Model RM4-IV
DIN Rail Process Monitor/Controller
Inputs from ±20mA, 4-20mA,
±100mVDC, ±1VDC, ±10VDC or
±100VDC or Slidewire
Operation and Instruction Manual

Table of Contents

1 Introduction

1.1 General description

This manual contains information for the installation and operation of the RM4-IV DIN rail monitor/controller. The RM4 is a general purpose instrument which may be configured to accept inputs of ±2mA, ±20mA, 4 to 20mA, ±100mV, ±1V, ±10V, ±100VDC or 3 wire slidewire (1kΩ slidewire to 1MΩ slidewire values).

Two separate sets of calibration scaling values can be stored with the display choice being made via a remote switch. The RM4-IV offers the choice of linear or square root display.

The instrument may be calibrated to display the input in engineering units. Two standard inbuilt relays provide alarm or PI control functions. A standard transmitter supply of 24VDC @ 25mA unregulated is also provided on both AC and DC powered models.

Alarm relays and optional retransmission may be set to operate from the live input value, the display value or to follow either the tare, peak hold, display hold, peak memory or valley memory remote input operations.

Unless otherwise specified at the time of order, your RM4 has been factory set to a standard configuration. Like all other RM4 series instruments the configuration and calibration is easily changed by the user. Initial changes may require dismantling the instrument to alter PCB links, other changes are made by push button functions.

Full electrical isolation between power supply, input voltage or current and optional retransmission output is provided by the RM4, thereby eliminating grounding and common voltage problems. This isolation feature makes the RM4 ideal for interfacing to computers, PLCs and other data acquisition devices.

The RM4 series of DIN Rail Process Modules are designed for high reliability in industrial applications. The 5 digit LED display provides good visibility, even in areas with high ambient light levels. A feature of the RM4-IV is the programmable display brightness function, this allows the unit to be operated with low display brightness to reduce the instrument power consumption and to improve readability in darker areas. To reduce power consumption in normal use the display can be programmed to automatically dim or blank after a set time, the display will return to its normal brightness level if any of the pushbuttons are pressed or if an alarm relay is activated.

1.2 Standard outputs

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

- A non isolated transmitter supply of approx. 24VDC (25mA max.) unregulated is provided.

1.3 Output options

- 1 or 2 extra relays (not configurable for PI control)

- Dual output transistor switched 24VDC (non isolated).

- Isolated 12 bit analog retransmission (single or dual analog output versions available) configurable for 4–20mA., 0–1V or 0–10V. The first analog output is configurable for retransmission or PI control.

- Isolated 16 bit analog retransmission configurable for retransmission or PI control plus extra relay

- 12VDC or 24VDC (link selectable) isolated transmitter supply/excitation voltage (25mA max.). Not to be used with the standard 24VDC unregulated transmitter supply

- Isolated RS232, RS485 or RS422 serial communications (8 bit ASCII or Modbus RTU)

- Isolated Optional outputs are available in certain combinations e.g. Analog output plus isolated transmitter supply.

2 Mechanical installation

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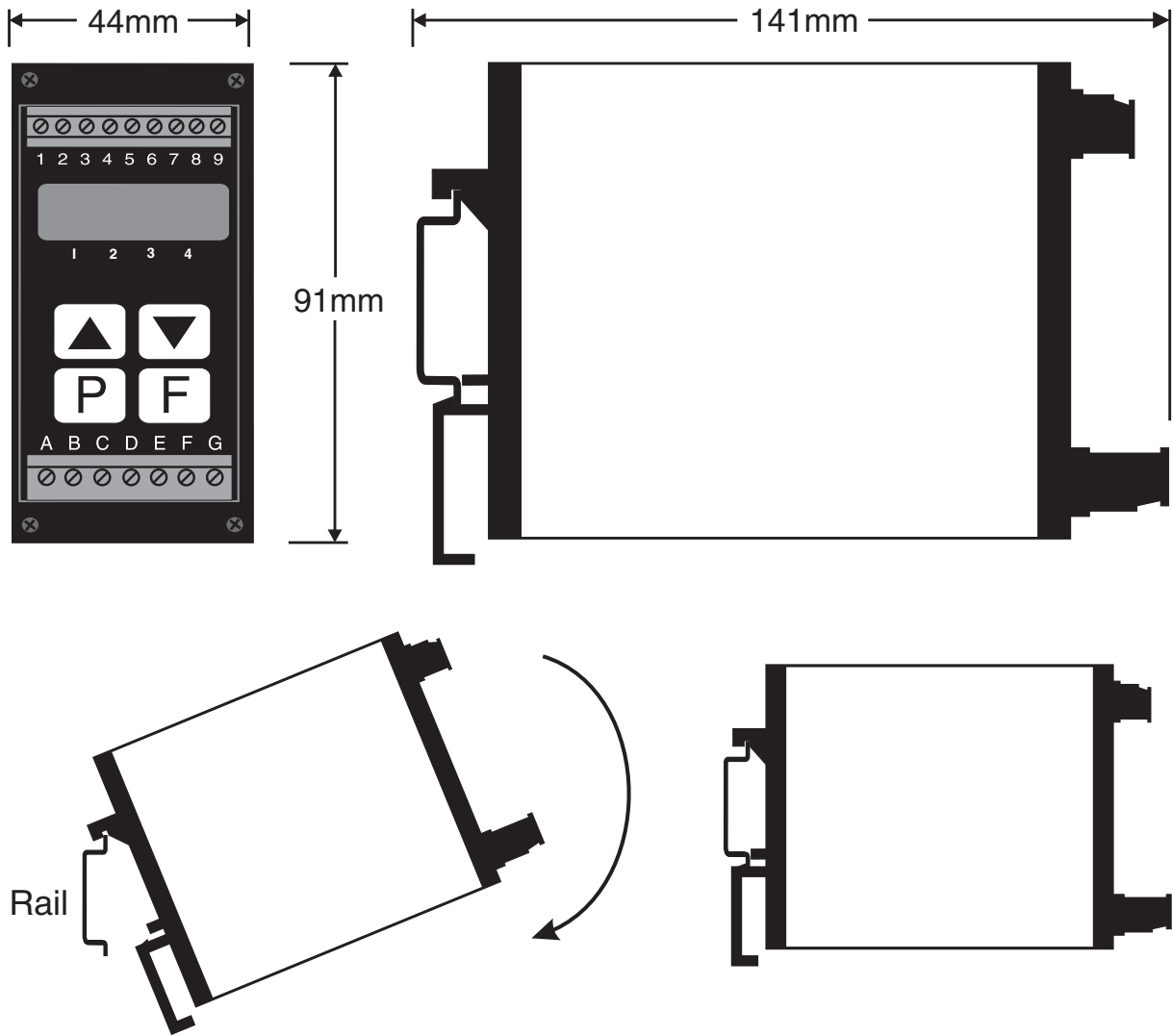
3 Electrical installation

The RM4 Meter is designed for continuous operation and no power switch is fitted to the unit. It is recommended that an external switch and fuse be provided to allow the unit to be removed for servicing. The terminal blocks allow for wires of up to 2.5mm^2 to be fitted for power supply and relays 1 and 2 or 1.5mm^2 for input connections and optional outputs. Connect the wires to the appropriate terminals as indicated below.

Refer to connection diagrams provided in this manual 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 resultant reading.

Note that the power supply type is factory configured. Check power supply type before connecting. Relay outputs are voltage free contacts.

Instrument data label (example)
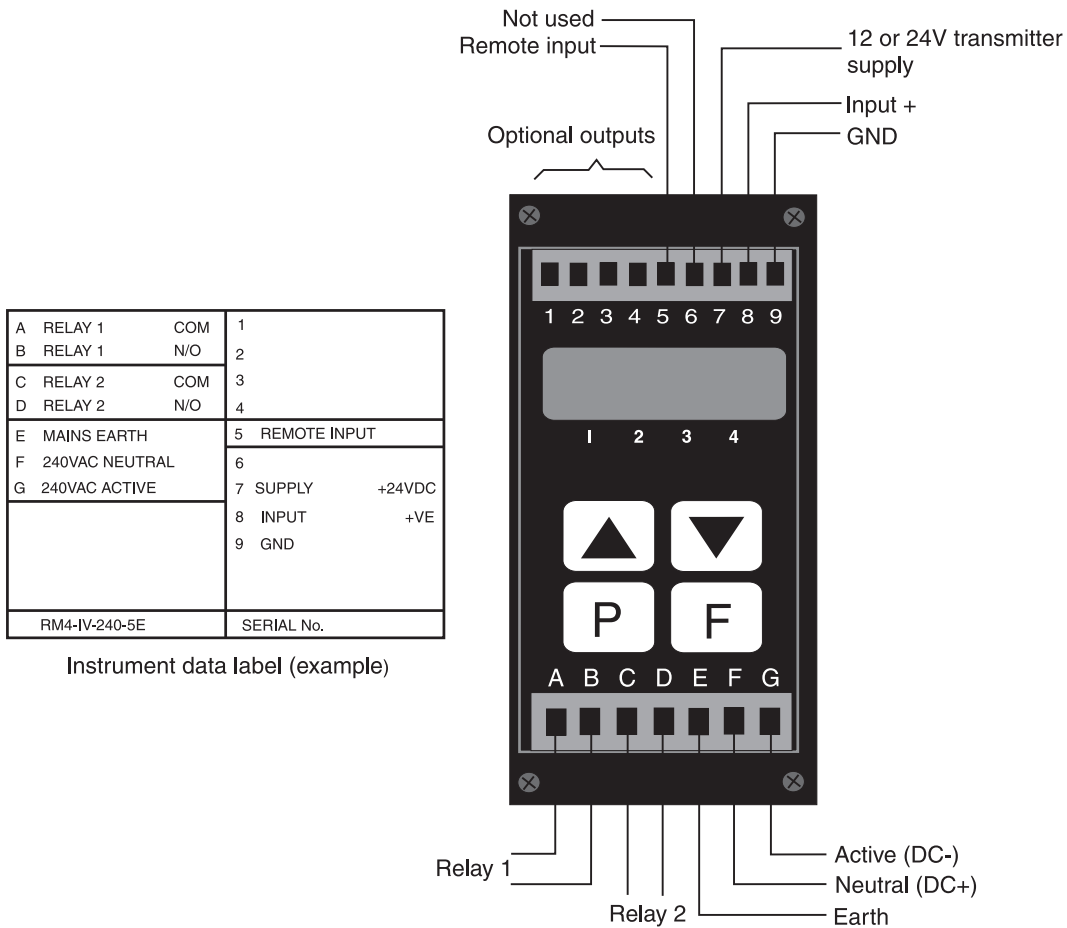
Check power supply type before connecting. Relay outputs are voltage free contacts.

3.1   Signal input connections

See section 3.3 for details of link settings.

4 wire 4-20mA. Externally powered.
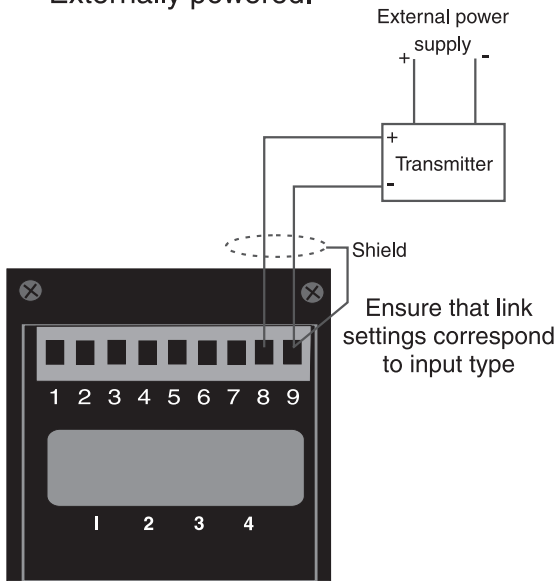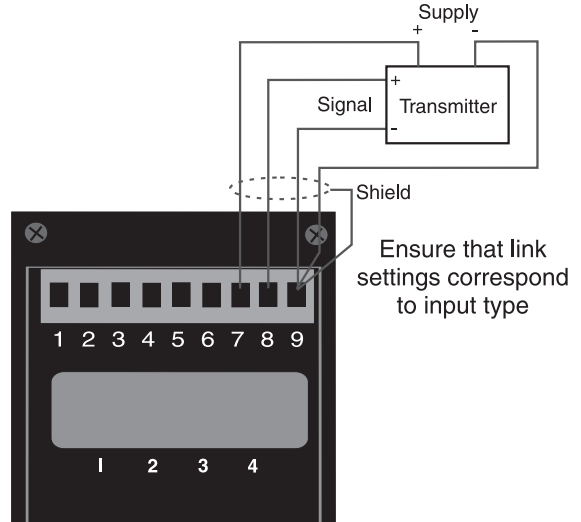
External power supply
+ -

+
Transmitter
-

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

I   2   3   4

4 wire 4-20mA. Powered via standard 24V unregulated.

Supply
+ -

+
Signal   Transmitter
-

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

I   2   3   4

3 wire 4-20mA. Powered via standard 24V unregulated.

Supply
+ -

+
Signal   Transmitter
-

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

I   2   3   4

2 wire 4-20mA. Powered via standard 24V unregulated.

+
Transmitter
-

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

I   2   3   4

2 wire 4-20mA. Externally powered.

External power supply

Transmitter

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

1 2 3 4
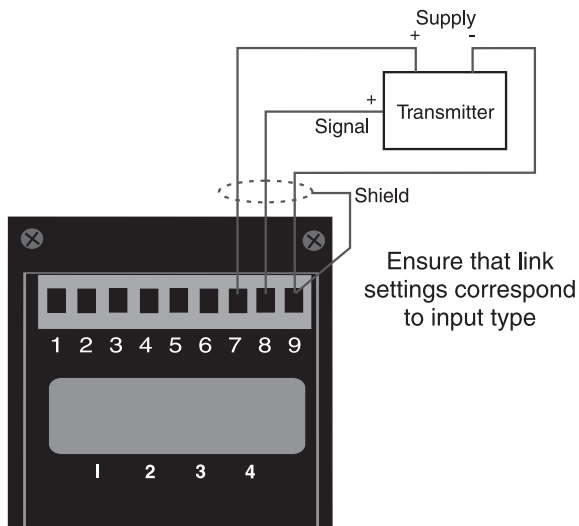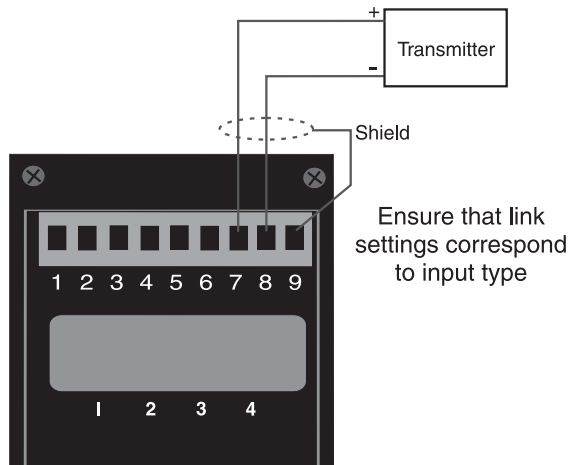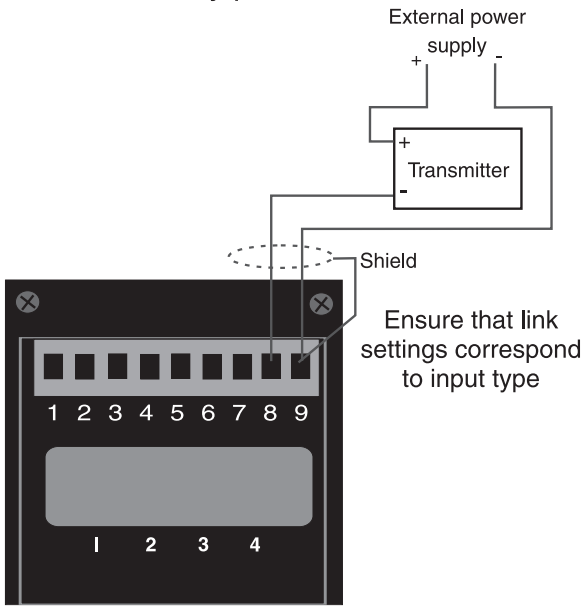
2 wire 4-20mA. Powered via optional 12 or 24V regulated.

Transmitter

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

1 2 3 4

DC voltage input

Sensor

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

1 2 3 4

Slidewire input

Shield

Ensure that link settings correspond to input type

1 2 3 4 5 6 7 8 9

1 2 3 4
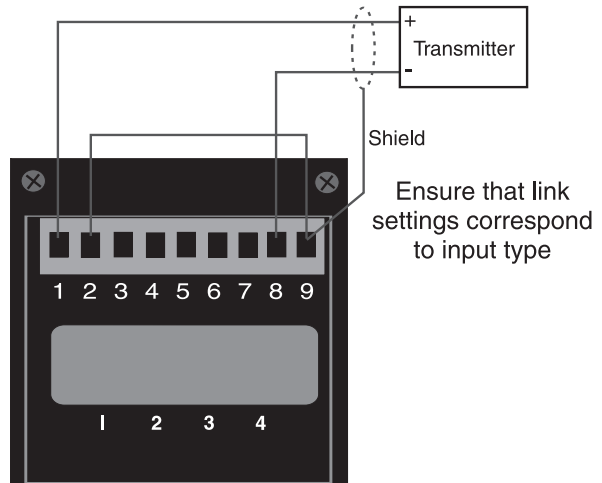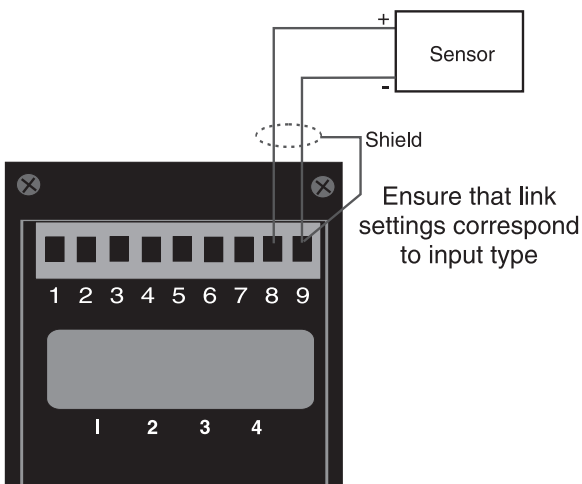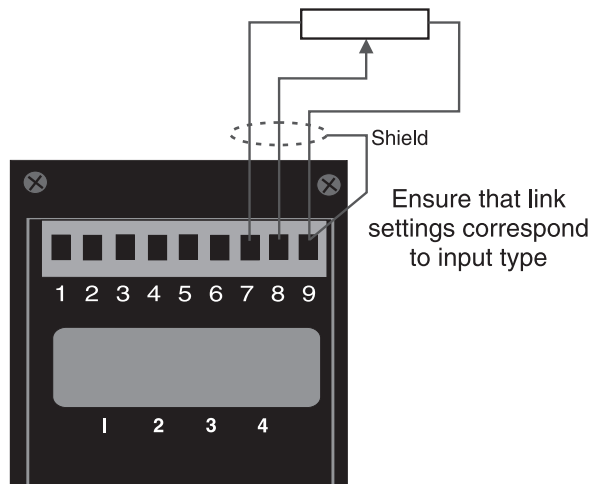
3.2   Remote input connections

The selected remote input function can be operated via an external contact closure via a switch, relay or open collector transistor switch.

Choose momentary or latching switch to suit function selected.

Remote input

1 2 3 4 5 6 7 8 9

I   2   3   4
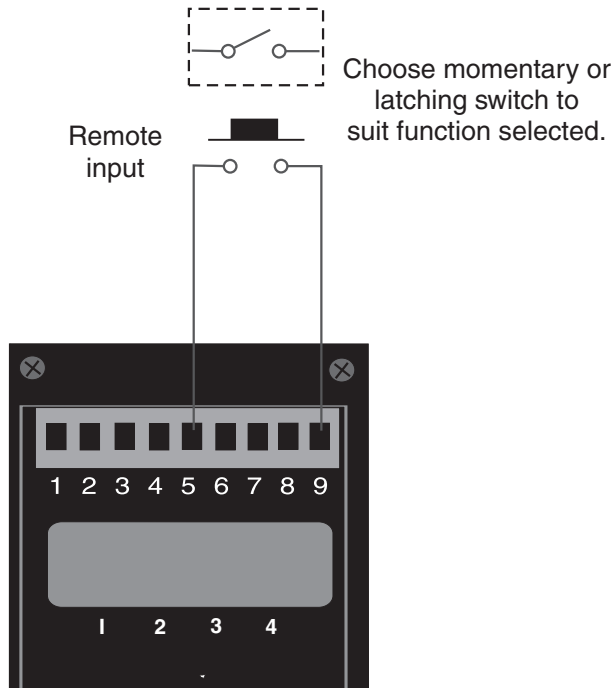
3.3   Configuring the input board

Remove the circuit board from the case following the instructions below. Link settings for the main input board are as shown below. For optional output link settings consult the separate "RM4 DIN Rail Meter Optional Output Addendum" booklet.

Remove the connectors, the four front bezel screws and the earth screw at the side of the case. Hold the front bezel and slide out the circuit boards.

Main circuit board

TX SUPPLY

Both links
in for 24V
transmitter
supply

Both links
must be out
for slidewire
operation

±100mV
links

±1V
links

±10V
links

±100V
links

0-20mA or
4-20mA links

±2mA
links

Slidewire
links
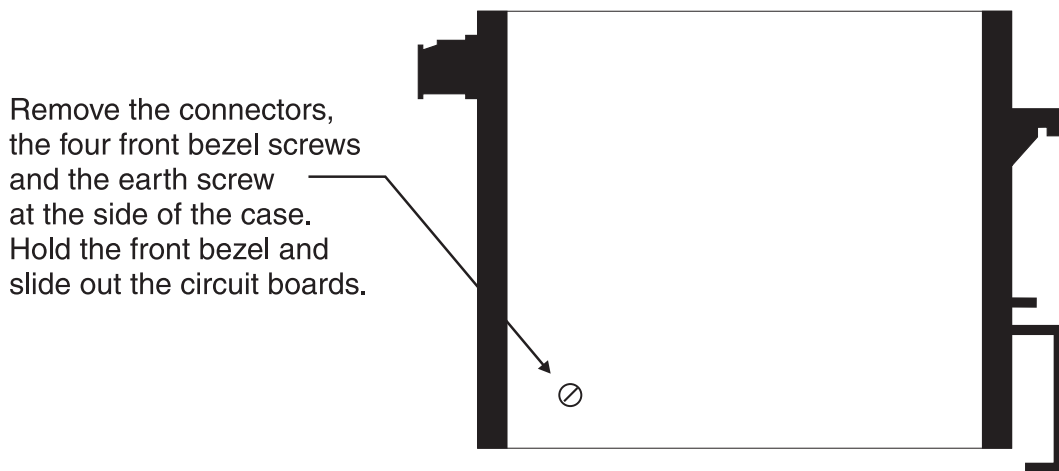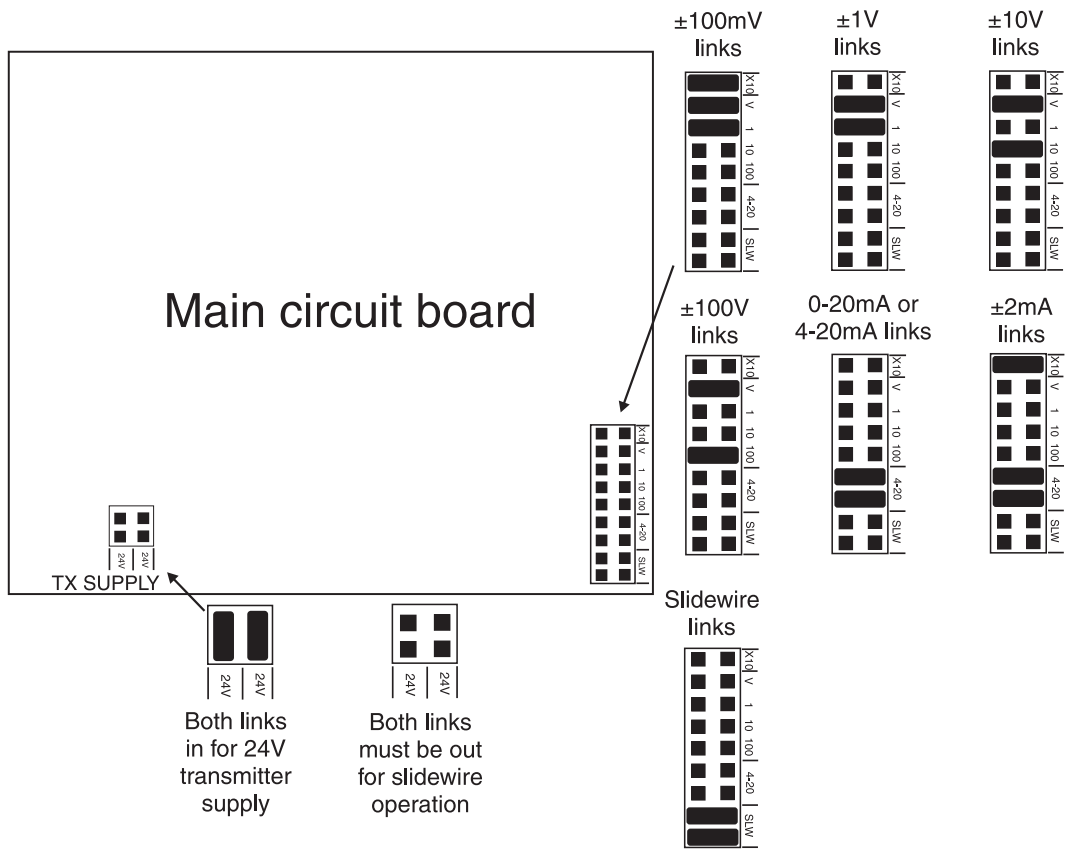
4   Function tables - summary of setup functions

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

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

Display	Function	Range	Default	Your record	Ref/Page
Ax.SP	PI relay control setpoint	Any display value	**0**	See 4.1	7.2 / 45
AxLo	Low setpoint value for designated alarm relay x	Any display value or **OFF**	**OFF**	See 4.1	5.2 / 17
AxHi	High setpoint value for designated alarm relay x	Any display value or **OFF**	**OFF**	See 4.1	5.3 / 18
AxHY	Hysteresis value for the designated alarm relay x.	**0** to **9999**	**10**	See 4.1	5.4 / 19
Axtt	Trip time delay for the designated alarm relay x.	**0** to **9999**	**0**	See 4.1	5.5 / 19
Axrt	Reset time delay for the designated alarm relay x.	**0** to **9999**	**0**	See 4.1	5.6 / 20
Axn.o or **Axn.c**	Alarm relay x action to normally open (de-energised) or normally closed (energised)	**Axn.o** or **Axn.c**	**Axn.o**	See 4.1	5.7 / 20
AxSP or **Axt1** etc.	Relay operation independent setpoint or trailing setpoint (*Optional)	**AxSP** or **Axt1** etc.	**AxSP**	See 4.1	5.8 / 20
brgt	Display brightness level	**1** to **15**	**15**		5.9 / 21
dull	Display remote brightness switching	**0** to **15**	**1**		5.10 / 21
d.oFF SECS	Auto display dimming timer	**0** to **9999**	**0**		5.11 / 21

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

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

Display	Function	Range	Default	Your record	Ref/Page
Ax OPEr	Relay operation mode, alarm or PI control	**Ax.AL** or **Ax.tP** or **Ax.Fr**	**Ax.AL**	See 4.1	5.12 / 22
rEC_	Analog output option low display value (*Optional)	Any display value	**0**		5.13 / 22

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

rEC⁻	Analog output option high display value (*Optional)	Any display value	*1000*		5.14 / 22
rEC_ Ch2	Second analog output option low display value (*Optional)	Any display value	*0*		5.15 / 23
rEC⁻ Ch2	Second analog output option high display value (*Optional)	Any display value	*1000*		5.16 / 23
drnd	Display rounding	*1* to *5000*	*1*		5.17 / 23
dCPt	Decimal point	*0*, *0.1* etc.	*0*		5.18 / 23
FLtr	Digital filter	*0* to *8*	*2*		5.19 / 24
rEc ctrl	Analog output PI control (*Optional)	*on* or *OFF*	*OFF*		5.20 / 24
CAL 1	First live input calibration scaling point	Any display value	n/a		5.21 / 24
CAL2	Second live input calibration scaling point	Any display value	n/a		5.22 / 24
CAL OFSt	Calibration offset	Any display value	n/a		5.23 / 25
ZErO rnGE	Zero range limit	Any display value or *OFF*	*OFF*		5.24 / 25
CAL ZErO	Zero reference point for *ZErO rnGE* operation	n/a	n/a		5.25 / 25
USEr En4	4mA input scale	Any display value	n/a		5.26 / 25
USEr En20	20mA input scale	Any display value	n/a		5.27 / 25
UCAL	Uncalibrate	n/a	n/a		5.28 / 26
Pbut	🅟 button function (for instruments with front 🅟 button)	*nOnE*.*Hi*. *Lo*.*Hi*.*Lo*. *tArE* or *ZErO*	*nOnE*		5.29 / 26
r.I nP	Remote input (external input) one function	*nOnE*. *P.HLd*. *d.HLd*.*Hi*. *Lo*.*Hi*.*Lo*. *tArE*.*ZErO*. *SP.Ac*. *no.Ac*.*CAL.S* or *duLL*	*nOnE*		5.30 / 27
ACCS	Access mode	*OFF*.*EASY*. *nOnE* or *ALL*	*OFF*		5.31 / 28
SPAC	Setpoint access mode	*A1*.*A1-2* etc.	*A1*		5.32 / 28
Sqrt	Square root mode	*on* or *OFF*	*OFF*		5.33 / 29

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

A1.A2 etc.	Alarm relay operation mode	**Li uE , tArE , P.HLd , d.HLd , Hi , Lo** or **di SP**	**Li uE**	See 4.1	5.34 / 29
rEC	Analog operation mode (***Optional**)	**Li uE , tArE , P.HLd , d.HLd , Hi , Lo** or **di SP**	**Li uE**		5.35 / 30
rEC2	Second analog operation mode (***Optional**)	**Li uE , tArE , P.HLd , d.HLd , Hi , Lo** or **di SP**	**Li uE**		5.36 / 31
Lo di SP	Low overrange visual warning limit value	Any display value or **OFF**	**OFF**		5.37 / 31
Hi 9H di SP	High overrange visual warning limit value	Any display value or **OFF**	**OFF**		5.38 / 31
di SP	Display visual warning flashing mode	**FLSH** or **-or-**	**FLSH**		5.39 / 32
bAUd rAtE	Baud rate for serial communications (***Optional**)	**300 , 600 , 1200 , 2400 , 4800 , 9600 , 19.2** or **38.4**	**9600**		5.40 / 32
Prty	Parity for serial communications (***Optional**)	**nOnE , EuEn** or **odd**	**nOnE**		5.41 / 32
O.Put	Output for serial communications (***Optional**)	**di SP , Cont , POLL , A.buS** or **m.buS**	**Cont**		5.42 / 32
Addr	Instrument address for serial communications (***Optional**)	**0** to **31**	**0**		5.43 / 33
SErL	Serial mode for serial communications (***Optional**)	**Li uE , tArE , P.HLd , d.HLd , Hi , Lo , Hi Lo** or **di SP**	**Li uE**		5.44 / 33

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

4.1 Relay table

Record your relay settings in the table below. Note: relays 3 and 4 are optionally fitted.

Display	Relay 1	Relay 2	Relay 3	Relay 4
*Ax*Lo				
*Ax*Hi				
*Ax*HY				
*Ax*tt				
*Ax*rt				
*Ax*n.o or *Ax*n.c				
*Ax*SP or *Ax*t1 etc.	n/a			
A1.A2 etc.				
Ax OPEr			n/a	n/a
Ax.SP			n/a	n/a
ctrl SPAN			n/a	n/a
Ax.Pg			n/a	n/a
Ax.Ig			n/a	n/a
Ax.IL			n/a	n/a
Ax.IH			n/a	n/a
Ax.bS			n/a	n/a
Ax.dc			n/a	n/a
Ax.dr			n/a	n/a

5   Explanation of functions

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

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

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

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

Entering **CAL** Mode

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

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

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

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

Entering **FunC** Mode

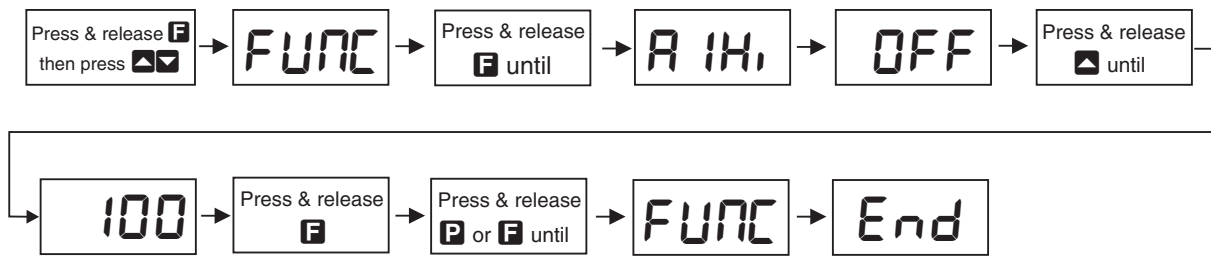No special power up procedure is required to enter **FunC** mode.

1. When the "wake up" messages have finished and the display has settled down to its normal reading press, then release the **F** button.
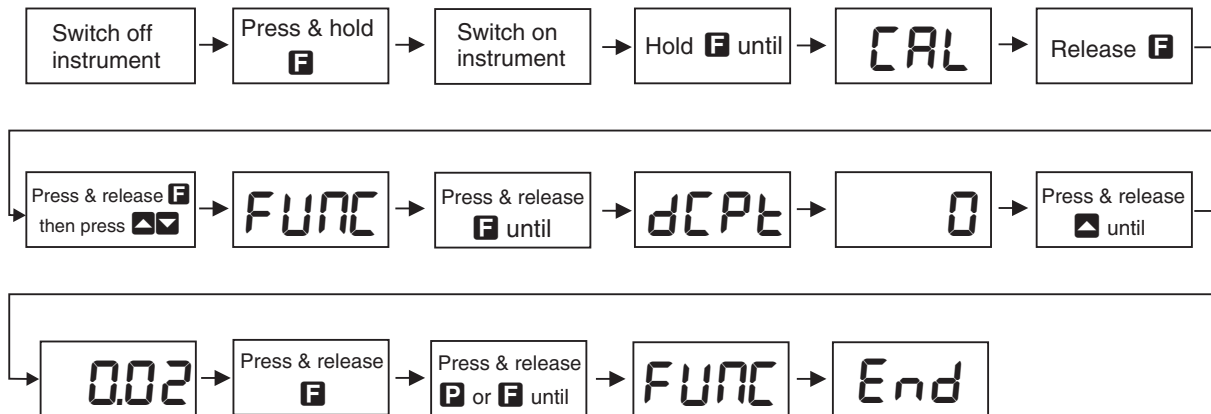
2. Within 2 seconds of releasing the **F** button press, then release the ▲ and ▼ buttons together. The display will now indicate **FunC** followed by the first function.

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

| Press & release **F** then press ▲▼ | → | **FUNC** | → | Press & release **F** until | → | **A 1Hi** | → | **OFF** | → | Press & release ▲ until |

| **100** | → | Press & release **F** | → | Press & release **P** or **F** until | → | **FUNC** | → | **End** |

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

| Switch off instrument | → | Press & hold **F** | → | Switch on instrument | → | Hold **F** until | → | **CAL** | → | Release **F** |

| Press & release **F** then press ▲▼ | → | **FUNC** | → | Press & release **F** until | → | **dCPt** | → | **0** | → | Press & release ▲ until |

| **0.02** | → | Press & release **F** | → | Press & release **P** or **F** until | → | **FUNC** | → | **End** |

Easy alarm relay adjustment access facility

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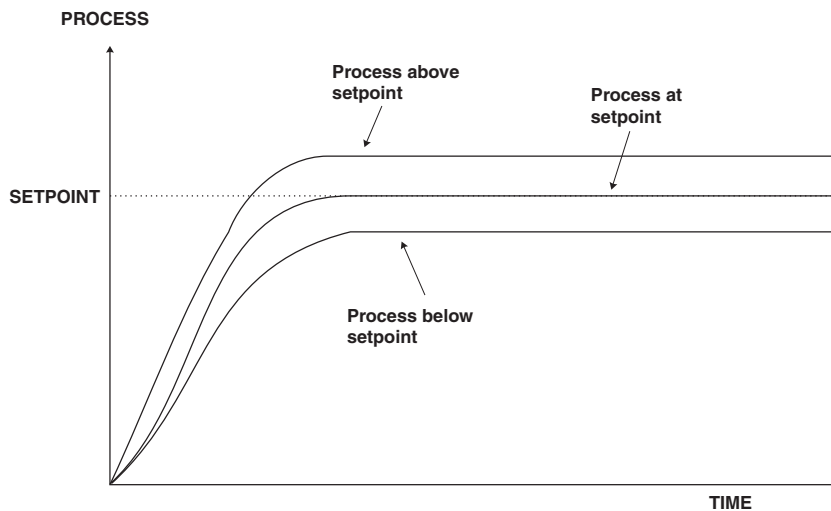
1. The **r.i nP** function must be set to **SPAC** or the **ACCS** function must be set to **EASY**.

2. At least one alarm must have a setpoint, nothing will happen if all the alarm setpoints are set to **OFF**.

3. The **SPAC** function must be set to allow access to the relays required e.g. if set to **A 1-2** then the easy access will work only with alarm relays 1 and 2 even if more relays are fitted.

4. The instrument must be in normal measure mode i.e. if the instrument is powered up so that it is in **CAL** mode then the easy access will not function. If in doubt remove power from the instrument, wait for a few seconds then apply power again.

5. If the easy access facility is used then the only way to view or alter any other function settings is to power up via **CAL** mode i.e. there is no entry to **FUNC** mode functions unless the instrument is powered up in **CAL** mode.

Explanation of Functions

5.1 PI relay control setpoint

Display: $Ax.\mathsf{SP}$

Range: Any display value

Default Value: 0

The control setpoint is set to the value in displayed engineering units required for the control process. The controller will attempt to vary the control output to keep the process variable at the setpoint. Note that the control setpoint value can be reached and adjusted via the "easy access" mode (see "Explanation of functions" chapter) if the ACCS function is set to EASY. This feature could be useful if the setpoint is to be frequently changed.

PROCESS

Process above setpoint

Process at setpoint

SETPOINT

Process below setpoint

TIME

5.2 Alarm relay low setpoint

Display: $Ax\mathsf{Lo}$

Range: Any display value or OFF

Default Value: OFF

Displays and sets the low setpoint value for the designated alarm relay x. Note x will be replaced by the relay number when displayed e.g. $A1\mathsf{Lo}$ for relay 1. Use this low setpoint function if a relay operation is required when the display value becomes equal to or less than the low setpoint value. To set a low alarm value go to the $Ax\mathsf{Lo}$ function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value. The low alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate OFF. If the relay is allocated both a low and high setpoint then the relay will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the relay will reset is controlled by the $Ax\mathsf{HY}$ function.

Example:
If $A1\mathsf{Lo}$ is set to 10 then relay 1 will activate when the display value is 10 or less.

Alarm low operation with hysteresis
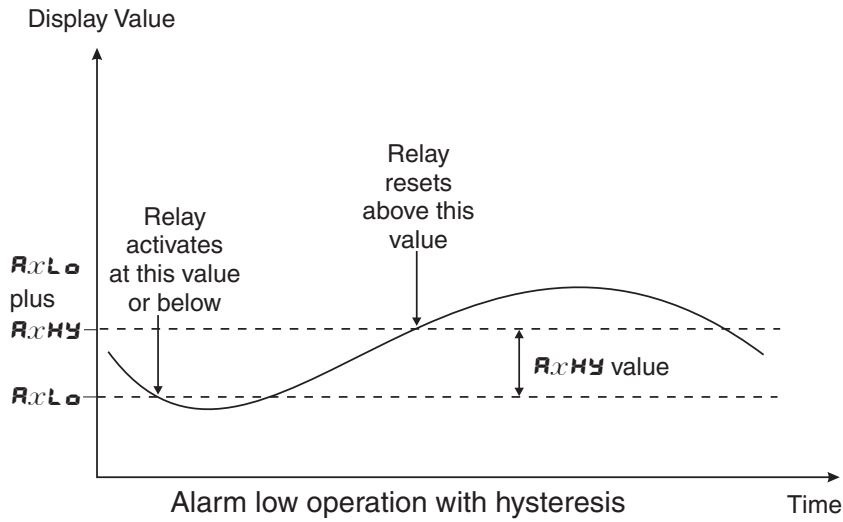
5.3 Alarm relay high setpoint

Display: AxH₁

Range: Any display value or **OFF**

Default Value: **OFF**

Displays and sets the high setpoint value for the designated alarm relay x. Note x will be replaced by the relay number when displayed e.g. **A 1H₁** for relay 1. Use this high setpoint function if a relay operation is required when the display value becomes equal to or more than the low setpoint value. To set a high alarm value go to the AxH₁ function and use the ▲ or ▼ push buttons to set the value required then press 🅵 to accept this value. The high alarm setpoint may be disabled by pressing the ▲ and ▼ push buttons simultaneously. When the alarm is disabled the display will indicate **OFF**. If the relay is allocated both a low and high setpoint then the relay will activate when the value displayed moves outside the band set by the low and high setpoints. The value at which the relay will reset is controlled by the Ax**HY** function.

Example:
If **A 1H₁** is set to **100** then relay 1 will activate when the display value is **100** or higher.

Alarm high operation with hysteresis
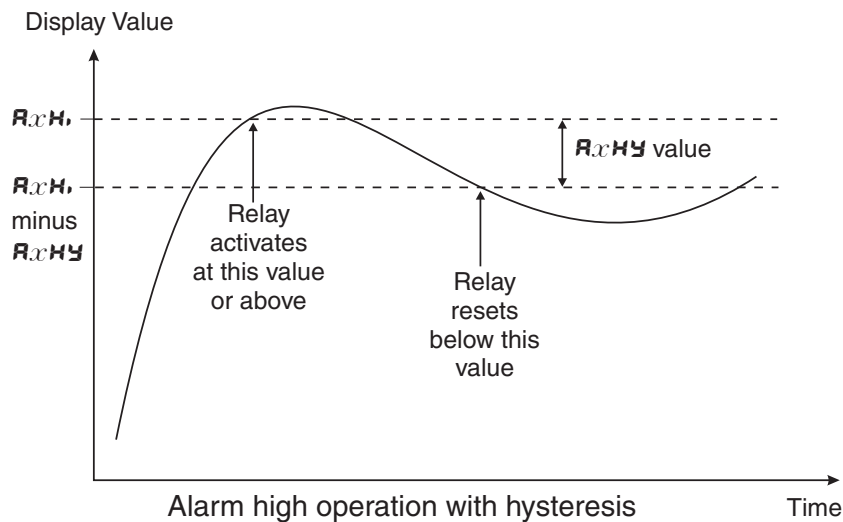
5.4   Alarm relay hysteresis (deadband)

Display: $AxHY$

Range: 0 to 9999

Default Value: 10

Displays and sets the alarm relay hysteresis limit for the designated relay x. Note x will be replaced by the relay number when displayed e.g. $A1HY$ for relay 1. To set a relay hysteresis value go to the $AxHY$ function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value. The hysteresis value is common to both high and low setpoint values. The hysteresis value may be used to prevent too frequent operation of the relay when the measured value is rising and falling around setpoint value. e.g. if $A1HY$ is set to zero the alarm will activate when the display value reaches the alarm setpoint (for high alarm) and will reset when the display value falls below the setpoint, this can result in repeated on/off switching of the relay at around the setpoint value.

The hysteresis setting operates as follows: In the high alarm mode, once the alarm is activated the input must fall below the setpoint value minus the hysteresis value to reset the alarm. e.g. if $A1Hi$ is set to 50.0 and $A1HY$ is set to 3.0 then the setpoint output relay will activate once the display value goes to 50.0 or above and will reset when the display value goes below 47.0 i.e. at 46.9 or below. In the low alarm mode, once the alarm is activated the input must rise above the setpoint value plus the hysteresis value to reset the alarm. e.g. if $A1Lo$ is to 20.0 and $A1HY$ is set to 10.0 then the alarm output relay will activate when the display value falls to 20.0 or below and will reset when the display value goes above 30.0 i.e at 30.1 or above. The hysteresis units are expressed in displayed engineering units.

Example: If $A1Hi$ is set to 100 and $A1HY$ is set to 10 then relay 1 will activate when the display value is 100 or higher and will reset at a display value of 89 or lower.

5.5   Alarm relay trip time

Display: $Axtt$

Range: 0 to 9999

Default Value: 0

Displays and sets the alarm trip time in seconds. The trip time is common for both alarm high and low setpoint values. The trip time provides a time delay before the alarm relay will activate when an alarm condition is present. The alarm condition must be present continuously for the whole trip time period before the alarm will activate. If the input moves out of alarm condition during this period the timer will reset and the full time delay will be restored. This trip time delay is useful for preventing an alarm trip due to short non critical deviations from setpoint. The trip time is selectable over 0 to 9999 seconds. To set a trip time value go to the $Axtt$ function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value.

Example: If $A1tt$ is set to 5 seconds then the display must indicate an alarm value for a full 5 seconds before relay 1 will activate.

5.6 Alarm relay reset time

Display: $Axrt$

Range: 0 to 9999

Default Value: 0

Displays and sets the alarm reset delay time in seconds. The reset time is common for both alarm high and low setpoint values. With the alarm condition is removed the alarm relay will stay in its alarm condition for the time selected as the reset time. If the input moves back into alarm condition during this period the timer will reset and the full time delay will be restored. The reset time is selectable over 0 to 9999 seconds. To set a reset time value go to the $Axrt$ function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value.

Example: If $A1rt$ is set to 10 seconds then the resetting of alarm relay 1 will be delayed by 10 seconds.

5.7 Alarm relay normally open/closed

Display: $Axn.o$ or $Axn.c$

Range: $Axn.o$ or $Axn.c$

Default Value: $Axn.o$

Displays and sets the setpoint alarm relay x action to normally open (de-energised) or normally closed (energised), when no alarm condition is present. Since the relay will always open when power is removed a normally closed alarm is often used to provide a power failure alarm indication. To set the alarm relay for normally open or closed go to the $Axn.o$ or $Axn.c$ function and use the ▲ or ▼ push buttons to set the required operation then press **F** to accept this selection. **Example:** If set to $A1n.o$ alarm relay 1 will be open circuit when the display is outside alarm condition and will be closed (short circuit across terminals) when the display is in alarm condition.

5.8 Alarm relay setpoint or trailing operation

Display: $AxSP$ or $Axt1$ etc.

Range: $AxSP$ or $Axt1$ etc.

Default Value: $AxSP$

Relay operation independent setpoint or trailing setpoint, this function only be seen where more than one relay is fitted. Each alarm relay, except relay 1, may be programmed to operate with an independent setpoint value or may be linked to operate at a fixed difference to another relay setpoint, known as trailing operation. The operation is as follows:

Alarm 1 ($A1$) is always independent. Alarm 2 ($A2$) may be independent or may be linked to Alarm 1. Alarm 3 ($A3$) may be independent or may be linked to Alarm 1 or Alarm 2. Alarm 4 ($A4$) may be independent or may be linked to Alarm 1, Alarm 2 or Alarm 3. The operation of each alarm is selectable by selecting, for example, (Alarm 4) $A4.SP$ = Alarm 4 normal setpoint or $A4.t1$ = Alarm 4 trailing Alarm 1 or $A4.t2$ = Alarm 4 trailing Alarm 2 or $A4.t3$ = Alarm 4 trailing Alarm 3. For trailing set points the setpoint value is entered as the difference from the setpoint being trailed. If the trailing setpoint is to operate ahead of the prime setpoint then the value is entered as a positive number and if operating behind the prime setpoint then the value is entered as a negative number.

Example: With Alarm 2 set to trail alarm 1, if **A 1H,** is set to **1000** and **A2H,** is set to **50** then Alarm 1 will activate at **1000** and alarm 2 will activate at **1050** (i.e. 1000 + 50). If Alarm 2 had been set at **-50** then alarm 2 would activate at **950** (i.e. 1000 – 50).

5.9 Display brightness

Display: **br9t**

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

Default Value: **15**

Displays and sets the digital display brightness. The display brightness is selectable from **1** to **15**, where **1** = lowest intensity and **15** = highest intensity. This function is useful for improving the display readability in dark areas or to reduce the power consumption of the instrument. See also the **dull** function. To set brightness level go to the **br9t** function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value.

5.10 Display remote brightness switching

Display: **dull**

Range: **0** to **15**

Default Value: **1**

Displays and sets the level for remote input brightness switching, see **r.1 nP** function. When a remote input is set to **dull** the remote input can be used to switch between the display brightness level set by the **br9t** function 5.9 and the display brightness set by the **dull** function. The display dull level is selectable from **0** to **15**, where **0** = lowest intensity and **15** = highest intensity. This function is useful in reducing glare when the display needs to be viewed in both light and dark ambient light levels. To set dull level go to the **dull** function and use the ▲ or ▼ push buttons to set the value required then press **F** to accept this value. The **d.oFF SECS** function (automatic display blanking or dulling) will also cause the **dull** function to appear if the **d.oFF SECS** function is enabled i.e. set to any value other than **0**.

Example: With **dull** set to **4** and **br9t** set to **15** and the **r.1 nP** function set to **dull** the display brightness will change from the **15** level to **4** when a switch connected to the remote input terminals is activated.

5.11 Auto display dimming timer

Display: **d.oFF SECS**

Range: **0** to **9999**

Default Value: **0**

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

dimming will not operate. If any of the front pusbuttons are pressed during this period this 2 minute delay will be canceled.

5.12 Alarm relay operation mode e.g. $A1\ OPEr$ etc.

Display: $Ax\ OPEr$

Range: $Ax.AL$ or $Ax.tP$ or $Ax.Fr$

Default Value: $Ax.AL$

Alarm relay operating mode (relays 1 and 2 only) - this function allows selection of standard alarm on/off setpoint operation ($A1.AL$ or $A2.AL$) using the alarm functions described in this chapter or PI control operation ($A1.tP$ or $A1.Fr$ or $A2.tP$ or $A2.Fr$). To set the alarm operation mode go to the $Ax\ OPEr$ function and use the ▲ or ▼ push buttons to choose the required operation then press **F** to accept this value.

Refer to the "Setting up the relay PI controller" chapter 7 for details of the PI control operations and functions. **Example:**
With $Ax\ OPEr$ set to $A1.Fr$ relay 1 will operate as a PI control relay with the frequency of the relay varying.

5.13 Analog output option low value

Display: $rEC\_$

Range: Any display value

Default Value: 0

Seen only when analog retransmission option fitted. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details and link settings. Displays and sets the analog retransmission (4–20mA, 0–1V or 0–10V, link selectable) output low value (4mA or 0V) in displayed engineering units. To set the analog output low value go to the $rEC\_$ function and use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

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

5.14 Analog output option high value

Display: rEC^-

Range: Any display value

Default Value: 1000

Seen only when analog retransmission option fitted. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when this option is fitted for wiring details and link settings. Displays and sets the analog retransmission (4–20mA, 0–1V or 0–10V, link selectable) output high display value (20mA, 1V or 10V) in displayed engineering units. To set the analog output high value go to the rEC^- function and use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

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

5.15   Second analog output option low value

Display: **rEC⌞ Ch2**

Range: Any display value

Default Value: **𝟢**

See **rEC⌞** function 5.13 for description of operation.

5.16   Second analog output option high value

Display: **rEC⌐ Ch2**

Range: Any display value

Default Value: **1𝟢𝟢𝟢**

See **rEC⌐** function 5.14 for description of operation.

5.17   Display rounding

Display: **drnd**

Range: **1** to **5𝟢𝟢𝟢**

Default Value: **1**

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

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

5.18   Decimal point

Display: **dCPt**

Range: **𝟢**, **𝟢.1** etc.

Default Value: **𝟢**

Displays and sets the decimal point. By pressing the ▲ or ▼ pushbutton at the **dCPt** function the decimal point position may be set. The display will indicate as follows: **𝟢** (no decimal point), **𝟢.1** (1 decimal place), **𝟢.𝟢2** (2 decimal places), **𝟢.𝟢𝟢3** (3 decimal places) or **𝟢.𝟢𝟢𝟢4**(4 decimal places). Note if the decimal point is altered the display may need to be recalibrated and alarm etc. settings checked.

5.19   Digital filter

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

Displays and sets the digital filter value. Digital filtering uses a weighted average method of determining the display value and is used for reducing display value variation due to short term interference. The digital filter range is selectable from **0** to **8**, where **0** = none and **8** = most filtering. Use ▲ or ▼ at the **FLtr** function to alter the filter level if required. Note that the higher the filter setting the longer the display may take to reach its final value when the input is changed, similarly the relay operation and any output options will be slowed down when the filter setting is increased. To set the digital filter value go to the **FLtr** function and use the ▲ or ▼ push buttons to set the required value then press **F** to accept this selection.

5.20   Analog output PI control

Display:	**rEc ctrl**
Range:	**on** or **OFF**
Default Value:	**OFF**

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

When this function is set to **on** the following associated functions will appear: **C.SEt**, **C.SPn**, **C_P9** , **C_Po** , **C.I 9**, **CI L.H**, **CI L.L** and **rEC SPAC**.

Refer to the separate "RM4 DIN Rail Meter Optional Output Addendum" booklet for description of the analog PI control functions.

5.21   First calibration scaling point

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

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

5.22   Second calibration scaling point

Display:	**CAL2**
Range:	Any display value
Default Value:	n/a

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

5.23 Calibration offset

Display: **CAL OFSt**

Range: Any display value

Default Value: n/a

Calibration offset - See section 6.3.

5.24 Zero range

Display: **ZErO rN9E**

Range: Any display value or **OFF**

Default Value: **OFF**

Zero range limit value - see section 6.4.

5.25 Zero reference point for **ZErO rN9E** operation

Display: **CAL ZErO**

Range: n/a

Default Value: n/a

Zero point calibration for **ZErO rN9E** function - see section 6.5.

5.26 4mA input scale

Display: **USEr En4**

Range: Any display value

Default Value: n/a

4mA input scale value, use only as an alternative to **CAL 1** and **CAL2** calibration - See "Calibration" chapter, section 6.2.

5.27 20mA input scale

Display: **USEr En20**

Range: Any display value

Default Value: n/a

20mA input scale value, use only as an alternative to **CAL 1** and **CAL2** calibration - See "Calibration" chapter, section 6.2.

5.28   Uncalibrate

Display: **UCAL**

Range: n/a

Default Value: n/a

Uncalibrate, resets calibration - required only when a calibration problem occurs and it is necessary to clear the calibration memory. At the **UCAL** function press the ▲ and ▼ buttons simultaneously. The message **CAL CLr** should be seen to indicate that the calibration memory has been cleared.

5.29   **P** button function

Display: **Pbut**

Range: **NONE ,Hi ,Lo ,Hi Lo ,tArE** or **ZEro**

Default Value: **NONE**

P button function - a only applicable models with front panel **P** buttons. The **P** button may be set to operate one of the following selections:

- **NONE** - **P** has no operation.

- **Hi** - Peak memory. This function allows the **P** to be used to view and reset the peak memory. The peak memory is the maximum positive display value (conductivity/resistivity or ppm) achieved since the peak memory was last reset. To view the peak memory press the **P** momentarily, the display will show the indicator **P Hi** followed by the peak reading. This peak reading will be retained on the display for approximately 20 seconds before returning to "live" display readings, alternatively the display can be forced to return to "live" measurement by pressing the **F**. To reset the peak memory hold the **P** pressed for 3 seconds or remove power to the display.

- **Lo** - Valley memory. Operates in the same manner as the **Hi** function above but operates on the lowest value in memory. The indicator **P Lo** will be seen prior to the valley memory value.

- **Hi Lo** - Peak/valley memory. Operates in the same manner as the **Hi** and **Lo** memories but allows toggling between high and low values i.e. press once momentarily to view peak high and again momentarily to view peak low.

- **tArE** - display tare. Short circuiting the remote input pins momentarily will allow toggling between nett and gross values (shown as **NEtt** and **9roS**). If the remote input is short circuited for approx. 2 seconds the display will be tared and will show zero. The tare will be lost if power is removed.

- **ZEro** - display zero. Zeroes the display in same manner as the tare function except that the zero is not lost when power is removed and the display will zero as soon as the remote input is shorted. When the **ZEro** operation is used the gross value cannot be recalled and the input at the time of the **ZEro** operation will become the new zero point.

5.30   Remote input one function

Display: **r.I NP**

Range: **NONE**, **P.HLd**, **d.HLd**, **HI**, **Lo**, **HI Lo**, **tArE**, **ZErO**, **SP.Ac**, **No.Ac**, **CAL.S** or **duLL**

Default Value: **NONE**

Remote input function - When these remote input terminals are short circuited, via a switch, relay, keyswitch etc. the instrument will perform the selected remote input function. A message will flash to indicate which function has been selected when the remote input pins are short circuited. The remote input functions are as follows:

NONE - no remote function required i.e. activating the remote input has no effect.

P.HLd - 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.HLd - 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.

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.

Lo - valley memory. The minimum value stored in memory will be displayed. Otherwise operates in the same manner as the **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.

tArE - display tare. Short circuiting the remote input pins momentarily will allow toggling between nett and gross values (shown as **NEtt** and **9rOS**). If the remote input is short circuited for approx. 2 seconds the display will be tared and will show zero. The tare will be lost if power is removed.

ZErO - display zero. Zeroes the display in same manner as the tare function except that the zero is not lost when power is removed and the display will zero as soon as the remote input is shorted. When the **ZErO** operation is used the gross value cannot be recalled and the input at the time of the **ZErO** operation will become the new zero point.

SP.Ac - setpoint access only. This blocks access to any functions except the alarm setpoint functions unless the remote input pins are short circuited or entry is made via **CAL** mode or if the **ACCS** function is set to **ALL**.

No.Ac - no access. This blocks access to all functions unless the remote input pins are short circuited or entry is made via **CAL** mode or if the **ACCS** function is set to **ALL**.

CAL.S - calibration select. The remote input can be used to select between calibration scaling values. Two sets of calibration scalings can be entered in the RM4, one set with the remote

input terminals open circuit and another set with the remote input terminals short circuit to ground. The remote input can then be used to switch between one set and the other. This allows two different load cells to be connected with a remote input being used to select the correct scaling for each or the same load cell could be used and the remote input used to toggle between different display units. Note: Alarm settings will not change when changing between calibrations scales. Only one set of alarm functions can be made and the alarm relay will operate from those set values no matter which calibration scale is being viewed at the time. The **dCPt**, **Lo di SP**, **HI 9H di SP**, **di SP**, and **ZErO rN9E** functions can be individually set for each channel. If **P.SEt** is used only one preset value can be used but only the channel displayed at the time is affected. Note; using different **dCPt** settings between channels will affect the preset and alarm setpoint values e.g. a preset of **25** on a channel with **dCPt = 0** will become **2.5** on a channel with **dCPt = 0. 1**.

duLL - display brightness control. The remote input can be used to change the display brightness. When this mode is selected the display brightness can be switched, via the remote input terminals, between the brightness level set at the **br9t** function and the brightness level set at the **duLL** function.

5.31   Access mode

Display: **ACCS**

Range: **OFF**, **EASY**, **NONE** or **ALL**

Default Value: **OFF**

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

5.32   Setpoint access mode

Display: **SPAC**

Range: **A 1**, **A 1-2** etc.

Default Value: **A 1**

Setpoint access - sets the access via **FUNC** mode and "easy alarm access" mode to the alarm relay setpoints. Two relays are fitted as standard, two more are optionally available. The following choices are available:
A 1 - Allows setpoint access to alarm relay 1 only.
A 1-2 - Allows setpoint access to alarm relays 1 and 2 only.
A 1-3 - Allows setpoint access to alarm relays 1, 2 and 3
A 1-4 - Allows setpoint access to alarm relays 1, 2, 3 and 4
The remote input function (**r.i NP**) must be set to **SP.AC** for this function to operate. Note: Only the setpoints which have been given a value will be accessible e.g. if **A 1Hi** is set to **OFF** then there will be no access to the **A 1Hi** function when **SPAC** is used.

5.33   Square root mode

Display: **59rt**

Range: **on** or **OFF**

Default Value: **OFF**

Square root - selects the square root scaling to **on** or **OFF**. When set to **on** a square root function is applied to the input. When set to **OFF** the calibration is a linear function. When the square root facility is used the scaled displayed value follows the square root of the percentage of the full scale input value. The upper and lower input limits are set as normal as are the values to be displayed at these limits.

Note: It is essential that the display is rescaled, using **CAL 1** and **CAL2** or **USEr En4** and **USEr En20**, whenever the square root function is turned on or off. The **CAL OFSt** function cannot be used when the **59rt** function is set to **on**.   **Example:**

For a 4–20mA input if you wish to display 0 at 4mA and 1000 at 20mA the square root function will calculate as follows:

At 20mA (100%) the display will be **1000** i.e. $\sqrt{1} \times 1000$.

At 16mA (75%) the display will be **866** i.e. $\sqrt{0.75} \times 1000$.

At 12mA (50%) the display will be **707** i.e. $\sqrt{0.5} \times 1000$ and so on.

5.34   Alarm relay operation mode

Display: **A1.A2** etc.

Range: **LiuE,tArE,P.HLd,d.HLd,Hi,Lo** or **diSP**

Default Value: **LiuE**

Alarm relay operation mode for relays 1, 2 etc. The following choices are available for alarm operation mode:

LiuE - live input mode. The alarm relay operation will always follow the electrical input at that time irrespective of the 7 segment display value. e.g. assume the remote input is set to **tArE** and **A1Hi** is set to **100**. If the instrument is tared at a display reading of **30** then the alarm will now activate at a display reading of **70**. Note that the **LiuE** mode does not follow the electrical input if a remote input or **P** button **ZErO** operation has been undertaken. This is due to the fact that the **ZErO** operation shifts the display calibration.

tArE - tare mode. The alarm relay operation will follow the tare function. e.g. in the example above (**LiuE**) if **A1** is set to **tArE** then the alarm would activate at a display reading of **100** (the setpoint value) rather than **70**.

P.HLd - peak hold mode. When **P.HLd** is selected and the remote input is set to peak hold (**P.HLd**) then once the peak display goes above any alarm high setpoint the alarm relay will activate and will not de-activate until the peak hold is released and the display value falls below the setpoint value.

d.HLd - display hold mode. When **d.HLd** is selected and the remote input is set to display hold (**d.HLd**) then the alarm relay will be held in its present state (activated or de-activated) until the display hold is released and the display is free to change.

Hi - peak (max.) memory mode. When **Hi** is selected and the remote input is set to peak memory (**Hi**) then the alarm will be activated if the peak memory value is above the high setpoint value. The alarm will not de-activate until the memory is reset.

Lo - valley (min.) memory mode. When **Lo** is selected and the remote input is set to valley memory (**Lo**) then the alarm relay will be activated if the valley memory value is below the low setpoint value. The alarm will not de-activate until the memory is reset.

di SP - display mode. When **di SP** is selected the alarms will operate purely on the display value at the time i.e. if the display is showing above high setpoint or below the low setpoint value then the alarm relay will activate.

5.35 Analog output operation mode

Display: **rEC**
Range: **Li uE**,**tArE**,**P.HLd**,**d.HLd**,**Hi**,**Lo** or **di SP**
Default Value: **Li uE**

This section describes the operation modes available for the retransmission options **rEC** (analog retransmission) operation mode. The following choices are available:

Li uE - live input mode. The retransmission will follow the electrical input and will not necessarily follow the 7 segment display. For example if the remote input is set for peak hold operation then when the remote input is closed the 7 segment display will only show the peak value but the retransmission will be free to change to follow the electrical input.

tArE - tare mode. The retransmission value will tare (fall to zero) along with 7 segment display when the remote input tare function is operated. If the remote input toggles the 7 segment display to show gross (**9rOS**) then the 7 segment display will change to show the gross value but the retransmission will not respond (see **Li uE** for alternative operation).

P.HLd - peak hold mode. The 7 segment display and retransmission value will indicate the peak value only whilst the peak value function is operated via a contact closure on the remote input i.e. the 7 segment display and retransmission can rise but not fall whilst the remote input switch is closed. When the remote input switch is opened the retransmission value will remain fixed i.e. it will not rise or fall, although the 7 segment display value will be free to alter. This peak retransmission output can be cleared by closing the remote input switch for another operation or by removing power from the instrument. Note: In this mode the retransmission will show a zero reading until the remote input is operated for the first time after switch on.

d.HLd - display hold mode. The 7 segment display and retransmission value will be held whilst the remote input display hold switch is closed. When the switch is opened the retransmission value will remain fixed at the held value although the 7 segment display value will be free to alter. The held retransmission output can be cleared by closing the remote input switch for another operation or by removing power from the instrument. Note: In this mode the bargraph will show a zero reading until the remote input is operated for the first time after switch on.

Hi - peak (max.) memory mode. With the peak remote input switch open the retransmission will indicate the peak value in memory i.e. the retransmission output can rise but not fall. The retransmission output can be reset by clearing the memory. The memory may be cleared either by closing the remote input switch for approximately 2 seconds or by removing power to the instrument.

Lo - valley (min.) memory mode. With the valley remote input switch open the retransmission will indicate the valley (min.) value in memory i.e. the retransmission output can fall but not rise. The retransmission output can be reset by clearing the memory. The memory may be cleared either by closing the remote input switch for approximately 2 seconds or by removing power to the instrument.

di SP - display mode. The retransmission output will follow whatever value is on the 7 segment display. For example if the remote input is set to **tArE** then the 7 segment and retransmission output will indicate the tared value and both will also be changed if the remote input toggles the displays between **nEtt** and **9rOS**. If the **rEC** or **d9OP** function had been set to **tArE** then the retransmission output would not respond to the **9rOS** toggle.

5.36 Second analog output mode

Display:	**rEC2**
Range:	**LivE**, **tArE**, **P.HLd**, **d.HLd**, **Hi**, **Lo** or **di SP**
Default Value:	**LivE**

Analog output mode for second analog output. Operates in the same manner as the first analog output, see function 5.35.

5.37 Low overrange visual warning limit value

Display:	**Lo di SP**
Range:	Any display value or **OFF**
Default Value:	**OFF**

Low overrange limit value - the display can be set to show an overrange message if the display value falls below the **Lo di SP** setting. For example if **Lo di SP** is set to **50** then once the display reading falls below **50** the message **-or-** will flash on and off or the display value will flash on and off instead of the normal display units (see **di SP** function 5.39). This message can be used to alert operators to the presence of an input which is below the low limit. If this function is not required it should be set to **OFF** by pressing the ▲ and ▼ buttons simultaneously at this function.

5.38 High overrange visual warning limit value

Display:	**Hi9H di SP**
Range:	Any display value or **OFF**
Default Value:	**OFF**

High overrange limit value - the display can be set to show an overrange message if the display value rises above the **Hi9H di SP** setting. For example if **Hi9H di SP** is set to **1000** then once the display reading rises above **1000** the message **-or-** will flash on and off or the display value will flash on and off instead of the normal display units (see **di SP** function 5.39). This message can be used to alert operators to the presence of an input which is above the high limit. If this function is not required it should be set to **OFF** by pressing the ▲ and ▼ buttons simultaneously at this function.

5.39   Display visual warning flashing mode

Display: **di SP**

Range: **FLSH** or **-or-**

Default Value: **FLSH**

Display overrange warning flashing mode - this function is used in conjunction with the **Lo di SP** and **HI 9H di SP** functions. The **di SP** function can be set to **FLSH** or **-or-**. If the display warning value set at the **Lo di SP** or **HI 9H di SP** function is exceeded and the **di SP** function is set to **FLSH** then the display value will flash on and off every second as a visual warning. If the display warning value set at the **Lo di SP** or **HI 9H di SP** function is exceeded and the **di SP** function is set to **-or-** then the **-or-** message will flash on and off once a second as a visual warning. The warning flashes will cease and the normal display value will be seen when the value displayed is higher than the low limit and lower than the high limit.

5.40   Baud rate for optional serial communications

Display: **bAud rAtE**

Range: **300**, **600**, **1200**, **2400**, **4800**, **9600**, **19.2** or **38.4**

Default Value: **9600**

Set baud rate - seen only with serial output option. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when optional outputs are fitted. Select from **300**, **600**, **1200**, **2400**, **4800**, **9600**, **19.2** or **38.4** baud. The baud rate should be set to match the device being communicated with.

5.41   Parity for optional serial communications

Display: **PrtY**

Range: **NONE**, **EUEN** or **odd**

Default Value: **NONE**

Set parity - seen only with serial output option. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when optional outputs are fitted. Select parity check to either **NONE**, **EUEN** or **odd**. The parity should be set to match the device being communicated with.

5.42   Output mode for optional serial communications

Display: **O.Put**

Range: **di SP**, **Cont**, **POLL**, **A.buS** or **ñ.buS**

Default Value: **Cont**

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

di SP - sends image data from the display without conversion to ASCII.

Cont - sends 8 bit ASCII form of display data at a rate typically 90% of the sample rate.

POLL - controlled by computer or PLC as host. Host sends command via RS232/485 and instrument responds as requested.

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

m.buS - Modbus RTU protocol.

5.43 Instrument address for optional serial communications

Display: **Addr**

Range: **0** to **31**

Default Value: **0**

Set unit address for polled (**POLL**) or **m.buS** mode (**0** to **31**)) - seen only with serial output option. Refer to the separate "RM4 Din Rail Meter Optional Output Addendum" booklet supplied when optional outputs are fitted. Allows several units to operate on the same RS485 interface reporting on different areas etc. if RS485 is available. The host computer or PLC may poll each unit in turn supplying the appropriate address. The unit address ranges from 0 to 31 (DEC) but is offset by 32 (DEC) to avoid clashing with ASCII special function characters (such as <STX> and <CR>). Therefore 32 (DEC) or 20 (HEX) is address 0, 42 (DEC) or 2A (HEX) is address 10. Do not use address 0 in **m.buS** mode.

5.44 Serial mode for optional serial communications

Display: **SErL**

Range: **LivE**,**tArE**,**P.HLd**,**d.HLd**,**Hi**,**Lo**,**Hi Lo** or **diSP**

Default Value: **LivE**

Seen only with serial output option - applies only when **O.Put** function set to **Cont**. Refer to **rEC** function. The **Hi Lo** selection in this functions allows both the peak and valley memories to be transmitted. The peak value will be transmitted followed by a space then the valley value.

6 Calibration

The instrument can be calibrated via a two point live input calibration method using functions **CAL 1** and **CAL2**. For 4-20mA inputs only an alternative method allows display scaling without live inputs using the **USEr En4** and **USEr En20** functions. An offset calibration scaling adjustment using the **CAL OFSt** function is available which allows the scaling to be adjusted by a fixed amount over the entire scale. Each of these methods and other calibration scaling function are described in this chapter.

In order to gain access to the calibration functions you must be in **CAL** mode, refer to Chapter 5 page 17 which shows the method of entering **CAL** mode.

6.1 Live signal input calibration

CAL 1 and **CAL2** - The functions **CAL 1** and **CAL2** are used together to scale the instruments display, values for both **CAL 1** and **CAL2** must be set when using this scaling method. The **CAL 1** function sets the first calibration point for live input calibration. When using this method different signals inputs must be present at the input terminals for **CAL 1** and **CAL2**. Note: **CAL 1** and **CAL2** can be set independently.

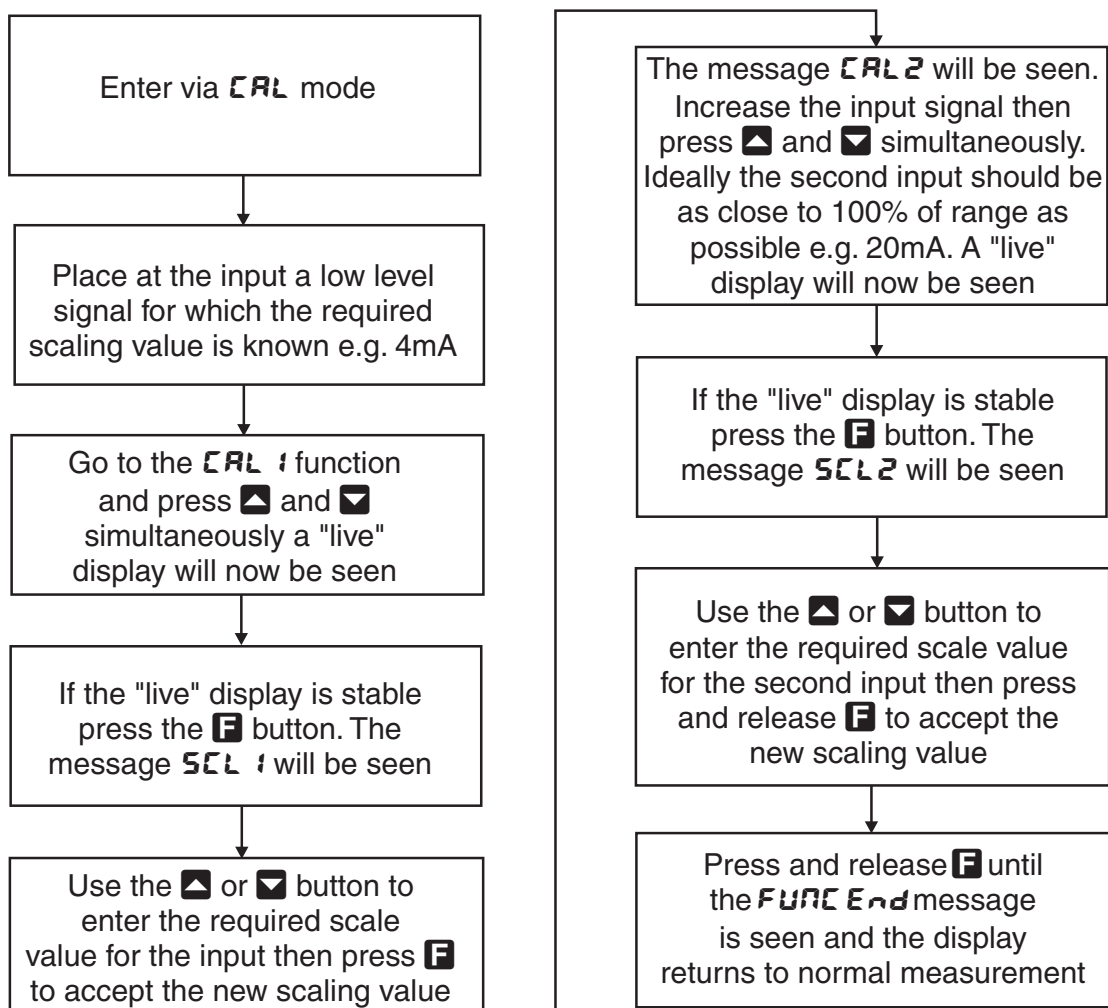The procedure for entering the first scaling point **CAL 1** is as follows:
a. Ensure that an input signal is present at the input terminals, this will usually be at the low end of the signal range e.g. 4mA for a 4-20mA input.
b. At the **CAL 1** function press ▲ and ▼ simultaneously then release them. The display will show the live input value. Do not be concerned at this stage if the live input display value is not what is required. It is important that the live input value seen is a steady value, if not then the input needs to be investigated before proceeding with the scaling.
c. Press then release the **F** button. The display will indicate **SCL 1** followed by a value. Use the ▲ or ▼ button to change this value to the required display value at this input. e.g. if 4mA was input and the required display at 4mA was **0** then ensure **0** is entered at **SCL 1**. Press the **F** button to accept changes or the **P** button to abort the scaling. If the scaling has been accepted the **CAL End** message should be seen.
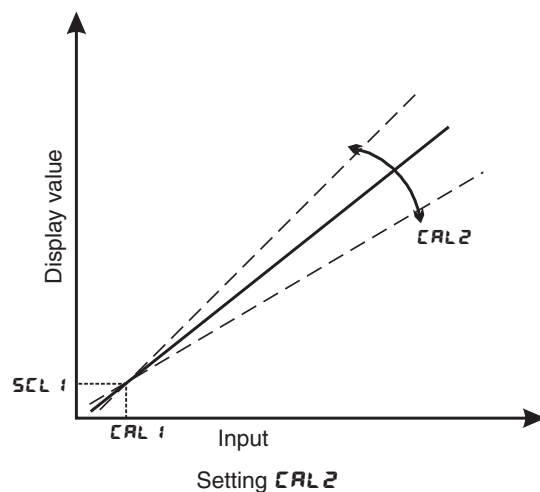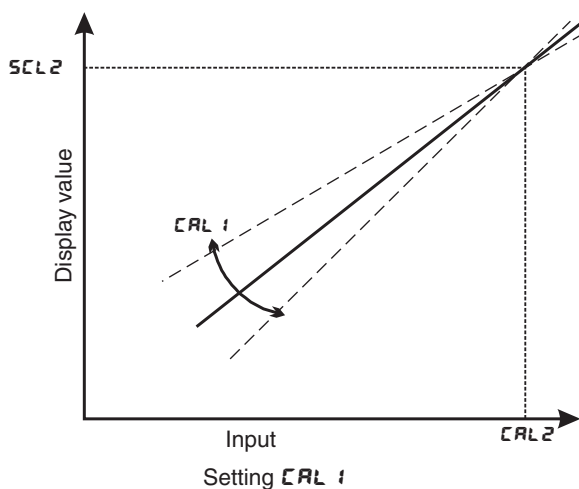
The procedure for entering the second scaling point **CAL2** is as follows:

a. Ensure that an input signal is present at the input terminals, this will usually be at the high end of the signal range e.g. 20mA for a 4-20mA input. The change in input signal from the **CAL1** input must be at least 10% of the input range full scale.

b. At the **CAL2** function press ▲ and ▼ simultaneously then release them. The display will show the live input value. Do not be concerned at this stage if the live input display value is not what is required. It is important that the live input value seen is a steady value, if not then the input needs to be investigated before proceeding with the scaling.

c. Press then release the **F** button. The display will indicate **SCL2** followed by a value. Use the ▲ or ▼ button to change this value to the required display value at this input. e.g. if 20mA was input and the required display at 20mA was **500** then ensure **500** is entered at **SCL2**. Press the **F** button to accept changes or the **P** button to abort the scaling. If the scaling has been accepted the **CAL End** message should be seen.

Example - Flow chart showing scaling using two live inputs

Enter via **CAL** mode

↓

Place at the input a low level signal for which the required scaling value is known e.g. 4mA

↓

Go to the **CAL1** function and press ▲ and ▼ simultaneously a "live" display will now be seen

↓

If the "live" display is stable press the **F** button. The message **SCL1** will be seen

↓

Use the ▲ or ▼ button to enter the required scale value for the input then press **F** to accept the new scaling value

The message **CAL2** will be seen. Increase the input signal then press ▲ and ▼ simultaneously. Ideally the second input should be as close to 100% of range as possible e.g. 20mA. A "live" display will now be seen

↓

If the "live" display is stable press the **F** button. The message **SCL2** will be seen

↓

Use the ▲ or ▼ button to enter the required scale value for the second input then press and release **F** to accept the new scaling value

↓

Press and release **F** until the **FUNC End** message is seen and the display returns to normal measurement

Note: If the "live" display at any scaling point is not stable then check the input signal for stability.

6.2   Alternative 4-20mA scaling

USEr En4 - 4mA input scaling without a live input - this calibration method can be used with 4-20mA inputs only. The instrument can be scaled for a 4-20mA input without a live input i.e. this is an alternative method to the **CAL 1** and **CAL2** method of scaling. To perform the first point (**En 4**) scaling simply press the ▲ and ▼ buttons simultaneously when the **USEr En4** function is displayed. The display will now indicate a value. Use the ▲ or ▼ button to change this value to the display value required for a 4mA input. Press the **F** button to accept changes or the **P** button to abort the scaling. If the scaling has been accepted the **CAL End** message should be seen.

USEr En20 - 20mA input scaling without a live input - this calibration method can be used with 4-20mA inputs only. To perform the second point (**En 20**) scaling simply press the ▲ and ▼ buttons simultaneously when the **USEr En20** function has been reached. The display will now indicate a value. Use the ▲ or ▼ button to change this value to the display value required for a 20mA input. Press the **F** button to accept changes or the **P** button to abort the scaling. If the scaling has been accepted the **CAL End** message should be seen.

Note: the **USEr En4** and **USEr En20** method relies on the accuracy of the signal input. If the sensor output is found to have an offset use the **CAL OFSt** function to correct for the offset. If the slope of the sensor output is not correct then **CAL 1** and **CAL2** methods will have to be used.

6.3   Offset calibration

CAL OFSt - Calibration offset - the calibration offset is a single point adjustment which can be used to alter the calibration scaling values across the entire measuring range without affecting the calibration slope. This method can be used instead of performing a two point calibration when a constant measurement error is found to exist across the entire range. To perform a calibration offset press the ▲ and ▼ buttons simultaneously at the **CAL OFSt** function. A "live" reading from the input will be seen, make a note of this reading. Press the **F** button, the message **SCLE** will now be seen followed by the last scale value in memory. Use the ▲ or ▼ button to adjust the scale value to the required display value for that input. For example if the "live" input reading was **50** and the required display value for this input was **70** then adjust the **SCLE** value to **70**. Press the **F** button to accept changes or the **P** button to abort the scaling. If the scaling has been accepted the message **OFSt End** should be seen. If the **ZErO rnGE Err** message is seen refer to the **ZErO rnGE** and **CAL ZErO** functions.

6.4   Zero range

ZErO rnGE - Zero Range - the zero range function allows a limit value to be set (in engineering units) above which the display will not zero i.e. if a zero operation is attempted via the **P** button, remote input or set zero function when the display value is greater than the zero range setting the display will refuse to zero and give a **ZErO rnGE Err** message (note that the **CAL OFSt** function is also affected by the **ZErO rnGE** setting). For example if the zero range setting is **10** the instrument will only respond to a zero operation if the display reading at the time is between **- 10** and **10**. If the zero range function is not required it can be set to **OFF** by pressing the ▲ and ▼ buttons simultaneously at this function. When switched off the instrument can be zeroed no matter what the display value. Note that the instrument keeps track of the value being zeroed at each operation, when the total amount zeroed from repeated operations becomes greater than the zero range value the instrument will reject the zero operation and a **ZErO rnGE Err** message will

be seen. To allow a zero operation beyond this point either the **ZErO rNGE** function value will need to be raised or a new zero reference point introduced via the **CAL ZErO** function. If repeated zero operations are required the **ZErO rNGE** function should be set to **OFF** or alternatively the **tArE** operation could be considered.

6.5   Zero range zero calibration

CAL ZErO - Zero range zero calibration - a **CAL ZErO** zero operation can be used to ensure that the display zero and the **ZErO rNGE** reference zero are at the same point after a calibration. After a calibration the **CAL ZErO** operation can also be used to select a zero point other than the display zero as the reference for the **ZErO rNGE** function. For example if the **CAL ZErO** operation is carried out with a display reading of **500** and a **ZErO rNGE** reading of **10** the zero range function will allow the display to zero only if the current display reading is between **490** and **510**. To perform a calibration zero press the ▲ and ▼ buttons simultaneously at the **CAL ZErO** function, a live reading will be seen, press the **F** button, the message **CAL ZErO End** should now be seen indicating that the instrument has accepted the zero point. Although the display reading will not change as a result of the calibration zero the input value on the display at the time of the operation will be the new zero reference point for the **ZErO rNGE** function.

6.6   Uncalibration

UCAL - Uncalibrate - used to set the instrument back to the factory calibration values. This function should only be used when calibration problems exist and it is necessary to clear the calibration memory. To clear the calibration memory press the ▲ and ▼ buttons simultaneously at the **UCAL** function. The message **CAL CLr** will be seen to indicate that the memory has cleared.

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 Rx **OPEr** function. Note that the Rx **OPEr** function will not be seen until a value has been set for the low or high alarm e.g. for **A1Lo** or **A1Hi** . 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.

Relay 1 and , if fitted, relay 2 can be set to operate in PI control mode. Any other relays fitted will only operate in normal, non PI operation. The "x" in the Rx **OPEr** and other functions indicates the chosen relay i.e. for relay 1 the display will show **A1 OPEr**, **A1.SP** etc. The Rx **OPEr** function allows three choices of operating mode for the chosen relay, namely $Rx.$**AL**, $Rx.$**tP** and $Rx.$**Fr**. If $Rx.$**AL** is selected the chosen relay will operate as a setpoint relay whose operation is controlled by the Rx**Hi** , Rx**Lo** etc. settings and the PI control settings will not be seen. See the "Explanation of functions" chapter for details of operation when $Rx.$**AL** is selected. If $Rx.$**tP** is selected then the chosen relay will operate in pulse width control mode. If $Rx.$**Fr** is selected then the chosen relay will operate in the frequency control mode.
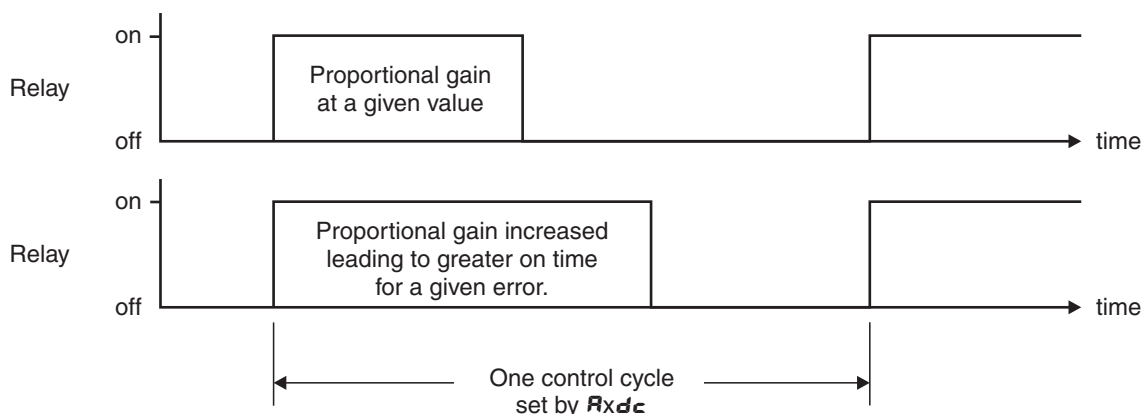
Pulse width control - operates by controlling the on to off time ratio of the relay. In a typical application this would be used to control the length of time for which a dosing pump is switched on during a control cycle i.e. the pump or other device will continuously operate for the length of time the 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 $Rx.$**tP** must be selected at the Rx **OPEr** function.

Pulse width control

Relay — on / off — time

Proportional gain at a given value

Relay — on / off — time

Proportional gain increased leading to greater on time for a given error.

One control cycle set by Rx**dc**

7.2 PI relay control setpoint

Display: $Ax.SP$

Range: Any display value

Default Value: 0

The control setpoint is set to the value in displayed engineering units required for the control process. The controller will attempt to vary the control output to keep the process variable at the setpoint. Note that the control setpoint value can be reached and adjusted via the "easy access" mode (see "Explanation of functions" chapter) if the **ACCS** function is set to **EASY**. This feature could be useful if the setpoint is to be frequently changed.
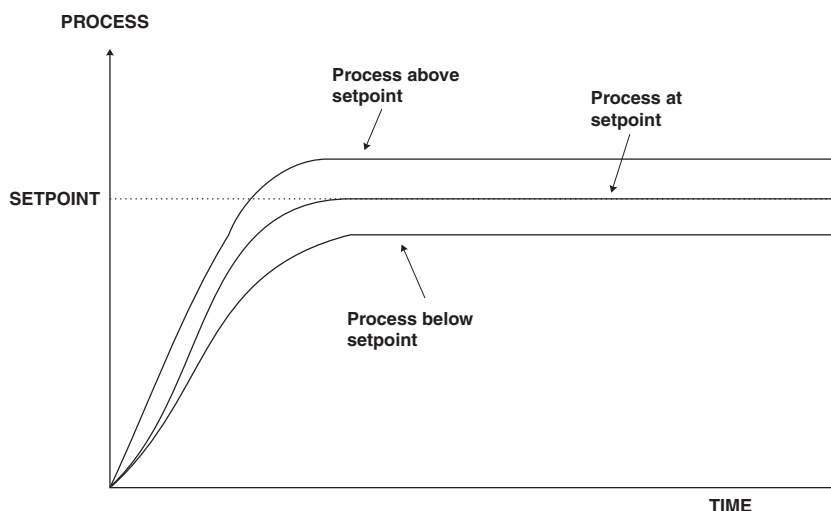
7.3 PI relay control span

Display: $ctrl\ SPAN$

Range: Any display value

Default Value: 100

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 ($Ax.SP$) is **70** and the **ctrl SPAN** is **20** and $Ax.PG$ 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 $Ax.SP$ at **70**, **ctrl SPAN** at **20**, $Ax.PG$ at **1.000** and $AxbS$ at **0.000** a display reading of **50** or lower ($Ax.SP$ minus **ctrl SPAN**) 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.
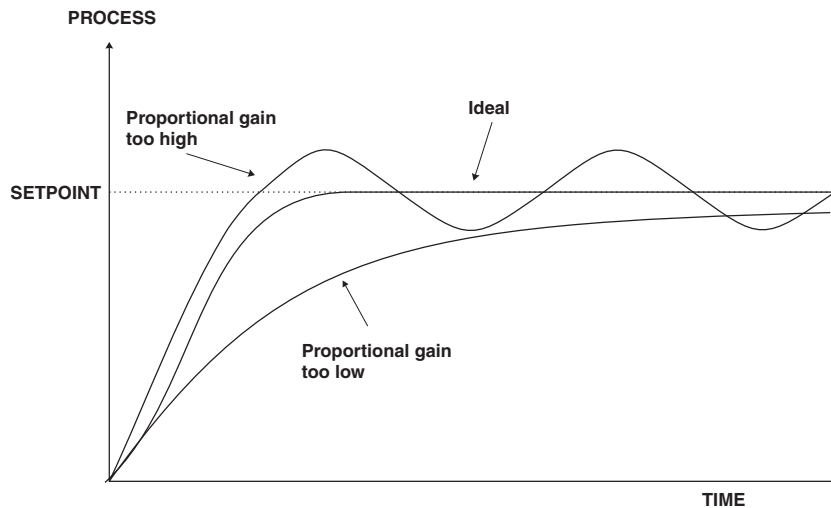
For instruments with more than one input where the number of decimal points displayed may vary the control span will take on the value of the main display and so may or may not match the decimal points shown in the input being controlled. e.g. a control span of 2.00 will act as a control span of 20.0 if the input to be controlled is displayed with only 1 decimal point.

7.4   PI relay proportional gain

Display: $Ax.P9$

Range: -32.767 to 32.767

Default Value: 0.010

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

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 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 of the output frequency of changing proportional gain and bias with the following settings: $ctrl$ $SPAN$ = 20, $A1.dc$ = 1.0, $A1.19$ = 0.000			
A1.SP	**A1.P9**	**A1.b5**	**Effect on relay operation**
70	1.000	0.0	Reading of **50** or below - relay permanently on. Reading of **50** to **70** - relay pulses with off time increasing as value approaches **70**. Reading **70** or above - relay permanently off.
70	1.000	100.0	Reading of **70** or below - relay permanently on. Reading of **70** to **90** - relay pulses with off time increasing as value approaches **90**. Reading **90** or above - relay permanently off.
70	1.000	50.0	Reading of **60** or below - relay permanently on. Reading of **60** to **70** - relay pulses with off time increasing as value approaches **70**. Reading **70** - relay pulses at 50% on and 50% off. Reading **70** to **80** - relay pulses with off time increasing as value approaches **80**. Reading **80** or above - relay permanently off.
70	0.500	50.0	Reading **50** or below - relay permanently on. Reading **50** to **70** - relay pulses with off time increasing as value approaches **70**. Reading **70** - relay pulses at 50% on and 50% off. Reading **70** to **90** - relay pulses with off time increasing as value approaches **90**. Reading **90** or above - relay permanently off.
70	-1.000	50.0	Reading of **60** or below - relay permanently off. Reading of **60** to **70** - relay pulses with on time increasing as value approaches **70**. Reading **70** - relay pulses 50% on and 50% off. Reading **70** to **80** - relay pulses with on time increasing as value approaches **80**. Reading **80** or above - relay permanently on.

7.5   PI relay integral gain

Display: $Ax.19$

Range: -32.767 to 32.767
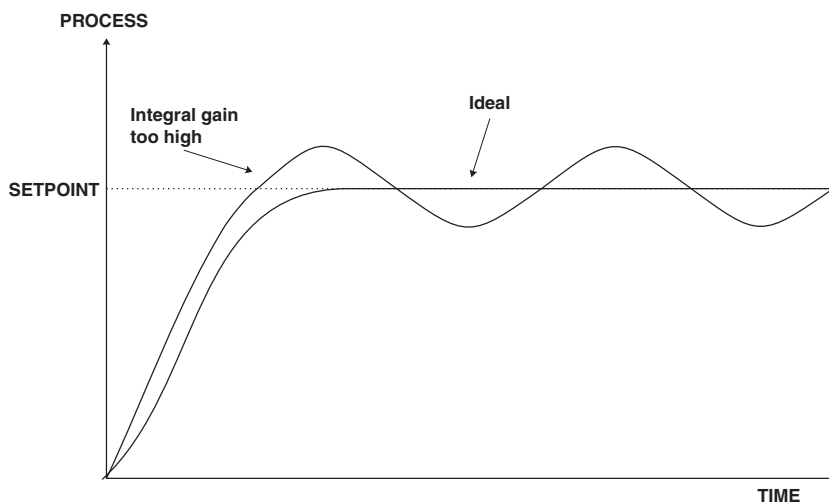
Default Value: 0.000

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 **10** or more (with control span set at **10**) 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 **10** 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 **A**x.**1 9**.

7.6 PI relay integral control high limit

Display:	**A**x.**1 H**
Range:	**0.0** to **100.0**
Default Value:	**100.0**

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 previously.

7.7 PI relay integral control low limit

Display:	$Ax.IL$
Range:	0.0 to 100.0
Default Value:	100.0

The minimum 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 bias ($Ax.bS$) 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.

7.8 PI relay control output bias

|	
Display:	$Ax.bS$
Range:	0.0 to 100.0
Default Value:	50.0

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 whist the measured input is at the setpoint.

7.9 PI relay control cycle period

Display:	$Ax.dc$
Range:	0 to 250
Default Value:	10

Displays and sets the control period cycle from 0 to 250 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.
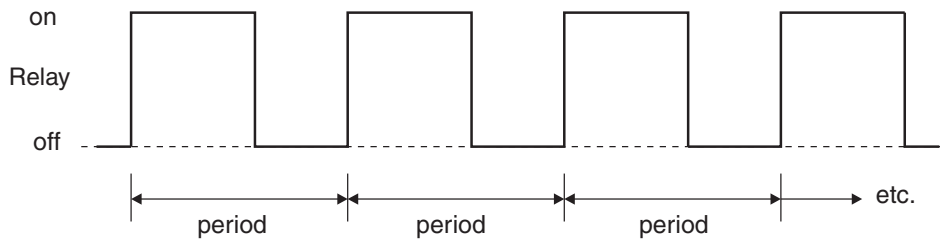
7.10   Setting up the PI pulse width controller

1. Set the Ax **OPEr** function to Ax.**tP**.

2. Set the control setpoint Ax.**SP** to the required setting.

3. Set the control span **ctrl SPAN** to the required setting.

4. Set the proportional gain Ax.**P9** to an arbitrary value e.g. **0.500**.

5. Set the integral gain Ax.**I9** to **0.000** (i.e. off).

6. Set the low and high integral Ax.**IL** and Ax.**IH** limits to an arbitrary value e.g. **20.00**.

7. Set the bias Ax.**bS** to **50.0**.

8. Set the cycle Ax.**dc** 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

7.11 Relay frequency modulation control mode

To use pulse width modulation control $Ax.Fr$ must be selected at the Ax $OPEr$ function. In frequency modulation mode the relay on time is fixed. A minimum relay off 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
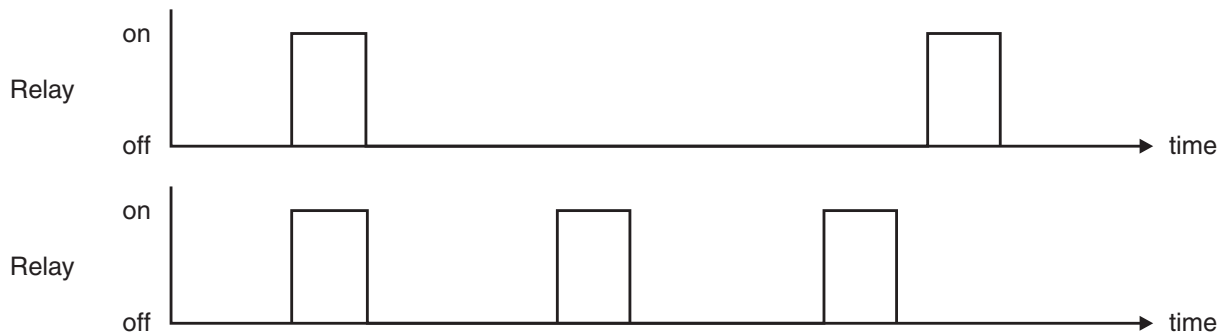
Frequency PI control operation has many functions in common with PI pulse width control, refer to the appropriate sections as shown below for these common functions.

$Ax.SP$ (Control setpoint) - refer to section 7.2

$ctrl$ $SPAn$ (Control span) - refer to section 7.3

$Ax.Pg$ (Proportional gain) - refer to section 7.4

$Ax.Ig$ (Integral gain) - refer to section 7.5

$Ax.IL$ (Integral control low limit) - refer to section 7.7

$Ax.IH$ (Integral control high limit) - refer to section 7.6

$Ax.bS$ (PI control bias) - refer to section 7.8

$Ax.dc$ (PI control cycle period) - refer to section 7.9. In frequency mode this function sets the minimum off time. If set to O the relay will be disabled. The control program can extend the off time to maintain the setpoint but not reduce it. If a 100% error is seen then the pulse rate will be at its maximum i.e. the off time will equal $Ax.dc$. If a 50% error is seen there will be a pulse every 2 times $Ax.dc$. For a 25% error there will be a pulse every 4 times $Ax.dc$ and for a 10% error there will be a pulse every 10 times $Ax.dc$.

This table shows the effect of the output frequency of changing proportional gain and bias with the following settings: $ctrl\ SPAN = 20$, $A\ 1.dc = 1.0$, $A\ 1.I\ 9 = 0.000$			
A 1.SP	**A 1.P9**	**A 1.bS**	**Effect on relay operation**
70	1.000	0.0	Reading of **50** or below - relay pulses at maximum frequency. Reading of **50** to **70** - relay pulses with frequency decreasing as value approaches **70**. Reading **70** or above - relay permanently off.
70	1.000	100.0	Reading of **70** or below - relay pulses at maximum frequency. Reading of **70** to **90** - relay pulses with frequency decreasing as value approaches **90**. Reading **90** or above - relay permanently off.
70	1.000	50.0	Reading of **60** or below - relay pulses at maximum frequency. Reading of **60** to **80** - relay pulses with frequency decreasing as value approaches **80**. (period increased by 50% at **70** compared to minimum period e.g. if minimum period is 4 seconds the period at **70** will be 6 seconds) Reading **80** or above - relay permanently off.
70	0.500	50.0	Reading **50** or below - relay pulses at maximum frequency. Reading **50** to **90** - relay pulses with frequency decreasing as value approaches **90**. (period increased by 50% at **70** compared to minimum period e.g. if minimum period is 4 seconds the period at **70** will be 6 seconds) Reading **90** or above - relay permanently off.
70	- 1.000	50.0	Reading of **60** or below - relay permanently off. Reading of **60** to **80** - relay pulses with frequency decreasing as value approaches **80**. (period increased by 50% at **70** compared to minimum period e.g. if minimum period is 4 seconds the period at **70** will be 6 seconds) Reading **80** or above - relay pulses at maximum frequency.

7.12   PI relay on duration

Display: $Ax.dr$

Range: **0.0** to **25.0**

Default Value: **1.0**

Displays and sets the control relay on duration from **0.0** to **25.0** 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 frequency controller

1. Set the $Ax\ OPEr$ function to $AxFr$.

2. Set the control setpoint $Ax.SP$ to the required setting.

3. Set the control span `ctrl SPAN` to the required setting.

4. Set the proportional gain `Ax.PG` to an arbitrary value e.g. `0.500`.

5. Set the integral gain `Ax.IG` to `0.000` (i.e. off).

6. Set the low and high integral `Ax.IL` and `Ax.IH` limits to an arbitrary value e.g. `20.00`.

7. Set the bias `Ax.bS` to `50.0`.

8. Set the cycle `Ax.dc` period to `20` seconds.

9. Set the relay on time `Ax.dr` 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:	Link selectable ±2mA, ±20mA, 4 to 20mA, ±100mV, ±1V, ±10V, ±100V or slidewire (3 wire 0–1kΩ to 0–1MΩ value slidewire)
Impedance:	135Ω (mA ranges), 1MΩ (Voltage ranges)
Accuracy:	0.1% of full scale ±1 display digit for alarms and display when calibrated.
Sample rate:	7.5 samples per second
ADC Resolution:	1 in 20,000
Display update:	4 per second
Conversion Method:	Dual slope ADC
Microprocessor:	HC68HC11F CMOS
Ambient temperature:	-10 to 60° C
Humidity:	5 to 95% non condensing
Display:	LED 5 digit 7.6mm + alarm annunciator LEDs
Power supply:	AC 240V, 110V 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 100mA at 12VDC and 50mA at 24VDC for RM4 with no optional outputs
Output (standard):	2 x relay, Form A, rated 5A resistive. Programmable N.O. or N.C

8.2 Optional outputs

Third relay:	Rated 0.5A resistive 30VAC or DC May be configured as form A or form C if the third relay is the only option fitted
Fourth relay:	Rated 0.5A resistive 30VAC or DC, form A
Analog output:	Isolated 4 to 20mA, 0 to 1V or 0 to 10V link selectable 12 or 16 bit versions available (4-20mA will drive into resistive loads of up to 800Ω) First analog output can be configured for retransmission or PI control.
Serial communications:	Isolated RS232, RS485 or RS422 (8 bit ASCII or Modbus RTU)
DC supply output:	Isolated and regulated 12VDC (50mA max) or 24VDC (25mA max)

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

8.3 Physical characteristics

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

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.