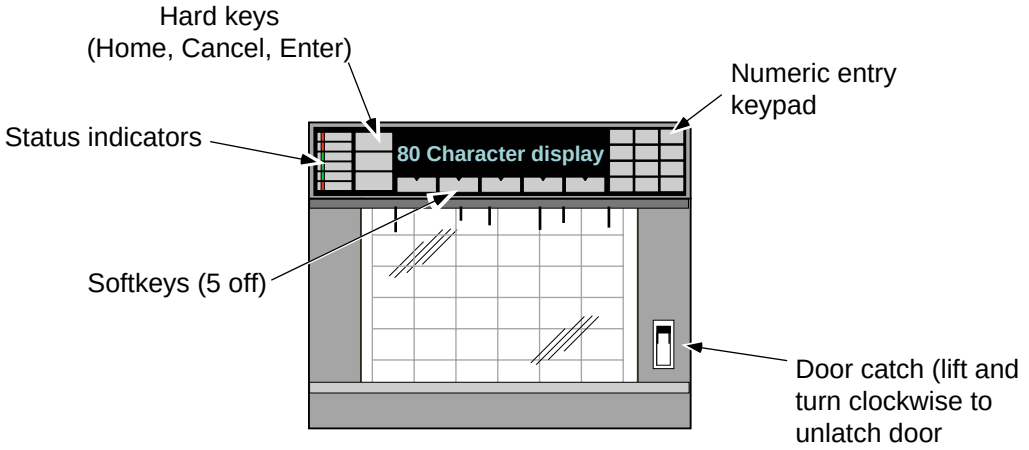
4250C

EUROTHERM
CHESSELL

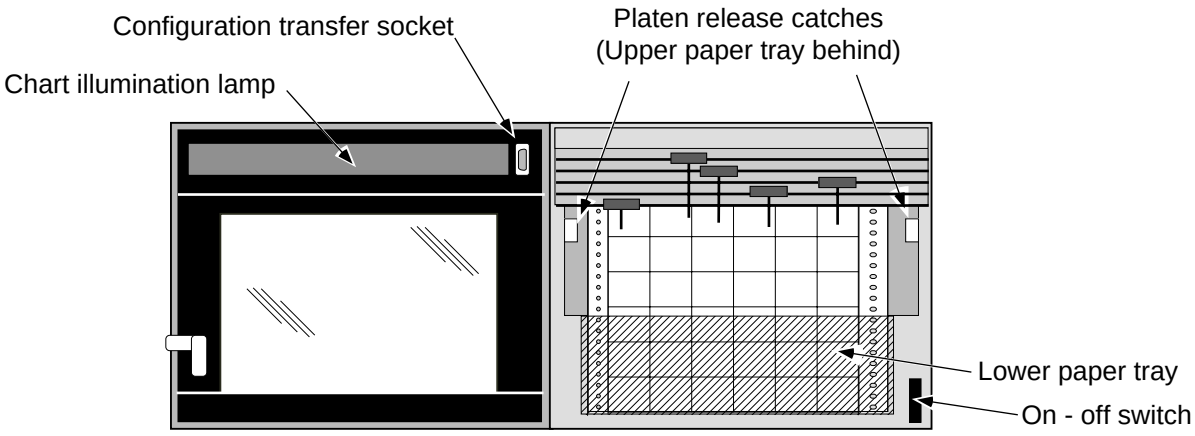
Model 4250C
Chart recorder

Installation and operation manual

Major functional parts



Door closed



Door open

Useful part numbers

Roll Charts (32 metre)	GD244109Uxxx
Z-fold Charts (22 metre)	GD244101Uxxx
Blue pen:	LA244371
Red pen:	LA244372
Green pen:	LA244373
Black pen:	LA244374
Violet pen (annotator):	LA243770

Technical Manual	HA247876
Communications manual	HA246958
Memory card manual	HA247361
CE Declaration of Conformity	IA249986U070
Attenuator	LA244180
Shunt (100Ω)	LA246779UK10
Shunt (250Ω)	LA246779UK25

Where xxx = N of chart divisions = 080, 100, 120, 140 or 150.

EUROTHERM CHESSELL

Declaration of Conformity

Manufacturer's name:	**Eurotherm Recorders Limited**
Manufacturer's address	**Dominion Way, Worthing, West Sussex, BN14 8QL, United Kingdom.**
Product type:	**Industrial chart recorder**
Models:	**4250C (Status level D5 or higher)**
Safety specification:	**EN61010-1: 1993 / A2:1995**
EMC emissions specification:	**EN50081-2 (Group1; Class A)**
EMC immunity specification:	**EN50082-2**

Eurotherm Recorders Limited hereby declares that the above products conform to the safety and EMC specifications listed. Eurotherm Recorders Limited further declares that the above products comply with the EMC Directive 89 / 336 / EEC amended by 93 / 68 / EEC, and also with the Low Voltage Directive 73 /23 / EEC

Signed: PRV de la Nougerède Dated: 18-12-96

Signed for and on behalf of Eurotherm Recorders Limited
Peter De La Nouger de
(Technical Director)

CE

IA249986U070 Issue 2 Dec 96

250mm Continuous-trace recorder

INSTALLATION AND OPERATION MANUAL

OVERALL CONTENTS LIST

(Continued)

OVERALL CONTENTS LIST (Cont)

YEAR 2000 COMPLIANCE

All software versions of this product comply with the requirements of the British Standards Institute document 'Disc PD2000-1. A Definition of Year 2000 Conformity Requirements', when the product is used as specified in this manual.

Safety Notes

1. Whenever it is likely that protection has been impaired, the unit shall be made inoperative and secured against unintended operation. The nearest manufacturer's service centre should be consulted for advice.
2. Any adjustment, maintenance and repair of the opened apparatus under voltage, should be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.
3. The Mains (supply voltage) wiring must be terminated in such a way that, should it slip in the cable clamp, the Earth wire would be the last wire to become disconnected.

WARNING!

Any interruption of the protective conductor inside or outside the apparatus, or disconnection of the protective earth terminal is likely to make the apparatus dangerous under some fault conditions. Intentional interruption is prohibited.

4. Where conductive pollution (e.g. condensation, carbon dust) is likely, adequate air conditioning/filtering/sealing etc. must be installed in the recorder enclosure.
5. This unit contains one or more batteries which must be treated and disposed of with care. In particular, batteries must not be shorted or an explosion can occur. Batteries should be disposed of in accordance with local regulations; they must not be discarded with normal refuse.
6. Signal and supply wiring should be kept separate from one another. Where this is impractical, shielded cables should be used for the signal wiring. Where signal wiring is carrying (or could carry, under fault conditions) hazardous voltages *, double insulation should be used.
7. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.
8. For both portable and panel mounting equipment, the protective earth terminal must remain connected (even when the recorder is isolated from the mains supply) if any of the I/O circuits are connected to hazardous voltages*.

* A full definition of 'Hazardous' Voltages appears under 'Hazardous Live' in BS EN61010. Briefly, under normal operating conditions Hazardous voltage levels are defined as >30V RMS (42.4V peak) or >60V dc.

Symbols used on the recorder labelling

One or more of the symbols below may appear on the recorder labelling.

	Refer to the Manual for instructions
	Protective Earth
	This recorder for ac supply only
	This recorder for dc supply only.
	Risk of electric shock

STATIC ELECTRICITY

High voltages (tens of kilo-volts) can be generated on the human skin through a number of mechanisms, such as friction between different materials (e.g. nylon and skin), and separation of similar materials (eg masking tape, nylon sheet). The gate-oxide region of all metal oxide semi-conductors (MOS) is extremely thin, and can be damaged by voltages as low as 60 Volts. Modern MOS devices have built-in clamp diodes which reduce the incidence of obvious static damage considerably. It is possible however, even with such clamping diodes, to produce a small rupture in the oxide layer. This might not destroy the device immediately, but it may result in a gradual reduction in the performance of the device until, eventually, it fails.

For this reason, the following precautions should be taken when handling any recorder circuit board.

1 Personnel handling MOS devices, or circuit boards containing them, should wear anti-static materials such as cotton. Nylon clothing should be avoided.

2. All bench tops should be covered with conductive material (10^4 to 10^5 Ohms per square) maintained at the recorder chassis potential.

3. Circuit boards removed from the recorder should be placed into a static-safe bag, initially at the recorder chassis potential, for storage. Before re-fitting the board, the containing bag should again be returned to the recorder chassis potential.

4. Personnel handling MOS devices, or boards containing them, should wear a wrist strap connected (via a safety resistor) to the bench top, or if appropriate, to a suitable grounding point on the rack.

5. Leads of MOS devices removed from circuit should be shorted together using conductive foam or similar.

6. MOS devices should not be extracted from or inserted into circuit whilst the circuit board has power applied.

TERMINOLOGY

ANTI-STATIC

This term means that the material in question does not of itself generate static electricity. Such materials do not afford protection against external electric fields.

STATIC SAFE

This means that a) the material in question does not generate static electricity, and b) any device enclosed in such material is safe from the effects of external electric fields.

SECTION 1 INSTALLATION

LIST OF CONTENTS

Note: The instrument can weigh up to 22 kg. It is therefore recommended that a risk assessment be carried out before it is handled

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SECTION 1 INSTALLATION

1.1 INSTALLATION PROCEDURE

The installation procedure is as follows:

1. Unpack the recorder (section 1.2)
2. If the recorder is to be panel mounted, fit the recorder into the panel (section 1.3)
3. Connect supply and signal wiring (sections 1.4 and 1.5)
4. Fit chart and pens (sections 1.7 and 1.8)
5. Switch on. Configure the recorder.

1.2 UNPACKING THE RECORDER

The recorder is shipped in a special pack, designed to ensure adequate protection during transit. Should the outer box show signs of abnormal wear or damage, it should be opened immediately and the recorder examined. If there is evidence of damage, the instrument must not be operated and the local representative contacted for instructions. After the recorder has been removed from its packing, the packing should be examined before it is discarded, to ensure that all accessories and documentation hhave been removed.

1.3 MECHANICAL INSTALLATION

As shown in figure 1.3 below, the recorder is intended for installation in a cutout 348 mm across by 273.5 mm. high, in a panel which is either vertical or sloping up to 30 degrees. Particular attention should be paid to the recommended minimum distances between adjacent recorders. These distances are advised in order to retain ease of access, to allow full door opening and for panel strength considerations.

The instrument is inserted through the panel cutout, from the front. With the weight of the recorder supported, the panel clamps are clipped into the holes located one each side of the recorder. The jacking screws are now tightened until the springs of the panel jacks are compressed to approximately half of their free length.

Once the recorder is securely mounted, the door should be opened (by lifting and then turning the latch clockwise) and the internal packing removed, and stored along with the remainder of the packing, against future transport requirements.

1.4 SUPPLY VOLTAGE CONNECTION

All connections are made at the rear of the recorder. Supply voltage wiring, supply voltage selection and fuse replacement can all be carried out without the removal of the terminal cover.

1.4.1 Supply voltage selection

As shown in figure 1.4.1 The supply voltage setting switch is located immediately above the fuse drawer associated with the IEC plug. The switch is operated downwards (230V indicated) to select 180 to 264 V, or upwards (115V indicated) to select 90 to 132V.

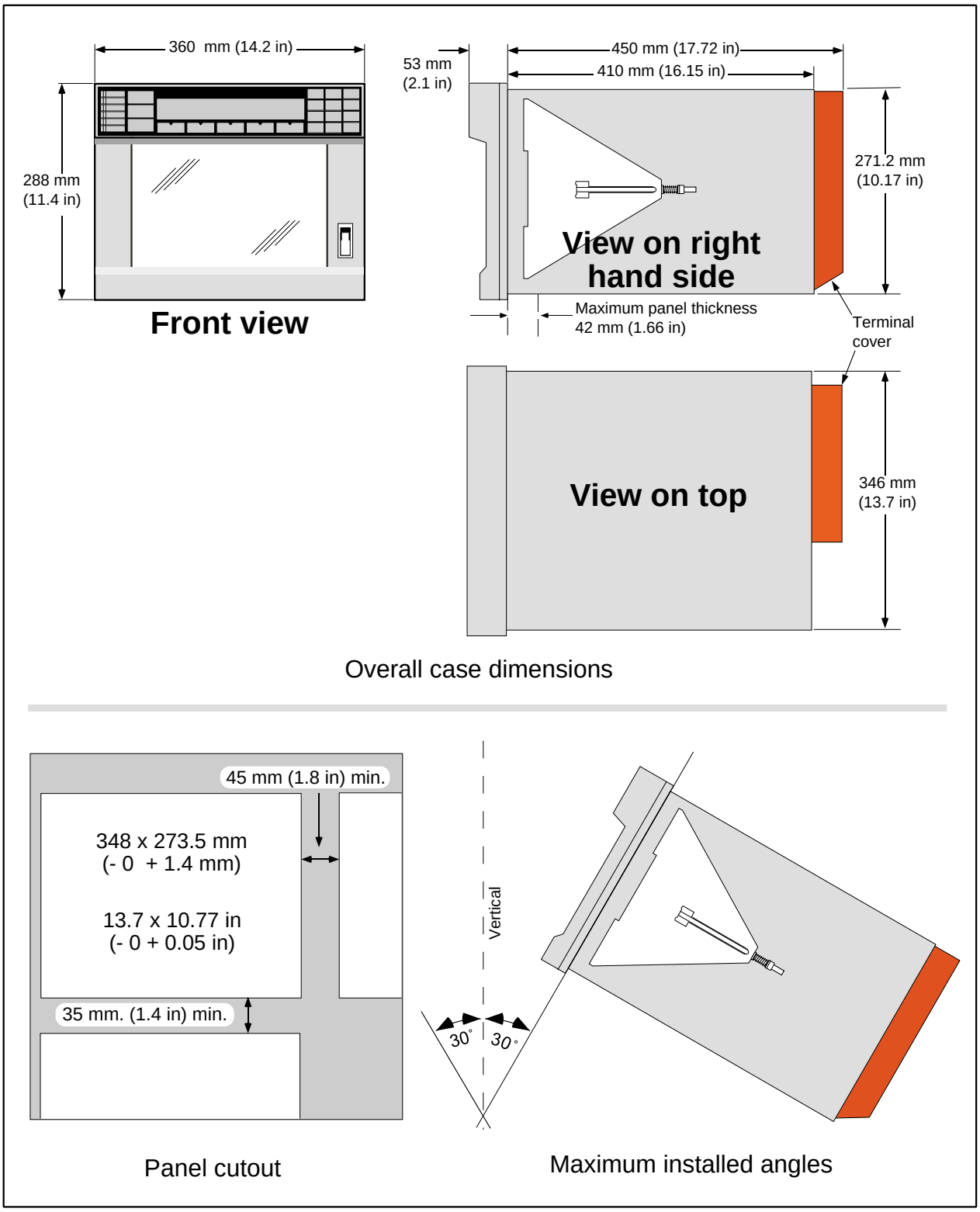


Figure 1.3 Mechanical installation

1.4.2 Supply voltage wiring

Before connecting the supply to the recorder, check that the recorder voltage select switch has been set to the correct voltage range, as described above.

Before proceeding further, please read the warnings on page i - 3.

The line supply is terminated using an IEC socket which is connected into the mating plug at the rear of the recorder power supply (figure 1.4.1). Recommended minimum wire size is 16/0.2 (0.5 mm^2)

1.4.3 Supply voltage fuse

The supply fuse is located in a pull-out drawer integral with the IEC plug. The fuse specifications (3.15 Amp type F) are the same for both supply voltage ranges, and are as follows:-

Rating:	3.15 Amps
Physical size:	20 mm
Speed:	Fast blow
Material:	Ceramic

It should be ensured that only fuses with the required rated current and of the specified type are used for replacement. The use of make-shift fuses, and the short-circuiting of fuse holders are prohibited, and will invalidate the manufacturer's warranty.

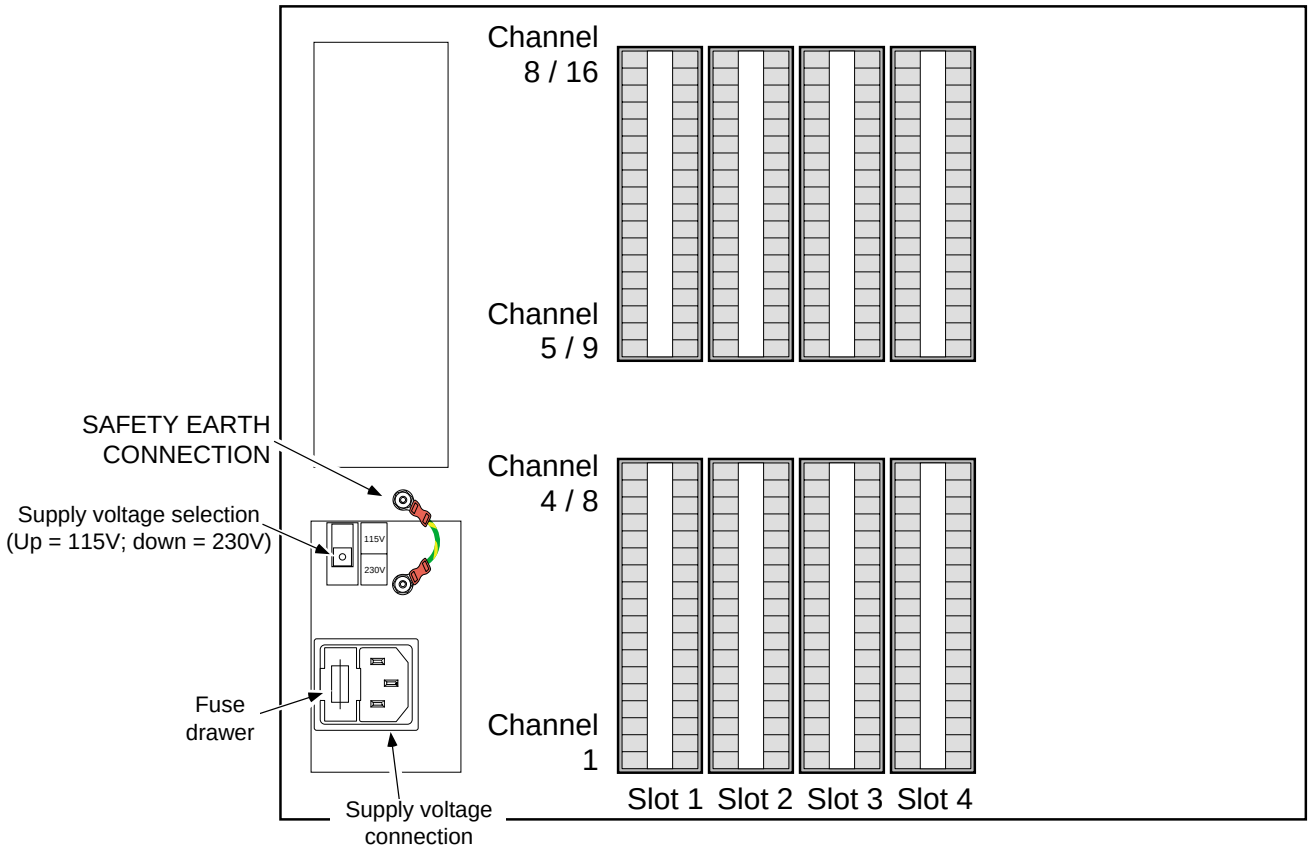


Figure 1.4.1 Recorder rear view with terminal cover removed

1.5 SIGNAL WIRING

It should be noted that the *overall* channel number (i.e. 1 to 32) is related to the slot number (figure 1.4.1) by the card address, as described in section 4.4.

All signal wiring terminations are located behind the terminal cover (figure 1.3). This acts not only as protection, but also as a thermal 'container' to reduce temperature fluctuations as much as possible for the thermocouple cold junction terminations. To remove the rear cover, release the two screws securing it to the rear of the recorder.

Figure 1.5 shows signal wiring for the various types of I/O board available.

Note: Maximum recommended wire size is 2.5mm^2

1.6 CONFIGURATION TRANSFER WIRING

As explained in section 4.11, the configuration of one recorder can be transferred to or from one or more other recorders using the 9-way D-type socket located on the inside of the recorder door. Figure 1.6a shows the cable specification for a connection between two recorders. No screen is necessary.

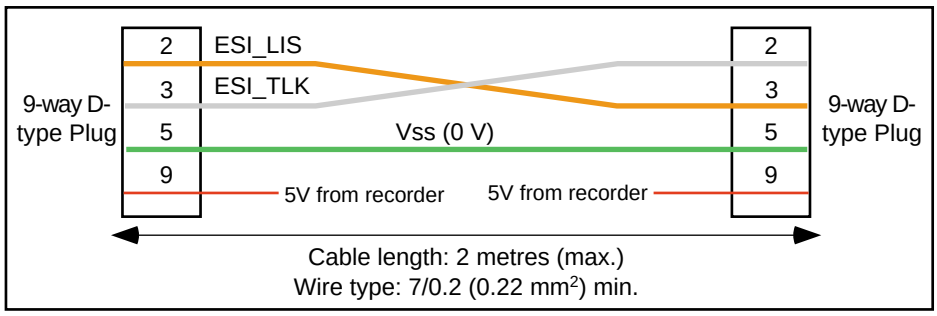


Figure 1.6a Cable specification for configuration transfer

Configuration transfer can also be carried out between the recorder and any host computer or configuration terminal which is capable of accepting 5V logic levels at its RS232 input, and which does not require hardware handshake. Figure 1.6b shows how to wire the recorder link to host computer 9-way and 25-way D-types. It is up to the user to determine whether a plug or socket is required at the host computer end of the link.

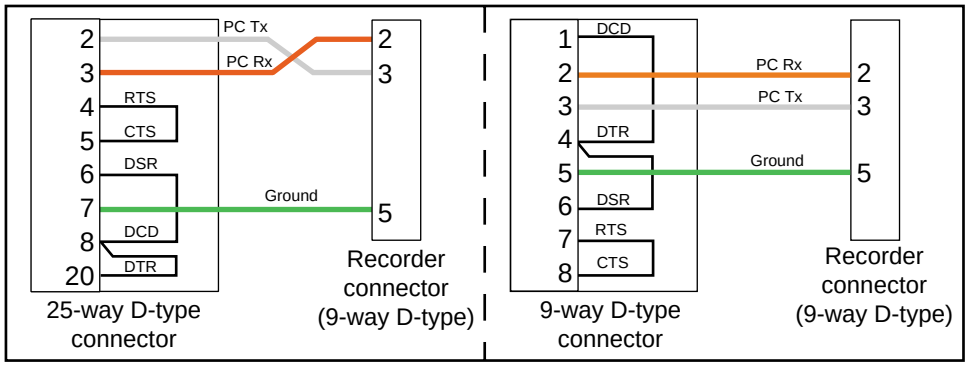
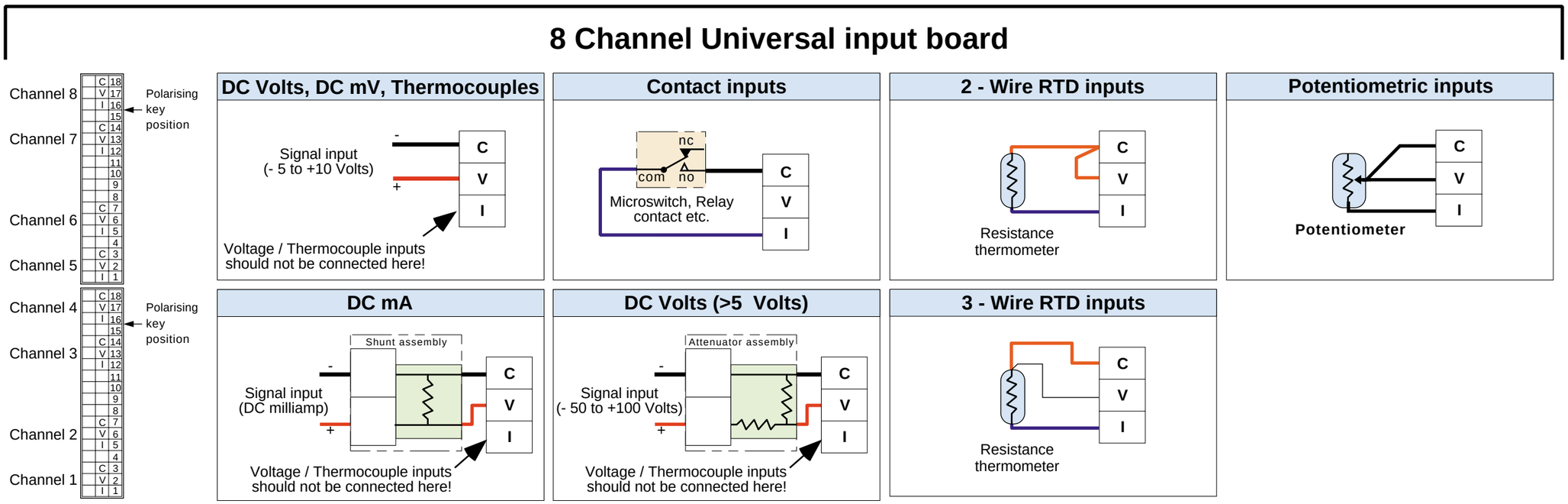


Figure 1.6b Configuration transfer port to host computer wiring

Alternatively, the communications option can be used. This allows not only configuration save and restore, but also full configuration and monitoring functions. A PC configuration tool is available from the manufacturer.



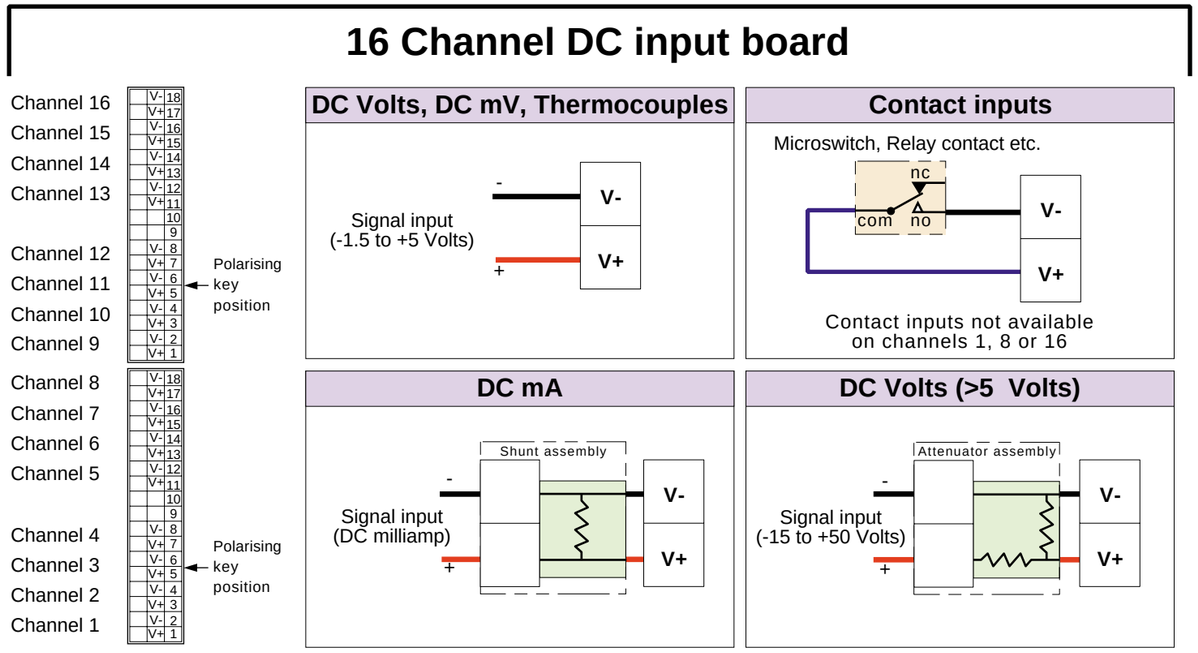


Figure 1.5 Signal Wiring
Sheet 1 Input boards

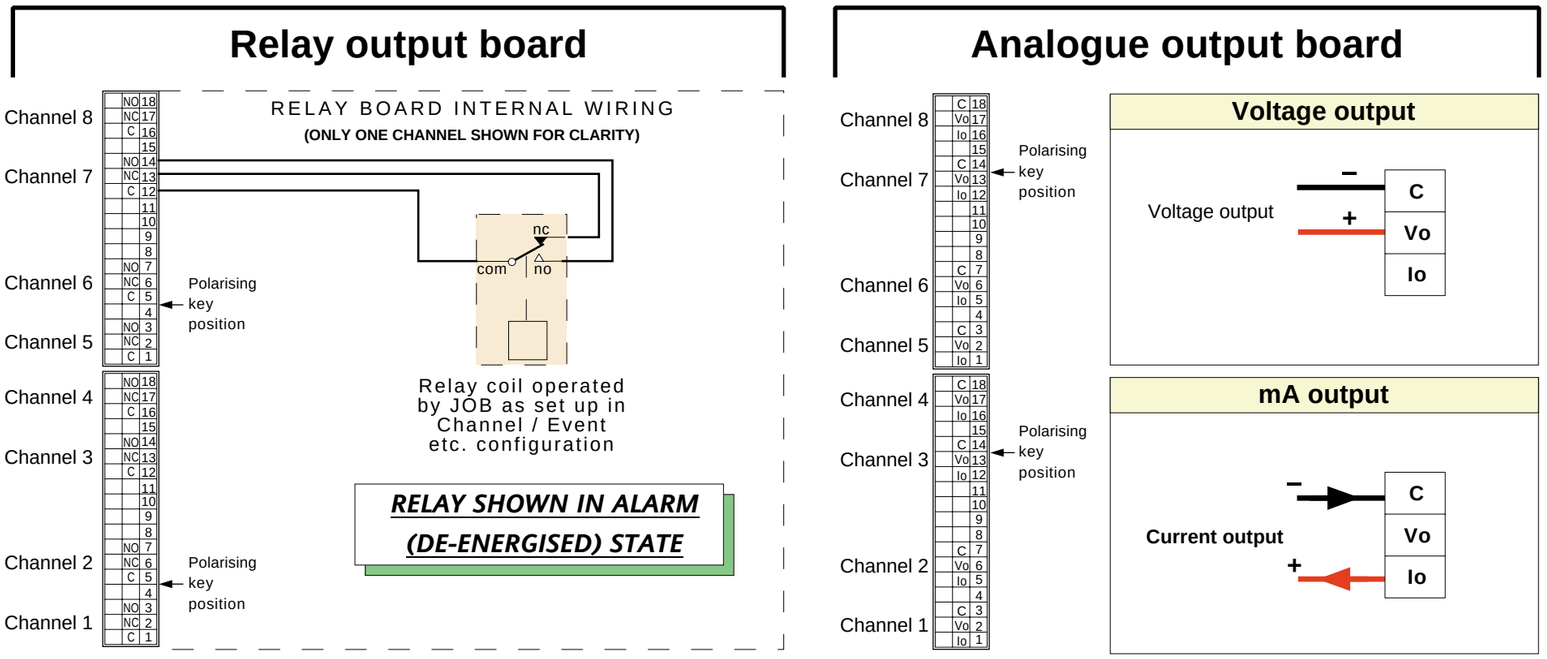


Figure 1.5 signal wiring
Sheet 2 output boards

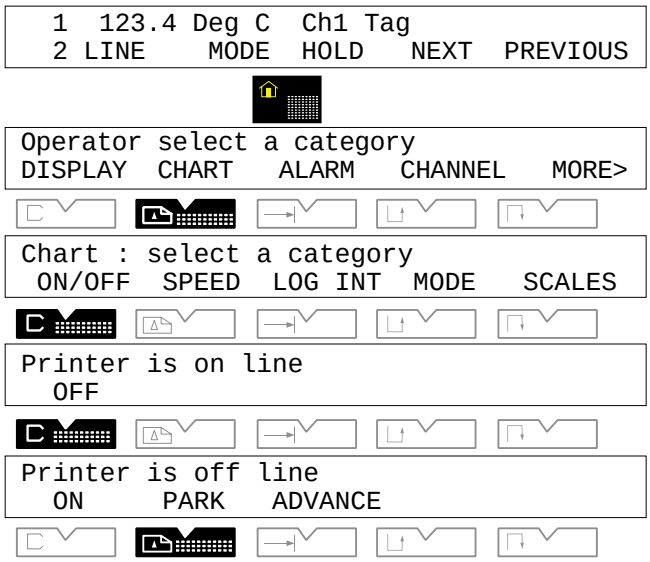
Figure 1.5 signal wiring
Sheet 2 output boards

Section 1
Page 1 - 8

1.7 Z-FOLD CHART INSTALLATION / REPLACEMENT

Before fitting a chart, it is recommended that tracing is switched off-line, as follows:

a. Operate the 'Home' hard key.
b. Operate the 'CHART' softkey.
c. Operate the ON/OFF softkey.
d. Operate the OFF softkey, then wait until the legend on the top line of the display reads 'Printer is off line'



Note the position of the ADVANCE softkey.

Open the recorder door by lifting, then rotating, the latch clockwise.

If fitting a chart for the first time, or if the previous chart has already been removed, go to section 1.7.2 (Fitting a new Z-fold chart).

1.7.1 Old chart removal

Pull the paper guide forwards, as shown, and disengage the remaining chart from the drive sprockets. Pull the end of the chart downwards clear of the platen.

Open the lower paper tray by rotating it forwards as shown in the figure, and remove the old chart.

Remove any residual paper dust from the paper tray, and then close it.

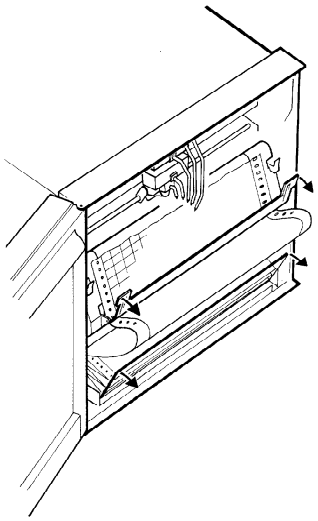


Figure 1.7.1 Z-fold chart removal

1.7.2 Fitting a new Z-fold chart

Release the platen by pushing upwards on one or both of the latches, as shown. Swing the platen forwards to reveal the upper paper tray. Remove any residual paper dust from previous charts (if any).

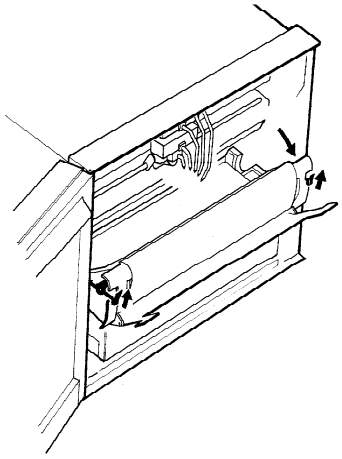


Figure 1.7.2a Paper tray access

1.7.2 FITTING A NEW Z-FOLD CHART (Cont.)

Remove the new chart from its packing, and fan (as shown in the figure) several times to separate the leaves, and to remove loose paper dust. Ensure that the leaves are fully separated, or the paper transport will not operate correctly.

Orient the chart such that the red 'end of chart' line is at the bottom, and the **circular** chart **holes** are **to the left** (i.e. the elongated **slots** are **to the right**).

Place the chart into the upper paper tray.

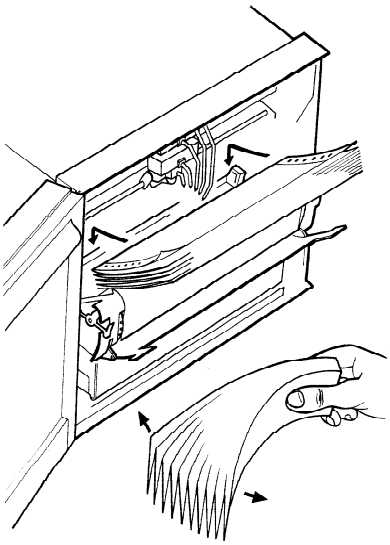


Figure 1.7.2b Chart loading (1)

Unfold the top two or three leaves. Push the platen closed **ENSURING THAT IT LATCHES CORRECTLY INTO PLACE**.

If the chart is loaded correctly, the circular holes will be on the left, and the printed grid will be uppermost, with no red line showing.

Pull the paper guide forwards and feed the end of the chart through the gap between the platen and the paper guide. Close the paper guide, ensuring that both sets of chart holes locate correctly on the drive sprockets, and that the horizontal grid lines are parallel with the chart guide.

Open the lower paper tray and introduce the first leaves of chart into it. Close the paper tray and, if necessary, apply power to the recorder and use the ADVANCE softkey to feed extra paper through.

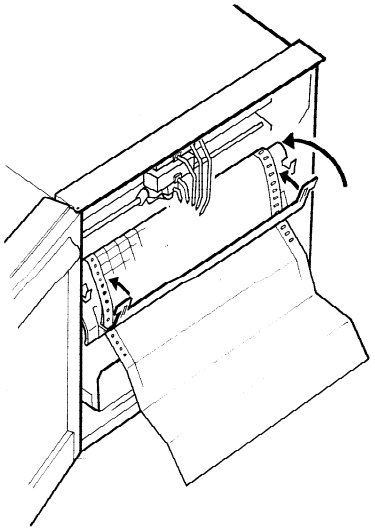


Figure 1.7.2c Chart loading (2)

Ensure that the paper lies naturally (i.e. the fold direction is the same as when packed by the chart manufacturer).

FAILURE TO ENSURE THAT THE CHART FOLDS NATURALLY WILL RESULT IN THE EVENTUAL MALFUNCTIONING OF THE CHART FEED.

Once the chart has been installed, it is recommended that the pen zeros and spans are checked against the chart zero and span - see section 4.15.2.

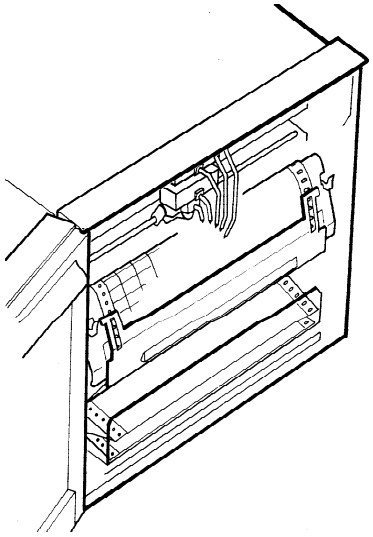


Figure 1.7.2d Chart loading (3)

1.8 ROLL CHART INSTALLATION

Before fitting a chart, it is recommended that tracing is switched off-line as described in section 1.7 above.

Open the recorder door by lifting, then rotating, the latch clockwise.

If fitting a chart for the first time, or if the previous chart has already been removed, go to section 1.8.2 (Fitting a new roll chart).

1.8.1 Chart removal

Release the platen by pushing upwards on one or both of the latches, as shown. Swing the platen forwards to reveal the upper paper tray. Remove the empty tube and discard. Remove any residual paper dust.

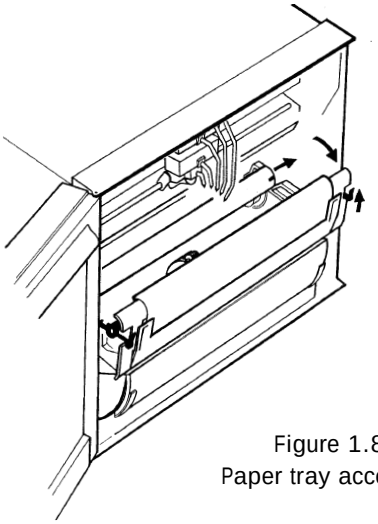


Figure 1.8.1
Paper tray access

1.8.2 Fitting a new roll chart

Remove the new chart from its packing. Unroll the first 10 to 20 cm, and place the roll in the tray, with the leading edge to the top (i.e. with the chart grid showing).

Push the platen closed **ENSURING THAT IT LATCHES CORRECTLY INTO PLACE.**

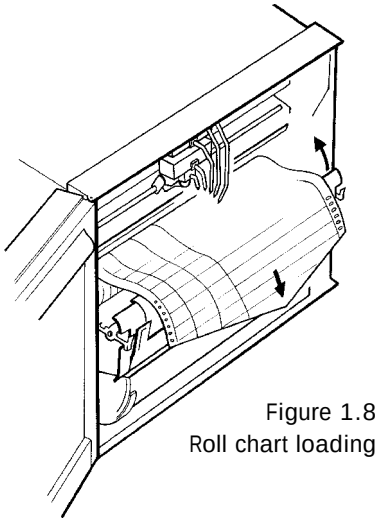


Figure 1.8.2a
Roll chart loading (1)

Pull the paper guide forwards and feed the end of the chart through the gap between the platen and the paper guide. Close the paper guide, ensuring that both sets of chart holes locate correctly on the drive sprockets, and that the horizontal grid lines are parallel with the chart guide.

If the chart is loaded correctly, the **circular holes** will be **on the left**, and the printed grid will be uppermost, and aligned with the paper guide.

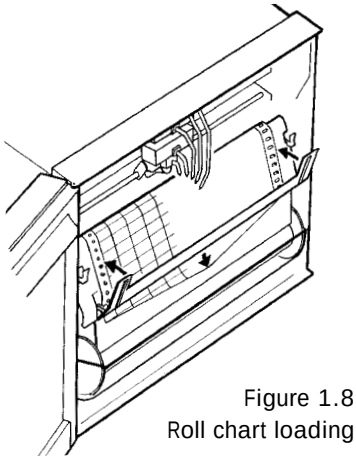


Figure 1.8.2b
Roll chart loading (2)

1.8.2 FITTING A NEW ROLL CHART (Cont.)

If applicable open the lower paper tray, and remove the take-up spool with the old chart.

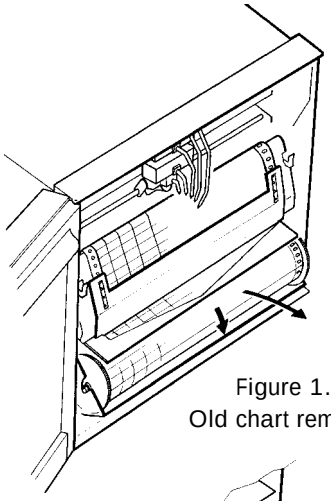


Figure 1.8.2c
Old chart removal

Remove the take-up spool gear wheels from the old chart by pulling them away from the inner tube. Slide the inner tube out of the chart. Re-fit the gearwheelsto the tube, ensuring that they are pushed fully home

Close the paper tray. If necessary apply power to the recorder and use the ADVANCE softkey to feed the chart through to the auto take-up mechanism.

Ensure that the paper takes-up neatly.

Once the chart has been installed, it is recommended that the pen zeros and spans are checked against the chart zero and span - see section 4.15.2.

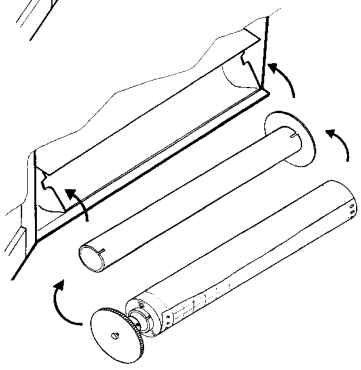


Figure 1.8.2d Take-up spool

1.9 PEN REPLACEMENT

CAUTION
BEFORE ATTEMPTING TO CHANGE PENS, IT IS ESSENTIAL TO ENSURE THAT THE CHART DRIVE IS OFF-LINE AND THE PENS ARE PARKED (SECTION 1.7)

Release the platen (figure 1.8.1).

1. Rotate the pen to be replaced ‘downwards’ out of its clip.
2. Remove the replacement pen from its packing, and fit it to the clip, taking care not to bend or rotate the tube. Remove the cover from the pen tip.
3. When all the required pens have been replaced, close the platen, ensuring it latches correctly and that the paper folds neatly back behind the platen.

Once new pens have been installed, it is recommended that their zeros and spans are checked against the chart zero and span - see section 4.15.2.

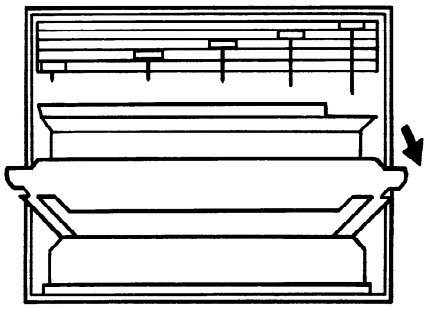


Figure 1.9a Pen access

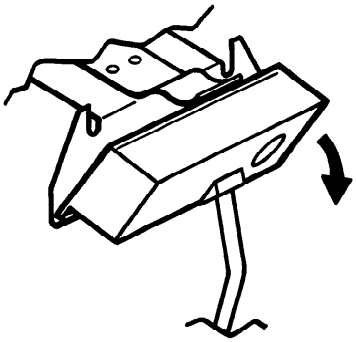


Figure 1.9b Pen removal detail

SECTION 2: BASIC OPERATION

LIST OF CONTENTS

SECTION 2: BASIC OPERATION

This section is designed to help you as a new user to configure a channel to a known set of parameters so you can start recording your own traces with the minimum of effort. Only those items which are necessary to get you going are explained; for full information about the Operator and Configuration displays see sections 3 and 4 respectively.

Figure 2.3 shows the top level menus for a recorder fitted with all available options. If an option isn't fitted then its softkey legend doesn't appear. For this reason, your displays might be slightly different from those depicted.

2.1 FIRST SWITCH ON

For current instruments, the power on-off switch is located at the bottom right-hand the chart cassette as shown in figure 2.1a. Older instruments have the on-off switch located behind the chart as shown on figure 2.1b.

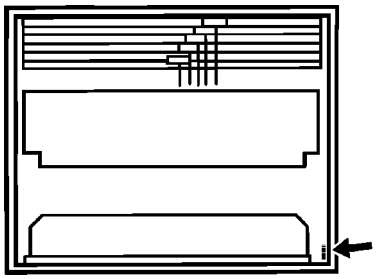


Figure 2.1a On-off switch (current instruments)

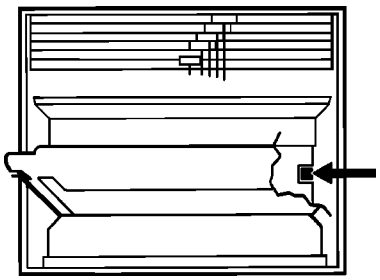


Figure 2.1b On-off switch (previous instruments)

If the annotator option is fitted, then after the on-off button is pressed, a 'Power on' message is printed on the chart. The message includes the current time and date, the print mode (trace priority) and chart speed (120 mm / hr).

The display goes into 'background mode' i.e. it displays a single channel's number, status and 'tag' on the top line, and a series of 'softkey' legends on the lower line.

```
01      OFF       1
2 LINE   MODE    HOLD    NEXT  PREVIOUS
```

The softkeys depicted (2 LINE, MODE etc.) are fully described in section 3.

The first channel to be displayed is the first channel fitted (normally channel 1). After approximately 3 seconds, the display changes to show channel 2 and so on until all the measuring channels have appeared. After all the measuring channels have been 'scrolled through' in this way, any derived (maths pack) channels, totalisers and/ or counters fitted are displayed in turn, before channel 1 is returned to.

As delivered, channels 1 to 4 are set 'Trace ON', with channel 1 green, channel 2 red, channel 3 blue and channel 4 black. Channel trace On/Off and channel colours can be selected as a part of Channel Configuration.

In order to carry out real measurements, you need to tell the recorder what input types are wired to each channel, what range and scale to use, whether there are alarm setpoints, what alarm types are to be used and so on. To do this you need to access the configuration menus, but before you do, here is some basic information you need to do the job.:

2.2 OPERATOR INTERFACE

The 'Operator interface' is the name given to the display and its associated hardkeys (including numeric keys), softkeys and status indicators.

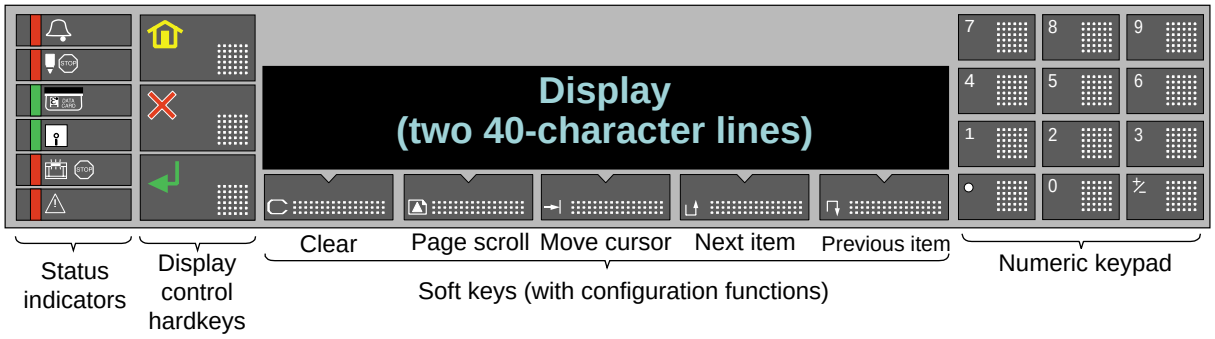


Figure 2.2 Display / Keyboard

2.2.1 Display control hardkeys

These three keys, located to the left of the display (figures 2.2, and 2.2.2) help you to access and edit items.

The 'Home' key is used to return to the top level Operator menu from anywhere within the Operator menu structure. During configuration, a single operation of the key causes a return to the top level Configuration menu; a further operation causing a return to the top level Operator menu.

The 'Cancel' key. When a change is made to any menu item, that item's cursor (underline) changes from flashing green to flashing red. The Cancel key can be used to 'undo' all the changes made since the previous operation of the 'Enter' key (described below). Further operation of the Cancal key moves the user up one menu level.

The 'Enter' key. When a change is made to any menu item, that item's cursor (underline) changes from flashing green to flashing red. The Enter key is used to cause all changes made since the previous operation of the Enter key to be made permanent (i.e. they are written into the recorder's data base) and the cursor to revert to green. Once this has been done, the Cancel key (above) cannot 'undo' the changes. Further operation of the key moves the user up one menu level.

2.2.2 Status indicators

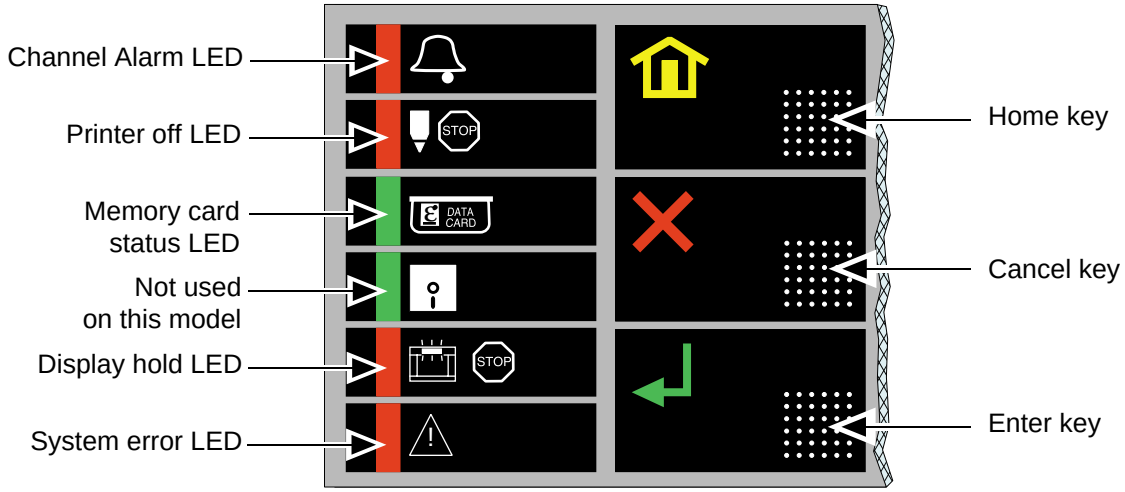


Figure 2.2.2 Status indicators and display control hardkeys

STATUS INDICATORS (Cont.)

As depicted in figure 2.2.2 above, there are six LED indicators located towards the left hand side of the display / keyboard assembly. These LEDs have the following functions:

1. Channel alarm LED. This LED flashes whenever an unacknowledged active alarm is present. The LED is steadily illuminated if an acknowledged alarm is present but again flashes if a further unacknowledged alarm becomes active. See section 3.2.3 for how to acknowledge alarms.
2. Off-line LED. This LED illuminates if the chart drive has been switched off line
3. Memory card status LED. This LED illuminates steadily when the memory card is inserted correctly, and flashes intermittently during data transfer. The LED is always fitted, whether or not the memory card option is supplied.
4. Rolling memory status LED. The rolling memory option is not available with this recorder.
5. Display hold LED. The display hold indicator illuminates whenever channels are selected for continuous display. (Normally all the channels in the selected group are displayed in rotation.)
6. System error LED. The System error indicator flashes if any of the items listed below are true. Any current system errors can be viewed via the Operator menu (Section 3) or instrument configuration pages (section 4.2)

    1. There is a fault with remote CJ temperature.
    2. The recorder battery pack is exhausted or missing.
    3. There is a failure in the real-time clock.
    4. There is a fault in the writing system.
    5. There is a fault in an input or derived channel.
    6. Battery-backed RAM failure or EEPROM failure.
    7. Memory card battery low or exhausted.

2.2.3 Text editing

The cursor and the up and down scroll keys  are used to enter and edit text strings. The cursor key is used to locate the cursor beneath the character to be edited. The scroll keys are then used to scroll through either the ‘normal’ or alternative character sets as depicted (approximately) below.

Notes:

1. The two sets can be switched between using the +/- key associated with the numeric keyboard.
2. The  key can be used to clear the text string from the cursor position to the end inclusive.
3. Should an error be made, the cancel key can be used to ‘undo’ all changes so far made to the text string.
4. Under certain circumstances, it is possible to have the current time, date etc. included in a message to be printed in the chart. See the ‘Embedded Sequences’ description in section 4.2.2.

NORMAL CHARACTER SET

A to Z, a to z, Ä ä à ç ê è é Ö ö ô Ü ü ù ß ∑ µ Ω δ space # $ % & ( ) * + comma - / : ; < = > _ £

ALTERNATIVE CHARACTER SET

² ³ ! " ’ [\ ] ^ ‘ { | } ~ ç â å ë ï î ì Å É æ Æ ò û y ¢ ¥ á í ó ú ñ Ñ a o ¿ ¡ « » α Γ π σ τ ϕ θ ∞ ∈ ∩ ≡ ± ≥ ≤ ÷ ≈ ▪ ° √ η ■

For full details of operator and configuration menus, see sections 3 and 4 respectively

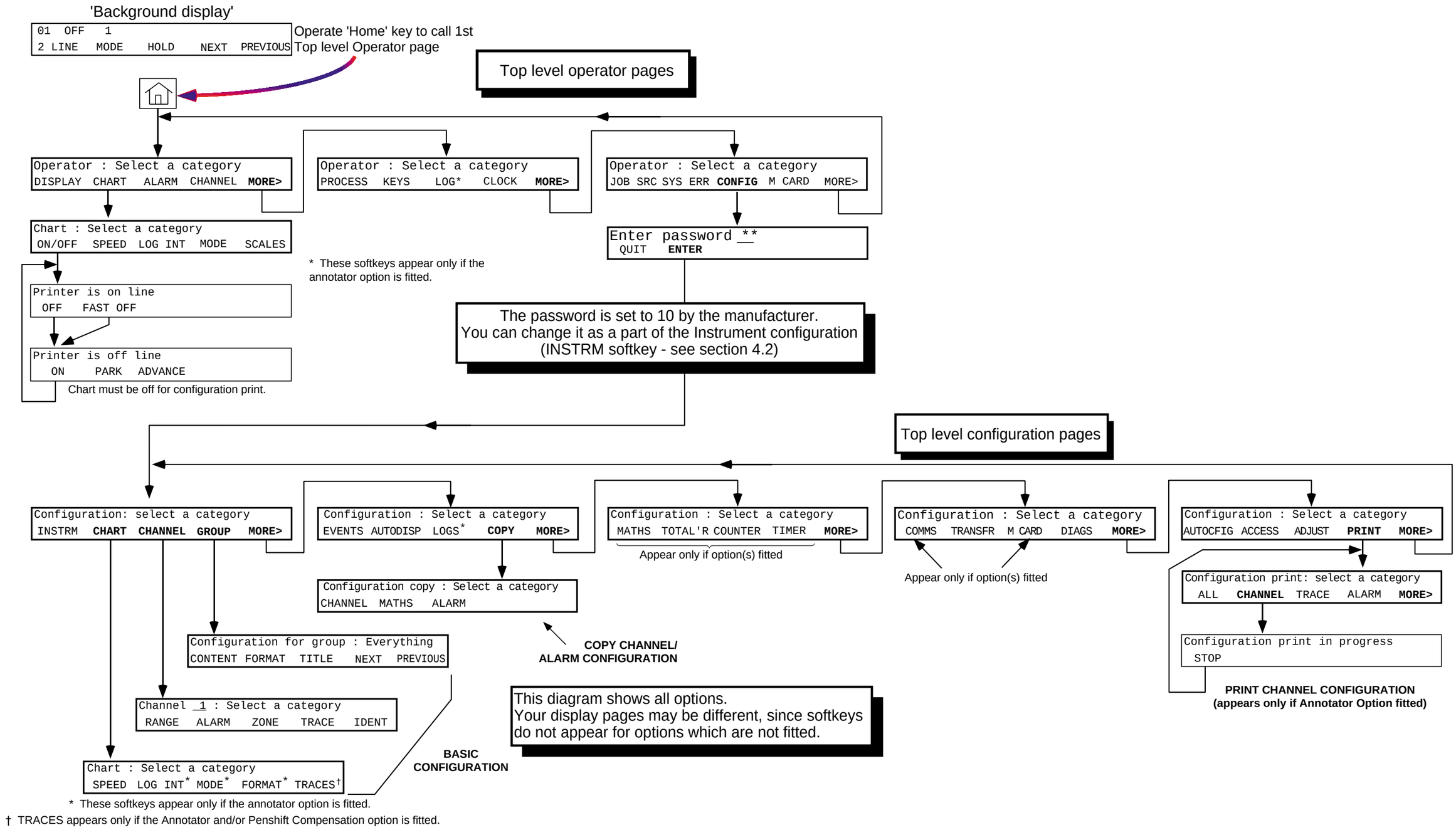


Figure 2.3
Basic configuraation menus

2.3 CONFIGURATION EXAMPLE

This section gives you a step-by-step guide to the configuration of a single channel (N 2) to an imaginary set of input and output conditions. It is recommended that if you are a new user, you first follow this example, and then modify it to suit your particular requirement. You can then use the COPY facility (section 2.4) to copy your configuration to one or more further channels before modifying them if necessary.

Note: This example assumes that the recorder is fitted with the annotator option. For recorders without annotation, certain items such as channel scales, logging etc. are not available and do not appear in the display pages.

2.3.1 Required channel inputs and outputs

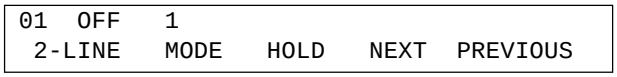
Before you start to configure any channel you will need to know exactly what you want the recorder to do with the input you are providing. It is recommended that, for each channel, you have a list of parameters which are to be set up similar to the following:

Channel Number	2
Temperature range	0 to 900 ˚C
Display scale	0.00 to 900.0 ˚C
Input type	Type K thermocouple, using the recorder's internal cold junction for compensation.
Chart span	400 to 800 ˚C
Chart scale	10 divisions
Input Break response	Upscale Drive.
Trace	Enabled; green;
Descriptor	Furnace No1 temp A
Tag	Furn01A
Alarm	Tripped immediately if temperature exceeds 780 ˚C. Remains tripped until acknowledged. Sounds internal buzzer whilst active.

The channel is to be displayed as a member of a group called 'Furnace 1 temps' which includes channels 2 and 3, and it is to be traced with the recorder chart speed set to 60 mm/hr.

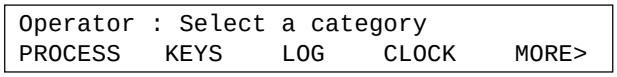
2.3.2 Accessing configuration

If the recorder is off, switch it on as described in section 2.1 above.

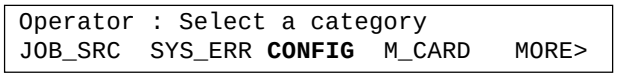


The first page to appear at the display is in the default type of display mode showing a single channel's value (OFF in this case) and tag (1). Operation of the home key calls the first of the top level Operator Menu pages to the display.

Operation of the MORE> Softkey calls the second of the top level Operator Menu pages to the display.



A further operation of the softkey calls the third of the top level Operator Menu pages to the display.



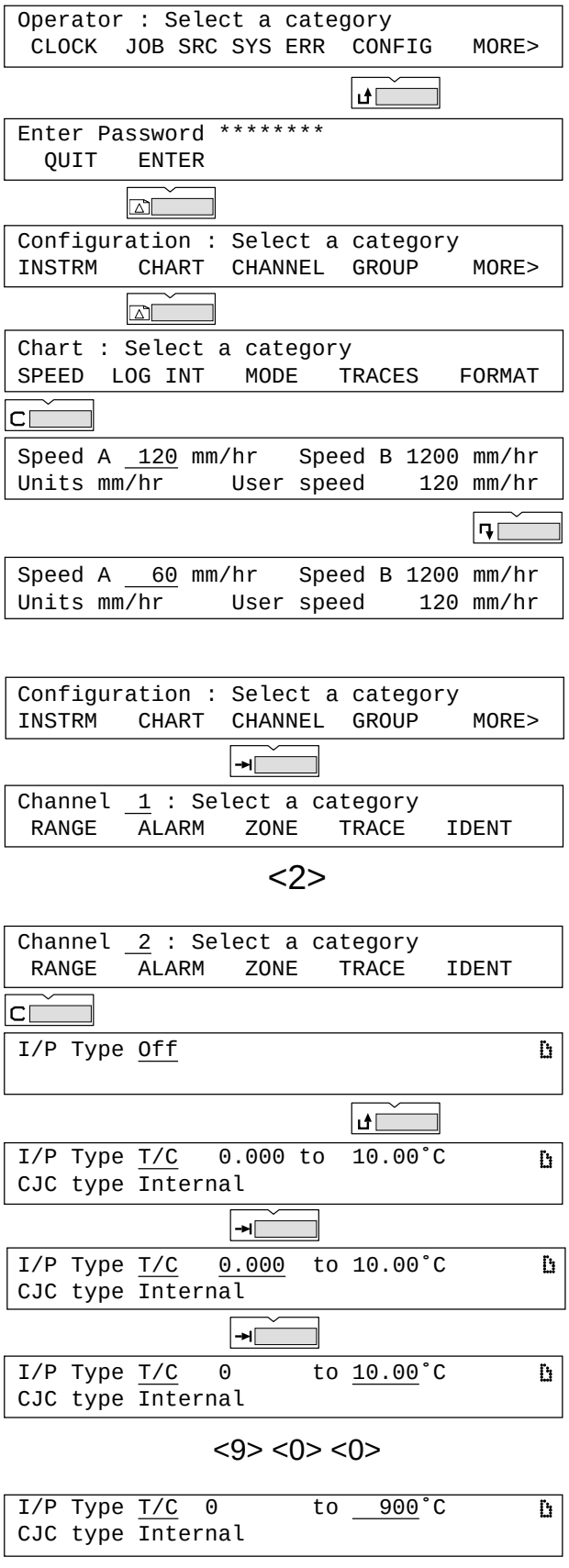
As you can see, CONFIG is the third softkey.

2.3.2 ACCESSING CONFIGURATION (Cont.)

THE RECORDER IS DESPATCHED FROM THE MANUFACTURER WITH A PASSWORD OF '10'

Operation of the softkey immediately below the CONFIG legend causes the Password entry page to appear. Enter the password, by operating the '1', then the '0' numeric keys followed by the 'Enter' hard key or softkey.

<1> <0> [↵] (Enter)



2.3.3 Chart speed

Operation of the CHART softkey calls the CHART configuration page. We are interested only in setting the chart speed, so the SPEED softkey needs to be operated.

Operate the scroll down key to change speed A to 60 mm/hr.

Press the enter key to save the new speed in the recorder's memory. Operate the 'HOME' key to return to the top level configuration menu.

[↵] [⌂]

2.3.4 Channel range

Use the CHANNEL softkey to call the top level Channel Configuration Menu to the display.

Enter the required channel number (2 in this case) using the numeric keyboard, then press the RANGE softkey.

INPUT TYPE, RANGE ETC.

You can use the field scroll keys to scroll through the various input types available. (A single operation of the up key calls T/C (thermocouple) as input type.)

Note that ˚C and CJC type internal are default values. Alternative values are scrollable using the field scroll keys.

Use the arrow key twice to move the cursor to the second of the temperature input fields.

Enter the high input range (900) using the numeric keys.

Do not operate the enter key yet !

Use the page scroll key to call the next page.

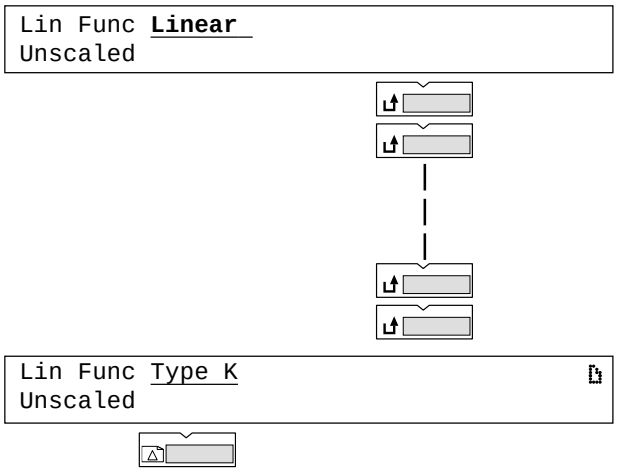
2.3.4 CHANNEL RANGE (Cont.)

LINEARISATION AND SCALING

The page scroll key calls the second channel range page to the display, where 'Linear' appears as the default.

Use the field scroll up key repeatedly to scroll through the linearisation types until 'Type K' appears.

Use the page scroll key to call the next display page:



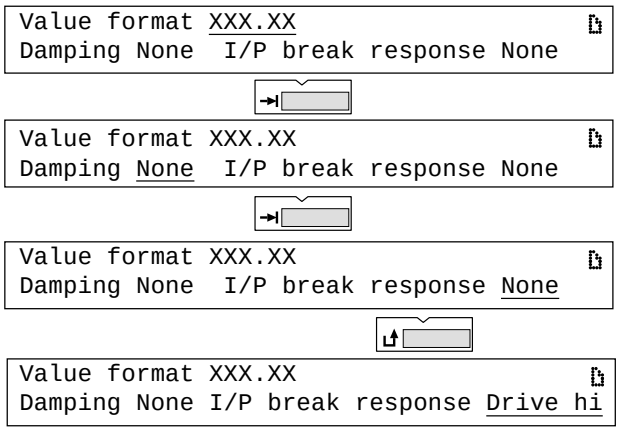
DISPLAY FORMAT, DAMPING AND BREAK RESPONSE

The default decimal point position is two decimal places as required. Use the arrow key to move to the 'Damping' field.

The default 'Damping' value of 'None' is as required.

Use the arrow key to move the cursor to the 'I/P break response field. Use the field scroll up key, to change from None to 'Drive hi'.

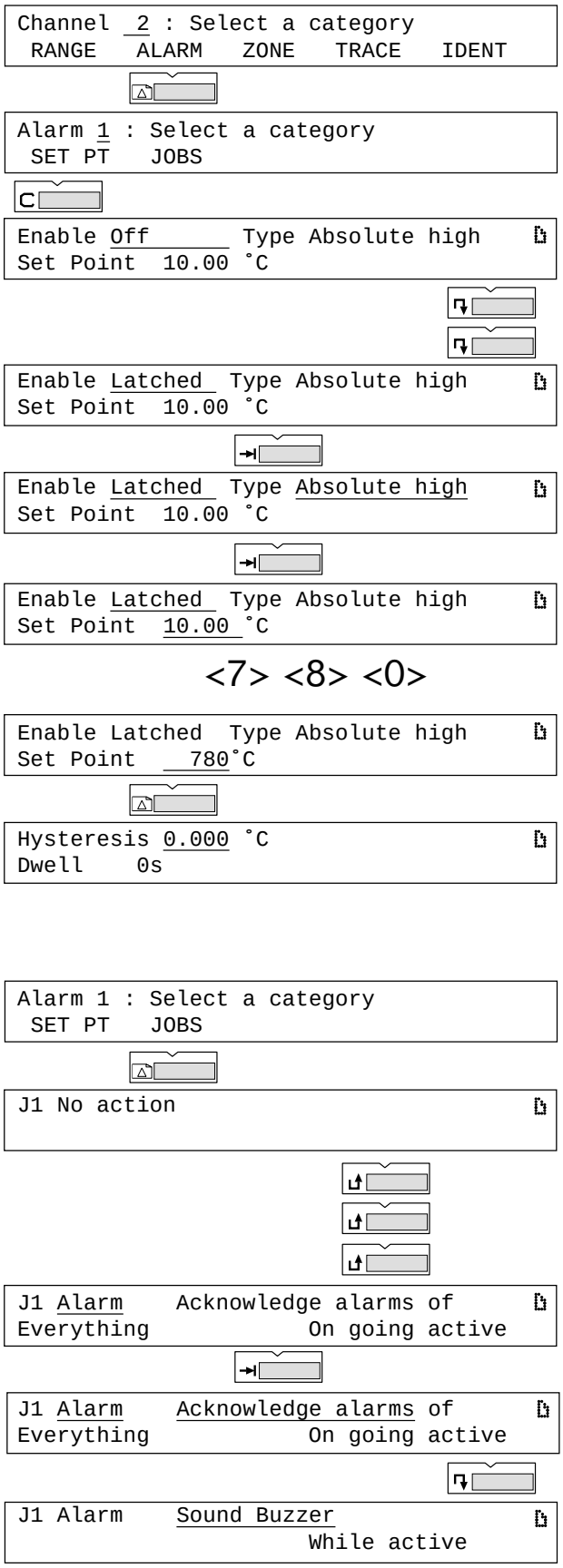
Operate the Enter key once to confirm all the changes so far, then again to return to the top level Channel Configuration menu.



2.3.5 Channel alarms

ALARM TYPE AND SETPOINT

Use the alarm softkey to call the alarm setpoint / jobs page to the display. The default alarm number is 1, which will be used here for convenience. (The numeric keys would be used to select alarms 2 to 4 for this channel if they were required.) Use the SET PT softkey to access the setpoint configuration page.



Use the field scroll down key twice to scroll the alarm enable field from 'Off' through 'Trigger' to 'Latched'.

The alarm type is as required, so use the right arrow key twice to move the cursor to the Setpoint field.

Use the numeric keys to enter the value of 780.

Use the page key to call the next alarm page. Hysteresis and dwell defaults are as required. (If it had been necessary, numeric entry keys would have be used to enter a hysteresis value and to change the dwell period.)

Use the enter key once to confirm the changes, then again to return to the top level alarm page.

ALARM ACTIONS

Operation of the JOBS softkey calls the Alarm Jobs page. The default job number is 1, which we will use for convenience. You would have to use Page scroll keys to select job 2 if it were required.

Use the field scroll up key to scroll through the job categories: Chart, Trace, Alarm.

Use the right arrow key to move the cursor to the action field, followed by a single operation of the field scroll down key to 'Sound Buzzer'. 'While active' is the required job action, and this completes the alarm configuration.

Operate the enter key once to confirm the changes, again, to return to the top level alarm page, and a third time to return to the top level channel configuration page.

2.3.6 Channel Zone

SETTING THE CHART AREA FOR TRACING

Use the ZONE softkey to call the first Channel Zone page. This, together with the following page allows you to enter values for Chart Span, Chart Zone and Chart Divisions

Use the field scroll key to access the span page.

Use the right arrow key and numeric keys to enter the chart range (span) of 400 to 800 ˚C

The default chart zone (full width of chart) is acceptable, so if the annotator option is fitted, operate the page scroll key to call the chart scale (number of divisions) page.

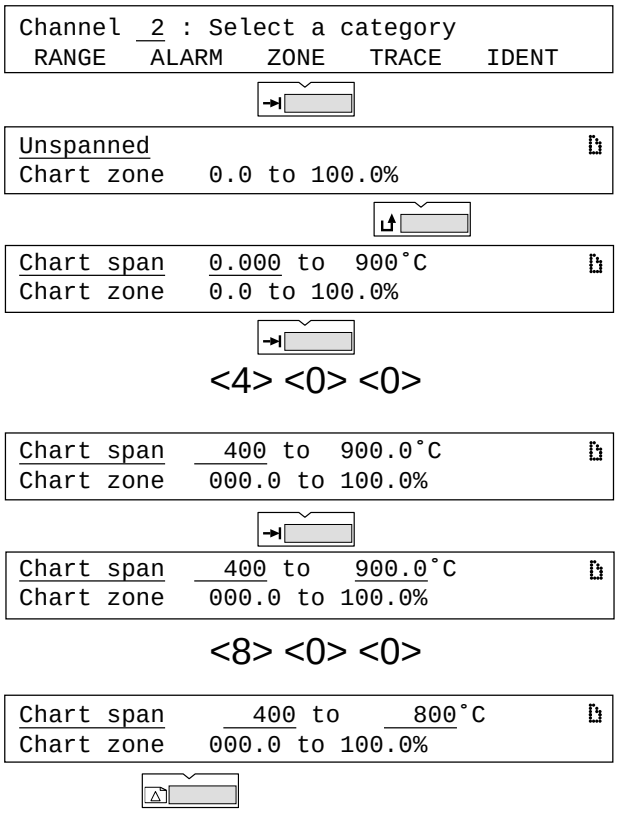
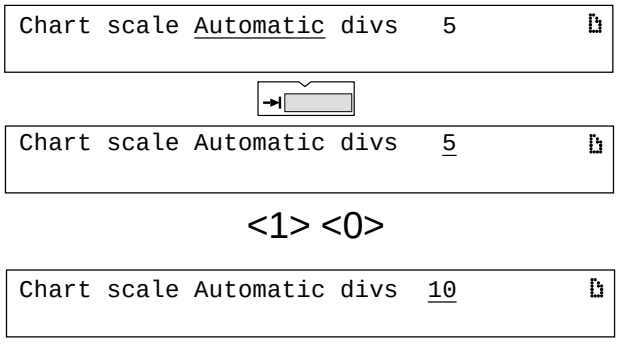


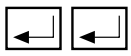
CHART SCALE

This section is available only to recorders fitted with the annotator option.

Use the right arrow key once, then the numeric keys <1> <0>, to change the number of divisions from the default (5) to 10 (as required).

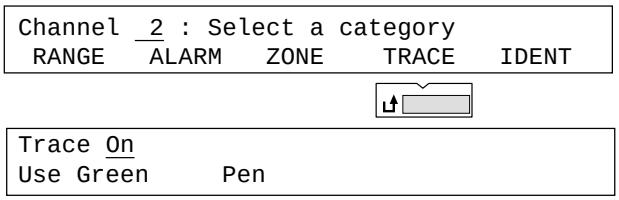
This completes the channel zone configuration. Operate the enter key twice to return to the top level Channel Configuration page.





2.3.7 Channel trace

TRACE ON/OFF; TRACE COLOUR



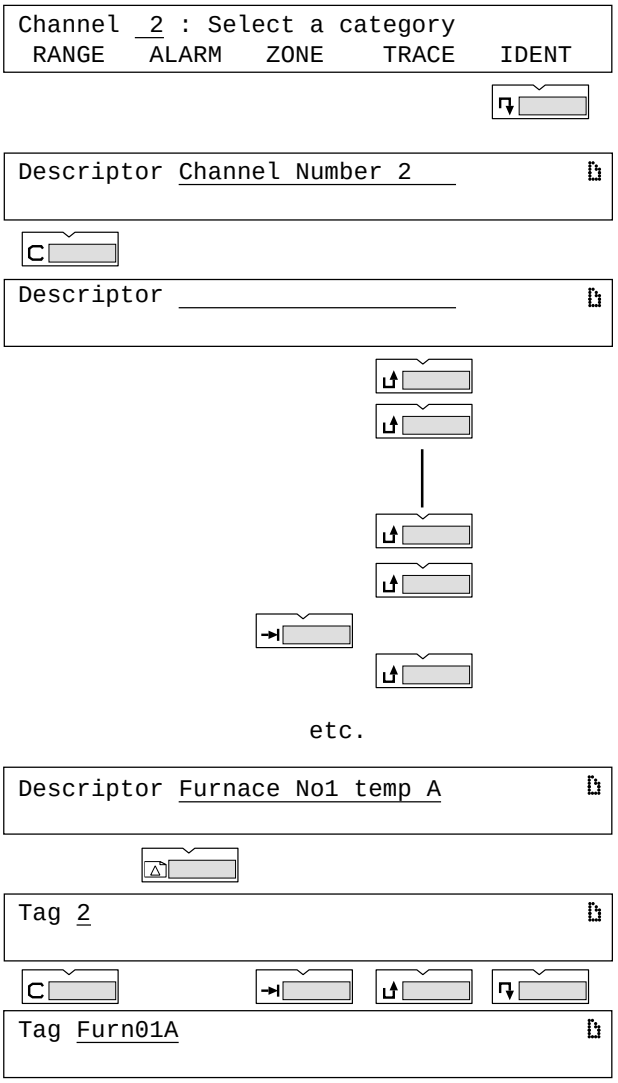
Use the TRACE softkey to call the trace definition page.

Default conditions are as required.

Use the Cancel key to return to the top level Channel Configuration page.

2.3.8 Channel identification

SETTING TRACE IDENTIFIERS



Use the IDENT softkey to call the first channel descriptor / tag page.

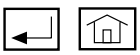
Use the Clear key to clear the default descriptor.

For each character to be edited, use the right arrow key to position the cursor, then the field scroll up and down keys to scroll through the available characters until the required letter, number or symbol appears.

(As described in section 2.2.3, there are two alternative character sets, each accessible from the other by use of the <+/-> key on the numeric keypad to the right of the display.)

Use the page key to call the Channel Tag page, and enter the new string (Furn01A) in a similar way to that described above for the descriptor.

Operate the Enter key to confirm the changes, then the Home key to return to the top level configuration page.



This concludes the channel configuration as defined at section 2.3.1. It now remains to set up the group to which it is to belong (Furnace 1 temps) and finally to select that group for display etc. We will then print the configuration on the chart (if the annotator option is fitted).

Note: The rest of section 2 (group configuration, printing the configuration on the chart and copying configuration) is not strictly necessary to get you going, but we recommend that you follow it through to learn more about the recorder.

2.3.9 Group configuration

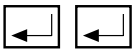
SELECTING THE GROUP

Use the GROUP softkey to call the top level Group Configuration page to the display.

Use the field scroll up key to scroll to the first empty group.

Use the TITLE softkey then enter the new name (Furnace 1 temps) using the Clear, Cursor and Field scroll keys as described for channel ident above.

A double operation of the Enter key confirms the changes, and re-calls the top level Group Configuration Page.

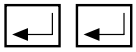


DEFINING GROUP CONTENTS

Operation of the CONTENT softkey calls the content page.

Use the ADD and TO softkeys and numeric entry keys to enter channels 2 to 3.

Operate the Enter key twice to confirm the changes and to return to the top level Group Configuration page.



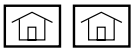
GROUP FORMAT

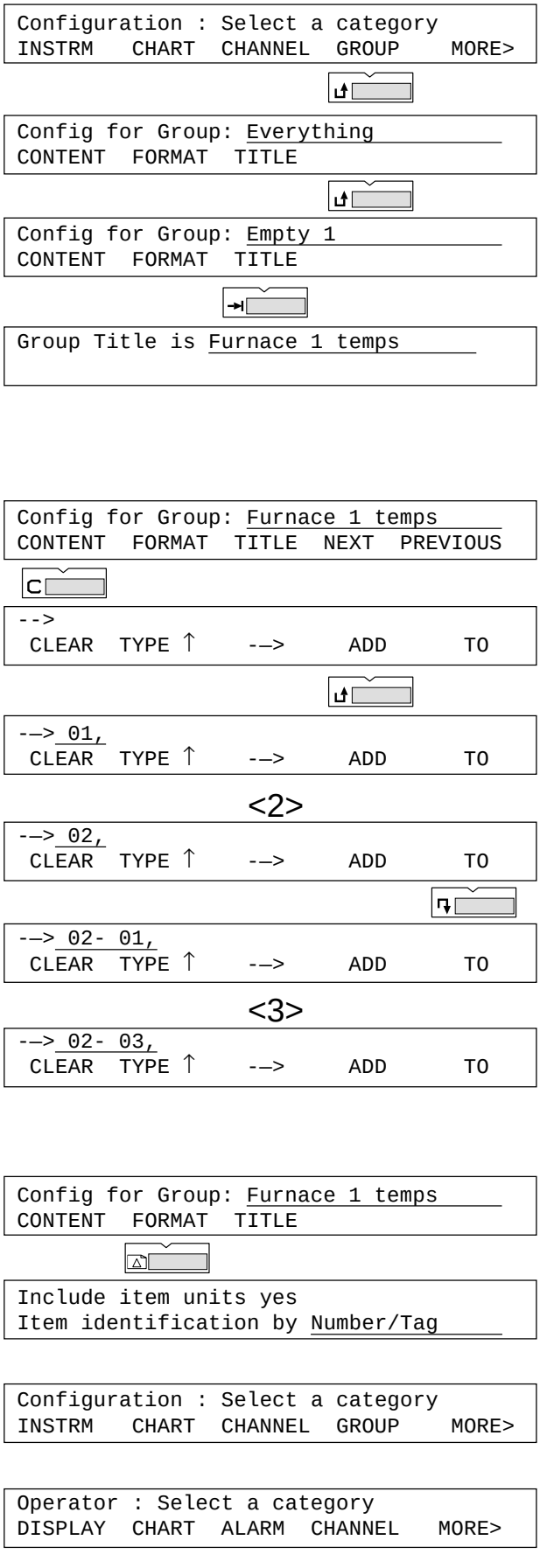
Operation of the format softkey allows the format of the channels in the specified group to be defined as 'Number/tag', 'Number only' or 'Number/Descriptor' using the field scroll keys.

The engineering units may be defined as being included or not according to the yes/no field on the bottom line of the display (field scroll key).

In this case, the defaults are acceptable, and the group configuration is completed by an operation of the Enter key.

This is followed by two operations of the Home key to cause a return to the Operator Top Level Menu.





2.3.10 Selecting the group for display

Operation of the DISPLAY softkey, followed by the MODE softkey, calls the 'Group Select' page to the display.

Use the NEXT and PREVIOUS keys to scroll through the various group names, until 'Furnace 1 temps' appears.

Operation of the Enter key now completes the configuration defined in Section 2.3.1

The displayed value (probably >Range or <Range) will be meaningless since the example set-up just completed does not match the actual input conditions of your own recorder. Remain in Operator Mode for the time being.

```
Operator : Select a category
 DISPLAY  CHART  ALARM  CHANNEL   MORE>
```

```
01 23.57 Deg C   Pond Temperature
 2-LINE    MODE   HOLD    NEXT   PREVIOUS
```

```
Grp :- Everything           Mode Numeric
                      ->    NEXT   PREVIOUS
```

```
Grp :- Furnace 1 temps      Mode Numeric
                      ->    NEXT   PREVIOUS
```

```
02 <Range ˚C  Furn01A
 2-LINE   MODE    HOLD    NEXT   PREVIOUS
```

2.3.11 Printing the configuration on the chart

The annotator option must be fitted if the configuration is to be printed.

Before the recorder will print the configuration on the chart, you will have to turn the chart drive off line. To do this, operate the HOME key to bring the top level Operator menu to the display.

```
02 <Range ˚C  Furn01A
 2-LINE   MODE   HOLD    NEXT   PREVIOUS
```

Operate the CHART softkey

```
Operator : Select a category
DISPLAY  CHART  ALARM  CHANNEL   MORE>
```

Operate the ON/OFF softkey

```
Chart : Select a category
 ON/OFF  SPEED  LOG INT   MODE  SCALES
```

```
Printer is on line
  OFF   FAST OFF
```

Operate the OFF or FAST OFF softkey

```
Printer is Off line
  ON      PARK  ADVANCE
```

Operate the Home key again and enter configuration mode as described in section 2.3.2.

2.3.11 PRINTING THE CONFIGURATION ON THE CHART (Cont.)

From the first top level configuration page, use the MORE> key repeatedly until the PRINT softkey appears. (How many MORE> keys there are, depends on how many options you have fitted in your recorder.)

'Maths', 'Total'r', 'Counter' and 'Timer' do not appear unless the options are fitted.

'Comms' and 'M Card' appear only if the options are fitted.

Operate the PRINT softkey.

Operate the CHANNEL softkey to initiate printing of the channel configuration on the chart.

This will cause the recorder to print the configuration of all the channels fitted.

Once this is finished, the display reverts to the previous top level page.

```
Configuration : Select a category
 INSTRM   CHART  CHANNEL  GROUP   MORE>
```

```
Configuration : Select a category
 EVENTS AUTODISP  LOGS    COPY    MORE>
```

```
Configuration : Select a category
  MATHS  TOTAL'R  COUNTER  TIMER  MORE>
```

```
Configuration : Select a category
 COMMS  TRANSFER  M CARD  DIAGS   MORE>
```

```
Configuration : Select a category
AUTOCFIG ACCESS  ADJUST  PRINT    MORE>
```

```
Configuration Print : Select a category
   ALL   CHANNEL  TRACE  ALARM  MORE>
```

```
Configuration print in progress
  STOP
```

```
Configuration : Select a category
AUTOCFIG ACCESS  ADJUST  PRINT    MORE>
```

Figure 2.3.11 is an attempt to show how the channel configuration just completed should look when printed on the chart. The configuration printed includes all channels which are not configured to OFF.

```
**********************************************************************************************************
                          4250C INSTRUMENT CONFIGURATION 4.2                11:46:30  20/06/97

                          INPUT CHANNEL CONFIGURATION 1
----------------------------------------------------------------------------------------------------------
  |TAG     |      DESCRIPTOR      |TYPE |      INPUT / RANGE          |FUNCTION|FORMAT    |      SCALE     |UNITS
--|--------|----------------------|-----|-----------------------------|--------|----------|----------------|-----
 2|Furn01A|Furnace No 1 tempA    |T/C  |0.0000>900.00 C    CJ INT    |TYPE K  |XXX.XX    |000.00>900.00   | C
----------------------------------------------------------------------------------------------------------

                          INPUT CHANNEL CONFIGURATION 2
----------------------------------------------------------------------------------------------------------
  |ADJUST      |CJ     |MV     |OHMS   |BREAK   |DAMPING
--|------------------|-------|-------|--------|--------
 2|NONE              |FACTORY|FACTORY|DRIVE HI|NONE
----------------------------------------------------------------------------------------------------------

**********************************************************************************************************
11:44:55 20/06/97 PRINTER OFF
```

Figure 2.3.11 Channel configuration print out.

2.4 COPY CONFIGURATION

Once a channel has been configured, you can copy its range, zone and alarm data to one or more other channels with similar hardware. The new channels retain their original trace and ident configurations.

EXAMPLE
To copy the configuration of channel 2 to channel 3, then to make the following changes:
Channel 3: Trace colour = Green; Descriptor = 'Furnace No 1 temp B'; Tag = Furn01B

Apart from these changes, the configuration of channel 3 (including alarm type and setpoint etc.) is to be the same as for channel 2.

2.4.1 Copy Range and Zone

Enter configuration as described in section 2.3.2 above.

Use the MORE> key, then the COPY key to access the copy menu page.

Use the CHANNEL softkey to access the channel copy page.

Note that the MATHS softkey appears only if the maths pack option is fitted.

Use the numeric keys and the cursor key to enter the source channel (2) and the destination channel range (3 to 3).

If the range is left as '3 to 01' then channel 2's configuration will be copied to channels 1 to 3.

Initiate the copy using the Enter key.

A further operation of the enter (or cancel) key causes a return to the previous (Select a category) page, from which you can select ALARM.

Enter source and destination channels, and initiate the copy as for copying channels above.

```
Configuration : Select a category
 INSTRM   CHART  CHANNEL  GROUP   MORE>
```

```
Configuration : Select a category
 EVENTS  AUTODISP   LOGS   COPY   MORE>
```

```
Configuration copy : Select a category
 CHANNEL  MATHS   ALARM
```

```
Copy channel 01's range / zone config to
channel(s) 01 to 01
```

<2>

```
Copy channel  2's range / zone config to
channel(s) 01 to 01
```

```
Copy channel  2's range / zone config to
channel(s) 01 to 01
```

<3>

```
Copy channel  2's range / zone config to
channel(s)  3 to 01
```

```
Copy channel  2's range / zone config to
channel(s)  3 to 01
```

<3>

```
Copy channel  2's range / zone config to
channel(s)  3 to  3
```

```
Please wait
```

```
Copy channel  2's range / zone config to
channel(s)  3 to  3
```

```
Configuration copy : Select a category
 CHANNEL  MATHS  ALARM
```

```
Copy Channel  1's alarm / job config to
channel(s)  1 to  1
```

2.4 COPY CONFIGURATION (Cont.)

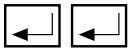
2.4.2 Trace colour

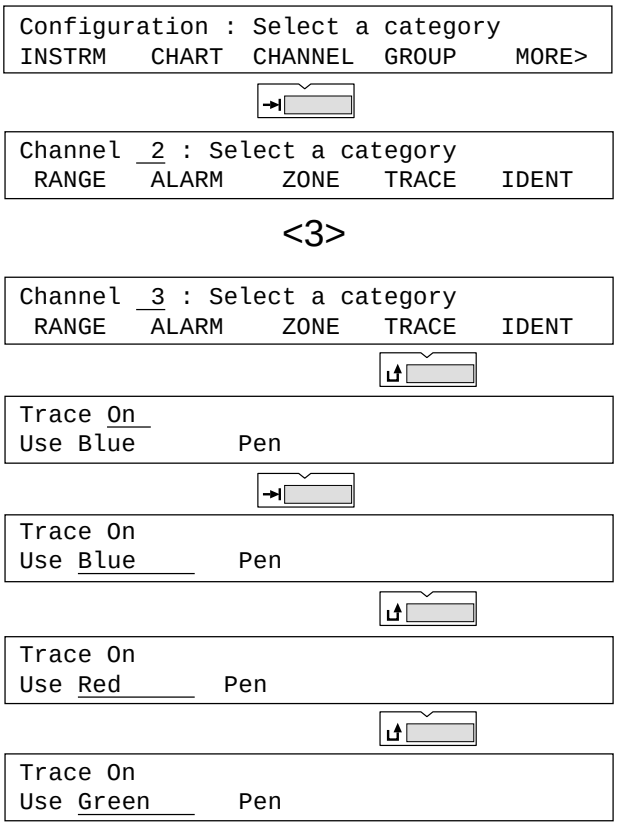
Operate the Home key and enter CHANNEL configuration.

Select channel 3, and operate the TRACE softkey to call the trace definition page.

The default pen for channel 3 is blue. Use the cursor key to move to the colour field, then the field scroll keys to select green as the trace colour

Use the enter key twice to return to the top level Channel Configuration page.





2.4.3 Trace identifiers

Use the IDENT softkey to call the first channel descriptor / tag page and use the Clear key to clear the default descriptor.

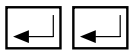
Enter the new descriptor using the right arrow key to position the cursor, then the field scroll up and down keys to scroll through the available characters.

(As described in section 2.2.3, there are two alternative character sets, each accessible from the other by use of the +/- key on the keypad to the right of the display.)

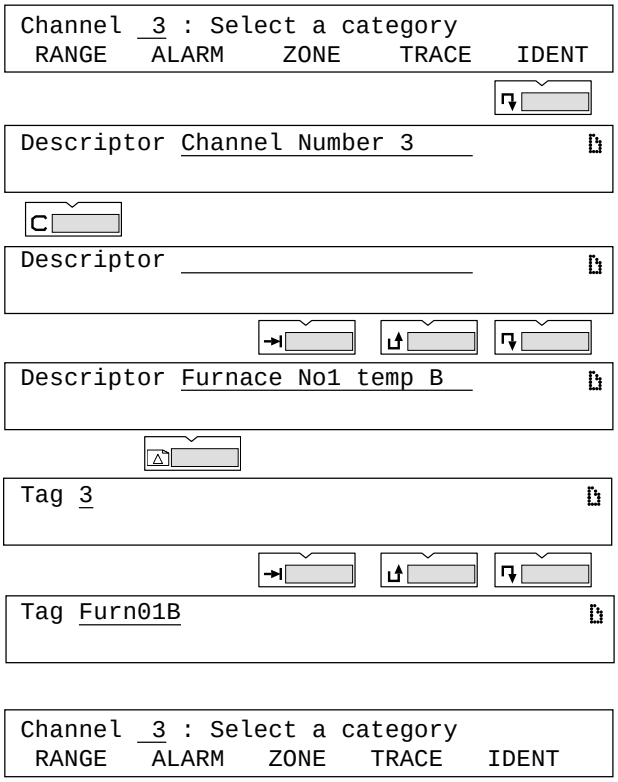
Use the page scroll key to call the Channel Tag page.

Use the Clear key to clear the default string, then enter the new string (Furn01B).

Use the enter key twice to return to the top level Channel Configuration page.

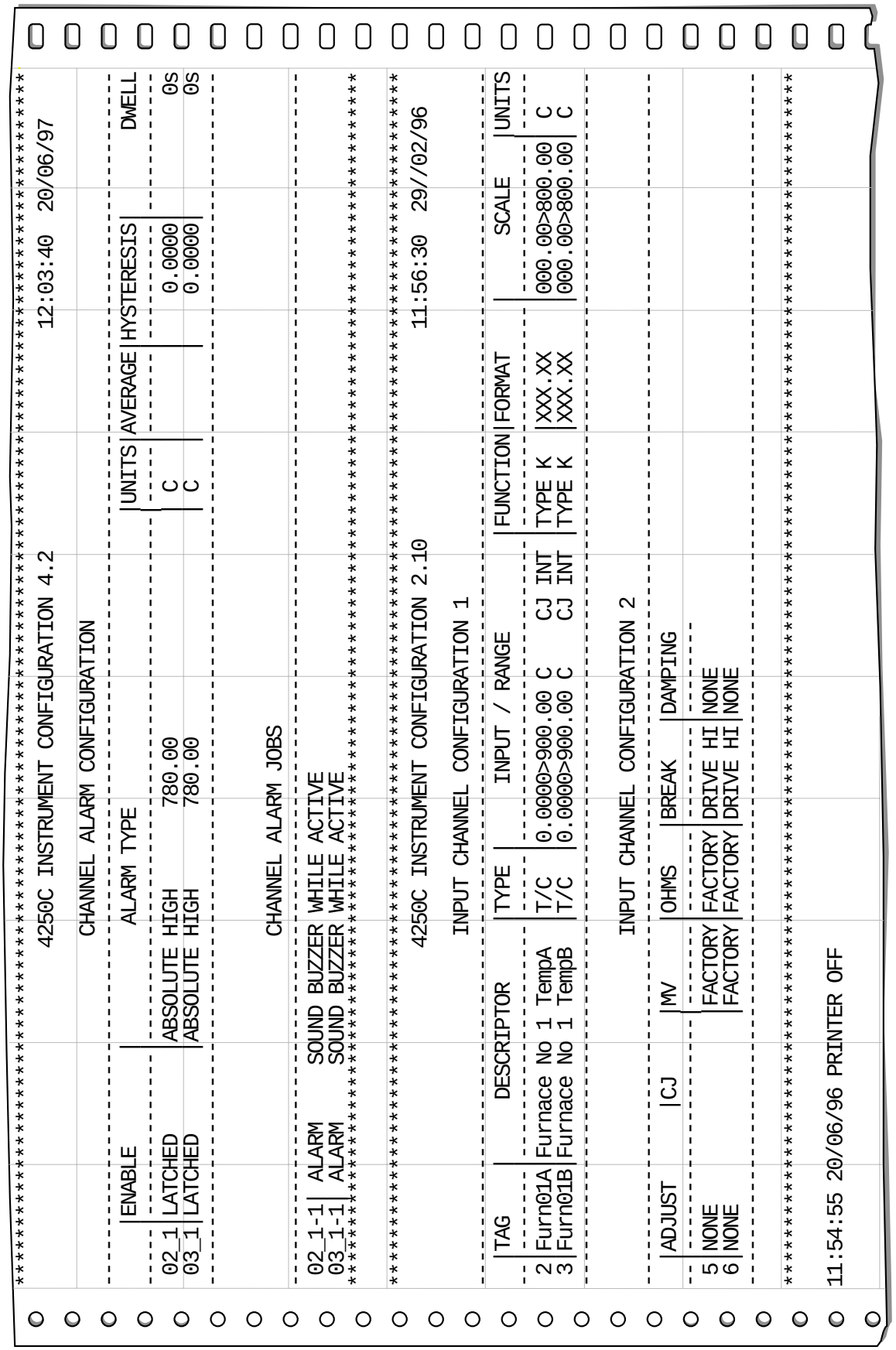


When complete, operate the Enter key to confirm the changes, then the Home key to return to the top level configuration page.



As a final check, if the annotator option is fitted, you can print the channel and alarm configurations on the chart.

2.4 COPY CONFIGURATION (Cont.)



```
4250C INSTRUMENT CONFIGURATION 4.2                    12:03:40  20/06/97

CHANNEL ALARM CONFIGURATION

|      |ENABLE |ALARM TYPE                |UNITS|AVERAGE|HYSTERESIS|     DWELL|
|------|-------|--------------------------|-----|-------|----------|----------|
|02_1  |LATCHED|ABSOLUTE HIGH     780.00  |  C  |       |  0.0000  |       0S |
|03_1  |LATCHED|ABSOLUTE HIGH     780.00  |  C  |       |  0.0000  |       0S |

CHANNEL ALARM JOBS

02_1-1| ALARM     SOUND BUZZER WHILE ACTIVE
03_1-1| ALARM     SOUND BUZZER WHILE ACTIVE

4250C INSTRUMENT CONFIGURATION 2.10                   11:56:30  29//02/96

INPUT CHANNEL CONFIGURATION 1

|  |TAG  |DESCRIPTOR      |TYPE|INPUT / RANGE          |FUNCTION|FORMAT|SCALE          |UNITS|
|--|-----|----------------|----|-----------------------|--------|------|---------------|-----|
| 2|Furn01A|Furnace No 1 TempA|T/C |0.0000>900.00 C  CJ INT|TYPE K  |XXX.XX|000.00>800.00  | C   |
| 3|Furn01B|Furnace No 1 TempB|T/C |0.0000>900.00 C  CJ INT|TYPE K  |XXX.XX|000.00>800.00  | C   |

INPUT CHANNEL CONFIGURATION 2

|  |ADJUST|CJ      |MV      |OHMS  |BREAK    |DAMPING|
|--|------|--------|--------|------|---------|-------|
| 5|NONE  |        |FACTORY |FACTORY|DRIVE HI|NONE   |
| 6|NONE  |        |FACTORY |FACTORY|DRIVE HI|NONE   |

11:54:55 20/06/96 PRINTER OFF
```

Figure 2.4 Configuration print for channels 2 to 3

SECTION 3 OPERATOR MENUS

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Section **Page**

SECTION 3 OPERATOR MENUS

3.1 INTRODUCTION

The operator menus (if enabled - see section 4.14) allow the operator to control certain basic recorder functions without having to use a password (i.e. without having to enter the recorder's configuration). The functions are as follows:

1 View process variable (e.g.channel, totaliser etc.) values and status
2 Chart control
3 Alarm status and acknowledgement
4 Channel value display and alarm setpoint adjustment
5 Derived channel, totaliser, counter and timer option view and control (if option(s) fitted)
6 Direct initiation of 'jobs' via softkey operation
7 Log initiation (if annotator or memory card logging option fitted)
8 Viewing of system time and date
9 Job source search
10 View system errors
11 Entry to configuration using the password.
12 Control of memory card functions (if option fitted)

The operator menus are arranged as a top level menu, with a number of lower levels accessed using softkeys, as depicted in figure 3.1. Page one of the top level menu appears when the 'HOME' hardkey is operated one or more times. Further pages are revealed by operating the MORE softkey on each page.

TOP LEVEL OPERATOR MENU PAGE 1 (Section 3.2)

```
Operator : Select a category
DISPLAY   CHART  ALARM  CHANNEL   MORE>
```

TOP LEVEL OPERATOR MENU PAGE 2 (Section 3.3)

```
Operator : Select a category
PROCESS   KEYS    LOG    CLOCK    MORE>
```

TOP LEVEL OPERATOR MENU PAGE 3 (Section 3.4)

```
Operator : Select a category
JOB SRC  SYS ERR CONFIG  M CARD   MORE>
```

Operation of MORE in page 3, causes a return to page 1. The above displays show all options current at time of print. The actual layout of the displays will depend on which options are actually fitted. For example, the LOG softkey appears only when the Annotator or Memory Card Data Logging option is fitted.

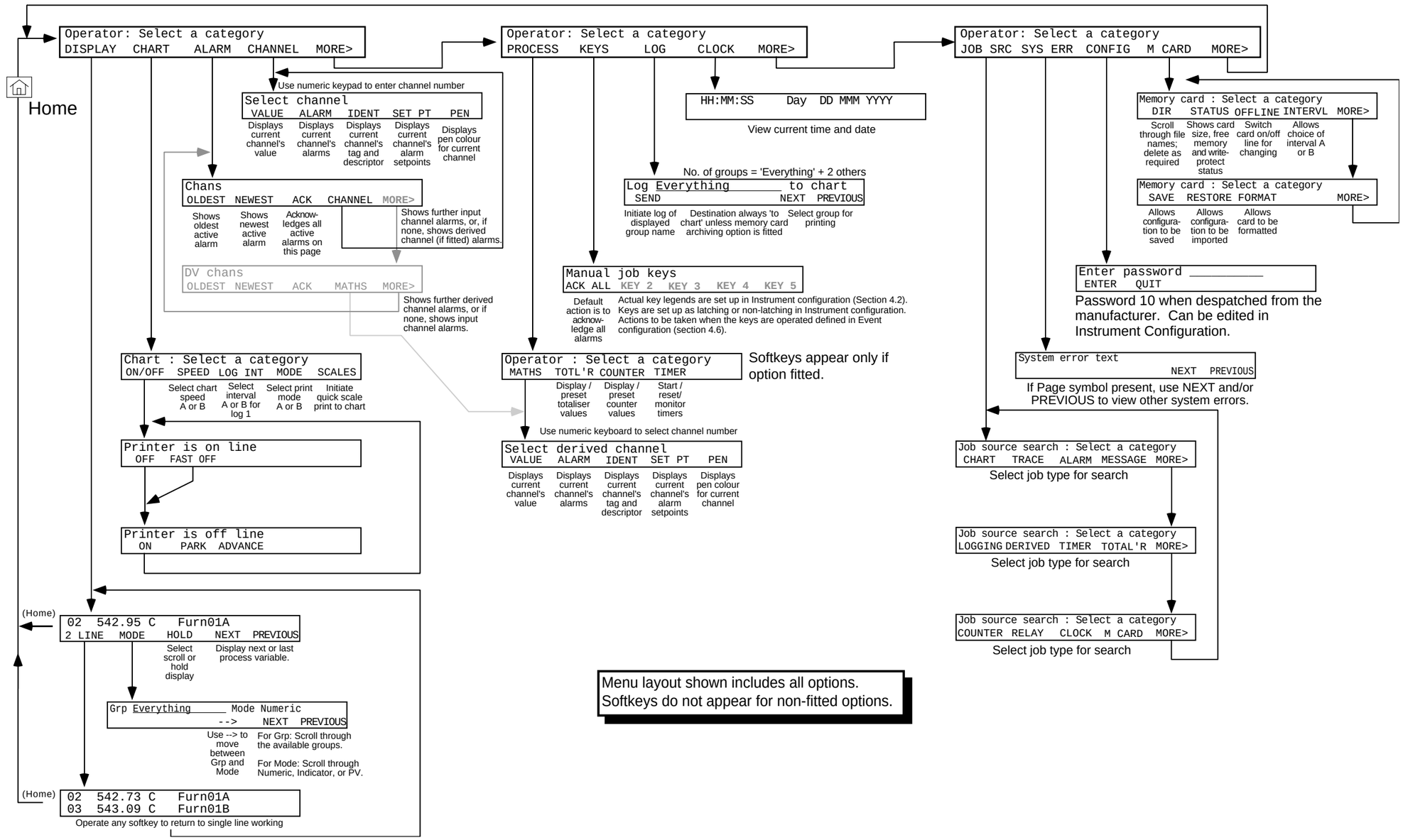


Figure 3.1 Operator Menu Structure

3.2 TOP LEVEL OPERATOR MENU PAGE 1

3.2.1 DISPLAY Softkey

Operation of the DISPLAY softkey calls the DISPLAY menu page. This page contains a process variable (PV) display (figures 3.2.1a and b) and the softkeys described below. After approximately 3 seconds, the PV number changes to the next highest in the group, unless HOLD has previously been selected (in which case the softkey legend is SCROLL, not HOLD).

```
01      OFF      1
2 LINE   MODE    HOLD    NEXT  PREVIOUS
```

Scroll mode

```
01      OFF      1
2 LINE   MODE    SCROLL  NEXT  PREVIOUS
```

Hold mode

2 LINE — Operation of this softkey causes the lower line of the display to show a second set of process variables, instead of the softkey captions. Enter or Cancel hardkeys, or any of the softkeys can be used to return to Single line display (i.e with softkeys on the bottom line).

Whilst in 2-line mode, the +/- key can be used to scroll through the PVs, in both Scroll and Hold modes.

MODE — Operation of this key calls the 'Display mode / Group Select' page to the display.

```
Grp Everything            Mode Indicator
                    —>    NEXT   PREVIOUS
```

Except when in PV mode (described below), the top line contains the name of the currently selected group and the present display mode (Indicator in the example above). The bottom line contains three new softkeys 'NEXT' and 'PREVIOUS' used to scroll through the groups/display modes, and '—>' used to move the cursor from 'Grp' to 'Mode'.

Grp — Use NEXT and / or PREVIOUS softkeys to scroll through the 3 groups.

Mode — Use NEXT and / or PREVIOUS softkeys to scroll through the display modes:

- Numeric — Up to three PVs can be displayed as digital values on each display line, depending on the format selected for the group. This group format (section 4.5) defines whether units and / or tags and / or descriptors appear alongside the value, and thus how many values can appear on each line (figure 3.2.1a).
- Indicator — The display contains a digital value for channels and a green dynamic analogue (bar) display for the channel value. Alarm setpoints (absolute and deviation) are shown using red underline characters (figure 3.2.1b).Totalisers, counters and timers appear only as digital values, without the bar display.
- Auto — Produces a display showing the highest and lowest channels etc. in the group, together with up to two other selected channels as configured. See section 4.7.
- PV Select — Allows up to 4 process variables to be selected for continuous display, independently of Group organisation. The display can be two PVs on a single line as shown in figure 3.2.1b, or if the 2 LINE softkey is operated, the bottom line can be used to display two further PVs.

  To select a PV, the cursor is moved to the appropriate field, the type (Derived, Totaliser etc.) is selected, and the number entered. The cursor is moved using the → softkey or (in 2-line mode), the decimal point key. The type is selected using the TYPE softkey or the numeric ± key, and the required PV number is entered using the numeric entry keys.

3.2.1 DISPLAY SOFTKEY (Cont.)

Group format defines what information appears at the display, and therefore how many process variables appear on each line. The examples below show two-line working.

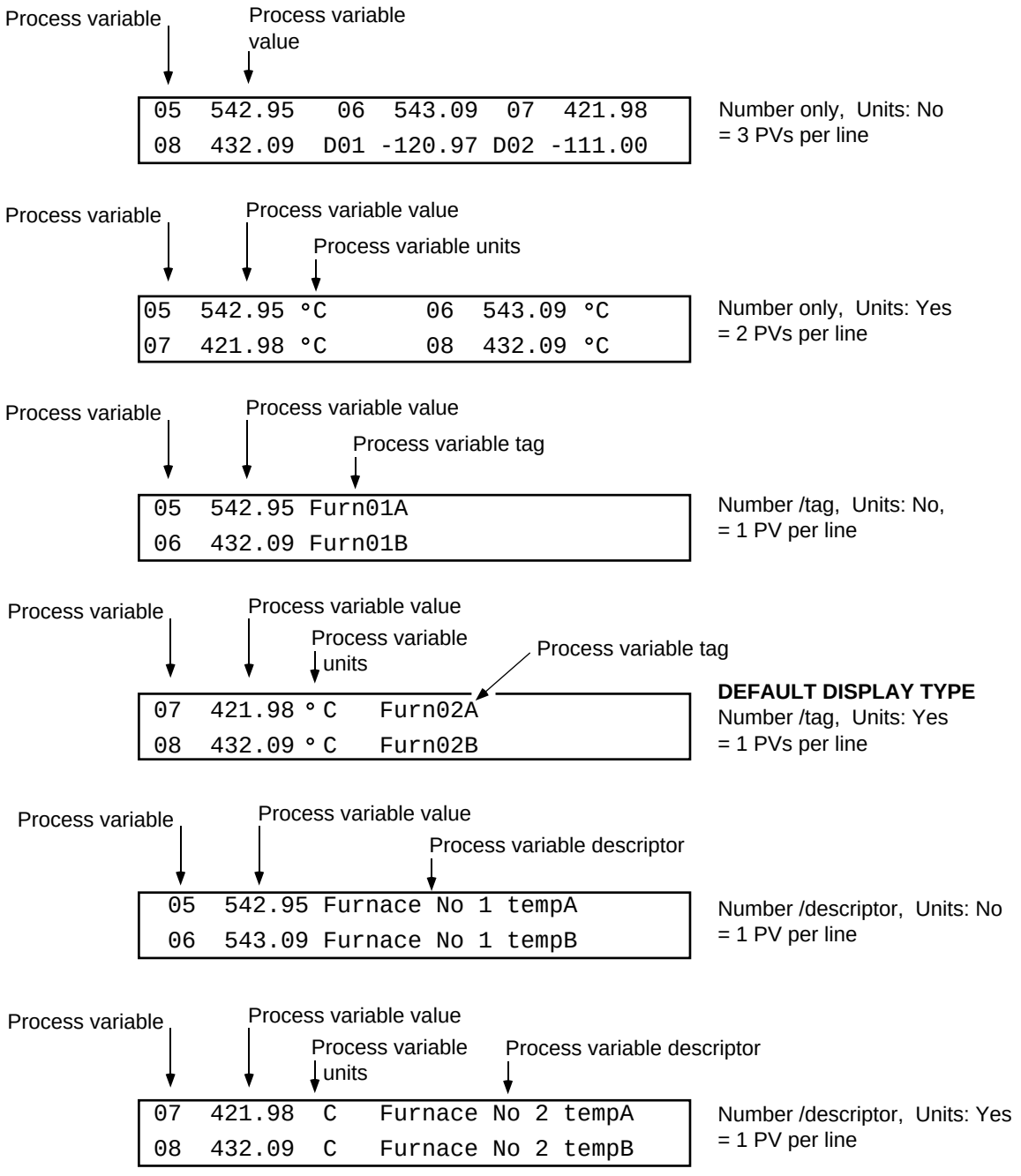


Figure 3.2.1a Numeric indication modes

Note: The above displays show 2-line working, entered using the 2-LINE softkey. Operation of the Cancel (X) or Enter hardkeys, or of any of the softkeys returns the display to single line working.

3.2.1 DISPLAY SOFTKEY (Cont.)

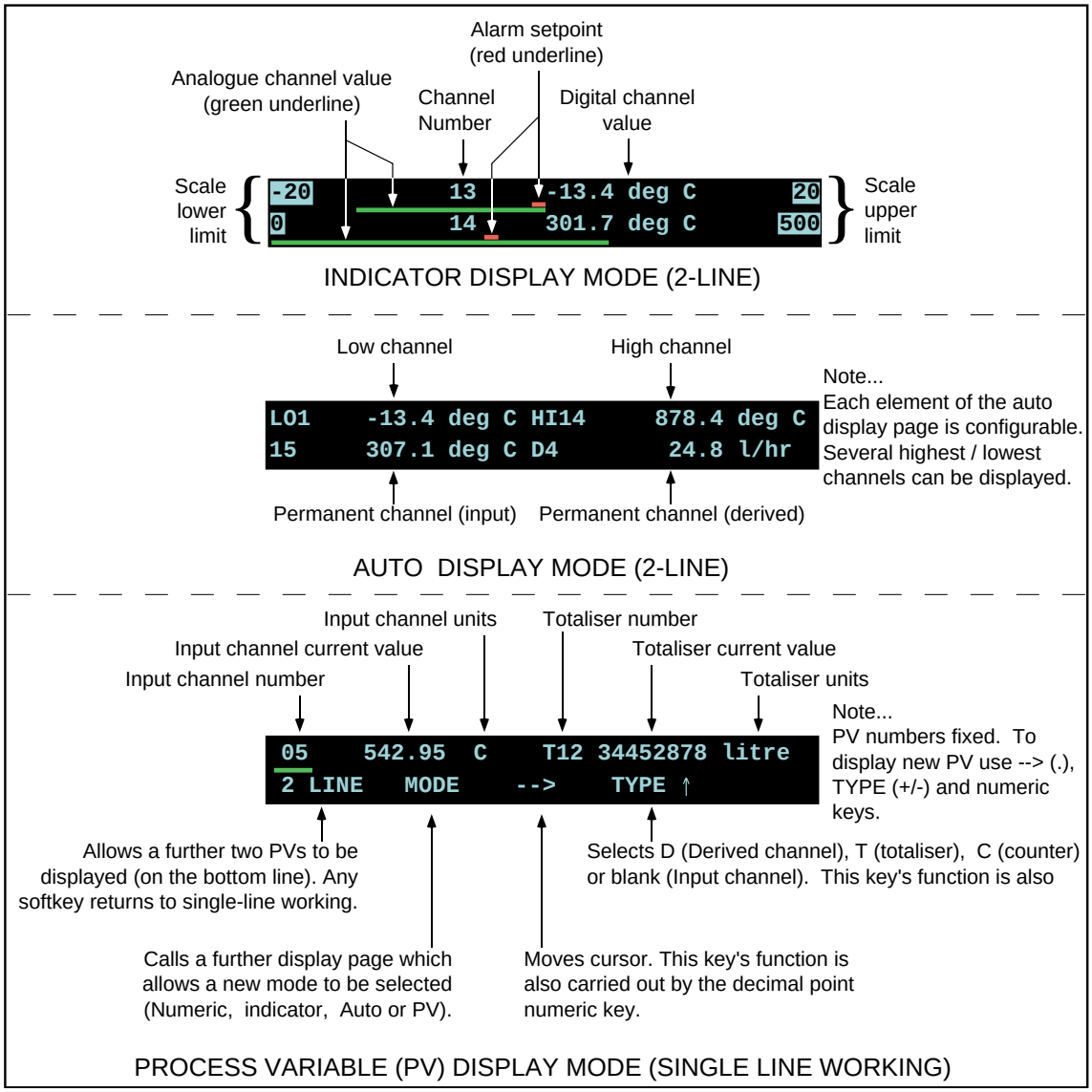


Figure 3.2.1b Other display modes

HOLD	Hold	Operation of this softkey causes the process variable currently being displayed to remain at the top line, instead of being replaced by the next PV in the group. Operation also causes the legend to change to 'Scroll' and the 'Hold' status indicator LED to be illuminated. If required, PVs can be scrolled through using the +/- key.
	Scroll	Operation of this softkey causes the normal PV scrolling process to take place, where each PV in the group is displayed in turn for about 3 seconds. Operation of the softkey also causes the legend to change to 'Hold' and extinguishes the 'Hold' indicator LED.
NEXT		Causes the next 'page-full' of process variables (PVs) in the currently selected group, to be displayed. The number of PVs on a display page depends on the format (see above) selected in Group Configuration (described in section 4.5) and on whether one-line or two-line operation is selected (see '2-LINE' above).
PREVIOUS		As 'NEXT' above, but the direction of scrolling is reversed.

3.2.2 Chart Control page

Possible chart controls	Set chart on or off; Advance chart; 'Park' pens; Select chart speed 'A' or 'B';
Print controls	Select log interval A/B; Select print mode A or B; Initiate rapid scale print.
'Access	HOME key (if necessary), followed by operation of the CHART softkey.

Operation of the CHART softkey calls the menu page depicted below. This page allows the operator access to the chart parameters described.

```
Chart: Select a category
 ON/OFF  SPEED   LOG INT  MODE   SCALES
```

ON-OFF SOFTKEY

ON/OFF — Operation of this soft key calls the chart on-off line page. With the chart on-line, the page is as depicted below.

```
Printer is  On line
  OFF  FAST OFF
```

OFF — If the OFF softkey is operated, annotating recorders will continue to print logs and queued demand messages before printing a Printer Off message and then switching the chart drive off-line and moving the pens to the left edge of the chart. The 'Printer Off' LED illuminates

FAST OFF — If the FAST OFF softkey is operated, annotating recorders will finish printing the current line of text (if any) before switching the chart off-line. Demand messages are lost, but if logging is in operation when FAST OFF is operated, the remainder of the log will be printed when the chart is switched back on-line.

Note: For recorders without annotation, OFF and FAST OFF have the same effect: the 'Printer off' LED illuminates, the chart drive is inhibited and the pens move to the left edge of the chart.

```
 Printer is Off line
  ON      PARK  ADVANCE
```

ON — Switches the chart and pen drives on. A 'printer on' message is printed on the chart (if the annotator option is fitted, the pens resume their recording positions, the display changes to the 'On-line' page and the 'Printer Off' LED is extinguished.

PARK — Causes the pens to fan. Charts and pens should be changed only with the pens parked in this way.

ADVANCE — Operation of this key causes the chart to advance 16 cm.

SPEED SOFTKEY

Operation of the SPEED softkey allows the operator to switch between two chart speeds, known as speed A and speed B, which are set up during chart configuration as described in section 4.3.

```
Chart speed is 120 mm/hr      : Speed  A
  120   1200
```

```
Chart speed is 1200mm/hr      : Speed  B
  120   1200
```

The current chart speed is shown in the top line of the display. Chart speed A (120mm/hr in the example above is selected by operation of the left-most soft key; speed B (1200 mm/hr) by operation of the adjacent softkey.

3.2.2 CHART CONTROL PAGE (Cont.)

LOG INT SOFTKEY

Appears only if the Annotator option is fitted.

Operation of the LOG INT softkey allows the operator to switch between two pre-configured log intervals (for log N1) in a way similar to that described above, for chart speed. The current log interval is shown in the top line of the display, and the softkey captions show the alternative intervals. A log interval of, say, 00:30 means that log N1 is printed on the chart every 30 minutes. A log interval of 00:00 stops the log being printed.

The contents of log 1 are defined in log configuration as described, in section 4.8. Intervals A and B are set up as a part of chart configuration (section 4.3)

For example purposes only, in the displays depicted below, log interval A is 0 and log interval B is 1 hour.

```
Logging interval is 00:00  : Interval  A
  00:00  01:00
```

```
Logging interval is 01:00  : Interval  B
  00:00  01:00
```

MODE SOFTKEY

Appears only if the Annotator Option is fitted

Operation of the Mode softkey allows the operator to switch between two pre-configured print modes, in a way similar to that described above for chart speed. The current print mode (Trace priority, Text priority or Text only) is shown in the top line of the display and the softkey captions show the alternative print modes available to the operator.

For example purposes only, in the displays depicted below, Print mode A is Trace priority and Print mode B is Text priority These two Print modes are set up during chart configuration described in section 4.3.

```
Print mode is Trace priority   : Mode  A
 TRC PRI TXT PRI
```

```
Print mode is Text priority    : Mode  B
 TRC PRI TXT PRI
```

SCALES SOFTKEY

Appears only if the Annotator option is fitted

Operation of this softkey causes the ‘Quick Scale Dump’ page to appear. Operation of the START soft key causes the recorder to print on the chart, the scales of all channels currently set up to trace (section 4.4.5).

```
Quick Scale Dump - Trace will be broken
  START
```

3.2.3 View and acknowledge alarms page

Facilities	Alarm viewing	Display of channels currently in alarm; Individual channel alarms.
	Alarm acknowledgement	Each alarm display page includes an acknowledgement softkey.

Access HOME key (if necessary) followed by operation of the ALARM softkey.

Operation of the ALARM softkey calls the first alarm overview page to the display. The top line of the display shows channels currently in alarm*. In the first example below, channels 3, 4 and 7 are in alarm. Alarms are presented in channel number order, with derived channels (second example below) following measuring channels.

* Or channels with latching type alarms that were not acknowledged before going out of alarm.

Channels with one or more unacknowledged alarms have a flashing underline; channels with all active alarms acknowledged have a steady underline.

```
Chans 03,  04, 07,
OLDEST  NEWEST    ACK    CHAN    (MORE)
```

```
DV chans D01, D02,
OLDEST  NEWEST    ACK    CHAN    (MORE)
```

OLDEST Shows details of the oldest currently active alarm. Allows the operator to scroll through the list of active alarms in chronological order and to acknowledge individual alarms as required.

NEWEST Shows details of the latest currently active alarm. Allows the operator to scroll through the list of active alarms in chronological order and to acknowledge individual alarms as required.

ACK Acknowledges all currently active, unacknowledged alarms on the display page.

Note: In general, to acknowledge all active alarms the operator need make only two or three keystrokes viz: HOME hardkey (if necessary) to enter the top level operator menu; ALARM softkey and finally ACK softkey.

CHAN Calls current channel ‘value’ page (see section 3.2.4 below for details), showing digital and bar graph values and alarm setpoints for the channel. This allows the operator to interrogate alarms channel by channel.

MORE If there are more active alarms than can be shown on one page, or if both I/O and derived channel alarms are active, then the softkey caption ‘MORE’ appears, allowing further alarm pages to be viewed.

3.2.4 Channel parameters and alarm setpoint adjustment page

Facilities — View channel value and scale.
View channel alarms;
View and/or modify alarm setpoints (thresholds)
View channel tag and descriptor.The tag (seven characters) is printed on the chart alongside the channel trace and can be configured to appear at the display. The descriptor (20 characters) can be configured to appear at the display, and in printed logs (if the annotator option is fitted).
View pen colour for each channel.

Access — Home key (if necessary) followed
a) by operation of the CHANNEL softkey then numeric entry of the channel required OR
b) direct to the channel value display from the alarm page described in 3.2.3 above.

Operation of the CHANNEL softkey in the top level operator menu, calls the channel menu page, as depicted below. Once the page is displayed, a channel number (3 in the page depicted below) can be entered using the numeric key-pad to the right of the display.

```
Channel _3: Select a category
 VALUE   ALARM  IDENT   SET PT    PEN
```

VALUE — This causes the selected channel's details to be displayed, showing current value (digital and bar-type display) descriptor, alarm setpoint(s) and scale end values.

ALARM — This causes details of the first of the channel's active alarms (if any) to be displayed. The top line shows the channel number and descriptor, the alarm number and type, and alarm time.

```
03₁  Furnace No 1 temp B  In   14:42:22
                    ACK    NEXT  PREVIOUS
```

ACK — Operation of the ACK softkey causes the alarm to be acknowledged, if unacknowledged.

NEXT — Operation of the NEXT softkey allows the channel's active alarms (if any) to be scrolled through.

PREVIOUS — Operation of the PREVIOUS softkey allows the channel's active alarms (if any) to be scrolled through.

Operation of the Enter or Cancel hardkeys causes a return to the Select Channel display.

IDENT — Operation of this softkey causes the channel's number, tag and descriptor to appear at the top line of the display. Other channels can be accessed using the NEXT and PREVIOUS softkeys. The Enter or Cancel hardkey is used to return to the Select Channel display.

(Continued)

3.2.4 CHANNEL PARAMETERS AND ALARM SETPOINT ADJUSTMENT PAGE (Cont.)

```
Channel  3: Select a category
VALUE   ALARM   IDENT  SET PT    PEN
```

SET PT — Allows the operator to change alarm setpoints, reference values etc. if permitted (see access configuration in section 4.14). The example below shows a deviation alarm page. numeric entry keys are used to change the setpoint, the new value appearing in the underlined field. Operation of the enter key causes the new value to be read into the recorder data base.

```
06₁     Dev in   Ref  10.00 Dev 5.000
CLEAR (PERIOD+)   —>    NEXT  PREVIOUS
```

CLEAR — Resets the entered values to zero.

PERIOD+ — Appears only with Rate-of-Change alarms, and allows scrolling of the 'period' field.

→ — This softkey allows the active (i.e. flashing) cursor to be moved between the configurable fields Ref and Dev. Once the flashing cursor is below the relevant field, the numeric keys are used to enter the new value. The cursor changes from green to red to indicate that the enter key needs to be operated to save the new value(s).

NEXT — Calls the next alarm for the channel.

PREVIOUS — Calls the previous alarm for the channel

PEN — Operation of this softkey allows the user to see which pen (if any) the selected channel is being traced by. Allocation of pen to channel is made in Channel Configuration - see section 4.4.5.

```
  1 being traced by Green     pen
```

Note: If more than one enabled channel is allocated the same pen, that pen will trace the lowest of the channel numbers allocated to it. (Does not apply to the annotator pen).

3.3 TOP LEVEL OPERATOR MENU PAGE 2

Facilities	PROCESS	Maths pack As for measuring channels, but channel number prefixed with 'D' (Use +/- key to toggle between measuring and derived channels). Totalisers View totaliser value; Edit pre-set value; Set totaliser to pre-set value. Counters View counter value; Edit pre-set value; Set counter to pre-set value. Timers Start and / or reset timer(s). View timer status.
	KEYS	Calls the user configured softkey captions to the display.
	LOG	Allows the user to select a log and cause it to be printed on the chart (if the annotator option is fitted) or logged to the memory card if either of the memory card data logging options is fitted.
	CLOCK	Allows the operator to view the system time and date.
Access	HOME key (if necessary) followed by operations of the MORE and PROCESS softkeys.	

```
Operator : Select a category
DISPLAY   CHART  ALARM  CHANNEL   MORE>
```

```
Operator : Select a category
PROCESS   KEYS    LOG    CLOCK    MORE>
```

3.3.1 Process Page

Operation of the PROCESS softkey calls the process menu page to the display if any options are fitted. If no options are fitted, then a message 'No process options fitted' will appear for three seconds.

```
Operator : Select a category
MATHS TOTAL'R COUNTER TIMER
```

MATHS Operation of this softkey calls the DERIVED CHANNEL menu page as depicted below.

```
Channel D02: Select a category
VALUE   ALARM   IDENT  SET PT  ZONE
```

Once the page is displayed, a channel number can be entered using the numeric keys. Where applicable a RESET softkey appears within the VALUE display. Otherwise, the remaining displays are as described for measuring channels (section 3.2.4 above).

TOTAL'R Operation of this softkey allows totaliser values to be viewed, and pre-set, if required. The relevant totaliser (1 to 6) is selected by use of the numeric entry keys.

```
Totaliser T 1 :Select a category
 VALUE  EDIT
```

VALUE	Operation of this softkey displays the value of the selected totaliser. The totaliser value can be set to the pre-set value, using the PRESET softkey. NEXT and PREVIOUS softkeys call other totalisers' values to the display.
EDIT	Allows the Pre-set value to be changed.

```
T 1 12345678 Units Totaliser descriptor
PRESET                    NEXT PREVIOUS
```

COUNTER Similar to the totaliser described immediately above allowing the counter to be set to a pre-set value, from which it will count.

3.3.1 PROCESS PAGE (Cont.)

TIMER Operation of this softkey calls the timer display page. The required timer (N) is selected using the numeric entry keys.

```
Timer  N:Select a category
CONTROL  IDENT
```

CONTROL Calls one of the following control pages, depending on current status:

```
Timer  N disabled
```

The timer is disabled in timer configuration (section 5.6)

```
Timer  N waiting for start
 START
```

START Causes the timer to start.

```
Timer  N duration left to run DDDDDD s
 RESET
```

```
Timer  N repeats in HH hr  MM min  SS s
 RESET
```

RESET Resets the timer. Duration / Repeat period set in timer configuration (section 5.6).

IDENT Allows a 20-character descriptor can be entered as a part of each timer's configuration (section 5.6).

```
Timer  N DDDDDDDDDDDDDDDDDDD
                          NEXT  PREVIOUS
```

NEXT Calls the next timer's ident page to the display
PREVIOUS Calls the previous timer's ident page to the display.

3.3.2 KEYS Softkey

Operation of this softkey calls the user-configured softkey captions to the display. The softkeys are used as 'event sources' to allow the operator to trigger jobs such as 'acknowledge alarms' (ACK ALL) which is the default for key 1. See section 4.2.1 'Page 2 Parameters' for how to edit the softkey captions, and section 4.6 for how to set up the actions for each key.

3.3.3 LOG Softkey

This softkey appears only if the annotator and / or one of the memory card logging options is fitted, and operator access to log generation has not been disabled (section 4.14). Operation allows the operator to initiate the sending of any of the 3 available logs to its destination (Chart or Memory card) as set up in Log Configuration (section 4.8)

```
Log Name of group        to chart
  SEND                 NEXT  PREVIOUS
```

SEND Causes selected log to be initiated.
NEXT Allows logs to be scrolled through in ascending order.
PREVIOUS Allows logs to be scrolled through in descending order.

3.3.4 CLOCK Softkey

Function To allow viewing of current system time and date.
Access HOME key (if necessary), followed by two operations of the MORE softkey, followed by operation of the CLOCK softkey calls the following page:

```
     HH:MM:SS    Day DD MMM YYYY
```

Section 4.2 (Instrument configuration) describes how to set the time and date.

3.4 TOP LEVEL OPERATOR MENU PAGE 3

```
Operator : Select a category
DISPLAY   CHART  ALARM  CHANNEL   MORE>
```

```
 Operator : Select a category
PROCESS   KEYS    LOG    CLOCK    MORE>
```

```
Operator : Select a category
JOB SRC  SYS ERR CONFIG  M CARD   MORE>
```

3.4.1 JOB SRC Softkey

Function To allow the operator to find all the triggers which have been set up to initiate a particular job.
Access HOME key (if necessary), followed by two operations of the MORE softkey, followed by operation of the JOB SRC softkey.

Operation of the JOB SRC softkey calls the first of the following pages to the display. Subsequent pages are called by operation of the MORE> softkey.

```
Job source search : Select a category
 CHART   TRACE   ALARM  MESSAGE   MORE>
```

```
Job source search : Select a category
LOGGING DERIVED  TIMER  TOTAL'R   MORE>
```

```
Job source search : Select a category
COUNTER   RELAY  CLOCK            MORE>
```

Operation of any of the category softkeys presents the menu of jobs associated with the selected category (section 4.1.4). Use of the next and / or previous softkeys allows the menu items to be scrolled through. The first item in the CHART category is depicted as an example, below.

```
Chart printer on line
                          NEXT  PREVIOUS
```

Once the required job has been located, operation of the enter key causes the recorder to search for all trigger sources for that job.

After a 'Please wait' message, the job sources will be presented at the bottom line of the display, as depicted below. Up to 8 sources can be displayed on one page, but if there are more than eight, the first six are displayed along with a 'MORE>' softkey to allow access to remaining sources.

3.4.1 JOB SRC SOFTKEY (Cont.)

```
Chart printer on line
011, D032, E06, T04, C01, t05, MORE>
```

Where:
Normal measuring channels are presented without prefix.
Derived channels have the prefix ‘D’.
Event numbers have the prefix ‘E’.
Totaliser numbers have the prefix CAPITAL ‘T’.
Timer numbers have the prefix ‘t’.
Counters have the prefix ‘C’.
Alarm numbers are presented as subscript numbers after the associated channel number.

Thus, in the above example, the chart is put on-line by Channel 1, Alarm 1 or Derived channel 3, Alarm 2 or Event 6 or Totaliser 4 or Counter 1 or Timer 5 or by further sources on subsequent pages (MORE>).

3.4.2 SYS ERR Softkey

System errors can be viewed by operating the SYS ERR key. System errors are presented one at a time on the top line of the display. If more than one system error is operative, the ‘page’ symbol appears as the right-most character of the top line, and the NEXT and PREVIOUS keys can be used to scroll through the list (section 4.6.1). If there are no active system errors, the message: No active system errors appears for about three seconds

3.4.3 CONFIG softkey

Operation of this softkey calls the ‘Enter Password’ page to the display. Entry of the correct password (10 when despatched form the factory) allows access to the recorder configuration. For details of how to change the password, see Instrument configuration (section 4.2.1 - Page 2 Parameters).

```
Enter Password _________
  QUIT   ENTER
```

3.4.4 M CARD SOFTKEY

A full description of this option is to be found in the Memory Card Instruction Manual supplied with every recorder fitted with the option.

Function — If operator access is allowed (section 4.14), the operator can format memory cards, save and restore recorder configurations and (if either of the data logging options is fitted) archive data for subsequent replay or manipulation in a PC. Also allows the operator to view the files on the card.

Access — HOME key (if necessary) followed by two operations of the MORE softkey, followed by operation of the M CARD softkey.

```
Memory card : Select a category
  DIR    STATUS OFFLINE INTERVL   MORE>
```

```
Memory card : Select a category
  SAVE  RESTORE  FORMAT           MORE>
```

SECTION 4 CONFIGURATION

LIST OF CONTENTS

(Continued)

List of contents (Cont.)

SECTION 4 CONFIGURATION

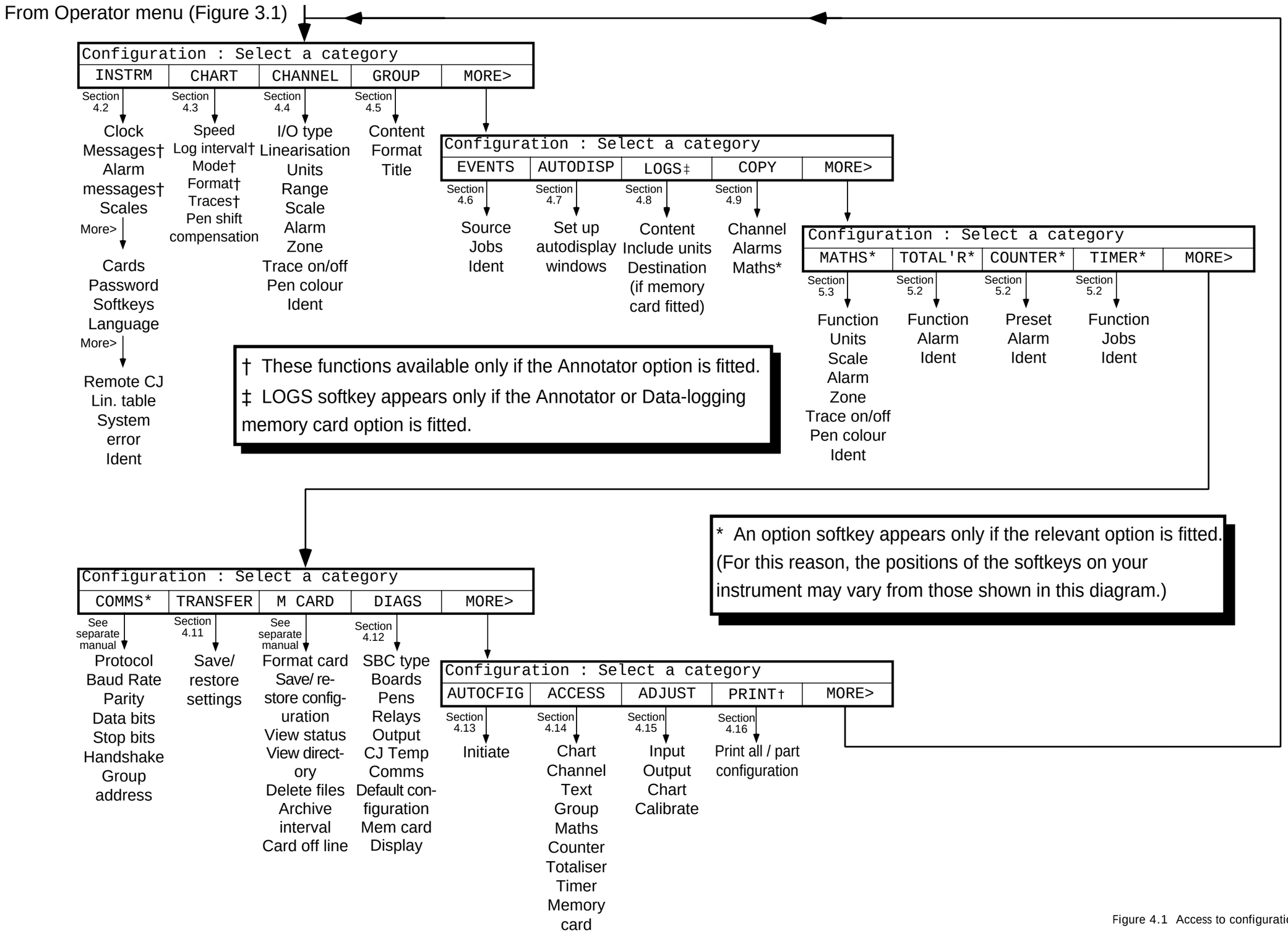


Figure 4.1 Access to configuration

4.1 INTRODUCTION

Note: In order to help new users, a configuration guide appears as Section 2 of this manual. This guide gives step-by-step instructions to allow the configuration of a single input channel to be carried out, the configuration to be copied to other channels and the configuration to be printed on the chart.

The configuration of the recorder is carried out in a number of separate operations (categories) as listed below in the order in which they appear at the recorder display (if all the options are fitted). See figure 4.1.

1. Instrument
2. Chart
3. Channels / alarms
4. Groups
5. Events and jobs
6. Auto display
7. Logs (Annotator option)
8. Configuration copy
9. Maths functions (option)
10. Totalisers (option)
11. Counters (option)
12. Timers (option)
13. Memory card (option)
14. Communications (option)
15. Transfer
16. Diagnostics
17. Autoconfiguration
18. Operator access
19. Adjust
20. Configuration print (Annotator option)

As will become clear, the techniques used in the configuration of the recorder are largely the same as those for the Operator Menu described in section 3 above. For this reason, large parts of this config-uration section are laid out more as a reference section than as descriptive matter

TIMEOUT

Unless one of the activities listed below is taking place, a return to the normal background display will be made after 4 minutes of keyboard inactivity. Should this happen, the configuration menus can be re-entered only after a further entry of the password (see section 4.1.1 below).

Timeout will not occur under the following conditions:
Changes to CARDS configuration are being confirmed
Autoconfiguration in progress
Configuration save or restore (to memory card) in progress
Memory card being formatted
Memory card is offline
Configuration printing is in progress
Channels are being copied
Channel adjustment, Input calibration or Cold Junction calibration is in progress
Recorder is in diagnostics.

4.1.1 Password

In order to prevent unauthorised access to the recorder configuration, a password protection system operates. **When dispatched from the factory the password is 10**. This password can be changed as a part of the Instrument Con-figuration described below.

To disable password protection, a password of 0 can be configured, allowing direct access to the configuration from the operator menu.

4.1.2 Character set

A number of configuration items (e.g. Channel descriptor) require text to be entered. Text entry is described in sec-tion 2.2.3 and embedded sequences (i.e. the automatic inclusion of time, date, channel number etc. in messages) is described in section 4.2.

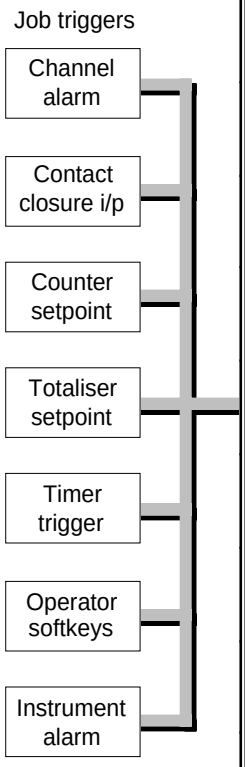
4.1.3 Option description

Software options are described in Section 5 of this manual. These include Maths Pack (Levels 1 and 2), Totalisers, Counters and Timers. Other options, such as Communications and Memory Card, are described in separate manuals, supplied with those recorders fitted with the options.

The Annotator Option functions affect a number of configuration menus, and for this reason have not been described in a separate section, but as and when they arise.

4.1.4 Jobs

A 'job' is defined as an action that can be initiated by an alarm, a timer, a counter etc. Jobs can be configured to be active continuously whilst the initiating source is active (or inactive) (e.g. Select chart speed B), or to carry out a particular task (e.g. Increment totaliser No. 3) as the result of a single trigger going active or inactive. Up to two jobs can be initiated by each alarm, timer etc. - see figure 4.1.4 below.



JOB TYPES	JOB ACTIONS (Up to two per trigger)
Chart Jobs	Switch chart drive on; Switch to chart speed B; Switch to print mode B; Chart advance.
Trace Jobs	Trace specified channel/group; Rapid scale print.
Alarm Jobs	Acknowledge alarms of specified group Disable alarms in specified group; sound buzzer.
Message Jobs	Output specified message to thedisplay, to the chart (if Annotator fitted) or to the memory card (if archiving option fitted).
Logging Jobs	If annotator fitted, output specified log; Switch to log interval B. If archiving option fitted, Switch to archive interval B
Derived Channel Jobs	Reset, trigger, disable, switch or trace specified channel or group of channels
Timer Jobs	Start or reset specified timer; Reset all timers (global reset).
Counter Jobs	Increment, decrement, preset or disable specified counter; Preset or disable group of counters.
Totaliser Jobs	Preset specified totaliser / group of totalisers; Disable specified totaliser or group of totalisers.
Relay Jobs	Operate specified relay on specified relay board.
Clock Jobs	Add or subtract one hour; Load preset time.

Figure 4.1.4 Job triggers and actions

4.1.5 Logs

Note: The Log functions are available only if the Annotator and / or Memory Card Logging Option is fitted.

Logs are alpha-numeric reports showing the current values of a specified group of variables. Which group is allocated to which log is set up as a part of the log configuration (section 4.8), as is the destination of the log (chart or memory card). The content of each group is set up in group configuration (section 4.5).

LOGGING TO CHART

Three logs are available, each of which can be allocated a 'group' as described in section 4.8. The printing of a log can be initiated in the following ways:

a) by the operator (section 3.3.4)
b) as a result of job action (section 4.1.4)
c) for log 1 only, automatically, at one of two fixed time periods (log intervals), - section 4.3.

When logging is in operation, the relevant values are printed across the full width of the chart. The number of values per line depends on how much information (e.g. descriptors, tags) is to be included (group configuration - section 4.5).

OPERATOR INITIATION
As described in section 3.3.4, log printing can be initiated, at any time, by the operator, from the LOG softkey in the level 1 Operator Menu.

JOB ACTION
As shown in figure 4.1.4, one of the jobs types available is 'Logging'. Within this category, a particular log number can be selected for printing when the job becomes active, and / or the logging interval can be selected to 'B'.

LOG INTERVAL
As detailed in section 4.3 below, two log intervals (A and B) can be entered as a part of Chart configuration to allow the automatic printing of log 1 at fixed periods. The intervals are in hours and minutes; an entry of 00:00 disabling automatic logging. As supplied by the factory, log interval A is set to 00:00 (off); interval B to 01:00 (1 hour).

Normally, log interval A is used by the recorder. Log interval B is selected either by the operator from the CHART menu, or by job action (See 4.1.4).

ARCHIVE INTERVAL
If memory card archiving software is fitted, two archive intervals (A and B) can be entered as a part of the memory card configuration to allow the automatic printing of log 2 at fixed periods. The intervals are in hours, minutes and seconds; an entry of 00:00:00 disabling automatic printing. As supplied by the factory, both intervals are set to 00:00:00. Refer to the Memory Card Manual for full details.

Normally, interval A is used by the recorder, but interval B can be selected for use from the top level Operator menu or by job action.

LOGGING TO MEMORY CARD
Logging to the memory card is initiated in exactly the same way as logging to chart, described above, except in that the destination set up in Log configuration (section 4.8) is a 'to *file name* ' instead of 'to chart'. For full details, refer to the Memory Card Instruction Manual.

4.2 INSTRUMENT CONFIGURATION

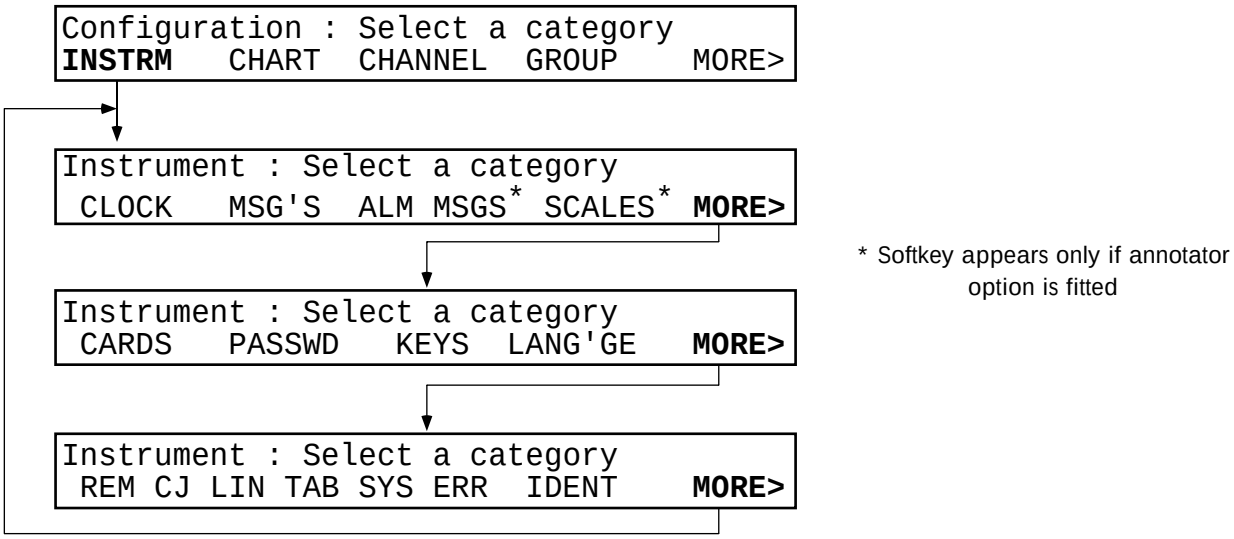


Figure 4.2 Instrument configuration

The instrument configuration allows the following items to be set up:

1. Current Date and Time (CLOCK softkey). It should be noted that adding or subtracting an hour can be done using 'Clock' jobs, simplifying time changes at Spring and Autumn.
2. A Preset Time (CLOCK soft key). Used to synchronize clocks of multiple instruments.
3. Allows the date format to be selected as Day/Month/Year or Month/Day/Year.
4. Printed messages (MSG'S softkey). Up to 10, printed if the annotator option is fitted, and / or displayed by job action. Messages may include embedded sequences (See section 4.2.2).
5. f the Annotator is fitted, alarm on/off and alarm acknowledgement messages, including the time at which the action occurred, can be printed automatically if the messages are enabled (ALM MSG'S softkey). The messages apply only to latching and non-latching alarms on measuring or derived channels. This saves the user having to set up jobs to trigger user messages.
6. the Annotator is fitted, customised scales can be entered (SCALES softkey). This allows the user to define exactly what information is to appear where, on the printed scale. Up to two scales can be set up, and any channel can be configured to use one of these scales, instead of the normal automatic scaling. See section 4.4.4 - Channel configuration: zone.
7. Which card type is located in which slot is usually determined automatically using AUTOCONFIG. This can be overruled from within the CARDS pages to allow slots to be used for COMMS or TEST inputs, neither of which requires an I/O board to be fitted. Further, it is possible to 'shutdown' I/O boards to allow them to be removed without generation of spurious alarms.
8. A new password can be entered (PASSWD softkey). The recorder is dispatched from the factory with the password '10'.
9. The five softkeys can be used as event sources (section 4.6.1). KEYS allows the labels (softkey legends), which are to appear above the keys, to be entered, and the key action to be defined as latching or non-latching. Softkey action is set up in Event Configuration (section 4.6).
10. The display language can be selected as French, German or English (LANG'GE softkey).
11. A channel number can be defined as a remote CJ input (REM CJ softkey). This is used whenever a channel is configured as having Remote Cold Junction Compensation. The remote CJ temperature units can also be set up.
12. A user linearisation table of up to 32 points can be entered as input / output pairs (LIN TAB softkey).
13. System errors can be displayed, and where relevant, cleared (SYS ERR softkey).
14. A recorder identifier can be entered for use when logging to memory card.

4.2 INSTRUMENT CONFIGURATION (Cont.)

As can be seen from figure 4.2 above, entry is by operation of the INSTRM softkey in the top level configuration menu. In order to return to higher levels of menu, the Cancel, Enter or Home key is operated.

PAGE 1 PARAMETERS

CLOCK (Page 1)	Time	Allows entry of Hours and Minutes. Entry method: numeric keys. The clock starts when the 'Enter' key is operated.
	Date	Allows entry of Day number, Month and Year. Entry method: field scroll keys (month); numeric entry (Day, month and year). Day name is automatically linked to the rest of the date.
	Preset time	Allows entry of pre-set hours and minutes for job action (e.g. clock synchronization among multiple recorders). Entry method: numeric keys.
CLOCK (Page 2)	Date format	Scroll through Day/Month/Year (DD/MM/YY) or Month/Day/Year (MM/DD/YY) for date display/printing.
MSG'S	Select Customised Message.	Entry method: Numeric or field scroll keys. (1 to 10)
	EDIT	Presents selected message text for editing. See also Section 4.2.2 for details of embedded sequences.
ALM MSG'S	Alarm on/off messages	This softkey appears only if the Annotator Option is fitted.Scrollable Yes or No to enable / disable, respectively, the auto- matic printing of alarm on and alarm off messages. (Format of messages is: HH:MM Alarm(s) on (off) CCn, DCCn etc, where HH:MM is the time at which the alarms changed state, CC is the channel number and n is the alarm number (1 to 4). DCC is used to denote a derived channel number.)
	Alarm acknowledgement messages	Scrollable Yes or No to enable/disable, respectively, the automatic printing of alarm acknowledgement messages.
SCALES	Select customised scale	This softkey appears only if the Annotator Option is fitted.Entry method: Numeric keys. (1 or 2).
	EDIT	Presents selected scale for editing. The lower line of the display initially represents the first 40 of the 104 positions at which characters can be printed on the chart. The → key is used to move the cursor along the scale. When the fortieth character is reached (i.e. the right-hand end of the display line) further operations of the → key result in the scale's apparently moving left, until cursor position 104 is reached. Any text character can be entered at any of the 104 positions. Operation of the 'Enter' key confirms the new scale. 'Cancel' or a further 'Enter' returns to the 'Select customised scale' page. If an error is made, scale entry can be completed. Once the 104th position is reached, a further operation of the → key will return to the beginning of the scale, allowing the error to be corrected. The scale is selected for use in the Channel Zone configuration described in Section 4.4.4.

4.2 INSTRUMENT CONFIGURATION (Cont.)

PAGE 2 PARAMETERS

CARDS	Addr1 to Addr8	Allows the card type for each address to be set up (see section 4.4.1), and to be defined as either enabled or shutdown. 'Shutdown' allows a card to be removed from its slot without any resulting alarms etc. being generated and also allows the recorder I/O to be configured even if the cards are not fitted. The page scroll keys are used to scroll through Empty, Universal i/p, Relay, Comms (if Communications option fitted), Test, 8-channel o/p, 16 channel i/p or 4-channel o/p. (Comms is used when data sent over a serial link to be traced on the chart without an I/O board.) If any modification is made, operation of the ENTER key will call up a 'QUIT / CONTINUE' page, asking if the instrument is to be re-initialised to the new card configuration.
PASSWD	Enter new password	A new password can be entered. Passwords can be up to 10 numeric characters long. A password of a single 0 (zero) allows direct entry to the configuration menus from the operator menu (i.e. a password is no longer required). Once the password has been confirmed by operation of the 'Enter' key, the operator is asked to enter it again (to ensure that it was correct the first time). If the second entry differs from the first, the message 'New Password Rejected' appears, and the recorder returns to the 'Instrument: Select a category' page.
KEYS	Operator key N	Allows the five softkeys to be defined for use (from the Operator menu) as event sources. The page scroll key is used to scroll through the five displays. On each page, the softkey legend can be entered, and each softkey can be defined as being latching or non-latching by using the field scroll keys. The actions associated with each softkey are defined in the Event configuration (Section 4.6).
LANG'GE	ENGLISH / FRENCH / GERMAN	Sets all further displays into English / French / German.

PAGE 3 PARAMETERS

REM CJ	For all cards	Scrolls through 'all cards', 'card 1', 'card 2' etc. to allow a single input channel to measure a Remote CJ either for the selected input board, or for all input boards.
	Channel NN (DNN)	Allows a channel to be defined (using the numeric keys) as measuring a remote CJ input. The input type, linearisation etc. must be entered as a part of the selected channel's configuration, using the same temperature units as those specified in the 'Units of' field described immediately below. The ± key may be used to toggle between measuring and derived channels.
	Units of	Allows ˚C, ˚F or Kelvin or Rankine to be selected using the field scroll keys.
	Enable/Disable	Allows the operator to enable or disable the remote CJ channel.
LIN TAB	CONTENT	Allows entry of a linearisation table of up to 32 input / output pairs, either equally or non-equally spaced. The user can select which sets of points to apply to a particular input signal. A linear interpolation is carried out between pairs.
	TITLE	Allows a table title to be entered.
SYS ERR		Operation of this softkey causes any system errors to be displayed. Where appropriate, a CLEAR softkey is included on the bottom line. If more than one error is active, the page scroll keys are used to access further pages.
IDENT		Allows the entry of a unique, 20-character instrument identifier for including in memory card logs if the relevant option is fitted.

4.2.1 Embedded sequences

Messages can include one or more embedded sequence, each of which causes the current value of a particular variable (eg. time, date, value of channel n etc.) to be included, automatically, in the message when printed. The sequences are embedded using the < and > characters (delimiters) to separate them from normal text. The available sequences, which must be entered as shown, are as follows:-

<TIME>	Embeds the current time in hh:mm:ss format
<DATE>	Embeds the current date in the format defined in the instrument configuration i.e. DD/MM/YY or MM/DD/YY.

The remaining sequences require both a source and a type to be defined as <ITEM.TYPE>.

ITEMS

Available 'items' are:-

Blank	Indicates that the triggering item itself (e.g alarm, totaliser) is to be used.
nn	Indicates that measuring channel nn is to be used.
Dnn	Indicates that derived channel nn is to be used.
Tnn	Indicates that totaliser No. nn is to be used.
Cnn	Indicates that counter No. nn is to be used.
Enn	Indicates that event nn is to be used.
tnn	Indicates that timer No. nn is to be used.

TYPES

Available 'types' are:-

PV	Causes the ITEM's process value to be embedded.
TA	Causes the ITEM's tag to be embedded.
DE	Causes the ITEM's descriptor to be embedded.
UN	Causes the ITEM's units string to be embedded
NO	Causes the ITEM's identification number (eg. 11, T2, D43) to be embedded.

Thus, the message <TIME><DATE><.TA><.PV><.UN> would cause the current time and date, followed by the tag, process value and units, to be printed for the message's triggering source.

For a specified ITEM (measuring channel 3 in this example) <TIME><DATE><3.TA><3.PV><3.UN> would result in the same message being printed, but for channel 3 instead of the triggering source.

4.3 CHART CONFIGURATION

Chart configuration allows the following items to be set up:

1. Chart speed units (SPEED softkey). This allows the choice of mm/hr or inches/hour. This selection should be made before any new chart speed settings are made.
2. Chart speeds A and B (SPEED softkey). This allows two alternative speeds to be entered for selection from the Operator menu (section 3.2.2) or by job action (section 4.1.4). The available fixed speeds (table 4.3) are scrolled through using the field scroll keys.
3. A user-defined chart speed is enterable using the numeric keys. The available range is from 0 to 7200 mm/hr (0 to 285 in/hr). Annotation is inhibited above 900 mm/hr (35 in/hr)
4. If the Pen Shift Compensation Option is fitted, this can be used to remove the effects of the 3 mm. gap between pens. (Equivalent to 54 minutes between pens 1 and 4 at a chart speed of 10 mm/hr.). (TRACES softkey). If the Annotator option is fitted, time marking relates to the position of the green pen.

If the Annotator Option is fitted, the following items can also be configured.

5. Logging intervals A and B (LOG INT softkey). This allows two alternative logging intervals to be entered for selection from the Operator menu or by job action. The logging interval defines how often log 1 is automatically printed on the chart or sent to yhe memory card (if fitted). (00:00 = log 1 not automatically printed.)
6. Print modes A and B (MODE softkey). This allows two print modes to be defined for selection from the Operator Menu or by job action. The available print modes: Trace priority, Text priority and Text only are described in section 4.3.1 below.
7. Interpolation (TRACES softkey). Allows interpolation to be switched on or off. Interpolation 'on' causes the annotator to print additional dots in an attempt to smooth the trace.
8. Adaptive recording (TRACES softkey). Allows adaptive recording to be switched on or off. Adaptive recording traces all signal variations even at low chart speeds, by inserting extra print passes inbetween chart increments if large signal variations are detected.
9. For extra clarity in 'Break Trace' Print Mode, the channel pens can be zeroed whilst annotation is taking place (TRACES softkey). See 'Print Modes' (section 4.3.1 below).

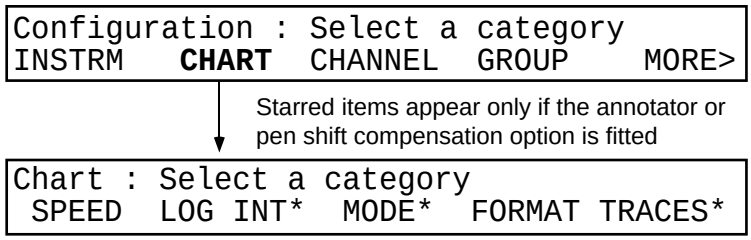


Figure 4.3 Chart configuration

As can be seen from figure 4.3, entry is by operation of the CHART softkey in the top level configuration menu. In order to return to higher levels of menu, the Cancel, Enter or Home key is operated.

* These softkeys appear only if the annotator option is fitted, or (for log interval) if one of the memory card archiving options is fitted

4.3.1 Print modes

If the Annotator Option is fitted, then at chart speeds of up to 900 mm/hr (35 in/hr) the recorder can print data on the chart in any one of the modes described below.

At chart speeds above 900mm/hr, all messages are lost if the recorder is in Trace Priority mode. In text priority mode, logs always break the trace and are printed as required; demand messages are held until the print queue is 70% full, when they are printed in break-trace mode; cyclic messages are lost. Text only mode is unaffected.

Trace priority

All message types can be printed, but the traces are not interrupted. All demand messages are queued until printed. If the queue over-flows, a 'Message lost' message is printed on the chart.

Text priority

Demand messages are printed in overprint mode (i.e. traces are not interrupted) if the print queue is less than 70% full. Otherwise message printing takes priority and the traces are broken ('break-trace' mode). When logging, the traces are always broken. If the queue overflows, 'Message lost' is printed on the chart.If 'Zero pens on break trace' is selected (TRACES softkey), pens 1 to 4 are set to chart zero whilst the recorder is printing in break trace mode.If 'Zero pens on break trace ' is not selected, the channel pens will continue to trace the channel values whilst demand messages are printed at optimum chart speed. To indicate that the chart time axis has been disrupted, the word 'BREAK' is appended to the first message to be printed. After the last message has been printed, a time stamp cyclic message will be printed as soon as possible.

Text only

All cyclic messages are inhibited. Channel pens move to the left side of the chart. Only logs and demand messages are output. This mode is used for report generation and alarm logging. If the queue over-flows, 'Message lost' is printed on the chart. The chart is driven as required for optimum printing speed.

4.3.2 Chart parameters

Note: If the chart speed units are to be changed, this should be done before setting chart speeds. In particular, the 'user speed' is not converted, so if a mm/hr value is entered and the units are subsequently changed to in/hr, the entered 'user speed' value is lost.

SPEED	Speed A (B)	Allows chart speed A (B) to be entered for selection by the operator or as a result of job action. Chart speeds are scrolled-through using the field scroll keys. The available fixed chart speeds are listed in the table below.
	Units	Allows mm/hr or in/hr to be selected using the field scroll keys. See the note above.
	User speed	Allows entry of any speed up to 7200 mm/hr or 285 in/hr using the numeric keys. Annotation on the chart is inhibited above 900 mm/hr. As stated in the note above, if this entry is made before the chart speed units are changed, the value is lost (i.e. set to zero).

Annotation inhibited

mm/hr	Off	5	10	20	30	60	120	300	600	1200	1500	User
in/hr	Off	0.25	0.5	1	2	4	5	6	10	25	50	User

Table 4.3 Available chart speeds

TRACES*	Pen shift compensation	Use the field scroll keys to switch pen shift compensation on / off.

If the Annotator Option is fitted, the following further items are configurable, but it should be noted that annotator operation is affected by chart speed - see section 4.3.1 above.

LOG INT	Logging interval A (B)	Allows log 1 logging interval A (B) to be entered for selection by the operator or as a result of job action. Logging intervals (in hours and minutes up to 99 hrs, 99 minutes.) are entered using the numeric entry keys. An entry of 00:00 causes automatic triggering of log 1 to be inhibited.
MODE	Print mode A (B)	Allows print mode A (B) to be entered for selection by the operator or as a result of job action. The field scroll keys are used to scroll through the three available modes: Trace priority, Text priority, Text only (section 4.3.1)..
FORMAT	Scale format	Allows channel scales to be printed with: descriptor only, tag only or descriptor and tag.
TRACES*	Interpolation	Use the field scroll keys to enable / disable interpolation.
	Adaptive recording	Use the field scroll keys to select enable/disable adaptive recording.
	Zero pen on break trace	Use the field scroll keys to enable / disable pen zeroing during break trace printing.

* TRACES softkey appears only if Pen Shift Compensation and / or Annotator option is fitted.

4.4 CHANNEL / ALARM CONFIGURATION

Channel / alarm configuration is described in the following sub-sections: Range, Alarm, Zone, Trace, Ident. Each of these categories is accessible by softkey action from the Channel level 1 display.

In order to help new users, Section 2 gives step-by-step instructions to allow the complete configuration of a single input channel to be carried out and then copied to other channels.

4.4.1 Channel address allocation

Each I/O board has an address (irrespective of its physical slot location) allocated to it by a user-accessible rotary switch. Each address is associated with eight channels as shown in table 4.4.1.

Address	Channel Numbers
0	Invalid
1	1 to 8
2	9 to 16
3	17 to 24
4	25 to 32
5	Relay o/p boards only
6	
7	
8	
9 to F	Invalid

Table 4.4.1
Channel addressing

ADDRESSING RULES

1. Addresses 0, and 9 to F are not recognised by the I/O boards, and any data requested or sent is ignored.
2. 16-channel boards use two addresses each so the next address after a 16-channel board must be left empty.
3. 8-channel input boards can be allocated addresses 1 to 4, providing the previous address is not assigned to a 16-channel board.
4. Relay output boards can be allocated any valid address provided the previous address is not assigned to a 16-channel board.
5. As despatched from the factory, address 1 is at the left-most slot when viewed from the rear of the recorder.

ACCESS TO ADDRESS SETTING SWITCHES

Caution

Always switch the recorder off, or isolate from mains power before opening the writing system, and ensure the pens are parked

Release the captive screws located as indicated in figure 4.4.1 and pull the writing system forwards to its stops, then lift it out of the case.

With the writing system removed, the I/O boards are revealed, and the address switches can be seen located on the front edges of the I/O boards. The address is adjusted by inserting a small, preferably plastic, tool into the switch slot, and rotating the switch wiper to the required position.

Once the required address has been set, the writing system should be returned to the case, and configuration continued.

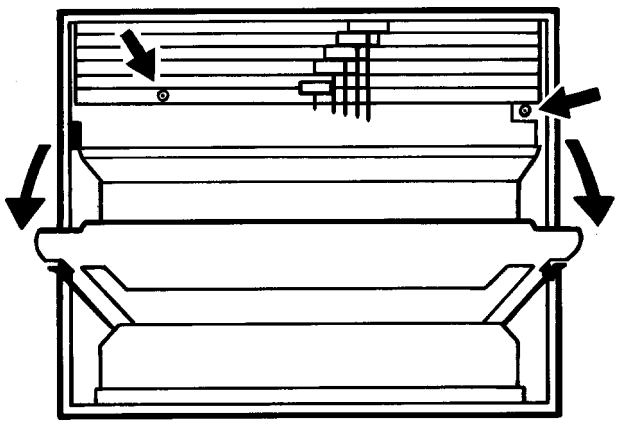


Figure 4.4.1 Removing the writing system

4.4.2 Channel configuration: Range

INPUT CHANNELS

Operation of the CHANNEL softkey causes the level 1 channel configuration page to appear. Operation of the RANGE softkey from this page calls the first of the three Range pages to appear. Four of the alternative input types, together with their subsequent pages are depicted in figure 4.4.2a. The parameters on these pages set the selected channel to measure as required and are desribed in the tables below.

On page one, select input type and range of measurement. Go to page two before operating the 'Enter' key. For thermocouples, select cold junction compensation type. For 'current' inputs, specify a shunt value. For 'digital' inputs, open and closed state labels (descriptors) can be entered.

On page two, select a linearisation type to match the input type selected at page one. For a voltage or current input representing a temperature, enter a linearisation range. For signals requiring scaling before trace and display, enter scale limits to match the input range.

On page three, select decimal point position for the display, select a damping period and input break response.

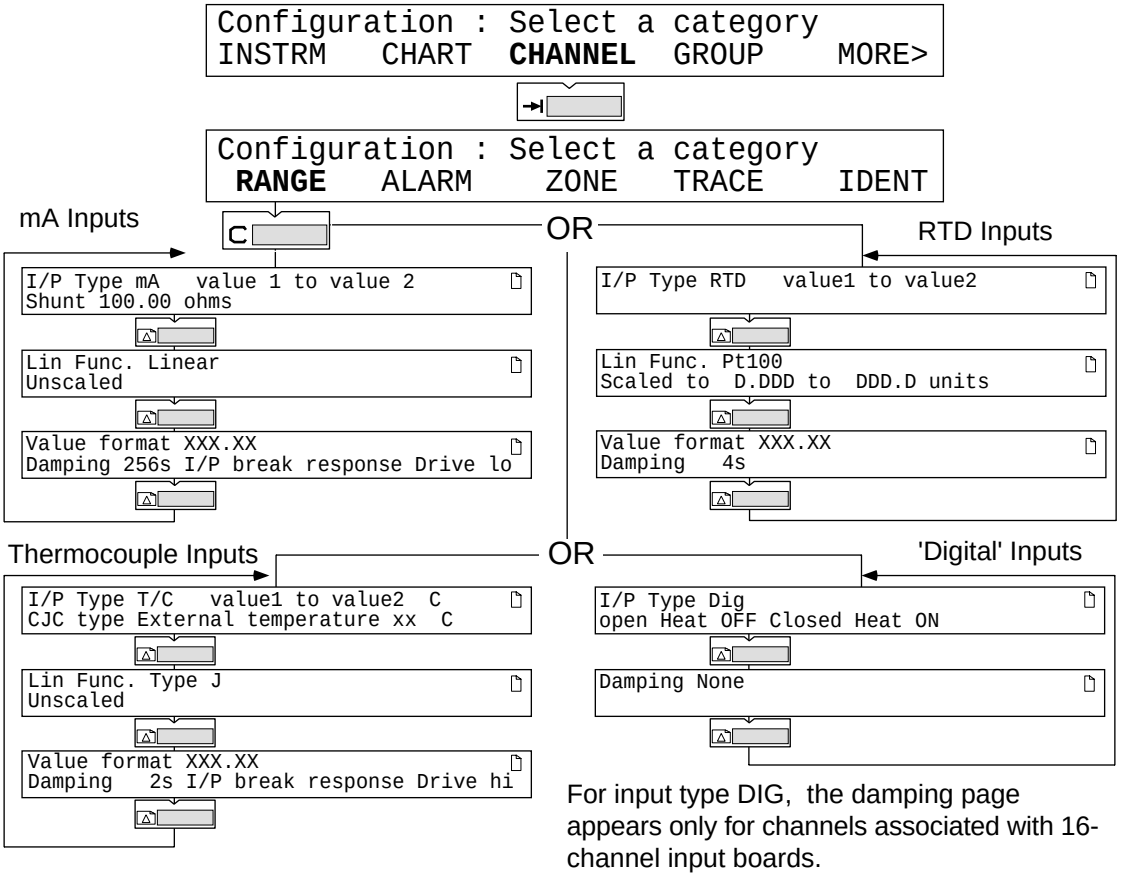


Figure 4.4.2a Input channel configuration: Typical range pages

4.4.2 INPUT CHANNEL CONFIGURATION: RANGE (Cont.)

PAGE ONE PARAMETERS

I/P type		Allows the required input type to be selected. The available types (scrolled by the field scroll keys) are as follows: Note: A suitable linearisation function must be selected from page two before the 'Enter' key is operated. If this is not done, the message 'Invalid configuration' will appear.
	Off	The channel is switched off with no processing of channel input or alarms.
	T/C	Selects 'thermocouple' as the type of input.
	mV	Selects mV as the type of input.
	V	Selects Volts as the type of input
	mA	Selects mA as the type of input
	RTD	Selects resistance thermometer as the type of input. (Not 16-channel board)
	Ohms	Selects Ohms as the type of input. (Not 16-channel board).
	Dig	Selects digital (discrete) input (switch contact). Open input is accepted if the resistance across the input terminals is > 3000 Ohms. Closed input is accepted if the resistance across the input terminals is less than 500 Ohms.Contact closure inputs are not available on channels 1, 8 or 16 of the 16 channel dc input board (dig does not appear as a menu item for these channels.)
	Comms	Must be selected if a host computer is to write to the channel (applicable only to recorders fitted with the communications option).
	Test	Allows a test sine or triangular waveform to be selected.
Value 1 (2)		Allows entry of the expected range of the input signal. Value 1 is the low end of the range; Value 2 the high end.
˚C		For thermocouple and RTD inputs, the temperature units can be set to ˚C, ˚F, K (Kelvin) or R (Rankine) using the field scroll keys.
CJC type		Allows Internal, external or remote cold junction compensation to be applied by scrolling through the three types, using the field scroll keys. Applies only if input type is 'thermocouple'.
	Internal	The recorder uses the recorder's integral cold junction for compensation.
	External	Allows the temperature, at which the external cold junction is to be maintained, to be entered using the numeric keys. The temperature units for the cold junction are those set up as input units.
	Remote	Selects 'Remote' to be used for cold junction compensation. The channel which measures the temperature to be used is defined as a part of the instrument configuration, as described in section 4.2.1 (REM CJ).
Shunt		Allows a shunt value to be entered (using numeric keys) when mA is selected as input type. A 100 Ohm shunt gives 2 V at 20 mA; a 250 Ohm shunt gives 5 V at 20 mA. The value entered must match the shunt connected across the inputs.
Open (Closed)		Allows two legends to be entered for 'digital' inputs, one for the open input case; the other for when the inputs are closed. These legends appear at the display as channel status.

The page down key is operated to call the second range page to the display:

Note: DEFAULT ALARMS. If the input type is changed to DIG, the alarm type defaults to OFF, Digital, Dwell 0 sec. If the input type is changed from DIG, the alarm type defaults to OFF, Absolute high, Setpoint 10.00.

4.4.2 INPUT CHANNEL CONFIGURATION: RANGE (Cont.)

PAGE TWO PARAMETERS

Lin Func	Allows an appropriate linearisation function to be defined for the input type selected at page one. The following linearisations can be scrolled through using the field scroll keys: Thermocouples: Types B, C E, J, K, L, N, R, S, T, U, NiMoNiCo (note 3) Platinel, User Resistance thermometers: Cu10, Pt100, Pt1000, Ni100, Ni120, User Other functions: Linear, sqrt, $x^{3/2}$, $x^{5/2}$, User

Notes:
1. An appropriate linearisation function must be selected here, before the i/p type is 'Entered' at page one. If this is not done, the message 'Invalid Configuration' will appear.
2, The 16-channel dc input board supports a maximum of eight different linearisation functions including linear
3. Previous versions of the recorder came with NiNiMo linearisation instead of NiMoNiCo.

Unscaled / Scaled to	The field scroll keys are used to scroll between 'Unscaled' and 'Scaled to'. Unscaled: The scale is identical with the range. Scaled to: Used to allow entry of chart / displayed values, when the input value (page 1) and the chart/displayed values are to be different, as in the following example. Example: An input from a transducer has a range of 0 to 5 V. It is required however that the displayed value is in %, where 0 V represents 0% and 5 V represents 100%. In such a case, a range would be set (in page 1) of 0 to 5, and a scale would be set here, in page 2, of 0 to 100.
Units	Allows a Units string to be entered using the cursor / field scroll keys. The → key is used to move from character to character. The Clear (C) key can be used to delete characters from the cursor to the end of the line inclusive. (Use of the Cancel (X) key will cause all the changes so far made in pages one and two to be lost).

The page down key is operated to call the third range page to the display.

PAGE THREE PARAMETERS

Value format	Allows the required decimal point position to be chosen for display. The available positions (scrolled-through by the field scroll keys) are: X.XXXX, XX.XXX. XXX.XX, XXXX.X, XXXXX.
Damping	For the 16-channel dc input board, one of the following time constants (scrolled-through using the field scroll keys) can be applied to any input signal: None, 2, 4, 8, 16, 32, 64, 128 or 256 seconds. For the 8-channel universal input board, damping can be applied to all types of input, except 'dig' (Contact closure).
I/P Break response	Allows Drive hi(gh), Drive lo(w) (not 16-channel board) or None to be selected, using the field scroll keys. Drive hi causes the trace to move to full scale (span) if the input goes open circuit. Drive lo causes the trace to move to chart zero. If none' is selected, the trace will drift, responding to any voltages picked-up by the external wiring acting as an aerial.

Operation of the Enter key causes all the changes made in pages one, two and three to be sent to the recorder data base. A further operation of the 'Enter' key, or operation of the cancel key returns the level 1 Channel configuration page to the display.

4.4.2 CHANNEL CONFIGURATION: RANGE (Cont.)

OUTPUT CHANNELS

Operation of the CHANNEL softkey causes the level 1 channel configuration page to appear. Operation of the RANGE softkey from this page calls the first of the Range pages to appear. Alternative output types, together with their subsequent pages are depicted in figure 4.4.2b. The parameters on these pages are described in the tables below.

On page one, select output type, range of measurement and source of input. For input or derived channel sources, page two allows offset and span values to be entered. For constant source, this page does not appear.

On page three, select decimal point position for the display and error response.

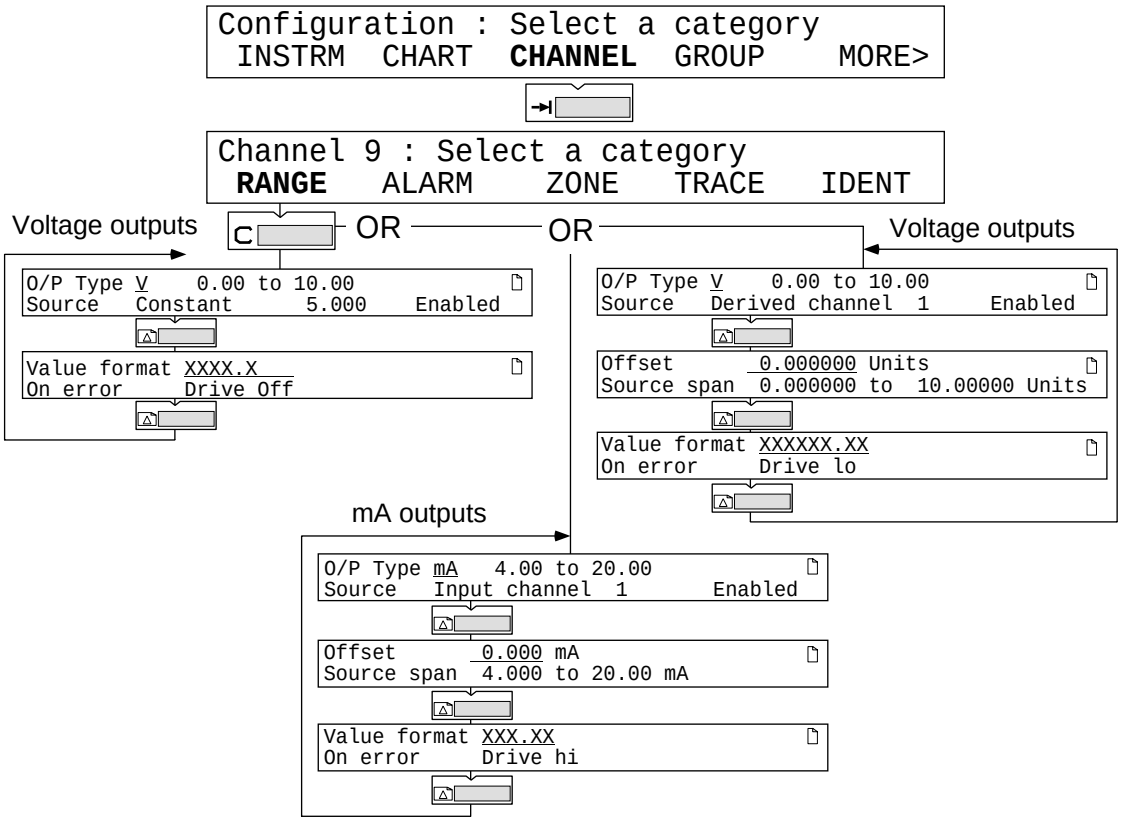


Figure 4.4.2b Output channel configuration: Typical range pages

4.4.2 OUTPUT CHANNEL CONFIGURATION (Cont.)

PAGE 1 PARAMETERS

O/P type		Allows the required output type to be selected as Off, V or mA
	Off	Channel output goes to 0mA at Io and C terminals, and approximately -1 Volt across Vo and C terminals.
	V	Sets the channel to apply a voltage signal across Vo and C terminals. Allows a span of up to 10V to be entered. Io is set to its Off state.
	mA	Sets the channel to source current at the Io and C terminals. Allows a span of up to 25mA to be entered. Vo is set to its Off state.
Source	Input channel N	Use numeric keys to enter channel number
	Derived channel N	If maths pack option fitted, use numeric keys to enter derived channel number.
	Constant	Allows a constant to be entered using the numeric keys. The output range available is -15 to +115% of the span set in the top line of the page, provided that this does not exceed the absolute maximum figures given in the technical specification at Annex A.
Enabled		Scrollable through 'Disabled' and 'Enabled'. When disabled to outputs are set to their off states.

PAGE 2 PARAMETERS

Note: this page does not appear when input source 'constant' is selected in page 1.

Offset	Allows an adjustment to be made to match the recorder output with external equipment.
Source span	Initially shows the source channel's span, but can be edited using the numeric keypad.

PAGE THREE PARAMETERS

Value format		Allows the required decimal point position to be chosen. For source = constant, the available positions (scrolled-through by the field scroll keys) are: X.XXXX, XX.XXX. XXX.XX, XXXX.X, XXXXX. For source = input or derived, additional formats are available as follows: XXXXXXXX, XXXXXXX.X, XXXXXX.XX, XXXXX.XXX, XXXX.XXXX, XXX.XXXXX, XX.XXXXXX, scientific, time, date, elapsed. See section 5.3.1 for details.
On error		Determines what the output signal does if the source channel fails or if the recorder internal communications stop.
	lo	Signal goes to 'zero' - 15% span.
	hi	Signal goes to span + 15% span
	Off	Switches output off as defined in 'O/P type' in 'Page 1 parameters' above.

4.4.3 Channel configuration: Alarms

INTRODUCTION

Up to four alarms can be set up for each channel, and these are configured in three steps: Type, Action and Jobs. The available alarm types are: Absolute high, Absolute low, Deviation in, Deviation out, Rate-of-change rise, Rate-of-change fall, , Discrete input High, Discrete input Low. The 'Action' for each alarm can be 'Off', 'Trigger', 'Latching' or 'Non-latching'. The jobs carried out as a result of an alarm going active are as described in section 4.1.4 above.

For absolute and deviation types, a hysteresis value can be configured to prevent continuous triggering of the alarm, should the process variable value 'hover' at or near the setpoint (sometimes called 'threshold'). For all types of alarm, a 'Dwell' period can be configured, to delay the alarm becoming active after it has been triggered. If the value goes out of alarm during the dwell period, then the alarm is ignored.

ALARM ACTIONS

Off	The alarm is disabled.
Trigger	Once active, the alarm stays active until the alarm source returns to a non-alarm state. Any continuous jobs (e.g. change print mode) will remain active for the duration of the alarm state. Trigger alarms are not annunciated in any way (e.g. no messages on the chart, no flashing LED) and do not appear in alarm history lists.
Latching	Once active, the alarm stays active until it is both acknowledged AND the alarm source has returned to a non-alarm state. Any continuous jobs (e.g. change chart speed) remain active until the source returns to a non-alarm state (whether or not the alarm has been acknowledged).
Non-latching	Once active, the alarm stays active until the alarm source returns to a non-alarm state. Any continuous jobs (e.g. change print mode) will remain active for the duration of the alarm state.

ALARM TYPES

NOTE: In the following diagrams, the measured value increases from left to right.

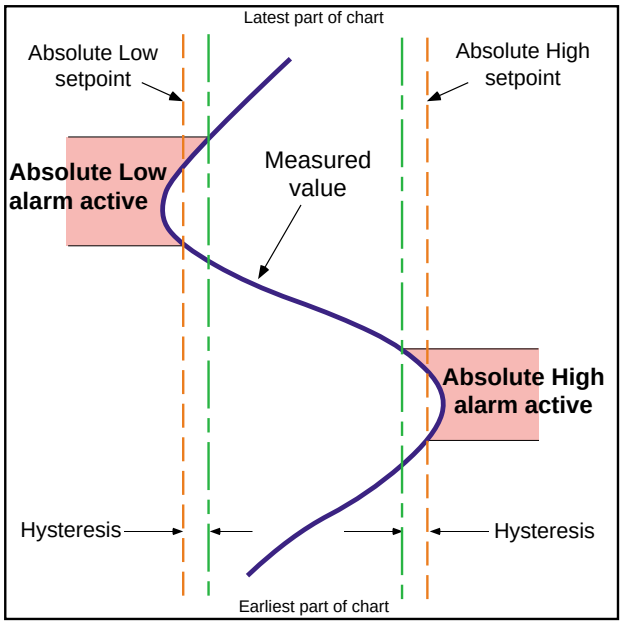


Figure 4.4.3a Absolute alarm definitions

An **absolute high** alarm becomes active when its setpoint value is exceeded, and it remains active until the measured value falls below the value (*setpoint - hysteresis*).

An **absolute low** alarm becomes active when its setpoint value is exceeded (in the negative sense), and it remains active until the measured value rises above the value (*setpoint + hysteresis*).

4.4.3 CHANNEL CONFIGURATION: ALARMS (Cont.)

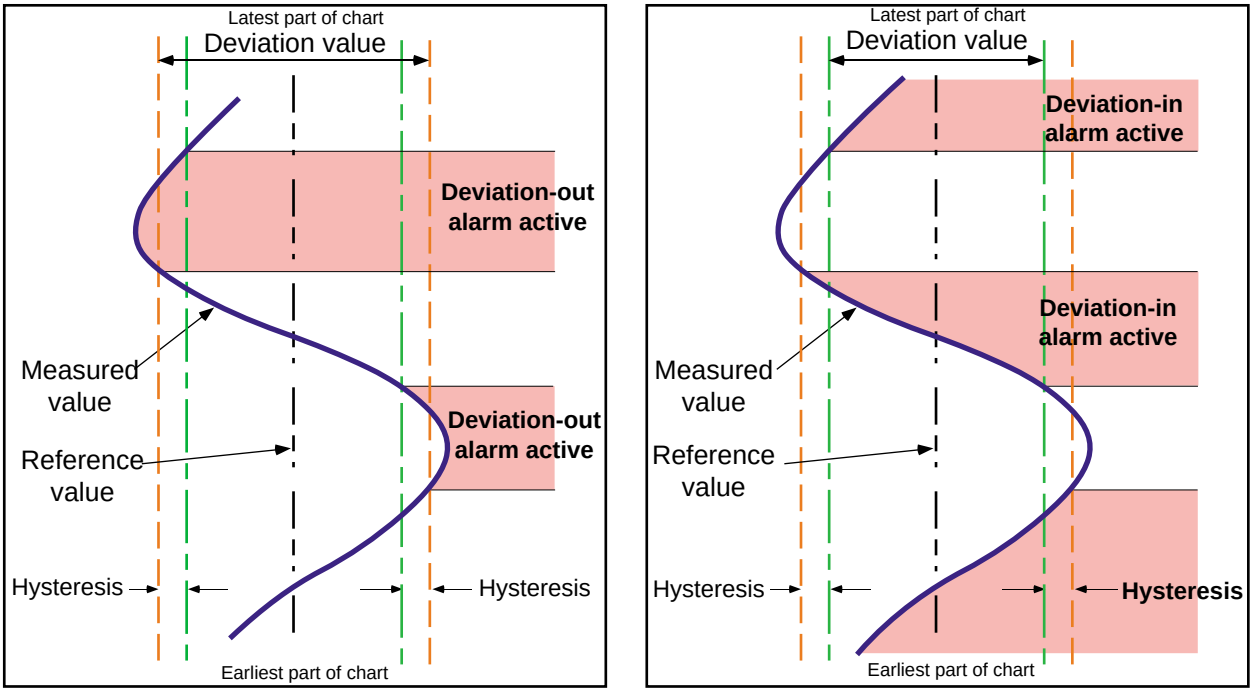


Figure 4.4.3b Deviation alarm definitions

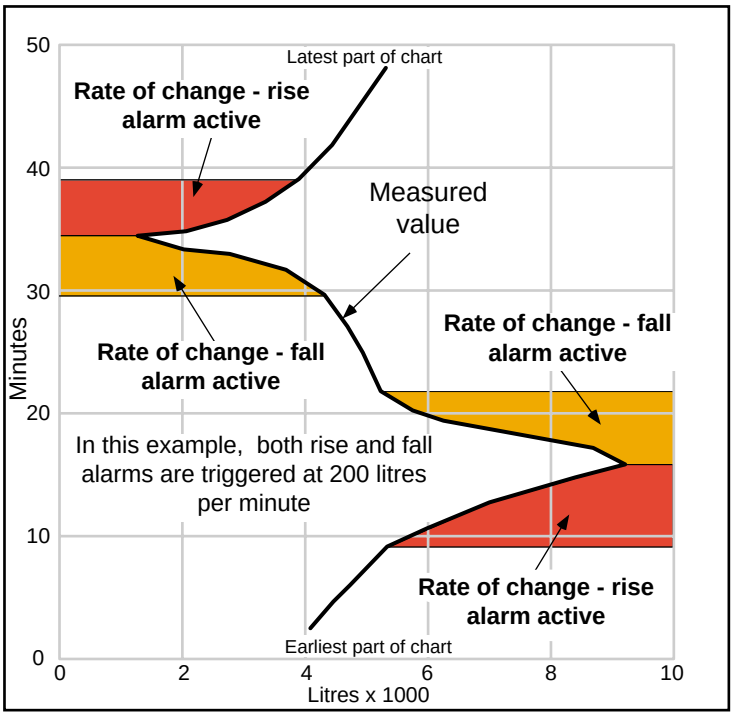


Figure 4.4.3c Rate-of-change alarm definitions

With Rate-of-change alarms, a value (200 litres in the above sketch), a time period (one minute above), and an averaging period have to be configured. The alarm is triggered if the measured value changes by more than the configured value in less than the configured period (more than 200 litres per minute in the above example). The averaging period is used to change the sensitivity of the alarm, such that noise spikes on, or normal oscillations in the input signal do not trigger false alarms.

4.4.3 CHANNEL CONFIGURATION: ALARMS (Cont.)

DIGITAL ALARMS

These alarms are triggered by contact closures or openings as defined during configuration. These alarm type is available only if 'Dig' has been selected as input type in 'Range' configuration (Section 4.4.2).

Note: Contacts closed is defined as a resistance of less than 500Ω across the input;
Contacts open is defined as a resistance of more than 3000Ω across the input.

ALARM CONFIGURATION

Figure 4.4.3d shows typical display pages for the four types of alarm Select alarm 1 to 4 for the channel using the field scroll keys.

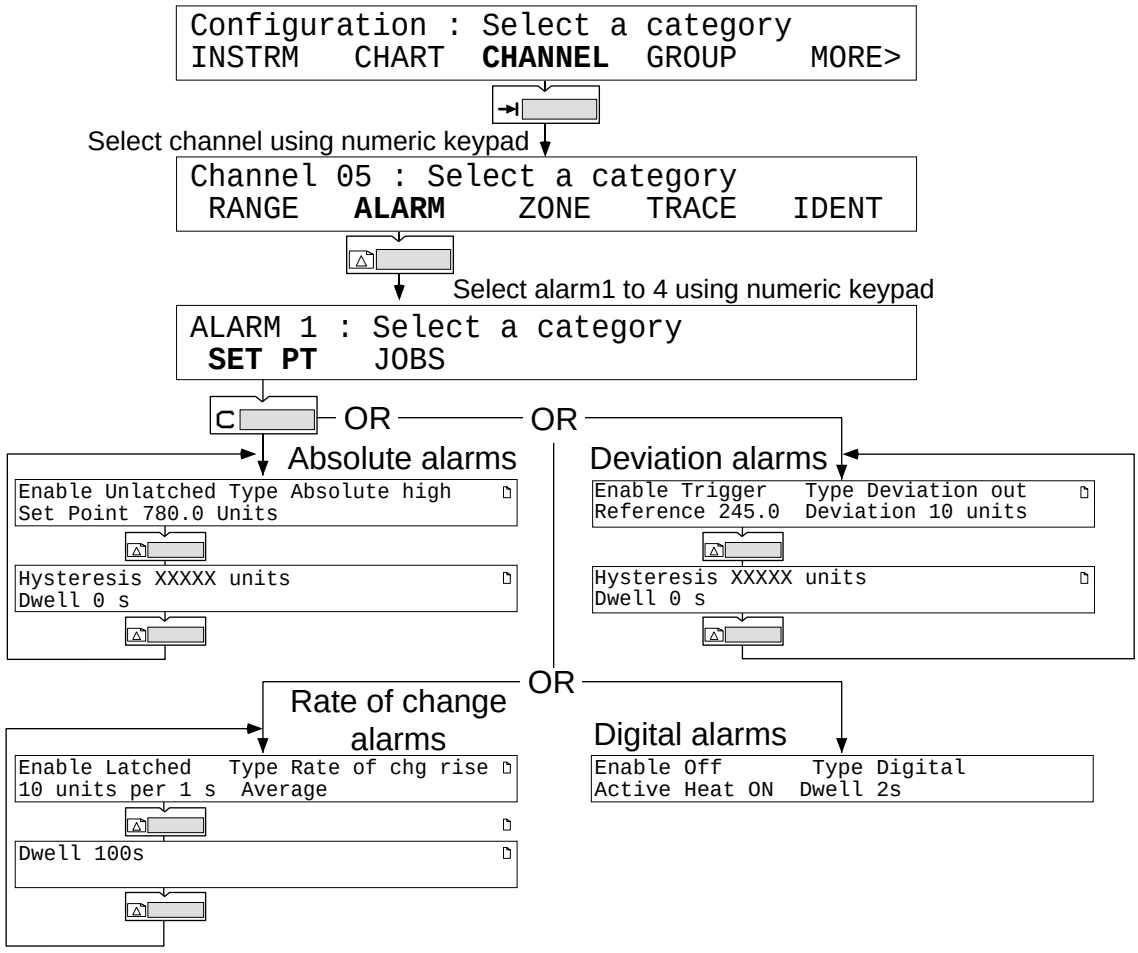


Figure 4.4.3d Channel configuration: Typical alarm pages

4.4.3 CHANNEL CONFIGURATION: ALARMS (Cont.)

SET PT SOFTKEY PAGE ONE PARAMETERS

Enable		Allows the following Enable functions to be scrolled-through using the field scroll keys.
	Off	All alarm action inhibited
	Trigger	Initiates Jobs but does not annunciate. Suitable for remote control purposes such as updating the clock, re-setting totalisers etc.
	Unlatched	Alarm display and job actions are active as long as the alarm is active.
	Latched	Alarm display is active as long until the source returns to a non-alarm state AND the alarm has been acknowledged. Job actions continue until the alarm source returns to its non-active state, whether the alarm is acknowledged or not.
Type		Allows the following different types of alarm to be scrolled through using the field scroll keys:
Absolute	Set Point	For absolute alarms only. This is the trigger level, or threshold, at which the alarm becomes active. Entered using the numeric keys.
Deviation	Reference	This sets a central value about which the Deviation value (see immediately below) is to operate. Entered using the numeric keys.
	Deviation	This sets a range, either side of the reference value, inside which a 'deviation in' alarm is active, or outside which a 'deviation out' alarm is active (see figure 4.4.3b). Entered using the numeric keys.
Rate	Value	Allows a value (D) to be entered using the numeric keys. If the change in the channel value (ΔPV) over the time period specified (T) (see immediately below) exceeds D, the alarm becomes active.i.e if ΔPV/T >D the alarm is active. D is positive for rising ROC alarms; negative for falling. ΔPV must be in the appropriate direction to trigger the alarm.
	Time	Allows a time period (T) to be entered (using the field scroll keys) for use with the above Value. Scrollable values are: 1, 10, 30 and 60 seconds, and 10, 30 and 60 minutes.
	Average	Allows averaging periods of 1 to 9 seconds to be entered using the numeric keys. This allows the sensitivity of the rate-of-change alarms to be varied.
Digital	Active	Scrollable between the Open state and Closed state text strings as entered in page one of the range configuration (see section 4.4.2 above). If set to the open state, then the alarm is active with a high resistance input. If set to the closed state the alarm is active with a low resistance input.
	Dwell	Allows initiation of alarm action to be delayed by up to 2048 seconds after the alarm is detected. If the channel goes out of alarm within this period, the alarm is ignored.

SET PT SOFTKEY PAGE TWO PARAMETERS

Hysteresis	Allows 'deadband' areas to be entered (using numeric keys), for absolute and deviation alarms, to stop 'twitching' if the channel value is hovering around the setpoint. See figures 4.4.3a and 4.4.3b.
Dwell	Allows initiation of alarm actions to be delayed for up to 2048 seconds after the alarm is detected. If the channel goes out of alarm within the dwell period, the alarm is ignored.

4.4.3 CHANNEL CONFIGURATION: ALARMS (Cont.)

JOBS SOFTKEY

Each setpoint may have up to two jobs allocated to it (see section 4.1.4). Figure 4.4.3e shows some typical job pages. The job number is selected using page scroll keys.

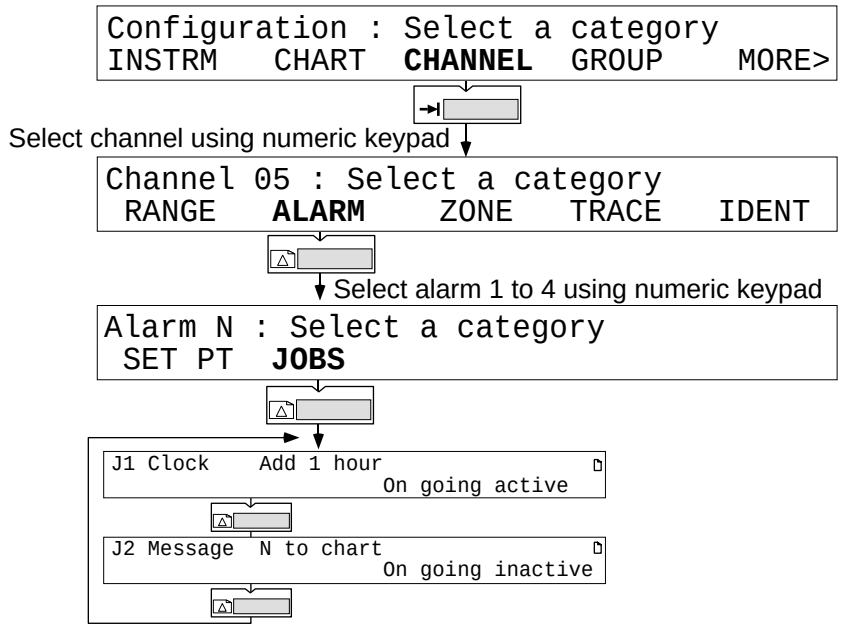


Figure 4.4.3e Typical Job pages

JOB PARAMETERS

Type	Allows a job category to be selected using the field scroll keys. Categories are: No action, Chart, Trace, Alarm, Message, Logging, Derived, Timer, Counter, Totaliser, Clock, Relay, Memory Card, assuming the relevant options are fitted.
Action	The actions that can be scrolled through (using the field scroll keys), depend on the category selected - see section 4.1.4.
Trigger	This field allows the trigger types to be scrolled-through using the field scroll keys. The types are: On going active; On going inactive; On acknowledgement; While active; While inactive, While unacknowledged.

4.4.4 Channel configuration: Zone

Zone configuration sets up the channel span, zone and scale, thus defining the location of the trace on the chart. Figure 4.4.4 shows the relevant display pages.

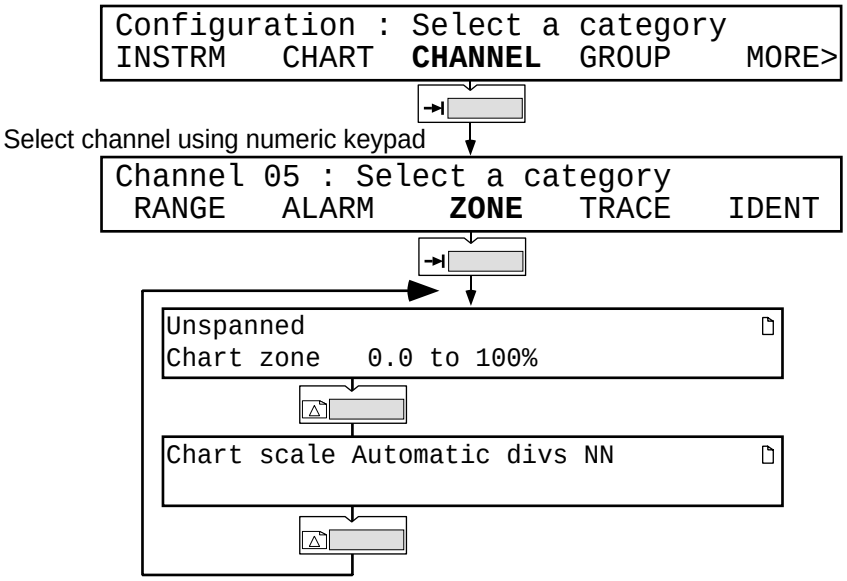


Figure 4.4.4 Channel configuration: Zone

ZONE PARAMETERS

Unspanned	Unspanned	Used when chart span is the same as the range / scale. Field scroll keys are used to scroll to Chart span.
	Chart span	Allows a chart zero and full scale to be entered that is different from the input zero and full scale. For example, the range 100 to 250 C may be traced on the chart out of an input range of say, 0 to 800 C, thus allowing an area of particular interest to be enlarged on the chart.
Chart zone		Allows the printing area of the chart to be defined in percentage terms. In this way, a particular trace can be restricted to a part of the chart which is clear of other traces.
Chart scale		Allows the user to define the format of the chart scale if the Annotator Option is fitted.
	Automatic divs	Defining automatic divisions 1 to 10 (numeric entry), allows the user to choose how many divisions of the scale are printed on the chart. Examples:Selecting '1', causes 'zero' and full scale values only to be printed. Selecting '4', causes 0, 25%, 50%, 75 and 100% of the span to be printed.
	Customised number N	Causes one of the two (selected by numeric entry keys) customised scales set up in the instrument configuration (section 4.2.1 (SCALES)) to be used by this channel. The portion which is used, of the customised scale, depends on the Zone.
	Off	Inhibits scale printing for this channel.

4.4.5 Channel configuration: Trace

Trace configuration allows the channel trace on the chart to be switched on or off and the trace colour for the channel to be defined. Figure 4.4.5 shows the relevant page. For channels being traced by the annotator pen (if fitted), interpolation can be set on or off as a part of Chart configuration - see section 4.3.

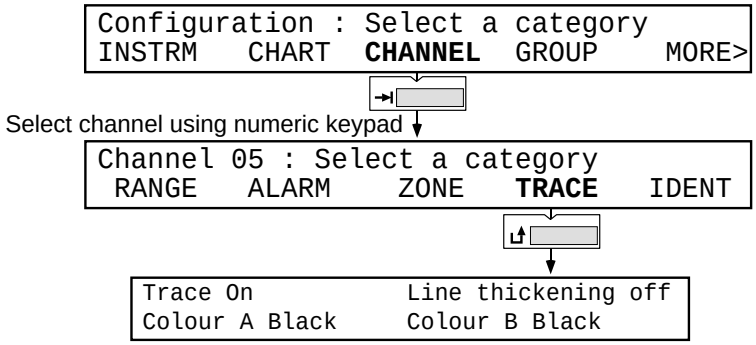


Figure 4.4.5 Channel configurtation: Trace

TRACE PARAMETERS

Trace	Allows the channel trace to be permanently ON, permanently OFF, or conditionally on or off as required by a 'job.' The field scroll keys are used to scroll through these choices.
Use AAA—AAA Pen	Allows Green, Red, Blue, Black or Annotator (if fitted) pen to be selected for the channel. One or more channels can be traced by the annotator pen, but if the same non-annotator pen is assigned to more than one channel, then that enabled channel which has the lowest number for that colour, will be traced.

4.4.6 Channel configuration: Ident

Ident configuration allows channel descriptors (20 characters maximum), and tags (7 characters maximum) to be entered using the cursor and field scroll keys. The descriptor is entered at page one; the tag at page two. The group configuration described below (Section 4.5) defines whether the descriptor or the tag is included in the PV display and printed on the chart in logs.

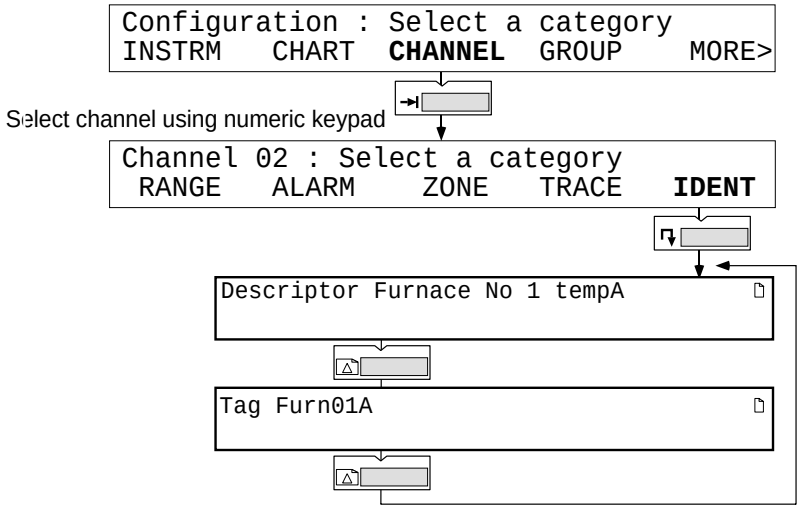


Figure 4.4.6 Channel configuration: Ident

4.5 GROUP CONFIGURATION

Channels (input and derived), totalisers and counters can be individually assigned to one or more 'groups'. For example, channels 1 to 3, 5 and 6 could be assigned to one group, and channels 5 to 8 and totaliser 6 could be assigned to another. This feature allows a number of otherwise unrelated process variables to be acted upon together (e.g. log channels 5 to 8 and totaliser 6 instead of log everything).

It is up to the operator to select (from the Operator menu - section 3.2.1) which of the 3 available groups is to be displayed/logged etc. Process variables not in the selected group are not displayed as a part of the normal scrolling sequence.

Each of the 3 groups can be given a name of up to 20 characters. At switch on, all channels are assigned to a group called 'Everything', which is why the display scrolls through every channel, totaliser and counter value in the recorder. The contents of the Everything group cannot be changed, so the lower line of the CONTENT page for this group has no softkey legends.

The NEXT and PREVIOUS softkeys are used to select the group to be modified.

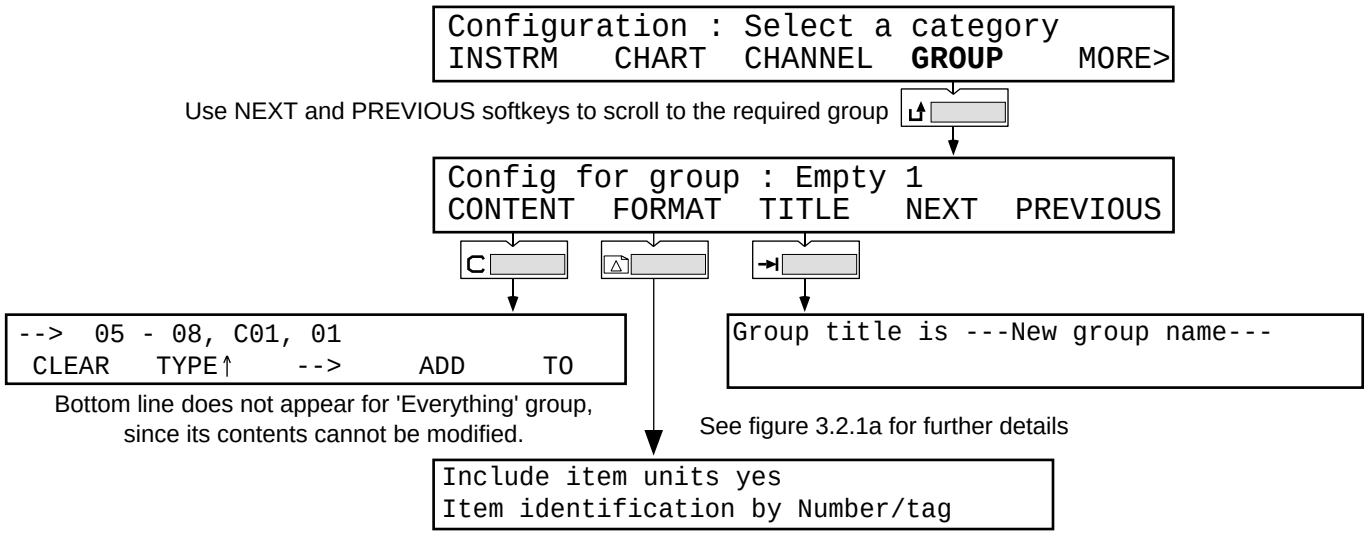
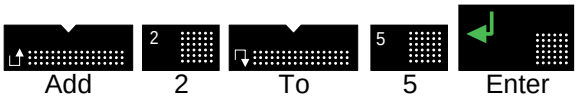


Figure 4.5 Group configuration

4.5.1 Group content parameters

CONTENT	CLEAR	Deletes the cursor item from the group contents.
	TYPE ↑	Operation of this key scrolls through the types of PV which can be part of a group i.e. D (Derived channel), T (Totaliser), C (counter) and measuring channel (no prefix) If no options are fitted, this key does not appear.
	ADD	Operation of this key causes a new entry (01) to be made. The numeric keys are used to enter the required number. The initial entry is a measuring channel. To change the entry to a derived channel, totaliser or counter, the TYPE ↑ softkey is used.
	TO	This key allows a range of inputs to be entered. For example, the keystrokes given below would enter measuring channels 2 to 5.



4.5.2 Group Format parameters

FORMAT	Include item units	Allows the channel units string to be added to the PV identification. For Units entry, see section 4.4.2 (Channel configuration: Range) above.
	Item identification by	Allows 'Number only', 'Number/Tag' or 'Number/Descriptor' to be scrolled-through using the field scroll keys. This defines how the group channels are identified in the logs, and at the display. For tag and descriptor entry, see section 4.4.6 (Channel configuration: Ident) above.

4.5.3 Group Ident parameters

TITLE	Group title is	Allows a title to be entered for the currently selected group. This title is up to 20 characters long, and is entered using the cursor and field scroll keys.

Notes:

1. The TO key can be used to toggle between 'from' and 'to' range limits.
2. Group items are scrolled-through in the order in which they are entered. To insert an item, the cursor is positioned below the item immediately to the left of where the new item is to appear, and the ADD softkey operated as usual. The new item is inserted to the right of the cursor.
3. A 'single' item can be changed to a range item by positioning the cursor below it and operating the TO key.
4. Multiple entries are allowed. This can be used for example, to ensure that a particular derived channel (e.g. Group Average) always appears at the bottom line of the display (in 2-line mode), by entering the derived channel as every other item in the group.

4.6 INTERNAL EVENT CONFIGURATION

Six internal events are configurable, and each event allows up to two jobs to be initiated as the result of single source or as combinations of sources as described below. Source types include both channel alarms and system errors.

It should be noted that, although only two sources can be combined for any one event, events themselves can be sources for other events, allowing multiple AND / OR functions to be carried out.

EXAMPLE

The buzzer is to be sounded if channel 1 or 5 or 8 is in alarm, and to continue to buzz whilst the alarm is active. To achieve this, Event 1, say, can OR 'Channel 1 in alarm' and 'Channel 5 in alarm' sources. Event 2 can then OR Event 1 and 'Channel 8 in alarm' sources to sound the buzzer if any of the three sources goes active.

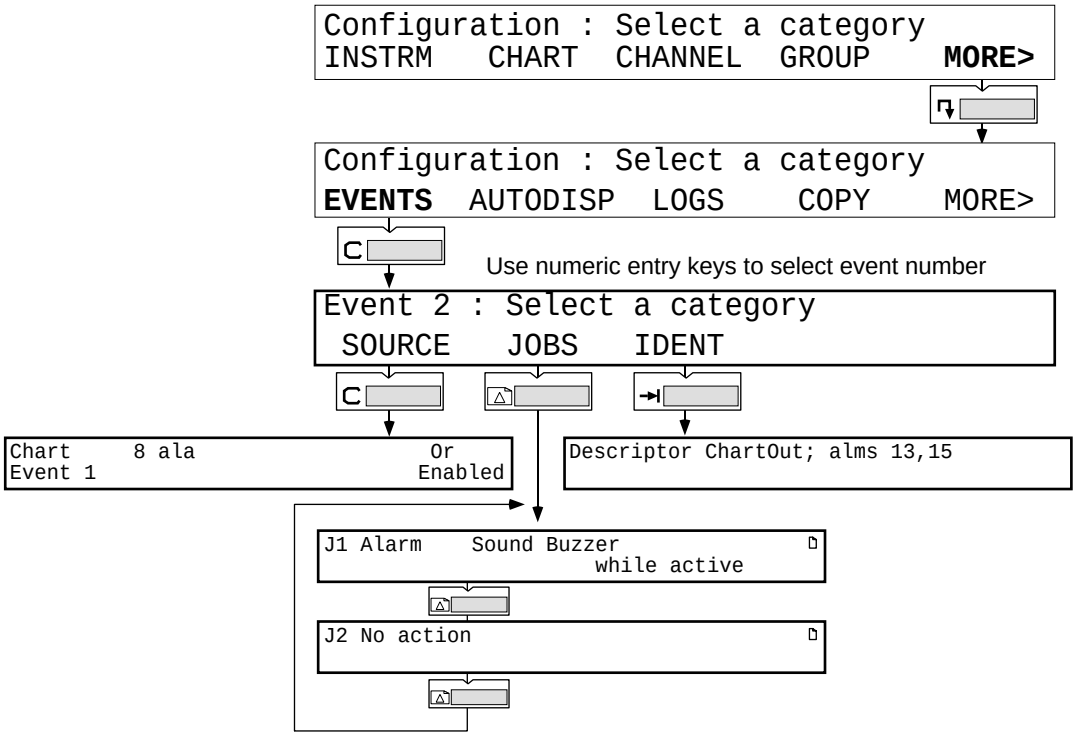


Figure 4.6 Event configuration: Typical pages

4.6 INTERNAL EVENT CONFIGURATION (Cont.)

4.6.1 Event source parameters

SOURCE		Allows the event sources to be scrolled through using the Field Scroll keys. The event sources available are:
	System error	Active if any of the following instrument alarms are active: Writing system failure, Battery pack low, Clock hardware failure, Input channel failure, Invalid remote cold junction temperature, EEPROM failure, battery-backed RAM failure, cycle time exceeded, memory card battery is low or exhausted.
	Writing system failure	Active if a failure in the chart drive or pen drives is detected.
	Battery low	Active when the RAM battery voltage drops below a safe voltage.
	Clock h/w failure	Active if the clock circuit fails.
	Power up	Triggers at initialisation.Manual keyThe operator soft keys can act as event sources. The field scroll keys are used to scroll through the available softkeys.
	Specific i/p channel failure	Active if a failure in a specified input channel is detected.
	Specific totaliser alarm	Active if a specified totaliser's alarm is active
	Group totaliser alarm	Active if any totaliser alarm is active in a specified group.
	Specific counter alarm	Active if a specified counter's alarm is active
	Group counter alarm	Active if any counter alarm is active in a specified group.
	Invalid remote cj temp	Active if a failure in the remote CJ sensing circuit is detected.
	Timer output	Allows one or more timers to be defined as event sources.
	Event	Allows one or more other events to be used as sources.
	Unack'ed group alarm	Allows any channel alarm in a specified group to act as an event source until the alarm is acknowledged.
	Channel alarm	Allows an alarm on a specific channel to be used as an event input.
	Channel alarm on group	Allows a group to be specified (field scroll). Any active alarm within this group will then act as an event source.
	Memory card battery	Active if memory card battery is low or exhausted.

4.6.2 Event Job parameters

JOBS	Type	Allows a job category to be selected using the field scroll keys.Categories are: No action, Clock, Derived, Totaliser, Counter, Timer, Logging, Message, Alarm, Trace, Chart, assuming the relevant options are fitted.
	Action	The actions that can be scrolled through (using the field scroll keys), depend on the category selected - see section 4.1.4.
	Trigger	This field allows the trigger types to be scrolled-through using the field scroll keys. The types are: On going active; On going inactive; On acknowledgement; While active; While inactive; While unacknowledged.

4.6.3 Event Ident

IDENT	Allows a 20-character descriptor to be entered for the event.

4.7 AUTODISPLAY CONFIGURATION

This function allows the four items which are to appear on the auto display page to be defined. See section 3.2.1 of this manual for further details of autodisplay. The figure below shows a typical configuration. The ± key can be used to toggle between 'input' and 'derived' channels.

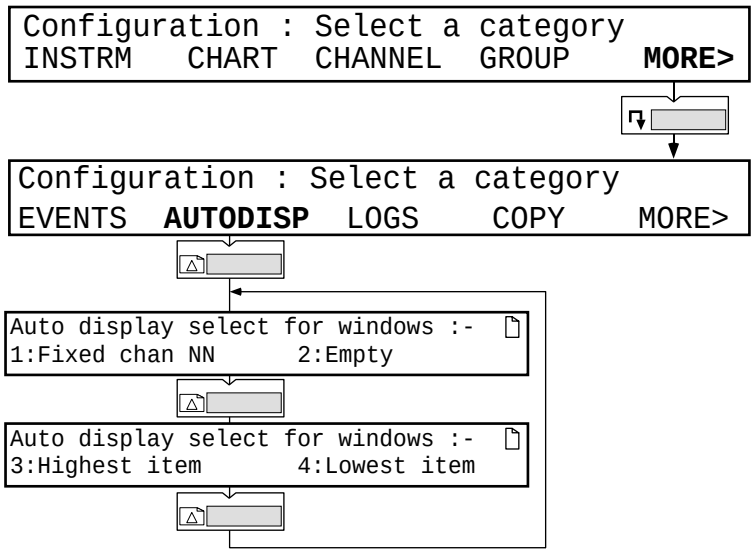


Figure 4.7 Autodisplay configuration

For each window location (1, 2, 3, 4) the field scroll keys can be used to scroll through: Empty, Fixed channel (numeric entry of channel number); Highest item (of currently selected group); Lowest item (of currently selected group). Where 'highest' or 'lowest' are selected, these always look at the current group, and will change if a new group is selected by the operator. Up to four highest or lowest channels can be selected in any combination. For example if 'highest' is selected for windows 1, 3 and 4, and 'lowest' in window 2, then the three channels with the highest values in the group will be displayed in windows 1, 3 and 4, and the channel with the lowest value in the group will appear at window 2.

4.8 LOG CONFIGURATION

Allows specific Groups to be associated with each log if Annotator or Memory Card Option fitted. Use the field scroll keys to select NN (01 to 03)

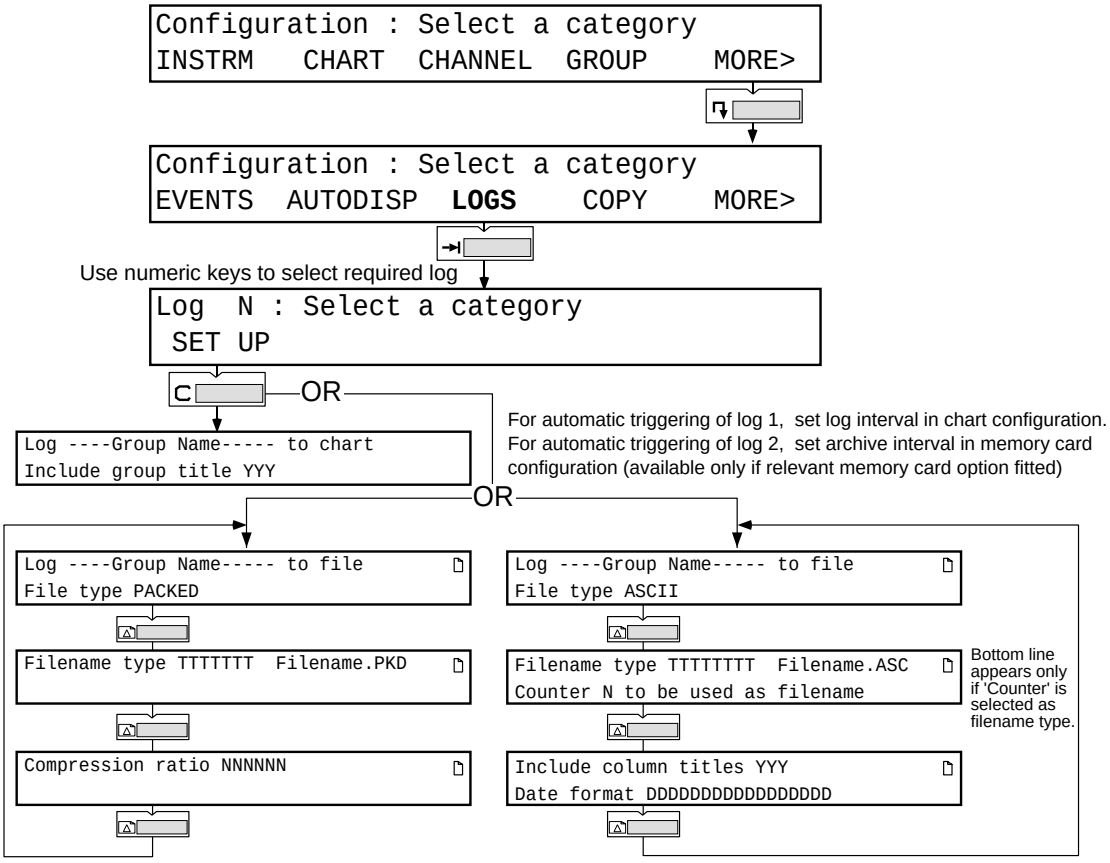


Figure 4.8 Log configuration

4.8.1 Log Parameters

Group name		The field scroll keys are used to scroll through the groups.
→ chart		The group is logged to chart.
	Include group title	The field scroll keys are used to scroll through ‘yes’ and ‘no’, to select whether the group name is to be included in the log.
→ file		If the PACKED data logging option is fitted, the field scroll keys are used to select PACKED or ASCII as log type. If ASCII data logging option is fitted, only ASCII is available. If neither option is fitted, the ‘to file’ menu item does not appear and the ‘to chart’ item is not editable. For full details of the PACKED and ASCII parameters refer to the Memory Card manual.
	PACKED	Filename type. Use the field scroll keys to scroll through text, hourly, daily or counter. Compression ratio. Use the field scroll keys to scroll between ‘Normal’ or ‘High’.
	ASCII	Filename type. Use the field scroll keys to scroll through ‘text’, hourly, daily or ‘counter’. Include column titles Use the field scroll keys to scroll between ‘Yes’ or ‘No’. Date format Use the field scroll keys to scroll through ‘Spreadsheet’, ‘Integer’ or DD/MM/YY,HH:MM:SS.

4.9 COPY CONFIGURATION

This facility allows the copying of Measuring channel range and zone information, Alarm configuration (including jobs), and (if the maths pack option is fitted) derived channel function and zone information. See secion 2 for a user guide.

Once the relevant sources have been selected, operation of the ENTER key initiates the copy process. During copying, a 'Please Wait' message is displayed. When copying is complete, the display returns to the previous channel, alarm or maths copy page.

Notes:

1. When copying alarm configuration, input channels can be copied only to other input channels, and derived channels can be copied only to other derived channels. The bottom line of the display always repeats the selection (input or derived) made in the top line.
2. If, during copying of range/zone, the input type is to be changed to digital the alarm type defaults to OFF, Digital, Dwell 0 sec. If the input type is to be changed from digital to analogue, the alarm type defaults to OFF, Absolute high, Setpoint 10.00.
3. If an attempt is made to copy an alarm / job configuration, where the source and destination input types are different (i.e. one digital and the other analogue), the copy will not be carried out, in order to avoid conflict between input type and alarm type.
4. 16-channel boards will not accept RTD or Ohms as input type; 'dig' as input type to channels 1, 8 or 16; input break drive lo(w).

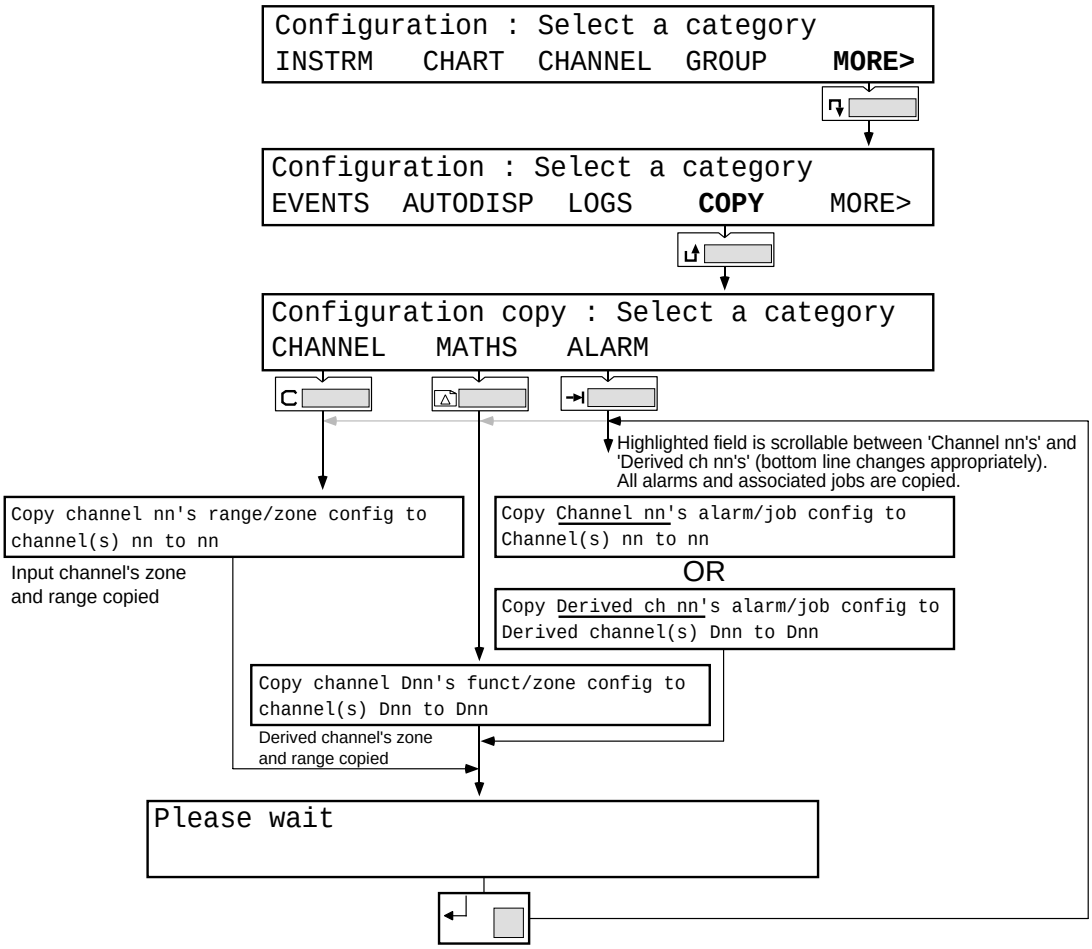


Figure 4.9 Copy Configuration

4.10 OPTIONS

For details of Maths pack levels 1 and 2, Totalisers, Counters and Timers, see section 5 of this manual. For details of the Memory card option refer to the Memory Card Instruction Manual; for details of the Serial Communications option, refer to the Serial Communications Manual.

4.11 TRANSFER CONFIGURATION

This feature is intended to allow the transfer of configuration between recorders, using the nine-way connector located on the inside of the recorder door, to the right of the chart illumination tube. It is also possible to use this port for configuration save and restore with a host computer*, provided that the host will accept logic levels (0 and 5V) at its RS232 serial link input and that it does not require hardware handshake. Section 1.6 shows wiring details.

If 5 Volt logic levels are not acceptable, use of the communications option is recommended. This allows not only the transfer functions described here, but also full configuration and monitoring of a number of recorders over the serial link. The communications option is connected at the rear of the recorder.

CAUTION

The transfer function can be used to transfer a configuration to a 'Destination' recorder. The existing configuration of the destination recorder is overwritten. Ensure that the transfer is carried out in the correct direction to avoid overwriting the Source recorder's configuration.

Note: When transferring configuration, any adjustments made in the Adjust area of the source recorder's configuration (Section 4.14 of this manual) are lost - only the default values are transferred.

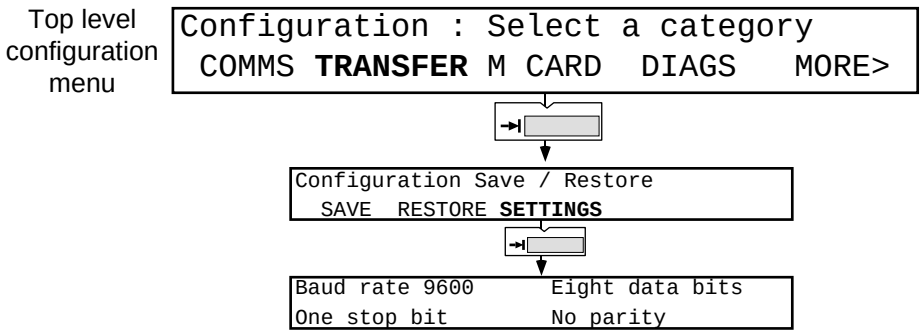


Figure 4.11 Configuration-transfer configuration

4.11.1 Transfer configuration parameters

TRANSFER		Calls the configuration transfer page to the display. Before initiating transfer, ensure that a suitable cable is fitted between the recorder and the other device. See figure 1.6
	SAVE *	Initiates an XMODEM transfer of the recorder configuration via the 9-way D-type port located beside the chart illumination tube on the inside of the door. This can be used to copy configuration to another 'destination' recorder (previously set to RESTORE), or to store the recorder's configuration in any device capable of XMODEM file transfer.
	RESTORE*	Allows a configuration to be loaded from a source recorder (set to SAVE) or from a PC or other configuration terminal.
	SETTINGS	Allows the field scroll keys to be used to set the Baud rate to 19,200, 9,600, 4,800, 2,400, 1,200, 600, 300 or 110 (must be the same at both devices). The other settings are fixed, as depicted in figure 4.11 above.

* A PC configuration tool is available from the recorder manufacturer.

4.12 DIAGNOSTICS

As shown in figure 4.12, operation of the DIAGS softkey calls the first of the diagnostics pages to the display. The following notes are intended to clarify the the information contained in the figure.

4.12.1 SBC

This softkey allows the operator to view details of the Controller board.

4.12.2 BOARD

Operation of this softkey calls board information for the board at address 1 to the display. The information is: Board type, Serial number and software version number. Board information for other addresses can be accessed by use of the page scroll keys.

4.12.3 PENS

When a continuous pen is selected for test (by operating the relevant softkey), the pen ramps continuously from zero to full scale and then back again, taking 1 minute in each direction. This shows whether the pen servo is working correctly or not. Once all required pens have been checked, Cancel (X) or Home keys cancel the test. When the annotator is selected for test, it prints line after line of TgTgTg continuously across the width of the chart, to demonstrate that the print density is the same across the chart. Cancel (X) or Home, cancels the test.Whilst any one pen is on test, the remaining pens are ‘parked’ at the left edge of the chart.

4.12.4 RELAYS

Operation of this softkey causes a display of relay status for the relay board (if any fitted) with the lowest address. Status is shown as E (Not in alarm state) or D (In alarm state). Relays can be toggled between E (Energised) and D (De-energised) using the page keys. Other relay boards can be accessed using the page-scroll key.

4.12.5 OUTPUT

Allows two analogue output channels to be exercised so that their actual outputs can be compared with their required outputs. All other channels are set to their 'on error' status (section 4.4.2 - output channels).

```
Output     n ±DDDDD.DD UUUUU ±dd.dd uu
for card N n ±DDDDD.DD UUUUU ±dd.dd uu
```

N	Slot number	Initially, the lowest slot number containing an analogue output (AO) board. When all the channels of this board have been scrolled through (Page keys) the next slot with an AO board fitted will appear. When all AO channels have been scrolled through, the first AO board is returned to.
n	Channel number	Pairs of channels are scrolled through using the Page keys .
±DDDDD.DD	Control value	User entered control value in engineering (UUUUU) units.
UUUUU	Engineering units	The engineering units in which the channel is configured.
±dd.dd	Actual value	The output value in Volts or mA (uu) as configured.
uu	Actual units	The output type (V or mA) as configured.

The only user accessible fields are the ±DDDD.DD fields which can be accessed using the cursor keys.

Notes:
1 All AO channels except the two on display are set to their 'On error' value
2 The message 'No analogue outputs configured' appears if no AO channels have been configured.

4.12 DIAGNOSTICS (Cont.)

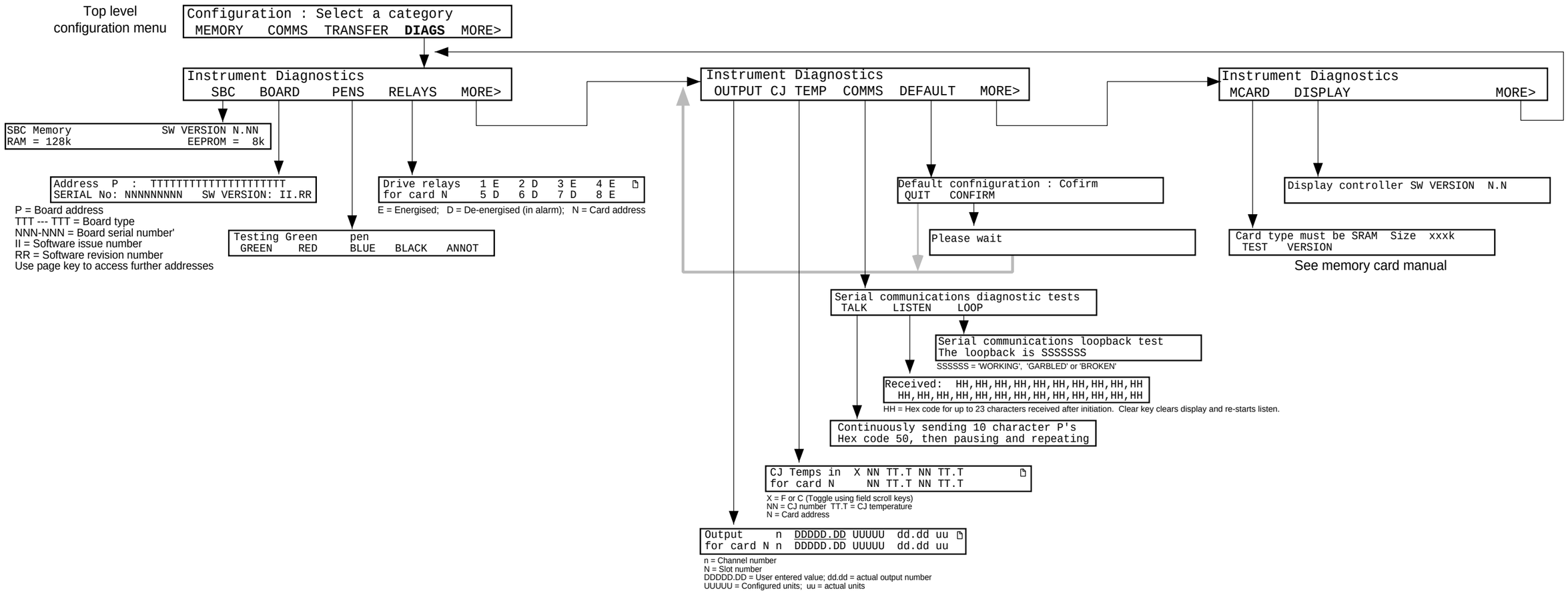


Figure 4.12 Diagnostics menu organisation

4.12 DIAGNOSTICS (Cont)

4.12.6 CJ TEMP

Shows the temperatures being measured by the cold junctions associated with the first relevant I/O board address. The field scroll keys can be used to toggle between Fahrenheit and Celsius. Further boards are accessed by using the field scroll keys.

4.12.7 COMMS

Operation of this softkey calls a further 'softkey page' allowing the user to send or receive data, and to check that the communications line is working correctly. **The communications tests are all run with the following parameters set: Baud rate = 9600; Data bits = 8; Stop bits = 1; Parity = None.**

TALK

Operation of this softkey causes a string of ten characters P (hex 50) to be transmitted, followed by a pause, then a further 10 characters P.

LISTEN

Operation of this softkey causes the next 23 transmitted characters to be displayed. Operation of the Clear key clears the display before the next 23 characters are displayed.

LOOP BACK

BEFORE INITIATING THIS TEST, THE Tx AND Rx CONNECTIONS SHOULD BE SHORTED TOGETHER AT SOME POINT IN THE TRANSMISSION LINE.

Operation of this softkey calls the loopback test page, showing that up to the point at which Rx and Tx are shorted, the link is working correctly (WORKING), working incorrectly (GARBLED) or not working at all (BROKEN).

4.12.8 DEFAULT

Operation of this softkey, followed by operation of the CONFIRM softkey, causes the factory configuration to be written to the recorder's data base.

This operation over-writes any customer-entered configuration data.

4.12.9 MEMORY CARD

TEST

Allows testing of the memory card and the memoryy card controller if the option is fitted.

VERSION

Operation of this softkey displays the version number of the card controller software.

4.13 AUTOCONFIGURATION

When triggered, the auto-configuration facility causes the recorder to determine whether any I/O boards, pen trays, options etc. have been added or deleted, and changes the configuration as appropriate. The validity of data is checked, and if any area of the configuration is no longer valid, it re-configures it to a default state.

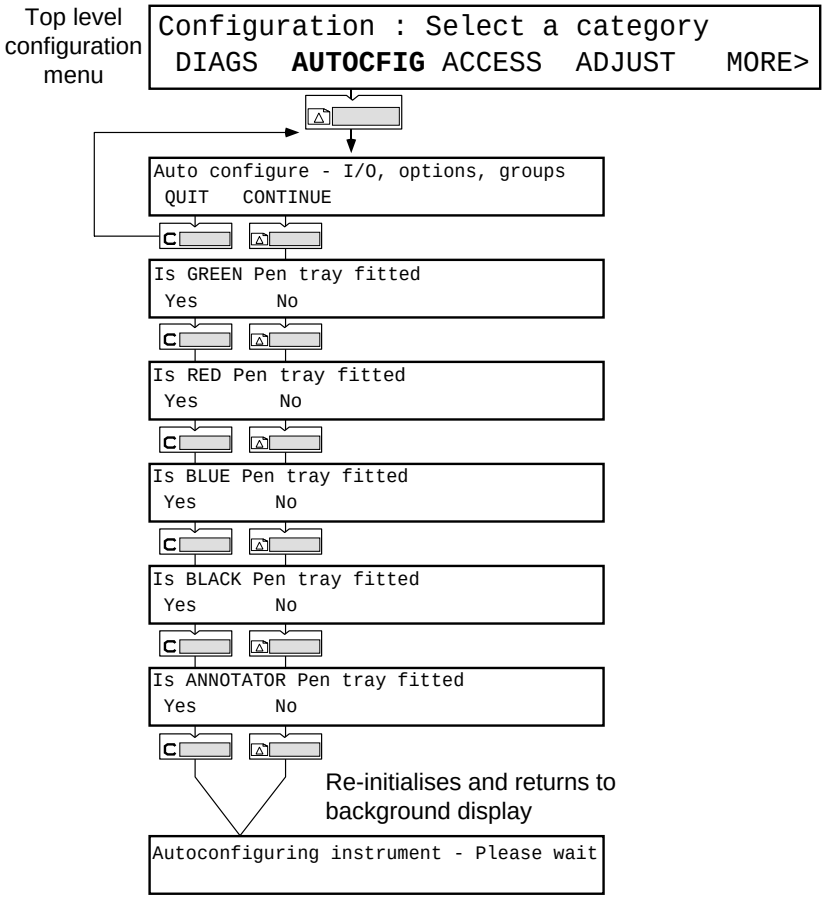


Figure 4.13 Autoconfig configuration

4.14 OPERATOR ACCESS CONFIGURATION

This section shows how certain parts of the recorder's configuration, normally accessible via the Operator's menu, can be made inaccessible, and *vice-versa*. Operation of the calls the first of the access category pages. Figure 4.14 shows the complete menu, allowing the items listed in table 4.14, below, to be toggled between Operator accessible (yes) and 'Not available' (no).

Chart	Speed A to Speed B (yes) Log interval A to Log interval B (yes) Mode A to Mode B (no) Printer on/off line (yes)
Channel	Alarm setpoints (no)
Group	Select specified group for display (yes)
Log	Initiate logging of specified log (yes)
Maths	Reset derived channels (no)) Alarm setpoints (no)Set memory card off line (no)

Counters	Preset counter (no)
Totalisers	Preset totaliser (no)
Timers	Control timers (no)
Memory Card	. Format card (no) Save / Restore configuration (no) Display status / directory (no) Delete files (no) Select archive interval B (no) Set memory card off line (no)

Table 4.14 Operator access parameters

4.14 OPERATOR ACCESS (Cont.)

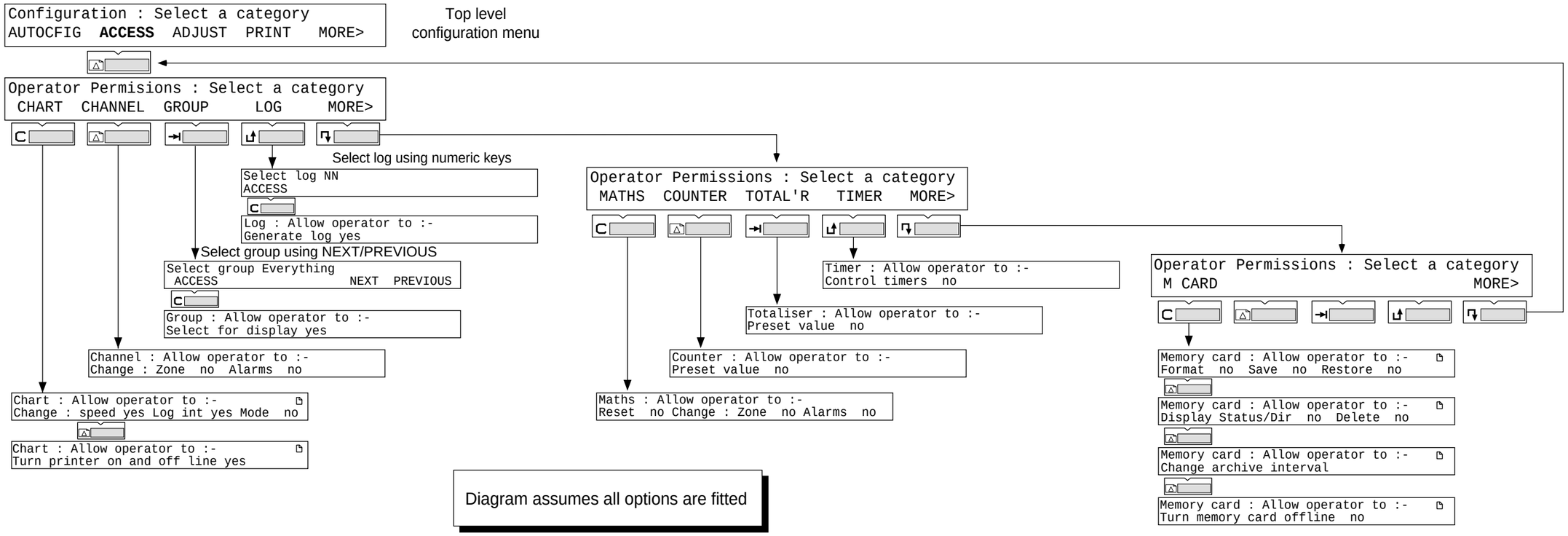


Figure 4.14 Operator access configuration

4.15 ADJUST

This section describes how the input channel can be adjusted to compensate for sensor tolerance errors, how to align the pens with the chart calibration marks, and how to calibrate input channels. The adjustments are in four subsections: Input, Output, Chart (Pen adjust), and Calibration

Note: Any changes made in this Adjust area of configuration are lost during configuation transfer (section 4.10)

4.15.1 INPUT ADJUST

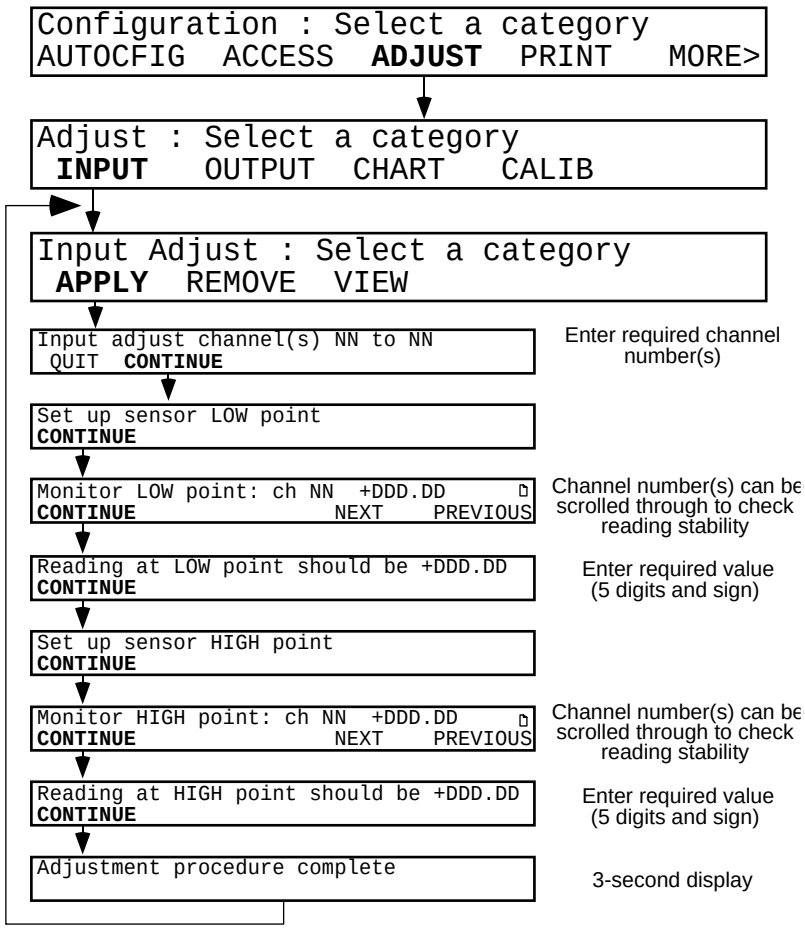


Figure 4.15.1 Channel input adjust menu

To adjust one or more channels, the prompts are followed as shown in figure 4.15.1 above. Numbers of channels to be adjusted and required values are entered using the numeric keypad. The monitor pages can be used for scrolling through the channels to ensure that the readings are all steady before adjustment is applied.

4.15.1 INPUT ADJUST (Cont.)

REMOVE

Note: It is possible to disable input adjustment, using the 'VIEW' page described below.

In order to remove any adjustment, the REMOVE softkey is operated to call the first 'remove' page:

```
Remove input adjust for ch(s) NN to NN
 QUIT    CONFIRM   -->
```

Operation of the CONFIRM softkey causes a return to the 'INPUT, OUTPUT, CHART, CALIB' page, via a 'fleeting' display page: 'Adjustment removal complete', which displays for three seconds.

VIEW

Operation of the VIEW softkey will call one of the two pages depicted below:

```
NN DDDDDDDDDDDDDDDDDDD unadjusted
```

```
NN DDDDDDDDDDDDDDDDDDD adjusted
Use adjustment YYY
```

In both cases, NN is the channel number, and DDD—DDD is the channel descriptor. The page scroll key can be used to scroll through the channel numbers.

The 'Use adjustment' field can be used to disable the adjustment, when set to 'no'. Use adjustment is set to 'Yes' as a default.

4.15.2 Output adjust

This allows the range of the analogue output to be adjusted to account for tolerance errors in external equipment. The technique used is:

1 To specify a low point, and then after a stabilisation time, to enter the value which is read by the external equipment.

2. To repeat the above for a high point.

The ouitput board then calculates newoffsets and gains for the channel.

Notes:

1. The CLEAR key is used to set the DDDDD.DD value to zero.
2. Adjust REMOVE and VIEW operate in a similar way to that described for input channels above.
3. Adjust is not available for channels with 'Constant' as their input source.

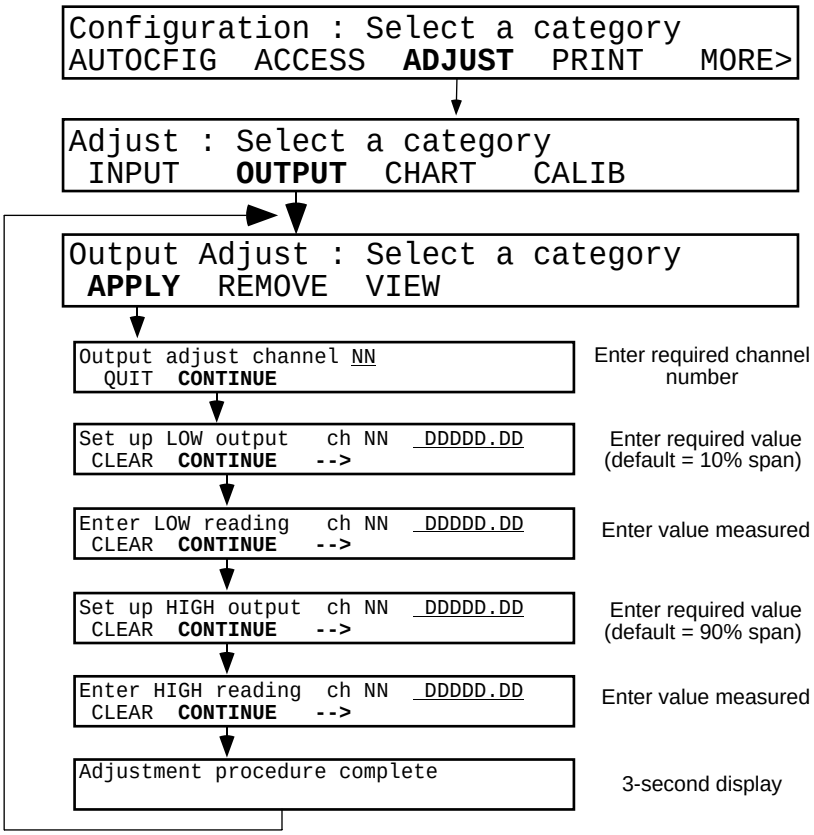


Figure 4.15.2 Output channel adjust menu

4.15.3 Pen adjust

Operation of the CHART softkey causes the recorder to go into pen-setting mode. All the pens except the green pen are driven to chart centre, whilst the green pen is driven to where it believes chart zero to be. The user can now use the <<ZERO and ZERO>> softkeys to adjust the pen zero position to chart zero if necessary.

Operation of the PAGE softkey calls the Green span-setting page to the display, and causes the green pen to be driven to where it believes the chart 100% position to be. The user can now adjust the pen to the chart by using the <<SPAN and SPAN>> softkeys.

Operation of the PAGE softkey calls the next pen, and the process is repeated until all the pens have been adjusted. Operation of the ENTER key saves the new pen zero and span positions into the recorder's data base.

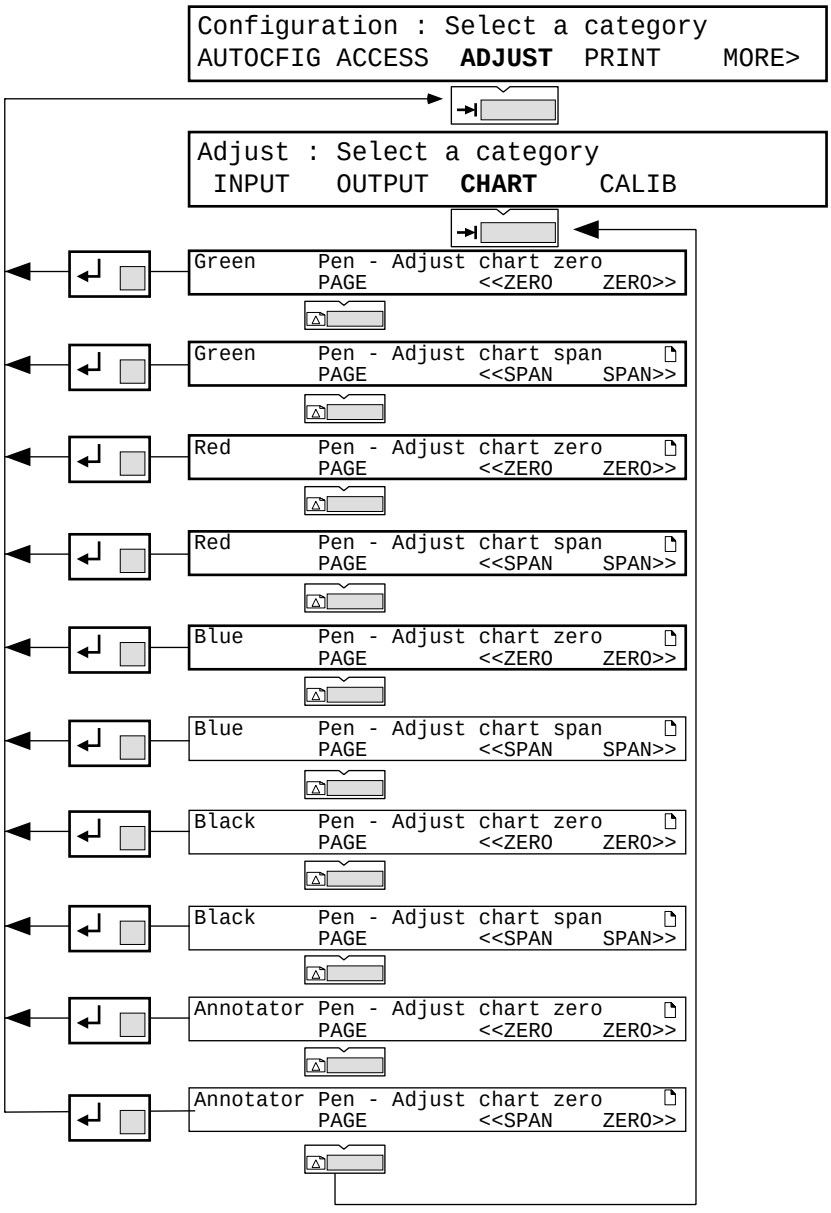


Figure 4.15.3 Chart calibration pages

4.15.4 CALIB Softkey

This feature allows the user to calibrate 8-channel universal input board channels to his or her own requirements. **The facility is not available for the 16-channel dc input board.** It is recommended that for maximum accuracy, the Input calibration be carried out before the Cold Junction calibration.

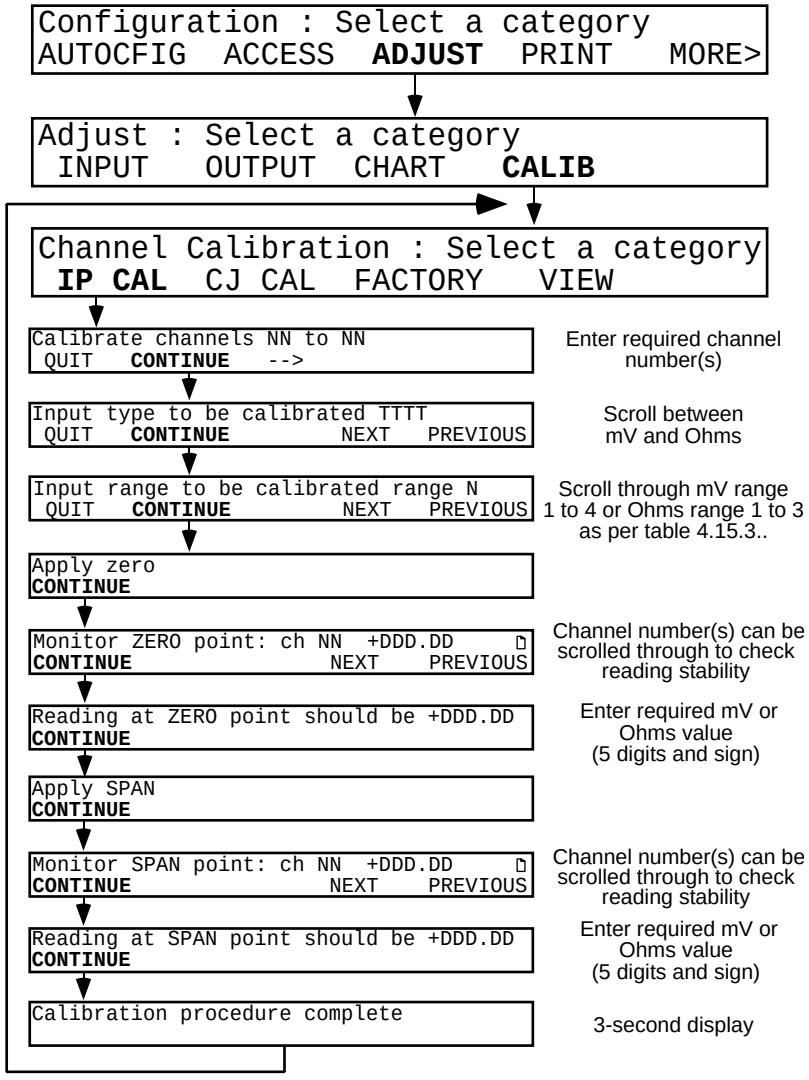


Figure 4.15.4 Input channel calibration menu

The input ranges (range N) above, are given in table 4.15.4 below. The user must choose the lowest possible of the available ranges which will suit the application.

Range number	mV ranges	Ohms ranges
1	0 to 49 mV	0 to 180Ω
2	0 to 200 mV	0 to 1,800Ω
3	0 to 1,000mV	0 to 10,000Ω
4	0 to 10,000mV	N.A.

Table 4.15.4 Input ranges

4.15.4 CALIB SOFTKEY (Cont.)

CJC CALIBRATION

Before this procedure can be carried out it is necessary to connect a thermocouple, (or thermocouple simulator) of a known type, held at a known reference temperature, to each of the input channels to be calibrated. The channels must then be configured for that type of thermocouple, and have 'internal' set as their cold junction compensation type.

Operation of the CJ CAL softkey calls the first Cold Junction calibration page to the display:

```
Calibrate cj(s) for channel(s) NN to NN
 QUIT   CONTINUE   —>
```

The relevant channel number(s) are entered using the numeric keys. 'CONTINUE' calls the next page:

```
Apply reference temperature
 QUIT   CONTINUE
```

Continue calls the next page:

```
Monitoring reference : ch NN   +DD.DDD
 CONTINUE                NEXT  PREVIOUS
```

The page scroll keys can be used to scroll through the selected channels to ensure that they are all stable, before the adjustment is applied. Continue calls the next page:

```
Reference temperature is TT.T
 CONTINUE
```

The known reference temperature (TT.T°C) is entered using the numeric keys. CONTINUE initiates the calibration procedure.

```
CJ calibration procedure complete

```

RESTORE FACTORY CALIBRATION

Operation of the FACTORY softkey calls the 'Use factory cal' page to the display. The relevant channel numbers are entered using the numeric keys.

```
Use factory cal for channel(s) NN to NN
 QUIT    CONFIRM   —>
```

Operation of CONFIRM returns the relevant channel(s) (including CJs) to factory calibration. A 'fleeting' display (Return to factory cal procedure complete) appears for three seconds.

VIEW

Operation of the VIEW softkey allows each channel to be scrolled through, to determine whether factory or field calibrations are in use for input and cold junction compensation.

```
NN DDDDDDDDDDDDDDDDDDDD cal being used
Input : FFFFFFF  Cold junction : FFFFFFF
```

where NN is the channel number, DDD — DDD is the channel descriptor and FFFFFFF is either 'Factory' or 'Field' as appropriate. The page scroll keys can be used to view other channels.

4.16 PRINT CONFIGURATION

This allows the instrument configuration to be output to the chart if the annotator option is fitted.

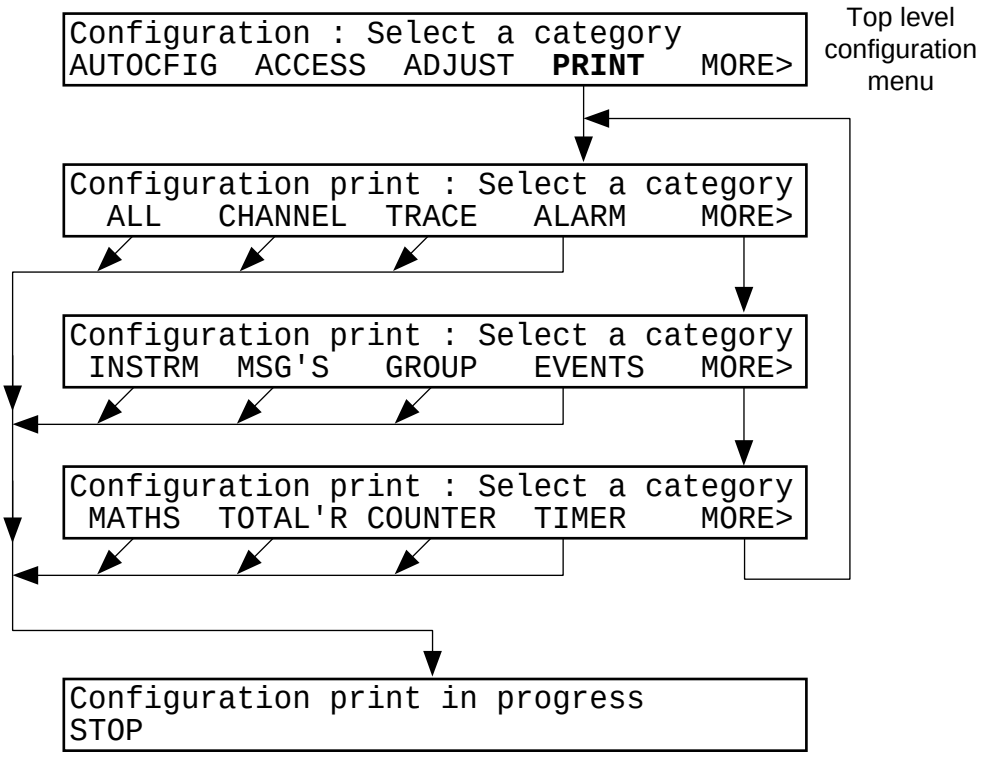


Figure 4.16 Configuration print

Note: Operation of the 'ALL' softkey causes a full configuration print. Operation of any other softkey causes only that section to be printed.

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SECTION 5 OPTIONS

LIST OF CONTENTS

SECTION 5: OPTIONS

This section contains details of the software options: Maths pack and Timers, Counters and Totalisers.

The various Annotator option functions are described as and when they arise in the Operation and configuration sections above.

The Pen Shift Compensation option is described in the 'Chart Configuration' section (section 4.3) The option can be combined with any of the maths pack, counters timers etc. options described below.

The Communications option is fully described in the Serial Communications Option Manual

Details of the memory card options are to be found in the Memory Card Instruction Manual

5.1 OPTIONS AVAILABLE

5.1.1 Maths pack options

Two levels of maths pack are available, called level one and level two, both of which are fully described in section 5.3. Both options support a further eight channels called 'Derived' channels. These Derived channels are similar to normal input channels but their inputs are other channels (input or derived) rather than direct inputs from outside the recorder. The mathematical funtions associated with the two options are given below, the level two funtions being additional to the level one functions.

When displayed or traced, Derived channel numbers are always preceded by the prefix 'D'.

When displayed or logged, derived channel values are either up to seven digits long (with configurable decimal position) or are given in scientific notation (D.DDD±ee) as defined in the channel's configuration.

The Pen Shift Compensation Option can be combined with either of the maths pack options.

Level 1 & 2 functions	Level 2 unique functions			
Constant	Square root	Log_e	Latching maximum	Zirconia probe
Copy	Channel average	Rate-of-change	Continuous maximum	Switch
Add	Group average	Sample and hold	Polynomial	High select
Subtract	Rolling average	Channel minimum	Relative humidity	Low select
Multiply	Exponent	Latching minimum	FVALUE	Stop watch
Divide	Log_e	Continuous minimum	Linear mass flow	Time stamp
Modulus	10^x	Channel maximum	Square root mass flow	

Table 5.1.1 Maths pack fiunctions

5.1.2 Totalisers, counters and timers

This option supplies six each of timers, counters and totalisers. The option may be combined with the Pen Shift Compensation option.

TOTALISERS

Totalisers integrate input or derived channels to calculate, for example, total flow from a flow rate input. High and low cutoffs can be defined, and each totaliser can be configured to count up or down. A threshold can be set up to initiate jobs in the same way as for channel alarms. If access is enabled (section 4.14), the operator can view and preset totalisers without password entry. Totalisers are displayed as 7 or 8-character values as defined in the configuration. Full details are to be found later in section 5.4.

COUNTERS

Counters are incremented or decremented as a result of job action and are used to count such things as alarms, contact closures etc. If access is enabled (section 4.14), the operator can preset the value of each counter and a threshold can be set up to initiate jobs in the same way as for channel alarms. Totalisers are displayed as 7 or 8-character values as defined in the configuration. Full details are to be found later in section 5.5.

TIMERS

Timers allow the recorder real-time clock to initiate up to four 'jobs'. If access is enabled (section 4.14), the operator can start and reset timers without password entry. Timer status (e.g. time remaining) can be displayed by the operator. Full details are to be found in section 5.6.

5.2 INSTALLING SOFTWARE OPTIONS

New software options are fitted by inserting an 'Option Key' into the control board at the rear of the writing system as shown in the diagram below. The new key can be fitted into any of the three locations. Once fitted, the 'Autoconfigure' facility (section 4.13) should be used to include the option in the data base.

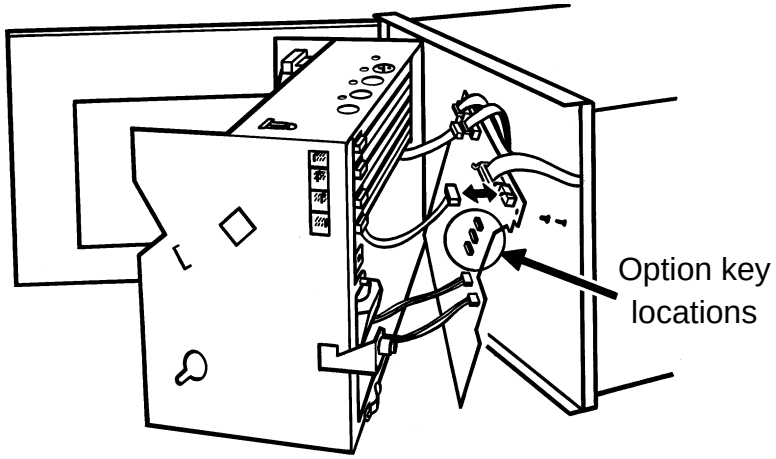

Figure 5.2 Option key location

5.3 MATHS PACK OPTIONS

5.3.1 Introduction

The maths pack option is available in two versions called level 1 and level 2, both of which support eight derived channels which are identified as D1 to D8. As described below, level 1 contains basic arithmetic functions, and level 2 contains more complex equations in addition to the level 1 functions.

When entering source channels, operation of the ± key will toggle between input and derived channels.

Derived channels are similar in configuration to measuring channels, and share the following parameters.

Channel units	Five-character user definable string
Zone	Span, scale and print zone as for measuring channels
Trace	On, off or conditionally-on as for measuring channels
Colour	Colour selectable as for measuring channels
Descriptor	20-character descriptor as for measuring channels
Tag	Seven-character tag as for measuring channels
Alarms	Types, setpoints, hysteresis etc as for measuring channels, though derived channel alarms and measuring channel alarms are not mixed on the Operator's alarm overview page; Derived channel alarms appear as a separate list, after measuring channel alarms.
Jobs	Type and actions etc as for measuring channels

Maths pack unique parameters are as follows:-

Value format	Each derived variable and associated parameters can be displayed in the following ways: Five digits with configurable decimal point position Seven digits with configurable decimal point position Eight digit integer (no decimal places). Scientific (X.XXX+ee) e.g. 12324 would be expressed as 1.232+04; 0.000012324 would be expressed as 1.232-05.

In addition, the following time/date formats are available:

Time as HH:MM:SS (Time part of Time Stamp function).
Date as DD/MM/YY or MM/DD/YY (Date part of Time Stamp function). Date format is specified as a part of 'Chart' configuration.
Elapsed time as HH:MM:SS. If the period is 100 hours or more, the format changes to HHHHH:MM.

Group reset enable	Allows the derived channel value to be reset as a part of a group reset.

5.3.2 Configuration

Figure 5.3.2 shows the configuration pages for the FUNCT softkey. After the FUNCT softkey has been operated, the function type is selected using the field scroll keys. Operation of the page scroll key results in the relevant configuration page for that function to appear. After all the necessary sources have been defined, the page scroll key is again operated to call the 'Group reset and value format' page to the display.

Alarm, Zone, Trace and Ident configuration are the same as for measuring channels.

5.3.2 MATHS PACK CONFIGURATION (Cont.)

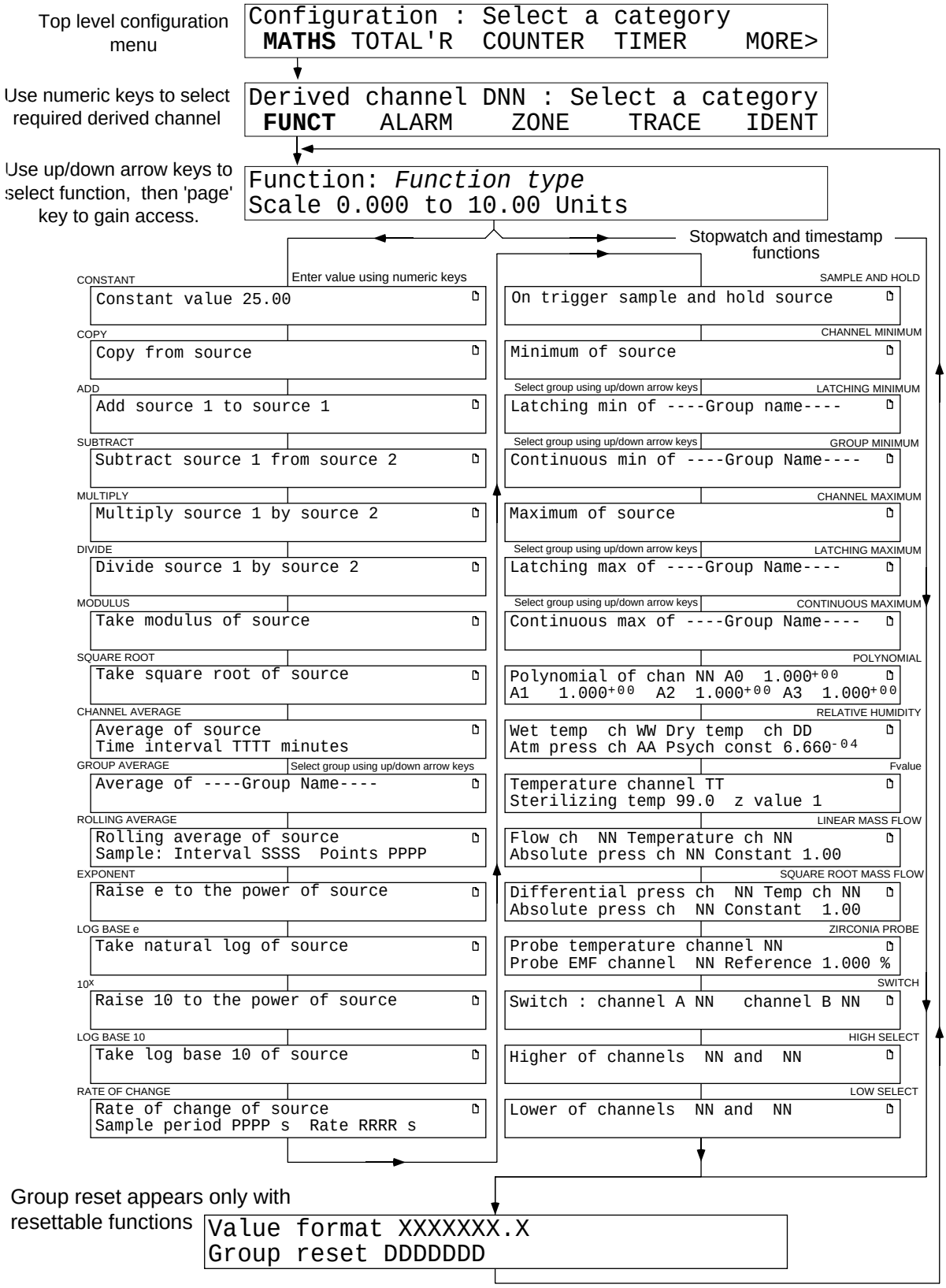

Figure 5.3.2 Derived channel configuration

5.3.3 Maths functions

The following maths functions are available. Unless otherwise stated, the word 'channel' is used as a general term to include both input (measuring) and derived channels.

MATHS PACK LEVEL 1

Constant	Allows entry of a constant
Copy	Allows a totaliser or counter value to be imported.
Add	Adds two channels together.
Subtract	Subtracts one channel from another
Multiply	Multiplies two channels together
Divide	Divides one channel by another
Modulus	Takes the value of the input without the sign.

MATHS PACK LEVEL 2

Square root	Takes the square root of a channel.
Channel average	Takes the average of the value of an input channel. The time over which the average is taken, and the frequency with which the average is updated can be configured.
Group average	Takes the average of a named group of channels.
Rolling average	Takes the average value of a specified channel over a specified time period.
Exponent	Provides the value of e raised to the power of a specified channel
Log_e	Takes the 'natural' log of a specified channel's value.
10^x	Output is 10 raised to the power of a specified channel.
Log_{10}	Take log10 of the channel value
Rate of change	Determines the change in value of the source channel over a specifiable time period.
Sample and hold	Allows the value of a channel to be held as a result of a trigger input.
Channel minimum	Holds the minimum value reached by a specified channel since the function was started.
Latching minimum	Holds the minimum value reached, since the function was initiated, out of all the channels in a specified group.
Continuous min.	The current minimum value out of all the channels in a specified group.
Channel maximum	Holds the maximum value reached by the source channel since the function was started.
Latching maximum	Holds the maximum value reached, since the function was initiated, out of all the channels in a specified group.
Continuous max.	The current maximum value out of all the channels in a specified group.
Polynomial	Third order polynomial curve fit $A0 + A1(X) + A2(X^2) + A3(X^3)$, where X is the value of the source channel and A0 to A3 are constants.
Relative humidity	Calculates relative humidity from wet and dry temperature inputs, atmospheric pressure input and psychrometric constant input.
Fvalue	Calculates F_O/F_H from temperature and z-value inputs.
Linear mass flow	Calculates mass flow from linear type transducer output.
Square root mass flow	Calculates mass flow from square root type transducer output.
Zirconia probe	Solves the Nernst oxygen equation.
Switch	Output copies either of two channels selected as input sources.
High select	Output is the higher of two source channels' values.
Low select	Output is the lower of two source channels' values.
Stopwatch	Increments four times per second whilst enabled.
Time Stamp	Holds current time and date value when triggered by a job.

5.3.4 Equations

CHANNEL AVERAGE

To provide the arithmetic mean of a channel over a specified time period.

$$A_t' = \frac{\sum_{t=1}^{t=T\times 60} ma_t}{T \times 60}$$

Where,
- A_t = Channel average at time t
- ma_t = Value of channel to be averaged, at interval sample time t
- T = Time interval in minutes

GROUP AVERAGE

To provide the average value of a all the channels in a group.

$$A_t = \frac{(ma_t + ---- + mn_t + ---- + mx_t)}{R}$$

Where,
- At = Mean value of the specified group of channels at time t
- mat = Value of first channel in the group at time t
- mn_t = Value of nth channel in the group at time t
- mx_t = Value of final channel in the group at time t
- R = Number of channels in the group

ROLLING AVERAGE

To calculate the arithmetic mean of consecutive readings of a source channel, sampled at a specified time interval. The user configures the number or readings to be averaged, and the time between samples.

$$A_t = \frac{\sum_{s=1}^{s=PT} ma_{(t-s)}}{P}$$

Where
- A_t = Rolling average of specified channel at time t.
- ma_{t-s} = Value of specified channel at time t - s.
- P = Number of valid samples taken.
- T = Sample interval in seconds.

At reset, the time period is restarted and the P set to zero.

RATE OF CHANGE

To calculate the rate of change (d/dt) of the value of a specified channel.

$$A_t = \frac{(ma_t - ma_{(t-Ta)}) \times R}{P}$$

Where,
- A_t = Rate of change value
- ma_t = Current value of source channel
- ma_{t-Ta} = Value of source channel last time
- R = Rate multiplier in seconds to give rate per minute, per hour etc. from sample rates of minutes, seconds etc.
- P = Sample period in seconds (time between successive calculations).

5.3.4 EQUATIONS (Cont.)

RELATIVE HUMIDITY

To determine the percentage relative humidity using wet and dry temperature, and atmospheric pressure inputs.

Note: The psychrometric constant used in the calculation (to be entered by the user) is generally 6.66 x 10^{-4}.

$$\%RH = \frac{VP_{Air}}{VP_{Sat}} \times 100$$

Where VP_{air} is the water vapour pressure in the atmosphere being measured, and VP_{sat} is the saturated water vapour pressure at the measured dry bulb temperature.

VP_{AIR} CALCULATION

VP_{air} is calculated as follows:

$$VP_{Air} = VP_{Wetsat} - \left\{6.66 \times 10^{-4} \times mc_t (ma_t - mb_t)\right\}$$

where,
- ma_t = value of the channel measuring dry bulb temperature (C)
- mb_t = value of the channel measuring wet bulb temperature (C)
- mc_t = value of the channel measuring the atmospheric pressure (bar)
- VP_{wetsat} = is the saturated water vapour pressure at the measured wet bulb temperature, calculated as follows:

$$VP_{Wetsat} = A0 + (A1 \times mb_t) + (A2 \times mb_t^2) + (A3 \times mb_t^3) + (A4 \times mb_t^4) + (A5 \times mb_t^5)$$

where,
- A0 = 6.17204663 10^{-3}
- A1 = 4.28096024 10^{-4}
- A2 = 1.53342964 10^{-5}
- A3 = 2.40833685 10^{-7}
- A4 = 3.04249240 10^{-9}
- A5 = 2.65867713 10^{-11}

VP_{SAT} CALCULATION

VP_{sat} is calculated as follows:

$$VP_{Sat} = A0 + (A1 \times ma_t) + (A2 \times ma_t^2) + (A3 \times ma_t^3) + (A4 \times ma_t^4) + (A5 \times ma_t^5)$$

where ma_t, and A0 to A5 are as described for VP_{air}, above.

5.3.4 EQUATIONS (Cont.)

FVALUE

To calculate the equivalent time at Sterilizing Temperature (for temperatures below, at and above Sterilizing Temperature) both in dry (F_H) and steam (F_O) sterilizing environments, using the following equation:

$$Fval_t = Fval_{t-1} + T \times 10^{\frac{ma_t - target\ temp}{Z}}$$

Where $Fval_t$ = F value at time t (minutes)
$Fval_{t-1}$ = F value last iteration
T = Internal recorder iteration rate (minutes)
ma_t = Value of temperature measuring channel
Target temp = 121.1˚C for F_O; 170˚C for F_H
Z = Temperature interval representing a factor-of-10 reduction in killing efficiency
= 10˚C for F_O; = 20˚C for F_H

Application Notes

To ensure that sterilizer loads which contain materials with differing thermal inertias are thoroughly sterilized, a typical sterilizer has up to 12 different measuring points within the load. To ensure accuracy, the temperature sensors should be calibrated, and the channel adjustment facility used to compensate for any inaccuracies found.

If each of the inputs is used to compute an F value, each of these values can then be used as an input to a Group Continuous Minimum function, with a high absolute alarm set at the correct F value. The alarm can be used to sound a warning, or an associated relay can be linked into the autoclave control system to signify the end of a sterilization cycle.

5.3.4 EQUATIONS (Cont.)

MASS FLOW (LINEAR)

Note: The overall accuracy of a flow measurement installation depends on a number of factors outside the control of the recorder manufacturer. For this reason, the manufacturer takes no responsibility for the accuracy of results obtained using the mass flow equations implemented in the maths pack.
It is not recommended that the recorder be used for custody transfer.

$$Qm_t = \frac{K}{Rg \times Z} \times \frac{Flow_t \times AbsP_t}{Temp}$$

where,
Qm_t = mass flow in kg/sec.
$Flow_t$ = measured value from the flow meter at time t
$AbsP_t$ = absolute pressure of the fluid at time t in kPa(A).
Temp =absolute temperature (Kelvin) of the fluid.
K = scaling factor (see below).
Rg = specific gas constant in J/(kg-K) (see below)
Z = compressability factor (see below).

For the recorder user, the equation above becomes: $$Mass\ flow = \frac{md \times ma_t \times mb_t}{mc_t}$$

where
ma_t = the value, at time t, of the channel measuring the flow meter output.
mb_t = the value, at time t, of the channel measuring the absolute pressure of the fluid.
mc_t = the value, at time t, of the channel measuring the fluid temperature.

$$Const = \frac{K}{Rg \times Z}$$

md = the constant value derived from the following:

SCALING FACTOR (K)

This is calculated from the following equation: $$K = \frac{S}{ma_{max}}$$

where,
S = the full scale output from the flow meter
ma_{max} = the full scale input of the channel reading the output from the flow meter.

SPECIFIC GAS CONSTANT (Rg)

The specific gas constant values are available from published tables.

For convenience, the Rg values for a number of common gases are given in table 5.3.4.

Gas	Rg (J/kg - K)
Air	287.11
Ammonia	488.2
Carbon dioxide	188.9
Carbon monoxide	296.8
Ethylene	296.4
Hydrogen	4116.0
Methane	518.4
Nitrogen	296.8
Oxygen	259.8
Propane	188.5
Steam	461.4

Table 5.3.4 Common gas constants

5.3.4 EQUATIONS (Cont.)

MASS FLOW (LINEAR) (Cont.)

COMPRESSIBILITY FACTOR (Z FACTOR)

The compressibility factor is a density related measure of how far a particular gas deviates from a 'perfect' gas under any set of temperature and pressure conditions, and is given by the equation:

$$Z = \frac{P}{T} \times \frac{1}{\rho}$$

where,
Z = Compressibility factor
P = Absolute pressure of the gas
T = Absolute temperature of the gas.
ρ = Gas density at pressure P and temperature T (from published tables)

Alternatively the Z-factor can be obtained experimentally.

MASS FLOW (SQUARE ROOT)

Note: The overall accuracy of a flow measurement installation depends on a number of factors outside the control of the recorder manufacturer. For this reason, the manufacturer takes no responsibility for the accuracy of results obtained using the mass flow equations implemented in the maths pack.
It is not recommended that the recorder be used for custody transfer.

$$Qm_t = \sqrt{\frac{K^2}{Rg \times Z}} \times \sqrt{\frac{DeltaP_t \times AbsP_t}{Temp_t}}$$

where,
Qm_t = mass flow in kg/sec.
$DeltaP_t$ = measured value of differential pressure across the orifice plate at time t, in kPa.
$AbsP_t$ = absolute pressure at the upstream tapping at time t, in kPa(A).
$Temp_t$ = absolute temperature at the upstream tapping at time t, in Kelvin.
K = Scaling factor (see below).
Rg = Specific gas constant in J/(kg-K)
Z = Compressibility factor

For the recorder user, the equation above becomes: $Mass\ flow = \sqrt{\frac{md \times ma_t \times mb_t}{mc_t}}$

where
ma_t = the value, at time t, of the channel measuring the flow meter output.
mb_t = the value, at time t, of the channel measuring the absolute pressure of the fluid.
mc_t = the value, at time t, of the channel measuring the fluid temperature.
md = the constant value derived from the following:

Where,
K = scaling factor (see below)
Rg = Specific gas constant in J/kg-K (see mass flow (linear) above).

$$Const = \frac{K^2}{Rg \times Z}$$

Z = Compressibility factor (see mass flow (linear) above).

SCALING FACTOR (K)

This is calculated from the following equation: $K = \frac{S}{\sqrt{ma_{max}}}$

where,
S = the full scale output from the flow meter
ma_{max} = the full scale input of the channel reading the output from the flow meter.

5.3.4 EQUATIONS (Cont.)

ZIRCONIA PROBES

A zirconia (oxygen) probe consists of two platinum electrodes bonded to a pellet or cylinder of zirconia. At elevated temperatures, such a probe develops an electromotive force (emf) across it which is proportional to the probe temperature and to the log of partial pressure (oxygen) difference between its two ends.

OXYGEN CONCENTRATION MEASUREMENT

In order to measure oxygen concentrations, one end of the probe is inserted into the atmosphere to be measured, whilst the other end is subject to a reference atmosphere. For most applications, air provides a suitable reference (reference input = 20.95% for air).

The temperature of the probe is normally measured using a type K or a type R thermocouple. The temperature effect on the thermocouple is such that for successful operation with the recorder, the probe temperature must be greater than 700˚C (973K).

The probe output obeys a law, described by the Nernst oxygen equation:

$$E = 0.0496 \times T \times \log \frac{P1}{P2} \text{ or, re-written } P2 = \frac{P1}{10^{\frac{E}{0.0496 \times T}}}$$

where,
P2 = Partial pressure of oxygen in the sampled gas (%)
P1 = Partial pressure of oxygen in the reference atmosphere (%) (20.95% for air)
E = Electromotive force across the probe, in mV
T = Probe temperature in Kelvin.

In order to obtain a useful result, it is necessary to scale the inputs and outputs correctly. The channel measuring the probe voltage will normally need a scale of 0 to 100 mV. The temperature measuring channel will probably be scaled at 300 to1800 K, whilst the output scaling would typically be 0 to 5% for boiler flues and 0 to 20% in kilns.

OXYGEN POTENTIAL MEASUREMENT

The oxygen potential of an atmosphere is a measure of its ability to oxidise or to reduce. For any element, a value of oxygen potential (free energy of formation) is known. Above this value, the material will oxidise, below it, no oxidation will occur.

Oxygen potential is given by the equation: $Op = 0.00457 \times T \times \log Op'$

where,
Op = Required oxygen potential (kilocalories)
T = Probe temperature (Kelvin)
Op´ = Partial pressure of oxygen in the reference atmosphere in atmospheres.

It can be shown that, because the oxygen potential of air is essentially constant over the temperature range 873 to 1473 K, the probe output is proportional to the oxygen potential of an atmosphere according to:

E = (10.84 T) + 40 mV between 873 and 1473K

Thus, it is possible to measure oxygen potential directly from a zirconia probe, using a standard input channel, scaled in units of Oxygen potential.

A typical input range would be 40 to 1124 mV, with a scale of 0 to - 100 kilocalories. Such scaling would be appropriate over the temperature range 873 to 1473 K.

5.3.4 EQUATIONS (Cont.)

SWITCH

This function copies one of two input or derived channels' values according to the state of its 'Select channel B for Dnn' job. I.E. if a relevant switch job is active, copy the value of source channel B, otherwise copy the value of source channel A.

HIGH SELECT

This function has two input or derived channels as sources, and copies whichever has the higher value at the time.

LOW SELECT

This function has two input or derived channels as sources, and copies whichever has the lower value at the time.

STOPWATCH

The stopwatch starts counting, as soon as the function is configured. The stopwatch can be disabled by a maths pack 'job', and can also be reset to zero. **The value is normally displayed as a number of 1/4 seconds, but if one of the date / time formats described in section 5.3.1 is selected, the value is displayed in hours/mins/seconds.**

TIME STAMP

When triggered by a maths pack 'job' becoming active, the time stamp reads the current time and date from the system clock and holds it. The time or the date can be displayed, according to the configured value format.

Note: The display format selected affects only the value displayed, not the internal value of the channel. This internal value is a number of 1/4 seconds, either elapsed since enabled (stopwatch) or elapsed since 1st of January 1988 (Time Stamp). This allows time functions to be processed in the maths pack. For example, two channels, each with a time stamp as its value can be subtracted to give the time between the two time stamps, and this can be displayed as elapsed time if so configured in the Value Format page.

5.4 TOTALISERS

5.4.1 Introduction

Each eight-digit totaliser can be used to integrate a measuring or derived channel's input, providing that it is above a low cut-off point, below a high cut-off point and within the channel's range.A 'setpoint' value can be entered, and when the totaliser value exceeds this threshold, up to two actions can be carried out. The jobs remain active until the totaliser is reset or disabled.

The function equation is: $tot_t = tot_{t-1} + \frac{ma_t}{PSF \times USF}$

Where
tot_t = totaliser value at time t.
tot_{t-1} = totaliser value last time
ma_t = input value of source channel (Ca) at time t
PSF = Period scaling factor
USF = Units scaling factor (negative for decrement; positive or un-signed for increment).

5.4.2 Totaliser configuration

FUNCTION SOFTKEY

PAGE 1	
Enabled/Disabled	Allows the totaliser to be turned on or off.
Source	Number of the input or derived channel to be used as the totaliser source.
Period scaler (PSF)	Changes time units of input to seconds. E.g. If input is litres / hr then PSF = 3600.
Units scaler (USF)	Changes the counting scale. E.g. If Input = litres/sec and the output is to be litres $x10^3$ (i.e. thousands of litres), then USF is set to 1000. Direction of count is defined by the sign of the USF, a negative USF causing the totaliser to decrement.
PAGE 2	
Group reset	Allows the totaliser to be susceptible to group reset (enable) or not (disable).
Preset	Allows entry of an eight-digit preset value, from which the totaliser will count after being reset
Cut off low	Value of the source channel (in engineering units) below which it is not to be totalised (can be negative).
Cut-off high	Value of the source channel (in engineering units) above which it is not to be totalised (must be positive).
PAGE 3	
Value format	Allows the number of decimal places to be selected for the displayed value.

ALARM SOFTKEY

SET PT SOFTKEY	
Set Point	Eight digit value entered using the numeric keys to act as the trip point for the job list.
Limit	Scroll through 'High' or 'Low'. Defines whether job list is initiated when the totaliser exceeds the setpoint (High) or when it falls below it (Low).
JOBS SOFTKEY	Allows jobs 1 to 2 to be selected from the list given in section 4.1.4. Can be used to reset totaliser

IDENT SOFTKEY

Allows a 20-character descriptor, a units string and a tag to be entered to describe the totaliser function.

5.4.2 TOTALISER CONFIGURATION (Cont.)

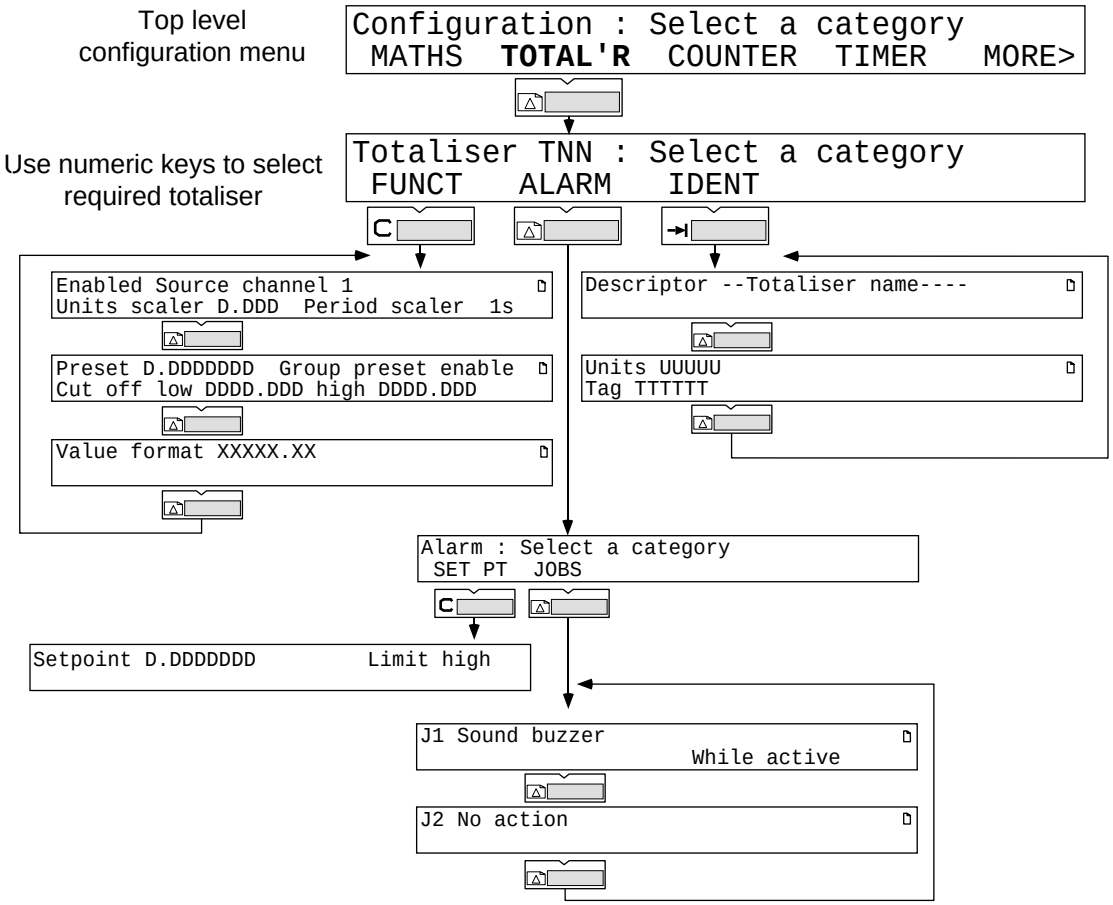

Figure 5.4.2 Totaliser configuration

Note: Totaliser values are held in battery-backed memory and are thus retained even when power is removed. It is recommended that the recorder is left switched ON whilst the battery pack is being replaced, to ensure that totaliser values are not lost. See section 6.2 for battery replacement procedure.

5.5 COUNTERS

5.5.1 Introduction

Counters are controlled from other recorder functions through job lists. As shown in section 4.1.4, counter jobs are:

a. Increment specified counter.
b. Decrement specified counter.
c. Preset specified counter or group of counters.
d. Disable specified counter or group of counters.

Each counter is configured with a threshold to allow it to trigger up to two jobs itself. A 'limit' input allows these jobs to be initiated either when the count value exceeds the threshold (Limit high) or when it falls below the threshold (Limit low).

Counter values are non volatile, i.e. the values are maintained with power removed from the recorder. In order to maintain this function, power must be maintained to the recorder whilst the battery pack is being replaced (section 6.2).

5.5.2 Counter configuration

The required counter (NN in figure 5.5.2) is selected using the numeric keys.

COUNTER PARAMETERS

PRESET	Preset		Eight-digit value of preset, entered using the numeric keys. The value is loaded into the counter by 'preset specified counter' job (section 4.1.4), or by operator action.
	Group Preset enable		Scroll through 'enable' or 'disable' to define the counter as being susceptible to group Preset (enable) or not (disable).
ALARM	SET PT	Set Point	An eight-digit value entered using the numeric entry keys. Acts as the trip point for the job list.
		Limit	Scroll through 'High' or 'Low'. Defines whether job list is initiated when the counter exceeds the setpoint (High) or when it falls below it (Low).
	JOBS		Allows up to two jobs to be set up to be initiated when the counter value passes the threshold value. See section 4.1.4 for job details.
IDENT	Descriptor		Allows the entry of a title of up to 20 characters to describe the counter's use and to distinguish it from other variables.
	Units		Allows a units string to be entered for the counter value.
	Tag		Allows a 'tag' to be entered for the counter

5.5.2 COUNTER CONFIGURATION (Cont.)

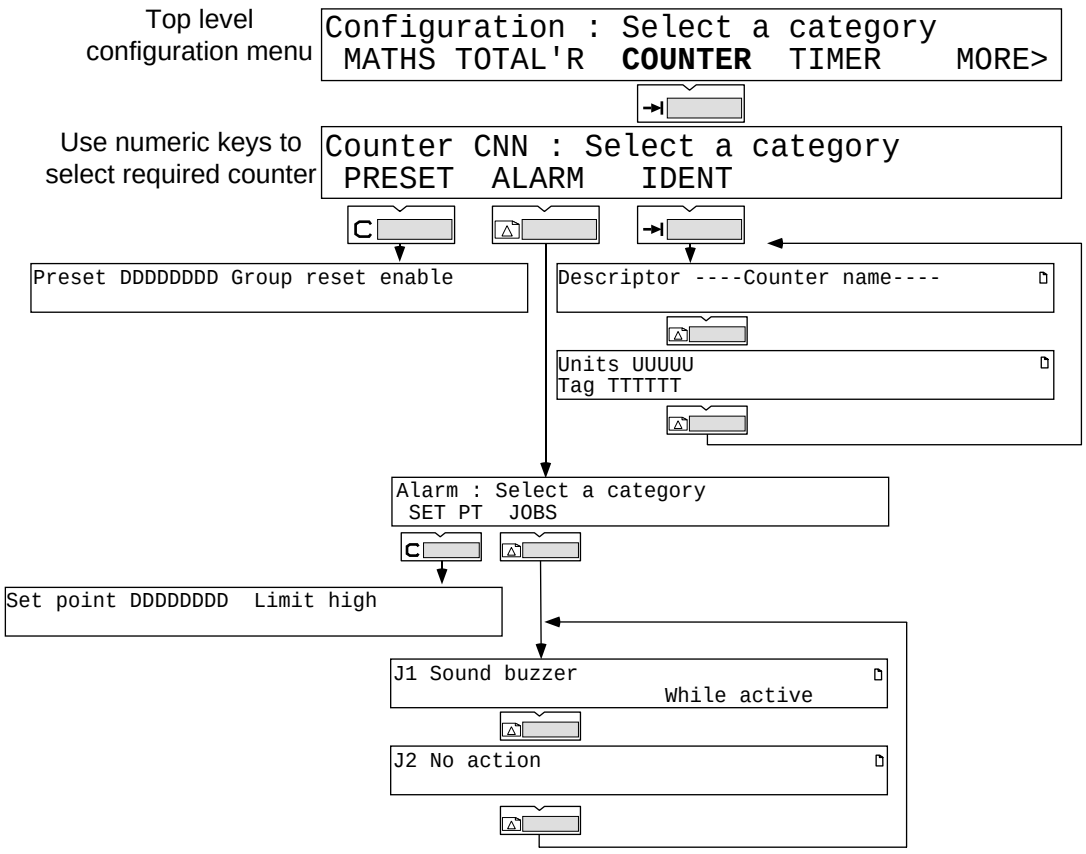

Figure 5.5.2 Counter configuration

5.6 TIMERS

5.6.1 Introduction

Each timer can be configured to start at a specific time and date (according to the real-time clock in the recorder). The timer will then run for a configurable time period (duration), and will repeat at a configurable rate. Alternatively, the timer can be initiated by a job (see 'Timer' jobs in section 4.1.4), and it will then repeat at the configured repetition rate. Once initiated, the timer will re-start every repeat period until it is disabled.

Each timer can have up to two jobs allocated to it from the list in section 4.1.4. The jobs are active for the timer Duration period.

Timer values are non volatile, i.e. the values are maintained with power removed from the recorder. In order to maintain this function, power must be maintained to the recorder whilst the battery pack is being replaced (section 6.2).

5.6.2 Timer configuration

The required timer (NN in figure 5.6.2) is selected using the numeric keys.

TIMER PARAMETERS

FUNCT Page 1		
	Enabled	Scroll through 'Enabled' or 'Disabled' to enable or disable the timer respectively.
	Global reset enable	Scroll through 'enable' or 'disable' to define the timer as being susceptible to global reset (enable) or not (disable).
	Start at	Field scroll keys are used to enter the time and date at which the timer is to start. (XX = 'Don't care' see note and example below). If all fields are left as XX, the timer can be started only by job or operator action.
FUNCT Page 2		
	Repeat every	Days, hours, minutes and seconds values are entered using the numeric keys, to define repeat period. If all zeros entered, timer does not repeat.
	Duration	Numeric entry of timer duration.
JOBS		Allows up to two jobs to be set up to be active for the timer duration. See section 4.1.4 for job details.
IDENT	Descriptor	Use of the → and field scroll keys allows the entry of a title of up to 20 characters, to describe the timer's use and to distinguish it from other variables.

Note: If no entry (i.e. XX) is made in the first field, then the timer operates every next-smallest time period. For example, if no month is entered, but a day number of 01 is entered, then the timer will operate on the 1st day of each month. If no month or day value is defined, but an hours value of 12 is entered, then the timer will operate every day at noon.

EXAMPLE

To start a timer at mid day on the 1st of each month:

```
Enabled          Global reset enable
Start at XX/01 month/date 12:00 hr:mins
```

5.6.2 TIMER CONFIGURATION (Cont.)

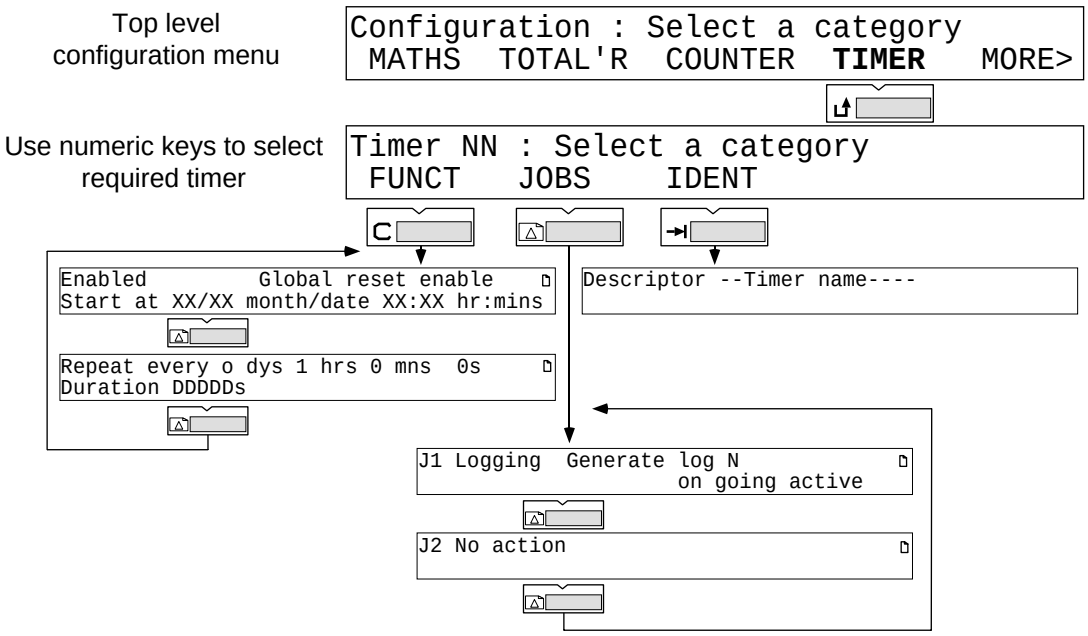

Figure 5.6.2 Timer configuration

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SECTION 6 SERVICE

LIST OF CONTENTS

Refer to the Technical Manual for full servicing and maintenance details.

WARNING

THE RECORDER SHOULD BE ISOLATED FROM MAINS (LINE) POWER BEFORE ANY ATTEMPT IS MADE TO REPLACE THE FLUORESCENT TUBE USED FOR CHART ILLUMINATION.

WARNING

THE EXHAUSTED TUBE MUST BE DISPOSED OF CAREFULLY. SHOULD THE TUBE BREAK, INHALATION OF THE FLUORESCENT POWDERY MATERIAL ON THE INSIDE OF THE TUBE SHOULD BE AVOIDED.

6.1 CHART ILLUMINATION LAMP REPLACEMENT (FIGURE 6.1)

After reading the warnings on Page 6 - 1 above, isolate the recorder from line power. Open the recorder door, and remove the plastic cover/reflector which surrounds the fluorescent tube. Rotate the tube 90 and pull it 'away' from the door, out of its end connections, and dispose of carefully.

Rotate the new tube such that the pins at each end will enter the connectors located at the door. Carefully push the tube home, and rotate the tube 90*. Spring the plastic cover / reflector into place. Re-apply mains (line) power, switch the recorder on, close the door and check that the chart illumination is working.

* CAUTION
THE TUBE MUST BE ROTATED 90, OTHERWISE A HEATER CIRCUIT WILL NOT BE COMPLETED, LEADING TO THE EARLY FAILURE OF THE TUBE.

6.2 BATTERY REPLACEMENT (FIGURE 6.2)

At the rear of the recorder, remove the battery cover, and with power applied to the recorder (see note 2 below), disconnect the battery pack, and fit the replacement. Re-fit the battery cover.

Notes...
1. The connector is polarised, so reverse connection is not possible.
2. Clock and totaliser data will be lost if the battery is changed with power removed from the recorder.

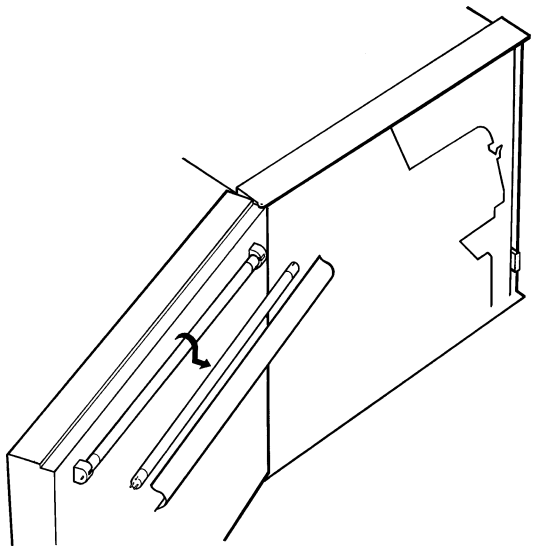

Figure 6.1 Chart illumination lamp replacement

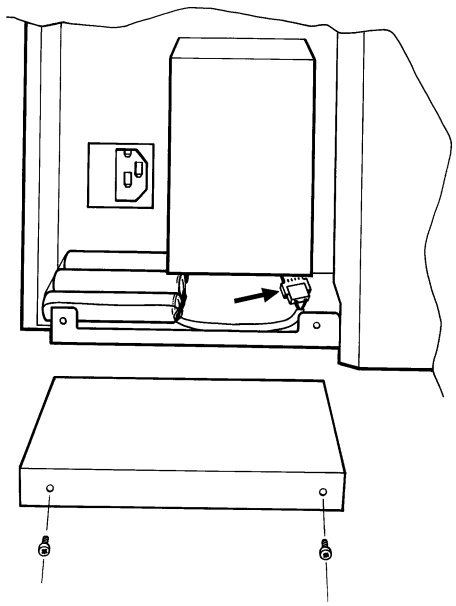

Figure 6.2 Battery replacement

SECTION 7 REFERENCE

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7.1 RECORDER MESSAGES

This section gives interpretations for messages, which appear at the display for the guidance of the user. The messages are 'fleeting', i.e they appear for approximately 3 seconds, before the previous display page is re-called.

FAILURE TO ADJUST

This message appears during input adjust procedure (section 4.15.1) if the channel being adjusted is not an analogue input type, or if there is a hardware or an internal communications failure within the recorder. If the channel is definitely an analogue input, a service engineer should be contacted.

```
Failed to adjust channel NN
CONTINUE
```

Operation of the CONTINUE key will call any further channels for which the adjustment failed. When all channels have appeared, the adjustment complete message appears:

```
Adjustment procedure complete
```

FAILURE TO CALIBRATE

This message appears during the input calibration procedure (section 4.15.3) if the channel being calibrated is not associated with an eight-channel Universal Input board, if there is a hardware or internal communications failure within the recorder or if the calibration limits are exceeded. The message also appears during CJ calibration, if the associated channel input type is not a thermocouple. The configuration of the channel should be checked, and if correct, a service engineer should be contacted.

```
Failed to calibrate channel NN
CONTINUE
```

Operation of the CONTINUE key will call any further channels for which the calibration failed. When all channels have appeared, the calibration complete message appears:

```
Calibration procedure complete
```

```
CJ Calibration procedure complete
```

FAILURE TO REMOVE ADJUSTMENT OR CALIBRATION

This message appears if an attempt is made to remove an adjustment or calibration previously entered (sections 4.15.1 and 4.15.3), if the input channel has been switched off or removed, if a hardware or internal communications failure has appeared or if the channel is not an analogue input type.

```
Failed to remove adjustment on ch NN
```

```
Failed to return ch NN to factory cal
```

7.1 RECORDER MESSAGES (Cont.)

INVALID INDEX

This message appears if a channel / totaliser etc. number is entered which is greater than the maximum number of channels / totalisers etc. fitted.

```
Invalid index
```

INVALID CONFIGURATION

This message appears if one part of the configuration conflicts with another e.g. if the linearisation type does not match the input type.

```
Invalid configuration
```

PRINTER MUST BE ON LINE

This message appears if a 'Quick Scale Print' (section 3.2.2) is requested with the printer off line. The operator CHART category must be entered (also section 3.2.2), and the chart switched on-line.

```
Printer must be on line
```

PRINTER MUST BE OFF LINE

This message appears if chart calibration (section 4.15.2) or configuration print (section 4.16) is requested with the printer on line. The operator CHART category must be entered (section 3.2.2), and the chart switched off- line.

```
Printer must be off line
```

CONFIGURATION ACCESS DISABLED BY COMMS

This message appears if an attempt is made to enter configuration after a 'DP' command mnemonic has been received by the recorder over the serial communications link. Configuration may not be entered until an 'EP' command mnemonic has been received. See Communications manual for details.

```
Configuration access disabled by comms
```

7.2 COSHH DATA

The COSHH data given here is derived from data sheets produced by the manufacturer to cover all its poducts. It therefore contains references to products additional to those used by this recorder.

7.2.1 Recording Pens

Product:	RECORDING PENS						
Part numbers: LZ127886 LZ127887 LZ127888 LZ127889 LZ127890	LA125451 LA125452 LA125453 LA128961 LA128962 LA128963 LA128964	LA128965 LA128966 LA128969 LA203211 LA203212 LA203213 LA203214	LA230393 LA233023 LA233461 LA233462 LA233463 LA233701 LA233702	LA233703 LA234423 LA234424 LA234425 LA235347 LA235348 LA235349	LA235350 LA243770 LA243771 LA243772 LA243773 LA244371 LA244372	LA244373 LA244374 LA246521 LA246522 LA246523 LA247158	LA249550 LA249551 LA249552 LA249553 LA249554 LA249556

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Formamide	25 to 30	Not established	Not established
Acid dyes	1.5 to 3	Not established	Not established

PHYSICAL DATA

Boiling point	100 ˚ C	Specific gravity	1.06 to 1.1
Vapour pressure	Due to H_2O only. 0.62% approx	Solubility in water	Complete
Odour	Nearly odourless	Colours	Various

FIRE AND EXPLOSION DATA

Flash point (deg C) (Method used)	Not flammable	FLAMMABLE LIMIT	
Extinguishing media	Use medium appropriate to primary cause of fire.	LEL Not applicable	UEL Not applicable
Special fire-fighting procedures	Not applicable		
Unusual fire and explosion hazards	Not applicable		

HEALTH HAZARD DATA

Threshold limit value	Unknown		
LD 50 Oral	Not established	LD 50 Dermal	Not established
Skin and eye irritation	Avoid skin and eye contact with ink		
Over-exposure effects	Unknown		

7.2.1 RECORDING PENS (Cont.)

HEALTH HAZARD DATA (Cont.)				
FIRST AID PROCEDURES				
Eyes and skin	Flush affected areas with water. If irritation develops, consult a physician			
Ingestion	If swallowed, dilute with water. Induce vomiting. Obtain immediate medical attention			
Inhalation	If inhaled, move to fresh air. If necessary, aid breathing and obtain medical attention			
REACTIVITY DATA				
STABILITY				Conditions to avoid
Stable	Yes	Unstable		Temperatures above 70˚C
Hazardous decomposition products	None			
Hazardous polymerisation	Will not occur			
SPILL OR LEAK PROCEDURES				
Wipe up spills with towels and cloths. Remove stains with soap solution.				
Dispose of waste in accordance with local environment control regulations				
SPECIAL PROTECTION INFORMATION				
Respiratory	If vapours are generated, use organic vapour respirator			
Ventilation	General			
Protective clothing	Not applicable			
Other	All colours contain dyes which are suspected carcinogens			

7.2.2 Nickel-Cadmium batteries

Product: BATTERY PACK (SEALED NICKEL-CADMIUM BATTERIES)			
Part numbers: PA244816 PA245002			
HAZARDOUS INGREDIENTS			
Name	% Range	TLV	Toxicological data
Negative electrode (cadmium metal, cadmium hydroxide, nickel sinter)	15 to 25	Not established	Highly toxic
Positive electrode (nickel hydroxide, cobalt hydroxide, nickel sinter)	5 to 15	Not established	Highly toxic if ingested
Electrolyte (potassium hydroxide)	5 to 15	Not established	Highly toxic iHighly corrosive

PHYSICAL DATA			
Boiling point	N/A	Specific gravity	N/A
Vapour pressure	N/A	Solubility in water	N/A
Odour	N/A	Colours	N/A

FIRE AND EXPLOSION DATA			
Flash point (deg C) (Method used)	N/A	FLAMMABLE LIMIT	
		LEL	UEL
Extinguishing media	Any	N/A	N/A
Special fire-fighting procedures	N/A		
Unusual fire and explosion hazards	Batteries can explode due to excessive pressure build-up which might not be self-venting. Toxic fumes (cyanogen) may be generated.		

HEALTH HAZARD DATA			
Threshold limit value	N/A		
LD 50 Oral	N/A	LD 50 Dermal	N/A
Skin and eye irritation	If cells leak, the leak material will be a caustic solution. Avoid contact.		
Over-exposure effects	N/A		
Chemical nature	See above. There are no risks in normal use		

7.2.2 NICKEL CADMIUM BATTERIES (Cont.)

HEALTH HAZARD DATA (Cont.)				
FIRST AID PROCEDURES				
Eyes and skin	If leakage occurs, wash the affected area with plenty of water and cover with dry gauze. If affected, wash eyes with plenty of water. Seek medical assistance.			
Ingestion	If leakage occurs, do NOT induce vomiting. Give plenty of milk to drink. Obtain immediate medical assistance, stating 'nickel cadmium battery'.			
Inhalation	N/A			
REACTIVITY DATA				
STABILITY				Conditions to avoid
Stable	Yes	Unstable		Mechanical damage, overcharging, shorting terminals. Storage temperatures outside the range 0 to 40 deg C.
Hazardous decomposition products	None			
Hazardous polymerisation	Will not occur			
SPILL OR LEAK PROCEDURES				
In normal conditions of use, there is no risk of leakage unless batteries are abused. Abuse can lead to the leaking of a caustic alkaline solution which corrodes aluminium and copper. The leak material should be neutralised by a weak acidic solution such as vinegar, or washed away with copious amounts of water.				
CONTACT SHOULD BE AVOIDED				
DISPOSAL				
Batteries must be disposed of in accordance with current local regulations. Batteries should not be discarded with normal refuse.				
SPECIAL PROTECTION INFORMATION				
Respiratory	N/A			
Ventilation	N/A			
Protective clothing	N/A			
Other	In addition to the electrolyte (potassium hydroxide), nickel-cadmium batteries contain cadmium, cadmium hydroxide and nickel hydroxide all of which are highly toxic.			

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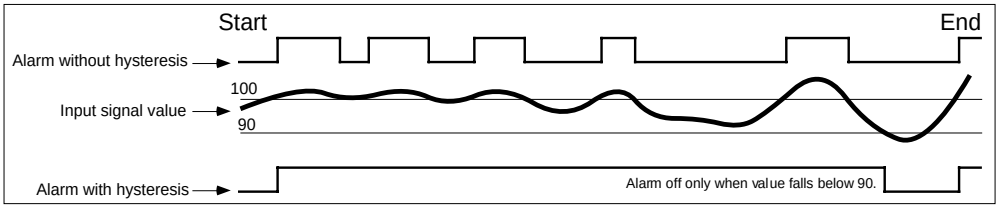
7.4 GLOSSARY OF TERMS

The following glossary is general to all the manufacturer's products and may thus contain terms which are not applicable to your particular unit. In particular, many of the terms are relevant only to configurable recorders.

Alarm	A function which is triggered when an *input signal* or a signal derived from it reaches a certain value (absolute or deviation alarms) or changes faster than a specified rate (rate-of-change alarms) or changes state (digital alarms). Once triggered, the alarm can initiate a *job list*, such as causing a *relay output* to change state, sounding a buzzer, changing chart speed etc.
Analogue input	An input which changes in a smooth (non-stepped) way (e.g. thermocouples, resistance thermometers).
Analogue output	An output from the recorder which is a scaled and linearised copy of an *analogue input* or *derived channel*. Also called retransmission output.
Attenuator	A resistive device which reduces the signal voltage by a known ratio (usually 100:1)
Break response	The recorder can detect an open circuit at its input terminals. As a part of the channel configuration, the instrument's response to an open circuit can be defined as 'None', 'Drive high' or 'Drive low'. If 'none' is selected the trace is allowed to drift according to what the input wiring is picking up (acting as an aerial). Drive high (low) causes the trace to be drawn at the extreme right (left) side of the chart.
Chart cassette	A mechanical paper transport system for containing and feeding the chart past the *pens* or *printhead* at a known speed. The cassette includes reservoirs for unused (pay-out tray) and used (take-up tray) sections of chart.
Cold Junction Compensation	Also known by the abbreviation CJC. The voltage generated by a *thermocouple* (TC) depends on the temperature difference between the bonded junction (the hot junction), and the other (non-bonded) end of the conductors (the cold junction (CJ)). Thus, for any reading from a TC to be accurate, the temperature of the CJ must be taken into account. This can be done in three ways: Internal, External or Remote. Internal. The recorder has integral temperature detectors measuring the temperature near the terminal blocks (the cold junction for directly connected TCs). External. For remote TCs, the cold junction can be held at a known temperature. This temperature is entered (in degrees) as a part of the CJC configuration. Remote. For remote TCs, an auxiliary temperature detector can be used to measure the cold junction temperature. This detector is then connected to a separate input channel. This input channel number is entered as a part of the CJC configuration.
Communications	Most recorders now offer a 'Serial Communications' option to allow a computer (PC) to communicate directly with one or more recorders in order to *configure* them, or to read information from them regarding the *process variables* being measured.
Configuration	This is used as a verb to mean 'the process of telling your recorder what you want it to do', and as a noun to mean 'the way in which the recorder has been set up (or configured)'. Recorders fitted with *memory card* or *communications* options can save their configuration to the memory card or to the host computer. This ensures against loss, and also allows configurations to be copied from one recorder to another.
Continuous trace	This is used to describe recorders which have a single *pen* associated with each *process variable*, and this pen *traces* the value continuously. See also multipoint recorder.
Counters	Counters can be incremented or decremented by digital/discrete inputs or by *job list* action. Counters can be preset. Each counter can have a set point which triggers a *job list* when the counter value passes through the set point either incrementing (High) or decrementing (Low).

Data acquisition	A general term describing the successful reading of an input signal. The term Data Acquisition Unit describes those units which are able to read input signals and act upon them (*alarms retransmission* maths functions etc) without necessarily having the facility of displaying or recording them.
Derived channel	A 'pseudo' channel which contains the results of maths pack operations so they can be traced on the chart, logged etc.
Derived Variable (DV)	The result of one or more *input channel* or *derived channel* being acted upon by a *mathematical function* (e.g. Channel average).
Digital (discrete) input	An input which has only two states (on or off). Examples are switch inputs or voltage pulse inputs.
Event input	A discrete (switch) or digital (voltage level) input. When active, an event input can initiate a *job list*.
Graphics recorder/unit	A recorder or display unit which uses a touch-sensitive liquid crystal display both as its operator interface, and to display traces as though on a chart. Recorders can come with or without charts; chartless recorders using electronic storage rather than paper to save information.
Hysteresis	When an *input signal* is 'hovering' near a *setpoint*, then an annoying and potentially damaging series of *alarms* can be generated, instead of just one alarm which can be acknowledged and the cause dealt with if necessary. To avoid this, a 'hysteresis' value can be entered in the alarm configuration, which effectively puts a dead band round the set point. For example an absolute high alarm with a set point of 100 and a hysteresis value of 10, would be triggered when the input signal value rose above 100, but would not re-trigger again until after the alarm had been 'cleared' by the process value falling below 90. An attempt to depict this example is given in the figure below.



Input channel	An input circuit which accepts voltage, current or digital *input signals* from the user.
Input signal	A voltage, current or digital input applied to the recorder input circuits. See also Analogue input and Digital (discrete) input.
Job list	A set of actions to be carried out by the recorder, when the job list becomes active. Typical 'jobs' are to activate a *relay*, display a message, change chart speed etc.
Linearisation table	Most *transducers* produce an output which is not directly proportional to the input. For example, the voltage output from a *thermocouple* does not vary linearly with the temperature it is exposed to. The recorder uses a 'look-up' table to find a temperature value for any mV input from a specified thermocouple type. Similar tables exist for other transducers such as *resistance thermometers*. In most modern instruments, the user can enter one or more tables of his/her own.
Log	Logging allows *process variable* values to be printed numerically in tabular form on the chart. Alternatively, logs can be sent to the *memory card* (if fitted).
Mathematical function	With the maths pack option(s) fitted, a number of mathematical functions become available to the user. For example, you may want to look at the difference between two *input signals*, in which case a simple Subtract function would be used. The resulting *Derived Variable* can be traced, using a *derived channel*, or could be used to trigger a *job list* if the difference between the two input signal became too great or too small, and so on. A complete list of functions is given below, but not all are available on all instruments.

Maths functions (Cont.)

Constant	Square root	Log base 10	Latching maximum	Switch
Copy	Channel average	Rate of change	Continuous maximum	High select
Add	Group average	Sample and hold	Polynomial	Low select
Subtract	Rolling average	Channel minimum	Relative humidity	Trace generator
Multiply	Exponent	Latching minimum	Linear mass flow	Stopwatch
Divide	Natural log	Continuous minimum	Square root mass flow	Time stamp
Modulus	10^X	Channel maximum	Zirconia probe	F value

Measured value — An umbrella term which means: the value of an *input channel, derived channel, totaliser, counter, timer* etc. measured in mathematical units as a proportion of the *span*. See also Process variable.

Memory card — Used to describe SRAM (Static Random Access Memory) solid state memory cards, or portable hard or floppy disks, used to record *configurations*, data etc. which can then be taken to a remote PC for further analysis, if required.

Multipoint recorder — This is used to describe recorders which have multiple pen *printheads* rather than individual pens to produce the *trace* on the chart. Each trace is made up of dots, produced by the print-head as it traverses across the chart at regular intervals. Advantages are that many more traces can be laid down on the chart, the traces can be annotated for identification and messages can be printed on the chart. Disadvantages are that fast transients may be missed at low chart speeds.

Operator interface — A term used to describe the controls (e.g. pushbuttons, keypads) and visual feedback (display) that are used to operate and configure the unit.

Paper transport system — This includes the *chart cassette* and the mechanical system, motors etc. needed to move the chart through the cassette. The paper transport system is often considered to be an integral part of the *writing system*.

Pen — A fibre-tipped disposable stylus with an integral ink reservoir. Used to draw (trace) the value of a single process variable on the chart in *continuous trace* recorders.

Pen offset compensation — With most *continuous trace* recorders, the mechanical positions of the pen tips are offset, in the time axis, in order that they do not collide with one another as they traverse the chart. A result of this is that simultaneous events in more than one channel can appear to be very far from simultaneous, particularly at slow chart speeds. To overcome this apparent time difference, most recorders now offer pen offset compensation, which delays the signals of all but the final channel. This has the disadvantage that changes may not appear on the chart until a considerable time after they have happened.

Pen tray — With modular recorder designs, each *pen* has its own mechanical system (including motor and feedback device) associated with it too drive it backwards and forwards across the chart. Pen tray is the general term for such mechanical systems. With some recorders, the pen drive electronics are integral with the pen tray.

Printhead — This is a device which, together with a disposable multi-colour cartridge, allows multi-point recorders to mark the chart.

Process variable — An umbrella term which means: the value of an *input channel, derived channel, totaliser, counter, timer* etc. measured in engineering units (e.g. Degrees Celsius). See also Measured value.

Relay output — A set of contacts which changes state as a result of a *job list* being run. Relays are energised continuously except when 'in alarm', so that if power to the recorder fails they go into their 'alarm' state.

Resistance thermometer — Also known as a resistance temperature detector (RTD), a resistance thermometer is constructed of a material whose resistance varies in a known way on the temperature it is exposed to. The resistance variation is non-linear, but for any given type, this non-linearity is well known and invariable and is compensated for by *linearisation tables* in the recorder memory.

Retransmission output — See Analogue output.

Setpoint	Also known as 'threshold', this is the point at which an *alarm* becomes active or inactive. See also *hysteresis*.
Shunt	The input circuit of each recorder channel measures voltage signals. If current signals are connected to the recorder, a low value resistor must be placed across the inputs, to convert the current signal to Volts, according to Ohms law (Volts = Amps x Ohms). Thus, a 0 to 20 mA (0.02 Amps) signal applied across a 250 Ω resistor produces a voltage range of 0 to (0.02 x 250) Volts = 5 Volts. Such resistors are called 'Shunt resistors' or 'Shunts' for short, and are usually of very close tolerance.
Span	Span has two common meanings: the right-most grid of the chart, or the value given by (maximum value - minimum value). The two meanings are identical where the minimum value is zero.
Trace	The line produced on the chart or display screen showing the value of the *process variable* being measured.
Thermocouple	A junction of two dissimilar metals which produces a small voltage, the value of which depends on the temperature of the junction. The voltage varies in a non-linear way with temperature, but for any given type, this non-linearity is well known and invariable and is compensated for by *linearisation tables* in the recorder memory.
Threshold	See setpoint.
Timer	Timers carry out general timing functions, and can initiate *job lists*.
Totaliser	A mathematical function which allows flow rates (e.g. cubic feet per second) to be converted to actual quantities (e.g. cubic feet).
Transducer	A device which produces an electrical output proportional to temperature, flow rate, pressure, speed, position etc. Common transducers are potentiometers, *thermocouples*, *resistance thermometers (RTDs)* and flow meters.
Transmitter	Thermocouple wire (compensation wire) is expensive, and if the thermocouple is a long way from the measuring device, it is often cheaper to instal a 'transmitter' local to the thermocouple. This device converts the mV signal from the thermocouple to a mA signal which can then be wired to the recorder using normal copper wire. Transmitters can be self powered, or they may need power generated for them. Most recorders can be fitted with Transmitter Power Supplies as an option.
Writing system	A general term used to describe the mechanical means of moving *pens/printheads* across the chart width. The term often includes the paper transport system used to drive the chart through the cassette.
Zero	Zero is generally taken to mean the value associated with the left-most grid line on the chart. Its actual value need not be zero, as long as it is less than the Span value.

ANNEX A

RECORDER SPECIFICATION

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INSTALLATION CATEGORY AND POLLUTION DEGREE

This product has been designed to conform to BS EN61010 installation category II and pollution degree 2. These are defined as follows:

INSTALLATION CATEGORY II
The rated impulse voltage for equipment on nominal 230V ac mains is 2500V.

POLLUTION DEGREE 2
Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

ANNEX A RECORDER SPECIFICATION

A1 GENERAL SPECIFICATION

I/O Board types

Input board types	8-channel 4 Hz universal input; 16-channel 1Hz dc input*
Output board type	8-channel relay output; 4/8 channel analogue output
Max number of input channels	32.
Max number of analogue outputs	8
Max. number of relay outpuys	Relays: 8 x no of free slots
Maximum number of traced channels	4 continuous (+ 1 or more dotted traces if annotator option is fitted)

Environmental Performance

General		To BS2011: 1981
Temperature limits	Operation:	0 to + 50 ˚C
	Storage:	-20 to +70 ˚C
Humidity	Operation/Storage:	5 to 85% RH; non-condensing
Maximum altitude		< 2000 metres
Protection		IP54 (door and bezel); IP31 (sleeve).
Shock		BS EN61010 1990 (safety); IEC 873: 1986
Vibration		BS EN61010 1990 (safety); IEC 873: 1986. Also recovers from 2g peak at 10 to 150 Hz

Electromagnetic compatibility (EMC)

Emissions	BS EN50081-2
Immunity	BS EN50082-2

Electrical Safety

To BS EN61010: 1990 class 1.

Physical

Bezel size	288 mm. high x 360 mm. wide x 53 mm. deep.
Panel cutout size	273.5 mm high x 348 mm. wide. (+ 1.4 mm. - 0 mm.)
Depth behind bezel rear face	450 mm. (inc. rear cover); 410 mm. (no rear cover)
Weight	20 kg. max.
Panel mounting angle	Up to ± 30˚ from vertical.

Power requirements:

Line voltage (45 to 65 Hertz)	90 to 132 Volts or 180 to 264 Volts (User selectable).
Maximum power	120 W
Fuse type	Ceramic 20 mm. 3.15 Amp. Fast blow.
Interrupt protection	100 ms at 60% load.

Performance

Maximum scan and update rate	All parameters in 1/4 second (1 second for 16-channel board inputs)
Maximum chart speed	1500 mm/hr. (60 in./hr.)
Clock accuracy	Better than 50 ppm

(Continued)

* DC inputs are defined as Volts, mV, mA, thermocouple and contact closure, but do not include resistance inputs.

A.1 GENERAL SPECIFICATION (CONT.)

Writing system

		1, 2, 3 or 4 fibre-tipped disposable (FTD) pens with individual pen trays provide continuous traces.
		Optionally, an annotator pen tray can be fitted, and this can be used to trace one or more channels if required.
Pen colours		Tray 1 (lowest tray if annotator not fitted): green.Tray 2: red; Tray 3: blue; Tray 4 (top tray): black
		Annotator (optional): Violet
Pen life	Continuous pens	1000 metres at pen-to-chart speed of 10m/hr.
	Annotator pen	500 000 dots
Pen spacing (chart time axis)		3mm. (Pen offset compensation can be invoked to synchronize traces.
Pen traverse time		0.5 seconds to within 2%, 1 second to 1%
Pen drive system		Low inertia servo, with resistive feedback element.
Annotator dot diameter		0.35 mm.
Annotator characters per line		104
Noise level		55 dBA max. (door closed).

Paper transport

Type	Tractor feed with selectable chart speed from 1 to 7200 mm/hr. (0.4 to 285 inches/hour)
Chart length	22 metres (z-fold - fold depth 75 mm.); 32 metres (roll)
Chart width	274.5 mm. overall; 250 mm. calibrated.
Chart visible length	155 mm.
Resolution (horizontal)	± 0.2 mm.
Pen-to-paper accuracy	0.2% of calibrated chart width
Transport accuracy	Better than 10 mm. in 32 metres

Memory protection

	EEPROM (for configuration)
	Battery-supported RAM for clock, totalisers etc.
RAM / clock-support battery type	Nickel-Cadmium (rechargeable)
Support period (no power to recorder)	3 months min. at 25 ˚C; 1 month min. at 50 ˚C.

A2 UNIVERSAL 8-CHANNEL INPUT BOARD SPECIFICATION

General specification

Number of inputs		8
Termination		Edge connector / terminal block
Input types		DC Volts, dc millivolts, dc milliamps (with shunt).
		Thermocouple, Resistance thermometer (2- or 3-wire), Ohms, Contact closure
Input type mix		User selectable during channel configuration.
Measurement frequency		All channels in 1/4 second
Step response to within resolution		< 1 second
Noise rejection	Common mode:	150dB above 45 Hz. (channel-channel and channel-ground.)
	Series mode:	67dB above 45 Hz.
Maximum common mode voltage		250 Volts
Maximum series mode voltage		10 mV at lowest range; 500 mV peak at highest range.
Isolation (dc to 65 Hz; BS EN61010)		Installation category II; Pollution degree 2 (See page A -1 for definitions)
		300 V channel-to-channel (double isolation) and channel-to-ground (basic isolation)
Dielectric strength		2350 V ac (channel – channel) 1350V ac (channel – ground) (both 1 minute type-tests)
Insulation resistance		50 MΩ at 500V dc.
Input impedance		>10 MΩ (68.8kΩ for 10V range)
Over-voltage protection		60 Volts peak, 500 V through 50 kΩ resistor
Open cct. detection (to 200 mV range)		65 nA current max.; 8 seconds recognition time (max.); 40 MΩ minimum break resistance.

DC input ranges

Ranges available		-10 to +40 mV; -50 to 200 mV; -500 mV to +1 V; -5 V to +10 V (100V with attenuator)
Temperature performance (worst case)		
-10 t o +40mV		80ppm/˚C pf reading + 27.9ppm/˚C of range
-50 t o +200mV		80ppm/˚C pf reading + 12.4ppm/˚C of range
-500mV to +1V		80ppm/˚C pf reading + 2.1ppm/˚C of range
-5V to +10V		272ppm/˚C pf reading + 4.7ppm/˚C of range
Shunt/Attenuator	Fitting method:	Resistor modules mounted on user's terminal block
	Additional errors:	0.1% (shunt); (0.2% attenuator)

Range	Resolution	Performance (worst case) in instrument at 20 ˚C
–10 mV to + 40 mV	1.4 µV	0.083 % reading + 0.056 % range
– 50 mV to + 200 mV	14 µV	0.072% reading + 0.073% range
– 0.5 V to + 1 V	37 µV	0.070% reading + 0.032% range
– 5 to + 10 V	370 µV.	0.223% reading + 0.034% range

Thermocouple data

Linearisation errors	0.15 ˚C or better
Bias current	<2 nA (<10 nA at 70 ˚C)
Cold Junction (CJ) types (selectable)	Off, internal, external, remote.
CJ error	0.5 ˚C or better
CJ rejection ratio	25:1 minimum
Remote CJ	Via any user-selected input channel.
Upscale/downscale drive	Configurable for each channel

T/C type	Range (˚C)	Standard
B	+ 200 to + 1800	IEC584.1:1977
C	0 to + 2300	Hoskins
E	- 200 to + 1000	IEC584.1:1977
J	- 200 to + 1200	IEC584.1:1977
K	- 200 to + 1370	IEC584.1:1977
L	-200 to + 900	DIN 43710
N	- 200 to + 1300	IEC584.1:1977
R	- 200 to + 1760	IEC584.1:1977
S	- 50 to + 1760	IEC584.1:1977
T	- 250 to + 400	IEC584.1:1977
U	- 100 to + 600	DIN 43710-85
NiMoNiCo	- 50 to +1410	ASTM E1751-95
Platinel II	-100 to + 1300	Engelhard R83

Note: Previous versions of the recorder came with NiNiMo linearisation instead of NiMoNiCo

A.2 UNIVERSAL 8-CHANNEL INPUT BOARD SPECIFICATION (CONT.)

3-wire RTD data

RTD linearisations: Pt100, Pt1000, Cu10, Ni100, Ni120

Linearisation errors: 0.012 ˚C or better

Influence of lead resistance error: 0.15 % of lead resistance

mismatch: 1 ohm per ohm.

RTD type	Range (˚C)	Standard
Pt 100	- 200 to + 850	IEC751: 1981
Pt1000	- 200 to + 850	Based on IEC751: 1981
Cu 10	-20 to + 250	General Electric
Ni 100	- 50 to + 170	DIN43760
Ni 120	- 50 to + 170	Based on DIN 43760

Pt100 figures (worst case)

Range ˚C	Resolution	Performance (worst case) in instrument at 20 ˚C
- 200 to + 200	0.02 ˚C	0.033% reading + 0.32 ˚C
- 200 to + 1000	0.14 ˚C	0.033% reading + 1.85 ˚C

Ohms ranges

Ranges available: 0 to 180Ω; 0 to 1.8kΩ; 0 to 10.0kΩ

Temperature performance (worst case)

0 to 180Ω: 35ppm/˚C of reading + 34.3ppm/˚C of range

0 to 1.8kΩ: 35ppm/˚C of reading + 14.6ppm/˚C of range

0 to 10kΩ: 35ppm/˚C of reading + 1.9ppm/˚C of range

Range	Lead resistance	Resolution	Performance (worst case) in instrument at 20 ˚C
0 to 180 Ω	10 Ω	5 mΩ	0.033% reading +0.070% range
0 to 1.8 kΩ	10 Ω	55 mΩ	0.033 % reading + 0.041 % range
0 to 10 kΩ	10 Ω	148 mΩ	0.037 % reading + 0.020 % range

Other linearisations

Tables available: $\sqrt{}$ value; $(value)^{3/2}$; $(value)^{5/2}$; User defined tables (up to 3 off)

Contact closure (switch) inputs

Type: Volt-free contact

Wetting voltage: 2.5 Volts nominal

Minimum latched pulse width: 125 ms.

De-bounce: Inherent 1 second.

A3 16-CHANNEL DC INPUT BOARD SPECIFICATION

General specification

Number of inputs	16
Termination	Edge connector / terminal block
Input types	DC Volts, dc millivolts, dc milliamps (with shunt). Thermocouple, Contact closure (not channels 1, 8, 16)
Input type mix	Software selected on configuration for each channel*.
Measurement frequency	All channels in 1 second
Step response	1.5 seconds
Noise rejection Common mode:	150dB above 45 Hz. (channel-channel and channel-ground.)
Series mode:	> 60dB between 10 to 100 Hz.
Maximum series mode voltage	Hardware range +50 mV.
Safety isolation (BS EN61010)	Installation category II; Pollution degree 2 (See page A-1 for definitions)
	300 V channel-to-channel (double isolation) and channel-to-ground (basic isolation)
Dielectric strength	2350 V ac (channel – channel); 1350V ac (channel – ground) (both 1 minute type-tests).
Input impedance	> 10 MΩ (68.8kΩ for 5V range)
Over-voltage protection	60 Volts peak, 500 V through 50 kΩ resistor
Open cct. detection (85 mV range only)	65 nA current (max.); 8 seconds recognition time (max.); 40 MΩ minimum break resistance.
Damping	2, 4, 8, 16, 32, 64, 128 or 256 secs. time constant, as configured.
	Damping improves o/p noise and performance figures listed in the table below.

DC input ranges

Ranges available	-15mV to +85 mV; -1.0 V to +5 V
Temperature performance (worst case)	
-15 to +85mV	80ppm/˚C of reading +12.9 ppm/˚C of range.
-1V to +5V	272ppm/˚C of reading +7.8 ppm/˚C of range.
Shunt	Resistor module mounted on user terminal block
Additional error due to shunt	0.1%.

Range	Resolution	Performance (worst case) in instrument at 20˚C
–15 mV to + 85 mV	± 5.5 µV	0.072% reading + 0.071% range
– 1.0V to + 5 V	± 280µV	0.223% reading + 0.055 range

Thermocouple data (in addition to the above)

Linearisation errors	0.15 ˚C or better
Bias current	< 2 nA (< 10 nA at 70 ˚C)
Cold Junction (CJ) types (selectable)	Off, internal, external, remote.
CJ error	1 ˚C or better
CJ rejection ratio	25:1 minimum
Remote CJ	Via any user-selected input channel.
Upscale drive	Configurable for each channel

Note: Previous versions of the recorder came with NiNiMo linearisation instead of NiMoNiCo

T/C type	Range (˚C)	Standard
B	+ 200 to + 1800	IEC584.1:1977
C	0 to + 2300	Hoskins
E	- 200 to + 1000	IEC584.1:1977
J	- 200 to + 1200	IEC584.1:1977
K	- 200 to + 1370	IEC584.1:1977
L	-200 to + 900	DIN 43710
N	- 200 to + 1300	IEC584.1:1977
R	- 200 to + 1760	IEC584.1:1977
S	- 50 to + 1760	IEC584.1:1977
T	- 250 to + 400	IEC584.1:1977
U	- 100 to + 600	DIN 43710-85
NiMoNiCo	- 50 to +1410	ASTM E1751-95
Platinel II	-100 to + 1300	Engelhard R83

* Maximum of eight different linearisations (seven + linear) allowed per board.
Contact closure inputs not available on channels 1, 8 and 16.

A.3 16-CHANNEL DC INPUT BOARD SPECIFICATION (CONT.)

Other linearisations

Tables available	√ value; (value)$^{3/2}$; (value)$^{5/2}$;User defined tables (up to 3 off)

Contact closure (switch) inputs (not available for channels 1, 8 and 16)

Type	Volt-free contact
Wetting voltage	2.5 Volts nominal
Minimum latched pulse width	250 ms.
De-bounce	Inherent 1 second.

A4 RELAY OUTPUT BOARD SPECIFICATION

No of relays per board		Eight
Contact format		Single pole change-over (single set of common, normally open and normally closed contacts)
Estimated life at 60VA load*		1,000,000 operations
Max contact voltage*		250 Volts ac.
Max contact current*	Make:	8 Amps
	Continuous:	3 Amps
	Break:	2 Amps
Maximum switchable power*		60 watts or 500 VA
Isolation (BS EN61010)		Installation category II; Pollution degree 2
		(See page A - 1 for definitions)
		250V ac channel-to-channel (double isolation) and
		channel-to-ground (basic isolation)
Dielectric strength (1 minute type-tests)		1350V ac (contact to contact)
		2350V ac (channel to channel)
		1350V ac (channel to ground)

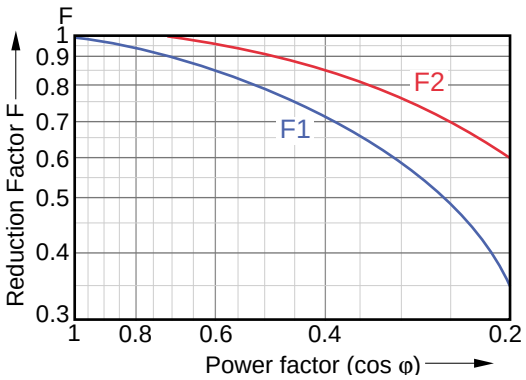

Figure A4 Derating curves

* With resistive loads; derate with reactive or inductive loads as per figure A4, in which:

F1 = Actually measured on representative samples

F2 = Typical values (according to experience)

Contact life = Resistive contact life x Reduction factor.

A5 ANALOGUE OUTPUT BOARD SPECIFICATION

General specification

Number of outputs		Four or eight as ordered
Termination		Edge connector / terminal block
Output types		Current or Voltage as configured for each channel
	Current:	0 to 25mA max. at up to 24 V
	Voltage:	-1 to 11V at up to 5 mA
Output frequency		All channels in 1 second
Output damping		250 msec rise time (10% to 90%)
Resolution		0.025% full scale, monotonic.
Isolation (dc to 65 Hz; BS EN61010)		Installation category II; Pollution degree 2 (See page A - 1 for definitions)
	Channel to channel:	250V RMS or dc (double isolation)
	Channel-to-ground:	250V RMS or dc (basic isolation)
Dielectric strength (BS EN61010)		(1 minute type tests)
	Channel to channel:	2350 V ac
	Channel to ground:	1350V ac
Insulation resistance		50 MΩ at 500V dc.

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Symbols

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Channel (Cont.)

Configuration (channel) (cont.)

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M cont.

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P

P cont.

Q

R

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S cont.

T

T cont.

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V

W

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Z

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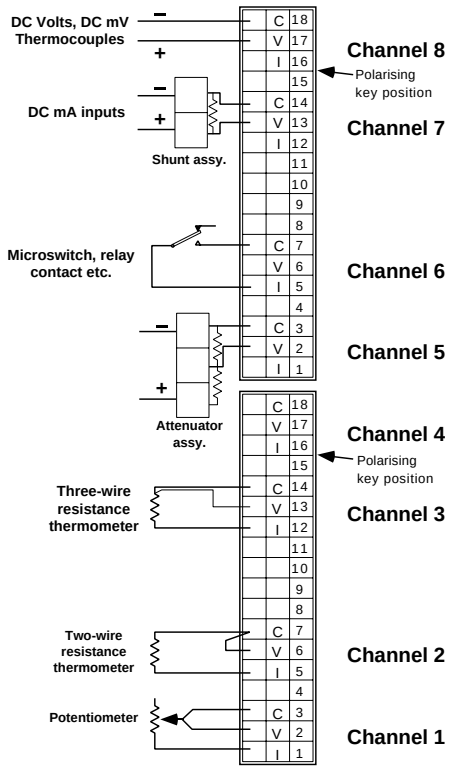
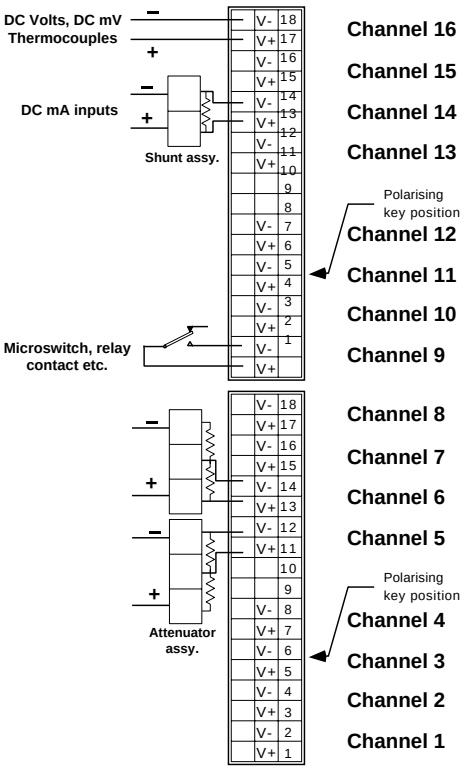
8 - Channel dc input board (typical input signal wiring)



In order to prevent mis-mating, a polarising key can be located between contacts 15 and 16.

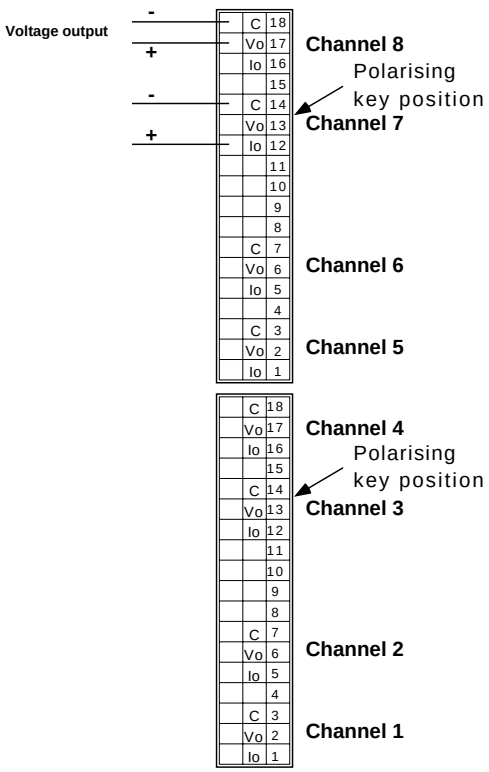
See inside front cover for shunt/attenuator part numbers

16 - Channel dc input board (typical input signal wiring)



In order to prevent mis-mating, a polarising key can be located between contacts 5 and 6.

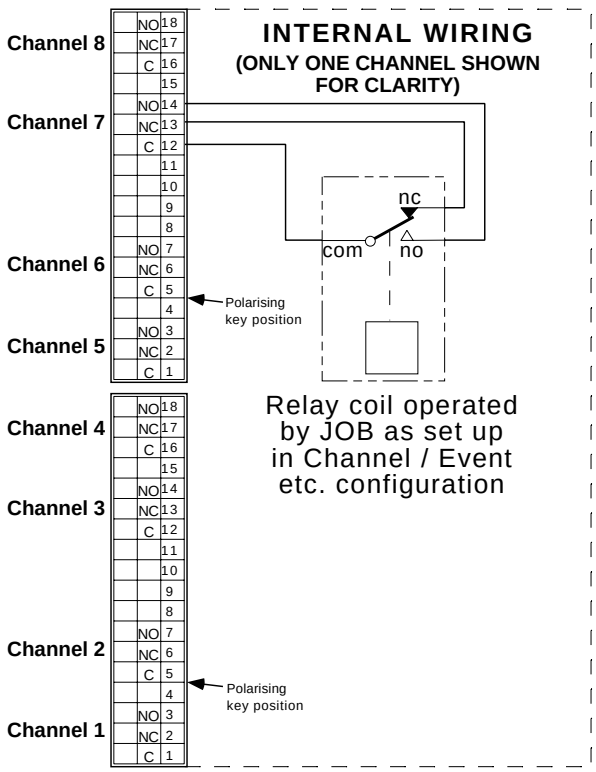
4/8 channel analogue output board (top connector not wired for 4-channel version)



In order to prevent mis-mating, a polarising key can be located between contacts 13 and 14.

Relay output board

Relay shown in alarm (de-energised) state



In order to prevent mis-mating, a polarising key can be located between contacts 4 and 5.

Slot 1 is the left-most slot when viewed from the back of the recorder.

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