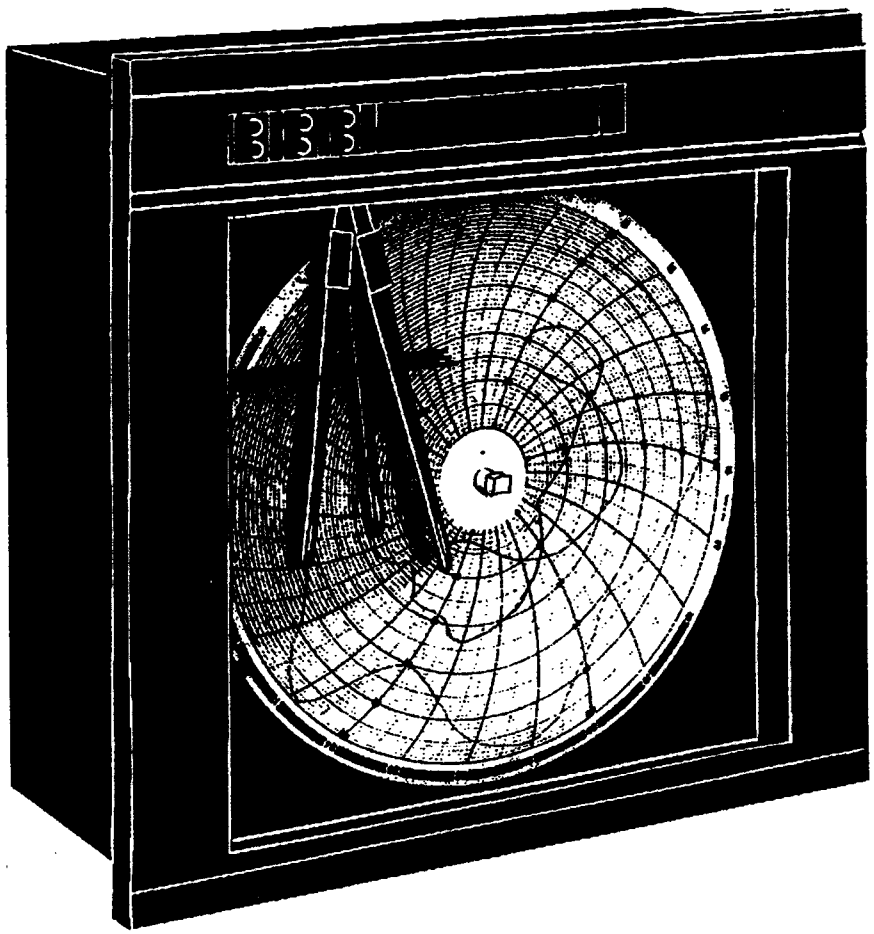
CT1000A Series

Circular Chart Recorders



OMEGA®

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Operator's Manual

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TABLE OF CONTENTS

NOTE: Pages 1 through 52 make up the CT1000A main manual.

UNPACKING

Remove the Packing List and verify that you have received all equipment. If you have any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

When you receive the shipment, inspect the container and equipment for any signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

NOTES

SECTION 1 INTRODUCTION

The OMEGA® CT1000A programmable circular chart recorder measures, displays and records signals from any of the following input types:

Thermocouple (THC), 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 CT1000A recorder is available in one-, two-. and three-channel versions with up to 12 output relays allocated to six setpoints 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 1 hr/revolution up to 168 hr/revolution.

An event marker option is installed on the CT-1214A and CT-1315A instruments only.

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

SECTION 2 PREPARATION

2.1 ACCESSORIES

The following items are packed with the instrument:

Door keys	Function label
Pen capsule pack(s)	Program card
Pack of charts	Operator's manual

Mounting brackets are supplied attached to the case.

2.2 CHECKING THE INSTRUMENT CODE NUMBER

Refer to Figure 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 phillips head screw.

③ Swing the chassis forward (hinged at the left hand side).

④ Check the type number on the serial number label.

Note Unless the user has requested a particular program the recorder is shipped 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.

⑤ Write the function of each channel beneath the appropriate color 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.

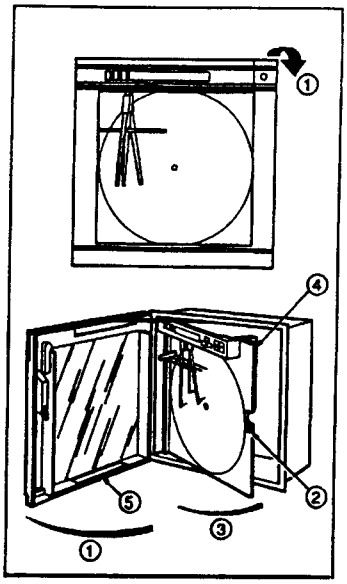


Figure 2-1. Checking the Instrument Code Number

2.3 MODEL NUMBERS

BASE MODELS

PART NUMBERS	DESCRIPTION
CT1100A	1 pen recorder, base unit *
CT1200A	2 pen recorder, base unit *
CT1300A	3 pen recorder, base unit *
CT1205A-MB	2 pen recorder, 1 analog, 1 event
CT1305A-MB	3 pen recorder, 2 analog, 1 event

(* For options, see next page)

MODULES

PART NUMBERS	DESCRIPTION
-M1	Single input
-M2	Dual relay output
-M5	24V counter drive
-M8	Isolated analog output with relay
-MA	Transmitter power supply
-MB	Event pen input
-MC	Frequency input
-ME	Ramp/Soak digital input
-MJ	Solid state relay output
-MK	Isolated analog input
-MS	RS-485 serial interface

Note: up to 6 I/O modules may be installed. The -M1, -M2 and -MA modules may be field installed. Others require options added to the base recorder.

Ordering example: CT1100A-M2 is a one-pen recorder with dual relay output module included.

ACCESSORIES

PENS	DESCRIPTION
CT-1000-RED	5 Red pens, channel 1
CT-1000-GREEN	5 Green pens, channel 2
CT-1000-BLUE	5 Blue pens, channel 3

CHART PAPER (all 500 charts/package & 24 hours unless otherwise stated)	RANGE
CT-1000C--100C-100C/24	–100°C to 100°C
CT-1000C--100C-200C/24	–100°C to 200°C
CT-1000C--125-375(0-100%)/24	–125 to 375 & 0 to 100%*
CT-1000C--20F-80F/24	–20°F to 80°F
CT-1000C-0-100/8HRS	0 to 100; 8 hours
CT-1000C-0-125PSI/24	0 to 125 PSI
CT-1000C-0-150/7	0 to 150; 7 days
CT-1000C-0-1600C/7	0°C to 1600°C; 7 days
CT-1000C-0-3000 PSI/8	0 to 3000 PSI; 8 days
CT-1000C-0-800F--100-200F/24	0°F to 800°F & –100 to 200F*
CT-1000C-150-350F/48HRS	150°F to 350°F; 48 hours
CT-1000C-200-400F/1	200°F to 400°F; 1 day
CT-1000C-DUAL-0-3000/0-500-12H	0-3000 & 0-500; 12 hours*

CHART PAPER (all 500 charts/package & 24 hours unless otherwise stated	RANGE
CT-1000C-1000-1500/7	1000 to 1500; 7 days
CT-1000C-50-250F/7	50°F to 250°F; 7 days
CT-1000C-50-300/12	50 to 300; 12 hours
CT-1000C-0-14PH/7	0 to 14 pH; 7 days
CT-1000C-0-200/24	0 to 200
CT-1000C-0-300/24	0 to 300
CT-1000C-0-200/7	0 to 200; 7 days
CT-1000C-0-50/7	0 to 50; 7 days
CT-1000C-0-800F/1	0°F to 800°F; 1 day
CT-1000C-100/24	0 to 100
CT-1000C-3000/24	0 to 3000
CT-1000C-100/7	0 to 100; 7 days

* = DUAL RANGE

OPTIONS FOR BASE UNITS

Options may be added to the base units by changing the third and/or fourth (i.e. last two) digits in the part number and adding the appropriate modules.

1) Flow option: change the third digit in the model number to a "5". No modules required. Example: CT1150A is a 1-pen unit with flow option.

2) Control option (supports control on channel 1 and/or 2): change the third digit in the model number to a "4". This option also requires you to purchase additional module(s) for the required output(s). Example: CT1240A-M8-M8 is a two-pen recorder with control option on both channels and two isolated analog outputs.

3) Ramp/Soak control (supports control on channel 1 and/or 2): change the third and fourth digits to "44". This option also requires you to purchase additional module(s) for the required output(s). Example: CT1344A-M8 is a three-pen recorder with ramp/soak control option and one isolated analog output (control on 1 channel).

4) RS-485 Communications option: change the fourth digit to "6". This option also requires the -MS module. Example: CT1106A-MS is a one-pen recorder with RS-485 communications. Note: the RS-485 option may be used with options 1 or 2.

SECTION 3 INSTALLATION

3.1 LOCATION

Select a location:

a) As close as possible to the primary sensing device(s).

b) Free from excessive vibration.

c) Within the temperature limits of 0° to 55°C and humidity limits of 0 to 80% RH.

d) Where the instrument's protection rating, IP54, is sufficient.

e) 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 grounded metal conduit must be used.

3.2 MOUNTING

Overall dimensions are shown in Figure 3-1. The instrument weighs approximately 10.5kg.

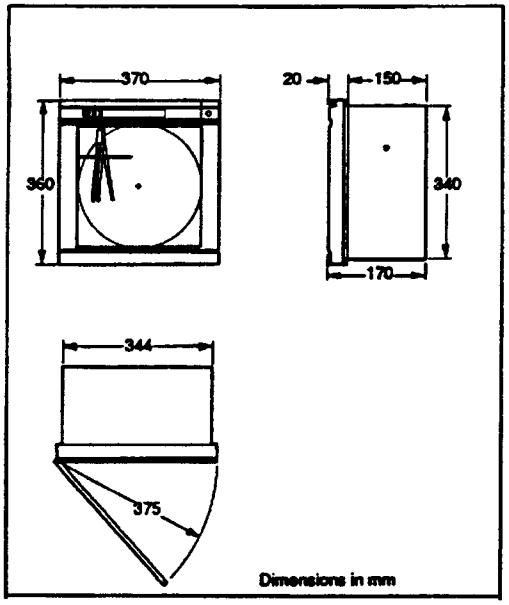


Figure 3-1. Overall Dimensions

3.2.1 Wall Mounting

Refer to Figure 3-2.

① Remove the three locating brackets from the top and sides of the case.

② Reverse the brackets and reattach to the case with the screws located in the holes in the brackets (not the slots). Tighten the screws firmly.

③ Mark and drill a mounting hole in the position for the top mounting bracket -the bracket locating hole is 8mm diameter.

④ Temporarily screw the instrument to the wall.

⑤ On the wall mark the positions of the remaining locating holes, making sure that the instrument is level. Drill appropriate holes in the wall.

⑥ Affix the recorder firmly to the wall.

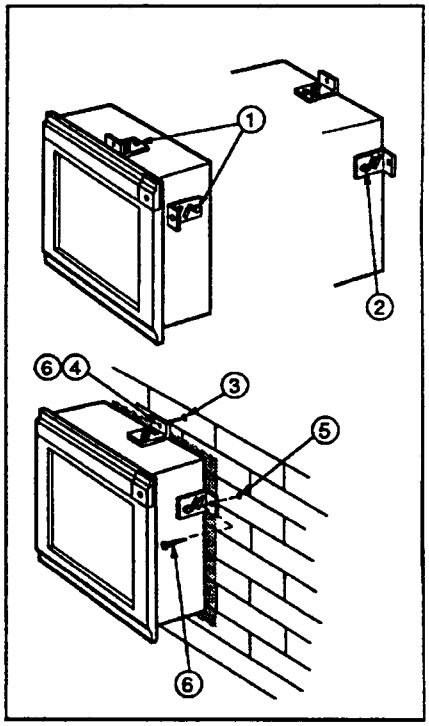


Figure 3-2. Wall Mounting

3.2.2 Panel Mounting

Use a heavy-duty panel. The maximum panel thickness is 35mm. Refer to Figure 3-3.

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 attaching brackets and screws from the top and sides.

③ Insert the instrument in the cut-out.

④ Replace the brackets, locating each attaching screw in the slot appropriate to the panel thickness.

⑤ Press the brackets hard against the panel and tighten the attaching screws.

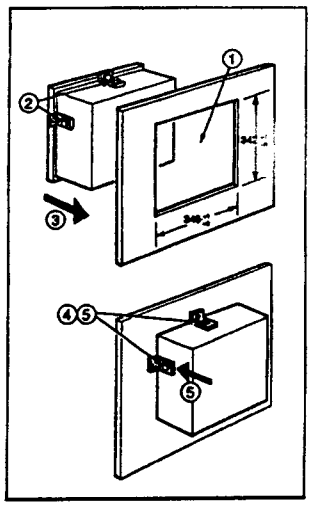


Figure 3-3 Panel Mounting

3.2.3 Fastening 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.

3.2.4 Post Mounting

The post mounting kit is designed for mounting the recorder on a 2" (2⅜" O.D.) vertical post. Refer to Figure 3-4.

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.

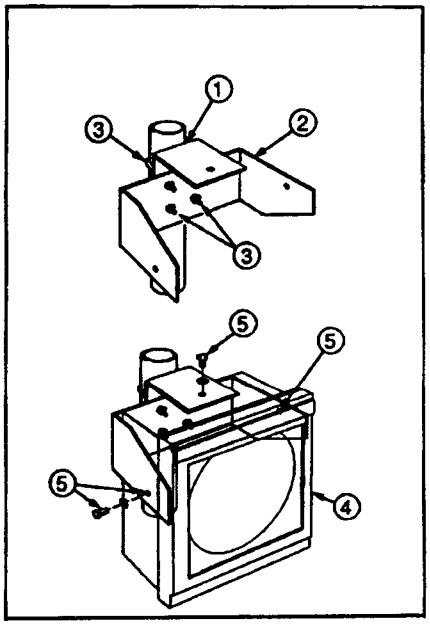


Figure 3-4. Post Mounting

SECTION 4 ELECTRICAL CONNECTIONS

WARNING

Before making any connections, make sure that the power supply, any high voltage power-operated control circuits and any high common mode voltages are turned off.

1. CAUTION To avoid damage to multichannel recorders, high common mode voltages up to 250V rms 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 to the negative terminals on all inputs are linked. Refer to Figures 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.

   If inter-channel isolation is required and the channel-to-channel voltage rises above 12.5V then use of the Type K isolation input module is recommended. Refer to Section 4.4.

2. If the recorder is to be re-programmed before use, make sure that the programming is complete before making any process signal connections. Refer to Section 8.

3. If the input type on any channel differs from that specified on the program card, refer to Section 4.3.1.

4.1 ACCESS TO TERMINALS

Unlock and open the door, release the chassis and swing it forward. Refer to Figure 2-1.

Now refer to Figure 4-1.

① Identify the signal connections terminal block.

② Identify the module(s) connections terminal block(s) if installed.

NOTE: Module types are defined in Section 2.3.

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 grounding cable connecting cover to case.

④ Identify the power supply terminal block.

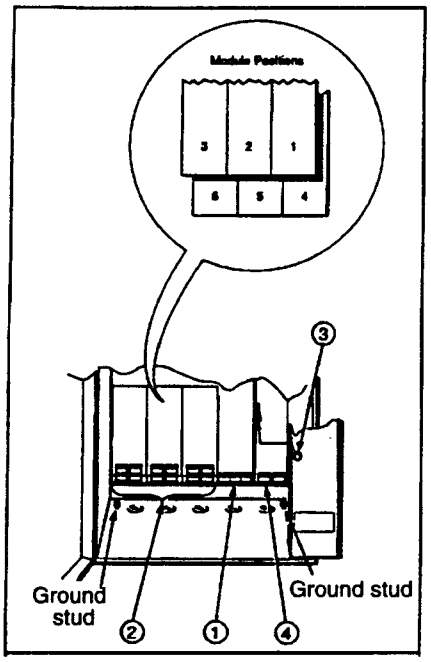


Figure 4-1. Access to Terminals

4.2 CONNECTIONS, GENERAL

a) The terminals accept cables of up to 2.5 mm^2 cross section.

b) Remove the 20mm diameter cable entry blanking plugs and replace them with cable glands or conduit adapters to suit the application.

c) Always route signal leads and power cable separately, preferably in grounded metal conduit. It is strongly recommended that, for signal inputs and relay connections, screened cable is used, with the screen connected to the ground stud(s). Refer to Figure 4-1.

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 (refer to Figures 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 install 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 Figure 4-5).

V and mA inputs - it is not necessary to make any connections to the input terminals (see Figure 4-3).

4.3.1 Selecting the Signal Input Type

Plug-in links are on the microprocessor printed circuit board. 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 - refer to Figure 2-1.

Refer to Figure 4-2.

① Identify the three links.

② Set the link positions for the required input type on each channel.

TABLE 2 THERMOCOUPLE CABLE COLORS

Type of Thermocouple	Thermocouple Wire			Extension Wire		
	+	–	Shield	+	–	Shield
J (Fe/Cu-Ni)	white	red	brown	white	red	black
K (Ni-Cr/Ni-Al)	yellow	red	brown	yellow	red	yellow
T (Cu/Cu-Ni)	blue	red	brown	blue	red	blue
E (Ni-Cr/Cu-Ni)	purple	red	brown	purple	red	purple
N (Nicrosil/Nisil)	orange	red	brown	orange	red	orange
R (Pt-13% Rh/Pt)	none established			black	red	green
S (Pt-10% Rh/Pt)	none established			black	red	green
Fe/Con (DIN 43710)	European			European		

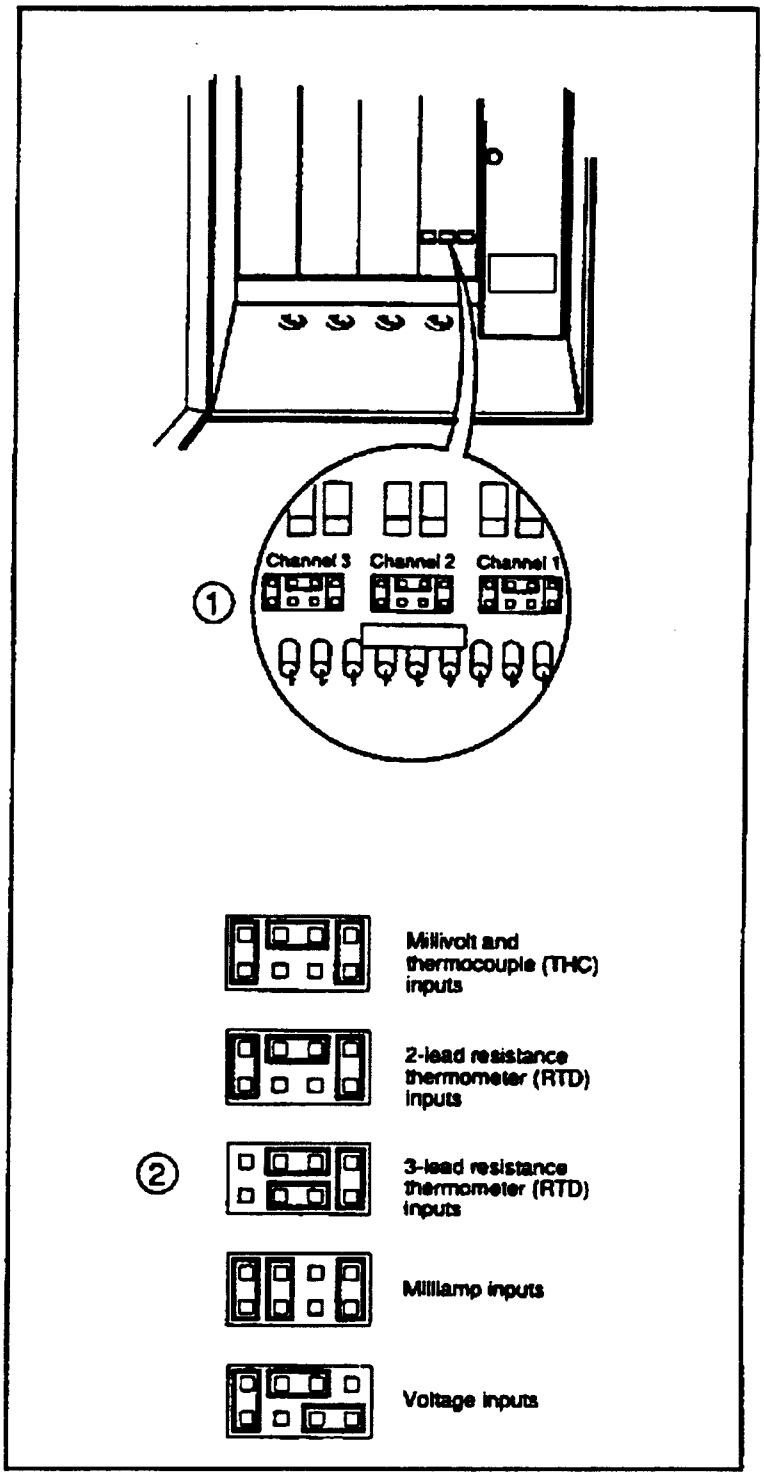


Figure 4-2. Selecting the Signal Input Type

4.3.2 Voltage and Current Inputs

Make connections as shown in Figure 4-3.

4.3.3 Thermocouple (THC) Inputs

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

Make connections as shown in Figure 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 RTD Inputs

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

Make connections as shown in Figure 4-5.

4.3.5 2-Lead RTD Inputs

Notes

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.

c) If the RTD is to be used in a hazardous area a 3-lead RTD must be used.

Make connections as shown in Figure 4-6.

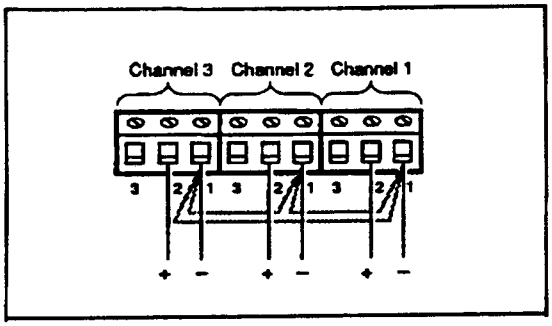


Figure 4-3. Voltage and Current Inputs

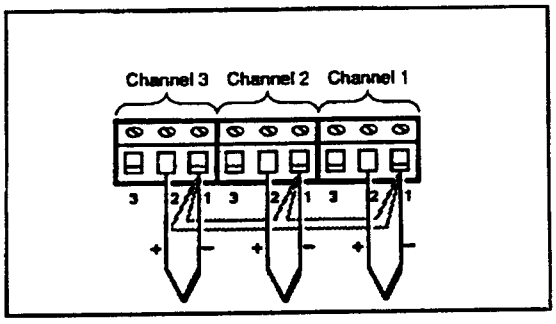


Figure 4-5. 3-Lead RTD Inputs

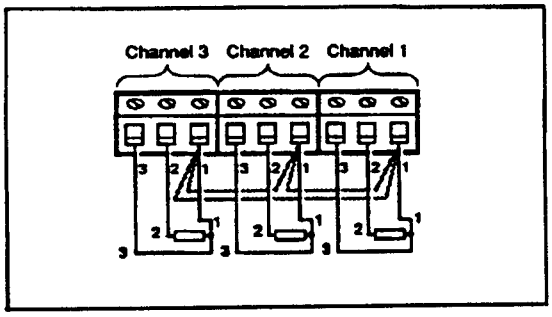


Figure 4-4. Thermocouple Inputs

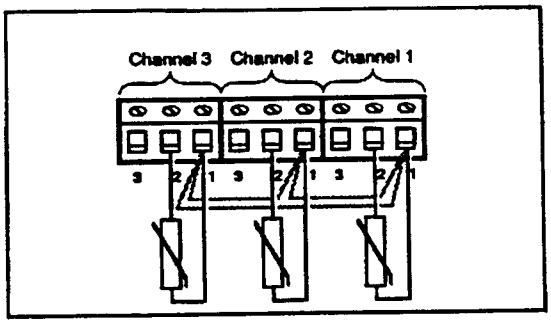


Figure 4-6. 2-Lead RTD Inputs

4.3.6 Transmitter Power Supply

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 Figure 4-7. Make connections as shown. Note that the connections shown dotted are made before the unit is shipped and must not be disturbed.

Determine the input voltage 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.

Refer to Figure 4-7:

① Identify the leads.

② Position both leads for the voltage supply to used by lifting each socket body away from the printed circuit board and withdrawing the lead. Lift the alternative socket away from the printed circuit board, push the lead in and snap the socket body down onto the printed circuit board to secure and make contact.

Note: A transmitter power supply board would not normally be installed in a DC powered instrument.

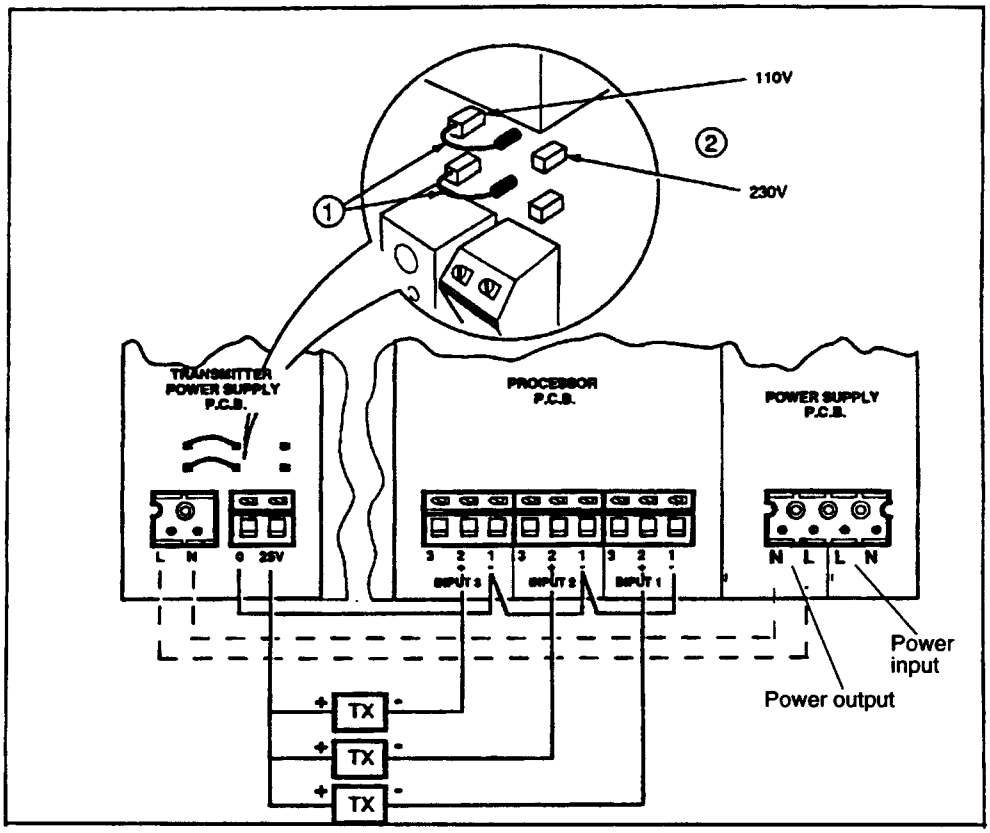


Figure 4-7. Transmitter Power Supply

4.4 ISOLATED SIGNAL CONNECTIONS

Up to two isolated input modules, Type K, may be installed to the recorder, occupying module position 2, for channel 2, and/or position 3 for channel 3 (see Figure 4-1).

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

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-ground isolation voltage is 2kV.

4.4.1 Selecting the Isolated Signal Input Type

Refer to Figure 4-8.

Plug-in links are 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. Refer to Section 8.

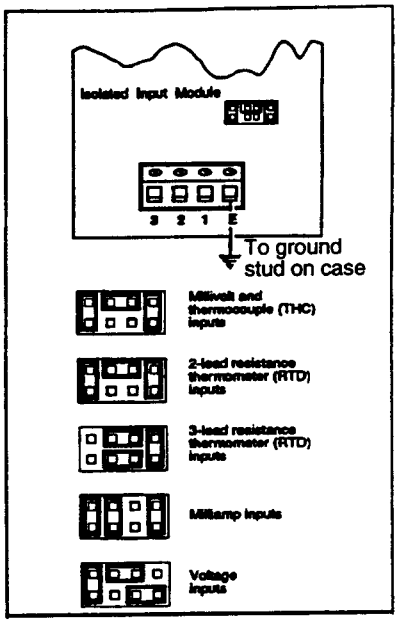


Figure 4-8. Selecting the Isolated Signal Input Type

TABLE 2 THERMOCOUPLE CABLE COLORS (repeated)

Type of Thermocouple	Thermocouple Wire			Extension Wire		
	+	–	Shield	+	–	Shield
J (Fe/Cu-Ni)	white	red	brown	white	red	black
K (Ni-Cr/Ni-Al)	yellow	red	brown	yellow	red	yellow
T (Cu/Cu-Ni)	blue	red	brown	blue	red	blue
E (Ni-Cr/Cu-Ni)	purple	red	brown	purple	red	purple
N (Nicrosil/Nisil)	orange	red	brown	orange	red	orange
R (Pt-13% Rh/Pt)	none established			black	red	green
S (Pt-10% Rh/Pt)	none established			black	red	green
Fe/Con (DIN 43710)	European			European		

4.4.2 Voltage and Current Inputs

Make connections as shown in Figure 4-9.

4.4.3 Thermocouple (THC) Inputs

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

Make connections as shown in Figure 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.

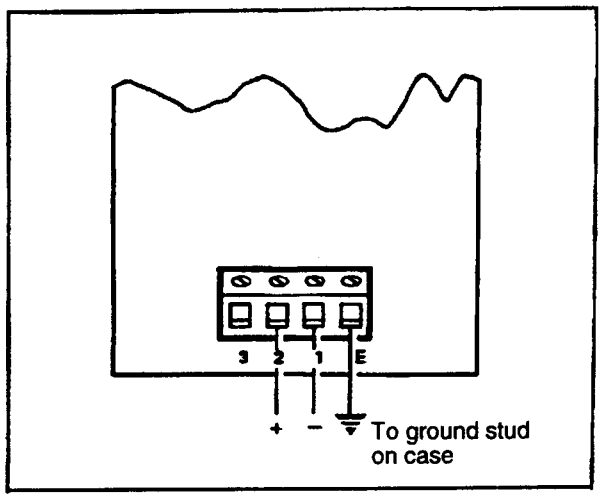


Figure 4-9. Voltage and Current Isolated Input

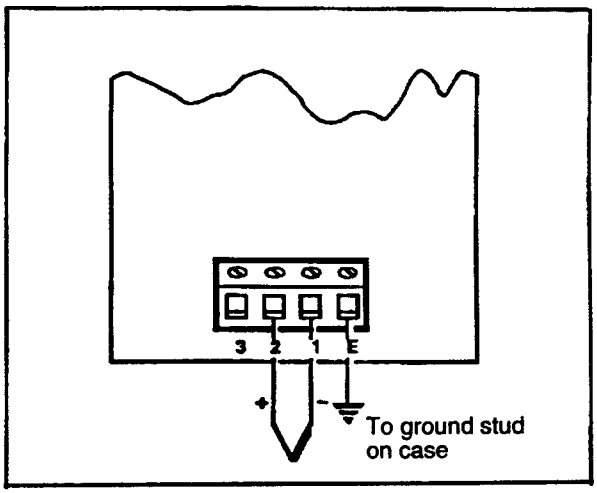


Figure 4-10. Thermocouple Isolated Input (non-hazardous areas)

4.4.4 3-Lead RTD Inputs

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

Make connections as shown in Figure 4-11.

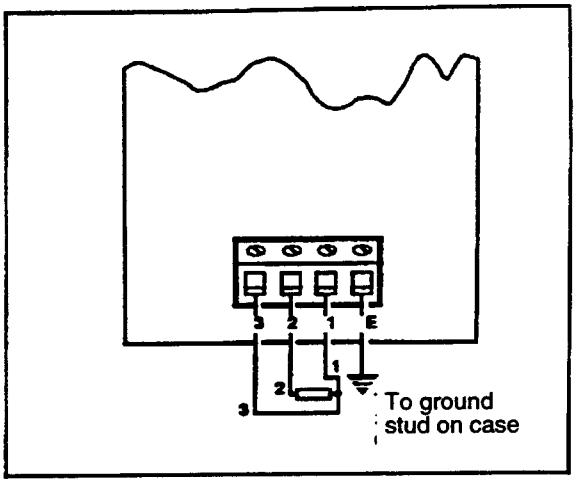


Figure 4-11. 3-Lead RTD Isolated Input (non-hazardous areas)

4.4.5 2-Lead RTD Inputs

Note:

a) If long leads are necessary it is preferable to use a 3-lead RTD. See the previous section.

b) If the lead resistance differs from that specified at the time of ordering, the recorder must be re-calibrated before using. See Section 10.

Make connections as shown in Figure 4-12.

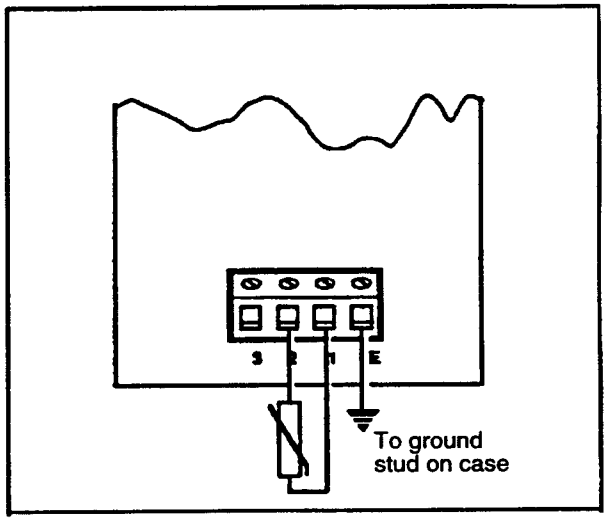


Fig. 4-12. 2-Lead RTD Isolated Input

4.5 OUTPUT CONNECTIONS

4.5.1 Relay Connections

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 Figure 4-13a or 4-13b.

NO = contact normally open

NC = contact normally closed

C = common

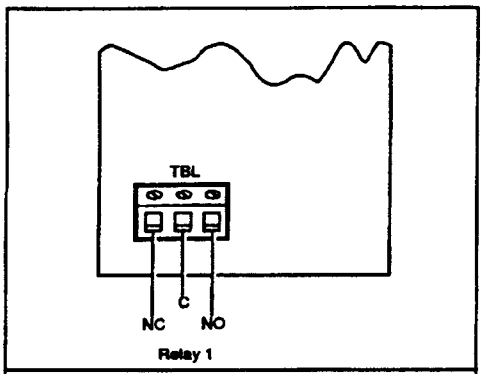


Figure 4-13a. Single Relay

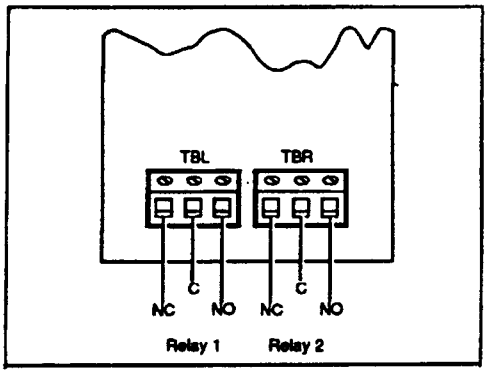


Figure 4-13b. Double Relay

4.5.2 Retransmission Connections

Make connections as shown in Figure 4-14a or 4-14b. The maximum output current (2mA or 20mA) is determined by the position of a plug-in link (PLI). Refer to Figure 4-14a.

① Position the link for the maximum output current required.

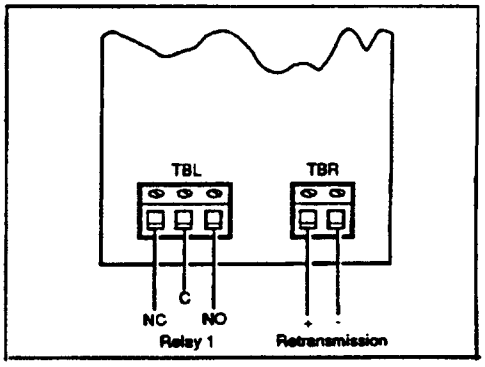


Figure 4-14b. Retransmission + Relay

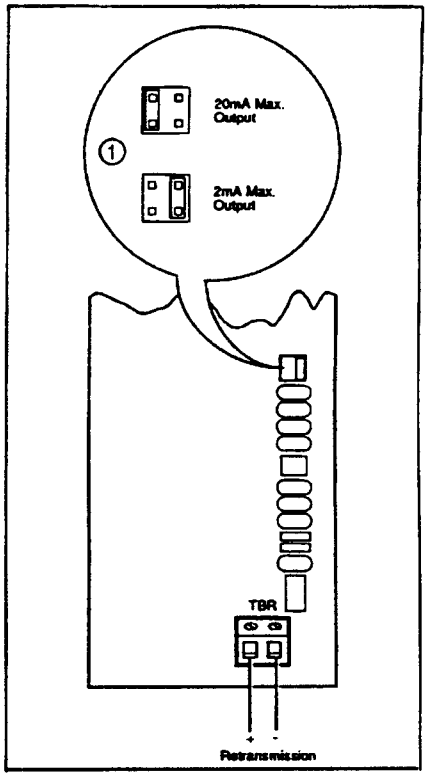


Figure 4-14a. Retransmission

4.5.3 Solid State Relay Drive

Where a solid state relay is used, make the relay drive connections as shown in Figure 4-15. The drive has a rating of 24V @ 30mA.

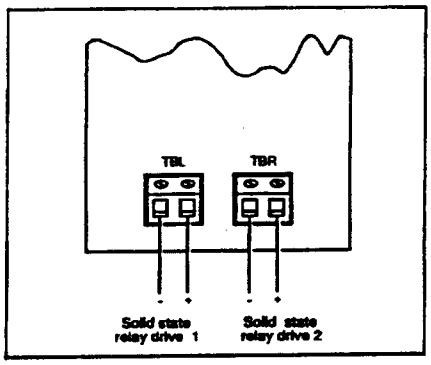


Figure 4-15. Solid State Relay Drive

4.5.4 Event Pen (CT-1214A or CT-1315A only)

Make connections to the terminal block on the event pen printed circuit board as shown in Figure 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 Figure 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.

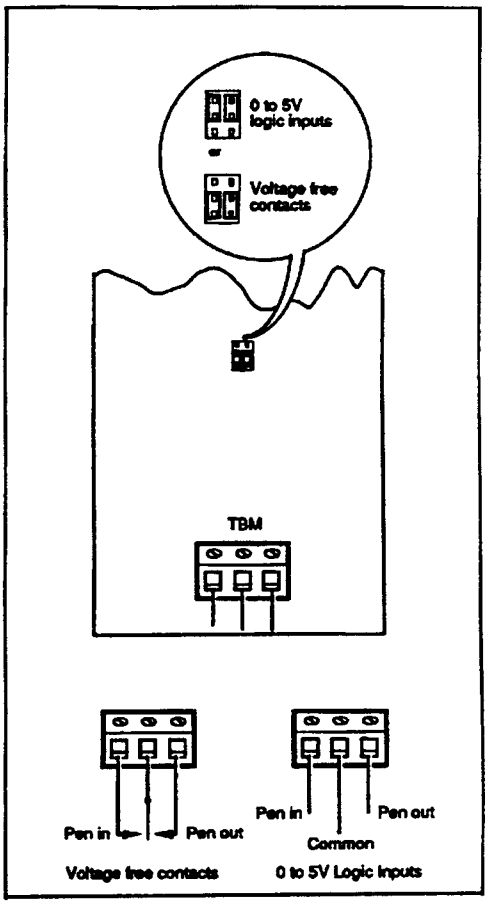


Figure 4-16. Event Pen

4.6 POWER SUPPLY

4.6.1 Input Voltage Connections

Unscrew the captive knurled attaching screw and remove the protective cover to the extent of the attached grounding cable (refer to Figure 4-1).

Connect the power cables as shown in Figure 4-17. Securely connect the power ground cable to the ground terminal stud attached to the recorder case. To select the input voltage refer to Section 4.6.2.

Reattach the protective cover. making sure that the grounding cable is securely attached and is within the cover after securing.

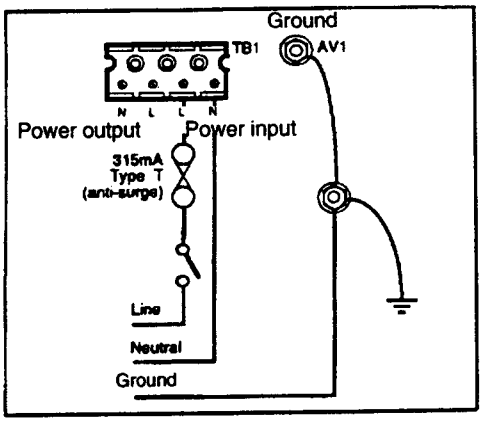


Figure 4-17. Power Input

4.6.2 Selecting the Input Voltage

The input voltage (110V or 230V) is selected by re-positioning a plug-in 'handbag' link on the power supply printed circuit board. Refer to Figure 4-18.

① Identify the link.

② Position the link for the supply voltage used.

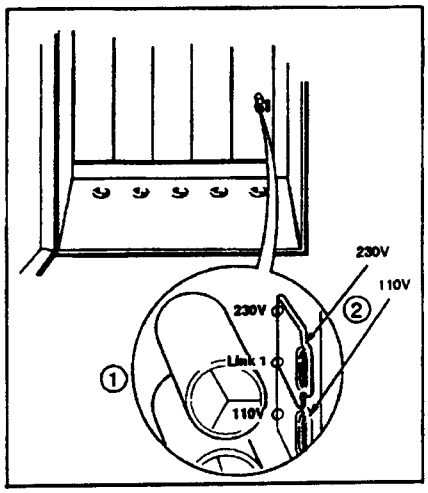


Figure 4-18. Selecting the Power Input Voltage

4.6.3 DC Supply

DC powered instruments accept a 10 to 30VDC supply. Make connections as shown in Figure 4-19.

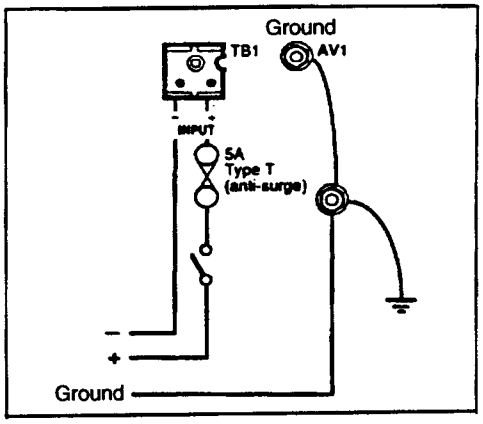


Figure 4-19. DC Supply Connections

SECTION 5 FAMILIARIZATION WITH CONTROLS, DISPLAY AND LED INDICATION

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

5.1 CONTROLS

Refer to Figure 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 (Refer to Figure 8-2).

'Page Advance' switch - used to advance to the next program page (refer to Figure 8-2).

'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

1. 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.
2. 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.

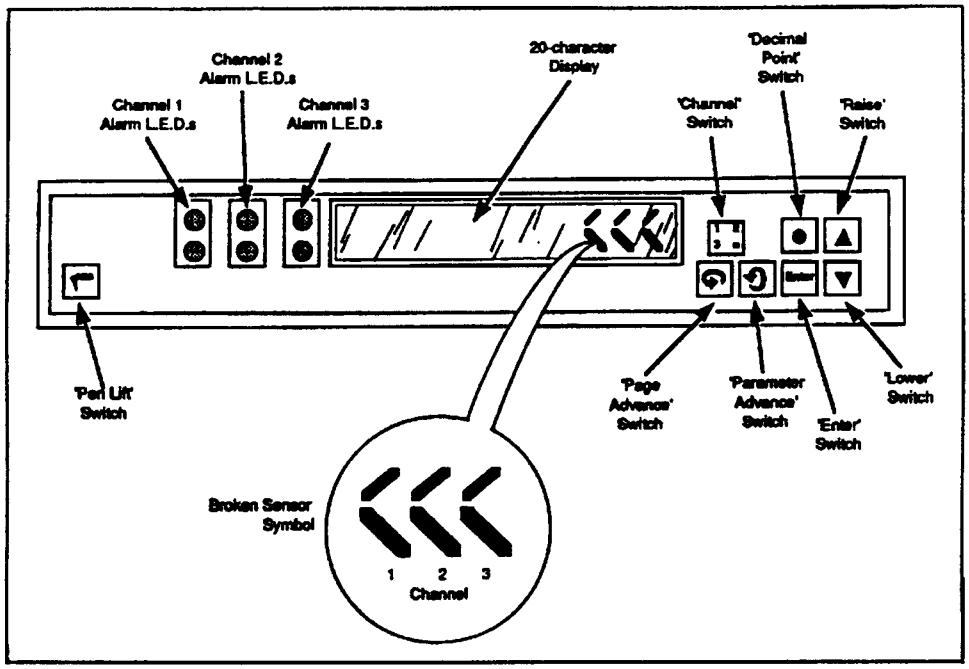


Figure 5-1. Control Panel

5.2 DISPLAY

A 20-character 5 x 7 dot-matrix, blue-filtered, 'vacuum fluorescent display is used to display of all operating and programming parameters. Refer to Figure 5-1.

5.2.1 Broken Sensor

The position of broken sensor symbols on the display identifies the channel affected - refer to Figure 5-1.

5.3 Alarm LED Indication

Alarm states are indicated by a vertical pair of red/green LEDs for each pen.

SECTION 6 SETTING UP

6.1 RECORDER START-UP

CAUTION Make sure that all connections, especially to the ground 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. (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. For instruments that also have an event pen, the event marker draws on the same time line as the red pen.

Turn on 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 turned 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). Refer to Section 7.1.

6.2 INSTALLING THE CHART

Refer to Figure 6-1. Make sure 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 Install the new chart on to the spindle, making sure 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 make sure 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.

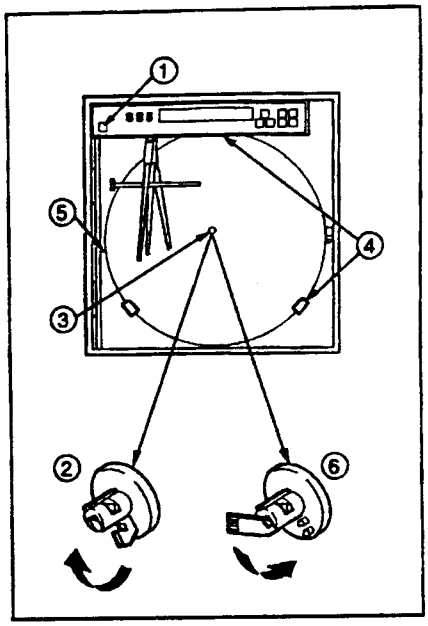


Figure 6-1. Installing the Chart

6.3 INSTALLING THE PEN CAPSULE(S)

With the power supply to the instrument turned on operate the 'Pen Lift' switch. Refer to Figure 5-1. While referring to Figure 6-2,

① Gently pull each individual pen arm down off the bracket, taking care not to bend the arms.

② Remove the used capsule by sliding it up the pen arm.

③ Install a new capsule on the arm by sliding the 'dove-tail' on the capsule into the slot in the pen arm. Pen arms are identified by the colored moldings at the top of each arm; red (No. 1 pen), green (No. 2 pen), and blue (No. 3 pen). The appropriate colored ink capsule must be used.

④ Hold the new pen capsule and gently twist and pull the cap from the pen fiber tip.

⑤ Slide the pen arm and capsule assembly on to the appropriate pen arm bracket until it clips into place, making sure 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 make sure 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 installed incorrectly, and this situation must be carefully corrected.

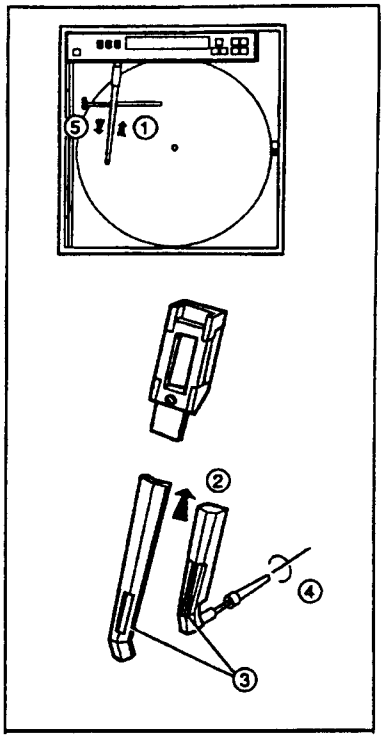


Figure 6-2. Installing the Pen Capsules

SECTION 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. Refer to Figure 5-1.

Operating the 'Page Advance' switch selects a second Operating Page **(Operating Page 2)** for viewing or changing the alarm setpoints. Required changes to the setpoint values are made using the 'Raise' and 'Lower' switches. Refer to Figure 5-1.

More pages can be selected using the 'Channel' and 'Page Advance' switches if the Security Link is enabled. Refer to Figures 5-1, 8-1 and 8-2.

7.1 OPERATING PAGE 1

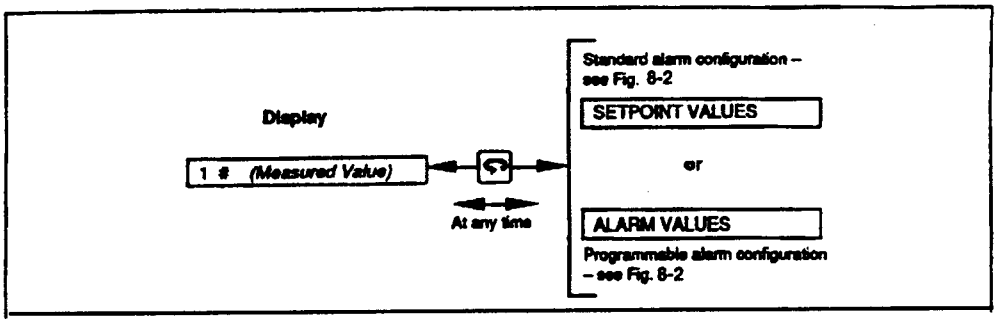


Figure 7-1. Operating Page 1, Single Pen Instruments

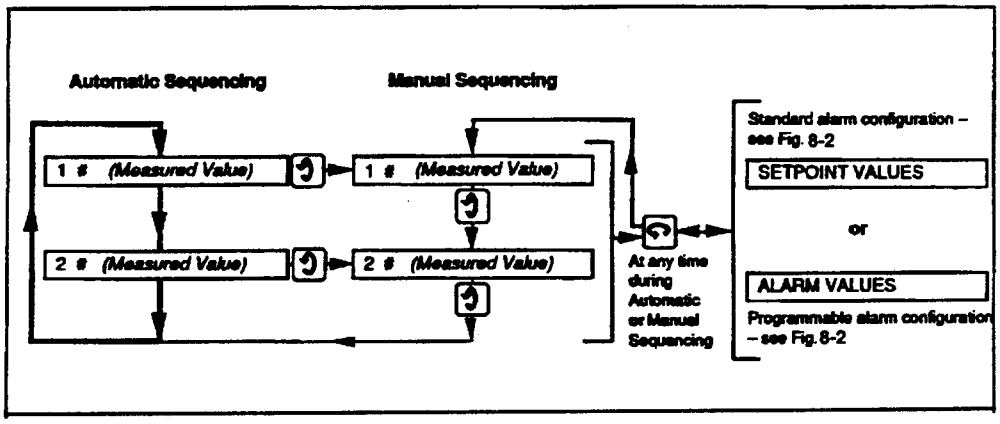


Figure 7-2. Operating Page 1, Two-pen Instruments

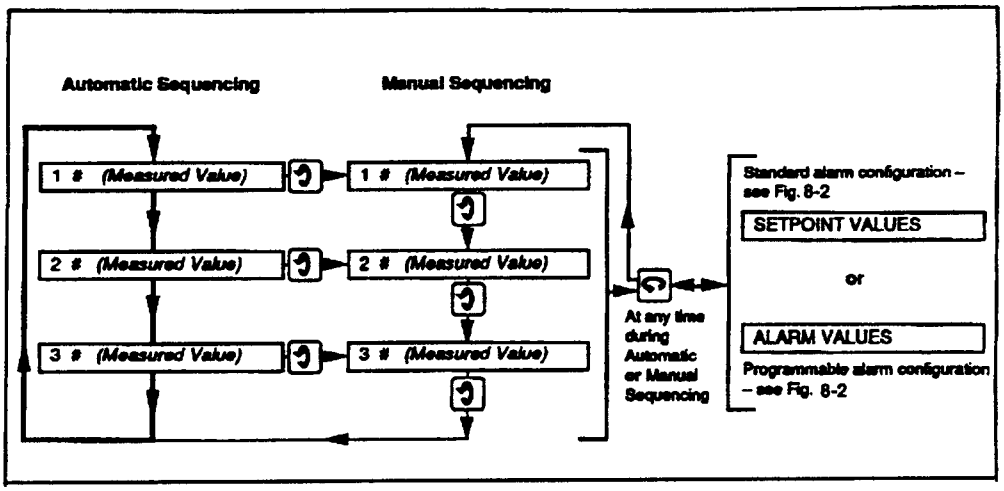
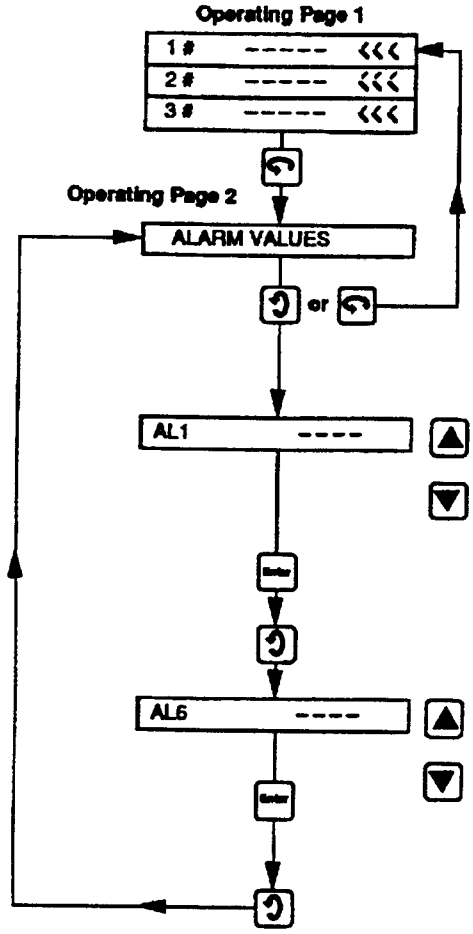


Figure 7-3. Operating Page 1, Three-pen Instruments

7.2 OPERATING PAGE 2

7.2.1 Programmable Options



Where ALARM CONFIG PROG has been selected in the PROG COMMON SETTINGS page (Figure 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.

Note 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. Refer to Figure 8-2.

Store.

Advance to next parameter.

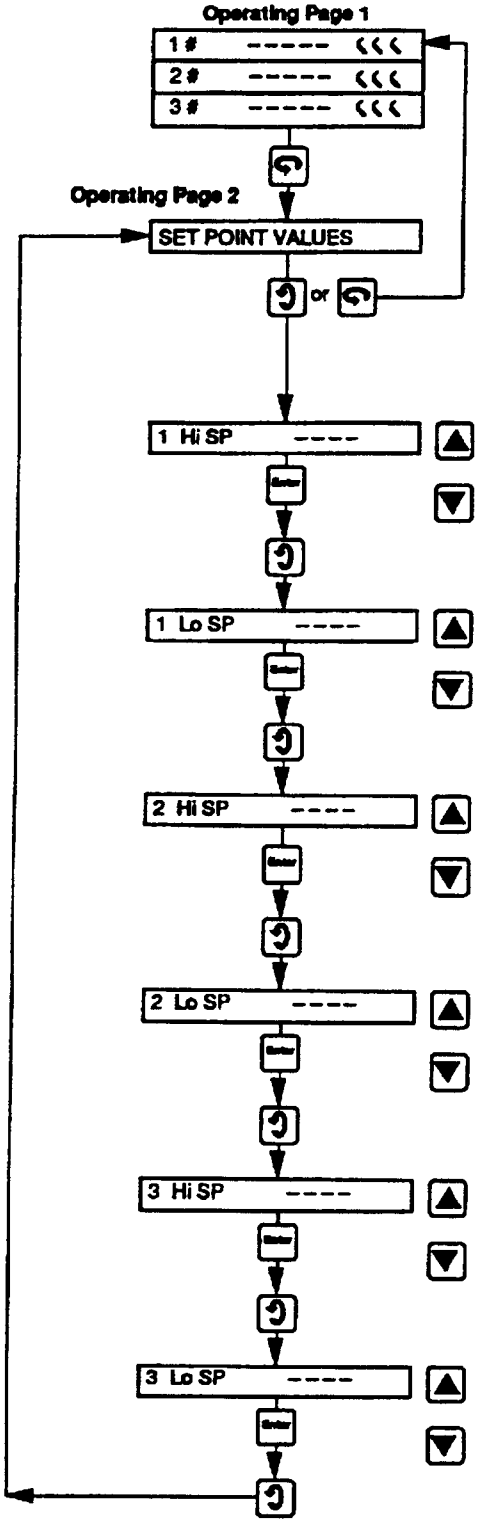
Alarm 6

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.

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

1 High Alarm Setpoint
Set the high level alarm value for channel 1.

Store.

Advance to next parameter.

1 Low Alarm Setpoint
Set the low level alarm value for channel 1.

Store.

Advance to next parameter.

2 High Alarm Setpoint
Set the high level alarm value for channel 2.

Store.

Advance to next parameter.

2 Low Alarm Setpoint
Set the low level alarm value for channel 2.

Store.

Advance to next parameter.

3 High Alarm Setpoint
Set the high level alarm value for channel 3.

Store.

Advance to next parameter.

3 Low Alarm Setpoint
Set the low level alarm value for channel 3.

Store.

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

SECTION 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) Make sure that programming is enabled. See Section 8.2.

8.2 PROGRAM SECURITY LINK

A plug-in link is used to prevent unauthorized programming of the instrument, by preventing access to the Programming Pages. Refer to Figures 8-1 and 8-2.

① Identify the link.

② Enable or disable the **Program Pages**, as required.

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

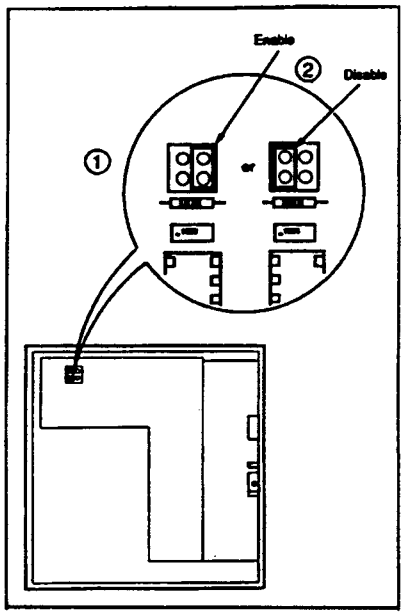


Figure 8-1. Setting the Program Security Link

8.3 TO CHANGE THE PROGRAM, PREPARATION

Open the door, release the chassis and swing it forward. Refer to Figure 2-1.

Make sure that:

a) Input links are correctly positioned. Refer to Figure 4-2 (or Figure 4-8 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. Refer to Figure 5-1.

Carry out all programming, other than calibration (see Section 10) with the pens lifted. If the pens drop during programming, press the 'Pen Lift' switch. Refer to Figure 5-1.

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

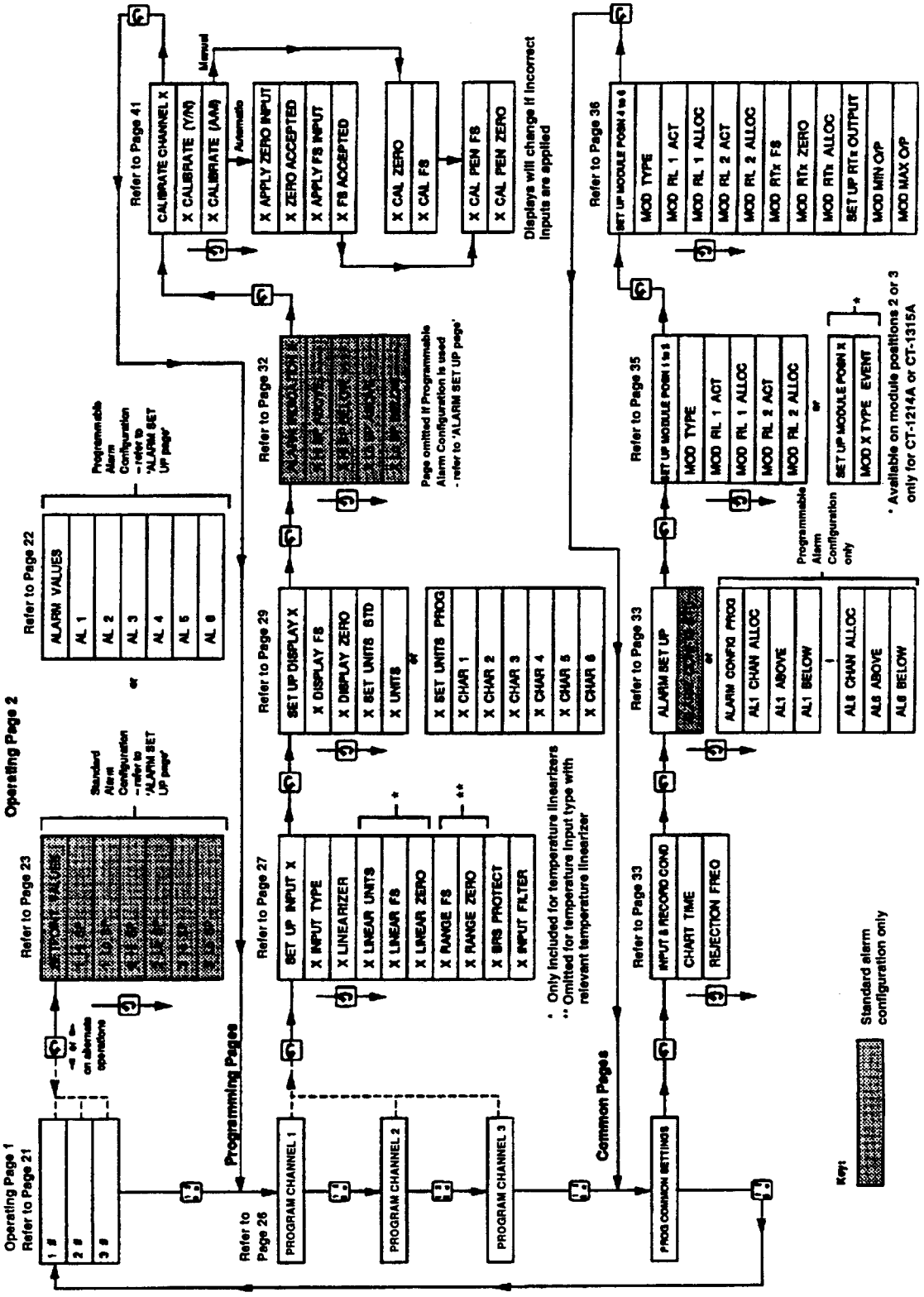
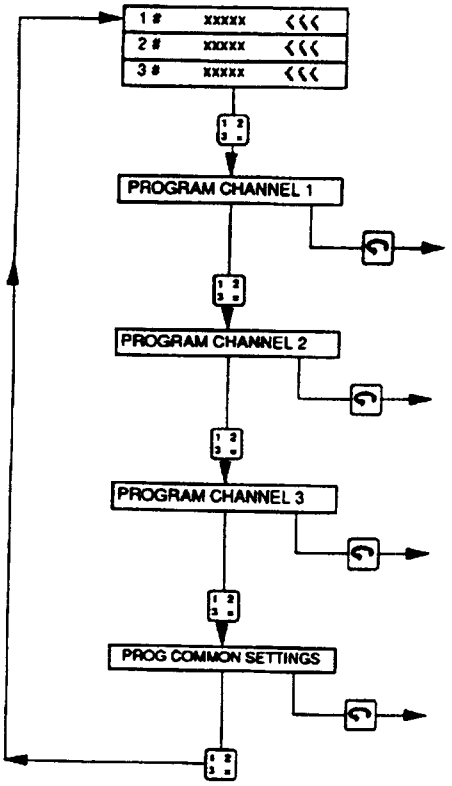


Figure 8-2. Overall Program Chart

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 ≤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.

Table 3 Electrical Limits

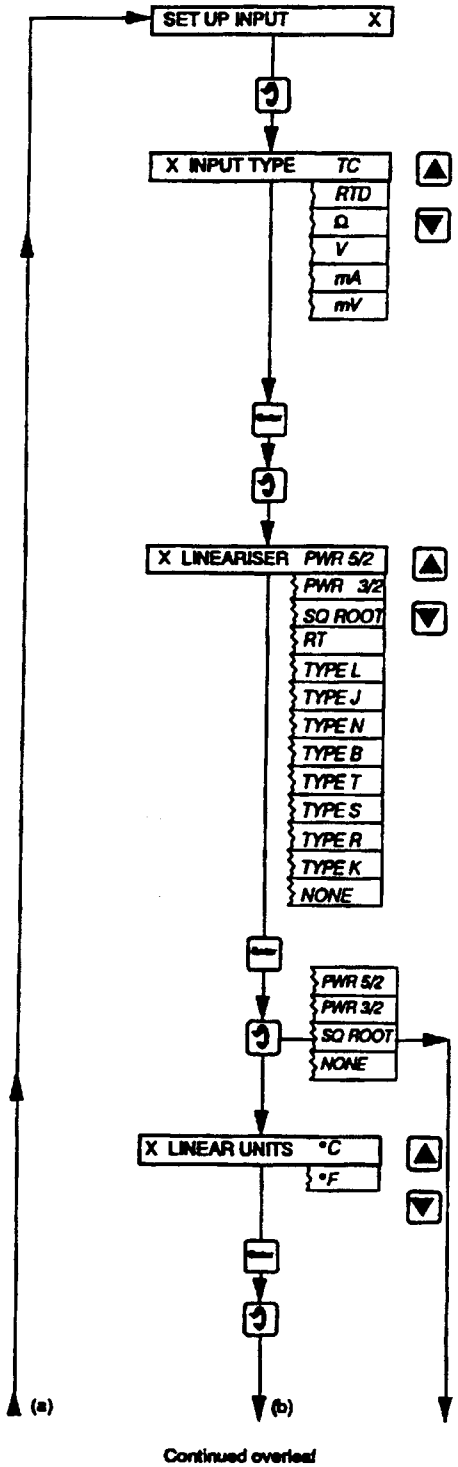
Input Type (Electrical)	Min. Start	Min. Span	Max. Span and Range Value
Millivolts	-999	5.00	1000
Volts	-20.0	0.50	20.0
Milliamps	-99.9	0.50	100.0
Resistance	20.0	20.0	2000

Table 4 Temperature Limits

Input Type (Temperature Inputs)	°Centigrade			°Fahrenheit		
	Minimum Start Temp.	Min. Span	Max. Temp.	Minimum Start Temp.	Min. Span	Max. Temp.
Thermocouples:						
Type J (Fe/Cu-Ni)	-100	100	900	-148	180	1652
(Fe/Con) DIN 43710	-100	100	900	-148	180	1652
Type K (Ni-Cr/Ni-Al)	-100	150	1300	-148	270	2372
Types R & S (Pt/PtRh)	-18	600	1700	0	1080	3092
Type T (Cu/Cu-Ni)	-250	120(+ve)* 170(-ve)**	300	-418	216(+ve)* 306(-ve)**	572
Type E (Ni-Cr/Cu-Ni)	-100	100	900	-148	180	1652
Type B (Pt-30%Rh/Pt-6%Rh)	-18	1100	1800	0	1980	3272
Type N (Nicrosil/Nisil)	-200	180(+ve)	1300	-328	324(+ve)	2372
RTD, Pt100 (BS1904)	-200	50	600	-328	90	1112

*Minimum span for ranges above zero
**Minimum span for ranges below zero

8.5 SET UP INPUT PAGE (CONTINUED)



Advance to next parameter.

Input Type

Make sure that the input links are in the correct positions for the required input type for the channel (refer to Figure 4-2 or 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.

Linearizer

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

Store.

Advance to next parameter.

Linearizer Units

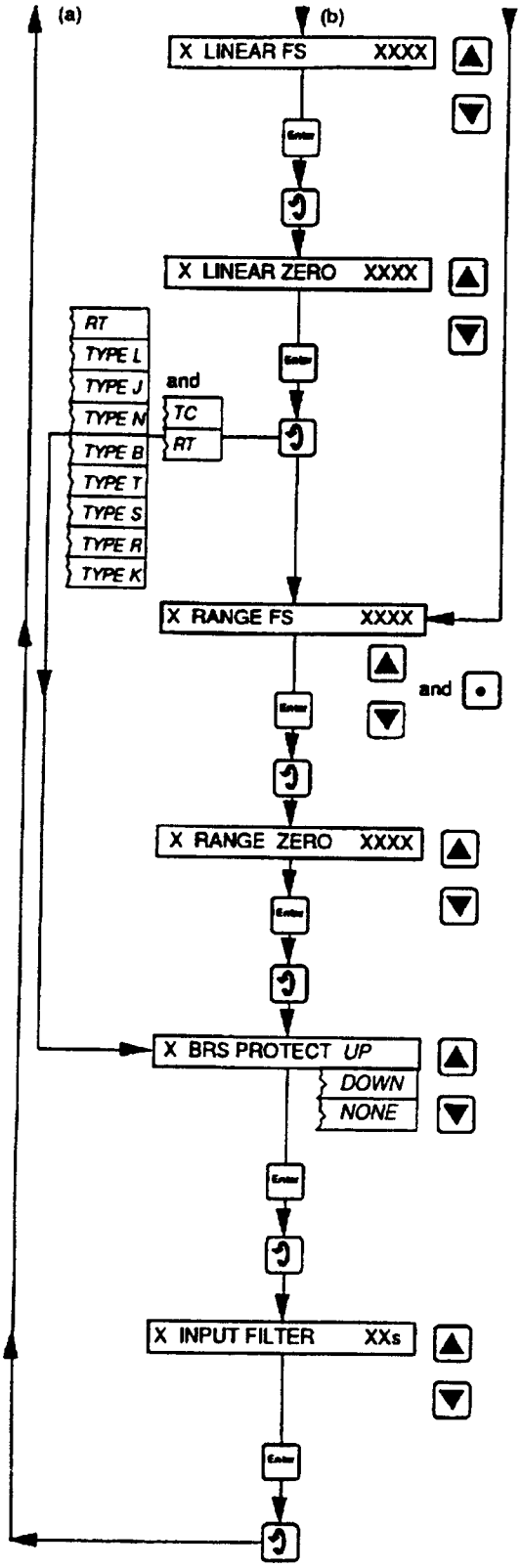
Select either °C or °F as required.

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

Store.

Advance to next parameter.

Continued from previous page



Linearizer 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.

Linearizer 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 with an event pen, see Section 8.11.4.

Store.

Advance to next parameter.

Range Zero

Set the lowest range value - 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.

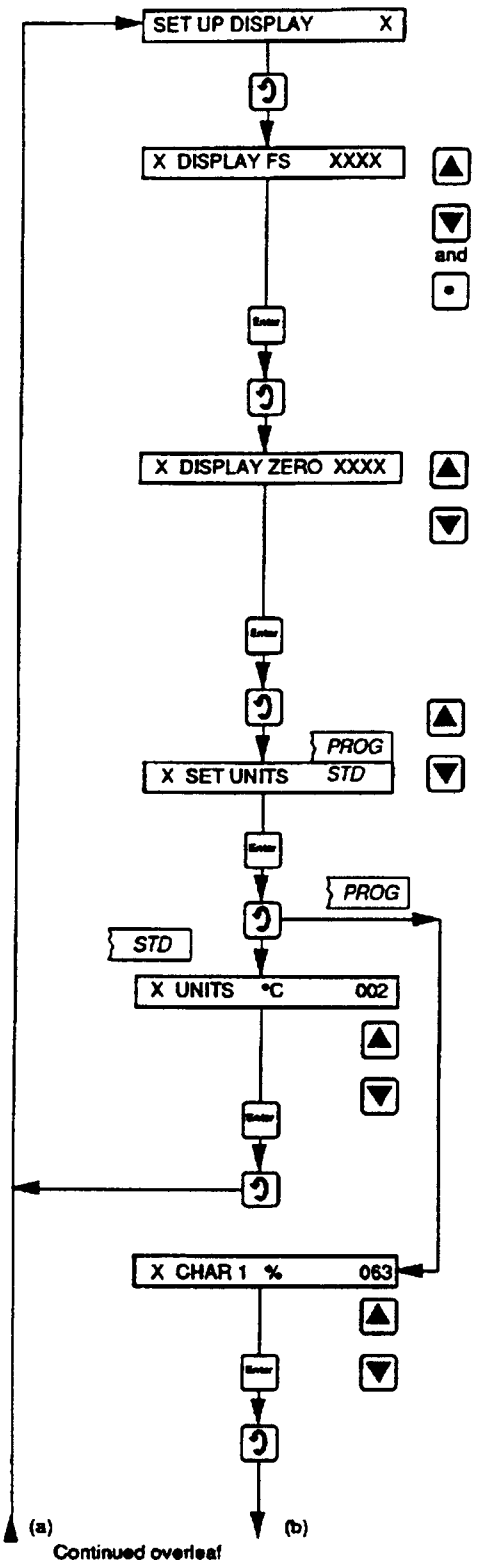
Input Filter

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 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 customize 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.

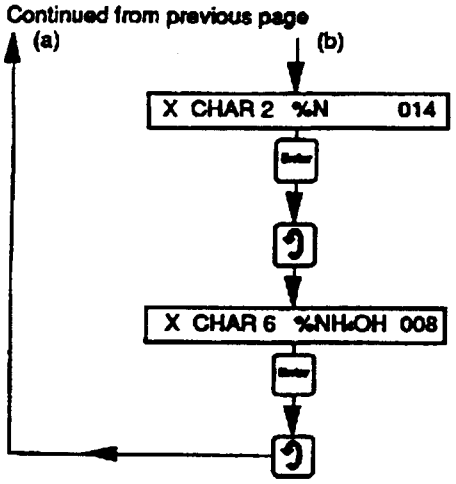
Store.

Advance to next parameter.

Character 1
Set the code number corresponding to the first character of the customized six-digit unit of measurement selected from the characters listed in Table 5.

Store.

Advance to next parameter.



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.

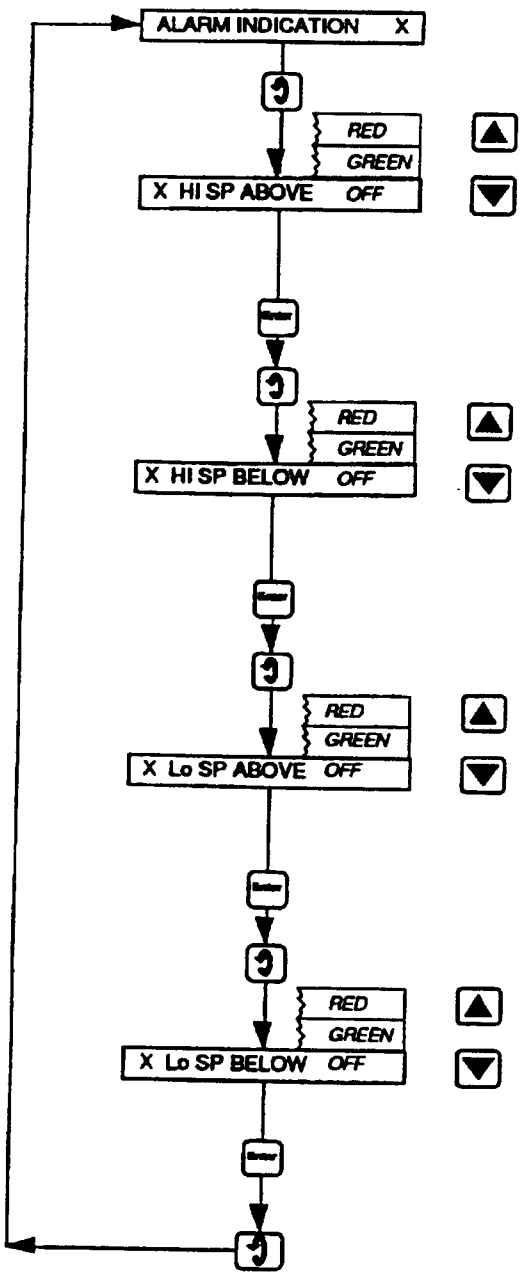
Table 5 Character Set

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	ð
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	β	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 6 Display Units Codes

Code	Unit	Display
001	(no unit)	
002	°Celsius	°C
003	°Fahrenheit	°F
004	Kelvin	K
005	differential °C	δ°C
006	differential °F	δ°F
007	% relative humidity	%RH
008	percent	%
009	parts/million	ppm
010	parts/billion	ppb
011	microvolts	µV
012	millivolts	mV
013	volts	V
014	kilovolts	kV
015	microamps	µA
016	milliamps	mA
017	amperes	A
018	ohms	Ω
019	kilohms	kΩ
020	megohms	MΩ
021	milliwatts	mW
022	watts	W
023	kilowatts	kW
024	megawatts	MW
025	voltamps	VA
026	kilovoltamps	kVA
027	reciprocal ohms	mho
028	siemens	S
029	microsiemens/cm	µS/cm
030	millisiemens/cm	mS/cm
031	microsiemens/meter	µS/m
032	millisiemens/meter	mS/m
033	potential hydrogen	pH
034	micrograms/kilogram	µg/kg
035	milligrams/kilogram	mg/kg
036	micrograms/liter	µg/l
037	milligrams/liter	mg/l
038	liters/day	l/d
039	liters/hour	l/h
040	liters/minute	l/m
041	liters/second	l/s
042	megaliters/day	Ml/d
043	megaliters/hour	Ml/h
044	megaliters/minute	Ml/m
045	megaliters/second	Ml/s
046	gallons/day	gal/d
047	gallons/hour	gal/h
048	gallons/minute	gal/m
049	gallons/second	gal/s
050	cubic meters/day	m^3/d
051	cubic meters/hour	m^3/h
052	cubic meters/minute	m^3/m
053	cubic meters/second	m^3/s
054	cubic feet/day	ft^3/d
055	cubic feet/hour	ft^3/h
056	cubic feet/minute	ft^3/m
057	cubic feet/second	ft^3/s
058	standard cubic ft/min	SCFM
059	kilograms/day	kg/d
060	kilograms/hour	kg/h
061	kilograms/minute	kg/m
062	kilograms/second	kg/s
063	tons/day	T/d
064	tons/hour	T/h
065	tons/minute	T/m
066	tons/second	T/s
067	pounds/day	lb/d
068	pounds/hour	lb/h
069	pounds/minute	lb/m
070	pounds/second	lb/s
071	imp. tons/day	ton/d
072	imp. tons/hour	ton/h
073	imp. tons/minute	ton/m
074	imp. tons/second	ton/s
075	millibars	mbar
076	bars	bar
077	millimeters water gauge	mm WG
078	meters water gauge	m WG
079	inches water gauge	in WG
080	feet water gauge	ft WG
081	millimeters of mercury	mm Hg
082	meters of mercury	m Hg
083	inches of mercury	in Hg
084	feet of mercury	ft Hg
085	pounds/sq. in.	psi
086	pounds/sq. in	lb/in^2
087	newtons/sq. meter	N/m^2
088.	kilonewtons/sq. meter	kN/m^2
089	pascals	Pa
090	kilopascals	kPa
091	megapascals	MPa
092	kilograms/sq. cm	kg/cm^2
093	newtons	N
094	grams	g
095	kilogram	kg
096	ounces	oz
0§7	pounds	lb
098	% saturation	% sat
098	milliliters	ml
100	liters	l
101	gallons	gal
102	millimeters	mm
103	meters	m
104	kilometers	km
105	British thermal units/hour	btu/h
106	seconds	sec
107	minutes	min
108	hours	hr
109	hertz	Hz
110	kilohertz	kHz
111	megahertz	MHz
112	% sulphuric acid	% H_2SO_4
113	% sulphur monoxide	%SO
114	% sulphur dioxide	%SO_2
115	% carbon monoxide	%CO
116	% carbon dioxide	%CO_2
117	% oxygen	%O_2
118	% nitric oxide	% NO
119	% nitrogen peroxide	% NO_2
120	% nitrogen	% N_2
121	% hydrogen	%H
122	% hydrochloric acid	%HCl
123	% fruit acid content	brix
124	nephelometric turbidity units	NTU
125	% obscuration	%OBS
126	kiloliters	kl
127	kilogallons	kgal
128	megaliters	Ml
129	megagallons	Mgal
130	cubic meters	m^3
131	kilo-cubic meters	km^3
132	mega-cubic meters	Mm^3
133	cubic meters per second	CUMEC
134	joules	J
135	kilojoules	kJ
136	megajoules	MJ
137	tons	T
138	kilotons	kT
139	megatons	MT
140	British thermal units	btu
141	cubic feet	ft^3
142	kilo-cubic feet	kft^3
143	mega-cubic feet	Mft^3
144	coulombs	C
145	revolutions per minute	rpm
146	grams/liter	g/l
147	grams/hour	g/h
148	grams/day	g/d
149	milliliters/minute	ml/m
150	milliliters/hour	ml/h
151	% dissolved oxygen	%dO_2
152	% dissolved carbon dioxide	dCO_2
153	millimolar	mM
154	molar	M
155	parts/million hydrogen sulphide	ppmH_2S
156	% hydrogen sulphide	%H_2S

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 Setpoint Above

Select the color of LED to be illuminated above the high setpoint.

Store.

Advance to next parameter.

High Alarm Setpoint Below

Select the color of LED to be illuminated below the high setpoint.

Store.

Advance to next parameter.

Low Alarm Setpoint Above

Select the color of LED to be illuminated above the low setpoint.

Store.

Advance to next parameter.

Low Alarm Setpoint Below

Select the color of LED to be illuminated below the low setpoint.

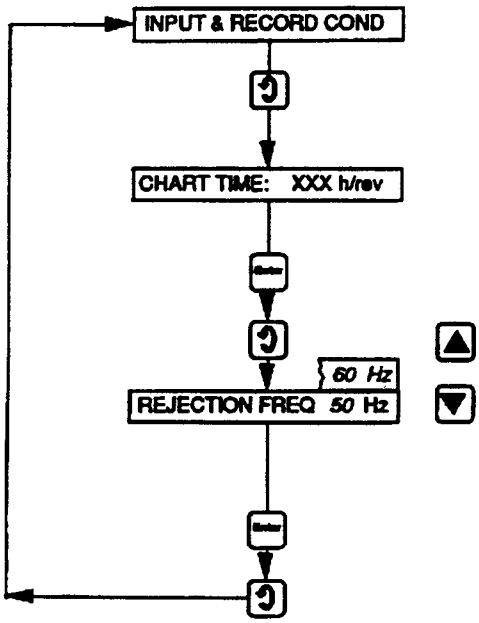
Store.

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.

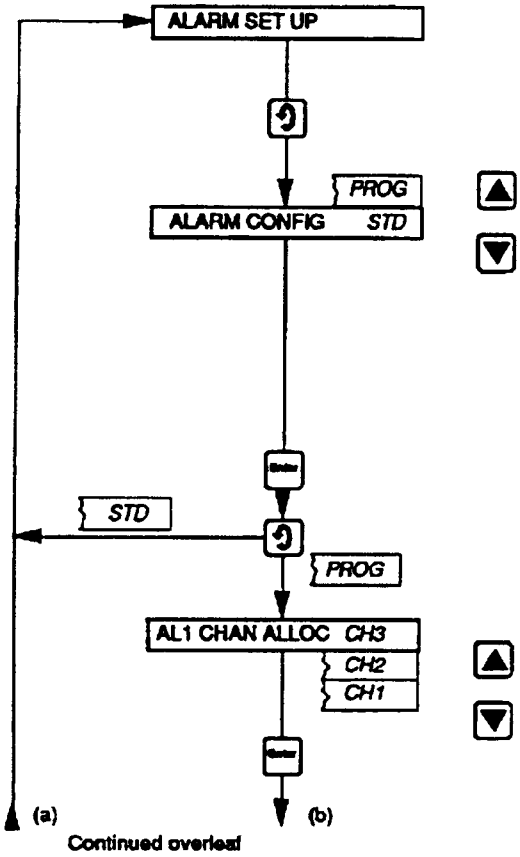
Rejection Frequency

Rejection Frequency eliminates interference at power frequency. Select local power of input frequency.

Store.

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

8.10 ALARM SET UP PAGE



Continued overleaf

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.

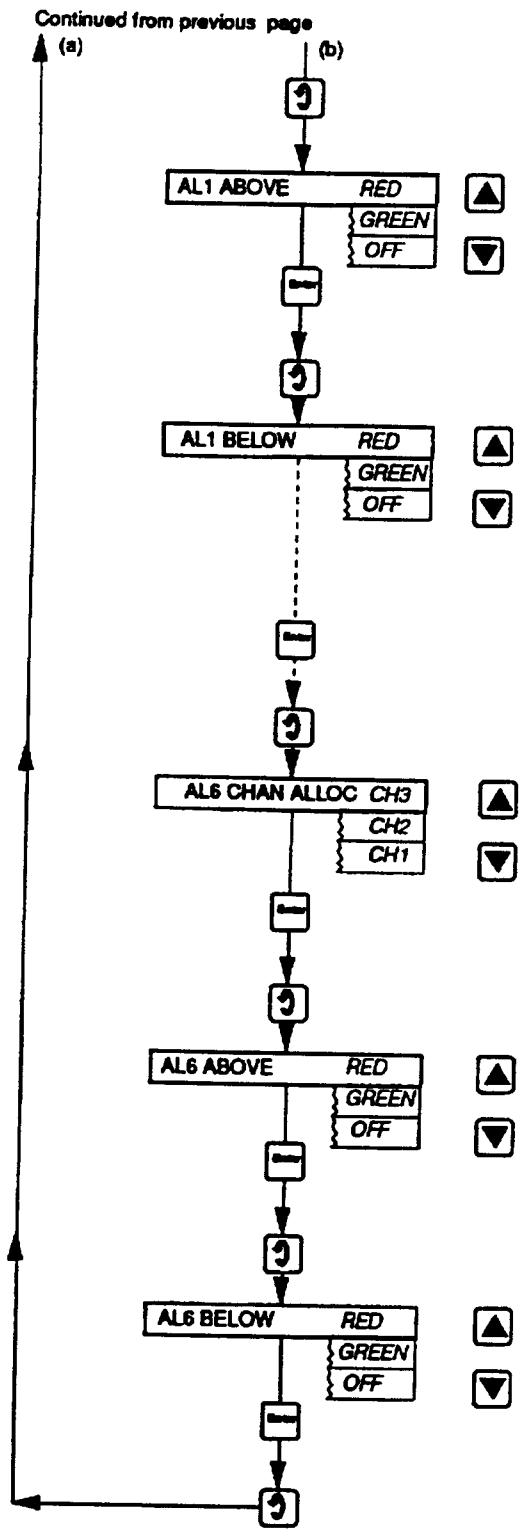
Store.

Advance to next parameter.

Alarm 1 Channel Allocation

Select the channel number to which the alarm setpoint is to be allocated.

Store.



Advance to next parameter.

Alarm 1 Above

Select the color of LED to be illuminated above the setpoint.

Store.

Advance to next parameter.

Alarm 1 Below

Select the color of LED to be illuminated below the setpoint.

Repeat the above steps for the remaining five alarm setpoints.

Store.

Advance to next parameter.

Store.

Advance to next parameter.

Store.

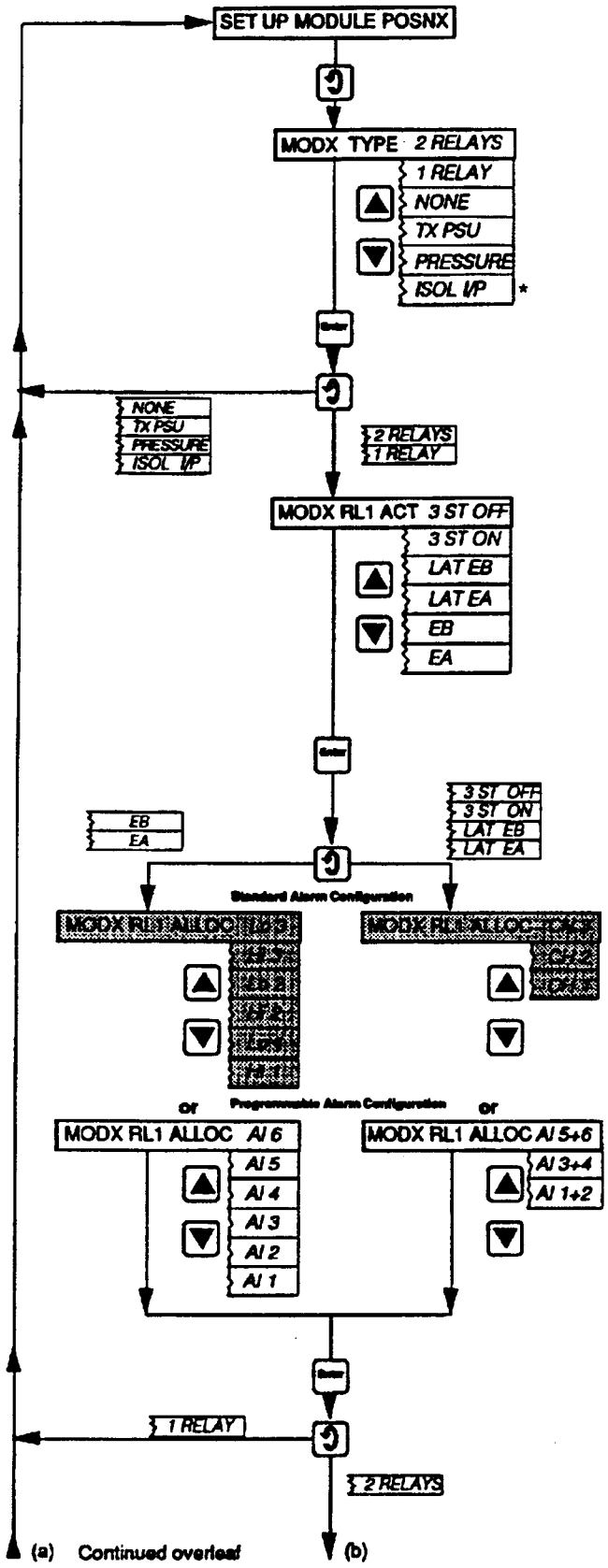
Advance to next parameter.

Store.

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

8.11 SET UP MODULE PAGE

8.11.1 Module Positions 1, 2 and 3



Set Up Module Position 1, 2 and 3.
Note On single pen instruments no modules can be installed in positions 2 and 3.

Advance to next parameter,

Module Position 1, 2 and 3 Type

Select the module type installed in module position 1, 2 or 3. Refer to Figure 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 setpoints
'3 ST ON'	- 3-state on between setpoints
'LAT EB'	- latch below setpoints
'LAT EA'	- latch above setpoints
'EB'	- energized below setpoint
'EA'	- energized above setpoint.

See Section 12 for more detailed information on alarm setpoints.

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.

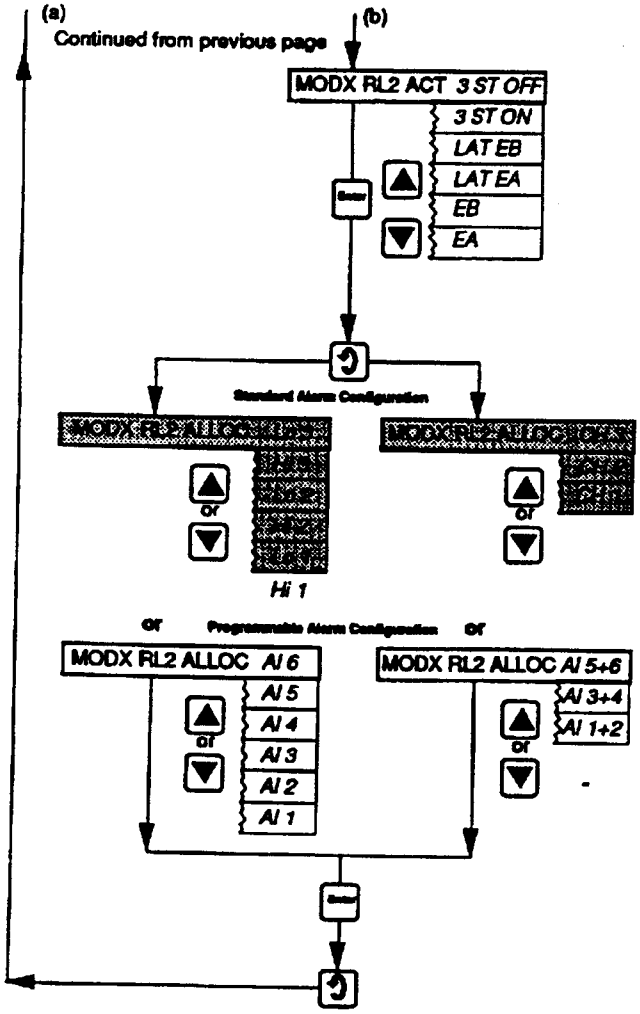
Module Position 1, 2 and 3, Relay 1 Allocation (Programmable Alarm Configuration)
For 'EA' or 'EB' alarm action:
Allocate the relay to an alarm point.

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.

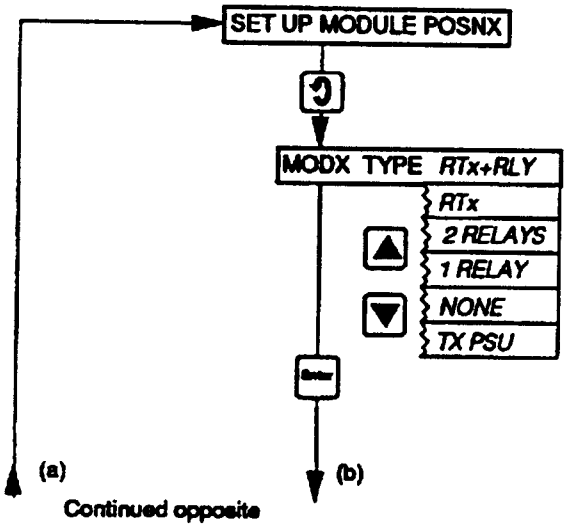
Module Position 1, 2, 3, Relay 2 Allocation (Programmable Alarm Configuration)

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.

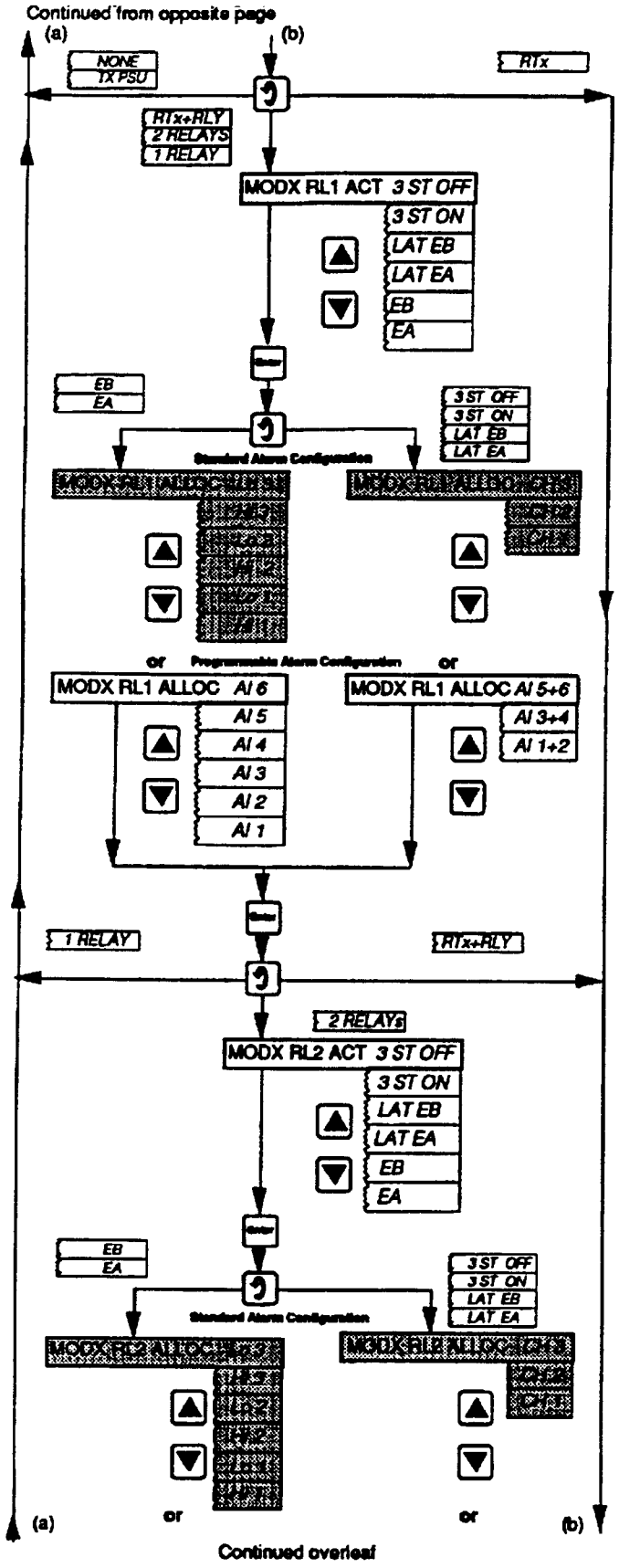
Advance to next parameter.

Module Position 4, 5 and 6, Type

Select the module type installed in module position 4, 5 or 6. Refer to Figure 4-1.

Store.

8.11 SET UP MODULES PAGE (CONTINUED)



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 setpoints
'3 ST ON'	- 3-state on between setpoints
'LAT EB'	- latch below setpoints
'LAT EA'	- latch above setpoints
'EB'	- energized below setpoint
'EA'	- energized 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:

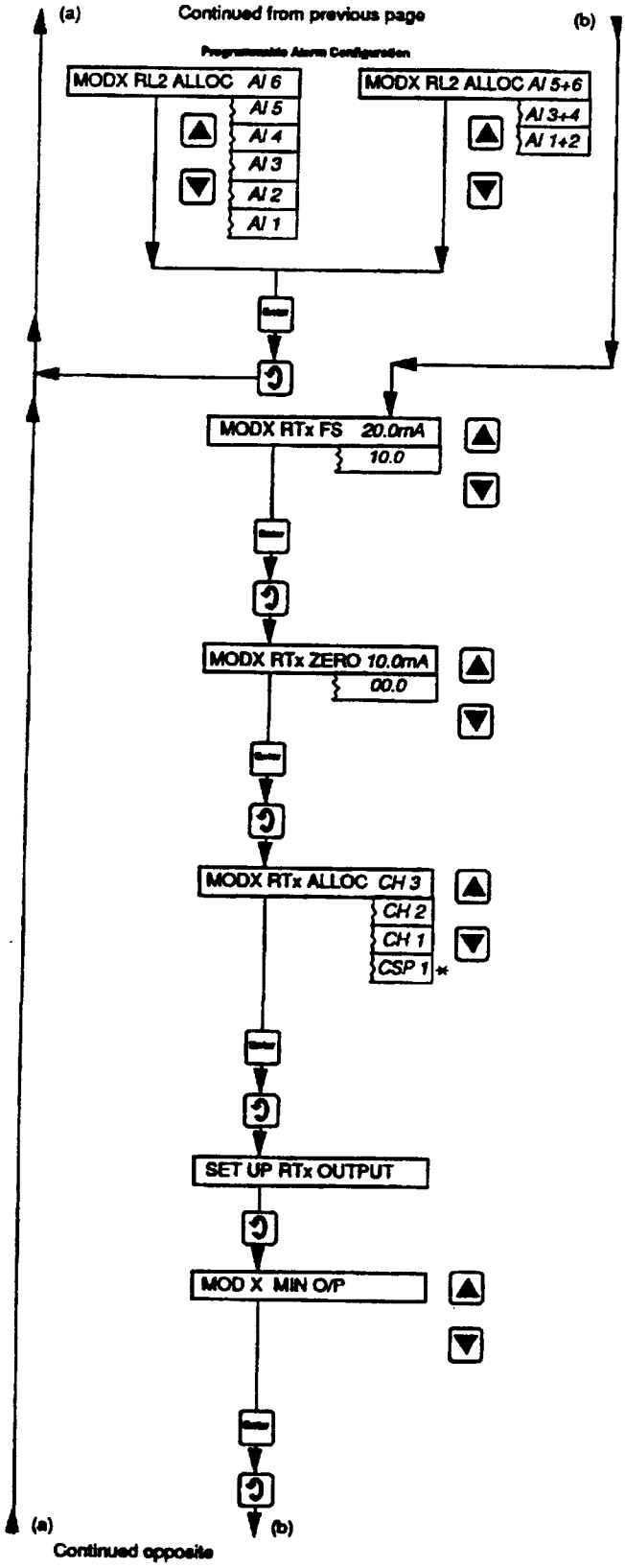
'3 ST OFF	- 3-state off between setpoints
'3 ST ON'	- 3-state on between setpoints
'LAT EB'	- latch below setpoints
'LAT EA'	- latch above setpoints
'EB'	- energized below setpoint
'EA'	- energized above setpoint.

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.



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. 1 mA steps in the range 10.0 to 20.0 mA.

Store.

Advance to next parameter.

Module Position 4, 5, 6, Retransmission Zero
Set the minimum value required for the retransmission signal, adjustable in 0.1 mA steps in the range 00.0 to 10.0 mA.

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 Setpoint 1 may be selected on recorders with PID facility. This parameter is not displayed for single channel recorders unless installed with PID option.

Store.

Advance to next parameter.

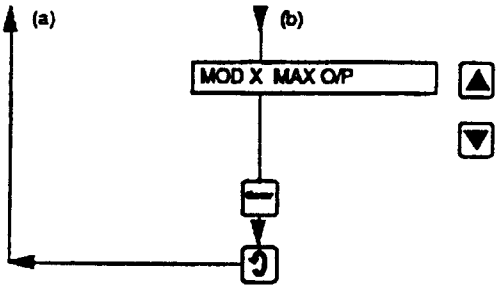
Set Up Retransmission Output

Advance to next parameter.

Module Position 4, 5, 6 Retransmission Minimum Output
Connect a 0 to 20 mA 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 from previous page



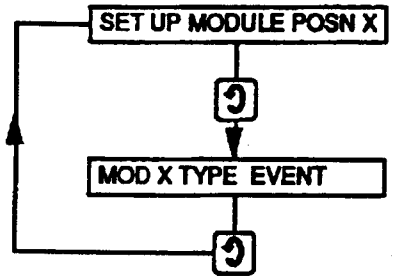
Module Position 4, 5, 6, Retransmission Maximum Output

Adjust the milliammeter 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 - CT-1214A
Set up module position 3 - CT-1315A

Advance to next parameter

Module 2 Type - CT-1214A
Module 3 Type - CT-1315A
This display cannot be changed.

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

8.11.4 Event Pen Ranges

If a CT-1214A or CT-1315A recorder with an event pen is using a standard chart, i.e. with a writing width of 105 mm, 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 **Linearizer 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 20 mA corresponding to a temperature range of 100° to 300°C from a Type K thermocouple:

Linearizer Full Scale = 0.96 [300 - 100] + 100

\- = 192 + 100

\- = 292

Range Full Scale = 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 x 16 + 4

= 15.35 + 4

= 19.35 mA

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.

SECTION 9 SIMPLE PROBLEM FINDING

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

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-energize? If so, see Section 9.1.

9.1 ARC SUPPRESSION CAPACITORS

Arc suppression capacitors are installed 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-energizing. If so, turn off the power supply and external alarm circuits. Identify the appropriate relay module. Refer to Figures 4-14a, 4-14b and 4-15. Remove the four screws retaining the printed circuit board and **carefully** unplug it.

CAUTION The connection pins at the top of the printed circuit board are very fragile and care must be taken not to bend or damage them.

Unsolder the appropriate capacitors as shown in Figure 9-1 and re-install the module.

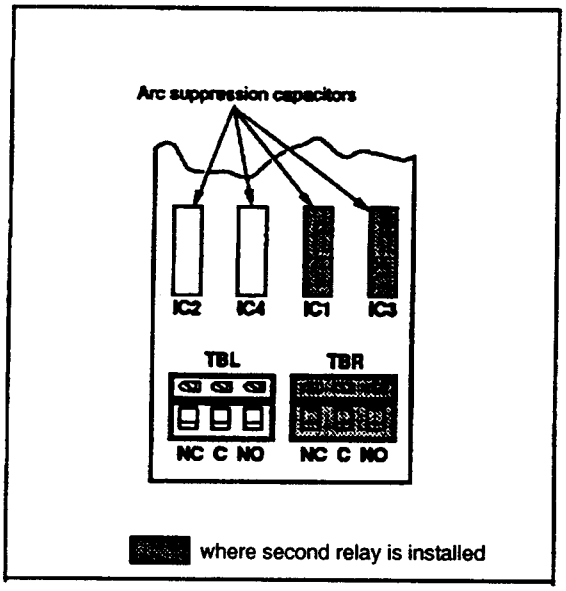


Figure 9-1. Location of Arc Suppression Capacitors

SECTION 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

Turn 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 . Refer to Table 2.

For **2-lead RTDs** 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.

Turn 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.

a) While referring to Figure 8-2, select the Input and Recording Conditions Page, make a note of the Chart Time and then reset it to 168 hr/rev. Store using the 'Enter' switch.

b) Make sure that the pens are touching the chart and that the time line marker on the chassis indicates the correct time line on the chart. Refer to Figure 6-1.

c) 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:

While referring to Figure 9-2:

① Loosen the clamp screw.

② Slide the pen arm in or out of the molding, as necessary.

③ Retighten the clamp screw when you are finished.

Make similar adjustments to the green and blue pen arms, as applicable. Make sure that the green pen records approximately 4 mm ahead of the red pen and the blue pen records approximately 4 mm 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 outfitted 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.

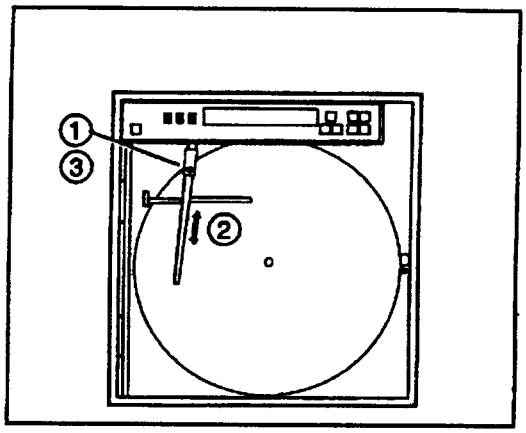
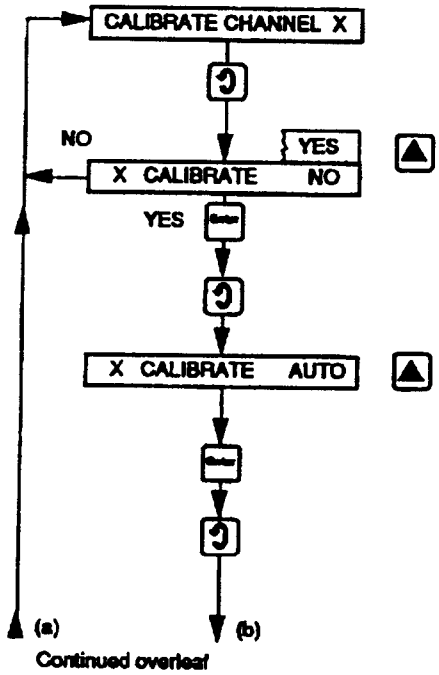


Figure 9-2. Pen Arm Length Adjustment

10.3 CALIBRATION PAGE (AUTOMATIC PROCEDURE)



Calibrate Channel

Advance to next parameter.

Calibration
Select 'YES' to calibrate the instrument

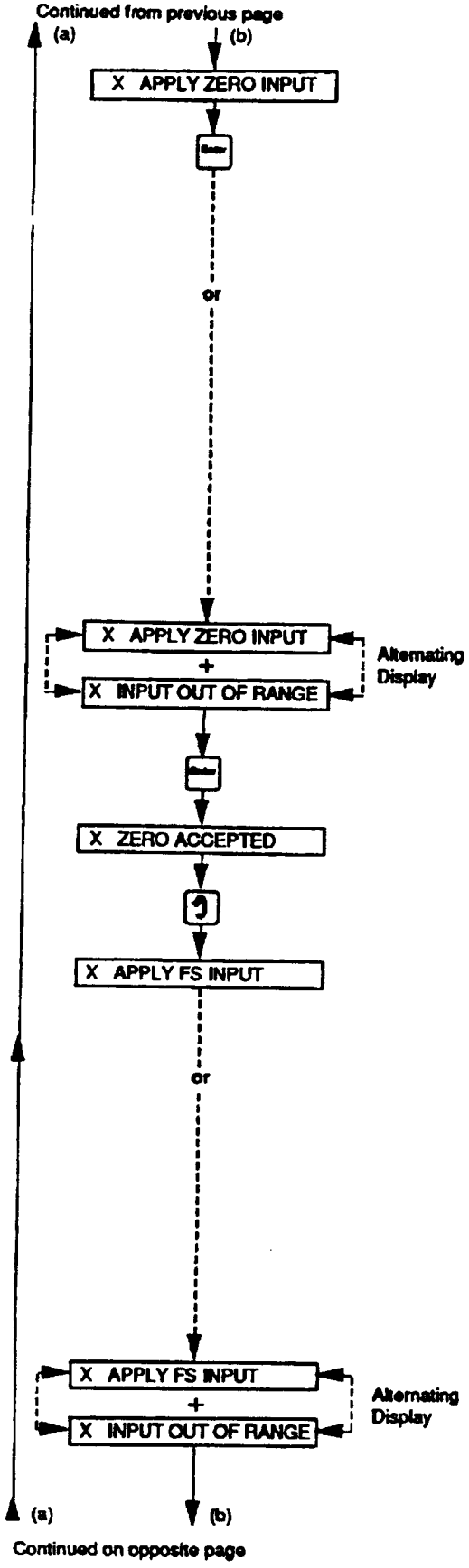
Store.

Advance to next parameter.

Calibration Mode (auto or manual)
Select automatic calibration mode. For manual calibration mode refer to Section 10.4.

Store.

Advance to next parameter.



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**.

RTD Inputs:

Apply a signal input equivalent to **Linearizer Zero** using resistance values obtained from standard tables. For 2-lead RTDs, make sure 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 **Linearizer Zero** temperature (b). 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.

Electrical Inputs: apply a signal equivalent to **Input Range Full Scale**.

RTD Inputs:

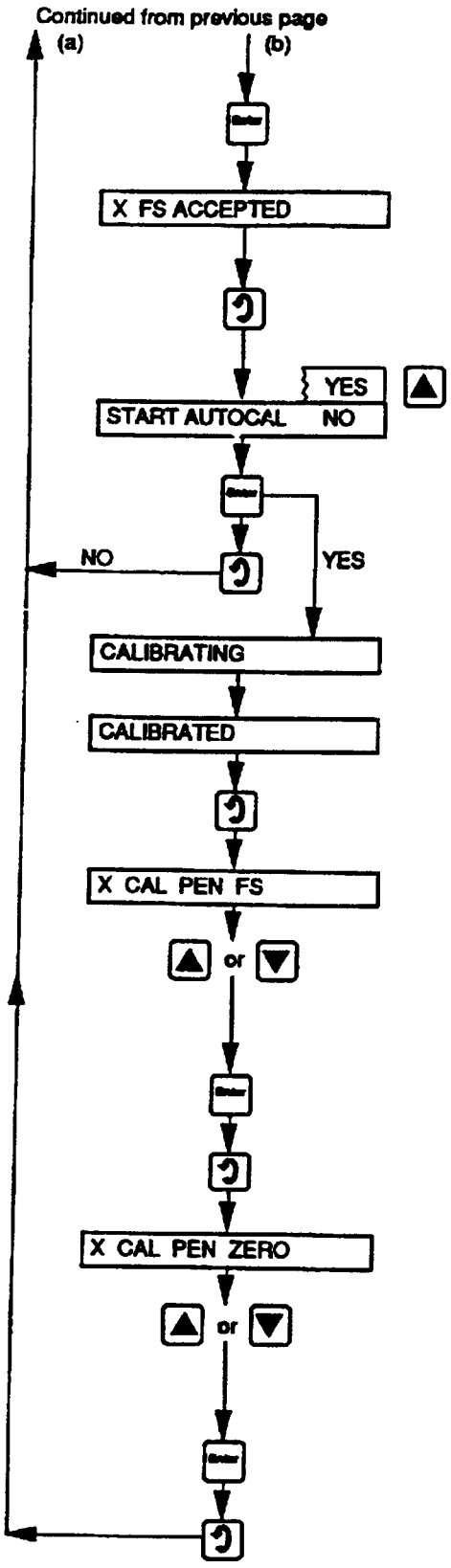
Apply a signal input equivalent to **Linearizer Full Scale** using resistance values obtained from standard tables. For 2-lead RTDs, make sure that the resistance source is either connected at the sensor end of the leads or that the total lead resistance is added to the value for range full scale.

Thermocouple Inputs:

Apply an input (c) - (a) where (c) is the millivolt equivalent of the **Linearizer 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.



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, make sure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen full scale on the chart. For instruments with event pen, see Section 8.11.4.

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, make sure 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)

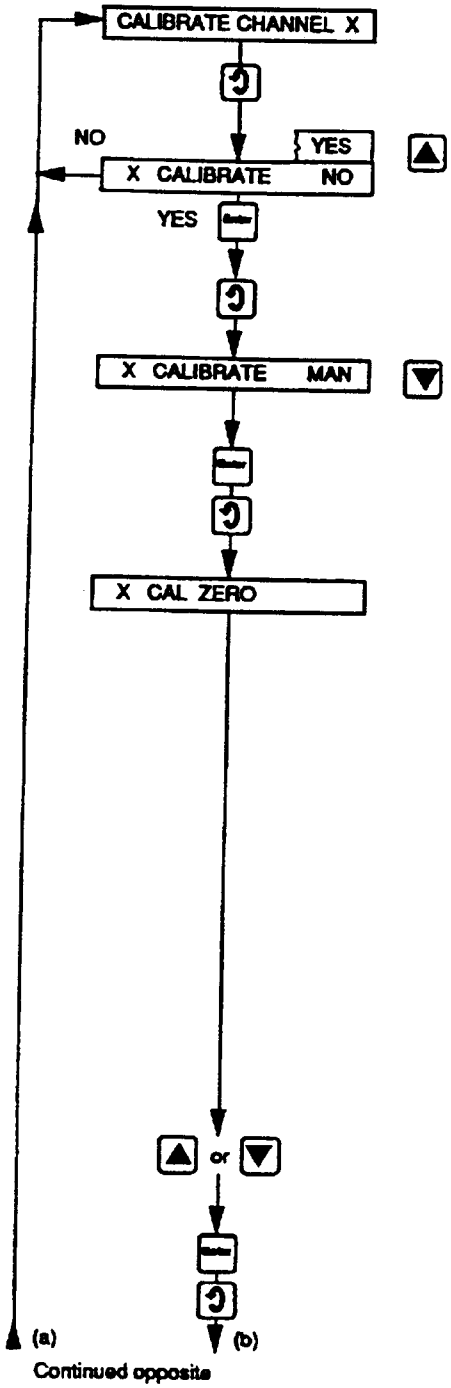
The procedures detailed in this section are for manual calibration at the normal range zero and full scale limits. However the manual calibration procedure also facilitates calibration of the instrument at selected points within the range other than zero and full scale.

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.



Continued opposite

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.

Store.

Advance to next parameter.

Calibrate Range Zero

Electrical Inputs:

Apply a signal input equivalent to Input Range Zero.

RTD Inputs:

Apply a signal input equivalent to **Linearizer Zero** using resistance values obtained from standard tables. For 2-lead RTDs, make sure 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 **Linearizer Zero** temperature (b). 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).

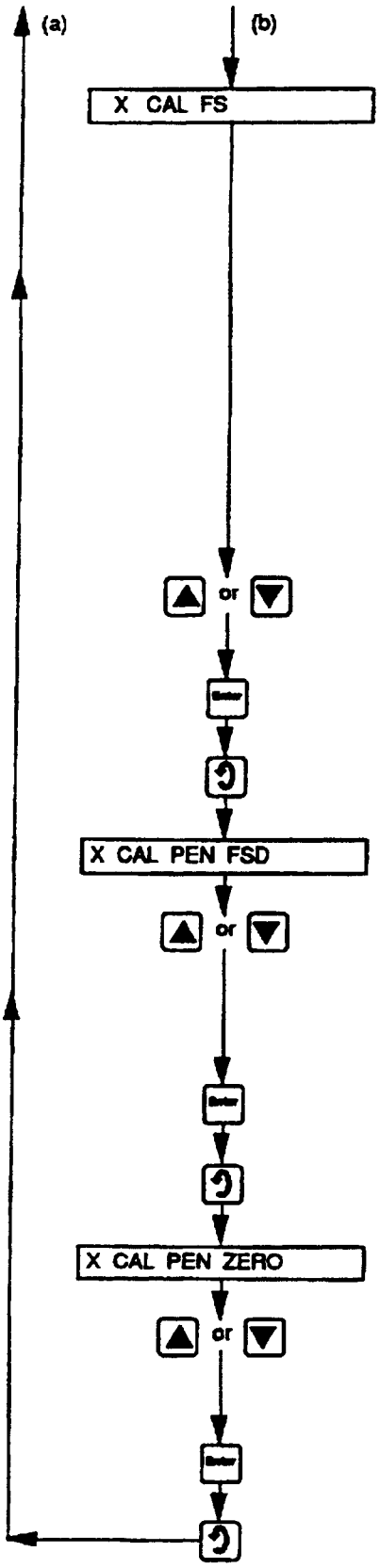
Note The displayed units are engineering units.

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

Store.

Advance to next parameter.

Continued from opposite page



Calibrate Range Full Scale

For instruments with event pen, see Section 8.11.4.

Electrical Inputs:

Apply a signal input equivalent to Input Range Full Scale.

RTD Inputs:

Apply a signal input equivalent to Linearizer Full Scale, use resistance values obtained from standard tables. For 2-lead RTDs, make sure 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 **Linearizer 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, make sure that the pen is touching the chart and use the 'Raise and Lower' switches to set pen full scale on the chart. For instruments with event pen, see Section 8.11.4.

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, make sure 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.**

SECTION 11 SPECIFICATION

Inputs

No. of inputs	1, 2 or 3
Voltage Span	20V DC max. 0.5V DC min.
Millivoltage Span	1000mV DC max.; 5mV DC min
Current Span	100mA DC max.; DC 5mA DC min
Input impedance:	
Millivolt inputs	>10MΩ
Voltage inputs	500kΩ
Current inputs	10Ω

See also Table 3

Temperature:	
Thermocouple	1800°C or 3272°F max.
Minimum span	100°C or 180°F
RTD	600°C or 1112°F max.
Minimum Span	50°C or 90°F

See also Table 4

Cold junction	Automatic cold junction compensation (ACJC) installed, temperature programmable
Broken sensor protection	Programmable, upscale or downscale drive or none (not available on mA and V inputs)
Event marker (CT-1214A & CT-1315A only)	Voltage-free contacts or 0 to 5V logic level
Linearization	Programmable for all inputs. State whether linear, square root, power 3/2, 5/2 law or type of thermocouple or RTD
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 ground	500V DC
Isolated Input Module (Type K):	
Isolation, module input to standard input	2kV
Isolation, input to ground	2kV

Interference suppression (based on 0 to 1000mV range input):

Radiated (r.f.)	<±2% f.s.d. deviation over range 20MHz to 1000MHz at field strength of 5V/meter
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 Setpoints

No. of setpoints	Up to 2 per channel	
Setpoint adjustment	Programmable	
No. of relays	Up to 2 per channel	
Relay contacts:	Single pole changeover	
Voltage	250V AC	250V DC max.
Current	5A AC	5A DC max.
Loading (non-inductive)	1250VA	50W max.
Insulation contacts to ground	2kV r.m.s.	

Relay action	Programmable - Energized above setpoint (EA) Energized below setpoint (EB) 3-state Latching External counter drive option (module 5) 50ms pulse 24V max. current 150mA
Analogue outputs:	
Module type 7	Isolated analog
Module type 8	Isolated analog with relay
Isolation voltage	2kV between input and output
Retransmission:	Programmable
Range	0 to 20.0 mA in 0.1 mA steps
Output impedance	Up to 20 mA into 1 kΩ max.

Power Supplies

Voltage requirements:		110VAC (min. 93V, max. 127V) or 230VAC (min. 195V, max. 265V) 50/60Hz Alternatively 10 to 30VDC	
Power requirement:			
AC Powered		<28VA	At maximum duty with full complement of options and modules
DC Powered*	10V to 12V	<22W	
	12V to 24V	<19W	
	24V to 30V	<22W	
Warm up time		10 seconds approx.	
Error due to power supply voltage variation		±0.1% span for ±15% variation	
Insulation, power to ground		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
Linearizer 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; all disposable

Environmental Data

Operating temperature limits	32° to 131°F (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(W x H x D)	14.6" x 14.2" x 6.7" (370 x 360 x 170mm)
Panel cut out	13.7"+ 0.039", -0" x 13.46"+0.039", -0" (348+1 ,-0mm x 342+1 ,-0mm)
Panel space requirement	16.1" wide x 15.7" high, 5.9" deep from panel face
	(410mm wide x 400mm high, 150mm deep from panel face)
Case and door	Sheet steel case with hinged chart plate. Foam-molded door with glass window (or polycarbonate to special order)
Weight	approximately 23.1 lb (10.5kg)

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

SECTION 12 APPENDICES

12.1 ALARM ACTIONS

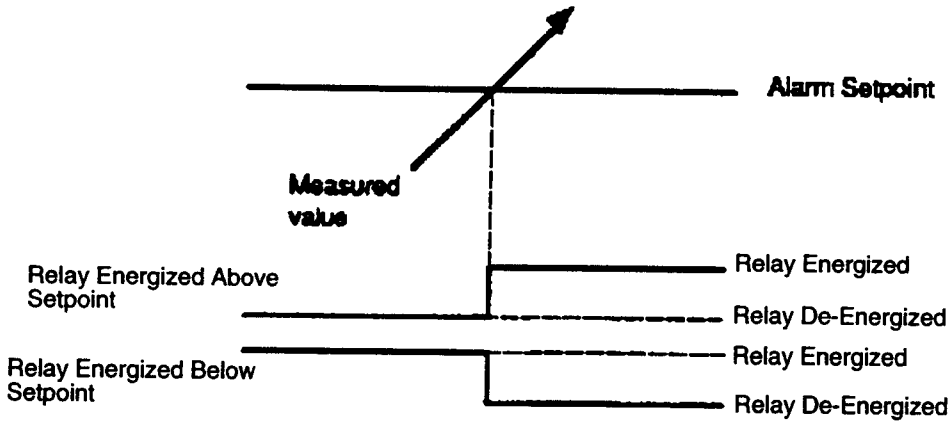


Figure 12-1. On/Off

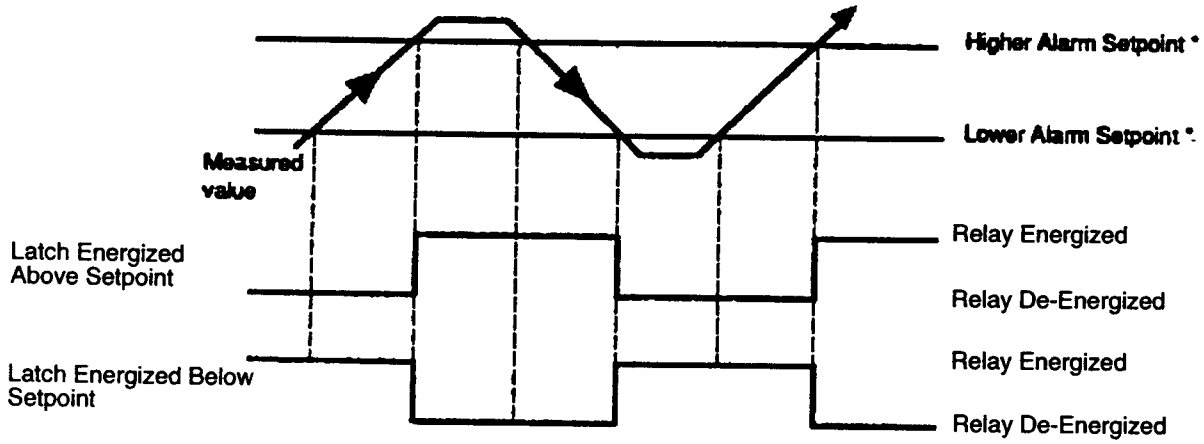


Figure 12-2. Latch

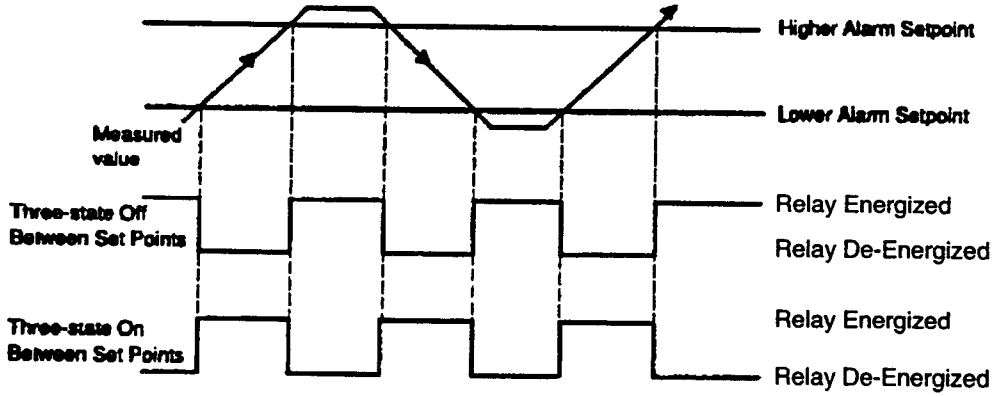


Figure 12-3. Three-State

12.2 INSTALLING AN ISOLATED INPUT MODULE

If an isolated input module Type K is to be installed in a recorder:

Turn off the power supply.

① Identify the required module position(s) and install 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 make sure that the plug pins are not damaged.

② Install IC34 as indicated in Figure 12-4, making sure of the correct orientation and using approved anti-static methods.

③ On the Processor printed circuit board identify and remove the process input connection(s) from channels 2 and/or 3 as required.

Short the unused input terminals for each channel on which a Type K module is installed.

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) Turn on the power supply.

c) While referring to Figure 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 reconnect the process input signal connections to the appropriate 'K' module(s).

12.3 RESOLUTION OF SUPPRESSED ZERO RANGES (ALL INPUTS OTHER THAN RTD)

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

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

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

Table 7 Constant (K) Values

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

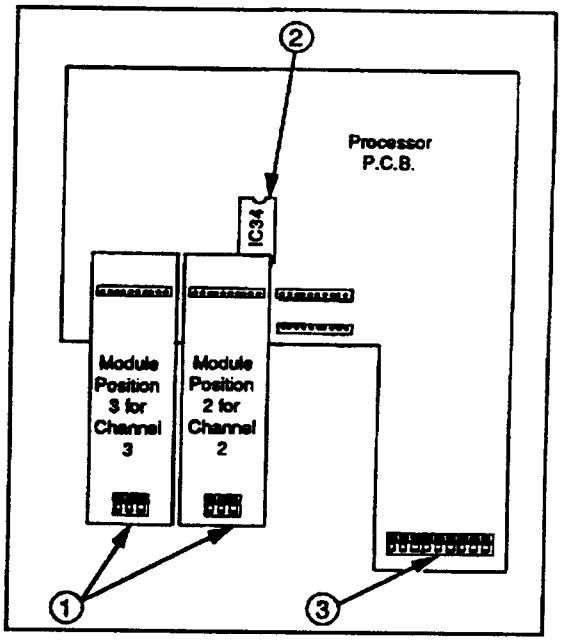


Figure 12-4. Isolated Input Module

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, Type K thermocouple.

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%

Note Linearizer 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 ≤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 RTD RANGES

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

Determine the ohmic span, $R_S - R_O$

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

PID

CONTROL

OPTION

CONTENTS

1(P) INTRODUCTION

The capability of CT1000A recorders is extended by provision of optional P.I.D. outputs for time proportioning and/or analog control. The P.I.D. outputs are available on up to two channels and may be turned on or off as required.

This supplement provides all **additional** information for setting up P.I.D. instruments and must be read in conjunction with the CT1000A main manual.

2(P) PREPARATION

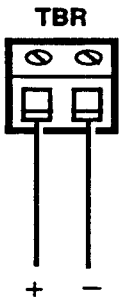
The procedure is as detailed in Section 2 in the main manual.

3(P) INSTALLATION

As detailed in Section 3 of the main manual.

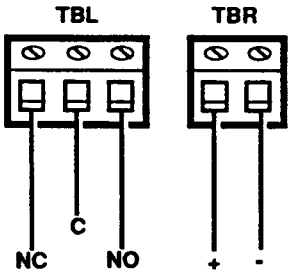
4(P) ELECTRICAL CONNECTIONS
As detailed in Section 4 of the main manual.

4.1(P) PID Output Connections – Figs. 4.1a and 4.1b
Make connections as shown in Fig. 4.1a or Fig. 4.1b.



P.I.D.Output

Fig. 4.1a(P) Connections for PID output (Module 7)



Relay 1 P.I.D. Output

Fig. 4.1b(P) Connections for PID output + relay (Module 8)

Fig. 4.1(P) Connection Details

5(P) FAMILIARIZATION WITH DISPLAY, CONTROLS AND LED INDICATION
As detailed in Section 5 of the main manual.

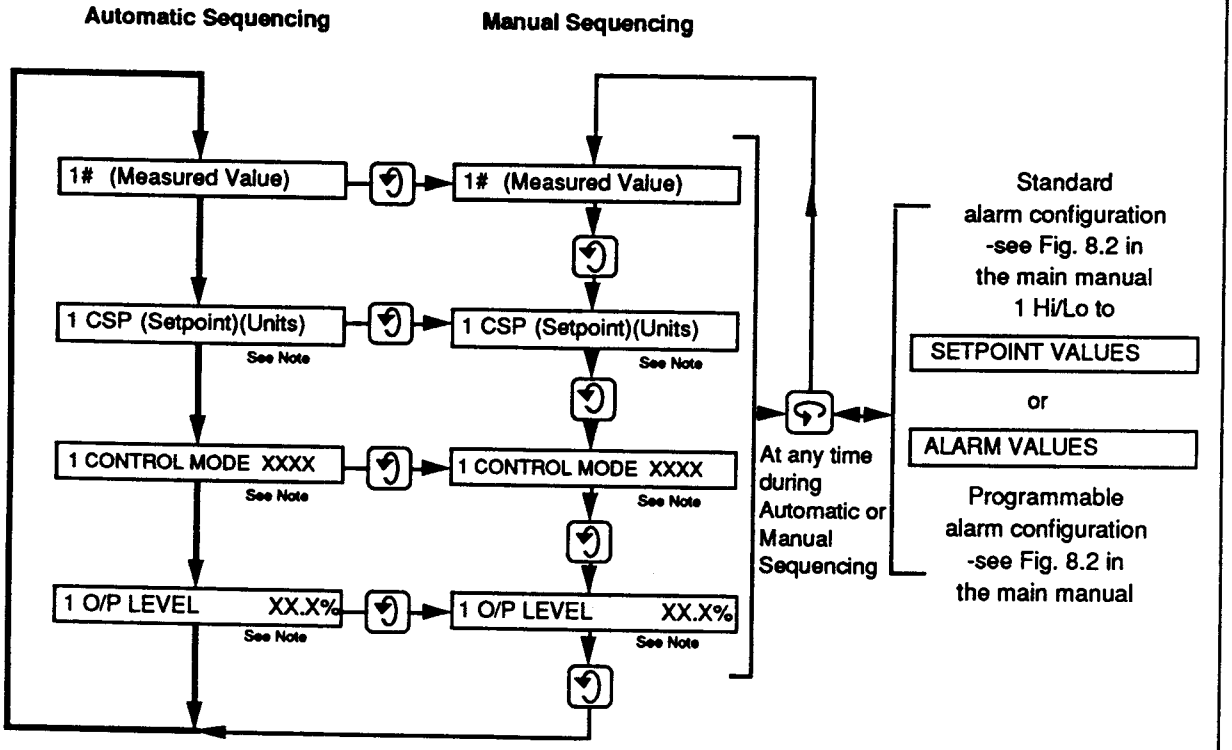
6(P) SETTING UP
As detailed in Section 6 of the main manual.

7.1(P) Operating Page 1

Refer to Section 7 of the main manual and refer to the following additional P.I.D. information – see Figs. 7.1(P), 7.2(P) and 7.3(P).

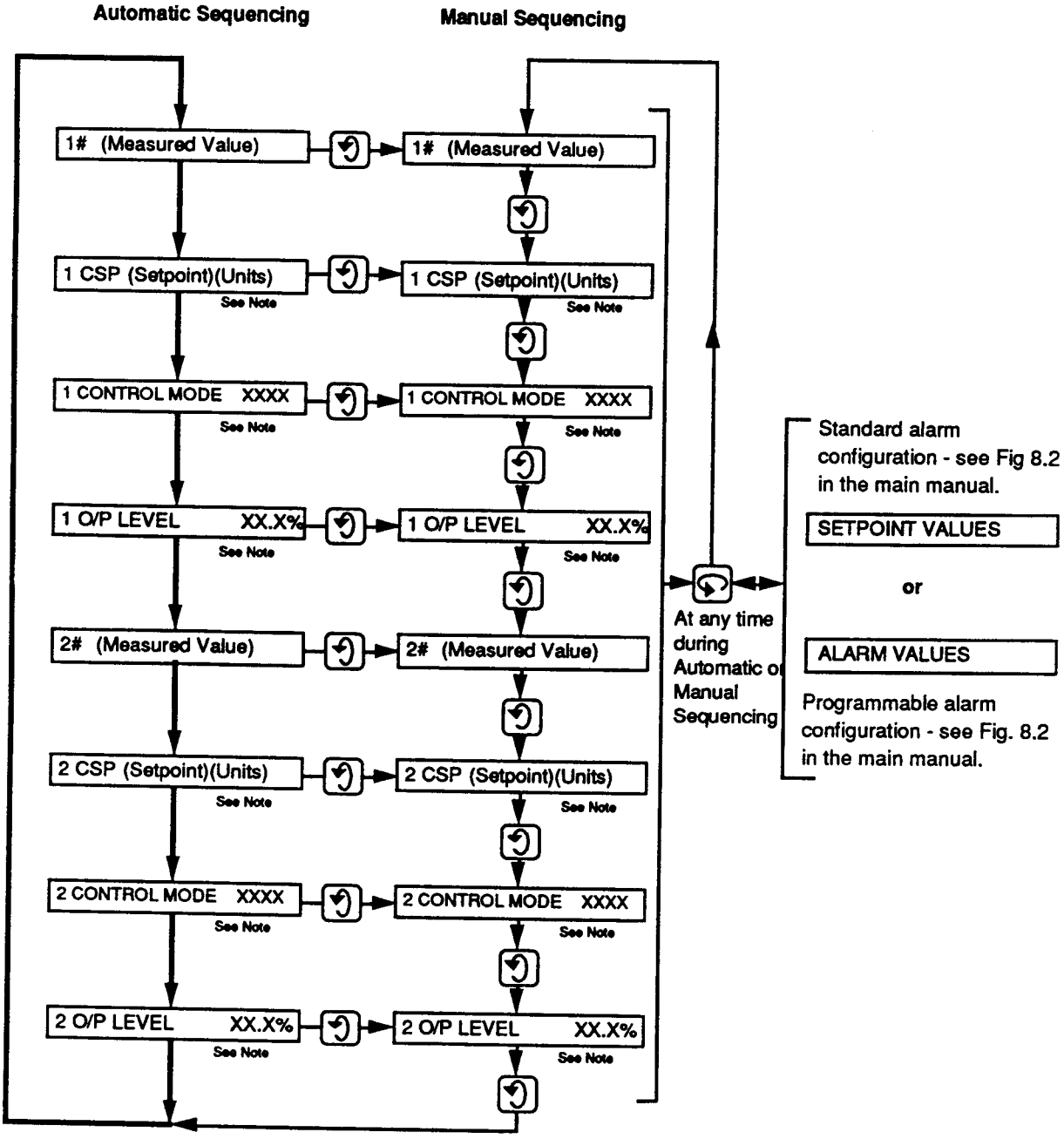
In normal operation the measured values for all channels are displayed in an 'auto-advancing' sequence (**Operating Page 1**). Each parameter can be held for viewing by operating the 'Parameter Advance' switch - see Fig. 5.1 in the main manual. Certain parameters within Operating Page 1 may require programming and this information is given in Section 7.1.1(P).

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



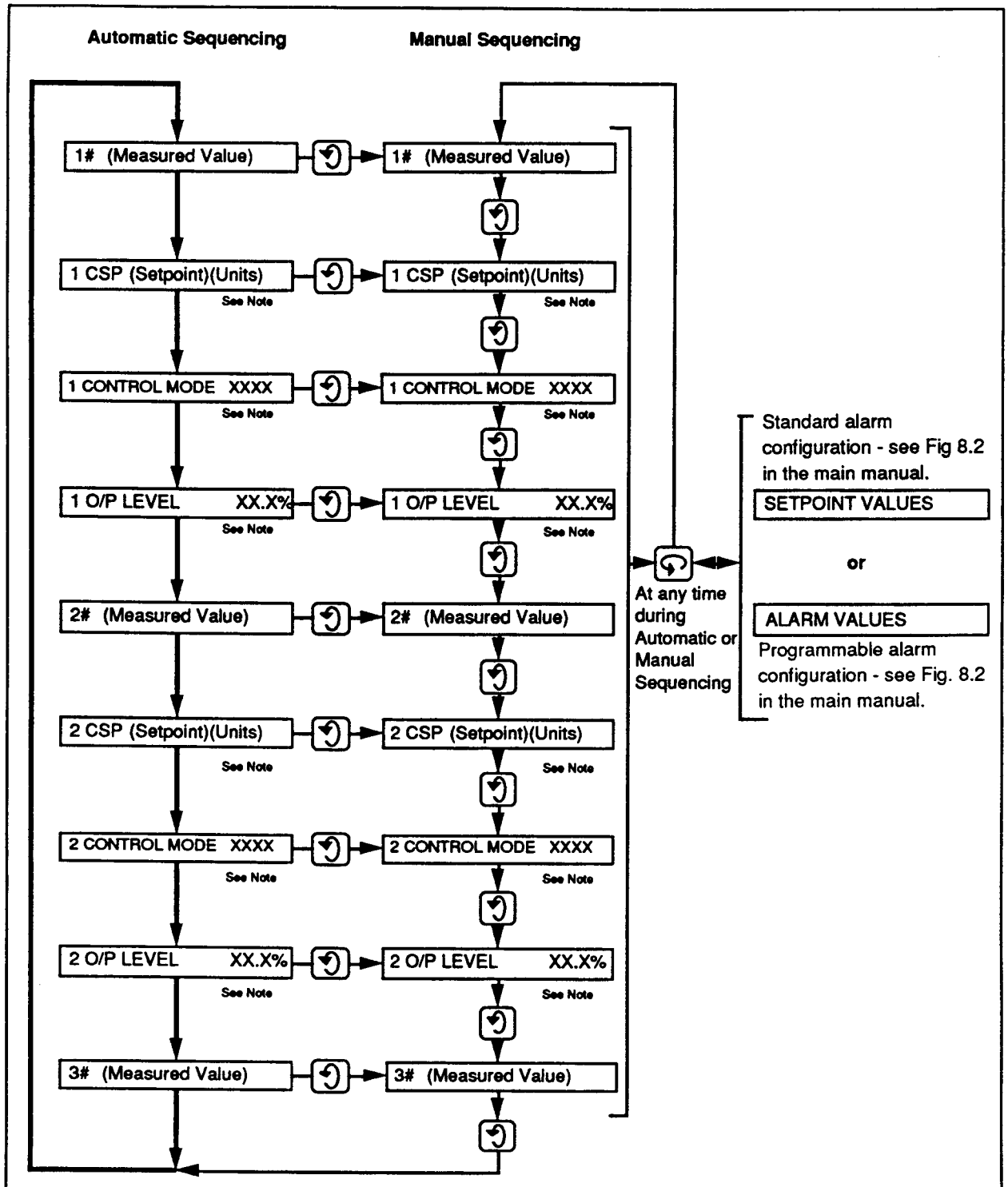
Note This parameter is not displayed when Controller is turned OFF in the Set Up Controller page. To set this parameter, see Section 8(P) PROGRAMMING.

Fig. 7.1(P) Operating Page 1, Single pen P.I.D. instruments



Note This parameter is not displayed when Controller is turned OFF in the Set Up Controller page. To set this parameter, see Section 8(P) PROGRAMMING.

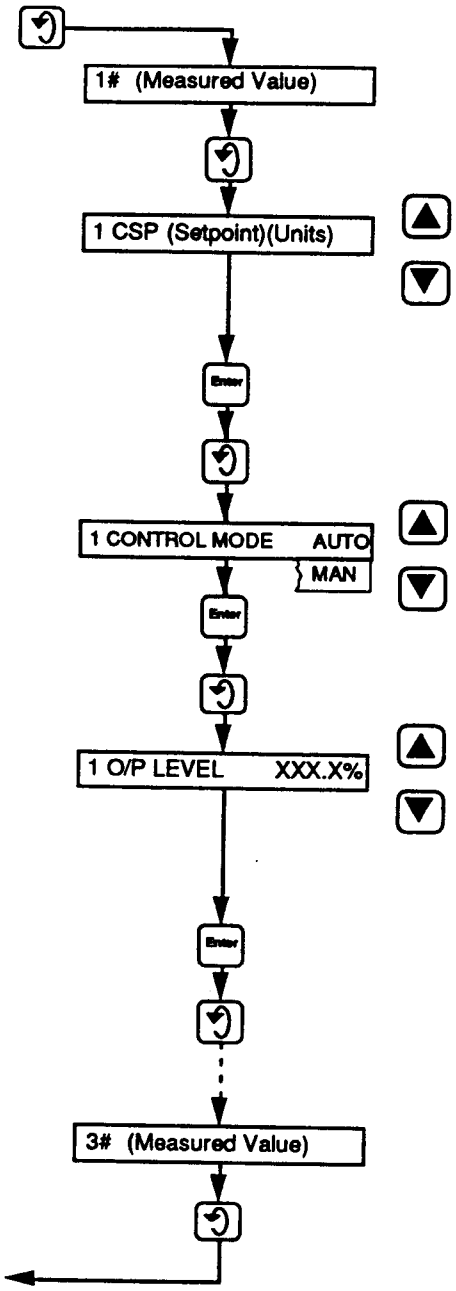
Fig. 7.2(P)



Note This parameter is not displayed when Controller is turned OFF in the Set Up Controller page. To set this parameter, see Section 8(P) PROGRAMMING.

Fig. 7.3(P) Operating Page 1, Three-pen P.I.D. instruments

Manual Sequencing



Advance from **Automatic Sequencing.**

Measured Value
Display of Measured Value for channel 1

Advance to next parameter.

Control Set Point
Enter the value required for the Control Set Point for channel 1. The units displayed are as selected in SET UP DISPLAY page for channel 1, see Fig. 8.1(P) on page 10.

Store.

Advance to next parameter.

Control Mode
Select manual or automatic operation for channel 1.

Store.

Advance to next parameter.

Output Level
Enter the required P.I.D. output value for channel 1 in the range 0 to 100.0%. Only possible when Manual is selected in the previous step. If Control Mode is set to Auto the output level is adjusted by the instrument and cannot be altered.

Store.

Advance to next parameter.

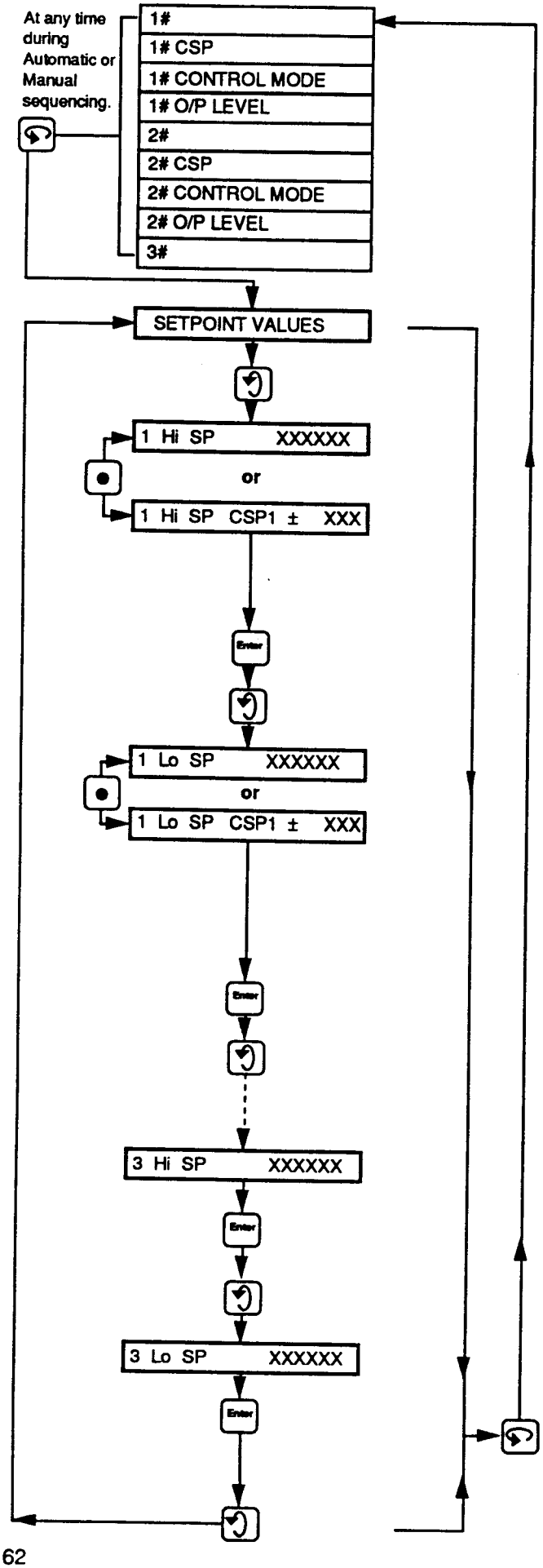
Repeat the previous steps for channel 2, where applicable.

Measured Value
Display of Measured Value for channel 3.

Return to **Automatic Sequencing.**

7.1.2(P) Operating Page 2 – Programming

Sequential Display



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

Setpoint Values

1 High / Deviation Alarm Set Point
Enter the high level alarm value for channel 1.

or, with the channel 1 controller turned on (see Section 8.1(P) use the Decimal Point switch and

Enter the value required for allowable **deviation** from the Control Set Point. This value is limited to the range programmed in the Set Up Display page for channel 1 and will be proportioned automatically about the Control Set Point for that channel.

Store.

Advance to next parameter.

1 Low / Deviation Alarm Set Point
Enter the low level alarm value for channel 1.

or, with the channel 1 controller turned on (see Section 8.1(P) use the Decimal Point switch and

Enter the value required for allowable **deviation** from the Control Set Point. This value is limited to the range programmed in the Set Up Display page for channel 2 and will be proportioned automatically about the Control Set Point for that channel.

Store.

Advance to next parameter.

Repeat the previous steps for high and low alarms for channel 2.

3 High Alarm Set Point
Enter the high level alarm value for channel 3.

Store.

Advance to next parameter.

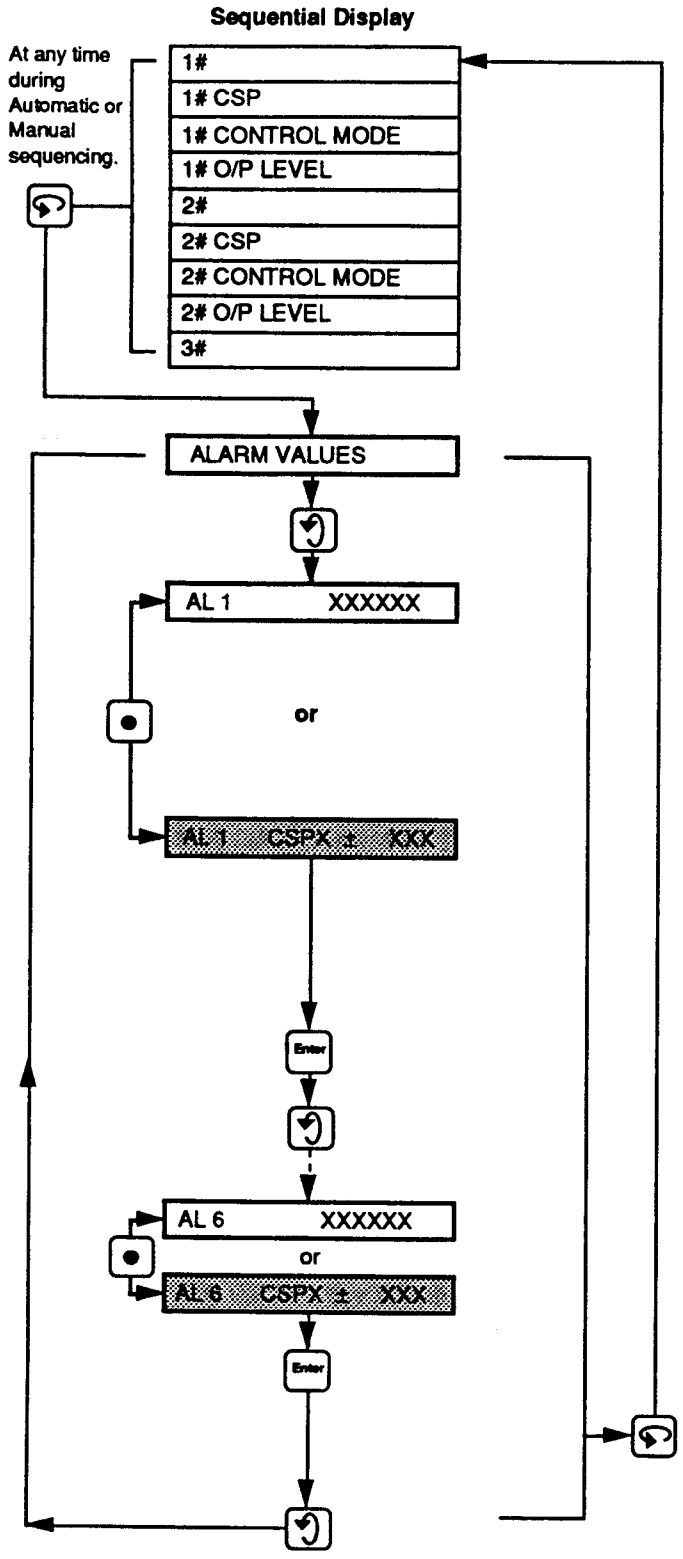
3 Low Alarm Set Point
Enter the low level alarm value for channel 3.

Store.

Return to **Sequential Display** at any time during programming.

or

Return to top of Operating Page 2.



Where **ALARM CONFIG PROG** has been selected in the **PROG COMMON SETTINGS** page then alarms AL1 to AL6 are displayed.

Alarm Values

Advance to next parameter

Alarm 1
Enter 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 Fig. 8.2(P).

or, with the controller for the selected channel turned on, use the Decimal Point switch and

Enter the value required for allowable deviation from the Control Set Point. This value is limited to the range programmed in the Set Up Display page for the channel to which the respective alarm has been allocated and will be proportioned automatically about the Control Set Point for that channel.
Store.

Advance to next parameter

Alarms 2 to 6
Repeat the previous steps for alarms AL2 to AL6

Store.

Return to **Sequential Display** at any time during programming.

or

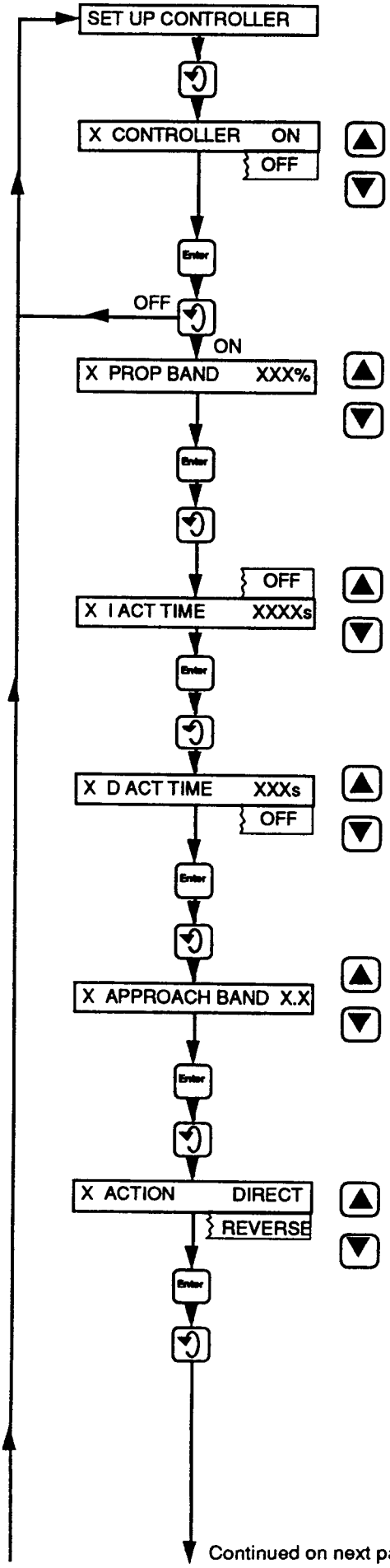
Advance to next parameter.

Only available when allocated to channels 1 and 2 and the controller for that channel is turned on.

8(P) PROGRAMMING

As detailed in Sections 8.1 to 8.10 of the main manual.

8.1 (P) Set Up Controller Page (available for channels 1 and 2 only)



Set Up Controller

Advance to next parameter.

Controller
Turn the P.I.D. function on or off as required. When turned off this function is not displayed in the Operating Page and deviation alarms are not available for this channel. Alarms previously set as deviation will revert to absolute values.

Store.

Advance to next parameter.

Proportional Band
Set the required proportional band percentage from 2% to 500%, adjustable in 1% steps.

Store.

Advance to next parameter.

Integral Action Time
Set the required integral action time, adjustable in 1s steps from 1 to1800s, then OFF.

Store.

Advance to next parameter.

Derivative Action Time
Set the required derivative action time, adjustable in 1s steps, from 600 to 1s, then OFF.

Store.

Advance to next parameter.

Approach Band
Set the required value between 0.1 to 3.0 proportional bands. (It is usual to set 1.0 initially.)

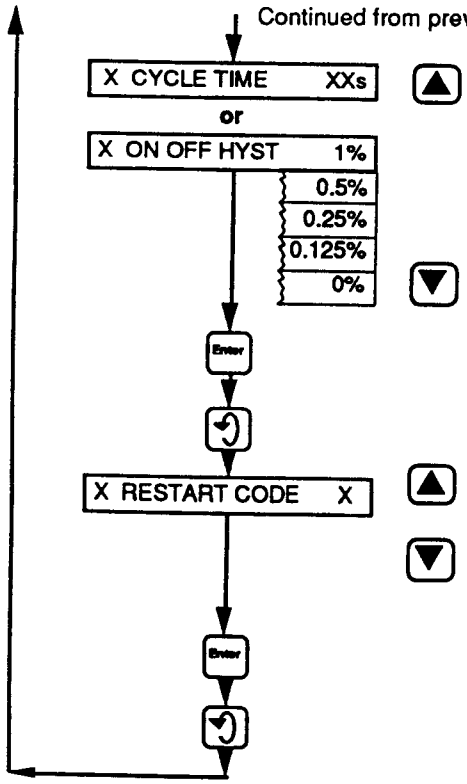
Store.

Advance to next parameter.

Action
Set for Direct or Reverse action as required.

Store.

Advance to next parameter.



Cycle Time/Hysteresis
If time proportioning control is required, enter the required cycle time from 5 to 60s in 1s steps.If the cycle time is adjusted below 5s then the controller changes to give on/off control with a selectable hysteresis. Enter the required hysteresis value from 0% to 1% (five discrete steps available). Above 1% the controller reverts to time proportioning control and the display shows cycle time.

Store.

Advance to next parameter.

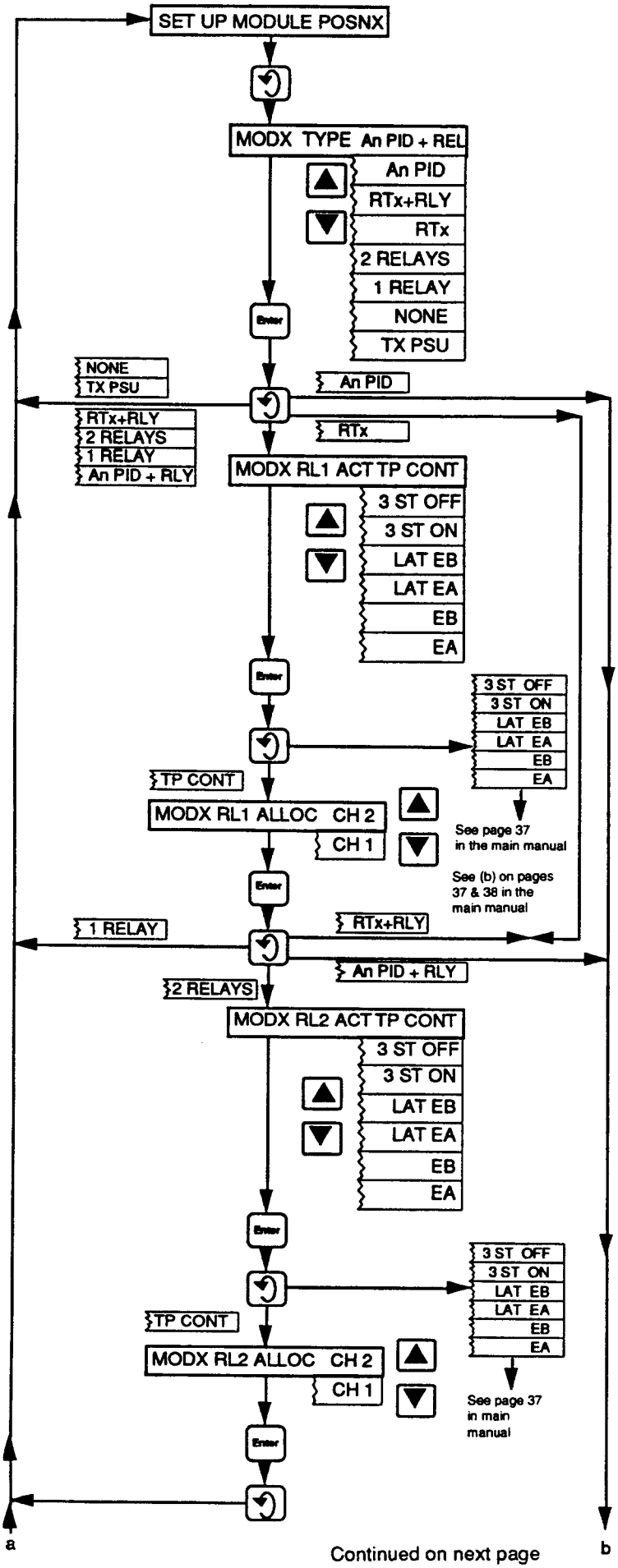
Restart Code
Set the required Code number to determine the instrument restart condition after a power interruption – see Table 2(P) below.

Store.

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

AUTO/MANUAL CODE	CONDITION BEFORE POWER INTERRUPTION		CONDITION AFTER POWER INTERRUPTION	
	CONTROL MODE	OUTPUT	CONTROL MODE	OUTPUT
0	Manual Auto	Manual setting Auto Control	Auto Auto	Auto Control Auto Control
1	Manual Auto	Manual Auto Control	Manual Auto	Previous Setting Auto Control
2	Manual Auto	Manual Setting Auto Control	Manual Manual	Previous Setting Minimum
3	Manual Auto	Manual Setting Auto Control	Manual Manual	Previous Setting Maximum

Table 2(P) Restart Code



Continued on next page

Module Position 4,5,6

Advance to next parameter.

Module Position 4,5,6, Type
Select the module type installed in the module position 4, 5 or 6 - see Fig 4.1 in the main manual.

Store.

Advance to next parameter.

Module Position 4,5,6, Relay 1 Action
Select the relay 1 action required:
'TP CONT' – time proportioning controller
'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' – energized below setpoint
'EA' – energized above setpoint.

Store.

Advance to next parameter.

Module Position 4,5,6, Relay 1 Allocation
Allocate the relay to channel 1 or 2.

Store.

Advance to next parameter.

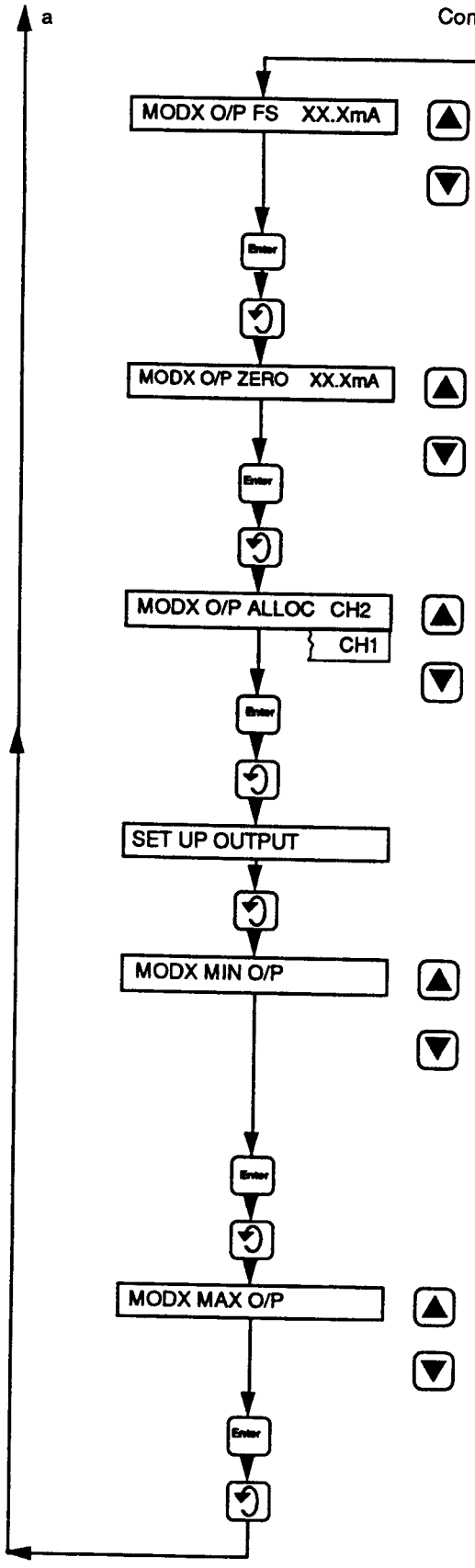
Module Position 4,5,6, Relay 2 Action
Select the relay 1 action required:
'TP CONT' – time proportioning controller
'3 ST OFF' – 3-state off between set points
'3 ST ON' – 3-state on between set points
'LAT EB' – latch below setpoints
'LAT EA' – latch above setpoints
'EB' – energized below setpoint
'EA' – energized above setpoint.

Module Position 4,5,6, Relay 2 Allocation
Allocate the relay to channel 1 or 2.

Store.

Return to top of Set Up Modules Page.

8.3(P) Set Up Module Page (Module Positions 4,5,6)



Module Position 4,5,6, Control Output Signal Full Scale
Set the maximum value required for the control output signal, adjustable in 0.1mA steps in the range 10.0 to 20.0mA.
Store.

Advance to next parameter.

Module Position 4,5,6, Control Output Signal Zero
Set the minimum value required for the control output signal, adjustable in 0.1mA steps in the range 00.0 to 10.0mA.
Store.

Advance to next parameter.

Module Position 4,5,6, Control Output Signal Allocation
Select the channel to which the control output signal is to be allocated.
Store.

Advance to next parameter.

Module Position 4,5,6, Set Up Control Output Signal

Advance to next parameter.

Module Position 4,5,6 Minimum Control Output Signal
Connect a 0 to 20mA milliammeter to the appropriate module output connection and adjust the milliammeter displayed value to coincide with the minimum control output signal specified above.

Store.

Advance to next parameter.

ModulePosition 4,5,6, Maximum Control Output Signal
Adjust the milliammeter displayed value to coincide with the maximum control output signal specified above.
Store.

Return to top of Set Up Module Page

9(P) SIMPLE FAULT FINDING

As detailed in Section 9 of the main manual.

10(P) CALIBRATION

As detailed in Section 10 of the main manual.

11(P) SPECIFICATION

Outputs	
Control	P, P+I, P+D or P+I+D. Available within P+I+D limits on channel 1 and / or channel 2 (direct or reverse acting – see Note. 1)
Proportional band	2 to 500% programmable in 1% steps.
Integral action time	1 to 1800 seconds, programmable in 1 second steps and OFF.
Derivative action time	1 to 600 seconds, programmable in 1 second steps and OFF.
Approach band (Note 2)	0.1 to 3.0 proportional bands, programmable in 0.1s steps.
Set point change	No erroneous generation of derivative response.
Analog controller output	Up to 20mA into 1kΩ max.
Time proportioning control	Cycle time 5 to 60 seconds programmable in 1 second steps
On/Off Control	Hysteresis 0%, 0.125%, 0.25%, 0.5% and 1%.

Notes.

1 Direct action signifies that the output increases as the input increases. For the majority of P.I.D. applications reverse action is used.

2 Normally approach band is initially set at 1.0.

APPENDICES

A1 Setting Up Three Term (P.I.D.) Control Parameters

The following procedures are intended as a guide for setting up a simple plant. For more complex operations the method could vary and the determination of the programmed control parameters will be dictated by experience. The controller is shipped with a standard program as detailed in Section 2.2 of the main manual which may be modified as follows.

A1.1 Selecting Reverse or Direct Action

Make sure that the controller action, reverse or direct, is correct for the application. For most applications reverse action is used, i.e. the output signal decreases as the measured value increases and the relay is energized when the measured value is below the set point.

A1.2 P.I.D. Settings

To enable the process to be satisfactorily controlled the following conditions must apply:

a) The process must be capable of reaching a natural balance with a steady load.

b) It must be possible to introduce small changes into the system without destroying either the process or the product.

The **Proportional Band Width** determines the gain of the system. (The gain is the reciprocal of the proportional band percentage, e.g. a proportional band of 20% is equivalent to a gain of 5). If the proportional band is too narrow the control loop may become unstable and cause the system to oscillate. With proportional band control only, the system normally stabilizes eventually but at a value which is offset from the setpoint.

The addition of **Integral Action Time** removes the offset but, if set too short, can cause the system to go into oscillation. The introduction of **Derivative Action Time** reduces the time required for the process to stabilize.

On start-up, if the process is changing rapidly there could be an unacceptable overshoot past the setpoint value. The **Approach Band** can be used to introduce the Derivative term before the Proportional Band is reached, i.e. using settings above 1.0. This has the effect of slowing down the rate of rise. However, if the rate of rise is very slow, the introduction of the Derivative term can be delayed, i.e. using settings below 1.0. The controller facilitates bumpless transfer from automatic to manual operation, under all conditions, and from manual to automatic operation, providing the measured variable is within the proportional band and some integral action time has been programmed.

continued

A1.3 Setting for Optimum Performance

a) Before starting up a new process or changing an existing process, set the **Proportional Band** to 100%, Integral **Action Time** to maximum (OFF), **Derivative Action Time** to zero (OFF) and **Approach Band** to 1.0.

b) Start up the process or change the load and note the response time (Fig. A1). This gives an indication of the time to be allowed between successive adjustments of the controls.

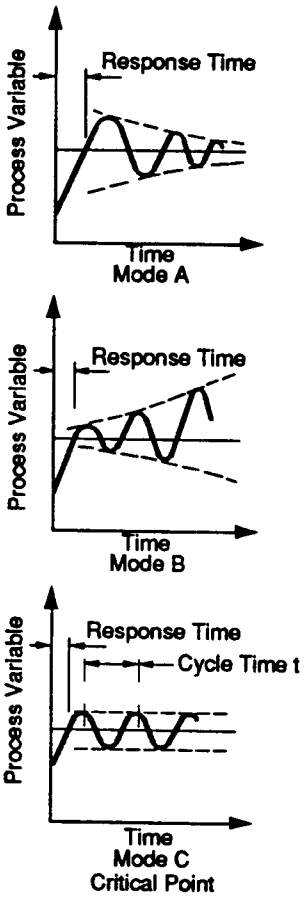


Fig. A1 Control Conditions

Note: If the system goes into oscillation with increasing amplitude (Mode B Fig. A1) with the initial settings as specified at step (a), set the Proportional Band to 200%.
If the system still oscillates as Mode B, increase the Proportional Band further until the system ceases to oscillate.
If the system oscillates as Mode A, or does not oscillate, proceed to step (c).

c) Reduce the **Proportional Band** in 20% steps and observe the response. Continue until the process cycles continuously without reaching a stable condition, i.e. a sustained oscillation with constant amplitude as shown in Mode C. This is the critical point.

d) Note the Cycle Time 't' of the process at the critical point (Fig. A1) and the **Proportional Band Width** (critical value) that has been set.

e) Set the **Proportional Band** to:

1.6 times the critical value
(for P+D or P+I+D control)

2.2 times the critical value (for P+I control)

2.0 times the critical value (for P only control)

f) Set the **Integral Action Time** to:

$\frac{t}{2}$ (for P+I+D control)

$\frac{t}{1.2}$ (for P+I control)

g) Set the **Derivative Action Time** to:

$\frac{t}{8}$ (for P+I+D control)

$\frac{t}{12}$ (for P+D control)

The controller is now ready for fine tuning by small adjustments to the P, I and D terms, after the introduction of a small disturbance of the setpoint.

A2 Alarm Action

The alarm action with respect to the alarm set points and the process variable is shown in Fig. A2.

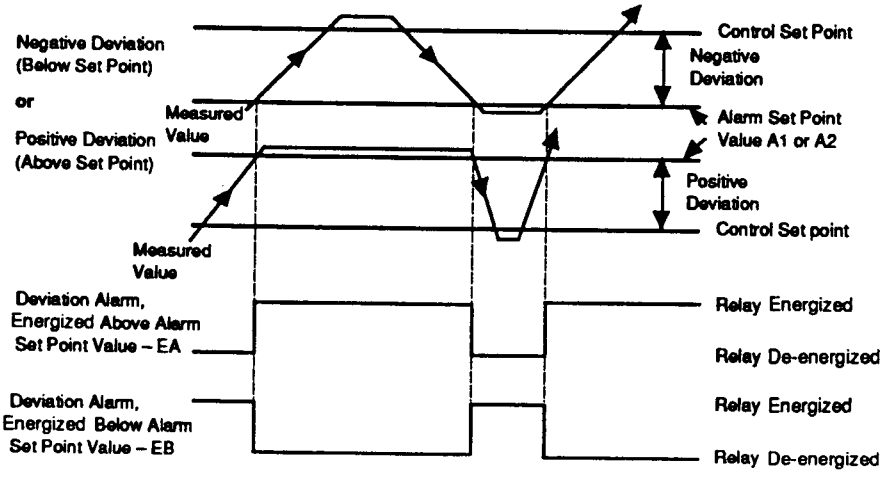


Fig. A2 Deviation Alarm

FLOW

OPTION

CONTENTS

1(F) INTRODUCTION

This supplement provides instructions on the features of CT1150A, CT1250A and CT1350A Flow Recorders which differ from those of the basic CT1000A recorders described in the main manual.

The Flow Recorders provide indication and recording of flow rates from input signals with linear, square law or power law characteristics or of the pulse frequency type.

Totalization is available for each channel and may be turned on or off as required.

The flow total for any channel may be viewed on the digital display and reset via the front panel controls. An additional internal 'Secure' total is also provided which can only be reset after gaining access to the Programming Pages.

External counters with their own power supplies can be driven using any of the standard relay module options. Alternatively, a counter drive module is available for which no external power supply is needed.

This manual must be read in conjunction with the main manual.

2(F) PREPARATION

The procedure is as detailed in Sections 2.1 to 2.2 in the main manual.

3(F) INSTALLATION

As detailed in Section 3 of the main manual.

4(F) ELECTRICAL CONNECTIONS

As detailed in Section 4 of the main manual.

External counters with their own power supply can be driven using any of the standard relay outputs in module positions 4,5 and 6 – see Section 4.5 in the main manual for connection details.

4.1(F) Counter Drive Module – Fig. 4.1(F)
A counter drive module may only be fitted in module positions 4, 5 and 6 – refer to Fig. 4.1 in the main manual.

Make connections as detailed in Fig. 4.1(F).

The positioning of two plug-in 'handbag' links on the counter drive board determines the 110V or 230V operation of the module.

While referring to Fig. 4.1(F):
1 Identify the links.

2 Set the link positions for the power supply used - refer to Section 4.6 in the main manual.

For a volt-free pulse output, fit a single, or double, relay module and allocate the relay(s) as shown in Section 8.4.2(F).

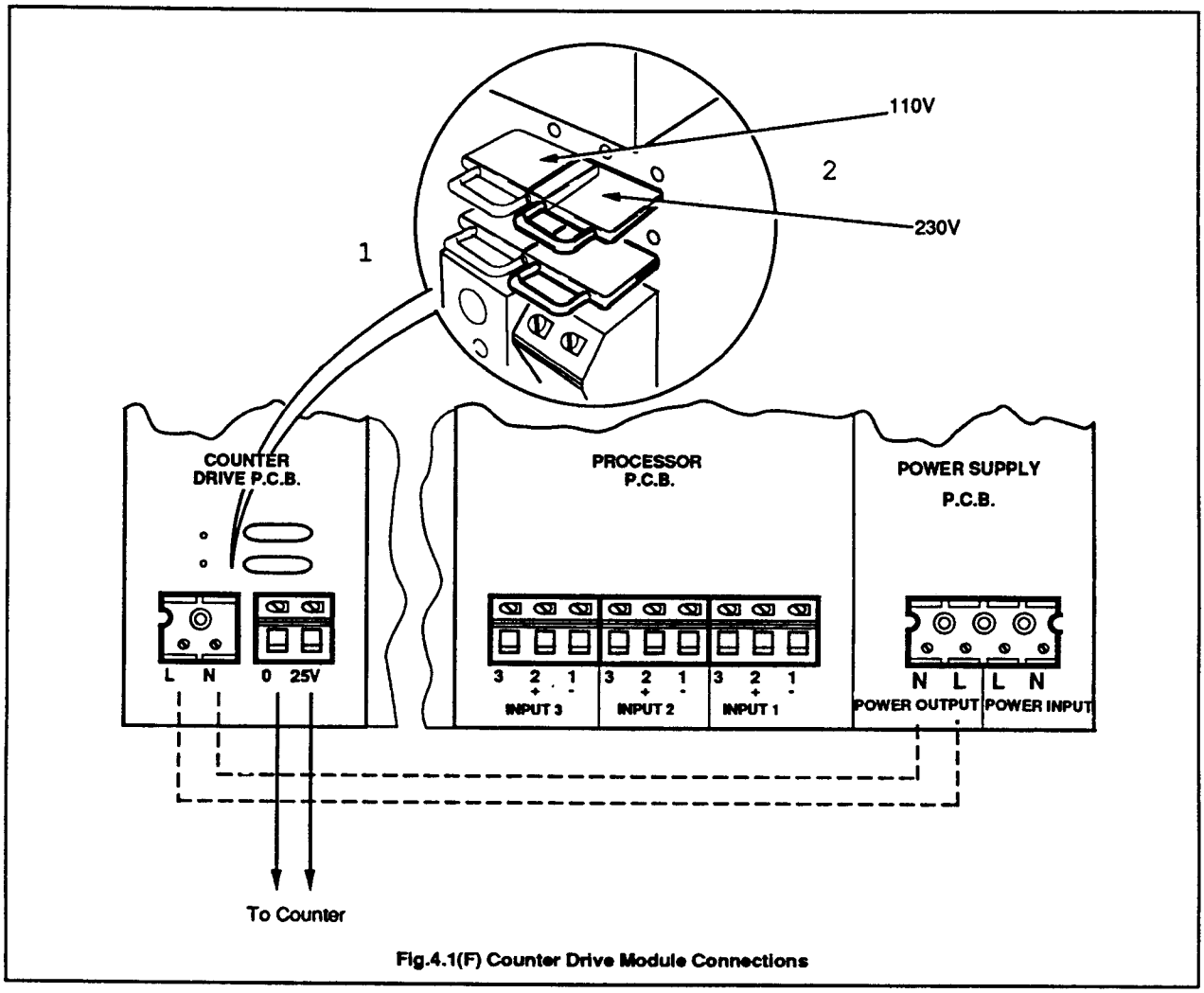


Fig.4.1(F) Counter Drive Module Connections

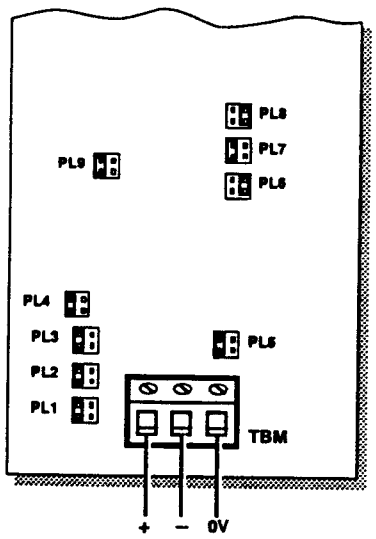


Fig. 4.2(F) Frequency Input Module Connections

4.2(F) Frequency Input Module

A frequency input module may only be installed in module positions 1,2 or 3 for channels 1,2,3 respectively – refer to Fig. 4.1 in the main manual.

Make connections and links as detailed in Fig. 4.2(F) and Table 2(F). The module is for frequency inputs only and Input Type FREQ should be selected – see Section 8.4.

Ensure that plug-in links PL1 to PL9 are configured to suit the frequency input – see Table 2(F).

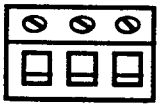
5(F) FAMILIARIZATION WITH CONTROLS, DISPLAY AND LED INDICATION

As detailed in Section 5 of the main manual.

6(F) SETTING UP

As detailed in Section 6 of the main manual.

TBM



Input Type	Connections	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8	PL9	Valid range
TTL square wave and Voltage input Lo –50V to +1V Hi +2V to +50V	+ 0V										0.003 to 0.1Hz to 4kHz
Open collector (2mA) and Dry contact (2mA)	+ 0V										0.003 to 0.1Hz to 4kHz
Vortex, VKA/B 4mA & 16mA systems	+ – *										0.003 to 4kHz
Turbine, Rotary Shunt Meter	+ – *										3Hz to 3kHz
General purpose A.C. coupled. D.C. offset max. ±50V	+ – *							**			3Hz to 4kHz
General purpose D.C. coupled	+ – *							**			0.003Hz to 4kHz

* Shield connection if required.

** Move PL7 to [2 1 / 3 4] if frequency compensation required at 1mV/Hz. At high frequency the internal frequency compensation limits the amplitude of the input signal avoiding saturation of the internal frequency measurement circuitry and should be used if the applied input waveform increases in amplitude with increasing frequency.

Table 2(F) Frequency Input Board Plug-in Link Selection

7(F) OPERATION

7.1(F) Operating Page 1

As detailed in Section 7 of the main manual but with the following additional flow total information.

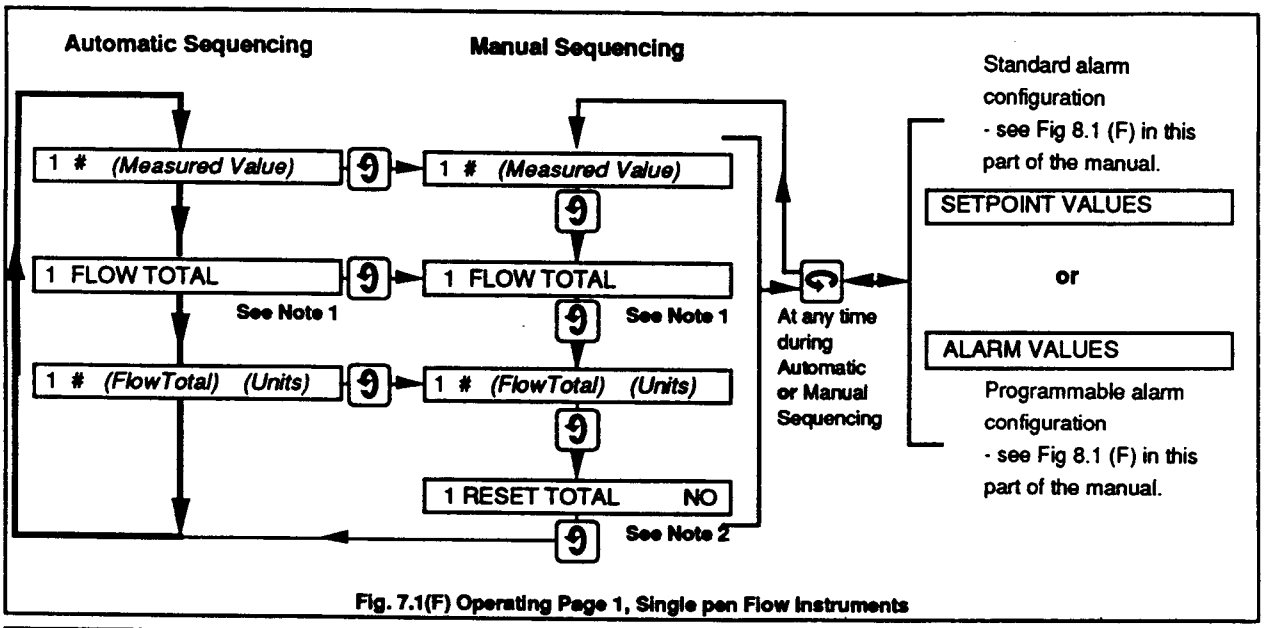


Fig. 7.1(F) Operating Page 1, Single pen Flow Instruments

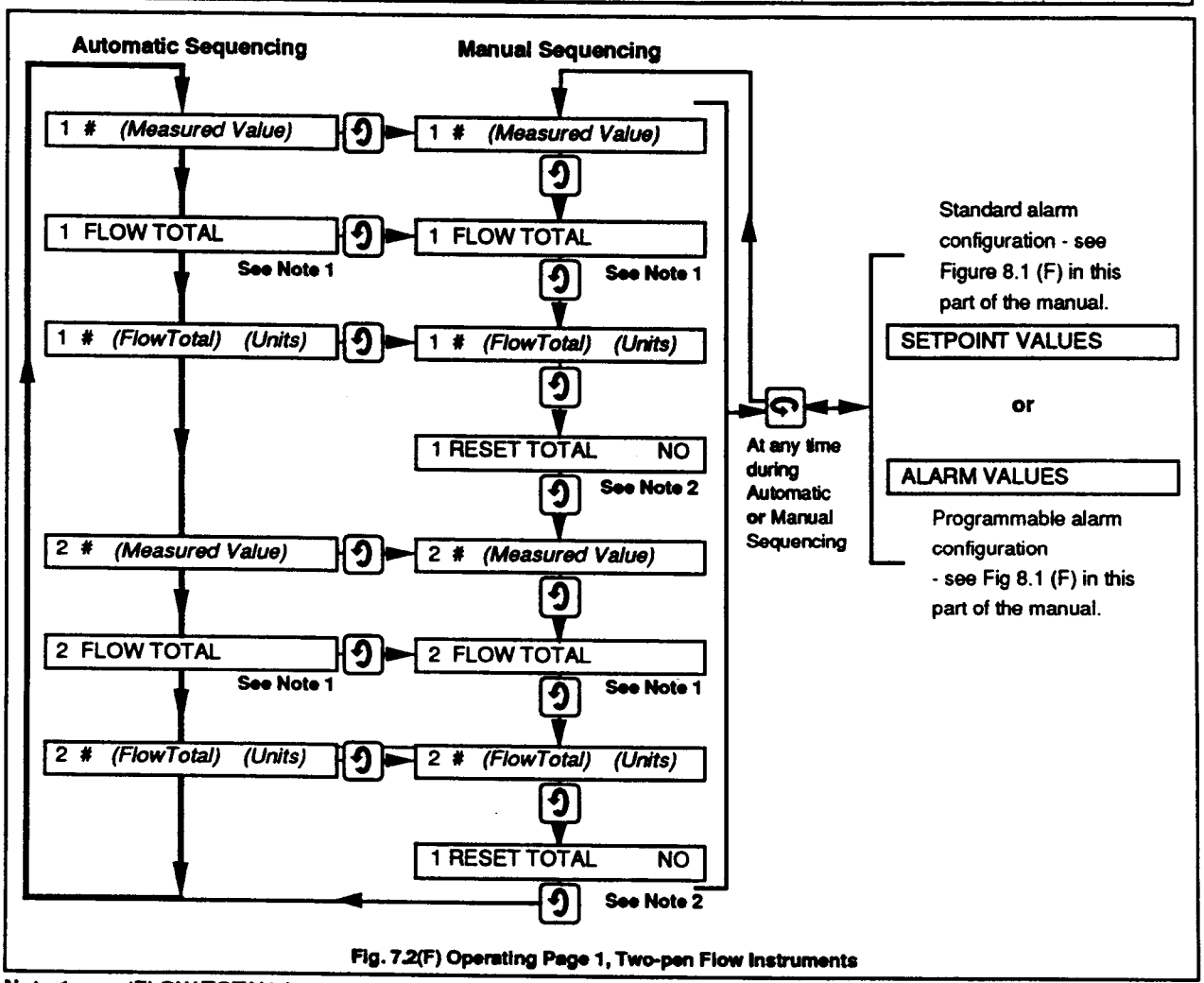


Fig. 7.2(F) Operating Page 1, Two-pen Flow Instruments

Note 1: 'FLOW TOTAL', its measured value and 'RESET TOTAL' are not displayed when 'TOTALIZER' is turned off in the **Totalizer Set Up Page** – see Section 8.3(F).

Note 2: 'RESET TOTAL' is not displayed during automatic sequencing, and only during manual sequencing when the reset function is enabled in the **Totalizer Set Up Page**. The total is reset to the **Preset Value** by selecting 'Yes' and pressing the 'Enter' switch –see Section 8.3(F).

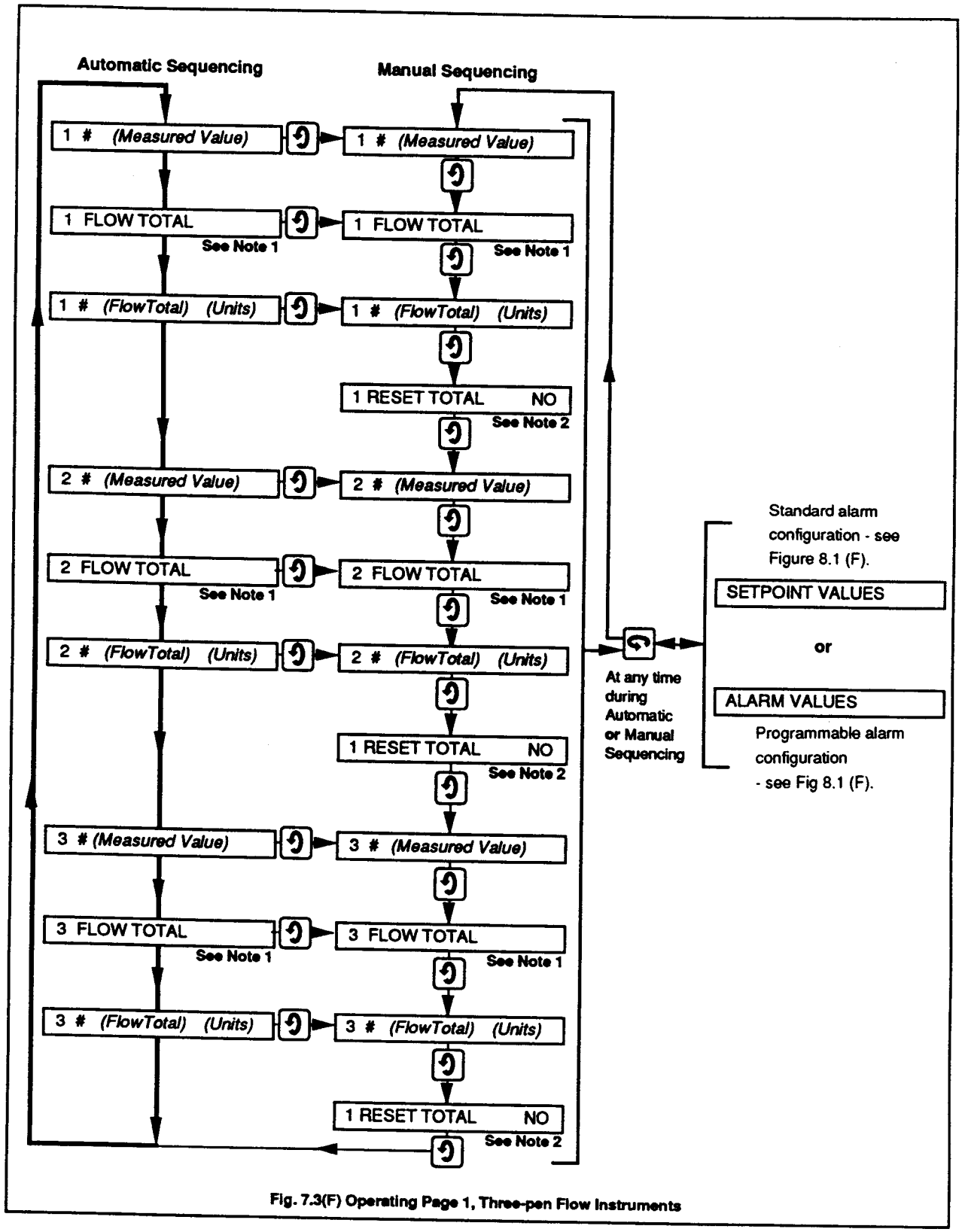


Fig. 7.3(F) Operating Page 1, Three-pen Flow Instruments

Note 1: 'FLOW TOTAL' and its measured value are not displayed when 'TOTALIZER' is turned off in the **Totalizer Set Up Page** – see Section 8.3(F).

Note 2: 'RESET TOTAL' is not displayed during automatic sequencing, and only during manual sequencing when the reset function is enabled in the **Totalizer Set Up Page**. The total is reset to the Preset value by selecting 'Yes' and pressing the 'Enter' switch –see Section 8.3(F).

7.2(F) Operating Page 2

The procedure is as detailed in Section 7.2 of the main manual.

8(F) PROGRAMMING

Generally as detailed in Sections 8.1 to 8.10 in the main manual and including the following modifications and additions.

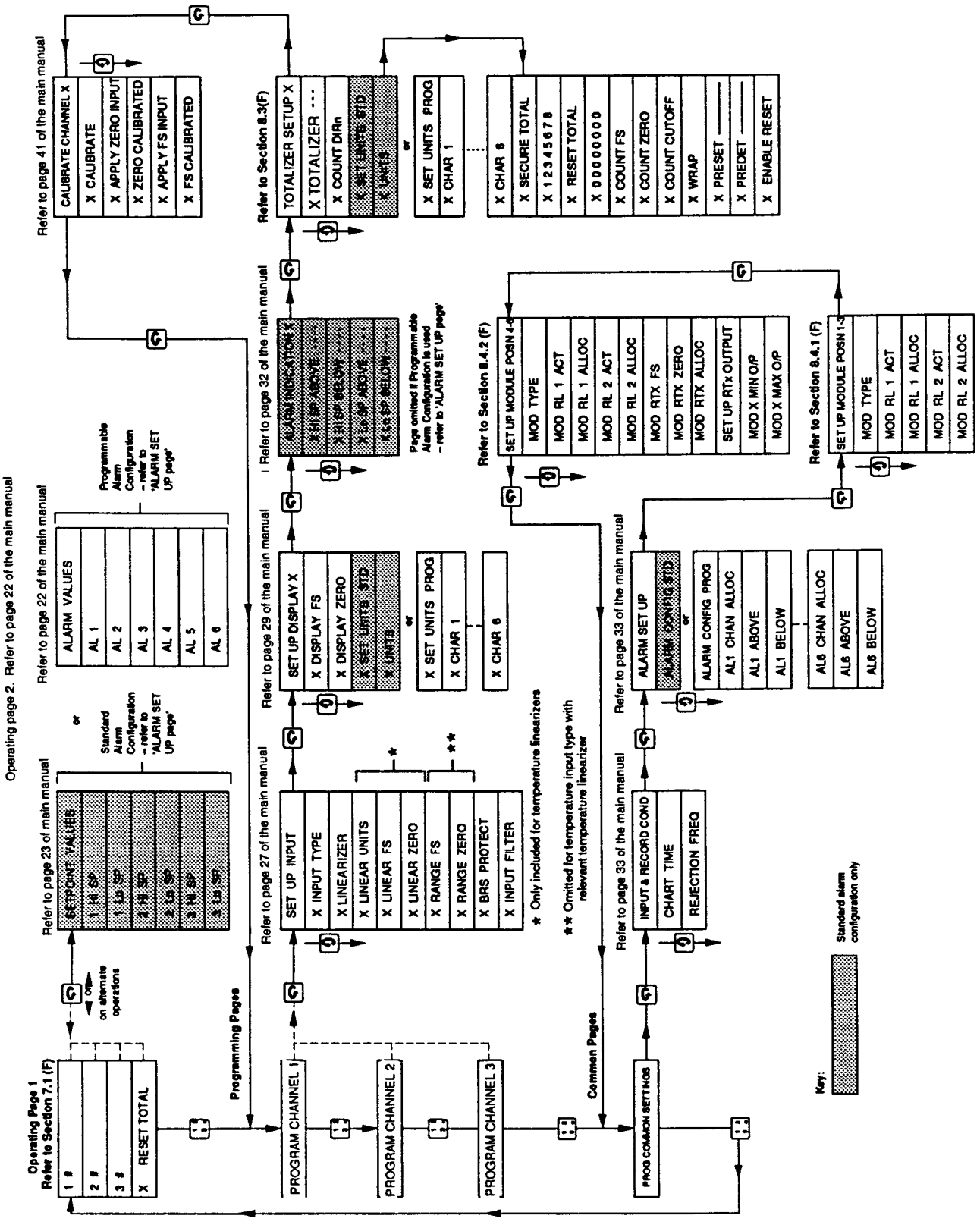
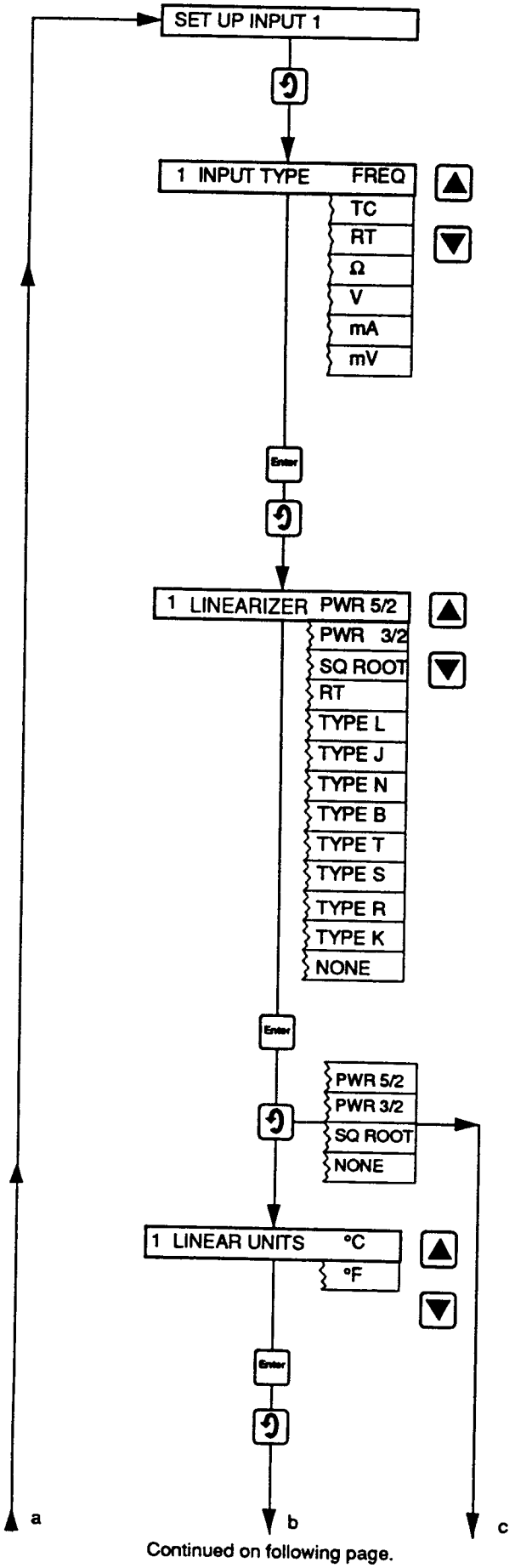


Fig. 8.1(F) Overall Program Chart, Flow Recorders



Continued on following page.

Advance to next parameter.

Input Type

Ensure that the Signal Input links are in the correct positions for the required input type for the channel - see Fig 4.2 of the main manual.

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 set below.

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

Store.

Advance to next parameter.

Linearizer

Select the desired linearizer, or NONE, to suit the applied input.

Store.

Advance to next parameter.

Linearizer Units

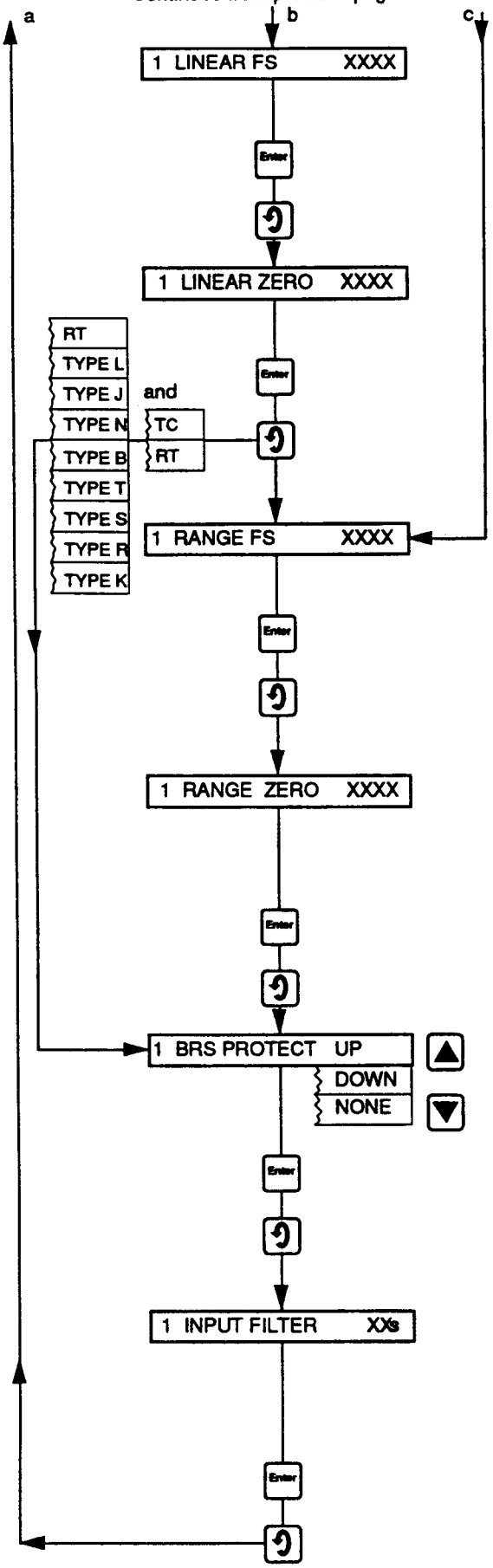
Select either °C or °F as required.

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

Store.

Advance to next parameter.

Continued from previous page.



Linearizer Full Scale

Set the range maximum temperature in °C or °F as selected at LINEAR UNITS within the limits detailed in Table 4 in Section 8.5 in the main manual.

Store.

Advance to next parameter.

Linearizer Zero

Set the range minimum temperature in °C or °F as selected at LINEAR UNITS, again within the limits detailed in Table 4 in Section 8.5.

Store.

Advance to next parameter.

Range Full Scale

Set the highest range value to the maximum number of decimal places possible.

For **Frequency** input set the highest frequency value within the range of 0.1 to 4095.

Store.

Advance to next parameter.

Range Zero

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

For frequency input set the lowest frequency value within the range 0.001 to 4095. The minimum valid value for frequency is 0.003, i.e. it must be greater than zero.

Store.

Advance to next parameter.

Broken Sensor Protection

Set 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 moves as programmed up- or down-scale, or not at all.

Store.

Advance to next parameter.

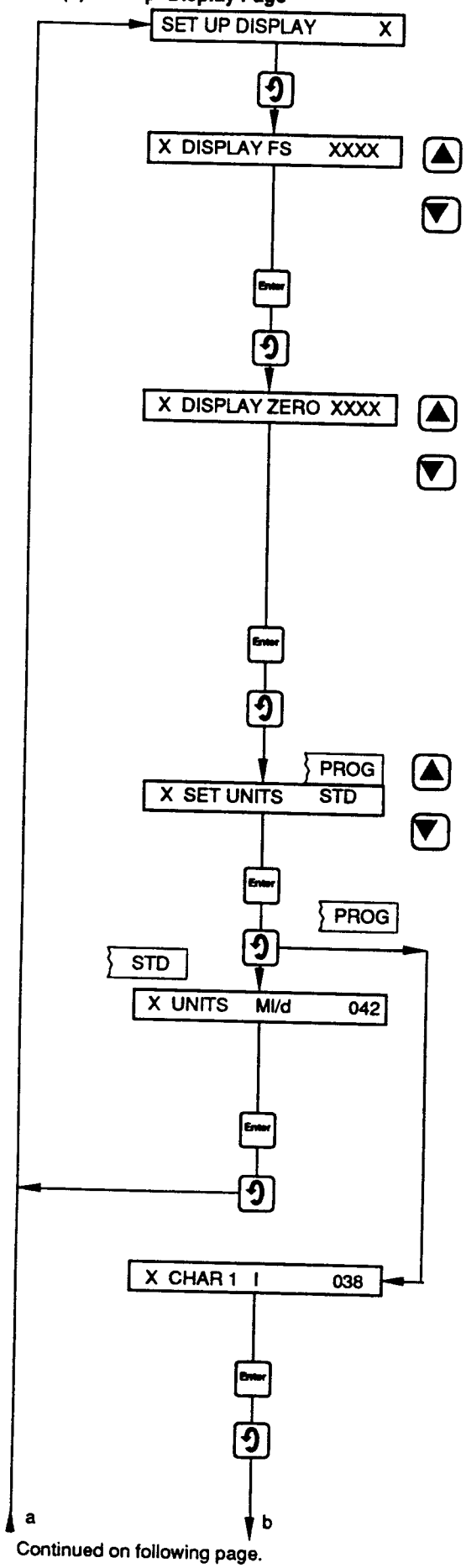
Input Filter

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

Store.

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

8.2(F) Set Up Display Page



Continued on following page.

Advance to next parameter.

Display Full Scale
Set the value of the variable represented by the maximum input signal
Example – if a 2.02 to 7.34 mV input represents a flow range of 50 to 180 Ml/day set '180.0'.
Available adjustment range is –999 to 4095.

Store.

Advance to next parameter.

Display Zero
Set the value for the variable represented by the minimum input signal. Using the example above, 50.0 would be set here. The decimal point is set automatically.
Available adjustment range is –999 to 4095.

Store.

Advance to next parameter.

Set Units
Select 'PROG' for a customized 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 in the main manual, corresponding to the required display units. The actual display units are visually confirmed here.

Store.

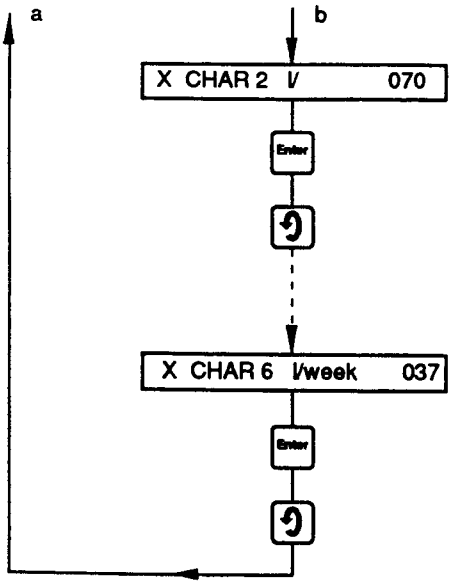
Advance to next parameter.

Character 1
Set the code number corresponding to the first character of the customized six-digit of measurement selected from the characters listed in Table 5 in the main manual.

Store.

Advance to next parameter.

Continued from previous page.



Character 2
Repeat the previous step for the second character.

Store.

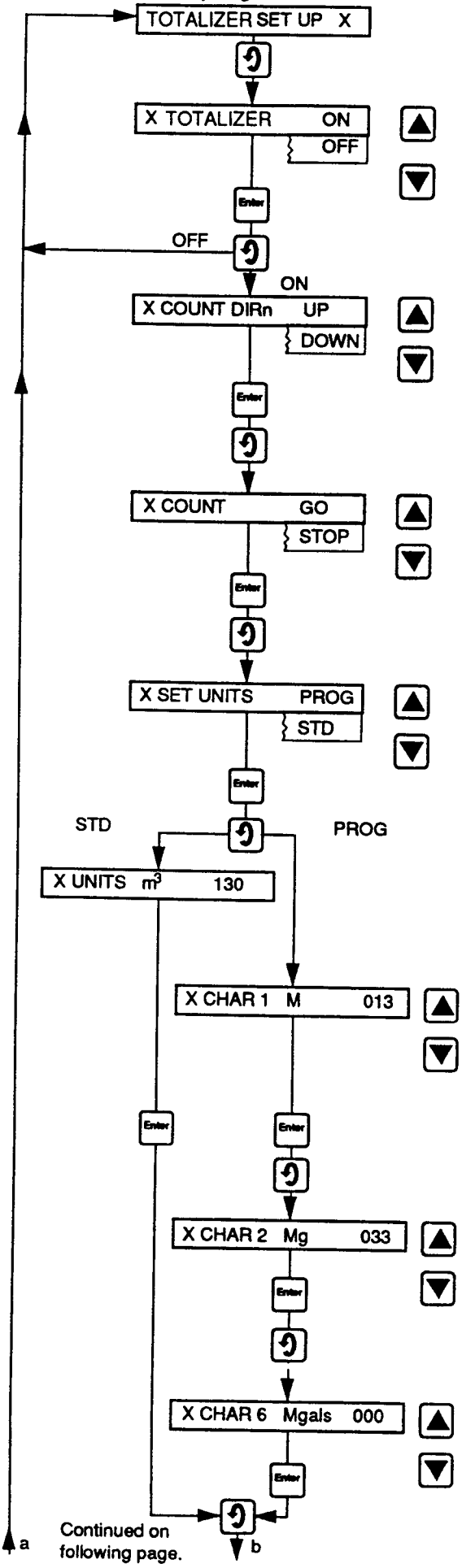
Advance to next parameter.

Character 6
Select characters 3 to 6 using the same method.

Store.

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

8.3(F) Totaliser Set Up Page



Advance to next parameter.

Totalizer

Turn the totalizer 'On' or 'Off' as required. When turned off, the Flow Total is not displayed in the Operating Page.

Store.

Advance to next parameter.

Count Direction

Select either incremental (UP) or decremental (DOWN) counter.

Store.

Advance to next parameter.

Counter On/Off

Enables/disables the counter from incrementing/decrementing

Store.

Advance to next parameter.

Set Units

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

Store.

Advance to next parameter.

Standard Units

In the example shown, set the code number selected from Table 6 in the main manual for the required units of measurement.

Programmable Units Character 1

In the example shown, set the code number corresponding to the first character of the customized six-digit unit of measurement selected from the characters listed in Table 5 in the main manual.

Store.

Advance to next character.

Character 2

Repeat the previous step for the second character.

Store.

Advance to next character.

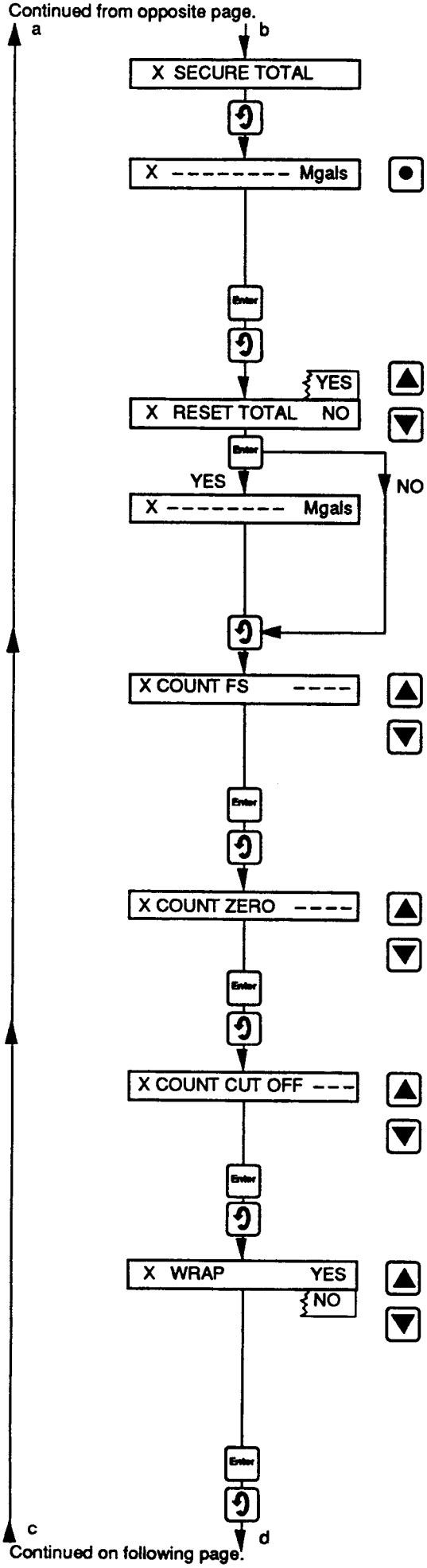
Character 6

Select characters 3 to 6 by the same method as above.

Store.

Advance to next parameter.

Continued from opposite page.



Continued on following page.

Secure Total

Advance to next parameter.

Secure Total Value (independent of displayed flow total)
This value can comprise up to 8 digits with the decimal point position selectable by operation of the Decimal Point switch from .00000000 to 00000000. Multiplication factors are available by further operations of the decimal point switch to give x10 or x100, e.g. 00000000 0 or 00000000 00.

Store.

Advance to next parameter.

Reset Total
Select 'YES' to initiate reset of secure total.

Store

New Total
The total is set to 00000000 if 'UP' is selected as count direction.
The total is set to 99999999 if 'DOWN' is selected as count direction.

Advance to next parameter.

Count Full Scale
Set the required count rate (pulses/second) corresponding to full scale input. This is programmable from 0.00 to 10.00 in 0.01 increments, or from 0.000 to 1.000 in 0.001 increments.

Store.

Advance to next parameter.

Count Zero
Set the required count rate corresponding to zero input as for **Count Full Scale** above.

Store.

Advance to next parameter.

Count Cut-Off
Set the lowest value at which the totalizer is to stop counting. This is adjustable over the range 0 to 100% of maximum flow rate.

Store.

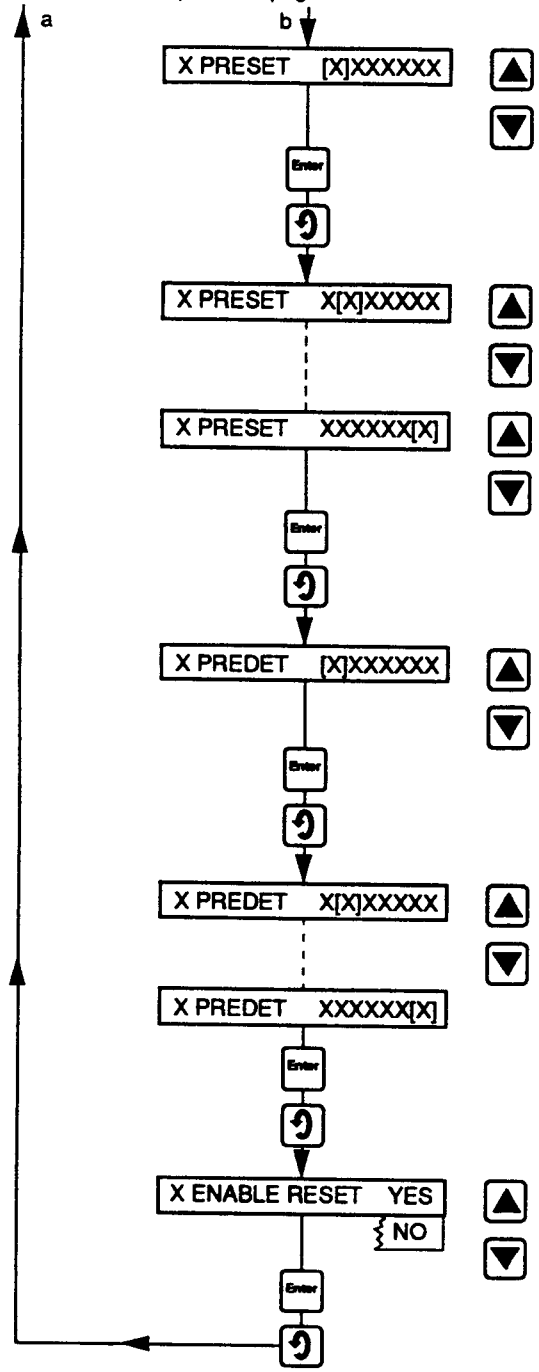
Advance to next parameter.

Wrap-around Feature
When the 'Wrap-around Feature' is selected, the front panel total is automatically reset to the PRESET value (see below) once the PREDETERMINED value (see below) is reached.
When the 'Wrap-around Feature' is not selected the front panel total stops counting when the PREDETERMINED value is reached .

Store.

Advance to next parameter.

Continued from previous page



Preset Value
Set the value to which the front panel total reverts when it is reset, beginning with the first digit within the cursor [ ].

Store.

Advance the cursor to the second digit.

Set the value for the second digit, store and advance the cursor.

Repeat the above for all digits.

Store.

Advance to next parameter.

Predetermined Value
Set the value required to cause a reset of the front panel total beginning with the first digit within the cursor [ ].

Store.

Advance the cursor to the second digit.

Set the value for the second digit, store and advance the cursor.

Repeat the above for all the digits.

Store.

Advance to next parameter.

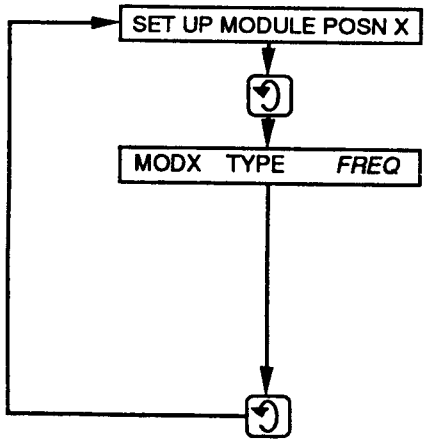
Enable Reset
Select 'YES' to allow reset of the front panel total to the Preset value.

Store.

Return to the top of **Totalizer Set Up Page**

8.4 (F) Set Up Module Page

8.4.1(F) Module Positions 1,2,3.

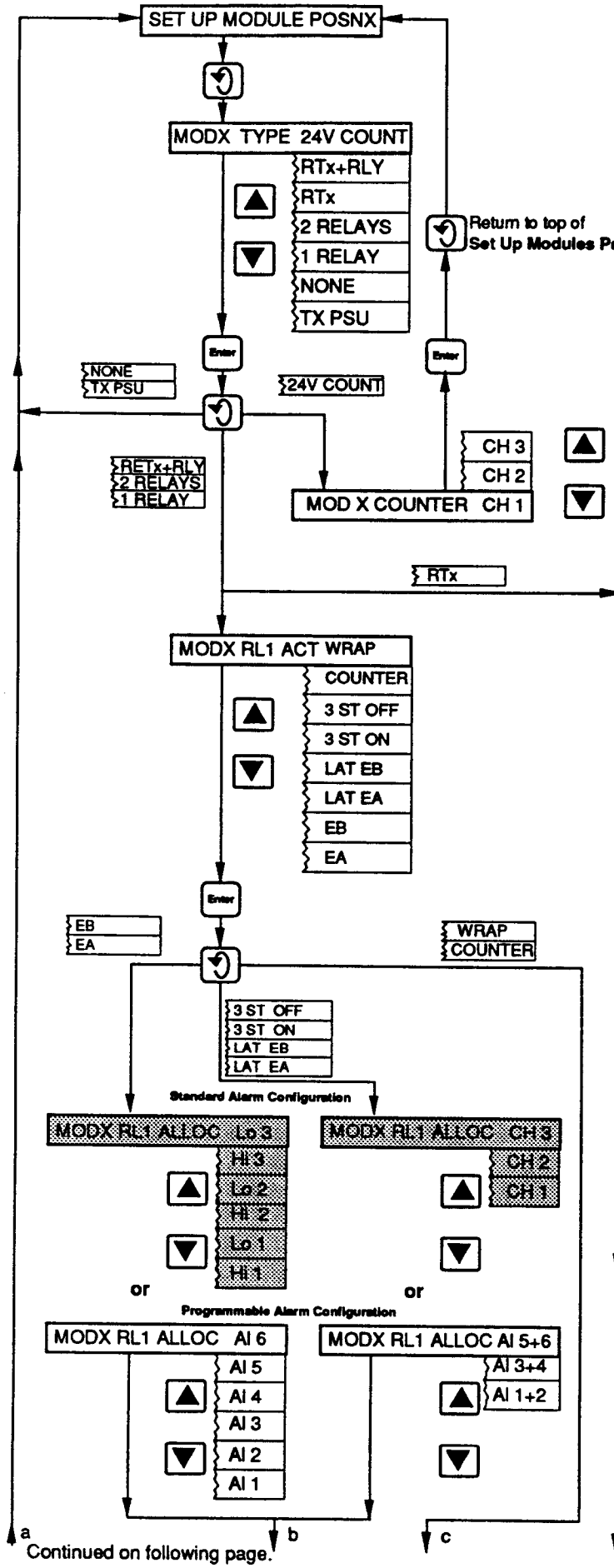


Module Position 1,2,3.

Advance to next parameter.

Module Position 1,2,3, Type
When FREQ is selected as **Input Type** in the **Input Page** for Channel 1 then FREQ is displayed in **Module 1 Type.**
Similarly for Channel 2, **Module 2 Type** and Channel 3, **Module 2 Type.**
This display cannot be changed and frequency modules must be used in these positions.
If FREQ is de-selected in the **Input Page** then **Set Up Module** page is as shown in Section 8.11 in the main manual.

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



Continued on following page.

Module Position 4,5,6.

Advance to next parameter.

Module Position 4,5,6, Type
Select the module type installed in the module position 4, 5 or 6 - see Fig 4.1 in the main manual.

Store.

Advance to next parameter.

Module Position 4,5,6,Counter
Select the channel to which the 24V counter drive output is to be allocated.This parameter is not displayed for single pen instruments and the display returns to top of **Set Up Module** page.

Module Position 4,5,6, Relay 1 Action
Select the relay 1 action required:

'WRAP'	– volt free pulse output *
'COUNTER'	– volt free pulse output
'3 ST OFF'	– 3-state off between set points
'3 ST ON'	– 3-state on between set points
'LAT EB'	– latch below setpoint
'LAT EA'	– latch above setpoint
'EB'	– energized below setpoint
'EA'	– energized above setpoint.

* Relay is energized for 1 second when batch total is auto-reset to the preset value.

Store.

Advance to next parameter.

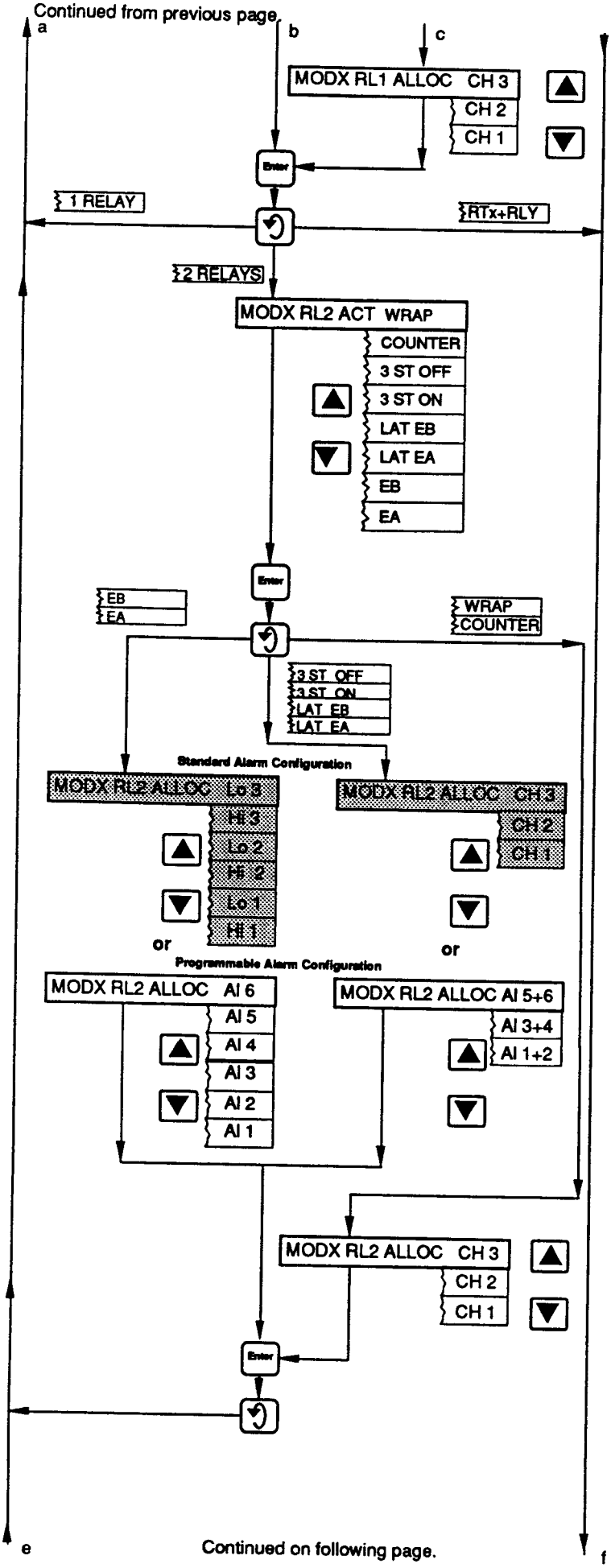
Module Position 4,5,6, Relay 1 Allocation (Standard Alarm Configuration)
For 'EA' or 'EB' alarm action:
Allocate the alarm to a high or low setpoint.

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.
Alarms AI 1, AI 3 and AI 5 must be set to a value greater than alarms AI 2, AI 4 and AI 6.

Continued from previous page.



Module Position 4,5,6, Counter/Wrap Relay 1 Allocation
Select the channel to which the counter relay is to be allocated.

Store.

Advance to next parameter.

Module Position 4,5,6, Relay 2 Action
Select the relay 2 action required:

'WRAP' – volt free pulse output *
'COUNTER' – volt free pulse output
'3 ST OFF' – 3-state off between set points
'3 ST ON' – 3-state on between set points
'LAT EB' – latch below setpoint
'LAT EA' – latch above setpoint
'EB' – energized below setpoint
'EA' – energized above setpoint.

* Relay is energized for 1 second when batch total is auto-reset to the preset value.

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.

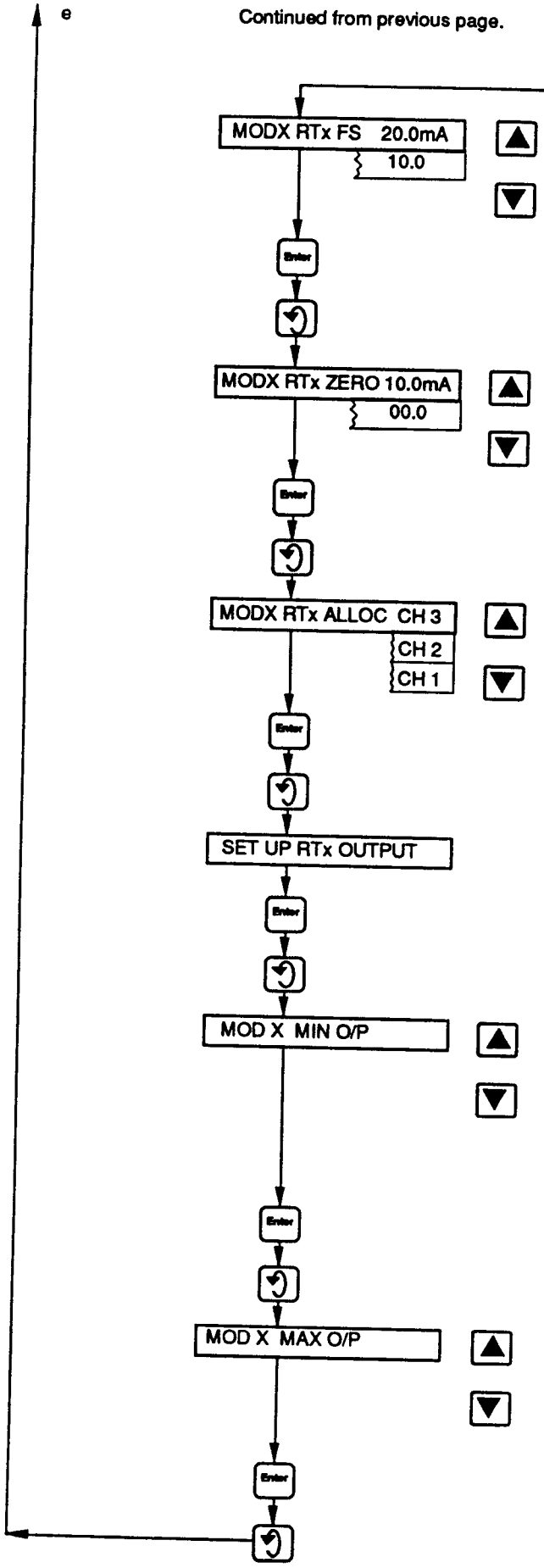
Module Position 4,5,6, Relay 2 Allocation (Programmable Alarm Configuration)
For 'EA' or 'EB' alarm action:
Allocate the relay to an alarm point.

For '3 ST OFF', '3 ST ON', 'LAT EB' or 'LAT EA':
Allocate the relay to an alarm point pair. Alarms AI 1, AI 3 and AI 5 must be set to a value greater than alarms AI 2, AI 4 and AI 6.

Module Position 4,5,6, Counter Relay 2 Allocation
Select the channel to which the counter relay 2 is to be allocated.

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. This parameter is omitted on single pen instruments.

Store.

Advance to next parameter.

Module Position 4,5,6, Retransmission Allocation
Select the channel to which the retransmission signal is to be allocated. This parameter is omitted on single pen instruments.

Store.

Advance to next parameter.

Set Up Retransmission Output

Store.

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 using the 'Raise'/'Lower' switches adjust the milliammeter displayed value to coincide with the retransmission minimum signal specified above.

Store.

Advance to next parameter.

Module Position 4,5,6, Retransmission Maximum Output
Use the 'Raise'/'Lower' switches to adjust the milliammeter displayed value to coincide with the retransmission maximum signal specified above.

Store.

Return to top of **Set Up Modules Page.**

9(F) SIMPLE FAULT FINDING

As detailed in Section 9 of the main manual.

10(F) CALIBRATION

As detailed in Section 10 of the main manual.

11(F) SPECIFICATION

Inputs		
No. of inputs		1,2 or 3 (refer to Section 2(F))
Flow		Analog, linear or square law from flow rate transmitters
Frequency	High level inputs	$x^3/_2$, $x^5/_2$ operating range 0.003 to 0.1Hz to 4kHz TTL level square wave Open collector 2mA,5V Voltage-free contacts 2mA,5V Square wave, low level –50V to +1V, high level +2V to +50V
	Low level inputs	Vortex and Electromagnetic flowmeters. Amplitude: 4mA or greater square wave, with an offset up to 20mA, e.g. 0 to 4mA, 16 to 20mA or 4 to 20mA. Voltdrop: Maximum 2V at 20mA. Frequency range: 3Hz to 4kHz. Turbine and Rotary Shunt meters. Amplitude: 12mV/Hz. Frequency range: 3Hz to 4kHz. General purpose AC coupled. Frequency range: 3Hz to 4kHz. Amplitude: Fixed or variable between the limits of 5mV peak to peak to 50V peak to peak. On inputs where the amplitude is proportional to frequency, automatic variable gain (maximum sensitivity 1mV/Hz) can be achieved by link positioning. General purpose DC coupled. Frequency range: 0.1 Hz to 4k Hz.

APPENDIX

A1(F) Calculation of Pulse Rate and Total Count

Pulse Rate

Convert full scale flow rate into units/second (1)

Pulse rate = $\frac{\text{units/second}}{\text{counter factor}}$ } Must be within the limits of 10.00 to 0.0001 pulses per second (2)

Counter factor i. e. what the first digit on counter represents

Example 1

Range: 0 to 100 m^3/hour

Counter factor: 1m^3

From (1) $= \frac{100}{60 \times 60}$ = 0.0278 m^3/second

From (2) pulse rate $= \frac{0.0278}{1}$ = **0.0278 pulses/second**

enter 0.028 at Counter FS

Example 2

Alternatively with Example 1 a counter factor of 0.1m^3 could be set giving a pulse rate of 0.278 pulses/second.

The decimal point switch (see Section 8.3(F), Secure Total Value) would be set to 10^{-1}.

Example 3

Range: 0 to 1000 m^3/minute

Counter factor: 1m^3

From (1) $= \frac{1000}{60}$ = 16.67m^3/second

From (2) pulse rate = 16.67 = **16.67 pulses/second** – this is too high

If counter factor = 10m^3

∴Pulse rate $= \frac{16.67}{10}$ = **1.667 pulses/second**

enter 1.67 at Counter FS and set decimal point switch to give x10 factor (see Section 8.3(F), Secure Total Value).

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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