



The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

BS EN ISO 9001:2000



Cert. No. Q 05907

EN 29001 (ISO 9001)



Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.



0255

Use of Instructions



Warning.

An instruction that draws attention to the risk of injury or death.



Note.

Clarification of an instruction or additional information.



Caution.

An instruction that draws attention to the risk of damage to the product, process or surroundings.



Information.

Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Marketing Communications Department.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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1 INTRODUCTION

The PX105 programmable circular chart recorder measures, displays and records signals from any of the following input types:

- Thermocouple (THC)
- Resistance thermometer (RTD)
- Linear current or voltage
- Non-linear current or voltage from temperature transmitters
- Square law and power root, current and voltage
- Other variables transduced to an acceptable current, voltage or resistance level

The PX105 recorder is available in one-, two-, and three-channel versions with up to 12 output relays allocated to six set points which in turn may be allocated to any channel or channels.

The recorder is microprocessor-based and requires no ranging components. The input mode may be changed by repositioning a link on the printed circuit board and all other changes to instrument operation are effected by a simple programming sequence. Chart revolution time may be programmed in steps of one hour, from a minimum of 1hr/revolution up to 168hr/revolution.

An event marker option is fitted to PX105/14 and PX105/15 instruments only.

The recorder may be wall- or panel-mounted or fitted into a carrying stand. A post mounting kit is also available.

2 PREPARATION

2.1 Accessories

The following items are packed with the instrument:

- Door keys
- Pen capsule pack(s)
- Pack of charts
- Function label
- Program card

Mounting brackets are supplied ready-fitted to the case.

2.2 Checking the Instrument Code Number – Fig. 2.1

Unlock the door.

- ① Pull the door catch forward and down to open the door, hinged at the left hand edge.
- ② Loosen the captive crosshead screw.
- ③ Swing the chassis forward (hinged at the left hand side).
- ④ Check the type number on the serial number label against Table 1, opposite.

Note. Unless the user has requested a particular program the recorder is despatched with a Company Standard Test Program which is defined on the program card. If this is not suitable for the user's requirements the instrument may be re-programmed. See **PROGRAMMING** on page 22.

- ⑤ Write the function of each channel beneath the appropriate colour on the function label and stick it on the inside edge of the door.

Swing the chassis back into position and tighten the captive screw. Close the door.

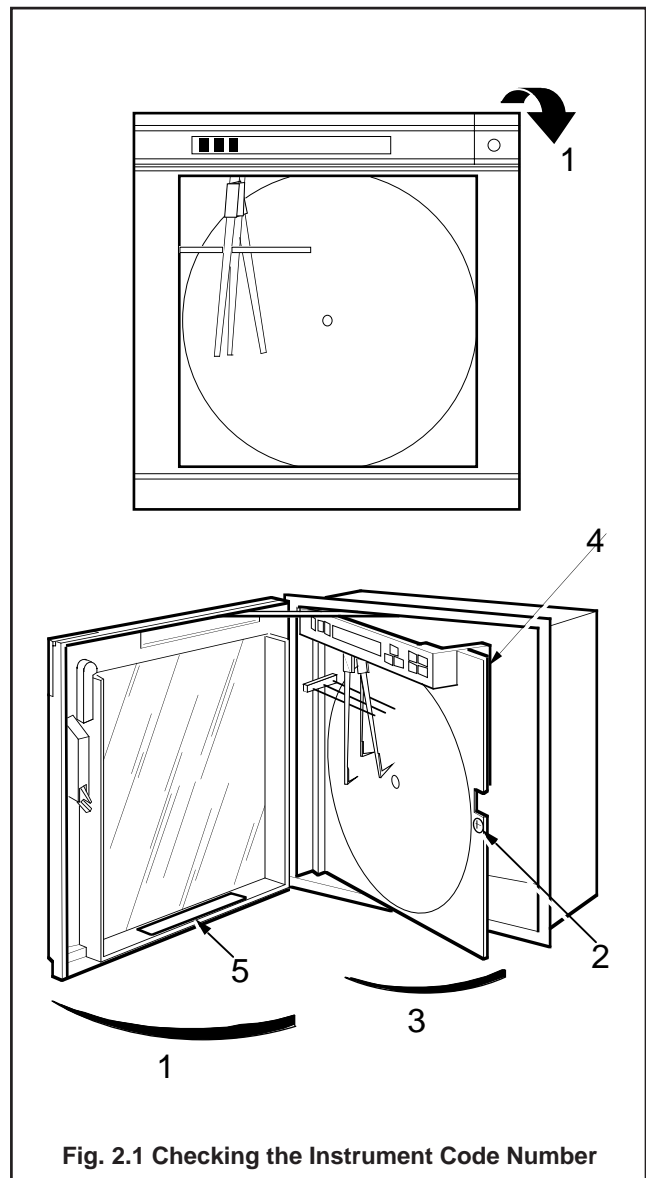


Fig. 2.1 Checking the Instrument Code Number

Basic Type	Function	Module in Position						Window Material	Power Supply
		1	2	3	4	5	6		
Code Digits 1,2,3,4,5/	6,7/	8	9	10	11	12	13/	14	15
PX105 circular chart micro-processor based recorder with 105mm pen travel	10 Basic single pen recorder	0 None	0	0	0	0	0 A	None Transmitter power supply	1 110V 2 50/60 Hz 3 230V 50/60 Hz 10 to 30V d.c.
	11 Single pen recorder	0	0	0	0 1 None 2 One relay 7 Two relays 8 Retransmission (analogue isolated) J Retransmission (analogue isolated + relay) Solid state relay output	0 1 2 7 8 J	0 1 2 7 8 J	0 A	
	12 Two pen recorder	0	0 K	0 A	0 1 2 7 8 J	0 1 2 7 8 J	0 1 2 7 8 J	0 1 2 7 8 J	
	13 Three pen recorder	0 1 2 A	0 1 2 A K	0 1 2 A K	0 1 2 7 8 A J	0 1 2 7 8 A J	0 1 2 7 8 A J	0 1 2 7 8 A J	
	14 Single pen recorder + event marker	0	B Event pen	0	0 1 2 7 8 J	0 1 2 7 8 J	0 1 2 7 8 J	0 A	
	15 Two pen recorder + event marker	0 A	0 A K	B	0 1 2 7 8 A J	0 1 2 7 8 A J	0 1 2 7 8 A J	0 1 2 7 8 A J	

This table is for identification of standard product codes only. Other permutations may be possible

Key to module types:

0 = None

1 = One relay

2 = Two relays

7 = Isolated analogue output

8 = Isolated analogue output + relay outputs

A = Transmitter power supply

B = Event pen input

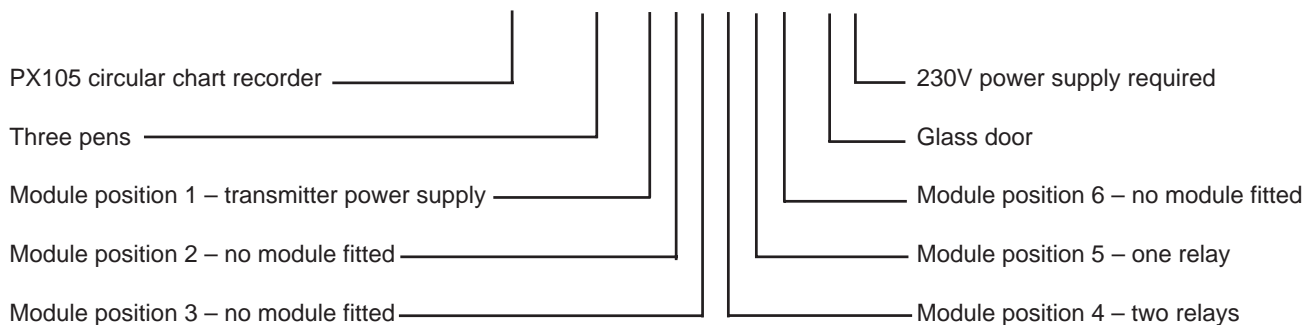
J = Solid state relay output

K = Isolated input module

Table 1 Identification of Instrument Code Number

2.3 Code Number Example

PX105 / 13 / A 0 0 2 1 0 / 1 2



3 INSTALLATION

EC Directive 89/336/EEC

In order to meet the requirements of the EC Directive 89/336/EEC for EMC regulations, this product must not be used in a non-industrial environment.

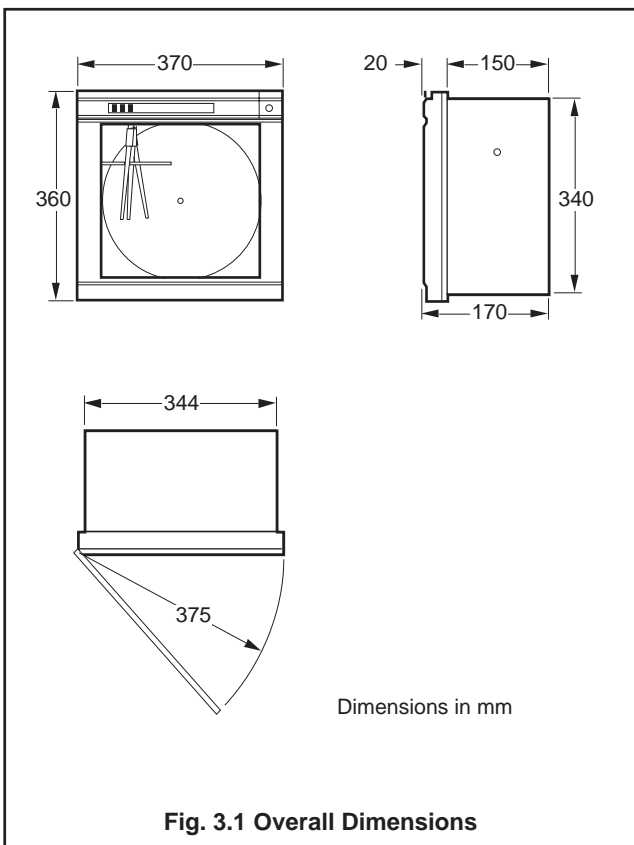
3.1 Siting

Select a location:

- As close as possible to the primary sensing device(s).
- Free from excessive vibration.
- Within the temperature limits of 0 to 55°C and humidity limits of 0 to 80% RH.
- Where the instrument's protection rating, IP54, is sufficient.
- Away from strong electrical and magnetic fields. If these cannot be avoided, particularly in those applications where 'walkie-talkies' are expected to be used, screened cables within earthed metal conduit must be used.

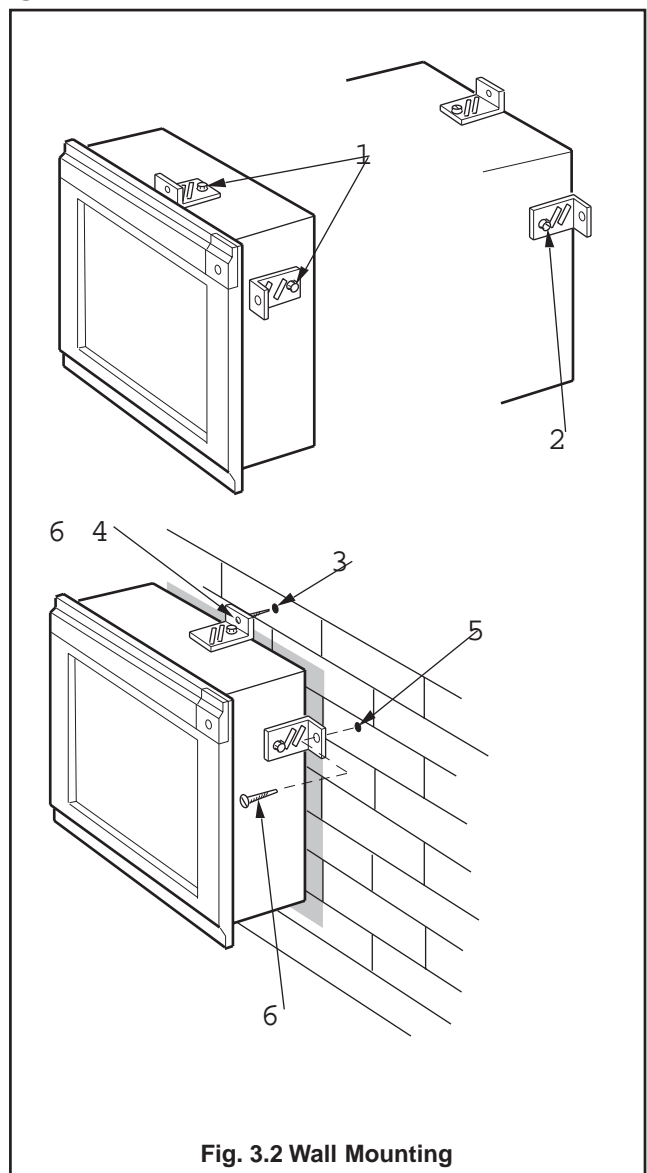
3.2 Mounting – Fig. 3.1

Overall dimensions are shown in Fig. 3.1. The instrument weighs approximately 10.5kg.



3.2.1 Wall Mounting – Fig. 3.2

- Remove the three fixing brackets from the top and sides of the case.
- Reverse the brackets and refit to the case with the fixing screws located in the holes in the brackets (not the slots). Tighten the screws firmly.
- Mark and drill a mounting hole in the position for the top mounting bracket – the bracket fixing hole is 8mm diameter.
- Temporarily screw the instrument to the wall.
- On the wall mark the positions of the remaining fixing holes, ensuring that the instrument is vertical. Drill appropriate holes in the wall.
- Fix the recorder firmly to the wall.



3.2.2 Panel Mounting – Fig. 3.3

Use a robust panel. The maximum panel thickness is 35mm.

- ① Cut a hole 342 (+1mm –0mm) high and 348 (+1 mm –0mm) wide in the panel. (For multiple installations allow a minimum of 65mm horizontally and 60mm vertically between cut-outs.)
- ② Remove the three fixing brackets and screws from the top and sides.
- ③ Insert the instrument in the cut-out.
- ④ Replace the brackets, locating each fixing screw in the slot appropriate to the panel thickness.
- ⑤ Press the brackets hard against the panel and tighten the fixing screws.

3.2.3 Fitting a Carrying Stand

The procedure is similar to that detailed in **Panel Mounting** above (steps ② to ⑤).

Note. It may be necessary to remove the cable entry plugs from the instrument's case before inserting it into the stand.

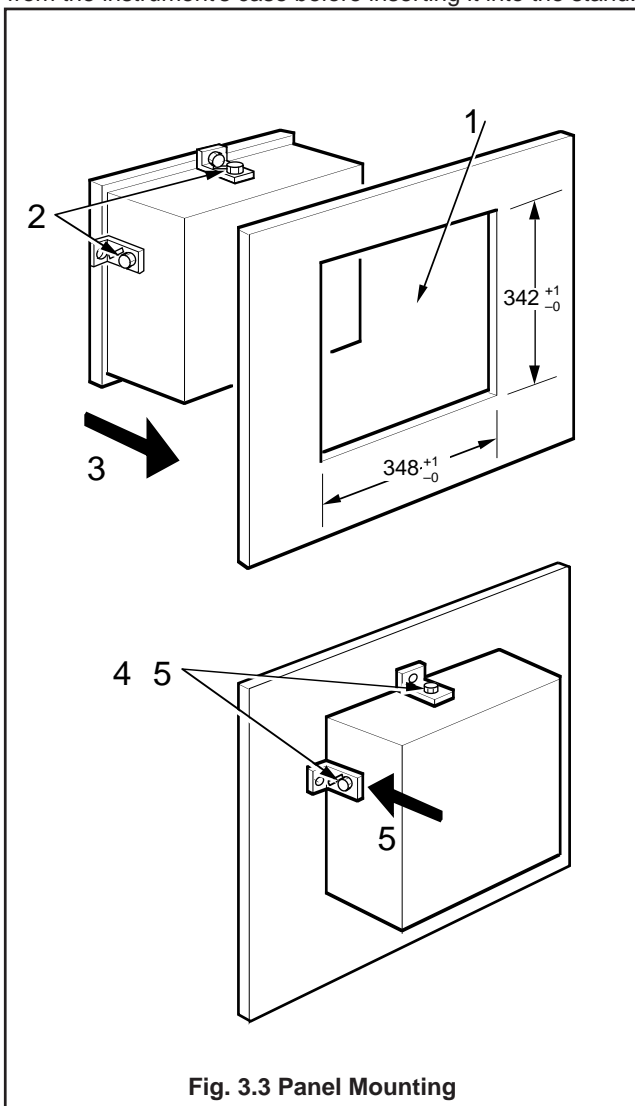


Fig. 3.3 Panel Mounting

3.2.4 Post Mounting – Fig. 3.4

The post mounting kit is designed for mounting the recorder on a 2 inch (2³/₈ inch O.D.) vertical post.

- ① Position the mounting bracket against the vertical post.
- ② Assemble the mounting plate to the mounting bracket.
- ③ Use the two 'U'-bolts, four nuts and the four M10 washers supplied to secure lightly the bracket assembly. Position the assembly and evenly tighten the four nuts.

Caution. Over-tightening the nuts can cause distortion of the mounting bracket.

- ④ Position the recorder within the bracket assembly.
- ⑤ Secure using the three M6 hexagon-headed screws and washers provided, one at the top and one each side.

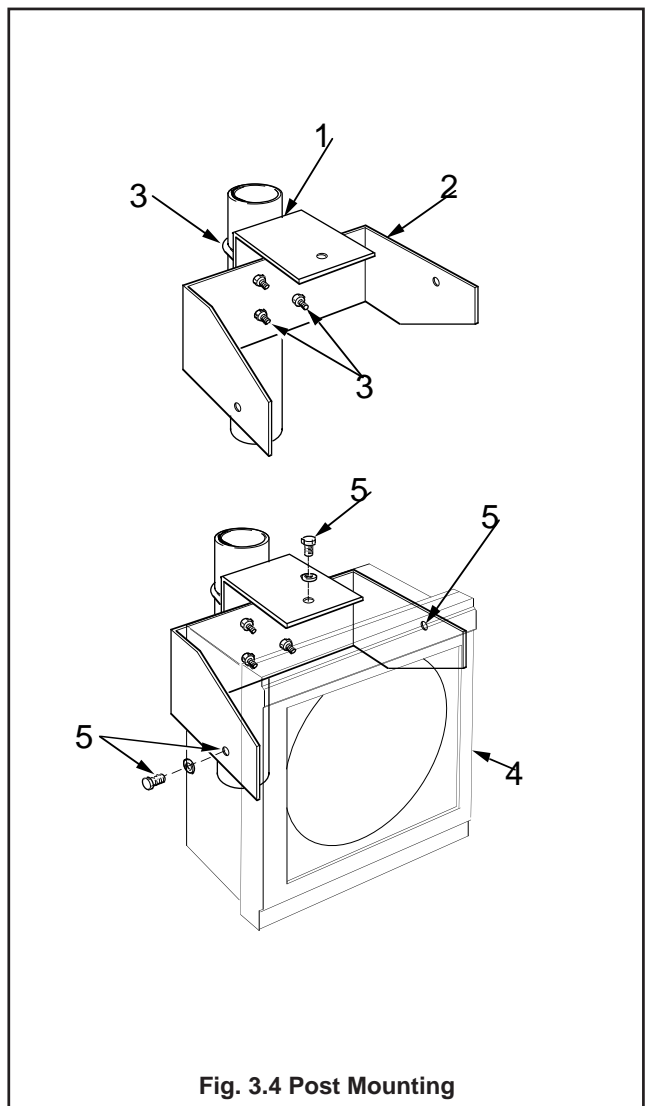


Fig. 3.4 Post Mounting

4 ELECTRICAL CONNECTIONS

WARNING. Before making any connections, ensure that the power supply, any high voltage power-operated control circuits and any high common mode voltages are switched off.

1. **CAUTION.** To avoid damage to multichannel recorders, high common mode voltages up to 250V r.m.s. max. must be present on all channels at all times, or not at all.

The maximum channel-to-channel voltage (between any two channels) must not exceed 12.5V or permanent damage to the instrument's input circuitry may occur. To prevent such damage the negative terminals on all inputs are linked – see Figs. 4.3 to 4.6.

For applications where the available 12.5V isolation is required, the link(s) between the relevant channel and the other channel(s) must be removed.

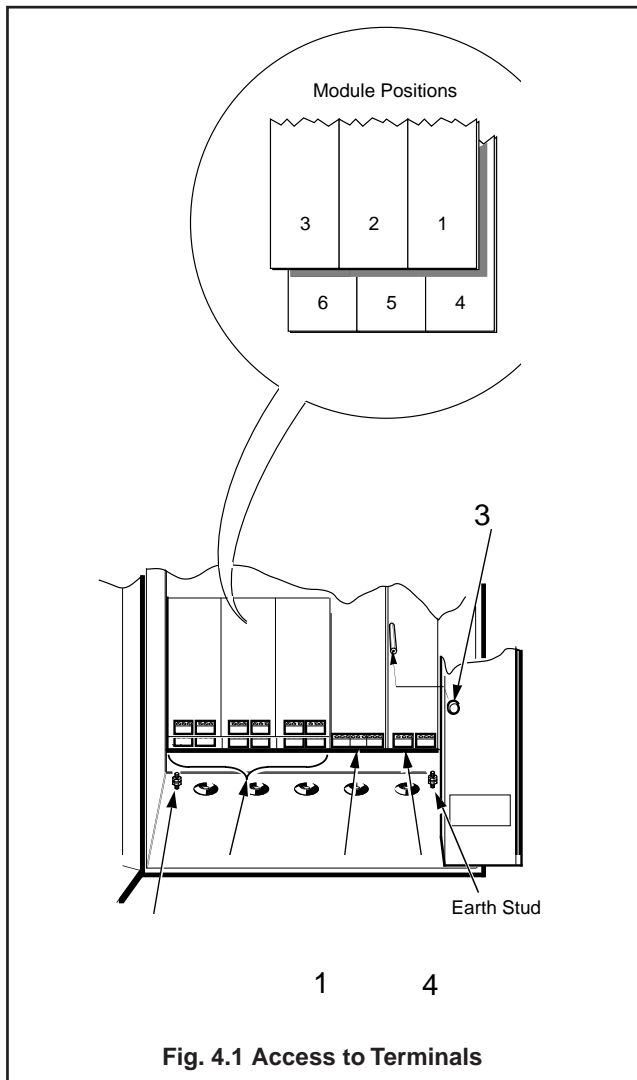


Fig. 4.1 Access to Terminals

If inter-channel isolation is required and the channel to channel voltage rises above 12.5V then use of the type 'K' isolated input module is recommended. See section 4.4.

2. If the recorder is to be re-programmed before use, ensure that the programming is complete before making any process signal connections – see Section 8.
3. If the input type on any channel differs from that specified on the program card, see Section 4.3.1.

4.1 Access to Terminals – Fig. 4.1

Unlock and open the door, release the chassis and swing it forward – see Fig. 2.1 on page 2.

- ① Identify the signal connections terminal block.
- ② Identify the module(s) connections terminal block(s) (if fitted)

Note. Module types are clarified in Table 1 on page 3.

To gain access to the power supply connections terminal block:

- ③ Undo the knurled captive screw retaining the protection cover and remove the cover. Take care not to stress the earthing cable connecting cover to case.
- ④ Identify the power supply terminal block.

4.2 Connections, General

- a) The terminals accept cables of up to 2.5mm² cross section.
- b) Remove the 20mm diameter cable entry blanking plugs and replace them with cable glands or conduit adaptors to suit the application.
- c) Always route signal leads and power cables separately, preferably in earthed metal conduit. It is strongly recommended that, for signal inputs and relay connections, screened cable is used, with the screen connected to the earth stud(s) – see Fig. 4.1.

Type of Thermocouple	BS4937 Part No.	Compensating Cable		Casing Colour
		+	-	
NiCr/NiAl (K)	4	Cu (white)	Con (blue)	Red
Pt/PtRh (R and S)	1 & 2	Cu (white)	CuNi (blue)	Green
Cu/CuNi (T)	5	Cu (white)	Con (blue)	Red
Fe/Con (J)	3	Fe (yellow)	Con (blue)	Black
Fe/Con (DIN 43710 type L)	–	Fe (blue + red trace)	Con (blue)	Blue
Nicrosil/Nisil (type N)	8	Orange	Blue	Orange

Table 2 Thermocouple Compensating Cables

4.3 Signal Connections

If a signal input is not connected or is not in use, even temporarily:

THC and mV inputs – short-circuit the + and – input terminals on each channel (see Figs. 4.3 and 4.4).

RTD inputs – from standard tables obtain the resistive equivalent of the temperature 'Range Zero' (noted on the Program Card) and fit a resistor, approximately equal to or higher than this value, across the input terminals for leads 1 and 2. Link the terminals for leads 1 and 3 (see Fig. 4.5a).

V and mA inputs – it is not necessary to make any connections to the input terminals (see Fig. 4.3).

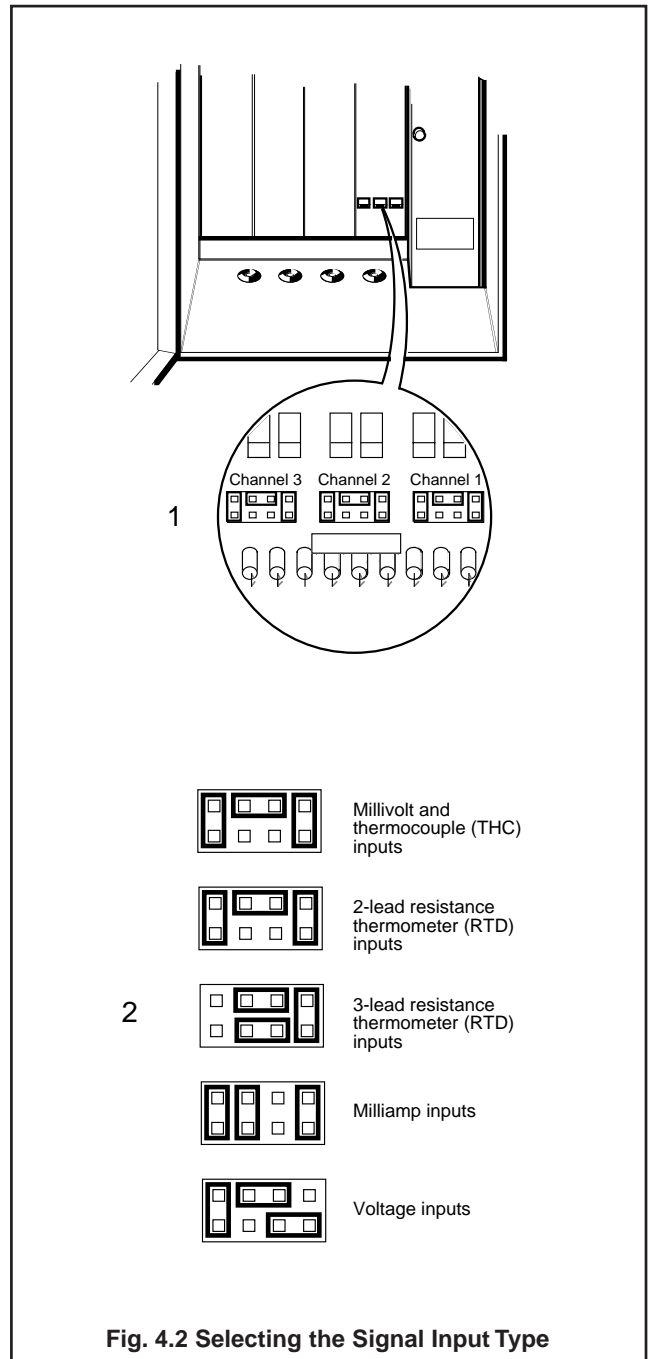
4.3.1 Selecting the Signal Input Type – Fig. 4.2

Plug-in links on the microprocessor p.c.b. select the input type; voltage, current or temperature (THC or RTD). If the input type differs from that originally stated on the program card, the links must be re-positioned before making any connections and the instrument must be re-programmed.

Open the door, release the chassis and swing it forward – see Fig. 2.1.

With reference to Fig. 4.2:

- ① Identify the three links.
- ② Set the link positions for the required input type on each channel.



4.3.2 Voltage and Current Inputs – Fig. 4.3

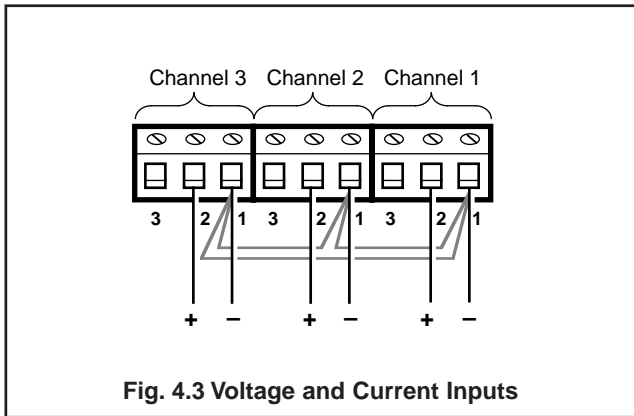
Make connections as shown in Fig. 4.3.

4.3.3 Thermocouple (THC) Inputs – Figs. 4.4

Use the correct compensating cable between the THC and the terminals – see Table 2, on page 6.

Make connections as shown in Fig. 4.4.

Note. Automatic Cold Junction Compensation (ACJC) is incorporated but an independent external cold (reference) junction may be used if the instrument is programmed for use with thermocouple inputs.



4.3.4 3-Lead Resistance Thermometer (RTD) Inputs – Figs. 4.5

The three leads must have equal resistance, not exceeding 50Ω each.

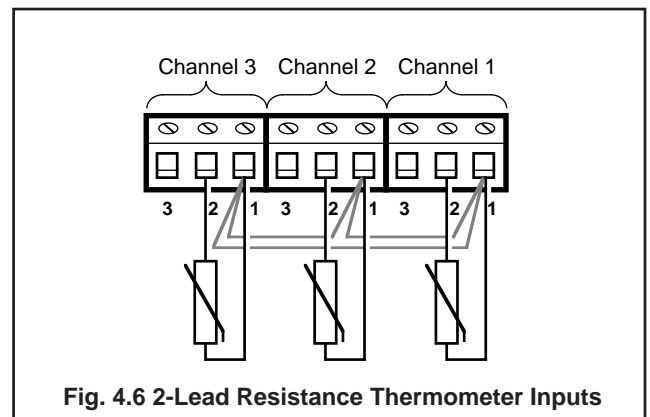
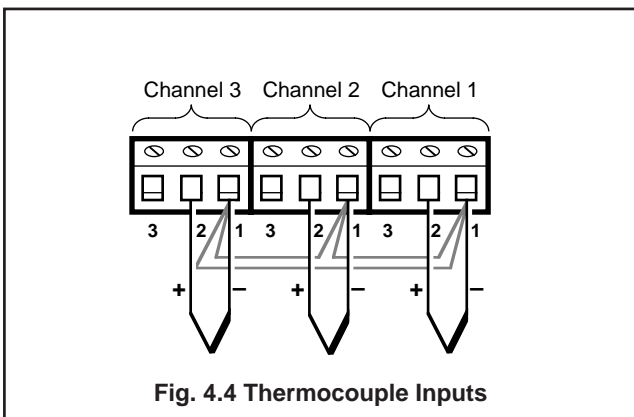
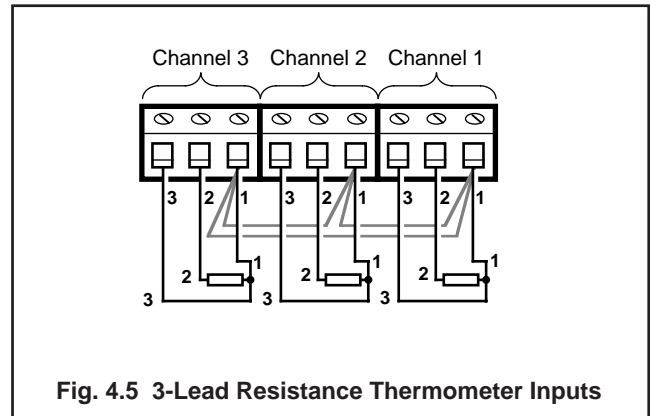
Make connections as shown in Fig. 4.5.

4.3.5 2-Lead Resistance Thermometer (RTD) Inputs – Fig. 4.6

Notes.

- If long leads are necessary it is preferable to use a 3-lead RTD, see previous section.
- If the lead resistance differs from that specified at the time of ordering, the recorder must be re-calibrated before use – see section 10.
- If the RTD is to be used in a hazardous area a 3-lead RTD **must** be used.

Make Connections as shown in Fig. 4.6.



4.3.6 Transmitter Power Supply – Fig. 4.7

The transmitter power supply occupies one of the module positions and can provide a common supply for up to three two-wire transmitters as shown in Fig. 4.7. Make connections as shown. Note that the connections shown dotted are made before despatch and must not be disturbed.

Determine the supply to the transmitter power supply module – see Section 4.6.2.

The positioning of two plug-in leads determines either 110V or 230V operation of the transmitter power supply module.

With reference to Fig. 4.7:

- ① Identify the leads.
- ② Position both leads for the mains supply used by lifting each socket body away from the p.c.b. and withdrawing the lead. Lift the alternative socket away from the p.c.b., push the lead in and snap the socket body down onto the p.c.b. to secure and make contact.

Note. A transmitter power supply board would not normally be fitted to a d.c. powered instrument.

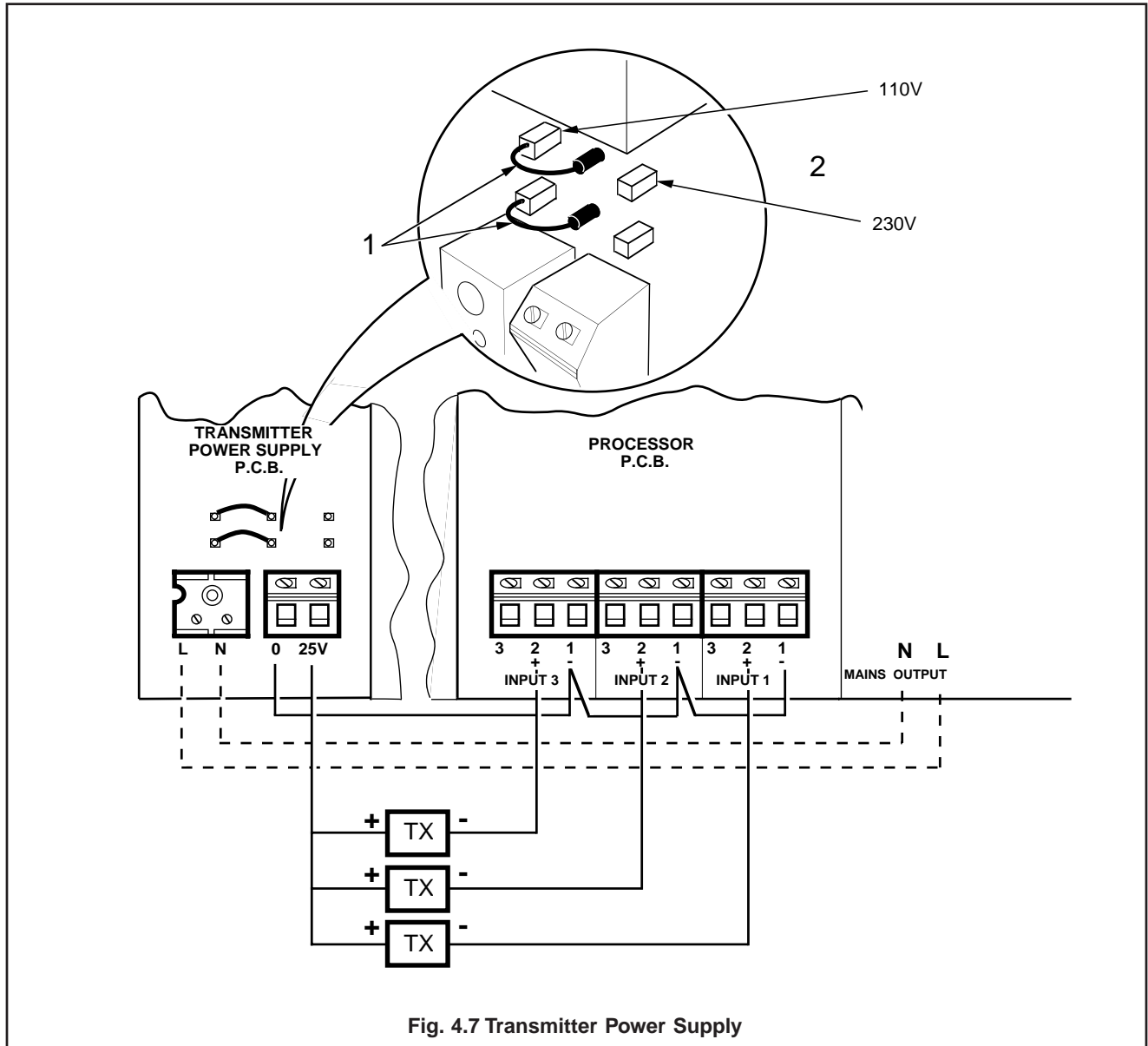


Fig. 4.7 Transmitter Power Supply

4.4 Isolated Signal Connections

Up to two isolated input modules, type K, may be fitted to the recorder, occupying module position 2, for channel 2, and/or position 3 for channel 3 (see Fig. 4.1).

If an isolated input module is to be added, refer to Section 12.2 for fitting instructions.

N.B.

Isolated signal input connections must be made to the input module(s) only. The respective input terminals for that channel on the processor board must be shorted out.

When changing a channel to or from an isolated signal input module it is advisable to re-calibrate the recorder as described in Section 10.

If a signal is not connected to an isolated input module, or is not in use, even temporarily, the procedures described in Section 4.3 must be carried out.

The maximum channel-to-channel and channel-to-earth isolation voltage is 2kV.

4.4.1 Selecting the Isolated Signal Input Type – Fig. 4.8

Plug-in links on the isolated signal input module select the input type: voltage, current or temperature (THC or RTD).

If the input type differs from that originally stated on the program card, the links must be re-positioned before making any connections and the instrument must be re-programmed, see Section 8.

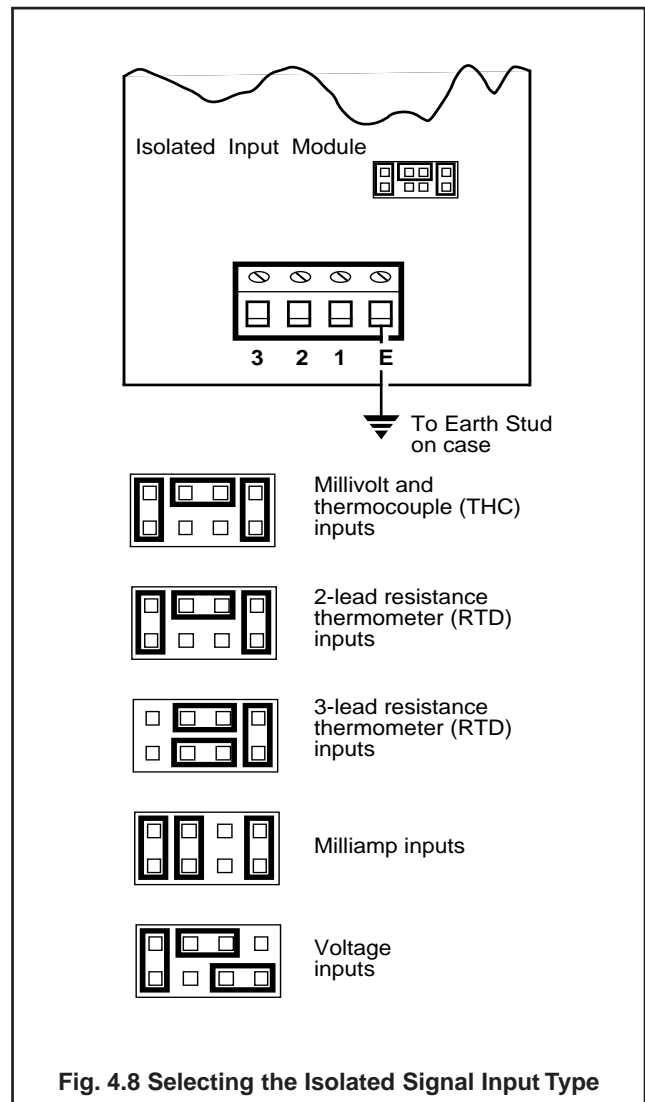


Fig. 4.8 Selecting the Isolated Signal Input Type

Type of Thermocouple	BS4937 Part No.	Compensating Cable		Casing Colour
		+	-	
NiCr/NiAl (K)	4	Cu (white)	Con (blue)	Red
Pt/PtRh (R and S)	1 & 2	Cu (white)	CuNi (blue)	Green
Cu/CuNi (T)	5	Cu (white)	Con (blue)	Red
Fe/Con (J)	3	Fe (yellow)	Con (blue)	Black
Fe/Con (DIN 43710 type L)	-	Fe (blue + red trace)	Con (blue)	Blue
Nicrosil/Nisil (type N)	8	Orange	Blue	Orange

Table 2 Thermocouple Compensating Cables (repeated)

4.4.2 Voltage and Current Inputs – Fig.4.9

Make connections as shown in Fig.4.9.

4.4.3 Thermocouple (THC) Inputs – Figs. 4.10

Use the correct compensating cable between the THC and the terminals – see Table 2 opposite.

Make connections as shown in Fig. 4.10.

Note. Automatic Cold Junction Compensation (ACJC) is incorporated but an independent external cold (reference) junction may be used if the recorder is programmed for use with isolated thermocouple inputs.

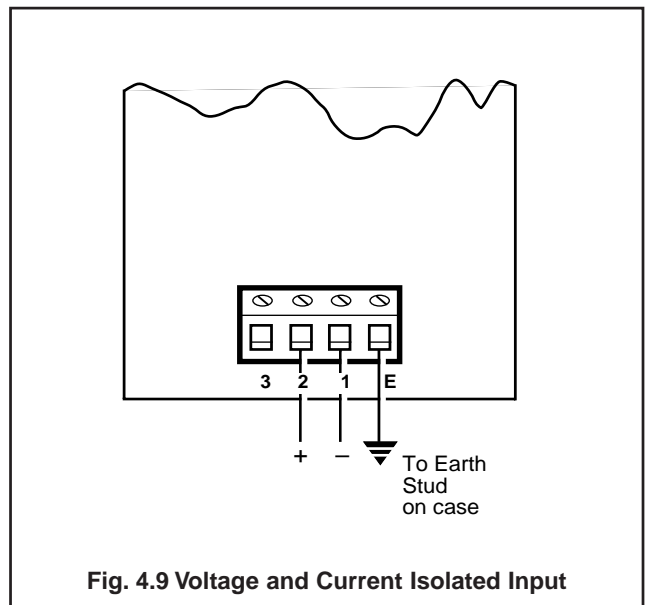


Fig. 4.9 Voltage and Current Isolated Input

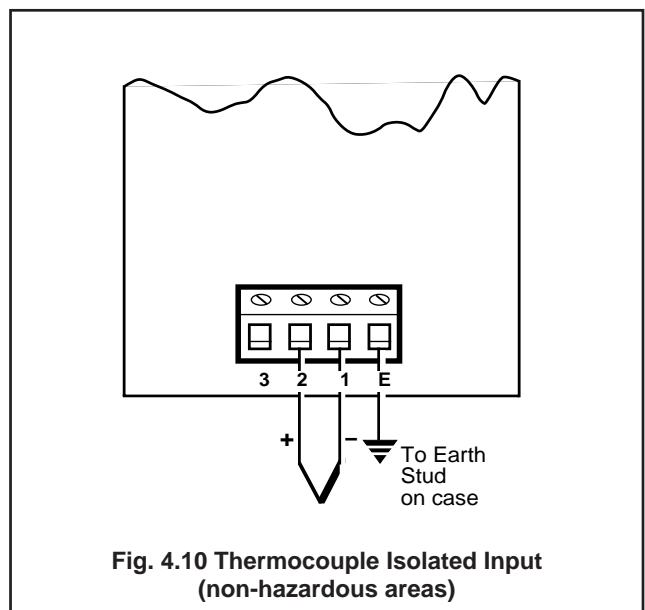


Fig. 4.10 Thermocouple Isolated Input
(non-hazardous areas)

4.4.4 3-Lead Resistance Thermometer (RTD) Inputs – Figs. 4.11

The three leads must have equal resistance, not exceeding 50Ω each.

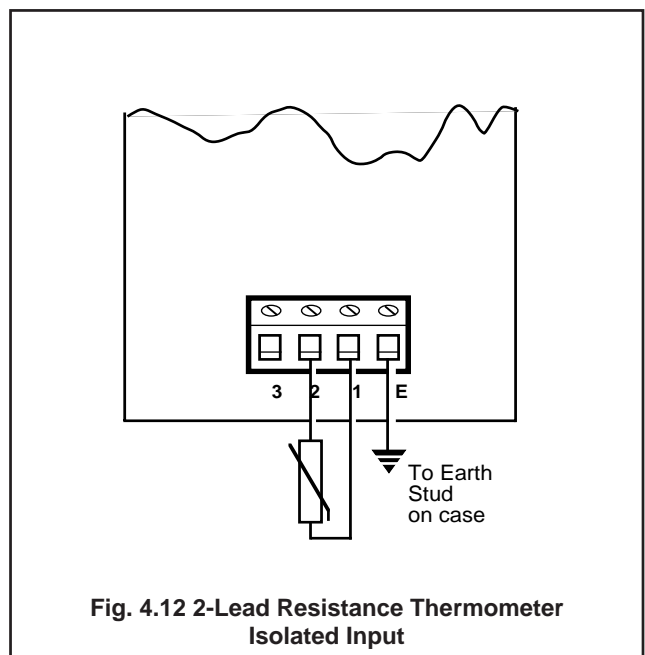
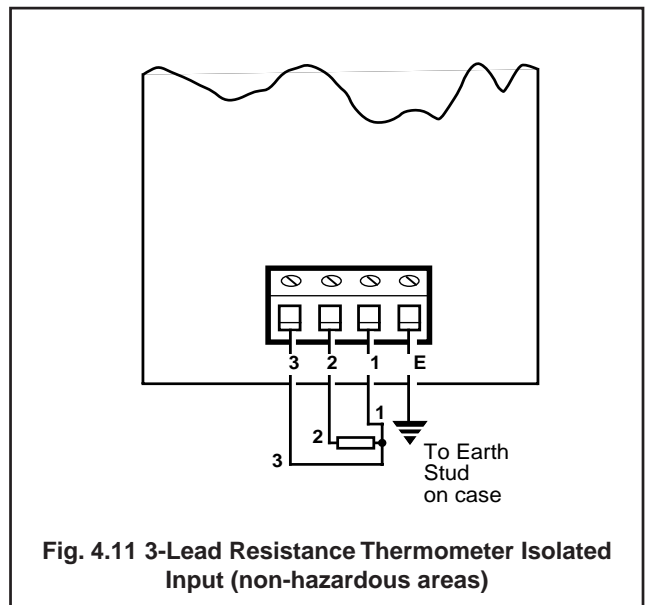
Make connections as shown in Figs. 4.11.

4.4.5 2-Lead Resistance Thermometer (RTD) Inputs – Fig.4.12

Note.

- a) If long leads are necessary it is preferable to use a 3-lead RTD, see previous section.
- b) If the lead resistance differs from that specified at the time of ordering, the recorder must be re-calibrated before use, see Section 10.

Make connections as shown on Fig. 4.12.

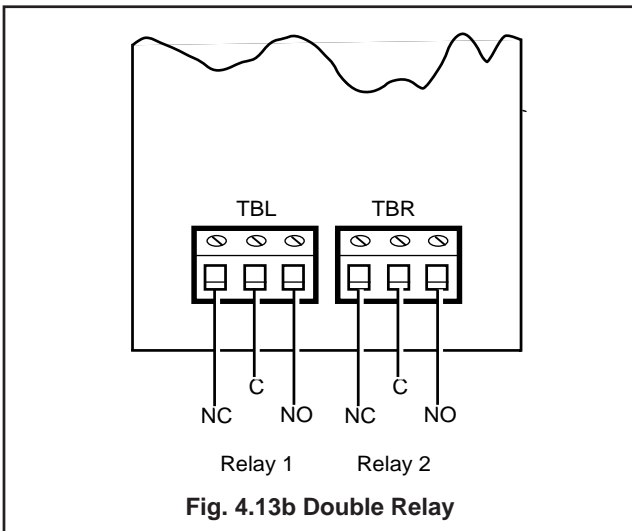
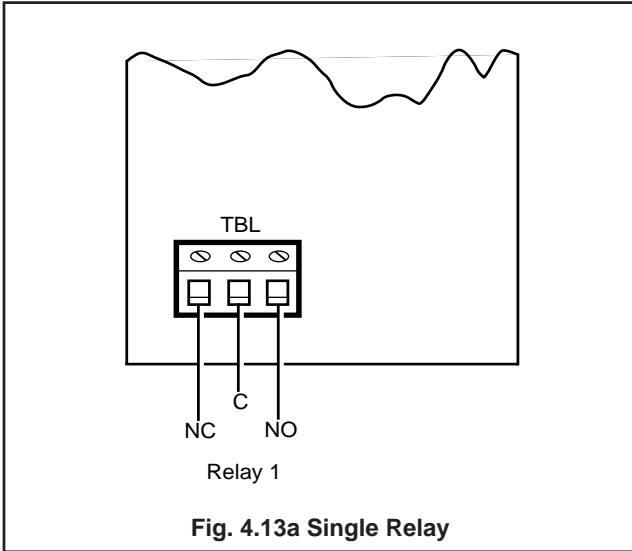


4.5 Output Connections

4.5.1 Relay Connections – Figs. 4.13a and 4.13b

All relay connections are voltage free; see Section 11 for relay contact ratings. Alarm circuits should be connected to an independent power supply to safeguard alarm operation in the event of power failure. Make connections as shown in Fig. 4.13a or Fig. 4.13b –

NO = contact normally open
 NC = contact normally closed
 C = common

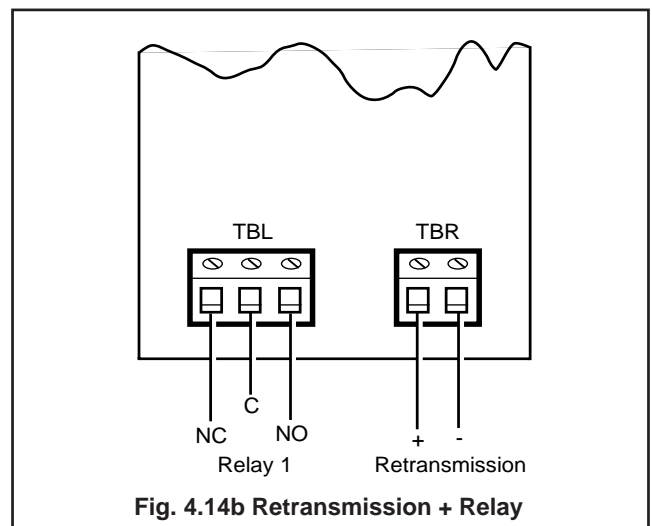
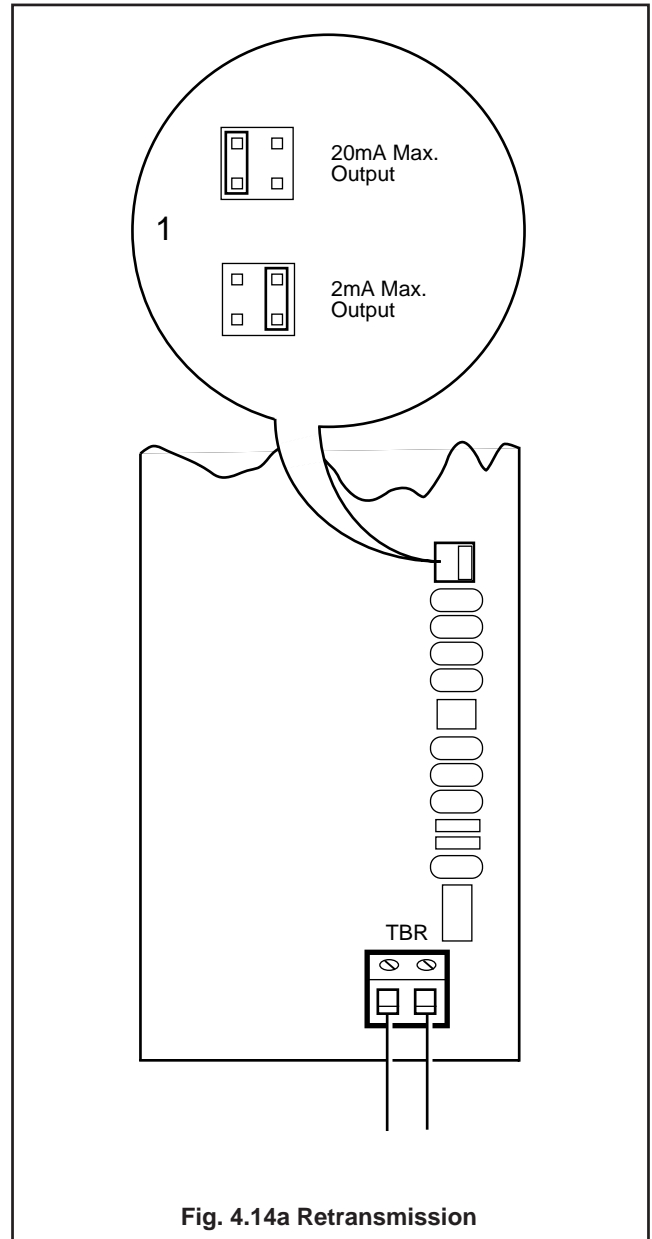


4.5.2 Retransmission Connections – Figs. 4.14a and 4.14b

Make connections as shown in Fig. 4.14a or Fig. 4.14b. The maximum output current (2mA or 20mA) is determined by the position of a plug-in link (PL1) – see Fig. 4.14a.

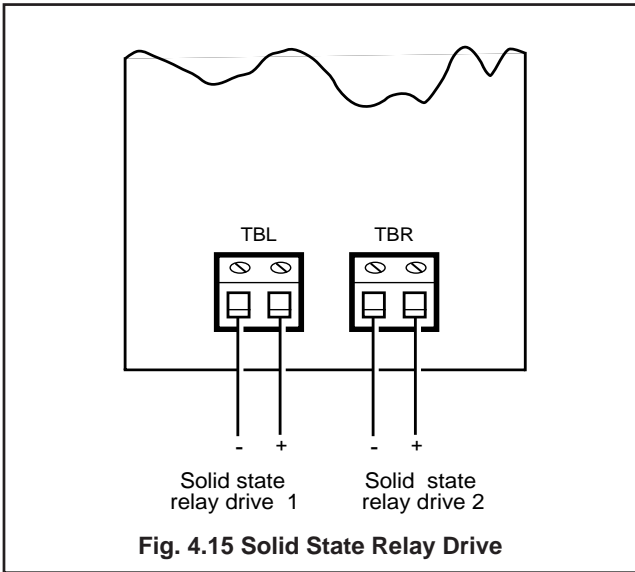
With reference to Fig. 4.14a:

- ① Position the link for the maximum output current required.



4.5.3 Solid State Relay Drive – Fig. 4.15

Where a solid state relay is used, make the relay drive connections as shown in Fig. 4.15. The drive has a rating of 24V @ 30mA.



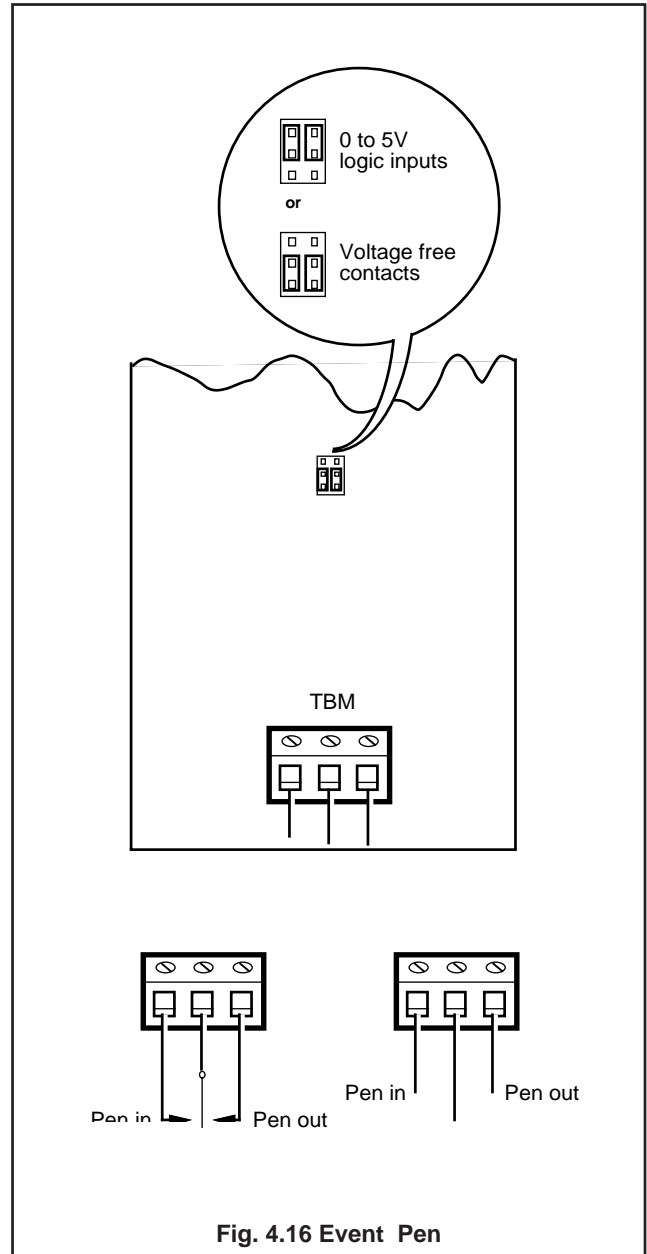
4.5.4 Event Pen – Fig.4.16 (PX105/14 or /15 only)

Make connections to the terminal block on the event pen p.c.b. as shown in Fig.4.16. Check that the plug-link configuration is correct for the input type.

Notes.

1. The event pen operates over the outer 5% of the chart width, moving both outwards and inwards from the neutral position (Pen out or Pen in Fig.4.16)
2. For **voltage-free contacts**, the pen takes up the neutral position when both contacts are open-circuited.

For **0 to 5V logic inputs**, the pen takes up the neutral position if both inputs are zero or if both are 5V.



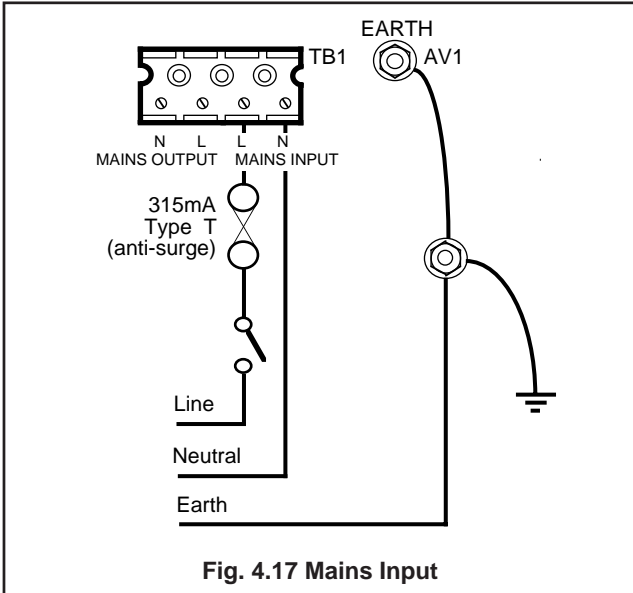
4.6 Power Supply

4.6.1 Mains Input Voltage Connections – Fig. 4.17

Unscrew the captive knurled fixing screw and remove the protective cover to the extent of the attached earthing cable (see Fig. 4.1).

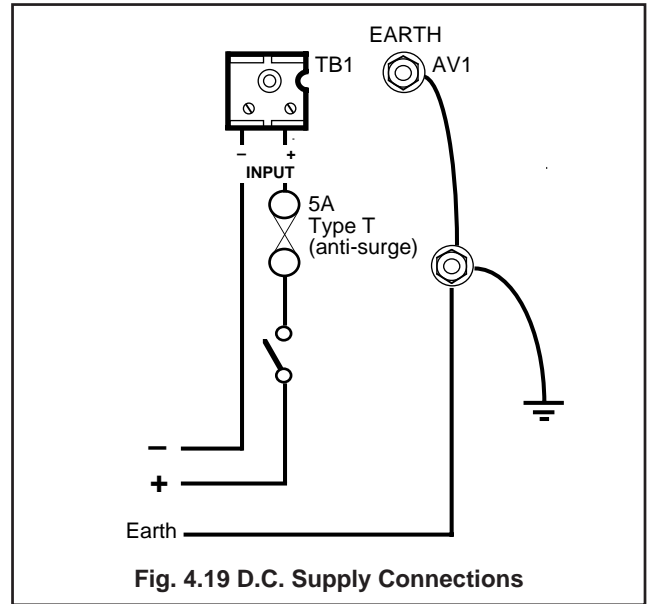
Connect the mains power cables as shown in Fig. 4.17. Securely connect the power earth cable to the earth terminal stud fitted to the recorder case. To select the mains input voltage refer to Section 4.6.2, following.

Refit the protective cover, ensuring that the earthing cable is securely attached and is within the cover after securing.



4.6.3 D.C. Supply – Fig.4.19

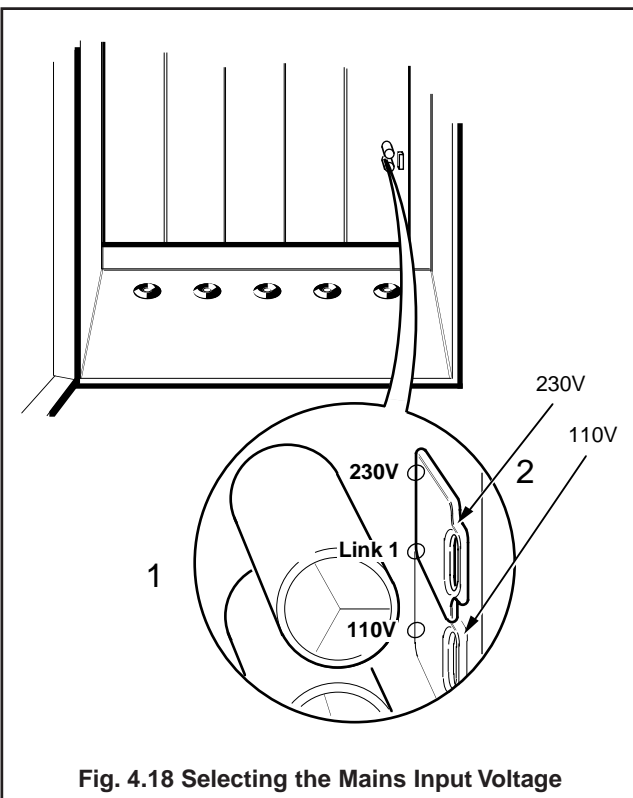
D.C. powered instruments accept a 10 to 30V d.c. supply. Make connections as shown in Fig.4.19.



4.6.2 Selecting the Mains Input Voltage – Fig. 4.18

The mains input voltage (110V or 230V) is selected by repositioning a plug-in 'handbag' link on the power supply p.c.b.

- ① Identify the link.
- ② Position the link for the mains supply voltage used.



5 FAMILIARISATION WITH CONTROLS, DISPLAY AND L.E.D. INDICATION

The tactile membrane switches, display and alarm l.e.d.s are located above the chart. Open the door for access to these controls.

5.1 Controls – Fig. 5.1

The controls comprise tactile membrane switches requiring only moderate finger pressure for operation.



'Pen Lift' switch – Used to raise and lower the pens on alternate operations. All the pens move to an automatic referencing position just outside full scale on the chart when raised using the 'Pen Lift' switch.

Note. If the 'Pen Lift' switch is not pressed to lower the pens, the pens automatically return to their operating positions after a five minute delay.



'Channel' switch – used to select the channel, or common settings, to be programmed (see Fig. 8.2 on page 23).



'Page Advance' switch – used to advance to the next program page (see Fig. 8.2 on page 23).



'Parameter Advance' switch – used for advancing to the next parameter within a program page or, if in **Operating Page 1** (Section 7), for stopping automatic parameter advancement, i.e. for viewing individual measured values.



'Raise' switch – used for increasing a parameter value or stepping-up through a selection of parameters (see **Note 1**).



'Lower' switch – used for decreasing a parameter value or stepping-down through a selection of parameters (see **Note 1**).



'Decimal point' switch – used to adjust the decimal point position during programming of certain parameters.



'Enter' switch – used for storing the programmed function parameters and values into the instrument's non-volatile memory (see **Note 2**).

Notes.

- Continued pressure on the 'Raise' and 'Lower' switches causes the rate of change of the displayed value to increase. To make small adjustments press the switches momentarily. Operation of the 'Raise' and 'Lower' switches during programming causes the value or parameter being changed to flash until the 'Enter' switch is pressed. If left flashing for approximately five minutes the display reverts to its original value.
- The 'Enter' switch must be operated each time a parameter or value is changed otherwise, on advancing to the next parameter, the value reverts to that originally displayed.

5.2 Display – Fig.5.1

A 20-character 5 x 7 dot-matrix, blue-filtered, vacuum fluorescent display is used for display of all operating and programming parameters.

5.2.1 Broken Sensor

The position of broken sensor symbols on the display identifies the channel affected – see Fig. 5.1.

5.3 Alarm L.E.D. Indication – Fig. 5.1

Alarm states are indicated by a vertical pair of red/green l.e.d.s for each pen.

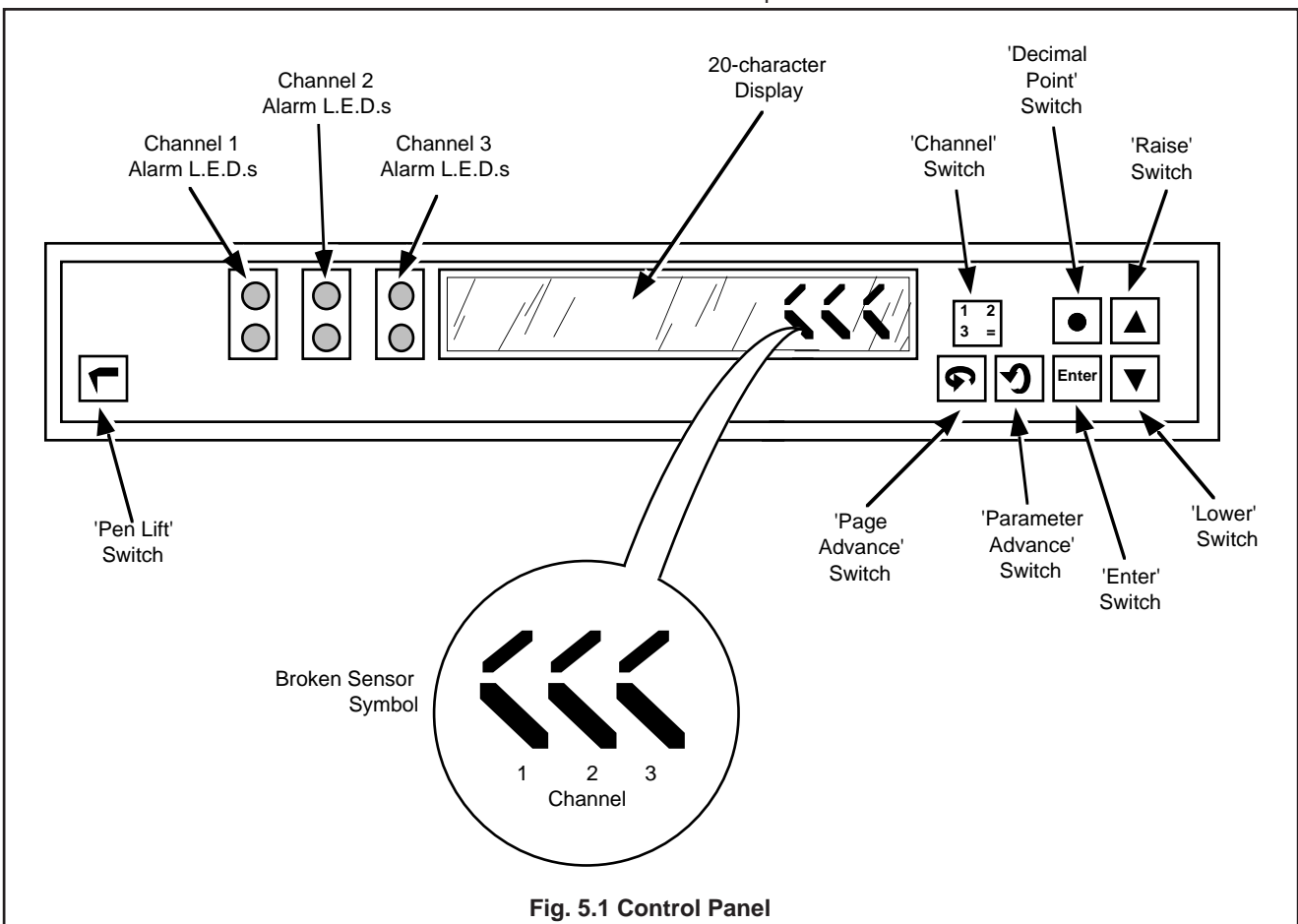


Fig. 5.1 Control Panel

6 SETTING UP

6.1 Recorder Start-up

CAUTION. Ensure that all connections, especially to the earth stud, are made correctly.

Check that:

- a) The input sensors are correctly installed.
- b) The red pen tip coincides with the correct time line on the chart – see step ⑤ below. (To avoid collision the green pen writes approximately 4mm ahead of the red pen and the blue pen writes approximately 4mm behind the red pen, with respect to time.)

Note. Only the red pen can follow precisely the time line on the chart, since the other pen traces are at different radii from the common pivot. On instruments fitted with an event pen the event marker draws on the same time line as the red pen.

Switch on the supply to the instrument, any power-operated control circuits and the input signals and wait for the pens to settle. (Pen lifting, referencing and lowering occur automatically when the power is first switched on.) 'TEST IN PROGRESS' is displayed for approximately five seconds to allow for internal referencing. The recorder then reverts to a display of the measured value(s) – see Section 7.1.

6.2 Fitting the Chart – Fig. 6.1

Ensure the power supply is on.

- ① Press the 'Pen Lift' switch.
- ② Lift the chart clamp and remove the old chart, if the recorder is already in use.
- ③ Fit the new chart on to the spindle, ensuring that it is beneath all the pen lifter arms.
- ④ Locate the lower edges of the chart in the retaining slots and the upper edge under the control panel.
- ⑤ Rotate the chart on the spindle until it is positioned for correct time recording by the red pen. Use the marker on the chassis as a guide only.
- ⑥ Lower the chart clamp and press on it firmly to ensure that the two locating pins pierce the paper.

If the instrument is already in use press the pen 'Raise/Lower' switch, otherwise proceed to Section 7.

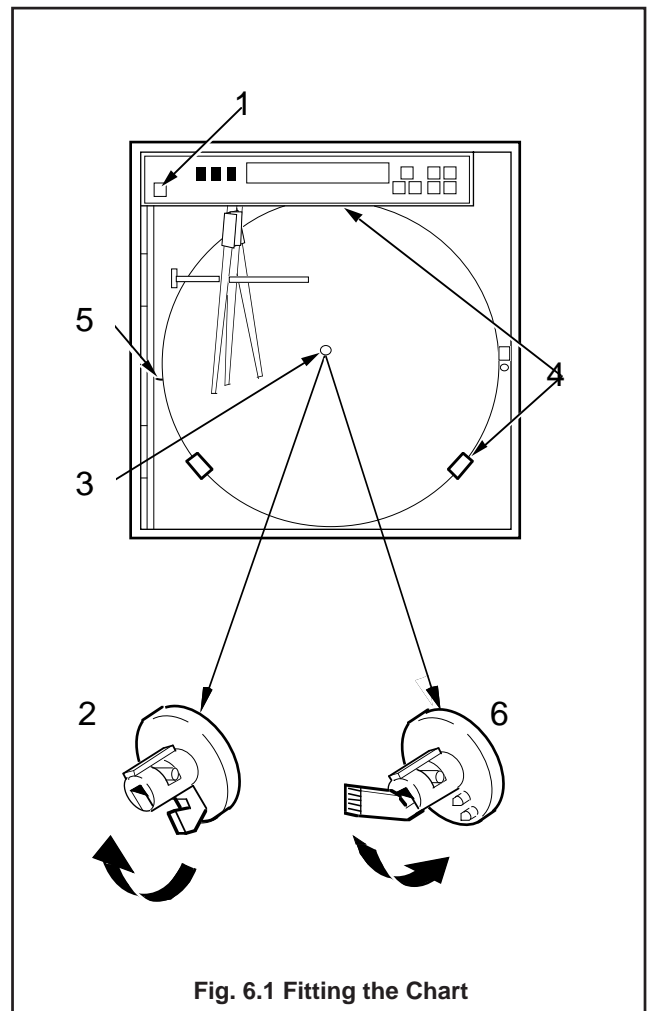


Fig. 6.1 Fitting the Chart

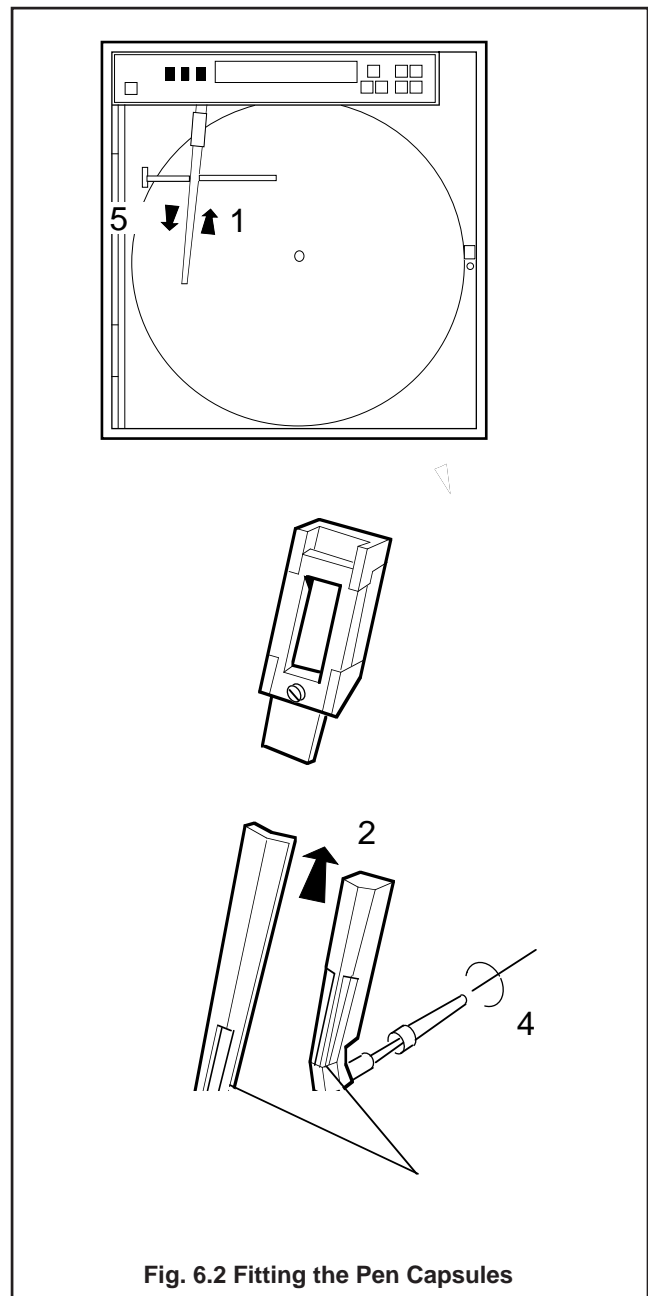
6.3 Fitting the Pen Capsule(s) – Fig. 6.2

With the power supply to the instrument turned on operate the 'Pen Lift' switch – see Fig. 5.1.

With reference to Fig. 6.2:

- ① Gently pull each individual pen arm down off the bracket, taking care not to bend the arms.
- ② Remove the spent capsule by sliding it up the pen arm.
- ③ Fit a new capsule to the arm by sliding the 'dove-tail' on the capsule into the slot in the pen arm. Pen arms are identified by the coloured mouldings at the top of each arm; red (No. 1 pen), green (No. 2 pen), and blue (No. 3 pen). The appropriate coloured ink capsule must be used.
- ④ Hold the new pen capsule and gently twist and pull the cap from the pen fibre tip.
- ⑤ Slide the pen arm and capsule assembly on to the appropriate pen arm bracket until it clips into place, ensuring that each arm is positioned just above its own pen lifter bar. The green pen arm fits the pen arm bracket adjacent to the chart, the red pen arm fits the central bracket and the blue pen arm fits the upper bracket.

Press the 'Pen Lift' switch to lower the pens, and ensure that the pens make contact with the chart and, on multi-pen instruments, that they do not collide when the pen lifter is operated and the pens traverse the chart. If collision occurs the pen arms have been bent, or fitted incorrectly, and this damage must be carefully rectified.



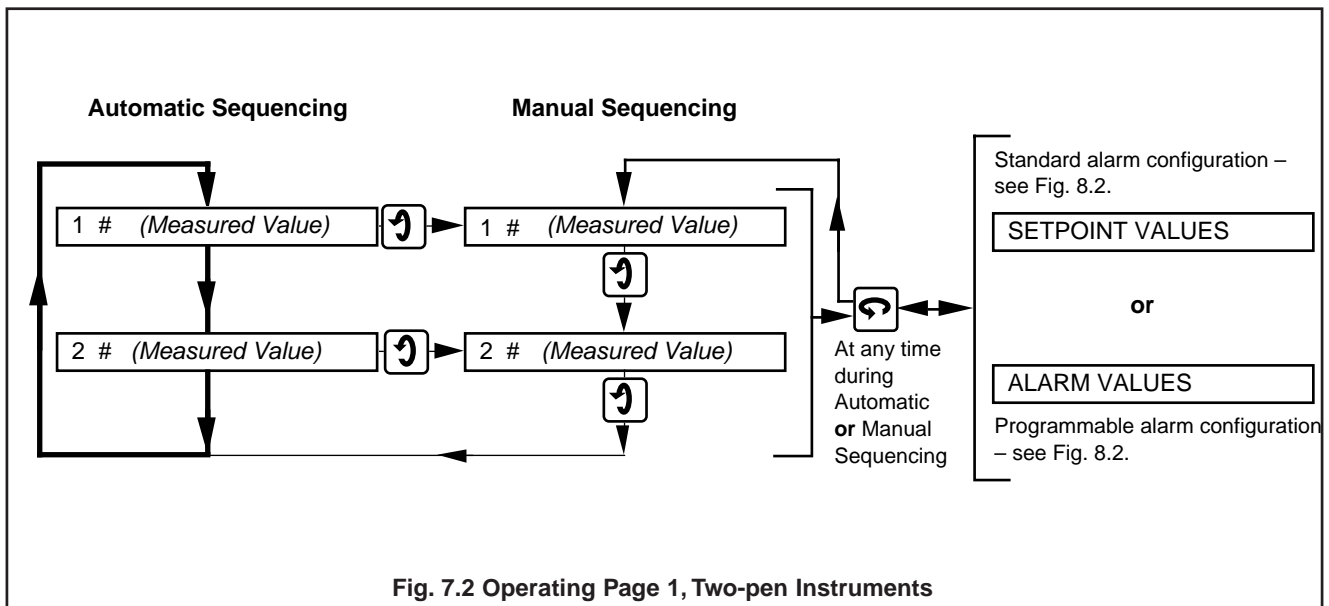
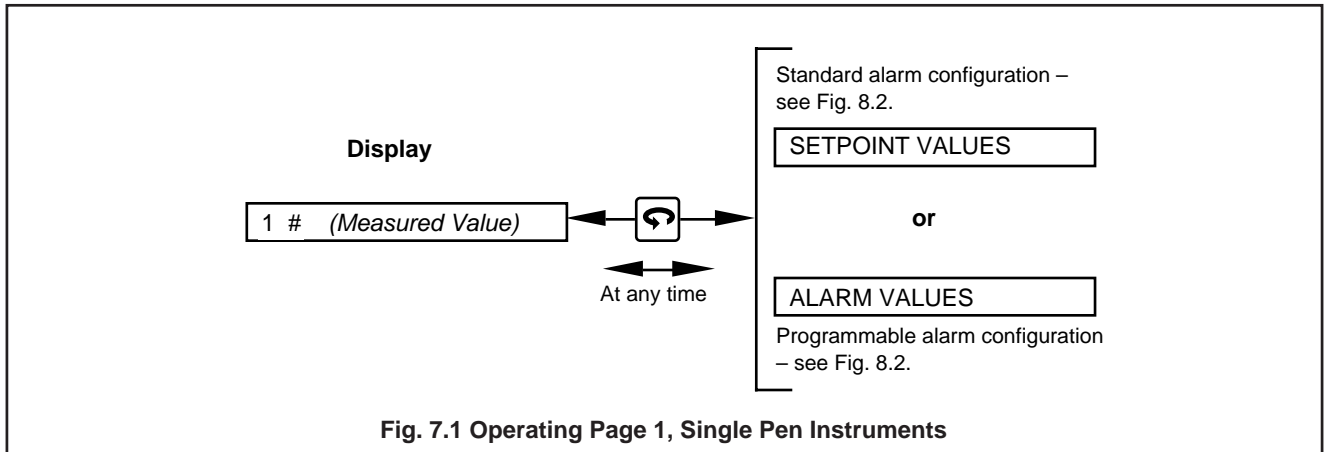
7 OPERATION

In normal operation the measured values for all channels are displayed in an 'auto-advancing' sequence (**Operating Page 1**). Each parameter can be held for viewing by operating the 'Parameter Advance' switch – see Fig. 5.1.

Operating the 'Page Advance' switch selects a second Operating Page (**Operating Page 2**) for viewing or changing the alarm set points. Required changes to the set point values are made using the 'Raise' and 'Lower' switches see Fig. 5.1.

A further series of pages can be selected using the 'Channel' and 'Page Advance' switches if the Security Link is enabled – see Figs. 5.1, 8.1 and 8.2 on pages 16, 22 and 23.

7.1 Operating Page 1



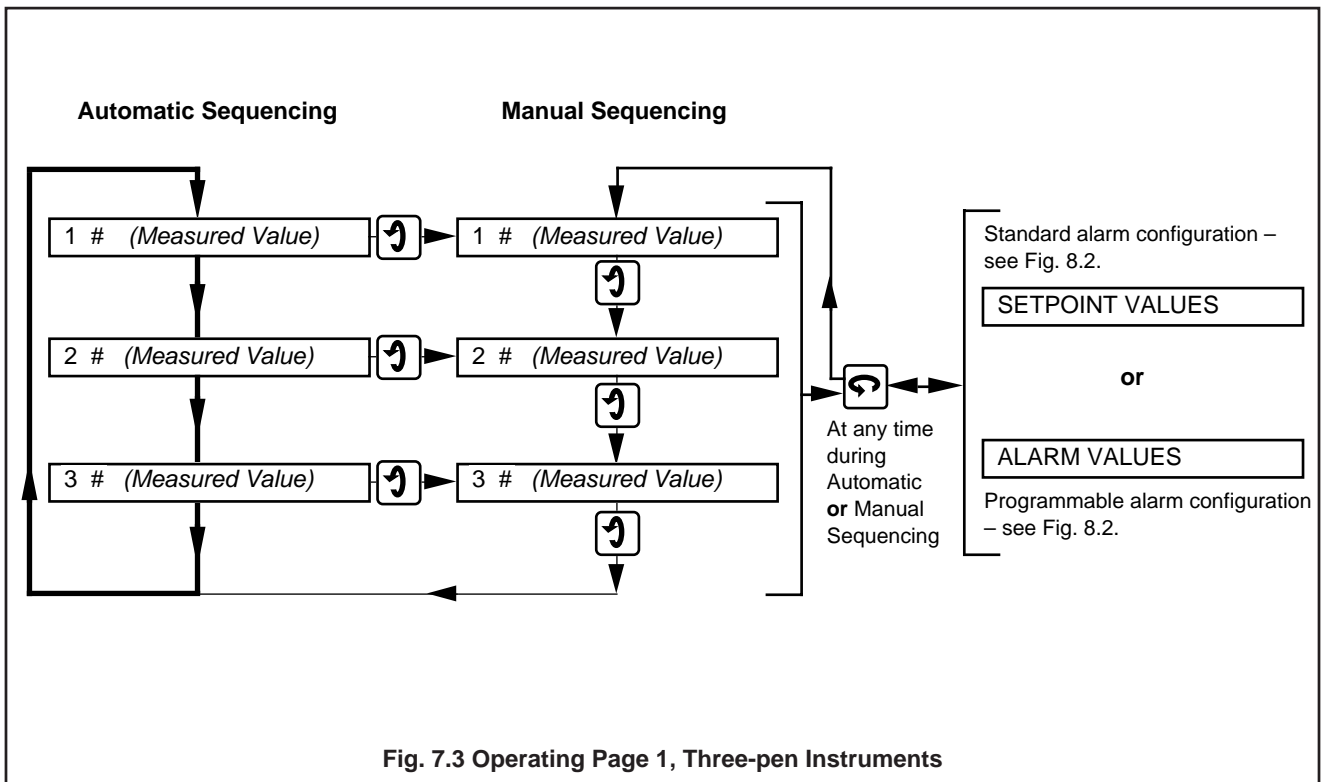
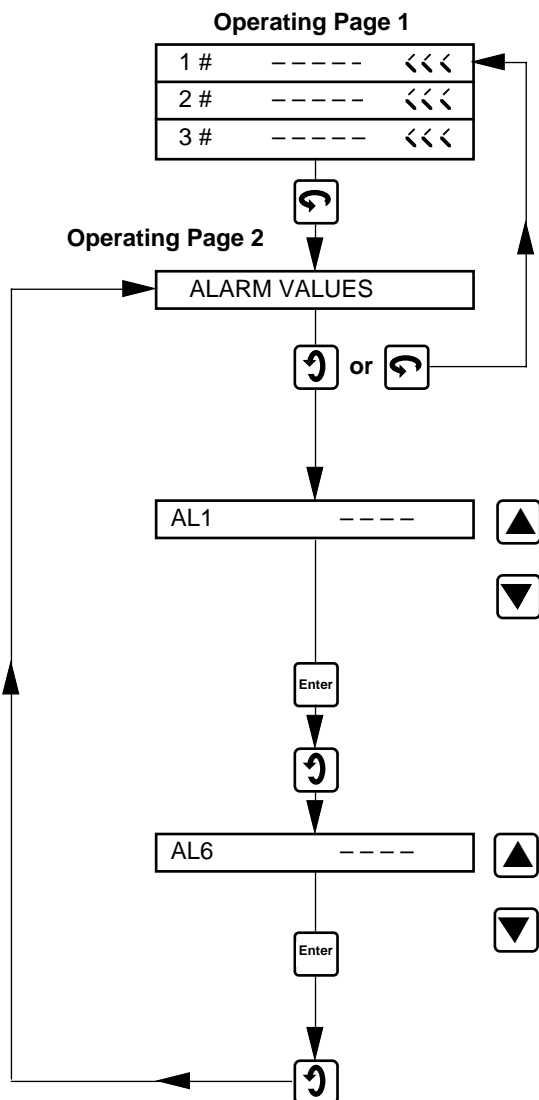


Fig. 7.3 Operating Page 1, Three-pen Instruments

7.2 Operating Page 2

7.2.1 Programmable Options



Where ALARM CONFIG PROG has been selected in the PROG COMMON SETTINGS page (Fig. 8.2) then AL1 to AL6 is displayed.

Advance to Operating Page 2.

Advance to next parameter or return to top of Operating Page 1.

N.B. To return to the top of Operating Page 1 at any time, operate the 'Page Advance' switch

Alarm 1

Set the value at which the alarm is to operate. Units displayed will be those related to the channel to which the respective alarm has been allocated in the ALARM SET UP page – see Fig. 8.2.

Store.

Advance to next parameter.

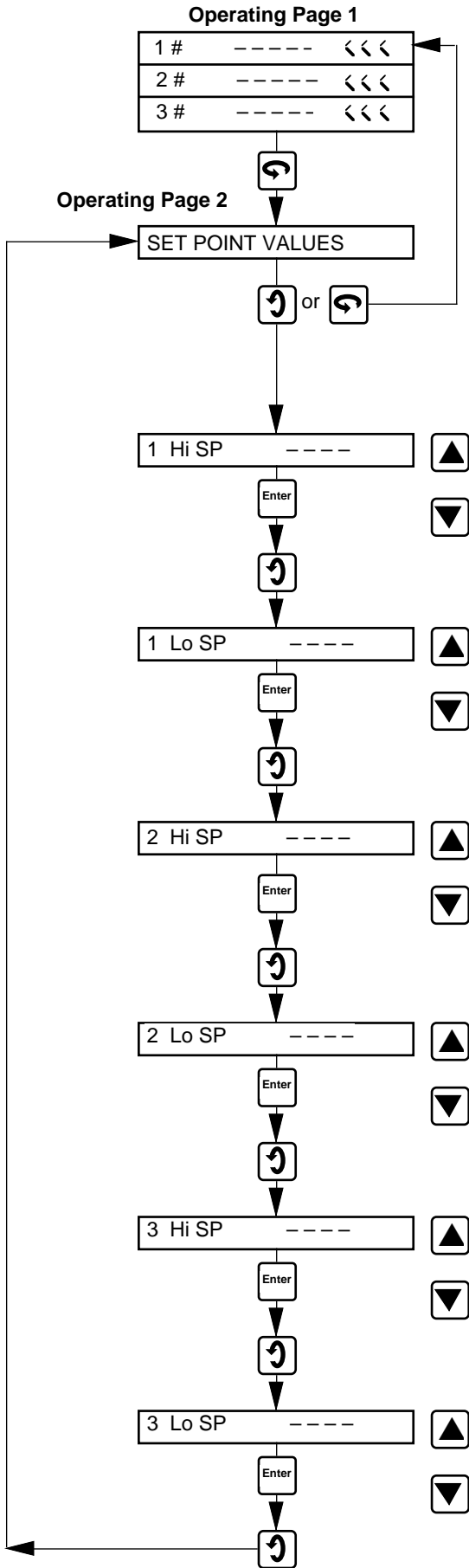
Alarm 6

Repeat as above for AL2 to AL6 as required.

Store.

Return to top of **Operating Page 2**

7.2.2 Standard Options



Where ALARM CONFIG STD has been selected in the PROG COMMON SETTINGS page then Hi / Lo SP for each channel is displayed.

Advance to Operating Page 2.

Advance to next parameter or return to top of Operating Page 1.

N.B. To return to the top of Operating Page 1 at any time, operate the 'Page Advance' switch

1 High Alarm Set Point

Set the high level alarm value for channel 1.

Store.

Advance to next parameter.

1 Low Alarm Set Point

Set the low level alarm value for channel 1.

Store.

Advance to next parameter.

2 High Alarm Set Point

Set the high level alarm value for channel 2.

Store.

Advance to next parameter.

2 Low Alarm Set Point

Set the low level alarm value for channel 2.

Store.

Advance to next parameter.

3 High Alarm Set Point

Set the high level alarm value for channel 3.

Store.

Advance to next parameter.

3 Low Alarm Set Point

Set the low level alarm value for channel 3.

Store.

Return to top of **Operating Page 2**.

8 PROGRAMMING

8.1 Programming, General

- a) When changing the input type it may be necessary to reposition the input type selection links accordingly – see Section 4.3.1.
- b) Ensure that programming is enabled – see Section 8.2.

8.2 Program Security Link – Fig. 8.1

A plug-in link is used to prevent unauthorised programming of the instrument, by preventing access to the Programming Pages – see Fig. 8.2.

With reference to Fig. 8.1:

- ① Identify the link.
- ② Enable or disable the **Program Pages**, as required.

With programming disabled any operation of the 'Channel' switch initiates 'PROGRAM DISABLED' to be displayed for a few seconds.

8.3 To Change the Program, Preparation

Open the door, release the chassis and swing it forward – see Fig. 2.1.

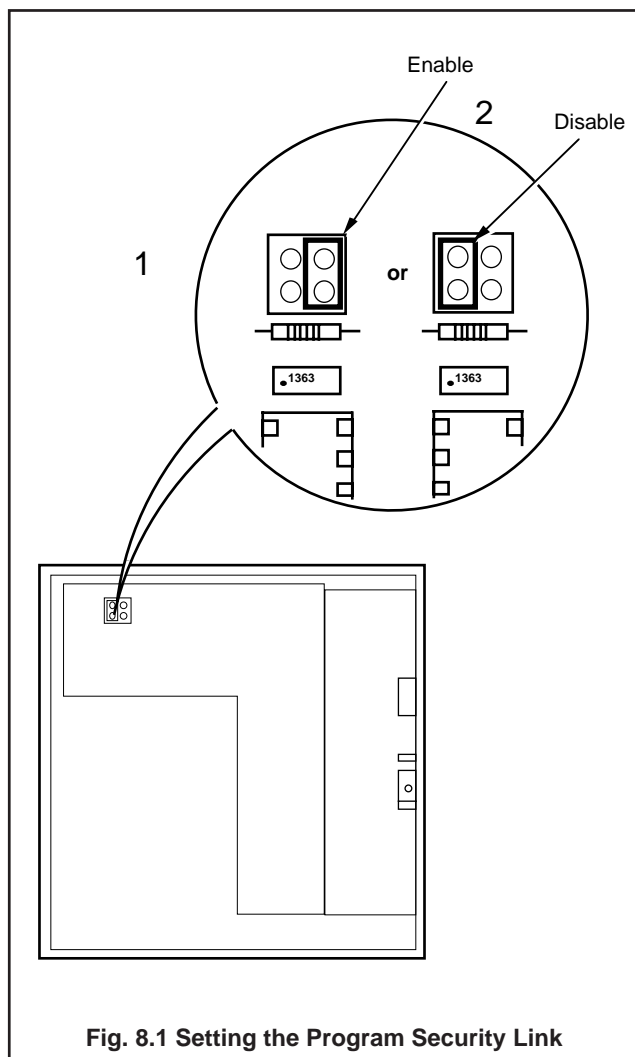
Ensure that:

- a) Input links are correctly positioned – see Fig. 4.2 (or Fig. 4.9 for isolated inputs).
- b) External alarm/control circuits are isolated if inadvertent operation during programming is undesirable.

Any changes to the operating parameters are made using the 'Raise', 'Lower', 'Decimal Point' and 'Enter', switches see Fig. 5.1.

Carry out all programming, other than calibration (see Section 10) with the pens lifted. If the pens drop during programming, operate the 'Pen Lift' switch – see Fig. 5.1.

When programming is complete disable the Programming Pages (Section 8.2) and recalibrate the instrument, see Section 10.



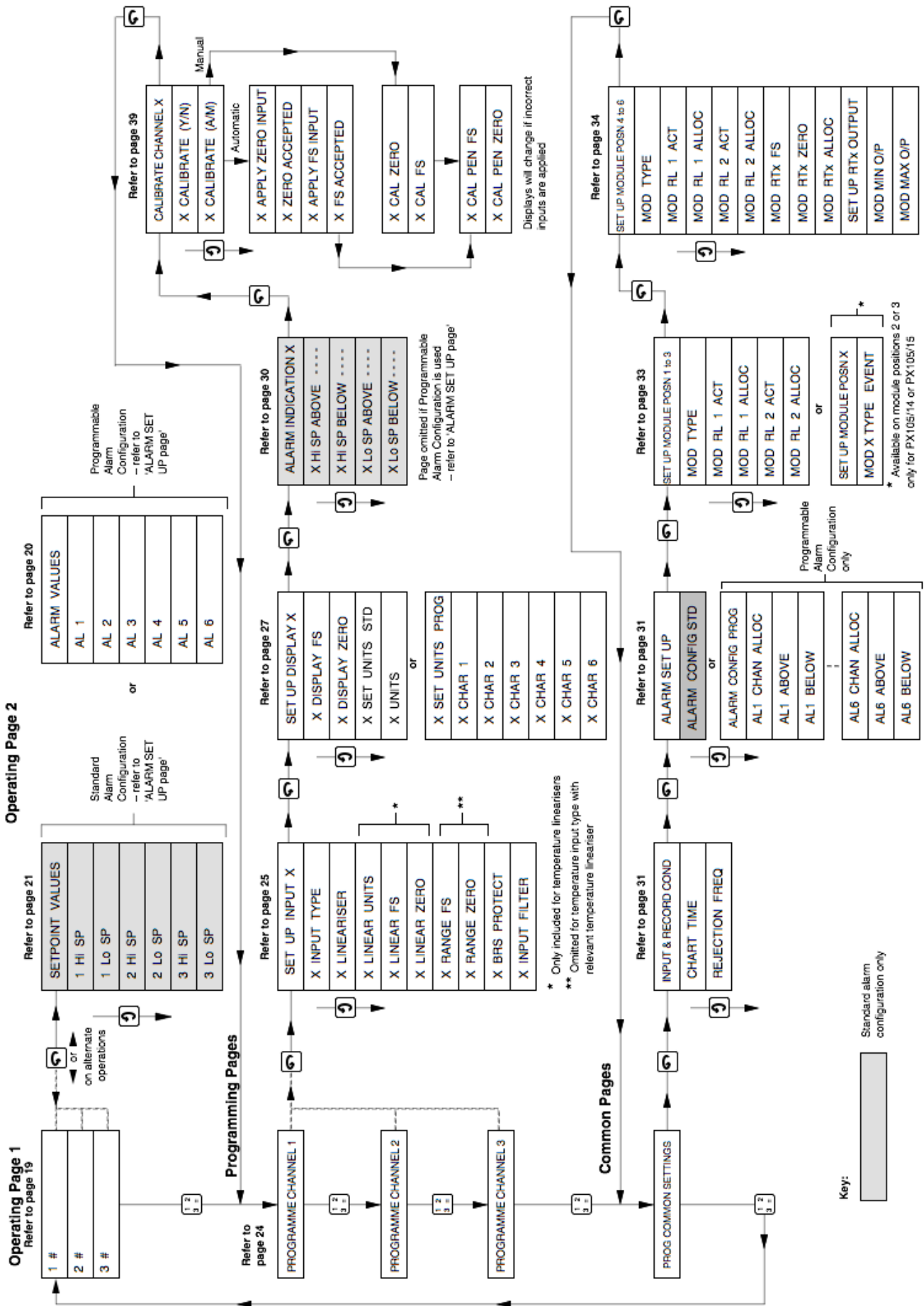
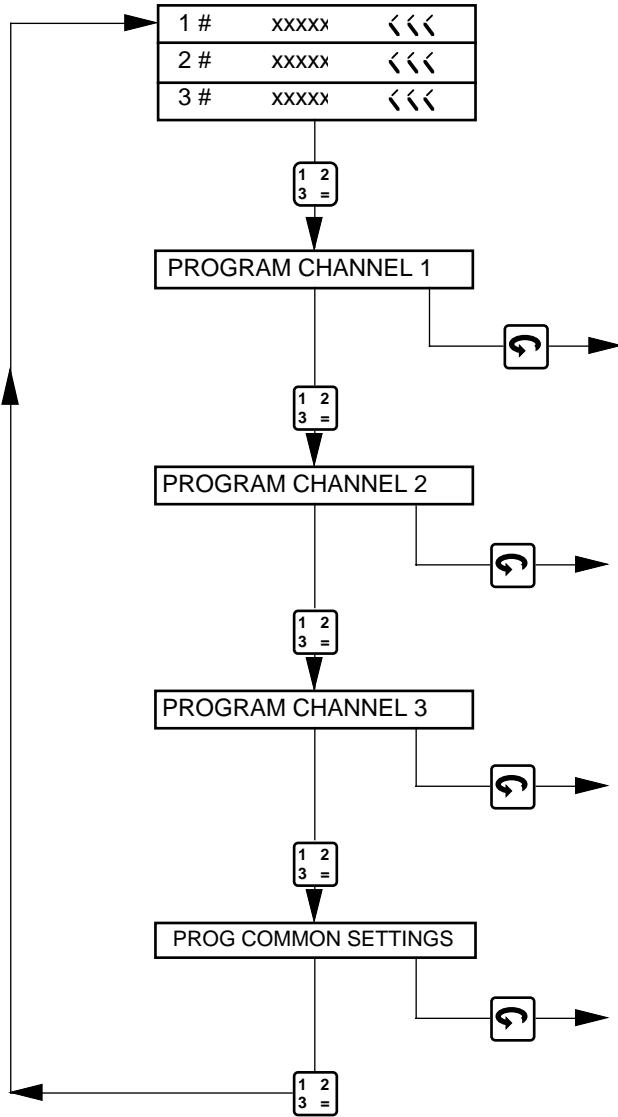


Fig. 8.2 Overall Programme Chart

8.4 Access to Programming Pages



Operating Page 1

Automatic sequencing display of measured values for all channels - see Section 7.1.

Advance to next parameter.

Program Channel 1

Advance to next parameter to program channel 1.
or
Advance to program channel 2 .

Program Channel 2

Advance to next parameter to program channel 2.
or
Advance to program channel 3.

Program Channel 3

Advance to next parameter to program channel 3.
or
Advance to program common settings.

Program Common Settings

Advance to next parameter to program common settings.
or

Return to top of Operating Page 1.

8.5 Set Up Input Page

The intrinsic error for zero based ranges is $\leq 0.25\%$ if the limits detailed in Tables 3 and 4 are observed. If a suppressed zero range is used the error could exceed this figure.

Input Type (Electrical)	Min. Start	Min. Span	Max. Span and Range Value
Millivolts	-999	5.00	1000
Volts	-20.0	0.50	20.0
Milliamps	-99.9	0.50	100.0
Resistance	20.0	20.0	2000

Table 3 Electrical Limits

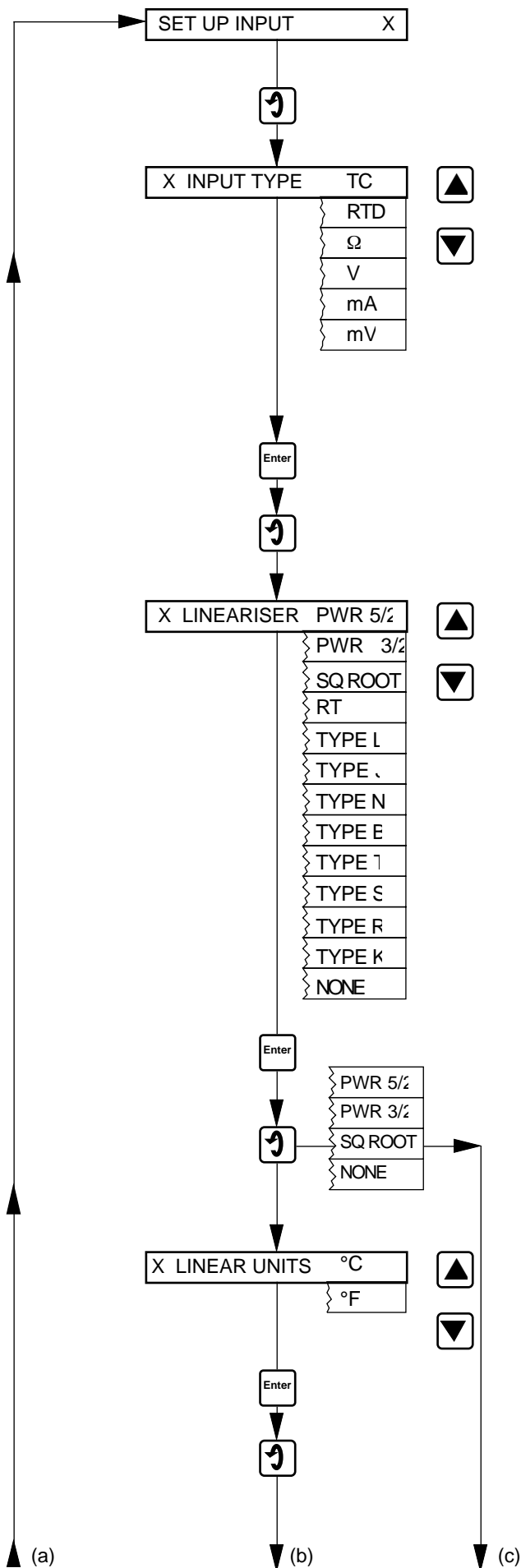
Input Type (Temperature Inputs)	°Centigrade			°Fahrenheit		
	Minimum Start Temp.	Min. Span	Max. Temp.	Minimum Start Temp.	Min. Span	Max. Temp.
Thermocouples:						
Fe/Con, BS type J and IEC584	-100	100	900	-148	180	1652
Fe/Con, DIN 43710 type L	-100	100	900	-148	180	1652
NiCr/NiAl, BS type K and IEC584	-100	150	1300	-148	270	2372
Pt/PtRh, BS types R & S and IEC584	-18	600	1700	0	1080	3092
Cu/CuNi, BS type T and IEC584	-250	120(+ve)* 170(-ve)**	300	-418	216(+ve)* 306(-ve)**	572
NiCr/CuNi, BS type E and IEC584	-100	100	900	-148	180	1652
Pt30%Rh/Pt6%Rh, BS type B and IEC584	-18	1100	1800	0	1980	3272
NiCrSi/NiSi, BS type N	-200	180(+ve)	1300	-328	324(+ve)	2372
Resistance Thermometer, Pt100 (BS 1904)	-200	50	600	-328	90	1112

*Minimum span for ranges above zero

**Minimum span for ranges below zero

Table 4 Temperature Limits

8.5 Set Up Input Page (continued)



Advance to next parameter.

Input Type

Ensure that the Input links are in the correct positions for the required input type for the channel (see Fig. 4.2 or Fig. 4.9).

Apply an input signal appropriate to (or compatible with) the input type selected and having an approximate mid-scale value of the range to be programmed below.

Select the required input. The display flashes until the 'Enter' switch is pressed to store the selected input into the memory.

Store.

Advance to next parameter.

Lineariser

Select the required lineariser, or NONE, to suit the applied input.

Store.

Advance to next parameter.

Lineariser Units

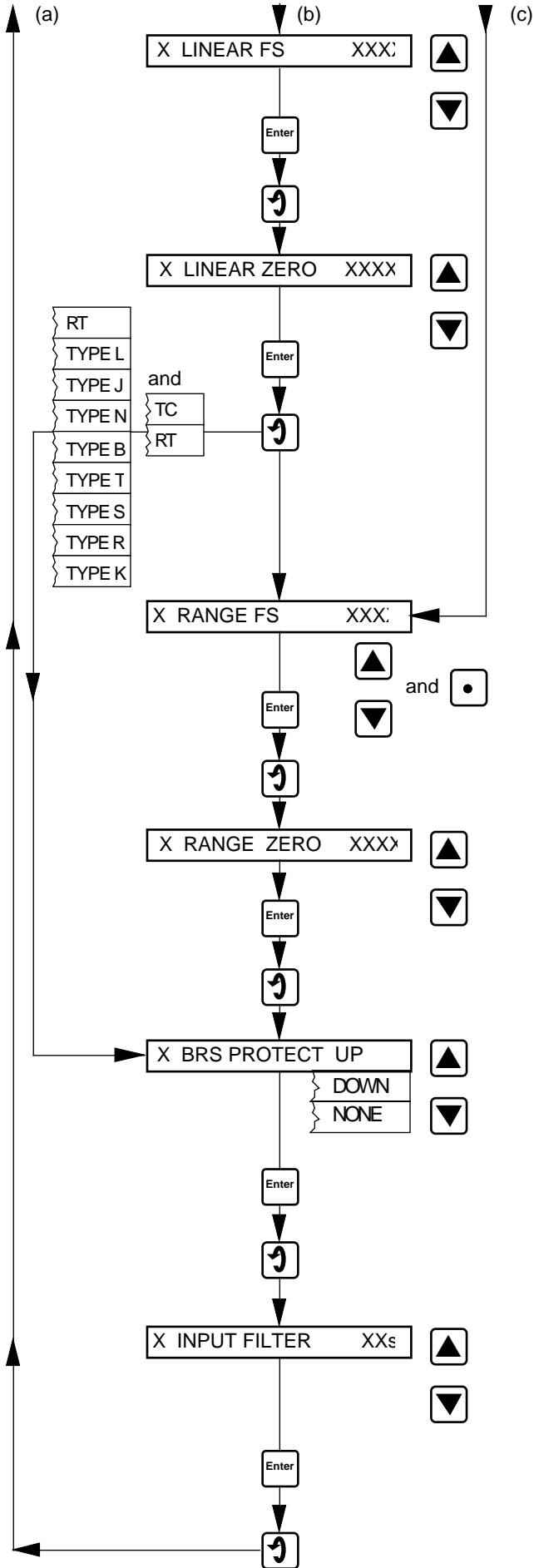
Select either °C or °F as required.

Note: If Lineariser Type L has been selected only °C is displayed.

Store.

Advance to next parameter.

Continued overleaf



Lineariser Full Scale

Set the range maximum temperature in °C or °F as selected at LINEAR UNITS on the previous page **within the limits detailed in Table 4.**
Store.

Advance to next parameter.

Lineariser Zero

Set the range minimum temperature in °C or °F as selected at LINEAR UNITS on the previous page **within the limits detailed in Table 4.**
Store.

Advance to next parameter.

Range Full Scale

Set the highest range value to the maximum number of decimal places possible, e.g. 20.0 instead of 20. For instruments fitted with an event pen see Section 8.11.4.

Store.

Advance to next parameter.

Range Zero

Set the lowest range value – the decimal point is set automatically.

Store.

Advance to next parameter.

Broken Sensor Protection

Select the broken sensor protection indication to 'UP' for upscale, 'DOWN' for downscale or to 'NONE'. In the event of a broken sensor occurring the pen will move as programmed up or down-scale, or not at all.

Store.

Advance to next parameter.

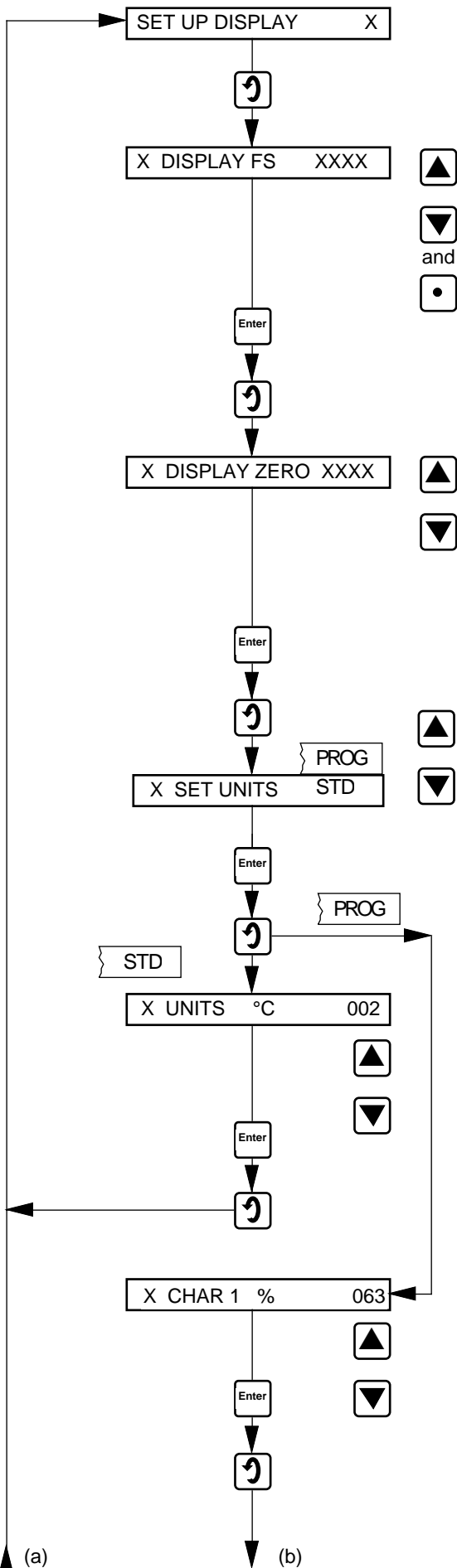
Input Filter

If the input is noisy it may be necessary to modify the instrument response to fast signals. Filter time is programmable from 0 to 60s in 1s steps. The value to be entered must be determined by trial and error. Enter 0 to turn the filter off.

Store.

Return to top of **Set Up Input** page.

8.6 Set Up Display Page



Advance to next parameter.

Display Full Scale

Set the required display value represented by the maximum input signal.

Example. If a 2.02 to 7.34 mV input represents a temperature range of 50 to 180°C set 180.0. Available adjustment range –999 to 3300.

For instruments fitted with an event pen see Section 8.11.4.

Store.

Advance to next parameter.

Display Zero

Set the value for the variable represented by the minimum input signal.

Example. From the above set 50.0. The decimal point is set automatically. Available adjustment range –999 to 3300.

Store.

Advance to next parameter.

Set Units

Select 'PROG' to customise a six-digit unit of measurement, 'STD' for standard units of measurement.

Store.

Advance to next parameter.

Units

Set the code number selected from Table 6, corresponding to the required display units. The actual display units are visually confirmed here.

Store.

Advance to next parameter.

Character 1

Set the code number corresponding to the first character of the customised six-digit unit of measurement selected from the characters listed in Table 5.

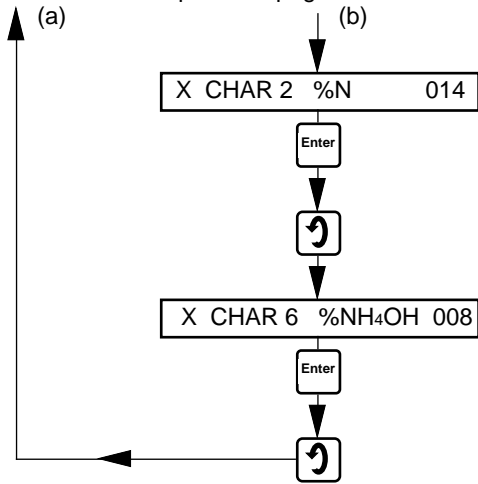
Store.

Advance to next parameter.

(a) Continued overleaf

(b)

Continued from previous page



Character 2

Repeat the previous step for the second character.

Store.

Advance to next parameter.

Character 6

Select characters 3 to 6 by the same method.

Store.

Return to top of **Set Up Display** page.

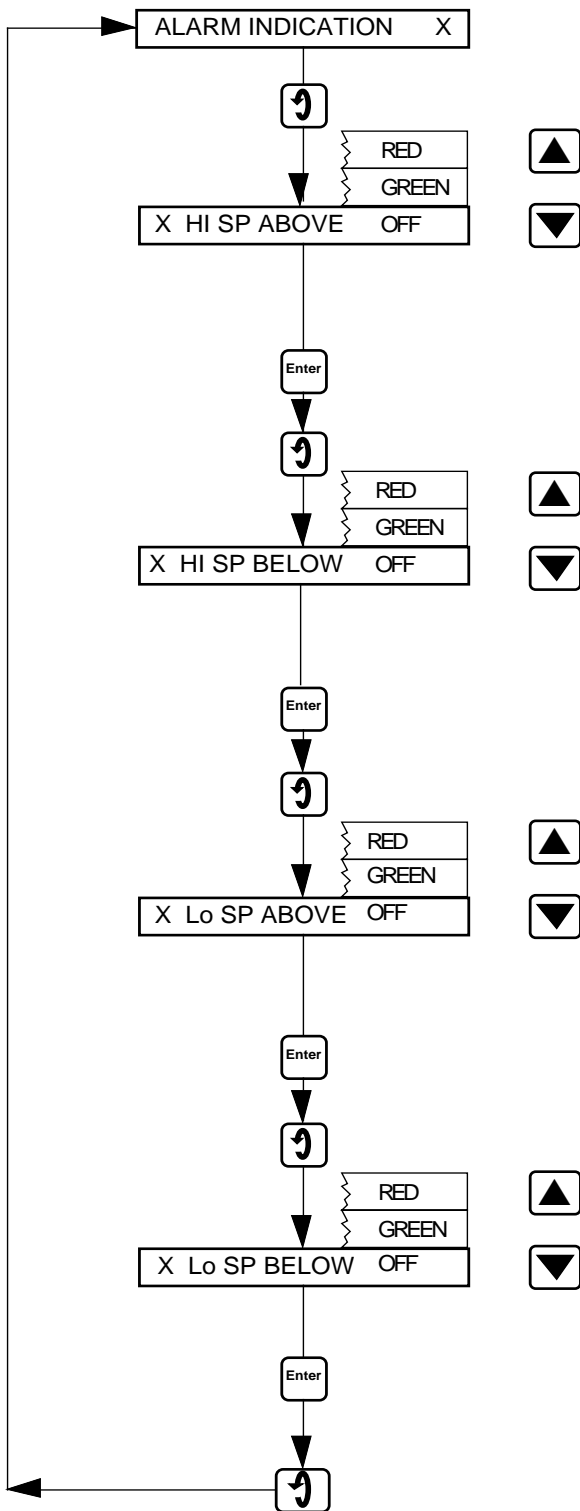
Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol	Code	Symbol
000	..... Space	020	..... T	040	..... n	060	..... 7	080	..... Σ
001	..... A	021	..... U	041	..... o	061	..... 8	081	..... μ
002	..... B	022	..... V	042	..... p	062	..... 9	082	..... ø
003	..... C	023	..... W	043	..... q	063	..... %	083	..... ö
004	..... D	024	..... X	044	..... r	064	..... &	084	..... Å
005	..... E	025	..... Y	045	..... s	065	..... ,	085	..... π
006	..... F	026	..... Z	046	..... t	066	..... -	086	..... θ
007	..... G	027	..... a	047	..... u	067	..... :	087 °
008	..... H	028	..... b	048	..... v	068	..... #	088	..... m ²
009	..... I	029	..... c	049	..... w	069	..... \	089	..... m ³
010	..... J	030	..... d	050	..... x	070	..... /	090	..... S ²
011	..... K	031	..... e	051	..... y	071	..... .	091	..... ²
012	..... L	032	..... f	052	..... z	072	..... ~	092	..... ³
013	..... M	033	..... g	053	..... 0	073	..... =	093	..... ⁴
014	..... N	034	..... h	054	..... 1	074	..... α	094	..... ⁵
015	..... O	035	..... i	055	..... 2	075	..... ß	095	..... ⁶
016	..... P	036	..... j	056	..... 3	076	..... Δ	096	..... ₂
017	..... Q	037	..... k	057	..... 4	077	..... δ	097	..... ₃
018	..... R	038	..... l	058	..... 5	078	..... Ω	098	..... ₄
019	..... S	039	..... m	059	..... 6	079	..... ρ	099	..... in

Table 5 Character Set

Code	Unit	Display	Code	Unit	Display
001	(no unit)		079	inches water gauge	in WG
002	°Celsius	°C	080	feet water gauge	ft WG
003	°Fahrenheit	°F	081	millimetres of mercury	mm Hg
004	Kelvin	K	082	metres of mercury	m Hg
005	differential °C	Δ°C	083	inches of mercury	in Hg
006	differential °F	Δ°F	084	feet of mercury	ft Hg
007	% relative humidity	%RH	085	pounds/sq. in	psi
008	percent	%	086	pounds/sq. in	lb/in ²
009	parts/million	ppm	087	newtons/sq. metre	N/m ²
010	parts/billion	ppb	088	kilonewtons/sq. metre	kN/m ²
011	microvolts	μV	089	pascals	Pa
012	millivolts	mV	090	kilopascals	kPa
013	volts	V	091	megapascals	MPa
014	kilovolts	kV	092	kilograms/sq. cm	kg/cm ²
015	microamps	μA	093	newtons	N
016	milliamps	mA	094	grams	g
017	amperes	A	095	kilogram	kg
018	ohms	Ω	096	ounces	oz
019	kilohms	kΩ	097	pounds	lb
020	megohms	MΩ	098	% saturation	% sat
021	milliwatts	mW	099	millilitres	ml
022	watts	W	100	litres	l
023	kilowatts	kW	101	gallons	gal
024	megawatts	MW	102	millimetres	mm
025	voltamps	VA	103	metres	m
026	kilovoltamps	kVA	104	kilometres	km
027	reciprocal ohms	mho	105	British thermal units/hour	btu/h
028	siemens	S	106	seconds	sec
029	microsiemens/cm	μS/cm	107	minutes	min
030	millisiemens/cm	mS/cm	108	hours	hr
031	microsiemens/metre	μS/m	109	hertz	Hz
032	millisiemens/metre	mS/m	110	kilohertz	kHz
033	potential hydrogen	pH	111	megahertz	MHz
034	micrograms/kilogram	μg/kg	112	% sulphuric acid	% H ₂ SO ₄
035	milligrams/kilogram	mg/kg	113	% sulphur monoxide	% SO
036	micrograms/litre	μg/l	114	% sulphur dioxide	% SO ₂
037	milligrams/litre	mg/l	115	% carbon monoxide	% CO
038	litres/day	l/d	116	% carbon dioxide	% CO ₂
039	litres/hour	l/h	117	% oxygen	% O ₂
040	litres/minute	l/m	118	% nitric oxide	% NO
041	litres/second	l/s	119	% nitrogen peroxide	% NO ₂
042	megalitres/day	MI/d	120	% nitrogen	% N ₂
043	megalitres/hour	MI/h	121	% hydrogen	% H ₂
044	megalitres/minute	MI/m	122	% hydrochloric acid	% HCl
045	megalitres/second	MI/s	123	% fruit acid content	brix
046	gallons/day	gal/d	124	nephelometric turbidity units	NTU
047	gallons/hour	gal/h	125	% obscuration	% OBS
048	gallons/minute	gal/m	126	kilolitres	kl
049	gallons/second	gal/s	127	kilogallons	kgal
050	cubic metres/day	m ³ /d	128	megalitres	MI
051	cubic metres/hour	m ³ /h	129	megagallons	Mgal
052	cubic metres/minute	m ³ /m	130	cubic metres	m ³
053	cubic metres/second	m ³ /s	131	kilo-cubic metres	km ³
054	cubic feet/day	ft ³ /d	132	mega-cubic metres	Mm ³
055	cubic feet/hour	ft ³ /h	133	cubic metres per second	CUMEC
056	cubic feet/minute	ft ³ /m	134	joules	J
057	cubic feet/second	ft ³ /s	135	kilojoules	kJ
058	standard cubic ft/min	SCFM	136	megajoules	MJ
059	kilograms/day	kg/d	137	tonnes	T
060	kilograms/hour	kg/h	138	kilotonnes	KT
061	kilograms/minute	kg/m	139	megatonnes	MT
062	kilograms/second	kg/s	140	British thermal units	btu
063	tonnes/day	T/d	141	cubic feet	ft ³
064	tonnes/hour	T/h	142	kilo-cubic feet	kft ³
065	tonnes/minute	T/m	143	mega-cubic feet	Mft ³
066	tonnes/second	T/s	144	coulombs	C
067	pounds/day	lb/d	145	revolutions per minute	rpm
068	pounds/hour	lb/h	146	grams/litre	g/l
069	pounds/minute	lb/m	147	grams/hour	g/h
070	pounds/second	lb/s	148	grams/day	g/d
071	imp. tons/day	ton/d	149	millilitres/minute	ml/m
072	imp. tons/hour	ton/h	150	millilitres/hour	ml/h
073	imp. tons/minute	ton/m	151	% dissolved oxygen	%dO ₂
074	imp. tons/second	ton/s	152	% dissolved carbon dioxide	dCO ₂
075	millibars	mbar	153	millimolar	mM
076	bars	bar	154	molar	M
077	millimetres water gauge	mm WG	155	parts/million hydrogen sulphide	ppmH ₂ S
078	metres water gauge	m WG	156	% hydrogen sulphide	%H ₂ S

Table 6 Display Units Codes

8.7 Alarm Indication Page



Alarm Indication page is not displayed when 'ALARM CONFIG PROG' in 'ALARM SET UP' page on the 'PROG COMMON SETTING' page is selected.

Advance to next parameter.

High Alarm Set Point Above

Select the colour of l.e.d. to be illuminated above the high set point.

Store.

Advance to next parameter.

High Alarm Set Point Below

Select the colour of l.e.d. to be illuminated below the high set point.

Store.

Advance to next parameter.

Low Alarm Set Point Above

Select the colour of l.e.d. to be illuminated above the low set point.

Store.

Advance to next parameter.

Low Alarm Set Point Below

Select the colour of l.e.d. to be illuminated below the low set point.

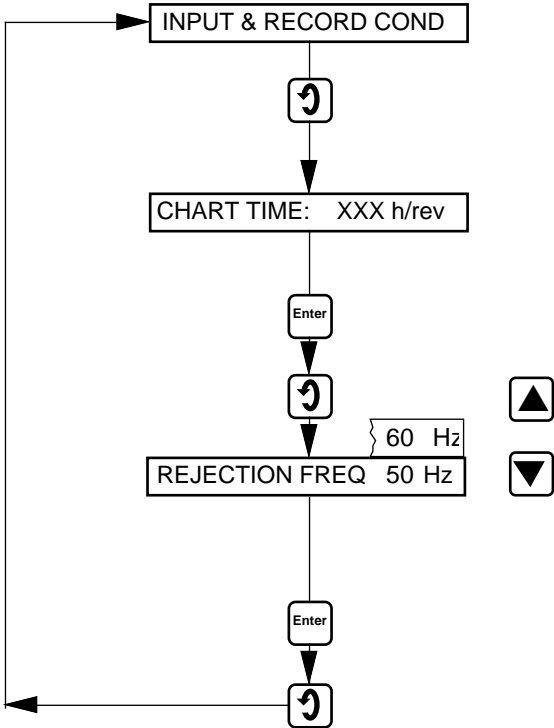
Store.

Return to top of **Alarm Indication** page.

8.8 Calibration Page

For full calibration details refer to Section 10.

8.9 Input and Recording Conditions Page



Advance to next parameter.

Chart Time

Set the chart speed in hours per revolution selected from the range 1 to 168 h/rev.

Store.

Advance to next parameter.

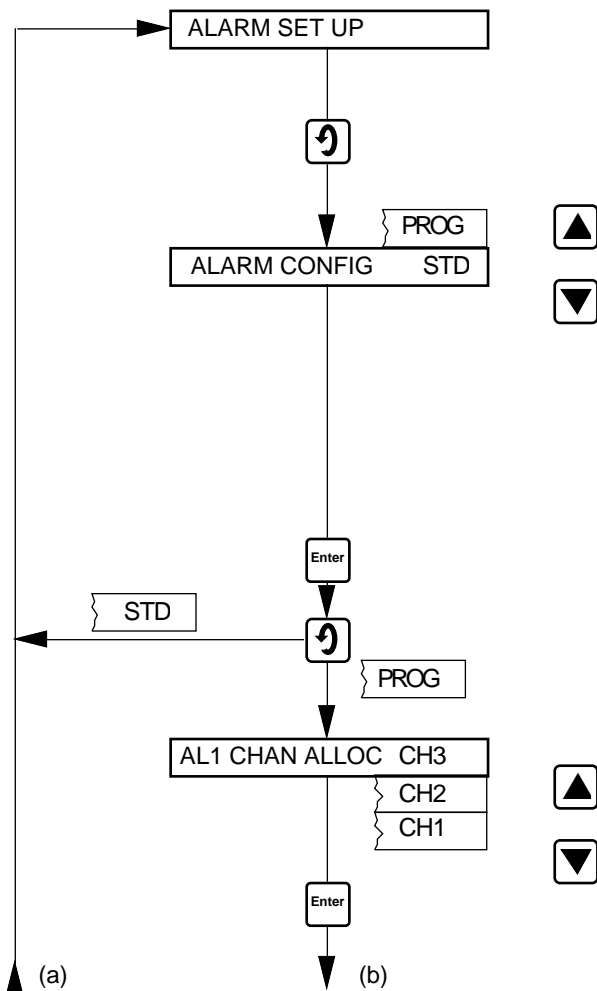
Rejection Frequency

Rejection Frequency eliminates interference at main frequency. Select local mains input frequency.

Store.

Return to top of **Input and Recording Conditions** page.

8.10 Alarm Set Up Page



Advance to next parameter.

Alarm Configuration

If 'ALARM CONFIG STD' on the 'ALARM SET UP' page in the 'PROG COMMON SETTINGS' page is selected then Hi SP / Lo SP for each channel is displayed. If 'ALARM CONFIG PROG' is selected then AL1 to AL6 is displayed.

Select STD if a standard alarm configuration of two alarms per channel is required. Select PROG if more than two alarms per channel from a total maximum of six is required.

Store.

Advance to next parameter.

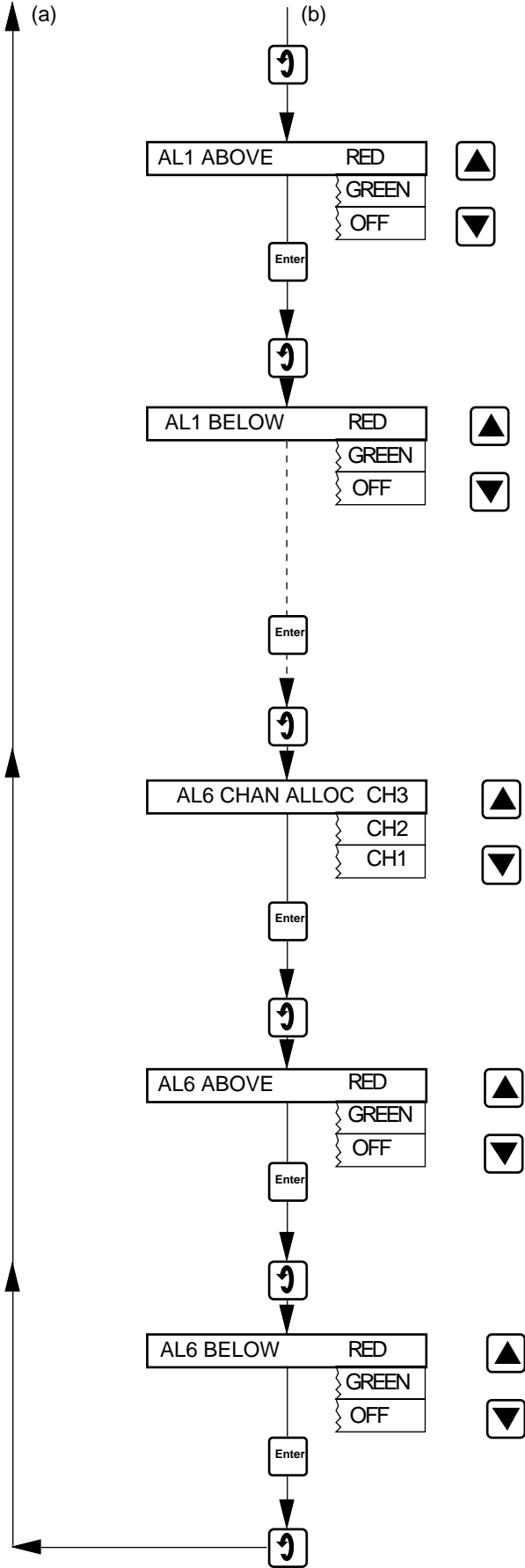
Alarm 1 Channel Allocation

Select the channel number to which the alarm set point is to be allocated.

Store.

(a) Continued overleaf

Continued from previous page



Advance to next parameter.

Alarm 1 Above

Select the colour of l.e.d. to be illuminated above the set point.

Store.

Advance to next parameter.

Alarm 1 Below

Select the colour of l.e.d. to be illuminated below the set point.

Repeat the above steps for the remaining five alarm set points.

Store.

Advance to next parameter.

Store.

Advance to next parameter.

Store.

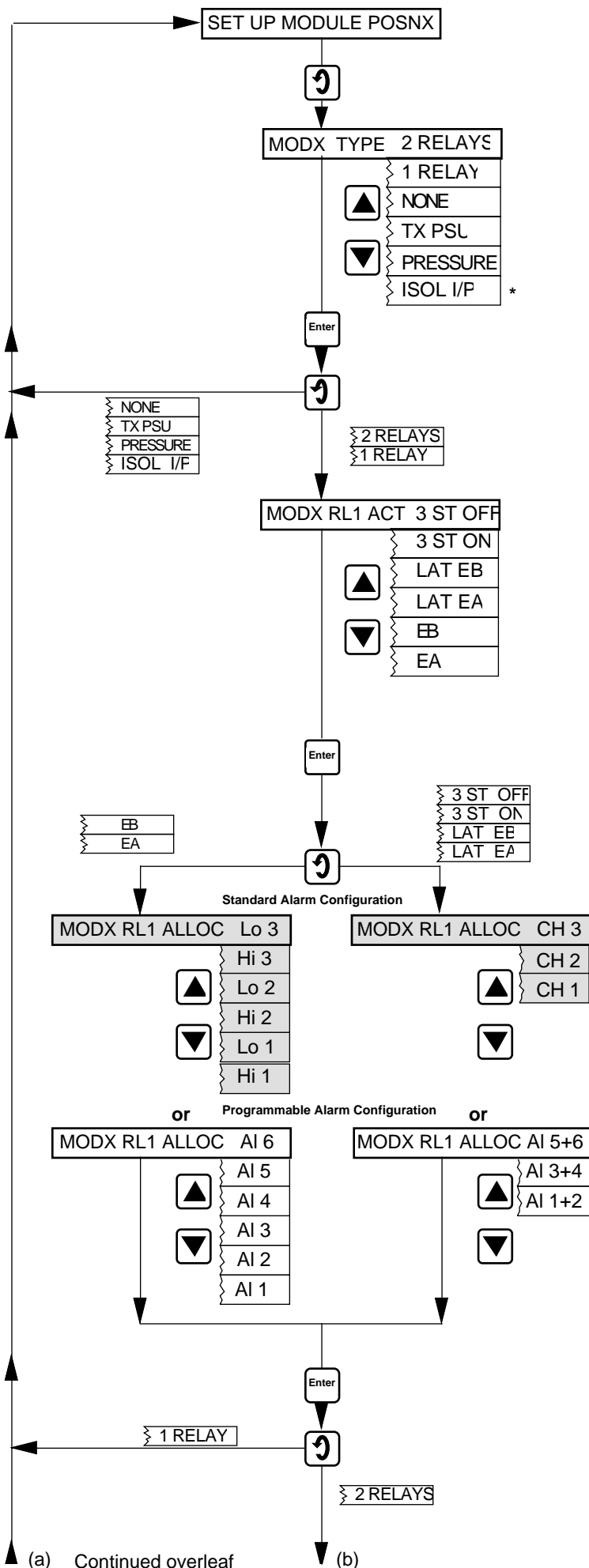
Advance to next parameter.

Store.

Return to top of **Alarm Set Up** page.

8.11 Set Up Module Page

8.11.1 Module Positions 1,2 and 3.



(a) Continued overleaf

(b)

Set Up Module Position 1,2 and 3.

Note. On single pen instruments no modules can be fitted in positions 2 and 3.

Advance to next parameter.

Module Position 1,2 and 3, Type

Select the module type fitted in module position 1,2 or 3 – see Fig. 4.1.

* This module type is not available for module position 1.

Store.

Advance to next parameter.

Module Position 1,2 and 3, Relay 1 Action

Select the relay 1 action required:

- '3 ST OFF' – 3-state off between set points
- '3 ST ON' – 3-state on between set points
- 'LAT EB' – latch below setpoints
- 'LAT EA' – latch above setpoints
- 'EB' – energised below setpoint
- 'EA' – energised above setpoint.

See Section 12 for more detailed information on alarm set points.

Store.

Advance to next parameter.

Module Position 1,2 and 3, Relay 1 Allocation (Standard Alarm Configuration)

For 'EA' or 'EB' alarm action:

Allocate the alarm to a high or low setpoint.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':

Allocate the relay to a channel.

Module Position 1,2 and 3, Relay 1 Allocation (Programmable Alarm Configuration)

For 'EA' or 'EB' alarm action:

Allocate the relay to an alarm point.

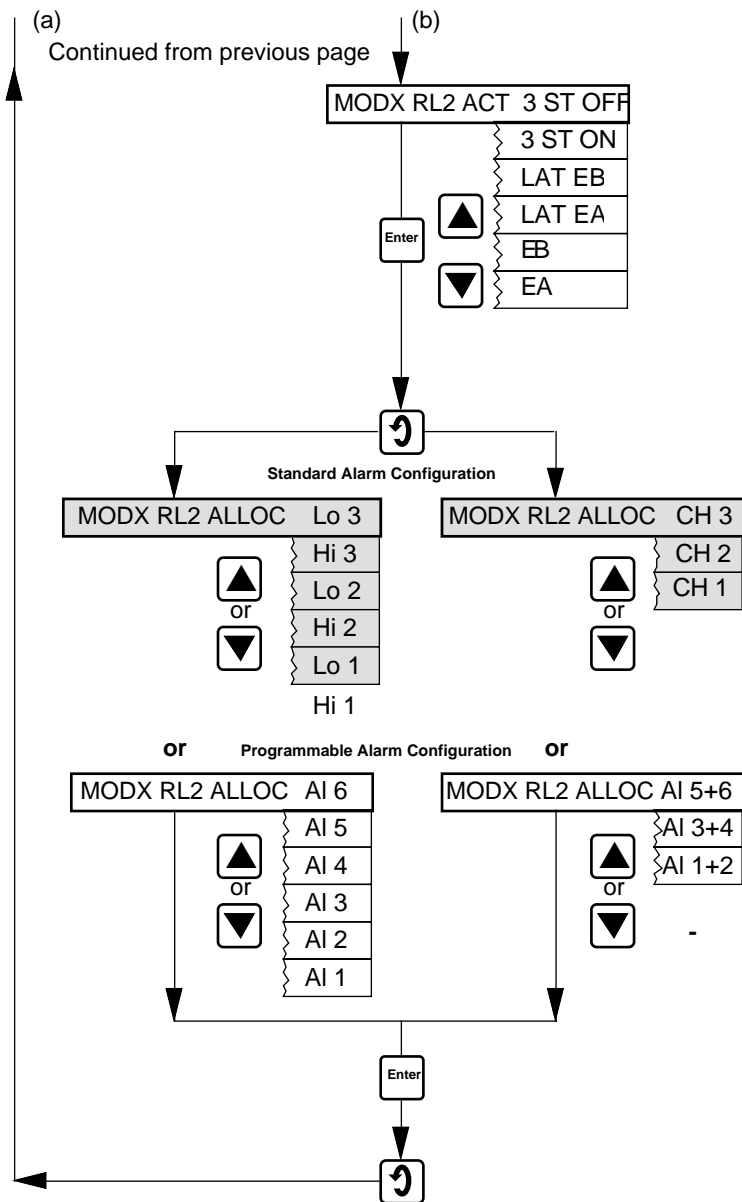
For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':

Allocate the relay to an alarm point pair.

Note. AI 1 > AI 2, AI 3 > AI 4, AI 5 > AI 6.

Store.

Advance to next parameter.



Module Position 1,2,3, Relay 2 Action
Repeat as for **Module Position 1,2,3, Relay 1 Action**, on previous page.

Store.

Advance to next parameter.

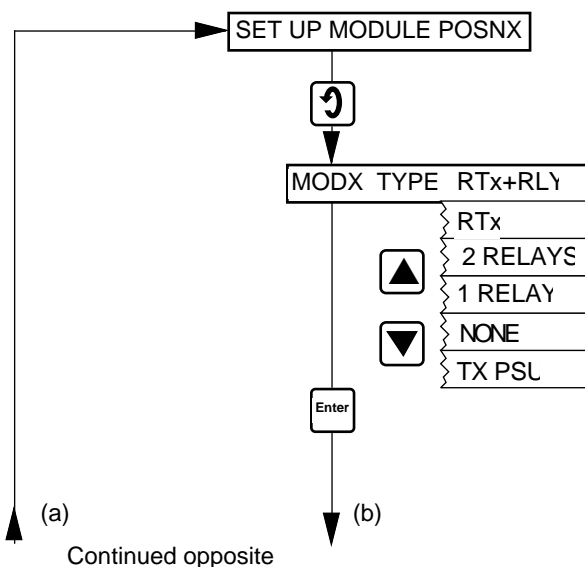
Module Position 1,2,3, Relay 2 Allocation (Standard Alarm Configuration)
Repeat as for **Module Position 1,2,3, Relay 1 Allocation (Standard Alarm Configuration)**, on previous page.

Module Position 1,2,3, Relay 2 Allocation (Programmable Alarm Configuration)
Repeat as for **Module Position 1,2,3, Relay 1 Allocation (Programmable Alarm Configuration)**, on previous page.

Store.

Return to top of **Set Up Module** page.

8.11.2 Module Positions 4,5,6



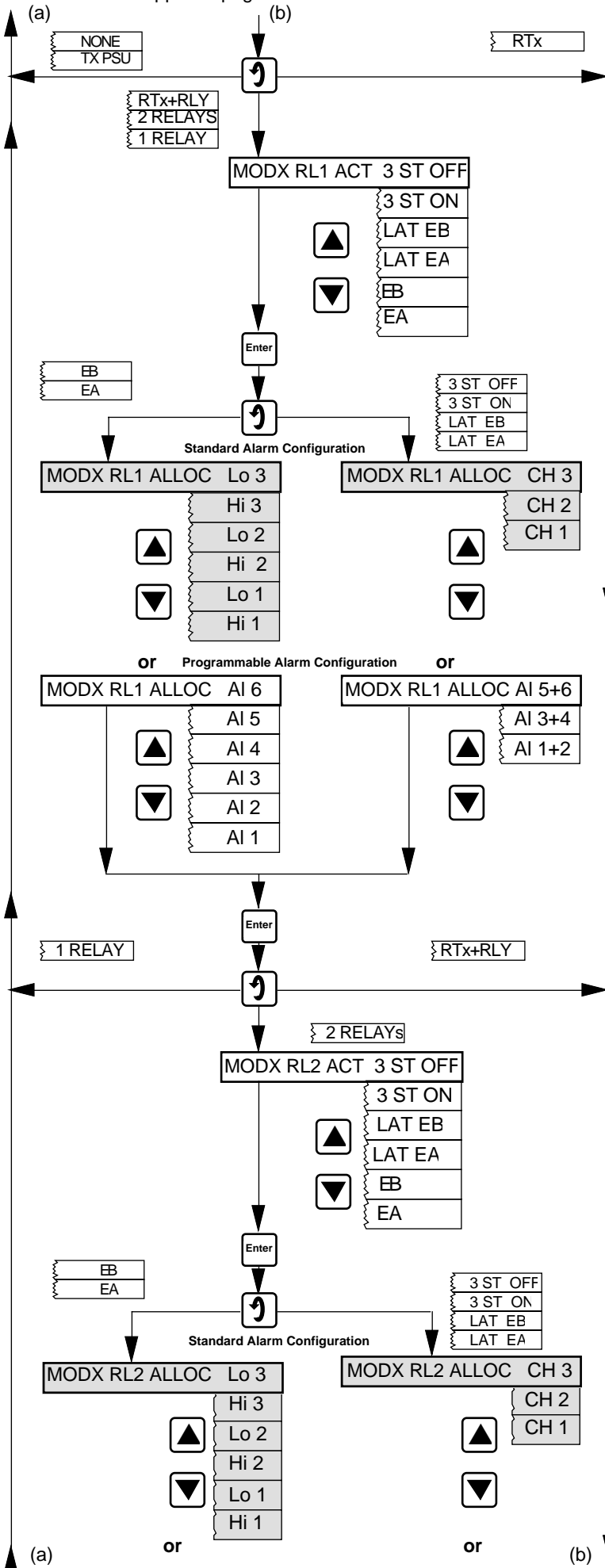
Set Up Module Position 4,5 and 6.

Advance to next parameter.

Module Position 4,5 and 6, Type
Select the module type fitted in module position 4,5 or 6 – see Fig. 4.1.

Store.

8.11 Set Up Modules Page (continued)
Continued from opposite page



Advance to next parameter.

Module Position 4,5,6, Relay 1 Action

- Select the relay 1 action required:
- '3 ST OFF' – 3-state off between set points
 - '3 ST ON' – 3-state on between set points
 - 'LAT EB' – latch below setpoints
 - 'LAT EA' – latch above setpoints
 - 'EB' – energised below setpoint
 - 'EA' – energised above setpoint.

Store.

Advance to next parameter.

Module Position 4,5,6, Relay 1 Allocation (Standard Alarm Configuration)

For 'EA' or 'EB' alarm action:
Allocate the alarm to a high or low setpoint.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':
Allocate the relay to a channel.

Module Position 4,5,6, Relay 1 Allocation (Programmable Alarm Configuration)

For 'EA' or 'EB' alarm action:
Allocate the relay to an alarm point.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':
Allocate the relay to an alarm point pair.

Note. AI 1 > AI 2, AI 3 > AI 4 and AI 5 > AI 6.
Store.

Advance to next parameter.

Module Position 4,5,6, Relay 2 Action

- Select the relay 2 action required:
- '3 ST OFF' – 3-state off between setpoints
 - '3 ST ON' – 3-state on between setpoints
 - 'LAT EB' – latch below setpoints
 - 'LAT EA' – latch above setpoints
 - 'EB' – energised below setpoint
 - 'EA' – energised above setpoint.

Store.

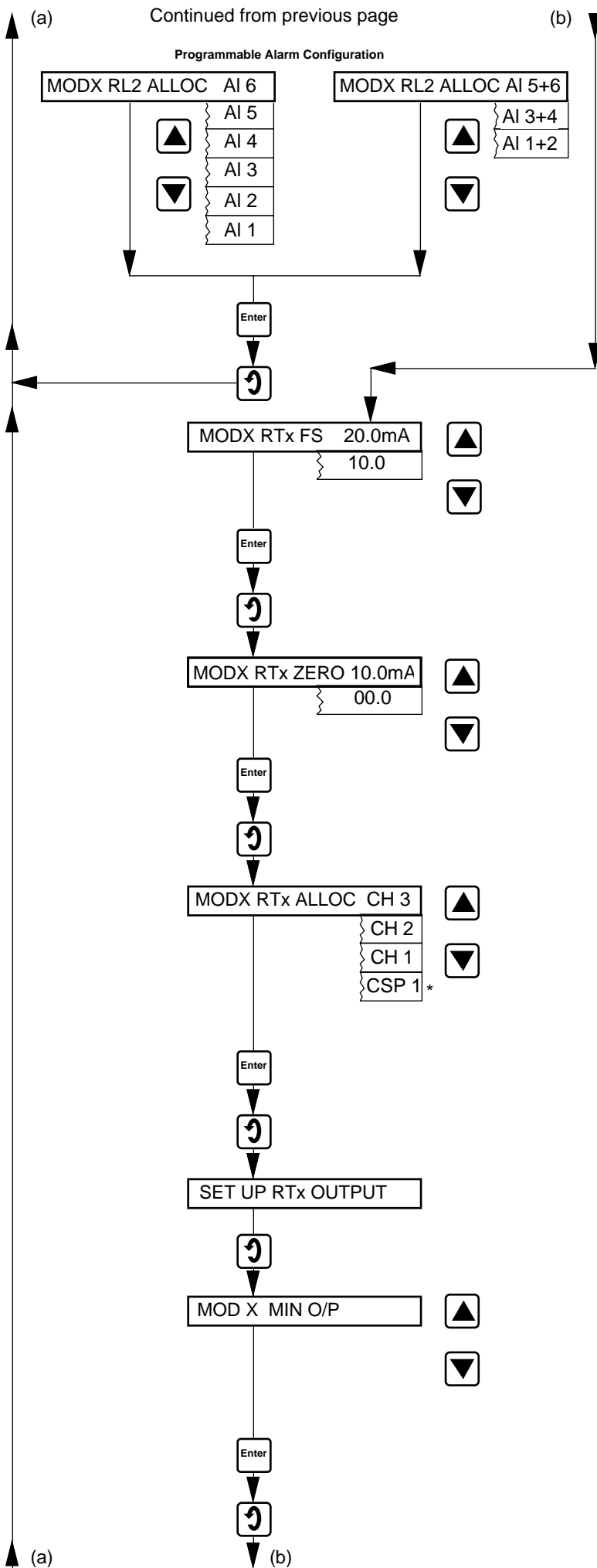
Advance to next parameter.

Module Position 4,5,6, Relay 2 Allocation (Standard Alarm Configuration)

For 'EA' or 'EB' alarm action:
Allocate the alarm to a high or low setpoint.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':
Allocate the relay to a channel.

Continued overleaf



Module Position 4,5,6, Relay 2 Allocation (Programmable Alarm Configuration)

For 'EA' or 'EB' alarm action:
Allocate the relay to an alarm point.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':
Allocate the relay to an alarm point pair.

Note. AI 1 > AI 2, AI 3 > AI 4, AI 5 > AI 6.

Store.

Advance to next parameter.

Module Position 4,5,6,Retransmission Full Scale

Set the maximum value required for the retransmission signal, adjustable in 0.1mA steps in the range 10.0 to 20.0mA.

Store.

Advance to next parameter.

Module Position 4,5,6,Retransmission Zero

Set the minimum value required for the retransmission signal, adjustable in 0.1mA steps in the range 00.0 to 10.0mA.

Store.

Advance to next parameter.

Module Position 4,5,6, Retransmission Allocation

Select the channel to which the retransmission signal is to be allocated. *Control Set Point 1 may be selected on recorders with PID facility. This parameter is not displayed for single channel recorders unless fitted with PID option.

Store.

Advance to next parameter.

Set Up Retransmission Output

Advance to next parameter.

Module Position 4,5,6 Retransmission Minimum Output

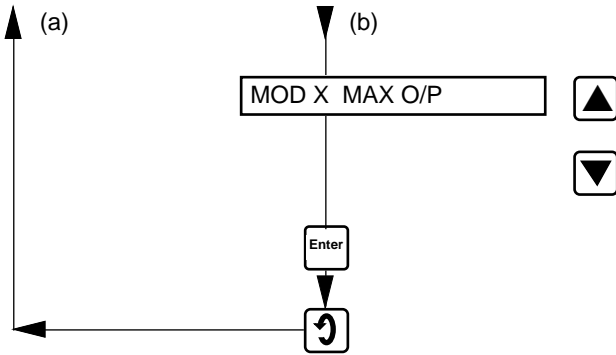
Connect a 0 to 20mA milliammeter to the appropriate module output connection and adjust the milliammeter displayed value to coincide with the retransmission minimum signal specified above.

Store.

Advance to next parameter.

Continued opposite

Continued from previous page



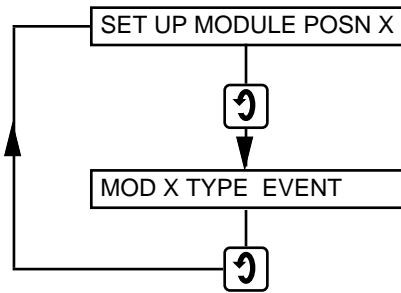
Module Position 4,5,6, Retransmission Maximum Output

Adjust the millimeter displayed value to coincide with the retransmission maximum signal specified above.

Store.

Return to top of **Set Up Module** page.

8.11.3 Module Position 2 or 3 (Event Pen Module)



Set up module position 2 – PX105/14
Set up module position 3 – PX105/15

Advance to next parameter

Module 2 Type – PX105/14
Module 3 Type – PX105/15
 This display cannot be changed.

Return to top of **Set Up Module** page

8.11.4 Event Pen Ranges

If a PX105/14 or PX105/15 recorder with an event pen is using a standard chart, i. e. with a writing width of 105mm, the range and display full scale values for the variable pens must be set as described below:

Zero-based ranges

On the input page set **Range Full Scale** and/or **Lineariser Full Scale** to 96% of the full scale input value.

On the Display page, set **Display Full Scale** to 96% of the variable represented by the full scale signal input.

Offset-zero ranges

Calculate the **Range Full Scale** and **Display Full Scale** settings by using the actual input or display span values rather than full scale; i.e. **Range Full Scale** would be 0.96 (input full scale – input min.) + input min.

Example. For an input of 4 to 20mA corresponding to a temperature range of 100 to 300°C from a type K thermocouple:

$$\begin{aligned}
 \text{Lineariser Full Scale} &= 0.96 [300 - 100] + 100 \\
 &= 192 + 100 \\
 &= 292 \\
 \text{Range Full Scale} &= \text{mV equivalent of } \left[\frac{292 - 100}{300 - 100} \right] \times 16 + 4 \\
 &= \left[\frac{11.876 - 4.095}{12.207 - 4.095} \right] \times 16 + 4 \\
 &= \left[\frac{7.781}{8.112} \right] \times 16 + 4 \\
 &= 0.9592 \times 16 + 4 \\
 &= 15.35 + 4 \\
 &= 19.35 \text{ mA}
 \end{aligned}$$

The above alternative setting procedures for **Range Full Scale** and **Display Full Scale** are not necessary if a chart with a writing width of 100mm is used.

9 SIMPLE FAULT FINDING

If the recorder does not appear to be working satisfactorily carry out the checks in the following table before contacting the Service Organisation.

Are all the connections made correctly?
Is there power to the instrument?
Is there a signal at the input terminals?
Does an external relay fail to de-energise? If so see Section 9.1, following.

9.1 Arc Suppression Capacitors – Fig. 9.1

Arc suppression capacitors are fitted across the contacts of the alarm/control relays. If these contacts are used to operate external relays, the capacitor leakage current may be sufficient to prevent the external relay from de-energising. If so, switch off the power supply and external alarm circuits. Identify the appropriate relay module – see Figs. 4.14a, 4.14b and 4.15b. Remove the four screws retaining the p.c.b. and **carefully** unplug it.

CAUTION.

The connection pins at the top of the p.c.b. are very fragile and care must be taken not to bend or damage them.

Unsolder the appropriate capacitors as shown in Fig. 9.1 and refit the module.

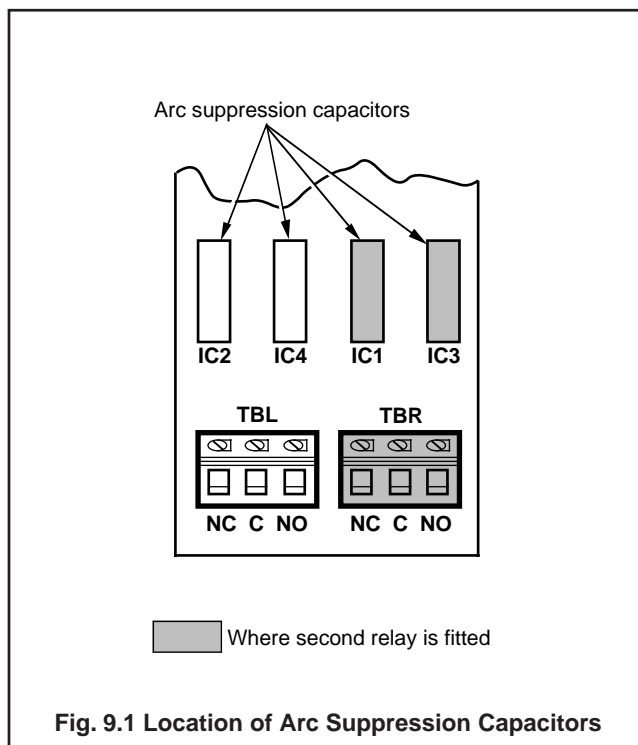


Fig. 9.1 Location of Arc Suppression Capacitors

10 CALIBRATION

The recorder should be calibrated annually or following a change to instrument operation. The pen arm length must be checked, and adjusted if necessary, before making any electrical adjustments.

10.1 Calibration, General

Switch off the power supply. Connect the instrument to a signal source or resistance box of known accuracy, suitable for simulation over the entire input range, to the input terminals – see Section 4.3.

For **thermocouple inputs**, connect the millivolt source using appropriate compensating cable – see Table 2.

For **2-lead resistance** thermometers the resistance box may be connected at the sensor end of the leads or the lead resistance added to calibration values – see Section 10.3.

For all other inputs connect using copper wire.

Switch on the power supply.

10.2 Pen Arm Length Adjustment

If the pen arm length is incorrect the pen does not record the correct time at all positions on the chart.

- With reference to Fig. 8.2, select the Input and Recording Conditions Page, make a note of the **Chart Time** and then reset it to 168hr/rev. Store using the 'Enter' switch.
- Ensure that the pens are touching the chart and that the time line marker on the chassis indicates the correct time line on the chart – see Fig. 6.1.
- Increase the channel 1 input signal from zero to full scale, within a period of 10 seconds, to draw an arc on the chart. For temperature inputs apply the equivalent millivolt or resistance values obtained from standard tables.

If the trace does not follow the time line the error must be corrected by adjusting the pen arm length as follows:

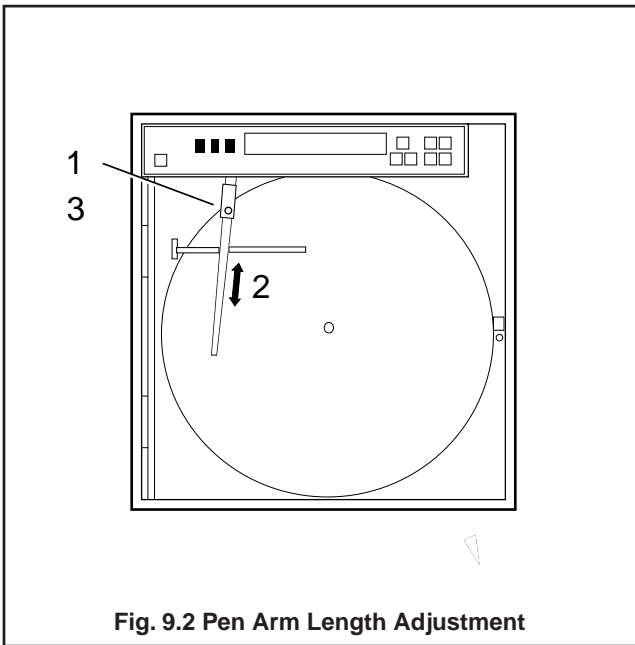
With reference to Fig. 9.2:

- Slacken the clamp screw.
- Slide the pen arm in or out of the moulding, as necessary.
- Retighten the clamp screw on completion.

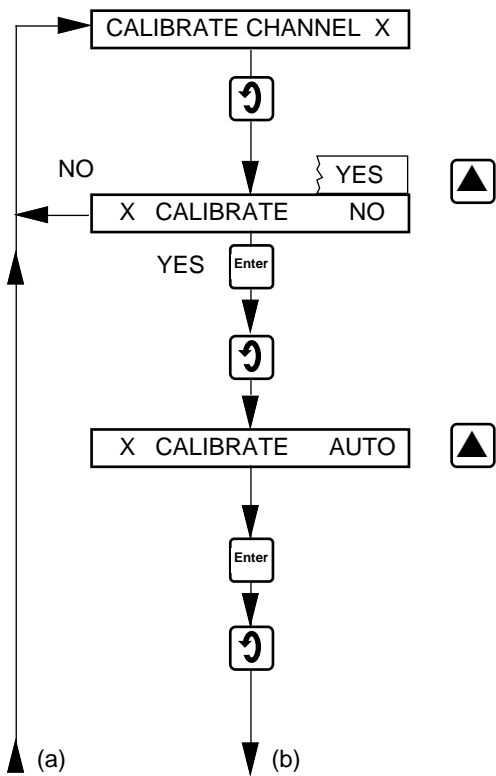
Make similar adjustments to the green and blue pen arms, as applicable. Ensure that the green pen records approximately 4mm ahead of the red pen and the blue pen records approximately 4mm behind the red pen (with respect to time) over the full chart width.

Note. Only the red pen can follow precisely the time line on the chart, since the radii of the other pens draw different loci. On instruments fitted with event marker the event pen draws on the same time line as the red pen.

Reprogram the original chart time noted at a), above and store using the 'Enter' switch.



10.3 Calibration Page (Automatic Procedure)



Continued overleaf

Calibrate Channel

Advance to next parameter.

Calibration

Select 'YES' to calibrate the instrument

Store.

Advance to next parameter.

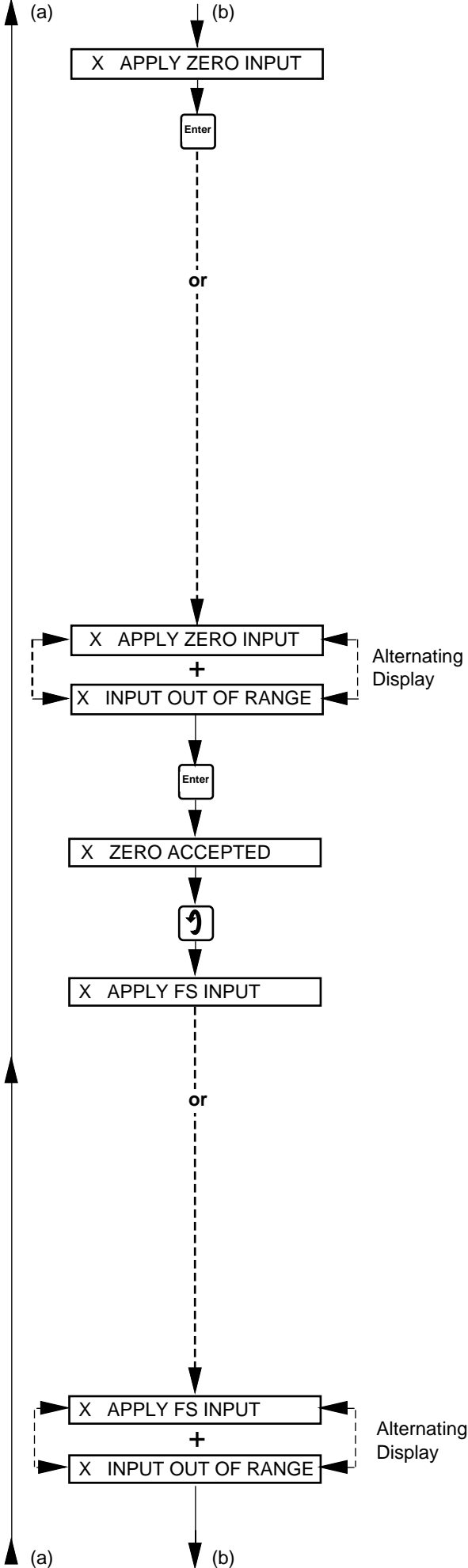
Calibration Mode (auto or manual)

Select automatic calibration mode. For manual calibration mode refer to Section 10.4 on page 42.

Store.

Advance to next parameter.

Continued from previous page



Continued on opposite page

Apply Zero Input

The channel number flashes in this display until the correct input signal is applied and the 'Enter' switch is operated.

Range Zero Calibration

Electrical Inputs:

apply a signal equivalent to **Input Range Zero**.

Resistance thermometer Inputs:

apply a signal input equivalent to **Lineariser Zero** using resistance values obtained from standard tables. For 2-lead RTDs, ensure that the resistance source is either connected at the sensor end of the leads or that the total lead resistance is added to the value for range zero.

Thermocouple Inputs:

measure the ambient temperature at the output terminals of the signal source (calibrator). From thermocouple tables obtain the millivolt equivalent of this temperature (a) and that for the **Lineariser Zero** temperature (b) – see page 26. Subtract (a) from (b) and set the signal source to the resultant value. (The voltage is negative if the range zero temperature is below the measured ambient temperature).

Note. If the applied signal level is outside acceptable zero range limits, the displayed message alternates between 'APPLY ZERO INPUT' and 'INPUT OUT OF RANGE'. If such a condition occurs check and reset the applied signal level.

Store.

Zero Input

The applied input is within acceptable limits for zero calibration.

Advance to next parameter.

Range Full Scale Calibration

For instruments with event pen see Section 8.11.4 on page 37.

Electrical Inputs:

apply a signal equivalent to **Input Range Full Scale**.

Resistance thermometer Inputs:

apply a signal input equivalent to **Lineariser Full Scale** using resistance values obtained from standard tables. For 2-lead RTDs, ensure that the resistance source is either connected at the sensor end of the leads or that the total lead resistance is added to the value for range full scale.

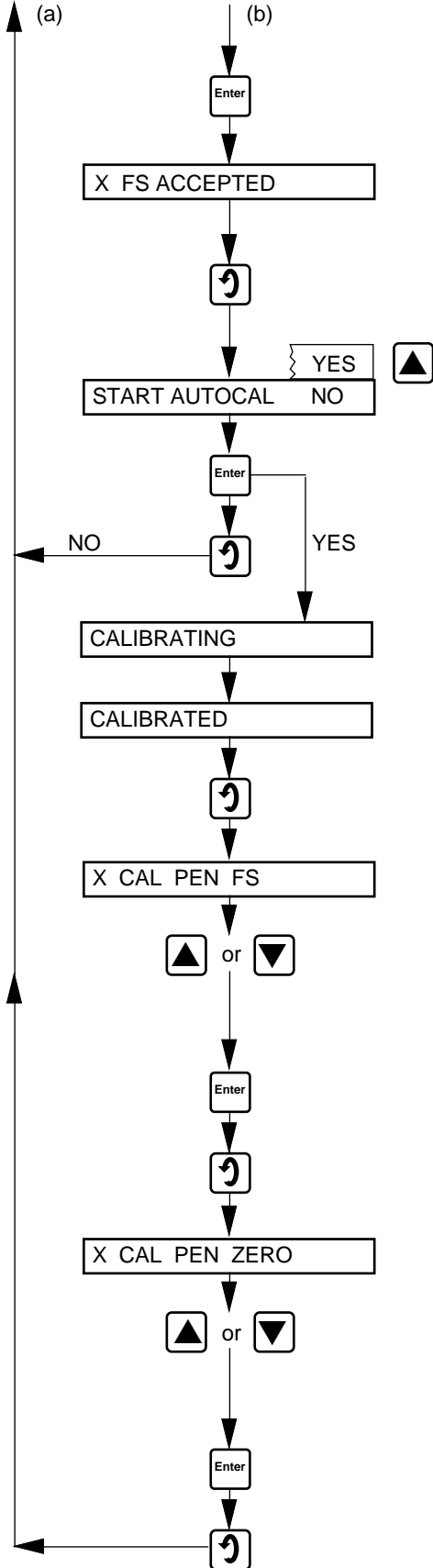
Themocouple Inputs:

apply an input (c) – (a) where (c) is the millivolt equivalent of the **Lineariser Full Scale** temperature obtained from standard tables.

Note. If the applied signal level is outside acceptable full scale range limits, the displayed message alternates between 'APPLY FS INPUT' and 'INPUT OUT OF RANGE'. If such a condition occurs check and reset the applied signal level.

Range Full Scale calibration, and hence the measured value displayed during normal operation (see **Operating Page 1**), is carried out automatically.

Continued from previous page



Store.

Full Scale Input

The applied input is within acceptable limits for full scale calibration.

Advance to next parameter.

Automatic Calibration

Select 'YES' to initiate automatic calibration.

Store.

Advance to next parameter.

'CALIBRATING' is displayed for a few seconds during the automatic calibration procedure.

'CALIBRATED' is displayed on completion of the calibration process.

Advance to next parameter.

Pen Full Scale Calibration

The pen is automatically positioned at full scale. If there is an error, i.e. pen not at full scale on the chart, ensure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen full scale on the chart. For instruments fitted with event pen see Section 8.11.4 on page 37.

Store.

Advance to next parameter.

Pen Zero Calibration

The pen is automatically positioned at the zero position. If there is an error, i.e. pen not at zero on the chart, ensure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen zero on the chart.

Store.

Return to top of **Calibration Page**.

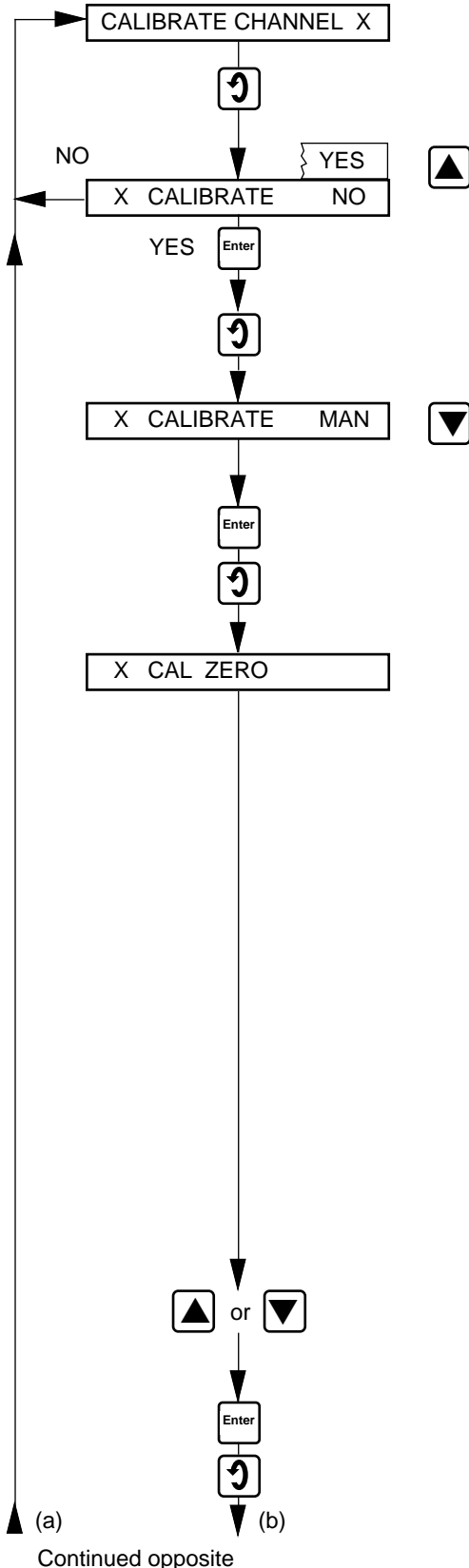
10.4 Calibration Page (Manual Procedure)

The procedures detailed in this section are for manual calibration at the normal range zero and full scale limits. However the manual calibration procedure also facilitates calibration of the instrument at selected points within the range other than zero and full scale.

As a general rule, spot calibration values should be:

- <50% of range span value when using **Calibrate Range Zero** parameters
- >50% of range span value when using **Calibrate Range Full Scale** parameters

This facility is particularly useful when optimum accuracy is required at 'spot' values within the range, e.g. for eliminating thermocouple errors by connecting the thermocouple to the instrument and keeping it at a constant temperature for the spot calibration.



Calibrate Channel

Advance to next parameter.

Calibration

Select 'YES' to calibrate the instrument

Store.

Advance to next parameter.

Calibration Mode (auto or manual)

Select manual calibration mode. For automatic calibration mode refer to Section 10.3 on page 39.

Store.

Advance to next parameter.

Calibrate Range Zero

Electrical Inputs:

apply a signal input equivalent to **Input Range Zero**.

Resistance Thermometer Inputs:

apply a signal input equivalent to **Lineariser Zero** using resistance values obtained from standard tables. For 2-lead RTDs, ensure that the resistance source is either connected at the sensor end of the leads or that the total lead resistance is added to the value for range zero.

Thermocouple Inputs:

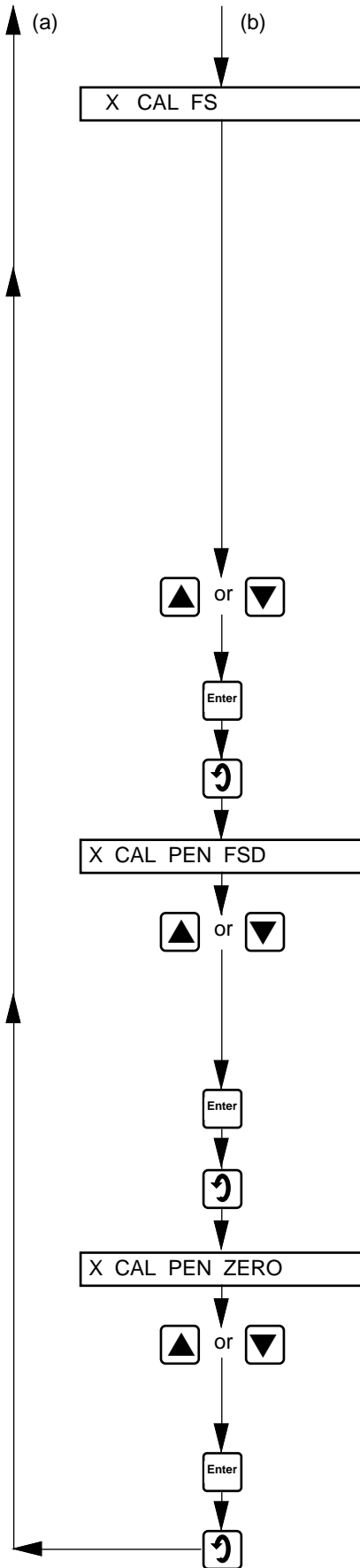
measure the ambient temperature at the output terminals of the signal source (calibrator). From thermocouple tables obtain the millivolt equivalent of this temperature (a) and that for the **Lineariser Zero** temperature (b) – see page 26. Subtract (a) from (b) and set the signal source to the resultant value. (The voltage is negative if the range zero temperature is below the measured ambient temperature).

Note. The displayed units are engineering units.

Set the value required. The decimal point position is set automatically.

Store.

Advance to next parameter.



Calibrate Range Full Scale

For instruments fitted with event pen see Section 8.11.4 on page 37.

Electrical Inputs:

apply a signal input equivalent to **Input Range Full Scale**.

Resistance Thermometer Inputs:

apply a signal input equivalent to **Lineariser Full Scale**, use resistance values obtained from standard tables. For 2-lead RTDs, ensure that the resistance source is either connected at the sensor end of the leads or that the total lead resistance is added to the value for range full scale.

Thermocouple Inputs:

apply an input (a) – (c) where (c) is the millivolt equivalent of **Lineariser Full Scale** temperature obtained from standard tables.

Set the value required. The decimal point position is set automatically.

Store.

Advance to next parameter.

Pen Full Scale Calibration

The pen is automatically positioned at full scale. If there is an error, i.e. pen not at full scale on the chart, ensure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen full scale on the chart. For instruments fitted with event pen see Section 8.11.4 on page 37.

Store.

Advance to next parameter.

Pen Zero Calibration

The pen is automatically positioned at the zero position. If there is an error, i.e. pen not at zero on the chart, ensure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen zero on the chart.

Store.

Return to top of **Calibration Page**.

11 SPECIFICATION

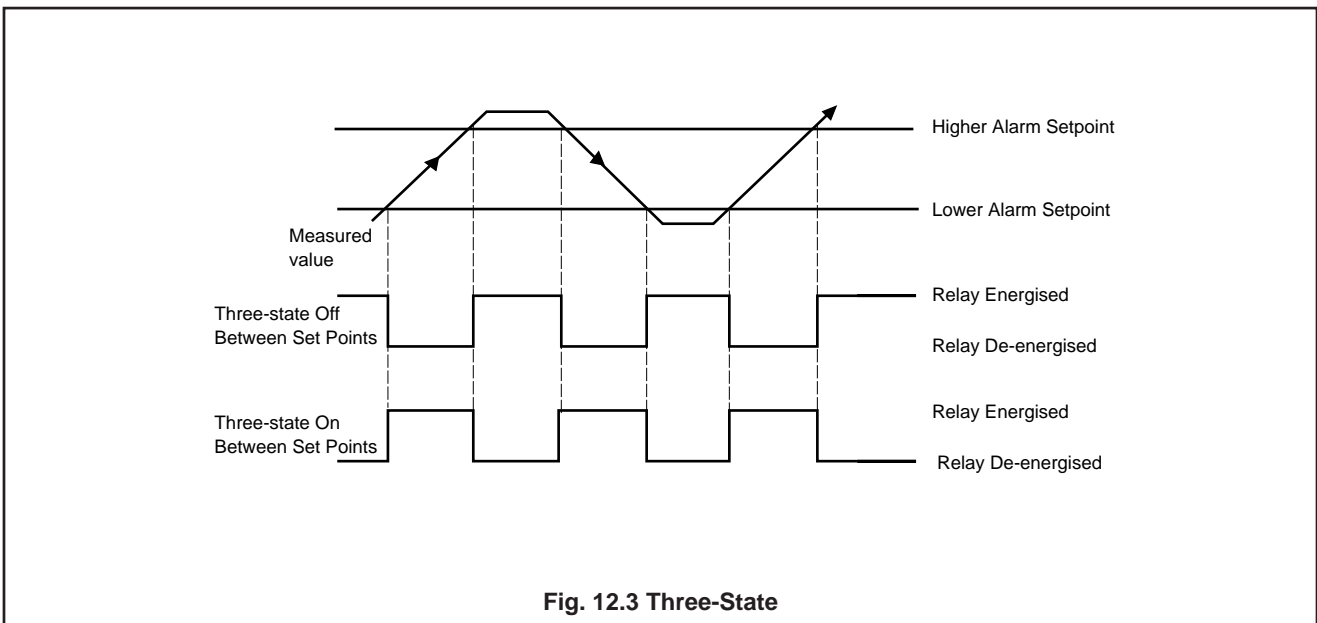
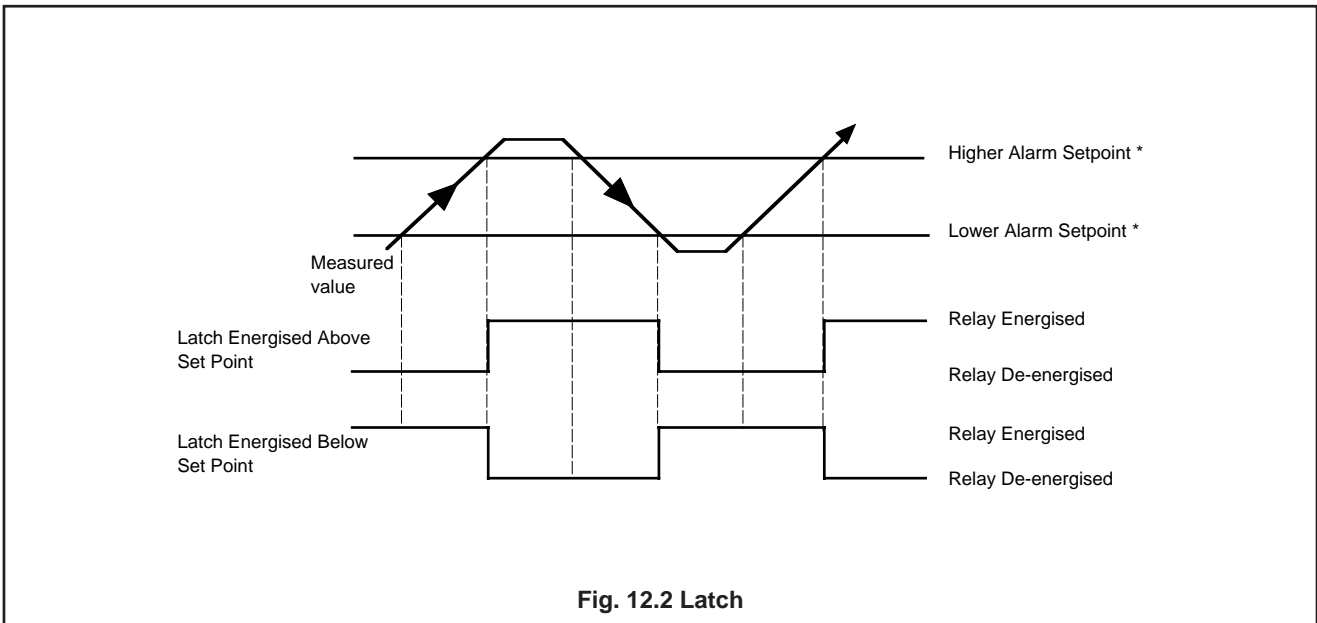
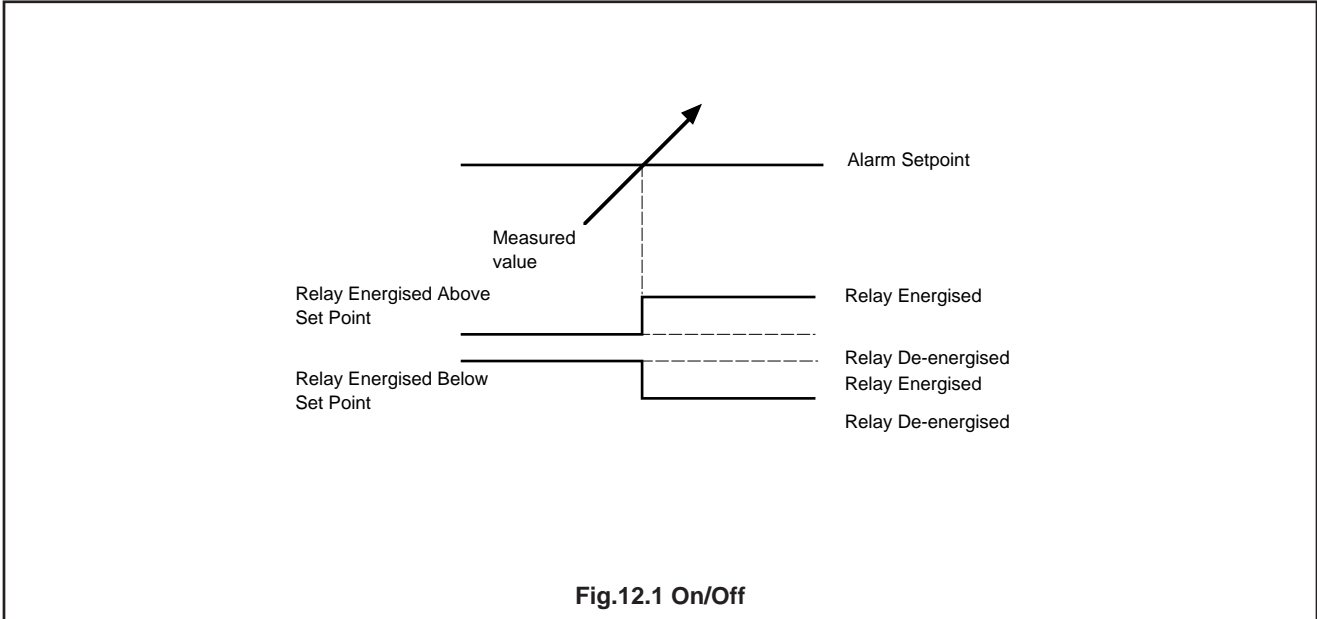
Inputs	
No. of inputs	1,2 or 3
Voltage Span	20V d.c. max. 0.5V d.c. min.
Millivoltage Span	1000mV d.c. max. 5mV d.c. min.
Current Span	100mA d.c. max. 0.5mA d.c. min.
	} See also Table 3.
Input impedance:	
Millivolt inputs	>10M Ω
Voltage inputs	500k Ω
Current inputs	10 Ω
Temperature:	
Thermocouple	1800°C or 3272°F max.
Minimum span	100°C or 180°F
Resistance thermometer	600°C or 1112°F max.
Minimum Span	50°C or 90°F
	} See also Table 4.
Cold junction	Automatic cold junction compensation (ACJC) fitted, temperature programmable
Broken sensor protection	Programmable, upscale or downscale drive or none (not available on mA and V inputs)
Event marker (PX105/14,/15 only)	Voltage-free contacts or 0 to 5V logic level
Linearisation	Programmable for all inputs. State whether linear, square root, power 3/2,5/2 law or type of thermocouple or resistance thermometer
Filter time	Programmable from 0 to 60 seconds in 1 second steps
Change of input mode	By repositioning plug-in link
Change of input range/span	Programmable
Program modification	By user-operated membrane switches above chart
Floating inputs-isolation	12.5V max. between channels upon removal of terminal block links
Isolation, inputs to earth	500V d.c.
Isolated Input Module (Type K):	
Isolation, module input to standard input	2kV
Isolation, input to earth	2kV
Interference suppression (based on 0 to 1000mV range input):	
Radiated (r.f.)	< \pm 2% f.s.d. deviation over range 20MHz to 1000MHz at field strength of 5V/metre
Line interruption	<110ms loss – no effect, >110ms loss – instrument returns to operation after automatic reset.
Line interference	<500V input, pulse width up to 125 μ s – no effect
Common mode	<1% span error max. for 250V r.m.s. 50Hz
Series mode	<1% span error for 200% span, 50Hz
Output and Set Points	
No. of set points	Up to 2 per channel
Set point adjustment	Programmable
No. of relays	Up to 2 per channel
Relay contacts:	Single pole changeover
Voltage	250V a.c. 250V d.c. max.
Current	5A a.c. 5A d.c. max.
Loading (non-inductive)	1250VA 50W max.
Insulation contacts to earth	2kV r.m.s.
Relay action	Programmable – Energised above set point (EA) Energised below set point (EB) 3-state Latching External counter drive option (module 5) 50ms pulse 24V max. current 150mA
Analogue outputs:	
Module type 7	Isolated analogue
Module type 8	Isolated analogue with relay
Isolation voltage	2kV between input and output
Retransmission:	Programmable
Range	0 to 20.0mA in 0.1 mA steps
Output impedance	Up to 20mA into 1k Ω max.

Power Supplies

Voltage requirements	110V a.c. (min. 93V, max. 127V) or 230V a.c. (min. 195V, max. 265V) 50/60Hz Alternatively 10 to 30V d.c.
Power requirement:	
A.C. Powered	<28VA
D.C. Powered*	10V to 12V <22W
12V to 24V	<19W
24V to 30V	<22W
	At maximum duty with full complement of options and modules
Warm up time	10 seconds approx.
Error due to power supply voltage variation	±0.1% span for ±15% variation
Insulation, mains to earth	2kV r.m.s.
Transmitter power supply:	
Output voltage	25V±0.5V at 0 or 60mA (loaded with 3 transmitters)
Output ripple	100mV peak to peak max.
Regulation	±0.1V for output change 4 to 20mA.
Output voltage variation with supply voltage	<0.1V for ±15% supply voltage
Accuracy	
Intrinsic error	±0.25% span max. for all zero based ranges within permitted limits (Tables 3 and 4) ref. conditions 20°C and 115V or 230V apply
Lineariser accuracy	±0.1°C typical
Resolution:	
Measurement– mV, V, mA, THC	≥0.1%span for all zero based ranges within permitted limits (Tables 3 and 4)
RTD	0.06Ω
Pen	≤0.1% full scale travel
Display	±1 digit
Pen response time	6 seconds for 0 to 100% typical
Filter time	0 to 60 seconds, programmable in 1 second steps
Displays and Records	
Display	20 character dot matrix vacuum fluorescent with blue filter
Programming	Up, down and tactile membrane switches above chart
Chart	Circular with linear graduations, 40, 45, 50, 60, 70 or 75 divisions.
Chart speed	1 revolution per hour up to 1 revolution per week (168 hours) programmable in 1 hour steps
Pens	Red, channel 1. Green, channel 2. Blue, channel 3. Disposable
Environmental Data	
Operating temperature limits	0 to +55°C.
Operating humidity limits	0 to 80% RH (paper and ink system) 0 to 95% RH (electronics)
Error due to ambient temperature variation	±0.02% span/°C typical (unsuppressed ranges)
Protection rating	IP54
Mechanical Data	
Mounting	Wall or panel by 3 brackets supplied as standard kit
Optional accessories	Post mounting kit Door seal moisture shield Carrying stand assembly complete with cover
Overall dimensions	370mm wide x 360mm high x 170mm deep
Panel cut out	348+1,–0mm x 342+1,–0mm
Panel space requirement	410mm wide x 400mm high, 150mm deep from panel face
Case and door	Sheet steel case with hinged chart plate. Foam-moulded door with glass window (or polycarbonate to special order)
Weight	10.5kg approx.

* At start up, instruments using a d.c. SMPSU may require an initial surge current of up to 5A (1ms duration max.)

12 APPENDICES
12.1 Alarm Actions



12.2 Fitting an Isolated Input Module – Fig. 12.6

If an isolated input module type K is to be fitted to a recorder:

Switch off the power supply.

- 1 Identify the required module position(s) and fit the type K module(s). Set the links on the 'K' module(s) to suit the input. See section 4.4.1.

Caution. Care must be taken to ensure that the plug pins are not damaged.

- 2 Fit IC34 as indicated in Fig. 12.6, ensuring the correct orientation and using approved anti-static methods.
- 3 On the Processor p.c.b. identify and remove the process input connection(s) from channels 2 and/or 3 as required.

Short out the unused input terminals for each channel on which a type K module is fitted.

12.2.1 Calibrating an Isolated Input Module(s)

- a) Connect the calibrator for channels 2 and/or 3, as appropriate, to the terminals on the 'K' module boards.
- b) Switch on the power supply.
- c) With reference to Fig. 8.2, in 'SET UP MODULE POSN 2/3' page, advance the display to 'MODX TYPE', select and enter 'ISOL I/P'.
- d) Advance to 'CALIBRATE CHANNEL 2/3' and re-calibrate the channel as described in Section 10.
- e) Disconnect the calibrator and remake the process input signal connections to the appropriate 'K' module(s).

12.3 Resolution of Suppressed Zero Ranges (all inputs other than resistance thermometers)

Note. In the following calculations, for thermocouple inputs use the equivalents of the required temperatures derived from standard tables.

From Table A1, obtain the value of the constant K corresponding to the input range maximum.

Divide K by the numerical value of the span to obtain the percentage range resolution.

Example 1 – Range 200mV to 250mV.

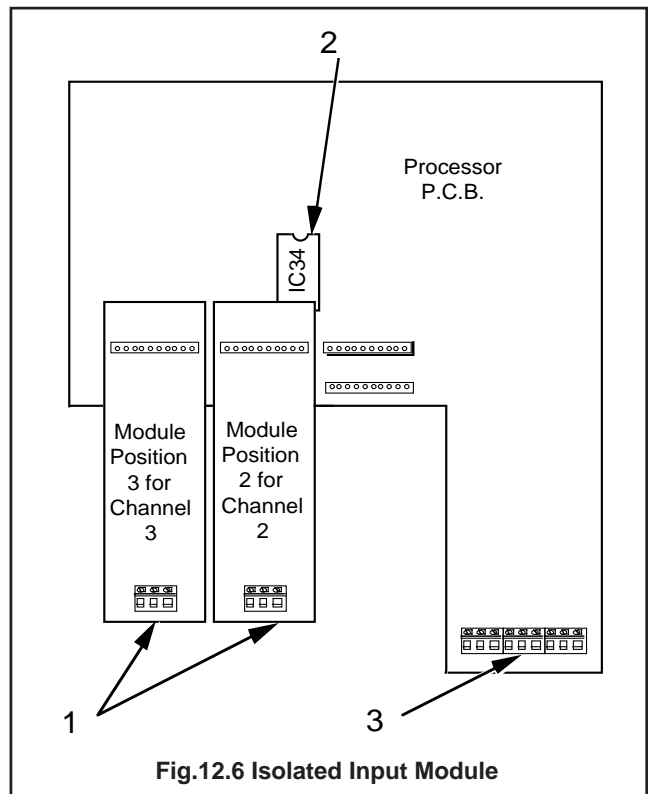
The value of K corresponding to 250mV is 24.4

$$\text{Range resolution} = \frac{K}{250 - 200} \% = \frac{24.4}{50} \% \approx 0.49\%$$

and overall accuracy = 0.49% + 0.15% = 0.64%

mV Inputs		mA Inputs		V Inputs	
Range Max.	K	Range Max.	K	Range Max.	K
5 to 15.99	0.39	0.5 to 1.599	0.39	0.5 to 1.599	0.39
16 to 63.9	1.56	1.6 to 6.39	1.56	1.6 to 6.39	1.56
64 to 249	6.03	6.4 to 24.9	6.03	6.4 to 20.0	6.03
250 to 1000	24.4	25 to 100.0	24.4		24.4

Table 7 Constant (K) Values



Example 2 – Range 4mA to 20mA.

The value of K corresponding to 20mA is 0.603

$$\text{Range resolution} = \frac{0.603}{20 - 4} \% = 0.038\%$$

This is within the pen resolution. Therefore the system resolution is 0.1% and the overall accuracy = 0.1% + 0.15% = 0.25%.

Example 3 – Range 1000°C to 1300°C, thermocouple type K. The millivolt equivalents of 1000°C and 1300°C are 41.27 and 52.40 respectively.

The value of K corresponding to 52.40mV is 1.56

$$\text{Range resolution} = \frac{K}{52.40 - 41.27} \% = \frac{1.56}{11.13} \% = 0.14\%$$

and overall accuracy = 0.14% + 0.15% = 0.29%

N.B. Lineariser accuracy of 0.1°C (0.38%) is not included in this value.

12.4 Resolution of Elevated Zero Ranges

If zero lies between the minimum and maximum range values, the range resolution is $\leq 0.1\%$ and overall accuracy 0.25%.

If the range maximum is a negative quantity, ignore the minus signs and calculate the range resolution as given for suppressed zero ranges above, i.e. treat a range of -250mV to -150mV as 150mV to 250mV.

12.5 Resolution of Resistance Thermometer Ranges

Using standard tables, determine the ohmic equivalent of the range maximum and minimum temperatures (R_s and R_o).

Determine the ohmic span, $R_s - R_o$

$$\text{Then resolution} = \frac{0.06 \times 100}{R_s - R_o} \%$$

Notes.

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- *Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.*

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United States of America

ABB Inc.
Tel: +1 (0) 755 883 4366
Fax: +1 (0) 755 883 4373

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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