Lo	Analog output 2 option low display value (*Optional)	Any display value	0		5.42 / 40
r02 Hi Sh	Analog output option high display value (*Optional)	Any display value	1000		5.43 / 40

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

4.4 Input function table

Display	Function	Range	Default	Your record	Ref/Page
InPut InPut tYPE	Input type	PH or ORP	PH		5.44 / 40
InPut dCPt	Decimal point selection	0 to 0.003	0		5.45 / 41
InPut drnd	Display rounding selection	0.0 1 to 50.00	0		5.46 / 41
InPut FLtr	Digital filter	0, 1, 2, 3, 4, 5, 6, 7, 8	2		5.47 / 41

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

INPUT INPUT POL	Input polarity	POS or NEG	POS		5.48 / 42
INPUT OFST CAL	pH/ORP offset calibration	n/a	n/a		5.49 / 42
INPUT CAL 1	pH/ORP calibration point 1	n/a	n/a		5.50 / 42
INPUT CAL2	pH/ORP offset calibration point 2	n/a	n/a		5.51 / 43
INPUT U.CAL	pH/ORP uncalibration	n/a	n/a		5.52 / 43
INPUT GRAB CAL	pH/ORP grab calibration sample	n/a	n/a		5.53 / 43
INPUT GRAB SCALE	pH/ORP grab calibration sample scaling value	Any display value	n/a		5.54 / 44
INPUT GRAB	pH/ORP grab calibration on/off	OFF or ON	n/a		5.55 / 44

(*__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	Ref/Page
BARG CH	Bargraph channel	PH or RTD	PH		5.56 / 44
BARG TYPE	Bargraph type	BAR, S.DOT, D.DOT. C.BAR or R.DOT	BAR		5.57 / 45
BARG LO	Bargraph low value	Any display value	0		5.58 / 45
BARG HI	Bargraph high value	Any display value	1000		5.59 / 46

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

4.6 Temperature sensor function table

Display	Function	Range	Default	Your record	Ref/Page
RTD TYPE	Temperature sensor type	NONE, 100, 1000	1000		5.60 / 46

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

rtd dEF °C	Manual temperature setting	-40.0 to 160.0	25.0		5.61 / 47
rtd U.CAL	Temperature uncalibration	no or YES	no		5.62 / 47
rtd CAL 1	First calibration point for temperature input	n/a	n/a		5.63 / 47
rtd CAL2	Second calibration point for temperature input 1	n/a	n/a		5.64 / 48

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

4.7 Display functions

Display	Function	Range	Default	Your record	Ref/Page
d. SP brgt	Display brightness	1 to 16	16		5.65 / 48
d. SP dul l	Dimmed display brighness	0 to 16	2		5.66 / 48

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

4.8 P button and remote input function table

Display	Function	Range	Default	Your record	Ref/Page
r.i nP P.but	Front P button operation mode	NONE, P.H., P.Lo, H., Lo or AL.Ac	NONE		5.67 / 49
r.i nP r.i n. 1	Remote input 1 operation mode	NONE, P.Hol d, d.Hol d, P.H., P.Lo, H., Lo, AL.Ac, ACCSS or dul l	NONE		5.68 / 49
r.i nP r.i n.2	Remote input 2 operation mode	NONE, P.Hol d, d.Hol d, P.H., P.Lo, H., Lo, AL.Ac or ACCSS	NONE		5.69 / 50

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

4.9 Remote signal level (digital inputs)

Display	Function	Range	Default	Your record	Ref/Page
d.i n d.i n.1 P.UP	Remote input (digital inputs) 1 pull up/down operation	OPEn, Hi 9h, Lo	Hi 9h		5.70 / 50
d.i n d.i n.1 Lvl	Remote input (digital inputs) 1 input level	Hi 9h, Lo	Hi 9h		5.71 / 51
d.i n d.i n.2 P.UP	Remote input (digital inputs) 2 pull up/down operation	OPEn, Hi 9h, Lo	Hi 9h		5.72 / 51
d.i n d.i n.2 Lvl	Remote input (digital inputs) 2 input level	Hi 9h, Lo	Hi 9h		5.73 / 51

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

4.10 Access modes function table

Display	Function	Range	Default	Your record	Ref/Page
ACCES EASY LEVEL	Easy access mode	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.74 / 52
ACCES r.i nPt LEVEL	Remote input access mode	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.75 / 52
ACCES USr. 1 P. n	PIN code 1	0 to 50000	0		5.76 / 52
ACCES USr. 1 LEVEL	PIN code 1 access level	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.77 / 53
ACCES USr.2 P. n	PIN code 2	0 to 50000	0		5.78 / 53
ACCES USr.2 LEVEL	PIN code 2 access level	nONE, 1, 2, 3, 4, 5, 6, CAL	nONE		5.79 / 54
ACCES Fn. 1 CodE	User assignable access function 1	0000 to FFFF hex.	0000		5.80 / 54
ACCES Fn. 1 LEVEL	User assignable access 1 level value	dFLt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFLt		5.81 / 54

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

ACCES Fn.2 CodE	User assignable access function 2	0000 to FFFF hex.	0000		5.82 / 55
ACCES Fn.2 LEVEL	User assignable access 2 level value	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFlt		5.83 / 55
ACCES Fn.3 CodE	User assignable access function 3	0000 to FFFF hex.	0000		5.84 / 55
ACCES Fn.3 LEVEL	User assignable access 3 level value	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFlt		5.85 / 56
ACCES Fn.4 CodE	User assignable access function 4	0000 to FFFF hex.	0000		5.86 / 56
ACCES Fn.4 LEVEL	User assignable access 4 level value	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL	dFlt		5.87 / 56

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

4.11 Serial output function table

Display	Function	Range	Default	Your record	Ref/Page
SEri OPEr	Serial operation mode (*__Optional__)	nonE, Cont, Poll, A.buS or diSP	nonE		5.88 / 57
SEri bAud	Serial baud rate (*__Optional__)	1200, 2400, 4800, 9600, 19.2, 38.4, 57.6, 115.2	9600		5.89 / 57
SEri PrtY	Serial parity (*__Optional__)	8n, 8E, 8O, 7E, 7O	8n		5.90 / 58
SEri Unit Addr	Serial address (*__Optional__)	1 to 127	1		5.91 / 58

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

4.12 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
HI SP							
LO							
HYST							
TRIP							
RST							
RLY							
TRAIL							
OPER			n/a	n/a	n/a	n/a	n/a
CH							
LATCH							
SPAN			n/a	n/a	n/a	n/a	n/a
SETP			n/a	n/a	n/a	n/a	n/a
P.S			n/a	n/a	n/a	n/a	n/a
I.S			n/a	n/a	n/a	n/a	n/a
I.H			n/a	n/a	n/a	n/a	n/a
I.L			n/a	n/a	n/a	n/a	n/a
BIAS			n/a	n/a	n/a	n/a	n/a
DUTY SECS			n/a	n/a	n/a	n/a	n/a
ON SECS			n/a	n/a	n/a	n/a	n/a

5 Explanation of functions

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

Explanation of Functions

5.1 Alarm relay high setpoint

Section:	AL 1 to AL 7
Display:	Hi SH
Range:	Any display value or OFF
Default Value:	OFF
Default Access Level	2
Function number	4000 to 4007

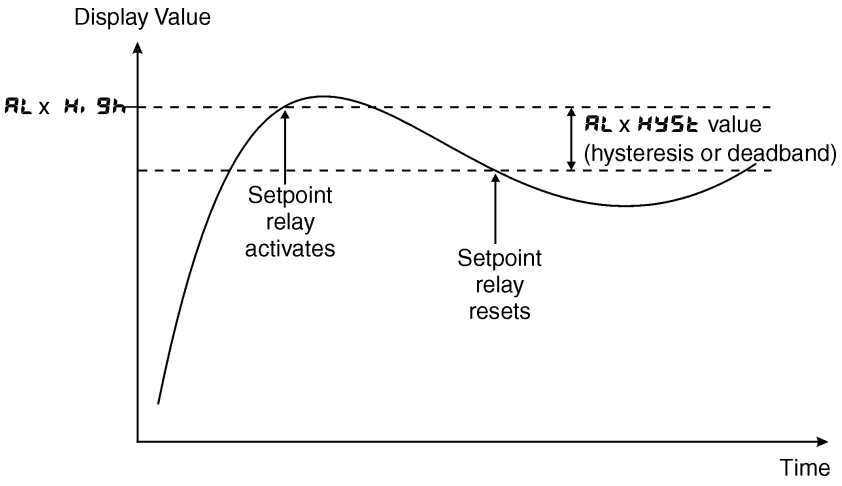
Displays and sets the high setpoint value for the designated alarm. Use this high setpoint function if an alarm operation is required when the display value becomes equal to or greater than the required setpoint value.

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

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

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

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



5.2 Alarm relay low setpoint

Section:	AL 1 to AL 7
Display:	Lo
Range:	Any display value or OFF
Default Value:	OFF
Default Access Level	2
Function number	40 10 to 40 17

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

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

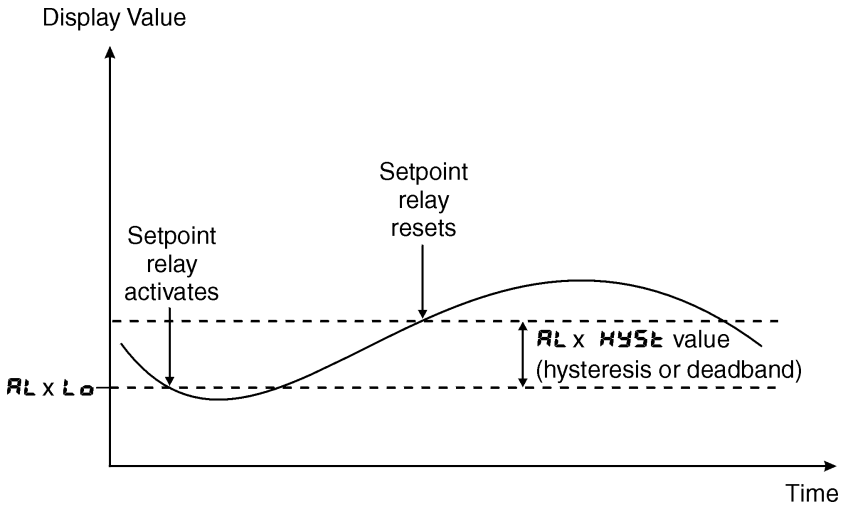
To set the low alarm value press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press F to accept this selection.

The low alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the alarm is allocated both a low and high setpoint then the alarm will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the alarm will reset is controlled by the Hysteresis function.

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

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

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



5.3 Alarm hysteresis (deadband)

Section:	AL 1 to AL 7
Display:	HYSt
Range:	0 to 50000
Default Value:	10
Default Access Level	3
Function number	4020 to 4027

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

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

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

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

5.4 Alarm relay trip time

Section:	AL 1 to AL 7
Display:	trP
Range:	0.0 to 5000.0
Default Value:	0.0
Default Access Level	3
Function number	4040 to 4047

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

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

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

5.5 Alarm relay reset time

Section:	AL 1 to AL 7
Display:	rSt
Range:	0.0 to 5000.0
Default Value:	0.0
Default Access Level	3
Function number	4050 to 4057

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

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

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

5.6 Relay PI control span

Section:	**AL** *x*
Display:	**SPAN**
Range:	Any display value
Default Value:	**100**
Default Access Level	**4**
Function number	**4290** to **4297**

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

5.7 Relay PI control setpoint

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

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

5.8 Relay PI control proportional gain value

Section:	**AL** *x*
Display:	**P.9**
Range:	Minimum display value to **32.767**
Default Value:	**0.0 10**
Default Access Level	**4**
Function number	**42 10** to **42 17**

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

5.9 Relay PI control integral gain value

Section:	**AL** *x*
Display:	**I .9**
Range:	Minimum display value to **32.767**
Default Value:	**0.000**
Default Access Level	**4**
Function number	**4220** to **4227**

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

5.10 Relay PI control integral high limit value

Section:	**RL** *x*
Display:	**I .H**
Range:	**0.0** to **100.0**
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4240** to **4247**

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

5.11 Relay PI control integral low limit value

Section:	**RL** *x*
Display:	**I .L**
Range:	**0.0** to **100.0**
Default Value:	**100.0**
Default Access Level	**4**
Function number	**4250** to **4257**

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

5.12 Relay PI control bias

Section:	**RL** *x*
Display:	**b, AS**
Range:	**0.0** to **100.0**
Default Value:	**50.0**
Default Access Level	**4**
Function number	**4260** to **4267**

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

5.13 Relay PI control duty cycle

Section:	**RL** *x*
Display:	**duty SECS**
Range:	**0.0** to **5000.0**
Default Value:	**0.0**
Default Access Level	**4**
Function number	**4270** to **4277**

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

ter.

5.14 Relay PI frequency control “on” time

Section:	AL x
Display:	on SECS
Range:	0.0 to 5000.0
Default Value:	0.0
Default Access Level	4
Function number	4280 to 4287

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

5.15 Alarm relay normally open/closed

Section:	AL x
Display:	rLY
Range:	n.o, n.c
Default Value:	n.o
Default Access Level	4
Function number	4030 to 4037

Displays and sets the setpoint alarm relay x action to normally open (de-energised) or normally closed (energised), when no alarm condition is present. Since the relay will always open when power is removed a normally closed alarm is often used to provide a power failure alarm indication.

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

Example: If set to n.o the alarm relay will be open circuit when the display is outside alarm condition and will be closed (short circuit across COM and N/O terminals) when the display is in alarm condition.

5.16 Alarm trailing or setpoint mode

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

This function will not be seen unless extra optional relays are fitted. Each alarm relay, except relay 1, may be programmed to operate with an independent setpoint value (SEt.P selected) or may be

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

- Relay 1 (**RL 1**) is always independent.
- Relay 2 (**RL2**) may be independent or may be linked to relay 1 (**tL 1**).
- Relay 3 (**RL3**) may be independent or may be linked to relay 1 (**tL 1**) or relay 2 (**tL2**).
- Relay 4 (**RL4**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**) or relay 3 (**tL3**).
- Relay 5 (**RL5**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**) or relay 4 (**tL4**).
- Relay 6 (**RL6**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**), relay 4 (**tL4**) or relay 5 (**tL5**).
- Relay 7 (**RL7**) may be independent or may be linked to relay 1 (**tL 1**), relay 2 (**tL2**), relay 3 (**tL3**), relay 4 (**tL4**), relay 5 (**tL5**) or relay 6 (**tL6**).

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

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

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

Example 1 - High alarm: With Relay 2 set to trail relay 1, if **RL 1 H, 9h** is set to **10.00** and **RL2 H, 9h** is set to **0.50** then relay 1 will activate at **10.00** and relay 2 will activate at **10.50** (i.e. 10.00 + 0.50). If relay 2 had been set at **-0.50** then Relay 2 would activate at **9.50** (i.e. 10.00 – 0.50) or above.

Example 2 - Low alarm: With Relay 2 set to trail relay 1, if **RL 1 Lo** is set to **6.00** and **RL2 Lo** is set to **2.00** then relay 1 will activate at **6.00** and relay 2 will activate at **8.00** (i.e. 6.00 + 2.00). If relay 2 had been set at **-2.00** then Relay 2 would activate at **4.00** (i.e. 6.00 – 2.00) or below.

5.17 Alarm relay operating mode

Section:	AL x
Display:	OPEr
Range:	Hi .Lo, CtrI , FrEq
Default Value:	Hi .Lo
Default Access Level	4
Function number	4 160 to 4 167

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

5.18 Alarm relay operation input selection

Section:	AL x
Display:	Ch
Range:	PH, rtd
Default Value:	LI UE
Default Access Level	4
Function number	4070 to 4077

Sets the input from which the selected alarm relay will operate. Selections available are:
LI VE - relay operates from the live value
LOAd - relay operates from the load value
L.HLd - relay operates from the load held value

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

5.19 Alarm relay latching operation

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

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

In latching mode the alarm annunciator (5 digit display type only) will flash when the display goes into alarm condition. If the display goes out of alarm condition without being acknowledged the flashing period will change to give a longer "off" time. If the alarm is acknowledged by pressing the

F button then the annunciator will change from flashing to solidly lit. Once the alarm has been acknowledged the relay will be free to reset once the display value moves out of alarm condition.

5.20 Output selection for analog output 1

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

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

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

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

5.21 Input selection for analog output 1

Section:	rO 1
Display:	InPut
Range:	PH, ORP or rtd
Default Value:	PH
Default Access Level	4
Function number	43E0

Seen only when analog retransmission option fitted. Sets the input from which the first analog output will operate. If the display is set to show pH then the ORP option will not be see. If the display is set to show ORP then the pH option will not be seen. Selections available are:
PH - output operates from the pH value
ORP - output operates from the ORP Redox value
rtd - output operates from temperature value

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

5.22 Analog output 1 PI control on or off

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

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

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

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

5.23 Analog output 1 PI control setpoint

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

Allows selection of the PI control setpoint.

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

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

5.24 Analog output 1 PI control span

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

Allows selection of the PI control span.

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

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

5.25 Analog output 1 PI control proportional gain

Section:	rO 1
Display:	P.9
Range:	Minimum display value to 32.767
Default Value:	1.000
Default Access Level	4
Function number	4620

Allows selection of the PI control proportional gain.

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

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

5.26 Analog output 1 PI control integral gain

Section:	rO 1
Display:	I.9
Range:	Minimum display value to 32.767
Default Value:	0.000
Default Access Level	4
Function number	4628

Allows selection of the PI control integral gain.

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

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

5.27 Analog output 1 PI control integral high limit

Section:	**rO 1**
Display:	**I.H**
Range:	**0.0** to **100.0**
Default Value:	**1.000**
Default Access Level	**4**
Function number	**4638**

Allows selection of the PI control integral high limit.

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

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

5.28 Analog output 1 PI control integral low limit

Section:	**rO 1**
Display:	**I.L**
Range:	**0.0** to **100.0**
Default Value:	**1.000**
Default Access Level	**4**
Function number	**4640**

Allows selection of the PI control integral low limit.

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

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

5.29 Analog output 1 PI control bias

Section:	rO 1
Display:	b, AS
Range:	0.0 to 100.0
Default Value:	50.0
Default Access Level	4
Function number	4648

Allows selection of the PI control bias.

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

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

5.30 Analog output 1 option low value

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

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

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

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

5.31 Analog output option high value

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

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

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

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

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

5.32 Output selection for analog output 2

Section:	**r02**
Display:	**OutPt**
Range:	**4-20**, **0- 1.0** or **0- 10**
Default Value:	**4-20**
Default Access Level	**4**
Function number	**4 14 1**

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

4-20 for 4 to 20mA output

0- 1.0 for 0 to 1VDC output

0- 10 for 0 to 10VDC output

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

5.33 Input selection for analog output 2

Section:	**r02**
Display:	**1 nPut**
Range:	**PH**, **ORP** or **rtd**
Default Value:	**PH**
Default Access Level	**4**
Function number	**43E 1**

Seen only when dual analog retransmission option fitted. Sets the input from which the second analog output will operate. See function **r0 11 nPut** for further details.

5.34 Analog output 2 PI control on or off

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

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

5.35 Analog output 2 PI control setpoint

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

Allows selection of the PI control setpoint.

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

5.36 Analog output 2 PI control span

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

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

5.37 Analog output 2 PI control proportional gain

Section:	r02
Display:	P.9
Range:	-32.768 to 32.767
Default Value:	1.000
Default Access Level	4
Function number	4621

Allows selection of the PI control proportional gain. See function r01P.9 for further details.

5.38 Analog output 2 PI control integral gain

Section:	r02
Display:	I.9
Range:	-32.768 to 32.767
Default Value:	0.000
Default Access Level	4
Function number	4629

Allows selection of the PI control integral gain. See function r011.9 for further details.

5.39 Analog output 2 PI control integral high limit

Section:	r02
Display:	I.H
Range:	0.0 to 100.0
Default Value:	1.000
Default Access Level	I.H
Function number	4639

Allows selection of the PI control integral high limit. See function r011.H for further details.

5.40 Analog output 2 PI control integral low limit

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

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

5.41 Analog output 2 PI control bias

Section:	FO2
Display:	bIAS
Range:	0.0 to 100.0
Default Value:	50.0
Default Access Level	4
Function number	4649

Allows selection of the PI control bias. See function FO1bIAS for further details.

5.42 Analog output 2 option low value

Section:	FO2
Display:	Lo
Range:	Any display value
Default Value:	0
Default Access Level	4
Function number	4121

Seen only when dual analog retransmission option fitted. See function FO1Lo for further details.

5.43 Analog output option 2 high value

Section:	FO2
Display:	HIGH
Range:	Any display value
Default Value:	1000
Default Access Level	4
Function number	4131

Seen only when dual analog retransmission option fitted. See function FO1HIGH for further details.

5.44 Input type

Section:	InPut
Display:	InPut tYPE
Range:	PH or ORP
Default Value:	PH
Default Access Level	CAL
Function number	4680

Displays and sets the input type, either pH or ORP (Redox) can be selected. To set the input type

go to the function, press F and when you see the setting flash use the ▲ or ▼ push buttons to set the required input type then press F to accept this selection.

5.45 Decimal point selection

Section:	InPut
Display:	dCPt
Range:	0 to 0.003
Default Value:	0
Default Access Level	CAL
Function number	4100

Displays and sets the decimal points to be displayed for the pH or ORP input. To set the input type go to the function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required number of decimal points then press F to accept this selection. As the accuracy of the ORP value is 5mV there is no reason to select any decimal points for the ORP display. A decimal point setting of 0.1 or 0.02 is recommended for the pH display, it will be difficult to obtain a stable reading with more decimal points.

5.46 Display rounding selection

Section:	InPut
Display:	drnd
Range:	0.01 to 50.00
Default Value:	0
Default Access Level	4
Function number	4360

Displays and sets the display rounding to be displayed for the pH or ORP input. For example if the display rounding is set to 0.05 the display value will only show multiples of 0.05. This can be used to reduce instability in the reading. To set the rounding value go to the function, press F and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required rounding value then press F to accept this selection.

5.47 Digital filter

Section:	InPut
Display:	FLtr
Range:	0, 1, 2, 3, 4, 5, 6, 7, 8
Default Value:	2
Default Access Level	4
Function number	43C0

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. Note that the higher the filter setting the longer the display may take to reach its final value when the input is changed, similarly the relay operation and any output options will be slowed down when the filter setting is increased. To set the filter go to the **FLtr** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.48 Input polarity

Section:	**InPut**
Display:	**InPut POL**
Range:	**POS** or **NEG**
Default Value:	**POS**
Default Access Level	**CAL**
Function number	**4682**

Allow selection of **POS** (positive) or **NEG** (negative) input polarity for the pH or ORP input signal. For most applications **POS** would be used. Use **NEG** if the electrode signal has been inverted e.g. if an inverting amplifier is used between the electrode and the display. To set the polarity go to the **InPut POL** function, press **F** and when you see a digit of the value flash use the ▲ or ▼ push buttons to set the polarity then press **F** to accept this selection.

5.49 pH/ORP offset calibration

Section:	**InPut**
Display:	**OFSt CAL**
Range:	n/a
Default Value:	n/a
Default Access Level	**CAL**
Function number	**0660**

The **OFSt CAL** function is used to perform an offset pH or ORP calibration.

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

5.50 pH/ORP calibration point 1

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

The **CAL 1** function is used to perform the first point of a two point pH/ORP calibration.

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

5.51 pH/ORP offset calibration point 2

Section:	**InPut**
Display:	**CAL2**
Range:	n/a
Default Value:	n/a
Default Access Level	**CAL**
Function number	**0610**

The **CAL2** function is used to perform the second point of a two point pH/ORP calibration.

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

5.52 pH/ORP uncalibration

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

Reset (uncalibrate) calibration for pH or ORP. The uncalibration process resets the calibration to factory default settings. Refer to the Calibration chapter for full details of the calibration procedure.

5.53 pH/ORP grab calibration sample

Section:	**InPut**
Display:	**GrAb CAL**
Range:	n/a
Default Value:	n/a
Default Access Level	**2**
Function number	**46BC**

The **GrAb CAL** function is used store a sample pH/ORP input, once the value is confirmed the required display value for this sample can be entered at the **GrAb SCALE** function.

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

5.54 pH/ORP grab calibration sample scaling value

Section:	**InPut**
Display:	**GrAb SCALE**
Range:	Any display value
Default Value:	n/a
Default Access Level	**2**
Function number	**46BA**

The **GrAb SCALE** function allows entry of the required pH or ORP value obtained by the grab calibration (**GrAb SCALE** function).

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

5.55 pH/ORP grab calibration on/off

Section:	**InPut**
Display:	**GrAb**
Range:	**OFF** or **On**
Default Value:	n/a
Default Access Level	**CAL**
Function number	**46B6**

The **GrAb SCALE** function allows entry of the required pH or ORP value obtained by the grab calibration (**GrAb SCALE** function).

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

5.56 Bargraph channel

Section:	**bArG**
Display:	**Ch**
Range:	**PH** or **rtd**
Default Value:	**PH**
Default Access Level	**4**
Function number	**43F6**

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

- **PH** - bargraph shows pH or ORP (Redox) value
- **rtd** - bargraph shows temperature value

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

5.57 Bargraph type

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

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

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

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

5.58 Bargraph low value

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

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

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

5.59 Bargraph high value

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

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

5.60 Temperature sensor type

Section:	rtd
Display:	tYPE
Range:	nONE, 100, 1000
Default Value:	1000
Default Access Level	CAL
Function number	4804

Allows selection of the temperature sensor type. Choices are:
100 - Pt100 RTD
1000 - Pt1000 RTD
nONE - No temperature sensor used but temperature can be manually set.

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

5.61 Manual temperature setting for input 1

Section:	rtd
Display:	dEF °C
Range:	-40.0 to 160.0
Default Value:	25.0
Default Access Level	CAL
Function number	4808

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

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

This temperature will be the one seen when the display is toggled to show temperature and will also be the temperature used for temperature compensation of pH readings.

5.62 Temperature uncalibration

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

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

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

5.63 First calibration point for temperature input

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

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

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

5.64 Second calibration point for temperature input

Section:	rtd
Display:	CAL2
Range:	n/a
Default Value:	n/a
Default Access Level	CAL
Function number	0611

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

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

5.65 Display brighness

Section:	d. SP
Display:	brgt
Range:	1 to 16
Default Value:	16
Default Access Level	4
Function number	4432

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

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

5.66 Dimmed display brighness

Section:	d. SP
Display:	dul 1
Range:	0 to 16
Default Value:	2
Default Access Level	4
Function number	4433

Displays and sets the level for remote input brightness switching. When a remote input is set to dul 1 the remote input can be used to switch between the display brightness level set by the brgt function and the dimmed display brightness set by the dul 1 function. The display dull level is selectable from 0 to 16, where 0 = lowest intensity and 16 = highest intensity. This function is useful in reducing glare when the display needs to be viewed in both light and dark ambient light levels.

5.67 Front P button operation mode

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

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

5.68 Remote input 1 operation mode

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

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

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

- **AL.Ac** - alarm acknowledge. Allows the remote input to be used to acknowledge a latching alarm. See the function.
- **ACCSS** - remote input access. Allows the remote input to be used for access control purposes. See the function.
- **dul I** - remote input brightness switching. When this mode is selected the display brightness will be switch from the brightness level set at the **d. SP br9t** to the brightness level set at the **d. SP dul I** function. This function is generally used to switch between daylight and night time viewing brightness requirements thereby avoiding glare when light levels are low.

5.69 Remote input 2 operation mode

Section:	**r.I nP**
Display:	**r.I n.2**
Range:	**nONE**, **P.Hol**, **d.Hol**, **d.P.H.**, **P.Lo**, **H.Lo**, **AL.Ac** or **ACCSS**
Default Value:	**nONE**
Default Access Level	**4**
Function number	**4722**

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

5.70 Remote input (digital inputs) 1 pull up/down operation

Section:	**d.I n**
Display:	**d.I n. I P.UP**
Range:	**OPEn**, **Hi 9h**, **Lo**
Default Value:	**Hi 9h**
Default Access Level	**4**
Function number	**4A50**

This function sets the voltage level present on the digital input terminal. If set to **Hi 9h** a 5VDC voltage will be placed on the input terminal via a pull up resistor and a short circuit to ground or voltage below 2V will be required to activate the remote input. If set to **Lo** then the input terminal will be connected to ground via a pull down resistor and a voltage between 5 and 24VDC will be required at the input to activate the remote input. If set to **OPEn** then both the pull up and pull down resistors will be taken out of circuit and the terminal voltage will be "floating", this choice can be used when input devices are used which may supply their own voltage to the digital input terminal, maximum acceptable voltage is 24VDC.

5.71 Remote input (digital inputs) 1 input level

Section:	d.I n
Display:	d.I n.1 LvL
Range:	HI 9h, Lo
Default Value:	HI 9h
Default Access Level	4
Function number	4A58

This function sets the input level required to activate the remote input. A setting of **Lo** means that a low voltage usually 0V or a short circuit to ground will activate the remote input. A setting of **HI 9h** means that a voltage of 5 to 24V is required to activate the remote input.

5.72 Remote input (digital inputs) 2 pull up/down operation

Section:	d.I n
Display:	d.I n.2 P.UP
Range:	OPEn, HI 9h, Lo
Default Value:	HI 9h
Default Access Level	4
Function number	4A51

This function sets the voltage level present on the digital input terminal. If set to **HI 9h** a 5VDC voltage will be placed on the input terminal via a pull up resistor and a short circuit to ground or voltage below 2V will be required to activate the remote input. If set to **Lo** then the input terminal will be connected to ground via a pull down resistor and a voltage between 5 and 24VDC will be required at the input to activate the remote input. If set to **OPEn** then both the pull up and pull down resistors will be taken out of circuit and the terminal voltage will be "floating", this choice can be used when input devices are used which may supply their own voltage to the digital input terminal, maximum acceptable voltage is 24VDC.

5.73 Remote input (digital inputs) 2 input level

Section:	d.I n
Display:	d.I n.2 LvL
Range:	HI 9h, Lo
Default Value:	HI 9h
Default Access Level	4
Function number	4A59

This function sets the input level required to activate the remote input. A setting of **Lo** means that a low voltage usually 0V or a short circuit to ground will activate the remote input. A setting of **HI 9h** means that a voltage of 5 to 24V is required to activate the remote input.

5.74 Easy access mode

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

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

5.75 Remote input access mode

Section:	ACCES
Display:	r.I nPt LEVEL
Range:	NONE, 1, 2, 3, 4, 5, 6, CAL
Default Value:	NONE
Default Access Level	5.CAL
Function number	0C01

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

5.76 PIN code 1

Section:	ACCES
Display:	USr.1 Pin
Range:	0 to 50000
Default Value:	0
Default Access Level	5.CAL
Function number	0C09

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

To access setup functions using the PIN code input access method press then release the F button

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

5.77 PIN code 1 access level

Section:	ACCES
Display:	USr.1 LEVEL
Range:	NONE, 1, 2, 3, 4, 5, 6, CAL
Default Value:	NONE
Default Access Level	5.CAL
Function number	0C02

This function allows choice of the access level available when using the PIN code 1 input access method. To access setup functions using the PIN code 1 input access method press and hold the F button until the message FUNC is seen followed by the first function message, this should take approximately 3 seconds. If the message FUNC End is seen at this point it means that the access level has been set to NonE.

5.78 PIN code 2

Section:	ACCES
Display:	USr.2 PIn
Range:	0 to 50000
Default Value:	0
Default Access Level	5.CAL
Function number	0C0A

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

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

5.79 PIN code 2 access level

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

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

5.80 User assignable access 1 function number

Section:	ACCES
Display:	Fn. 1 CodE
Range:	0000 to FFFF hex.
Default Value:	0000
Default Access Level	5.CAL
Function number	0C 10

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

5.81 User assignable access 1 level value

Section:	ACCES
Display:	Fn. 1 LEVEL
Range:	dFLt, 1, 2, 3, 4, 5, 6, CAL, 5.CAL
Default Value:	dFLt
Default Access Level	5.CAL
Function number	0C40

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

5.82 User assignable access 2 function number

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

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

5.83 User assignable access 2 level value

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

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

5.84 User assignable access 3 function number

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

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

5.85 User assignable access 3 level value

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

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

5.86 User assignable access 4 function number

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

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

5.87 User assignable access 4 level value

Section:	ACCES
Display:	Fn.4 LEVEL
Range:	dFlt, 1, 2, 3, 4, 5, 6, CAL, S.CAL
Default Value:	dFlt
Default Access Level	S.CAL
Function number	OC43

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

5.88 Serial operation mode

Section:	SEri
Display:	OPEr
Range:	nonE, Cont, Poll, A.buS or di SP
Default Value:	nonE
Default Access Level	4
Function number	4480

Allows selection of the operating mode to be used for RS232 or RS485 serial communications. Choices are:

- **nonE** - no serial comms. required
- **Cont** - sends ASCII form of display data at a rate typically 90% of the sample rate.
- **Poll** - controlled by computer or PLC etc. as host. The host sends command via RS232/485 and instrument responds as requested.
- **A.buS** - this is a special communications mode used with Windows compatible optional PC download software. Refer to the user manual supplied with this optional software.
- **di SP** - sends image data from the display without conversion to ASCII. This mode should only be used when the serial output is connected to another display from the same manufacturer.

5.89 Serial baud rate

Section:	SEri
Display:	bAud
Range:	1200, 2400, 4800, 9600, 19.2, 38.4, 57.6, 115.2
Default Value:	9600
Default Access Level	4
Function number	0431

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

1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200

5.90 Serial parity

Section:	SEr1
Display:	PrtY
Range:	8N, 8E, 8O, 7E, 7O
Default Value:	8N
Default Access Level	4
Function number	4482

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

5.91 Serial address

Section:	SEr1
Display:	Unit Addr
Range:	1 to 127
Default Value:	1
Default Access Level	4
Function number	0430

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

5.92 Error Messages

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

  This indicates that the calibration attempt has failed and can be seen at the first or second calibration point. This error most usually occurs when there is not enough change in input signal level between calibration points. If this message is seen at only one calibration point then try proceed with the second point. If the second point is successful then try the first point again. If the error message is seen at both points then see below.

  For pH/ORP uncalibrate and check the reading with at least one known value solution. If the reading is not close to the known value there is no point in trying to calibrate, check the electrode and settings. If then reading is close to the known value then try calibration again.

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

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

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

- **-or-** - overrange message - This error message is seen if the input signal is above the range of the sensor or the measuring range of the display for that sensor e.g. above 160 degrees C for a temperature display in a PM4-PH meter.

- **-ur-** - underrange message - This indicates that the input is below the range expected for that input. e.g. below -40 degrees C for a temperature display in a PM4-PH meter.

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

- **HI.rng** - this is not an error message, if this is seen during the "wake up" messages it indicates that the input range has been extended. Typically this will mean that the ORP range has been extended to -2000 to +2000mV.

6 Calibration

6.1 Introduction

The calibration of the display is necessary to match the pH or ORP sensor to the instrument. Since the output from pH and ORP sensors changes over time regular calibration will be necessary. The period between calibration checks and recalibration will depend on the process being measured and the quality requirements of the application.

If calibration problems occur a basic check of the electrode and display the instrument can be uncalibrated using the **InPut U.CAL** function. Once uncalibrated place the electrode in a known pH or ORP solution. If the reading is not close to the known value then there is no point in attempting calibration, the electrode, wiring and display should be examined separately.

If a temperature compensation sensor is used it is essential that the temperature input is reading correctly before performing a pH calibration. If necessary calibrate the temperature input before the pH input.

Various methods of pH and ORP calibration methods are available in the PM5-PH, a brief outline is given below:

- Two point calibration using the **CAL 1** function together with the **CAL2** function sets the calibration slope.
- A single point offset calibration can be carried out using the **OFSt CAL** function. An offset calibration will adjust values across the calibration slope.
- A "grab sample" single point calibration can carried out using the **GrAb CAL**. The grab sample method allows a measurement to be taken and stored in memory whilst the sample in analysed. The value of the sample can then be entered some time later.
- The calibration memory can be cleared using the **U.CAL**. The clearing of the calibration memory can be useful prior to a two point calibration to ensure that spurious values in memory entered by previous failed calibrations are cleared before the new two point calibration is attempted.

6.2 pH or ORP Calibration

6.2.1 Two point calibration

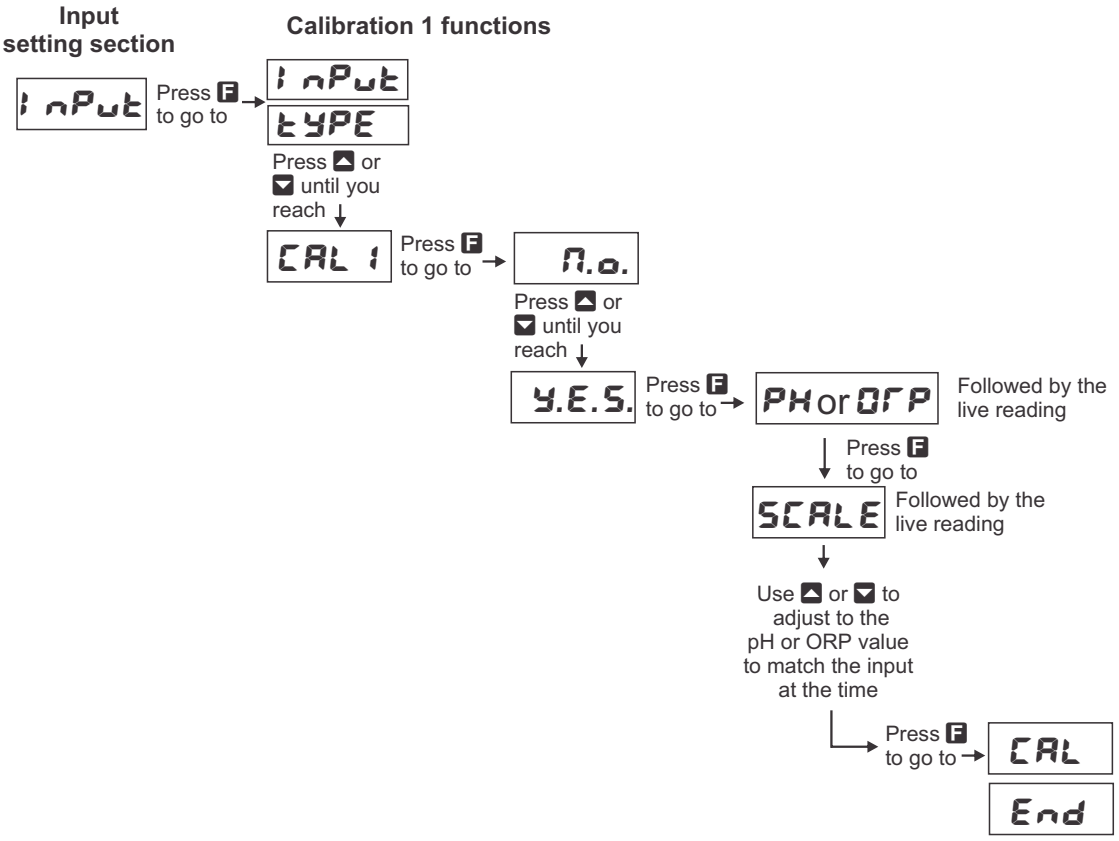
CAL 1 and **CAL2** functions are used together to scale the instruments display for pH or Redox. Two calibration buffer solutions will be required e.g. 4.00 and 7.00 pH buffers. The **CAL 1** function sets the first calibration point. The procedure for entering the first scaling point is:

1. If a temperature sensor is used check that the temperature reading is correct. If it is not correct perform a temperature calibration using function **CAL 1** and **CAL2** before proceeding. If a temperature sensor is not used then check that the default temperature setting (function **dEF °C**) is set correctly before proceeding.
2. Place a cleaned and dabbed dry probe into the first buffer solution e.g. 4.00 pH (use distilled water for cleaning the probe).
3. Enter the setup functions and go to the **InPut** section. Press **F** to enter the input function section then press and release ⏏ until the **CAL 1** function is reached.

4. At the CAL 1 function press F. The display will indicate NO, press the ▲ button to change this to YES then press the F button. The display will show PH or ORP depending on the input type followed the live input value. Do not be concerned at this stage if the live input display value is not the pH or ORP value required. Allow time for the reading to stabilise. It is important that the live input value seen is a steady value. If the reading does not stabilise then the input needs to be investigated before proceeding with the scaling.

5. Press, then release the F button. The display will indicate SCALE followed by a value. Use the ▲ or ▼ button to change this value to the buffer value at this input. e.g. 4.00 for a 4.00 pH buffer. Press the F button to accept changes.

pH/ORP calibration point 1 flow chart



CAL 2 Second scaling point for 2 point scaling method

The second point scaling is performed in exactly the same manner as CAL 1. It is essential that the second buffer is different in value to the one used for the CAL 1 input. Start at the CAL 2 function and follow the same procedure as above.

6.2.2 Offset calibration

The offset calibration offers a single point adjustment across the whole pH or Redox calibration slope. The offset procedure can be used to adjust the reading when the same error exists at all readings e.g. reading 0.5 pH high.

1. Place a cleaned and dabbed dry into the sample or buffer of known value.

2. Enter the setup functions and go to the **InPut** section. Press **F** to enter the input function section then press and release ▲ until the **OFSt CAL** function is reached.

3. The display will indicate **nO**, press the **F** button to to enter the offset function then use the ▲ button to change the **nO** to **YES** then press the **F** button. The display will show **PH** or **ORP** depending on the input type followed the live input value.

4. Press the **F** button. The display will show **OFSt CAL** followed by a value. Use the ▲ or ▼ pushbutton to enter the display value required for this sample. Press the **F** button to accept this new value, the display should show the message **OFSt End** to indicate that the offset has been accepted.

6.2.3 Grab sample calibration

The grab sample calibration method can be used to provide a single point offset calibration. This method allows a sample to be taken and the input at that time stored in memory. The sample can then be analysed and the value for this sample entered at a later time. The grab sample offset calibration method operates as follows:

1. Set the **GrAb** function to **On**. Press the **F** button to accept the change.

2. When ready to perform a grab sample calibration ensure that the electrode is in the solution to be measured. Go to the **GrAb CAL** function and press **F** pushbutton then the ▲ pushbutton to select **YES** then press the **F** button to accept the change.

3. A live pH or ORP reading will now be displayed. When the reading has settled to a steady value press the **F** button. The pH or ORP value for that sample will now be stored in memory. The message **GrAb End** will be seen and the display will move to the **GrAb SCLE** function.

4. When the sample has been analysed or checked with a reference meter if any adjustment to the display reading is needed the true value for the sample can be entered at the **GrAb SCLE** function.

5. At the **GrAb SCLE** function press the **F** to allow the value to be adjusted. A value will be seen. Adjust this value to the required value for the sample using the ▲ or ▼ button.

6. When the required value is displayed press the **F** button to accept the new value, the message **GrAb dONE** will be displayed and the calibration will now be adjusted to the new value.

6.3 pH or ORP 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 **InPut** section is reached. Press **F** enter this section and then press and release the ▲ pushbutton until **U.CAL** is displayed.

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

6.4 Temperature Calibration

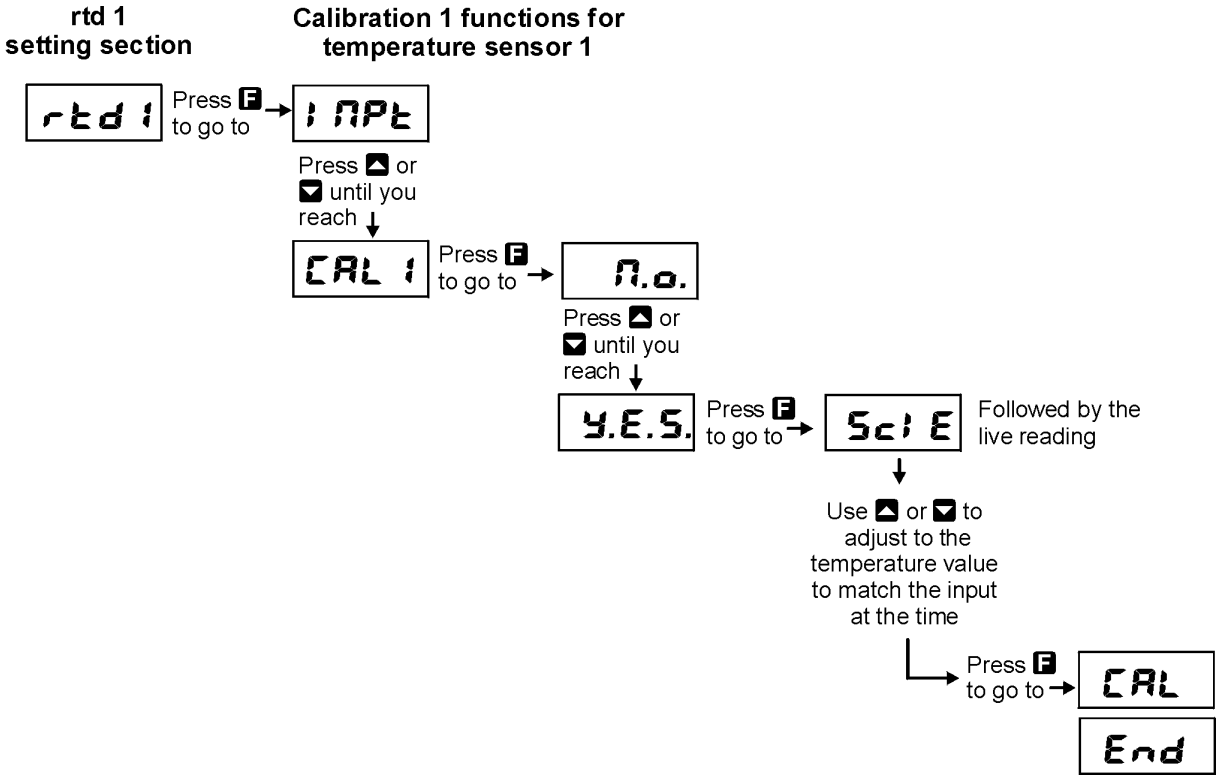
A two point calibration is provided for temperature sensors. The two point calibration requires that the sensor is allowed to stabilise at two known temperatures. Ideally the temperatures chosen should span the normal temperature measurement range of the process being measured. A minimum difference of 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 section is reached i.e. rtd. Press F to access the channel setup and then press and release the ▲ pushbutton until CAL 1 is displayed.
3. Press F the display will show the message no. Use the ▲ or ▼ pushbutton to toggle this to YES then press F to accept this. The display will show the temperature. When the temperature is stable press F.
4. The display will show the message SCALE 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 section is reached i.e. rtd. Press F to access the channel setup and then press and release the ▲ pushbutton until is displayed.

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

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

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

6.5 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 emperature section is reached i.e. rtd.. Press F to access the channel setup and then press and release the ▲ pushbutton until is displayed.

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

7 Setting up the relay PI controller

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

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

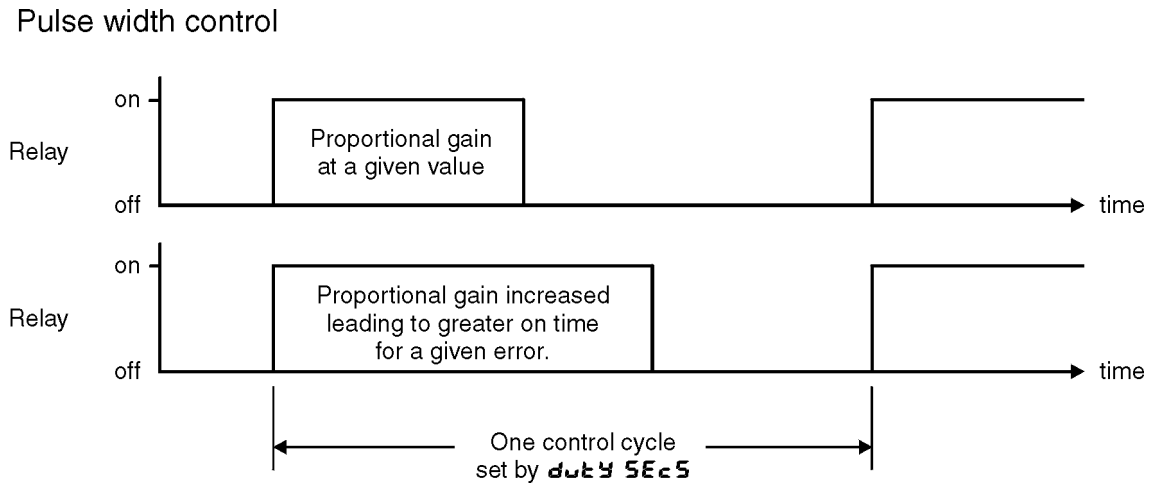
If ctrl is selected then the chosen relay will operate in pulse width control mode. If FREQ is selected then the chosen relay will operate in frequency control mode.

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

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

7.1 Relay pulse width modulation control mode

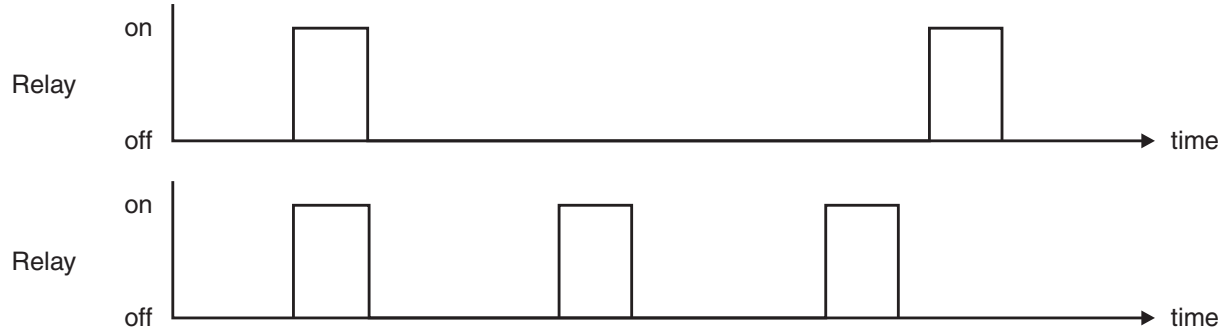
To use pulse width modulation control ctrl must be selected at the function.



7.2 Relay frequency modulation control mode

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

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



PI control functions and setup procedure

7.3 Alarm relay operating mode

Section:	**AL** *x*
Display:	**OPEr**
Range:	**Hi .Lo**, **ctrl** or **FrEq**
Default Value:	**Hi .Lo**
Default Access Level	**4**
Function number	**4 160** to **4 166**

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

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

7.4 Relay PI control span

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

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

be at 100% i.e. the relay will be on continuously. The control output will then gradually adjust the on/off time as the display value reaches the setpoint.

7.5 Relay PI control setpoint

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

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

7.6 Relay PI control proportional gain value

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

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

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

7.7 Relay PI control integral gain value

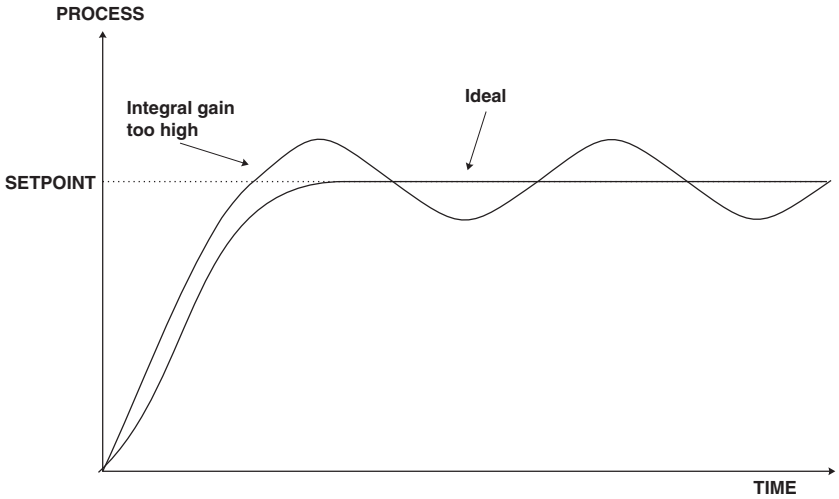
Section:	AL x
Display:	1.9
Range:	-32.768 to 32.767
Default Value:	0.000
Default Access Level	4
Function number	4220 to 4226

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

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

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

Where Ig is the integral gain set via the function.



7.8 Relay PI control integral high limit value

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

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

7.9 Relay PI control integral low limit value

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

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

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

7.10 Relay PI control bias

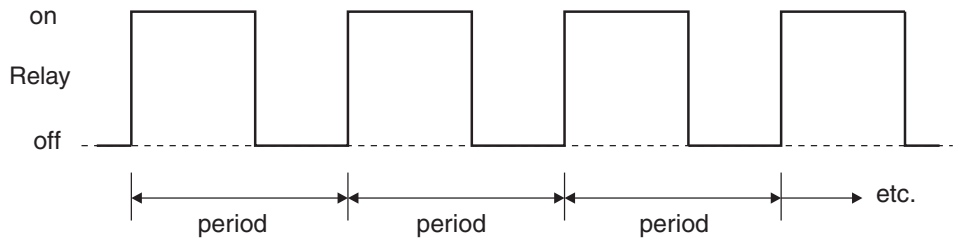
Section:	**AL** x
Display:	**b, AS**
Range:	**0.0** to **100.0**
Default Value:	**50.0**
Default Access Level	**4**
Function number	**4260** to **4266**

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

7.11 Relay PI control duty cycle

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

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



7.12 Relay PI frequency control "on" time

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

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

controlled receives an acceptable on pulse.

7.13 Setting up the PI pulse width controller

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

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

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

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

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

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

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

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

7.14 Setting up the PI frequency controller

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

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

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

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

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

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

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

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

8 Specifications

8.1 Technical Specifications

Input:	pH - any electrode where Eo=7 Redox - any standard Redox (ORP) electrode (-1100mV to 1100mV nominal standard, extended range -2000mV to 2000mV to special order)
Temperature input:	100Ω RTD, 1000Ω RTD or manually set
Impedance:	Greater than $10^{10}\Omega$
Measuring range:	0.00 to 14.00pH,±1100mV for Redox and-40 to 160^{o}C for temperature.
Accuracy:	pH ±0.03 pH , Redox ±5mV standard or ±10mV for extended range, temperature ±1^{o}C
Sample Rate:	8 samples per second.
Ambient Temperature:	LED -10 to 60^{o}C, LCD -10 to 50^{o}C
Humidity:	5 to 95% non condensing
Display:	LED Models 4 digit 20mm, 5 digit 14.2mm + status LEDs + 4 way keypad. 6 digit 14.2mm + 4 way keypad. LED Bar Graph 20 segment bar + 5 digit 7.6mm LED plus relay status LEDs LCD and 4 digit LED displays are available for computer or remote keypad only setup and calibration
Power Supply:	AC 240V, 110V, 48V, 32V or 24V 50/60Hz or DC isolated wide range 12 to 48V. Note: supply type is factory configured
Power Consumption:	AC supply 4 VA max, DC supply typically 160mA at 12V, 80mA at 24V (basic model with no output options)
Output (standard):	1 x relay, Form A rated 5A at 240VAC resistive load
Relay Action:	Programmable N.O. or N.C. On/off alarm/control or PI control (pulse width or frequency)

8.2 Output Options

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

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

8.3 Physical Characteristics

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

9 Guarantee and service

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

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

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

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

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

This product is designed and manufactured in Australia.