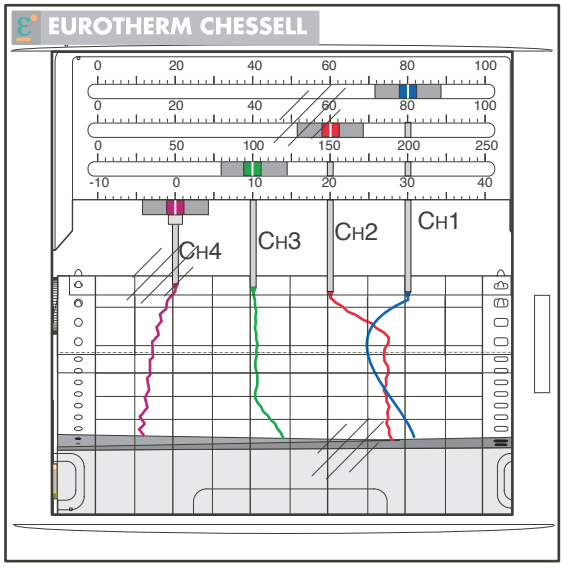
4101C/M

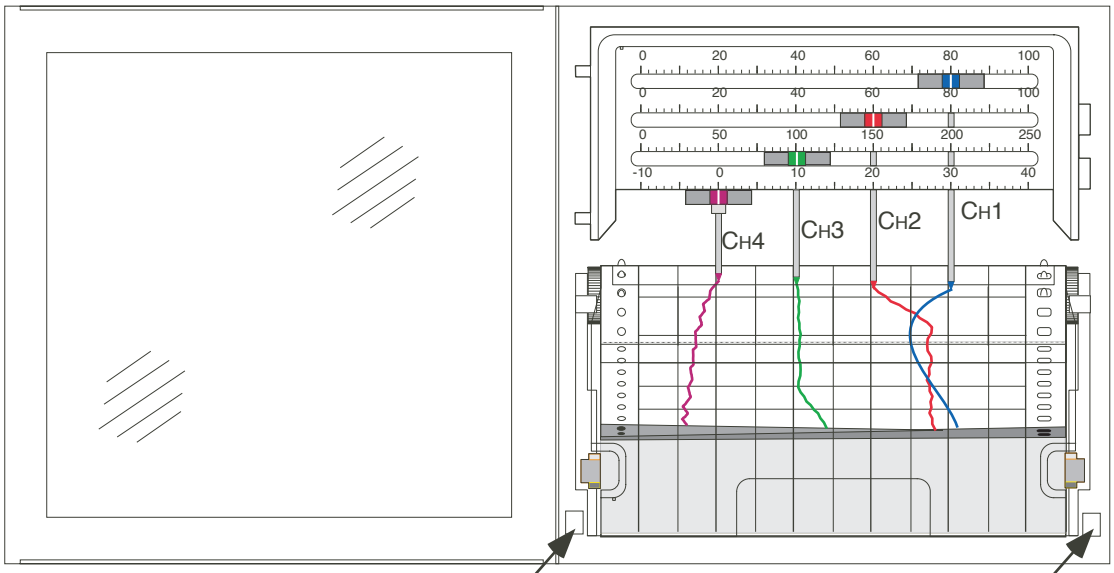
100mm chart recorders

User guide

invensys®
EUROTHERM®

MAJOR FUNCTIONAL ITEMS





PENS (Model 4101C)

Blue (channel 1) LA249551
Red (channel 2) LA249552
Green (channel 3).....LA249553
Violet (channel 4).....LA249554
Annotator (black) LA249550

Consumables

CARTRIDGE (Model 4101M)

LA249556

CHARTS

Z-fold (16 metres) GD128970Uxxx
Roll (32 metres) ... GD128971Uxxx

Where □
xxx = 040, 045, 050, 060, 070 or 075
= number of chart divisions

Signal conditioning components

Shunt 100Ω.....LA246779UK10 Shunt 250Ω.....LA246779UK25 Attenuator.....LA244180

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:	**4101C (Status level J12 or higher)** **4101M (Status level J12 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: 14-May-97

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

CE

IA249986U010 Issue 3 May 97

SAFETY NOTES

1. Before any other connection is made, the protective earth  terminal shall be connected to a protective conductor. 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.
2. In the case of portable equipment, the protective earth terminal must remain connected (even if the recorder is isolated from the mains supply), if any of the I/O circuits are connected to hazardous voltages*.

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.

Note: In order to comply with the requirements of safety standard BS EN61010, the recorder shall have one of the following as a disconnecting device, fitted within easy reach of the operator, and labelled as the disconnecting device.

a. A switch or circuit breaker which complies with the requirements of IEC947-1 and IEC947-3
b. A separable coupler which can be disconnected without the use of a tool
c. A separable plug, without a locking device, to mate with a socket outlet in the building

3. The mains supply fuse within the power supply unit is not replaceable. If it is suspected that the fuse is faulty, the manufacturer's local service centre should be contacted for advice.
4. Batteries within recorders are not user replaceable. Contact the manufacturer's local service centre if a problem is suspected.
5. 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.
6. 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.
7. Where conductive pollution (e.g. condensation, carbon dust) is likely, adequate air conditioning/filtering/sealing etc. must be installed in the recorder enclosure.
8. Signal and supply voltage wiring should be kept separate from one another. Where this is impractical, shielded cables should be used for the signal wiring.
9. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.

* A full definition of "Hazardous' voltages appears under 'Hazardous Live' in BS EN61010. briefly, under normal operating conditions, hazardous voltages are defined as > 30V RMS (42.2V 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.
	This recorder for either ac or dc supply
	Risk of electric shock

USER GUIDE

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LIST OF CONTENTS (CONT.)

100 MM. RECORDER USER GUIDE

1 INTRODUCTION

The recorder comes in two versions - a continuous-trace recorder with up to four pens and a multipoint recorder giving up to six traces on the chart. Chart annotation is standard with the multipoint version, but is an optional extra (specified at time of order) with the continuous trace recorder. When fitted, this annotator option prints time, date, scales and channel tags on the chart to simplify trace interpretation.

Designed to fit a DIN cutout (138 x 138 mm) the recorders feature an exceptionally small back of panel dimension of 220 mm. (no terminal cover) or 236 mm with cover.

The recorders are factory configured to customers' requirements, but chart speed and alarm setpoints can be adjusted by the operator, as can the zero and full-scale (span) positions of the pens or printhead.

ANNOTATOR BATTERIES

When the batteries associated with the Continuous Trace annotator option are fully charged, they will maintain the real-time clock for approximately one month (depending on temperature etc.), without power applied to the recorder. The batteries are uncharged when despatched from the factory, and it takes approximately 175 hrs to charge them fully. Should power be removed from the recorder before this, the retention time will be reduced accordingly.

1.1 UNPACKING THE RECORDER

The recorder is despatched in a special pack designed to give adequate protection during transit. Should the outer box show signs of damage, it should be opened immediately and the recorder examined. If there is evidence of damage, the instrument should not be operated and the local representative contacted for instructions. After the recorder has been removed from its packing, the packing should be examined to ensure that all accessories and documentation have been removed. Once the recorder has been installed, any internal packing should be removed, and stored with the external packing, against future transport requirements.

2 INSTALLATION

2.1 MECHANICAL INSTALLATION

Figure 2.1 gives installation details.

The recorder is inserted through the panel aperture from the front of the panel. With the weight of the recorder supported, the panel clamps are inserted into one pair of the rectangular apertures (either at the top and bottom or at the right and left sides) of the recorder. The jacking screws are then be tightened sufficiently to clamp the recorder into position. EXCESS FORCE SHOULD NOT BE USED IN TIGHTENING THESE SCREWS.

2.2 ELECTRICAL INSTALLATION

WARNING!

Refer to the safety notes on page 1 of this manual before proceding.

Figure 2.2 gives mains (line) and signal wiring information.

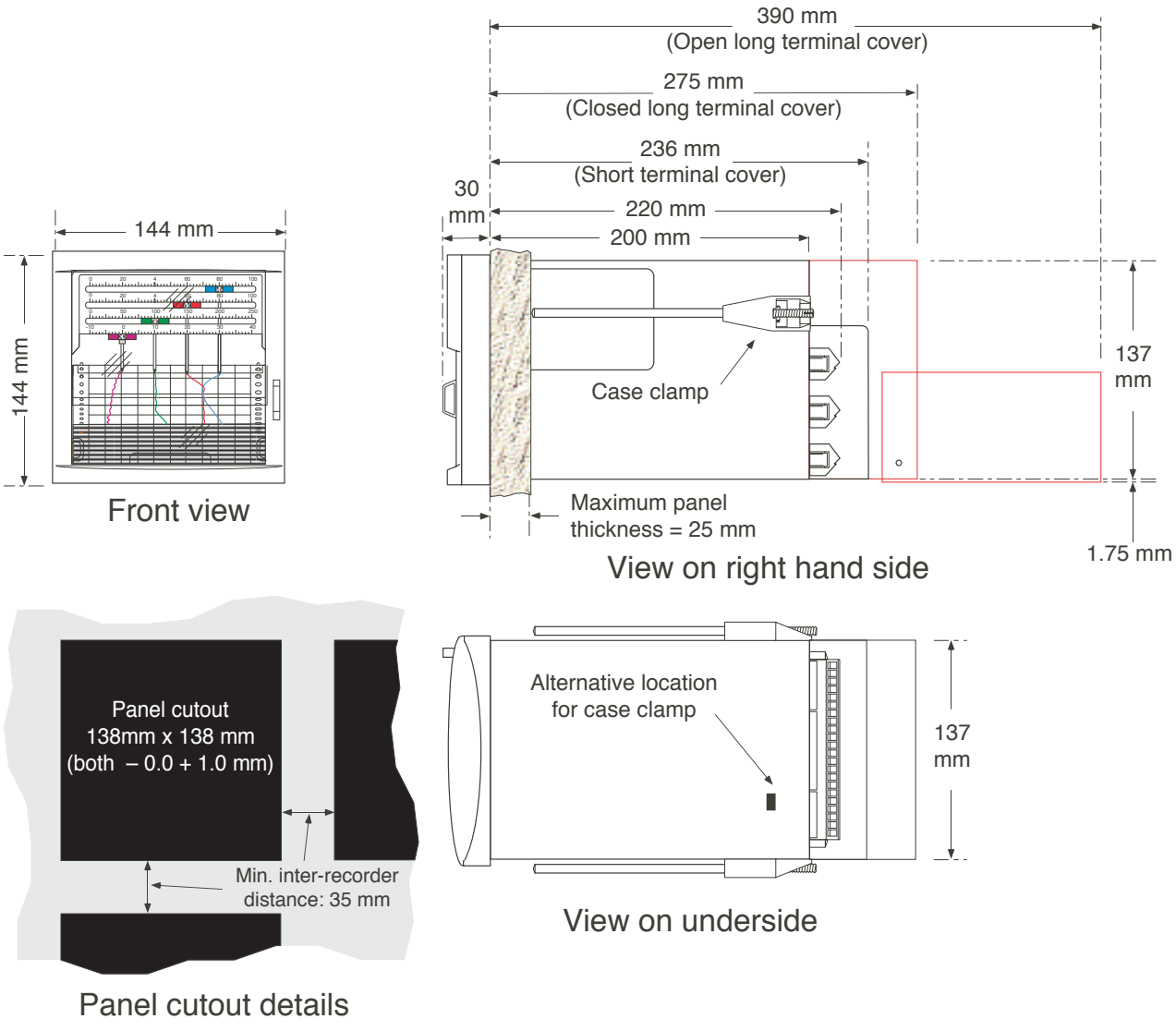


Figure 2.1 Mechanical installation

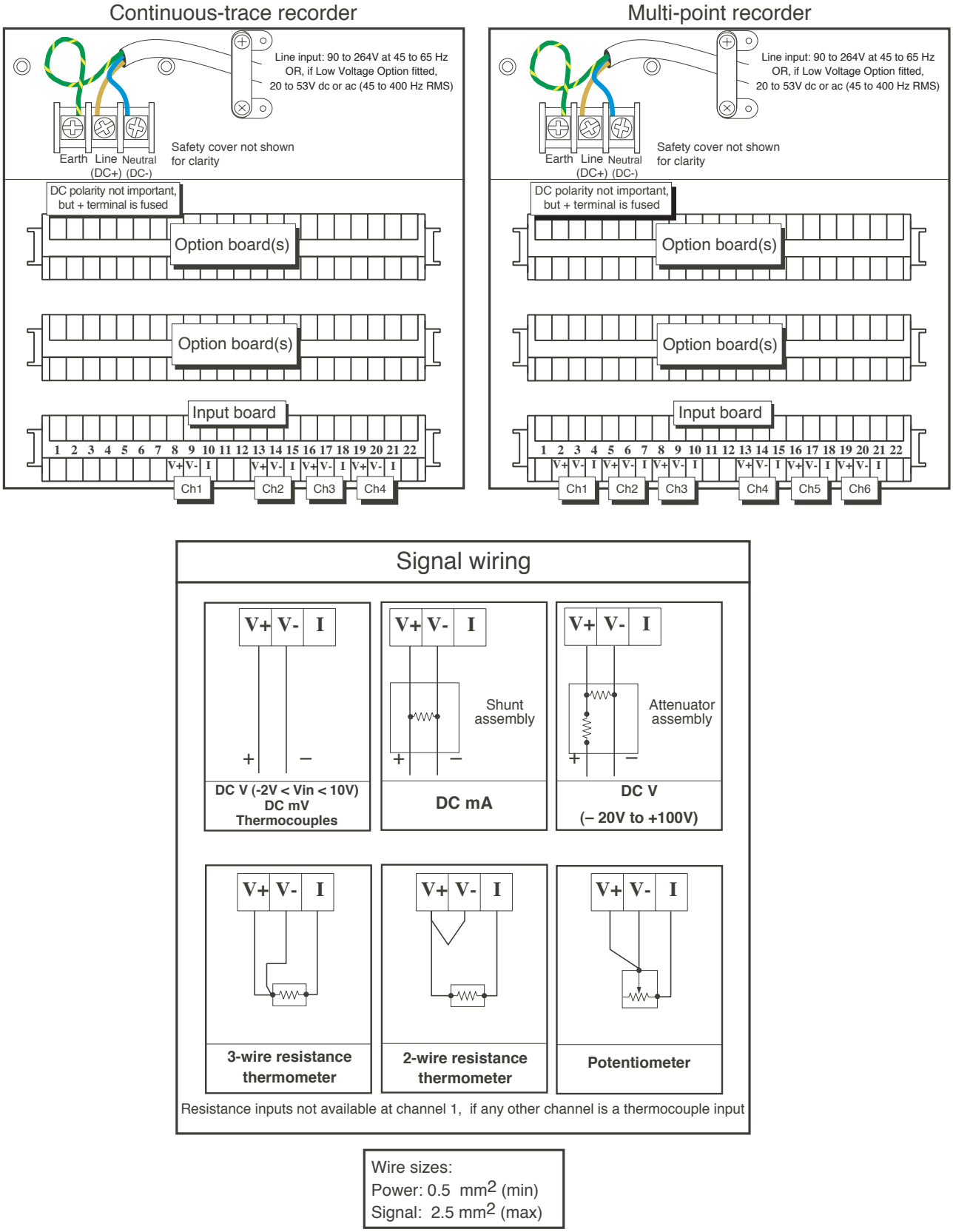
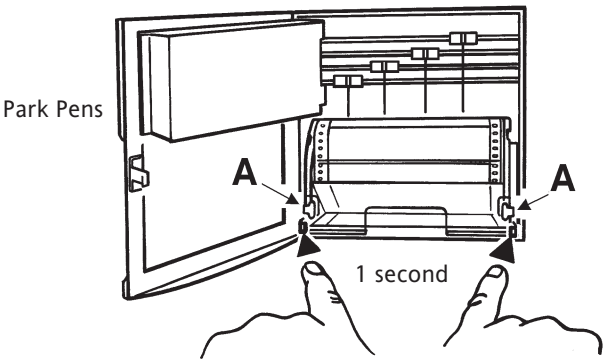


Figure 2.2 Electrical Installation

2.3 CHART REPLACEMENT

Notes

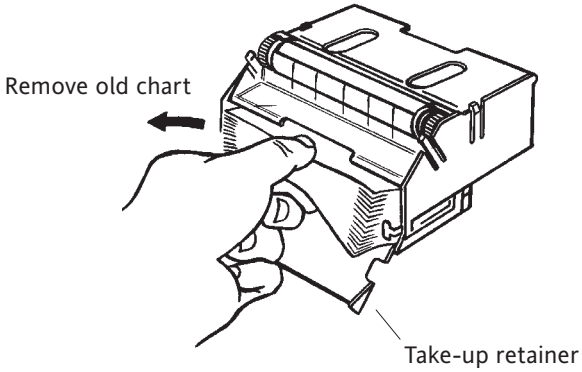
1. If this is a multipoint recorder then for 'pens' read 'printhead'
2. For recorders with status levels K13 or higher, if the cassette type (i.e. roll or z-fold) is changed, or if the recorder loses its configuration, the recorder must be reconfigured for the correct cassette type or the chart drive will not operate correctly. The manufacturer's local service centre should be contacted for advice



Open the door of the recorder and operate the two switches (at bottom left and bottom right of the recorder) simultaneously for approximately one second, then release. (Do not expect anything to happen until you let go!)

This causes the pens to go to their park positions.

Once the chart has been replaced, return the cassette to the recorder and operate the two switches simultaneously for over four seconds (to return to normal operations) or for about one second if you wish to check the pens' zeros/spans against the new chart. See 'Setting up the recorder' below.

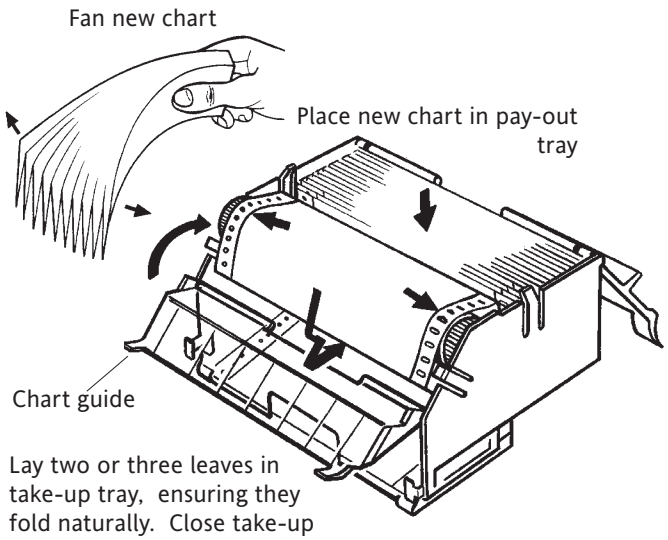


2.3.1 Z-Fold charts

Remove the cassette, by pulling on the two latches ('A' in the top figure). If a used chart is present, open the take-up retainer and remove the used chart.

Open the top of the paper pay-out tray, and remove any residual paper dust. Open the chart guide.

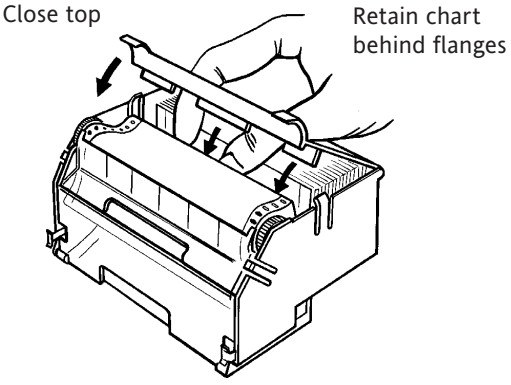
Unpack the replacement chart and fan it several times to separate the leaves and to remove as much perforation dust as possible.



Orient the chart so that the circular holes are to the left, the slots to the right, and the red end-of-chart line to the back (all directions relative to the front of the cassette). Place the chart into the pay-out tray, unfolding three or four leaves at the same time. Pull the free end of the chart over the drive roller and down behind the chart guide and lay the free leaves in the take-up tray.

Lay two or three leaves in take-up tray, ensuring they fold naturally. Close take-up retainer and chart guide.

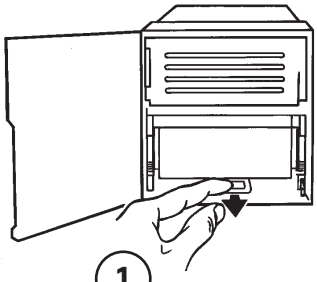
Ensure that the paper folds naturally into the tray, that the printed grid is uppermost and that the slots are at the right hand edge of the chart (i.e. the circular holes are to the left).



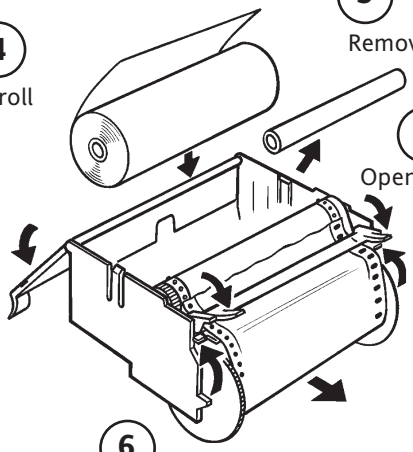
Close the take-up retainer and the chart guide, ensuring the paper holes/slots fit over the sprockets on the drive roller. Close the top of the paper pay-out tray, ensuring that the chart is contained behind the flanges on the top.

2.3.2 Roll charts

Carry out the'Park procedure described in section 2.3 above. Once the chart has been replaced, return the cassette to the recorder and operate the two switches simultaneously for over four seconds (to return to normal operations) or for about one second if you wish to check the pens' zeros/spans against the new chart. See 'Setting up the recorder' below.



1 Remove cassete by pressing down on, then pulling on the retaining clip.



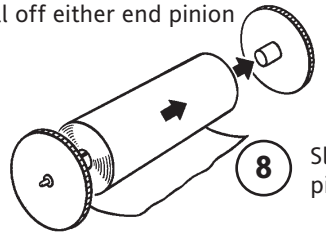
2 Open cassette top

3 Remove inner tube

4 Insert new chart roll

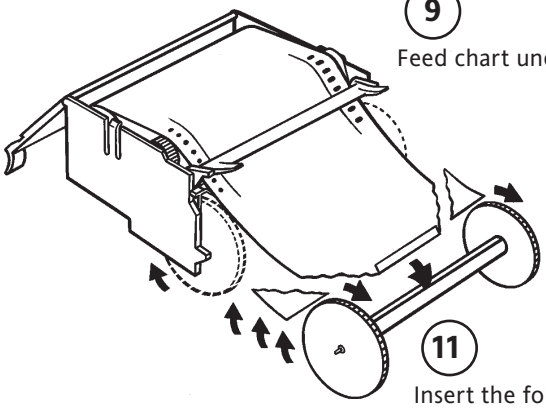
5 Open paper guide/chart tear-off

6 Lift 'ears' to eject take-up spool with used chart.



7 Pull off either end pinion

8 Slide the chart off the take-up spool, then push the pinion fully back onto the empty spool.

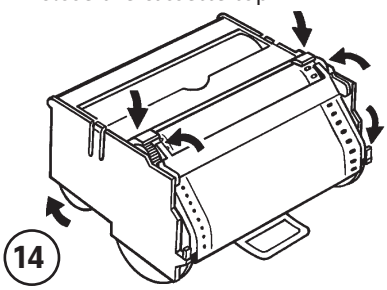


9 Feed chart under paper guide/chart tear-off.

10 Tear the corners off the chart, then fold about 5mm of the point back

11 Insert the fold into the slot, then roll the paper onto the take-up spool, and re-insert the spool into the cassette.

12 Close the cassette top



13 Close the paper guide/chart tear off strip, ensuring that the chart is 'square' with the cassette.

14 Tension the chart.

2.4 CHANGING THE PENS/CARTRIDGE

Note: Care should be taken to avoid pen/cartridge contact with skin or clothing

2.4.1 Continuous-trace recorders

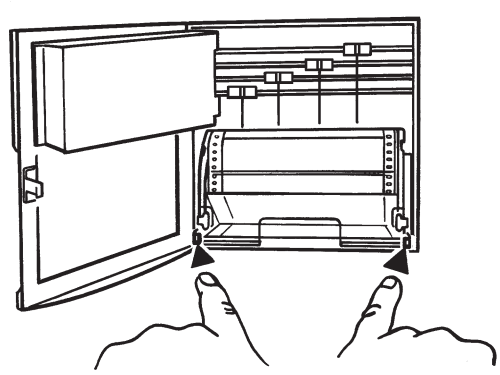
Open the recorder door, and the scale plate, both hinged at their left edge.

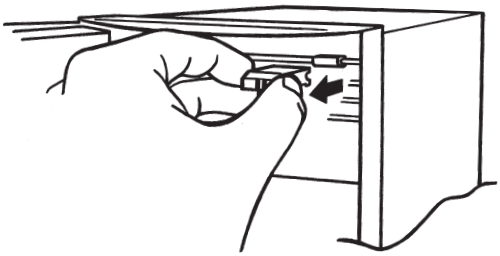
With power applied to the recorder, operate both push switches together, for between 1 and 2 seconds.

After the switches have been released, the pens will 'fan' to allow easy access.

Pull the pens forwards off their guide bars.

Fit the new pens and close the scale plate. Operate the switches simultaneously for over 4 seconds to return to normal recording, or for between 1 and 2 seconds to check the pen zeros and spans (section 2.5)





2.4.2 Multipoint recorders

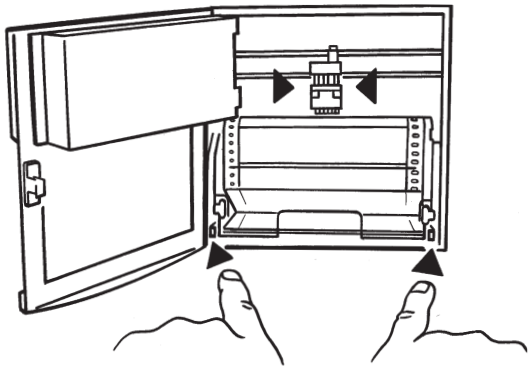
Open the door and the scale plate, both hinged at their left edge.

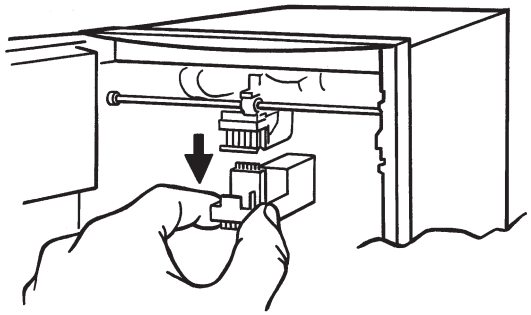
With power applied to the recorder, operate both push switches simultaneously for between 1 and 2 seconds. After the switches are released, the printhead travels to the centre-chart position.

Remove the chart cassette and pull the exhausted print cartridge 'vertically' downwards out of its holder.

Offer up the new cartridge to the printhead, and push it upwards into place.

Return the chart cassette to the chassis. Operate the switches simultaneously for over 4 seconds to return to normal recording, or for between 1 and 2 seconds to check the printhead zeros and spans (section 2.5).





2.5 SETTING UP THE RECORDER

An auto-repeat feature is included in the recorder interface, so when a key has to be operated repeatedly, the key can be held continuously actuated instead if appropriate until the required number of increments has been achieved.

2.5.1 Continuous trace recorder with no annotator

Activating the two pushbutton switches for approximately 1 second causes the chart to stop and the pens to fan ready for replacement. Repeated operations of the right hand switch scrolls through the list below. At any point, a further 1 second operation of both keys simultaneously ('Enter') allows access to the parameter for adjustment using either or both the switches.

1	Pen fan	7	Pen 3 zero	13	Channel 2 alarm 1
2	Chart speed	8	Pen 3 span	14	Channel 2 alarm 2
3	Pen 1 zero	9	Pen 4 zero	15	Channel 3 alarm 1
4	Pen 1 full scale (span)	10	Pen 4 span	16	Channel 3 alarm 2
5	Pen 2 zero	11	Channel 1 alarm 1	17	Channel 4 alarm 1
6	Pen 2 span	12	Channel 1 alarm 2	18	Channel 4 alarm 2

SETTING THE CHART SPEED

When chart speed is selected for setup, all the pens move to the centre of the chart except for pen 1 which drives to 40%, 45%, 50%, 55% or 60% of span according to the currently selected speed (40% = Chart drive off). The left and right switches can be used to move the channel 1 pen to the required chart speed position. A further simultaneous operation of the two switches causes the new chart speed to become operational.

Your recorder's chart speed range is defined at time of order. The speed range-number can be found on the configuration label on the bulkhead behind the chart cassette. Table 5.1 shows the speeds associated with that range.

SETTING THE PEN ZEROS AND SPANS

Each time a pen zero setup is selected all the pens move to 10% of chart width, except the selected pen which moves to 5%. A further enter drives this pen to where it thinks chart zero is. The left and/or right switches move the pen 0.15 mm left or right respectively each operation, allowing the pen to be aligned with the chart zero.

Similarly when a pen span is selected, all the pens move, to 90% of chart width except the selected pen which moves to 95%. After a further 'Enter', the selected pen moves to where it thinks chart span is. The left and/or right switches move the pen 0.15 mm left or right respectively each operation, allowing the pen to be aligned with the chart span.

SETTING ALARM THRESHOLDS (SETPOINTS)

Each time an alarm 1 setup is selected all the pens move to 20% of chart width except the selected pen which moves to 15%. After a further 'Enter', the selected channel's pen will drive to its current set point. The left and/or right switches move the pen approximately 0.15 mm left or right respectively each operation, allowing the setpoint to be adjusted. A further simultaneous operation of the switches causes the new information to be saved, and alarm 2 to be moved to.

Similarly when an alarm 2 is selected for editing, all the pens move to 80% chart width except the selected pen which moves to 85%. After a further 'Enter', the selected pen moves to its current setpoint. The left and/or right switches move the pen 0.15 mm left or right respectively each operation, allowing the setpoint to be adjusted.

The recorder's alarm types are defined at time of order and details can be found on the label behind the cassette

RETURN TO RECORDING

At any time during setup, simultaneous operation of the two push switches for over 4 seconds returns the recorder to normal operation

2.5.1 CONTINUOUS TRACE RECORDER WITH NO ANNOTATOR (Cont.)

12 After 'Entering' the final channel's alarm 2 threshold, the recorder returns to normal operations

11 Further 'Enter' selects channel 2 alarm 1 setting, and so on.

10 Further 'Enter' selects channel 1 alarm 2 setting. Pens 2, 3 and 4 move to 80%; pen 1 to 85%. After further Enter, pen 1 moves to current alarm 2 threshold. Adjust using LH and RH switches, then Enter.

9 Pens 2, 3 and 4 move to 20%; pen 1 to 15%. After further Enter pen 1 moves to current alarm 1 threshold. Adjust using LH and RH switches, then Enter.

8 Further 'Enter' selects Pen 2 zero setting, and so on. When all pens' zeros and spans entered, further 'Enter' selects channel 1 alarm 1 setting

7 Further 'Enter' selects Pen 1 span setting. Pens 2, 3 and 4 move to 90%; pen 1 to 95% After further Enter pen 1 moves to near 100%. Set span as for zero

6 Use left & right switches to adjust, then 'Enter'

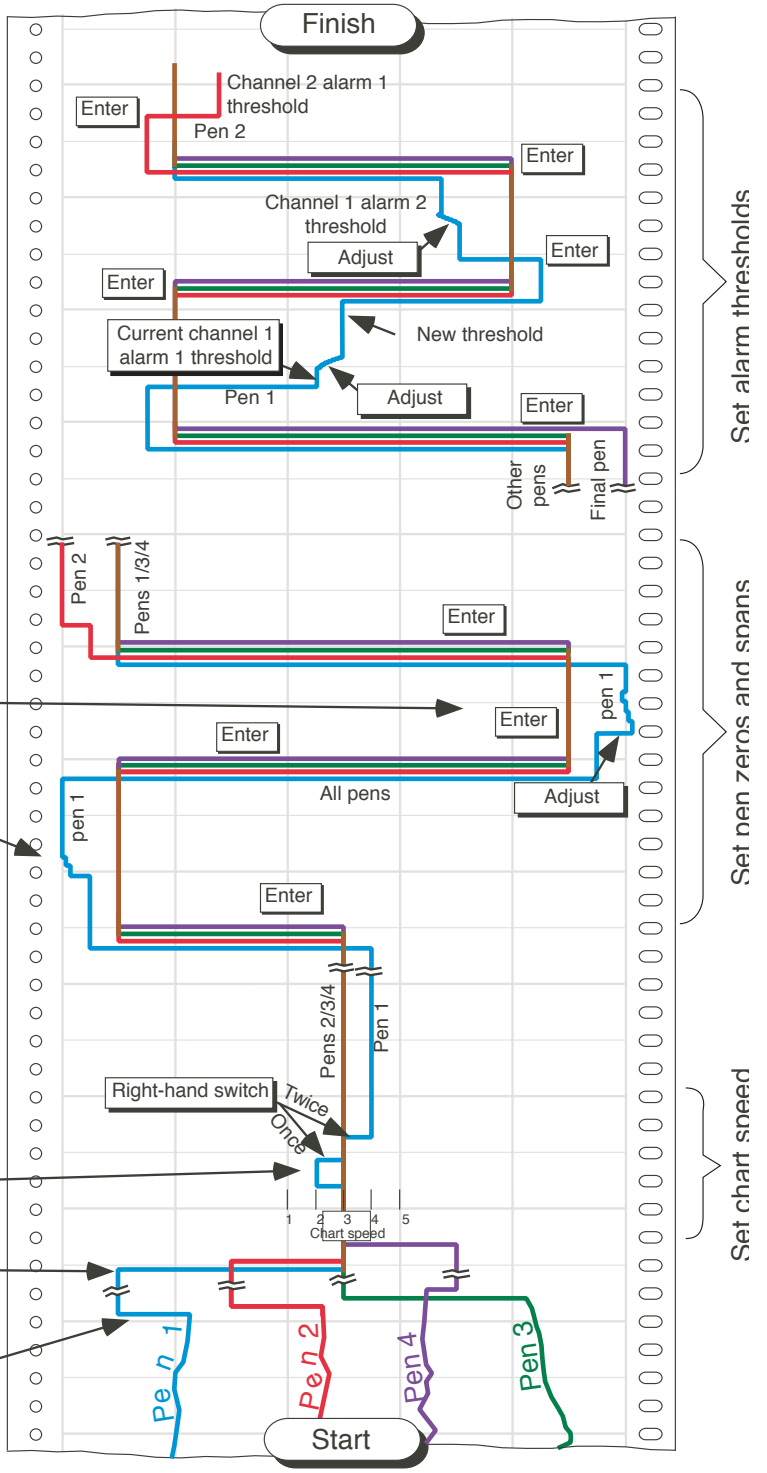
5 Further 'Enter' selects Pen 1 zero setting. Pens 2, 3 and4 move to 10%; pen 1 to 5% After further Enter, pen 1 moves to near zero.

4 Use LH or RH switch to select new chart speed (RH twice to select speed 4 in this example)

3 'Enter' causes pen 1 to move to 40% , 45%, 50%, 55% or 60% according to current chart speed (2 in this example). (40% = off).

2 Operation of RH switch centres pens

1 Single 'Enter' fans pens for changing. Chart stops



Notes:

1 RH = Right hand; LH = Left hand

2 Enter = Simultaneous operation of both left and right hand switches for between 1 and 2 seconds then release.
(Operation of both switches for over 4 seconds quits configuration without saving any changes made since last 'enter'.)

3 Chart speeds: There are five chart speeds, 1 to 5, where 1 = Off. For speed range fitted, see the label behind the cassette. Table 5.1 shows speeds per range.

4 Alarms (if fitted): Each alarm can be absolute high or absolute low as specified at time of order. See configuration label (behind cassette) for type fitted.

Figure 2.5.1 Simulated chart sample

2.5.2 Continuous trace recorder with annotator

Apart from the fact that the annotator prints only in black, the setting up procedure for continuous-pen recorders with annotation is the same as that given below for multi-point recorders.

2.5.3 Multipoint recorder

Operating the two switches simultaneously for between 1 and 2 seconds, causes the printhead to park at 50% chart width.

Operating the right-hand switch moves to the next parameter, or operating both switches together for about 1 second, enters the parameter's setup.

Parameters appear in the following order:

Chart speed,

Chart zero,

Chart span,

Alarm setpoints

Time

Date.

Once in setup, the right and left hand keys are used to adjust the value. Operating both keys together for 1 to 2 seconds 'enters' the new value.

Figure 2.5.3b shows the programming sequence, including changing the time from 15:12 to 16:35, and the date from 12/12/95 to 29/2/96.

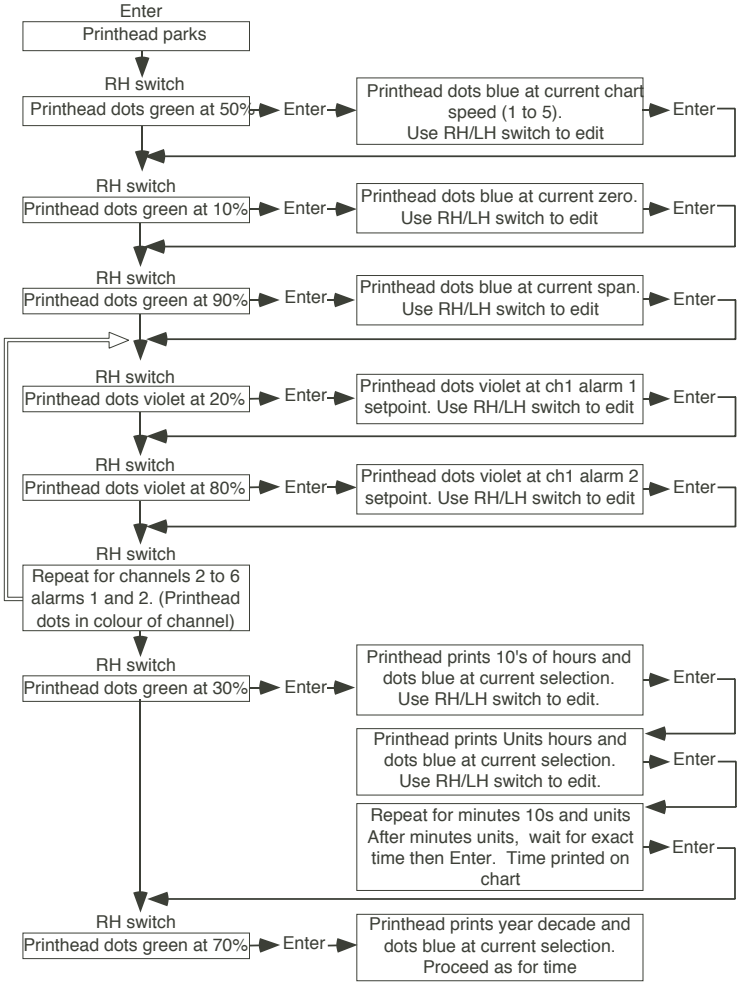


Figure 2.5.3a Set up sequence

2.6 CYCLIC MESSAGES

Cyclic messages are printed on the chart approximately every 2 cm. on a convenient time boundary. The messages are right-justified on the chart and are printed in the following order:

Time; Date; Chart speed; Channel 1 tag, units and scale; Time; Date; Chart speed; Channel 2 tag, units and scale; ...and so on. Channel information is printed on two lines, with Channel tag and scale 'zero' value at the left of the chart and units and span value at the right of the chart, as illustrated in figure 2.6

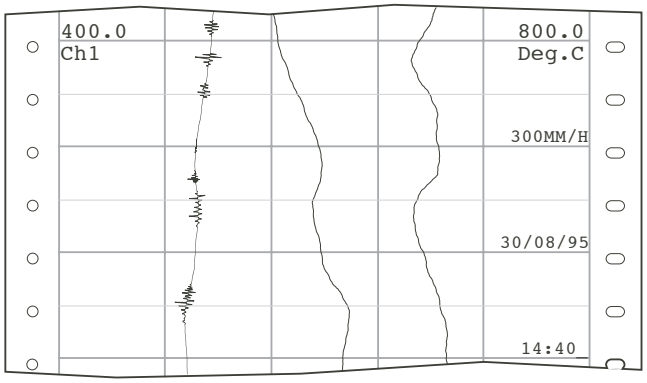
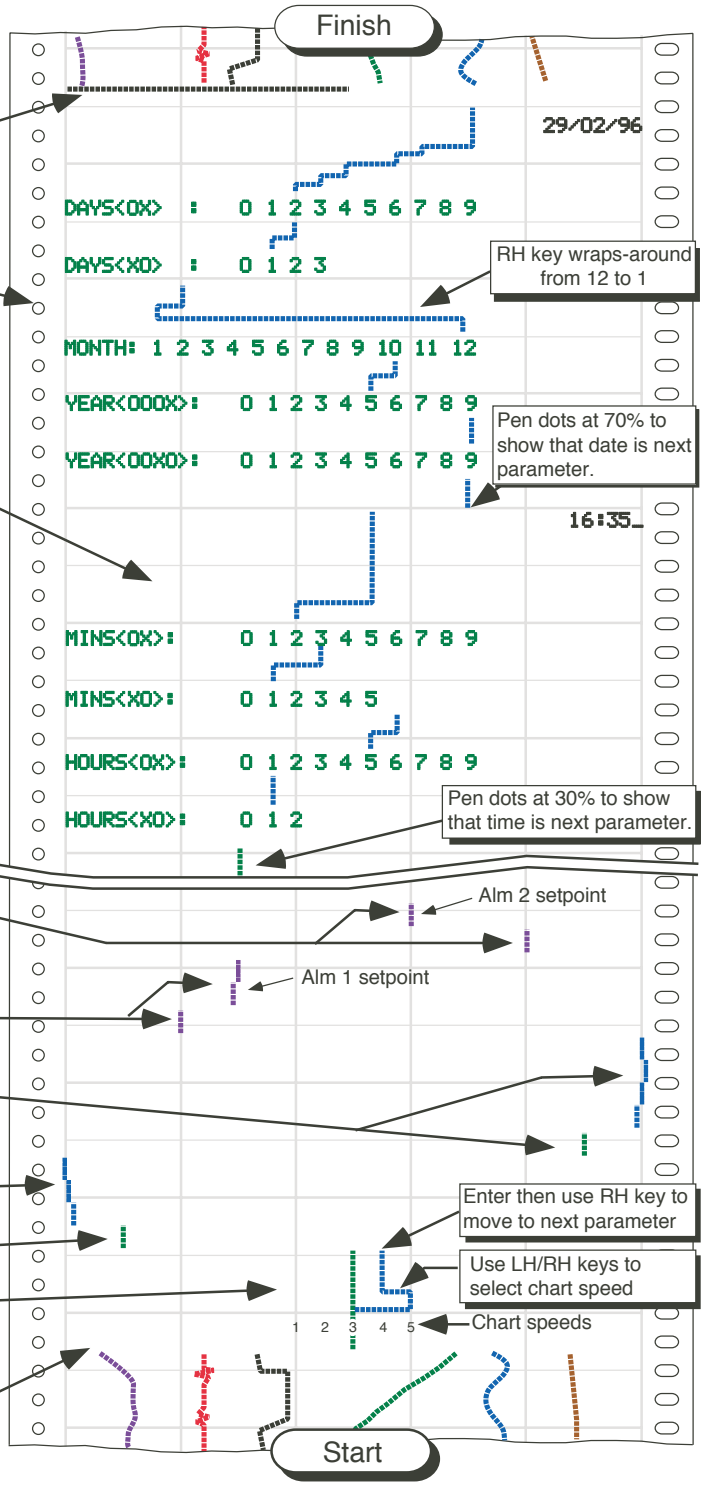


Figure 2.6 Cyclic message printing example



(11) Operate both keys simultaneously for more than 4 seconds to return to normal recording. End of setup indicated by black line drawn from 0 to 50%.

(10) Date set up is carried out using the same method as described below for time setting. Final enter causes date to be printed.

(9) After all alarms are set up, and 'entered', RH key causes 'Time' to be selected for entry. (Pen dots at 30%)

Enter causes the 10s of hours select line to be printed on the chart in green, with the current value being indicated by the blue pen. LH and/or RH keys are used to edit.

Enter followed by RH key causes next line to be printed. Hours units and Minutes 10s and units are set up in the same way.

When minutes units have been set up, wait until exact time, then Enter. Time is printed on the chart.

(8) RH key causes next alarm 1 to be selected (not shown). Continue until all alarm setpoints set up, then Enter.

(7) RH key causes 'Ch1 Alarm 2' set up to be selected for entry (violet pen dots at 80%). Enter causes the violet pen to indicate current setpoint. Use left/right keys to adjust, then Enter.

(6) RH key causes 'Ch 1 Alarm 1' set up to be selected for entry (violet pen dots at 20%). Enter causes the violet pen to indicate current setpoint. Use left/right keys to adjust, then Enter.

(5) RH key causes 'Chart span' set up to be selected for entry (green pen dots at 90% chart width). Enter causes the blue pen to indicate current span. Use left/right keys to adjust, then Enter.

(4) Enter causes blue pen to indicate current zero. Use left/right keys to adjust, then Enter.

(3) RH key causes 'Chart zero' set up to be selected for entry (green pen dots at 10% chart width).

(2) RH key causes 'Chart Speed' set up to be selected for entry (green pen dots at 50%). Enter key causes pen to indicate current selection. Use left/right keys to select new chart speed, then Enter.

(1) Enter stops tracing and causes the print head to park at the centre of the chart (50%).

Notes:

1 RH = Right hand; LH = Left hand

2 Enter = Simultaneous operation of both left and right hand switches for between 1 and 2 seconds then release. (Operation of both switches for over 4 seconds quits configuration without saving any changes made since last 'enter'.)

3 Chart speeds: There are five chart speeds, 1 to 5, where 1 = Off. For speed range fitted, see the label behind the cassette. Table 5.1 shows speeds per range.

4 Alarms (if fitted): Each alarm can be absolute high or absolute low as specified at time of order. See configuration label (behind cassette) for type fitted.

Figure 2.5.3b Simulated chart sample (multipoint recorders)

3 OPTIONS

Up to four 1/2-width option boards can be fitted, as specified at time of order (i.e. options are not retro-fittable).

3.1 RELAY OUTPUTS

The relay output option comes in three versions, each of which uses a 1/2 - width circuit board. The relay specification for resistive loads is as given below. For inductive ac loads, contact life = resistive life x reduction factor in figure 3.1a, in which F1 = measured on representative samples; F2 = typical values (according to experience)

Maximum ac switching power	500 VA
Maximum ac contact voltage	250V within the VA rating above
Maximum ac breaking current	2 A, within the VA rating above.
Maximum dc power/voltage/current	See figure 3.1b.
Isolation (dc to 65Hz; BS EN61010)	Installation category II; Pollution degree 2 (See specification section for definitions)
Contact to contact	300V RMS or dc (double insulation)
Contact to ground	300V RMS or dc (basic insulation)
Estimated life	30,000,000 operations

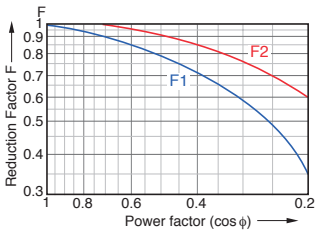


Figure 3.1a

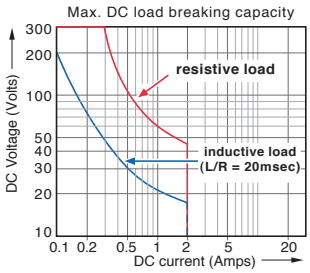


Figure 3.1b

Each recorder channel has two alarm thresholds (alarm 1 and alarm 2), which can both be absolute high or absolute low as defined at time of order. If the channel's value lies above a high threshold, the relevant relay for that channel alarm is active. If the channel's value lies below a low threshold, the relay for that channel alarm is activated.

Notes:

1. There is a 1% of span hysteresis built into the recorder so that if a high alarm becomes active at say, 78% of span, it will remain active until the value has returned to less than 77% of span. This prevents the alarm's continuously changing state when the channel's value is hovering about the threshold.
2. The relays are de-energised in alarm and power off conditions, to provide fail-safe operation.

3.1.1 Three change-over relays board

This 1/2 board provides three change-over relays (i.e. with common, normally open and normally closed contacts). In alarm, the common and normally closed contacts are closed. Wiring details for up to 12 relays are shown in figure 3.1.1 below.

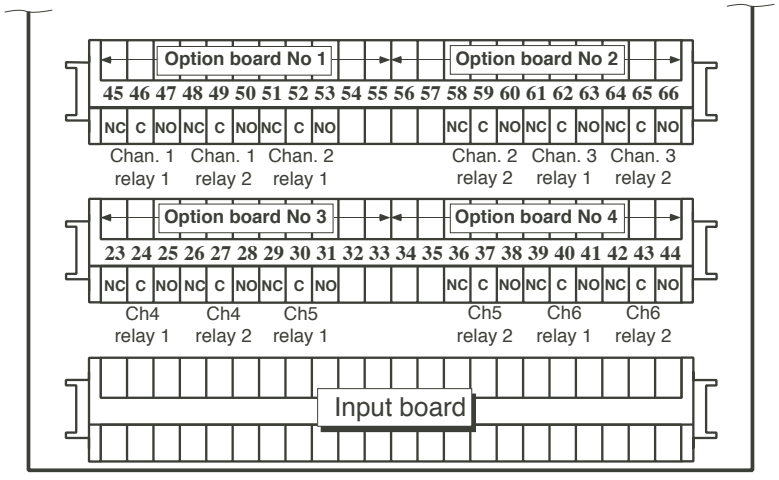


Figure 3.1.1 Change-over relay wiring (alarm / power off state)

3.1.2 Four normally-open relays board

This 1/2 board supplies four relays with common and normally open contacts. In alarm or power off conditions, the common and normally open contacts are open. Figure 3.1.2 below, shows wiring details for 12 relays located at option board positions 1, 2 and 3.

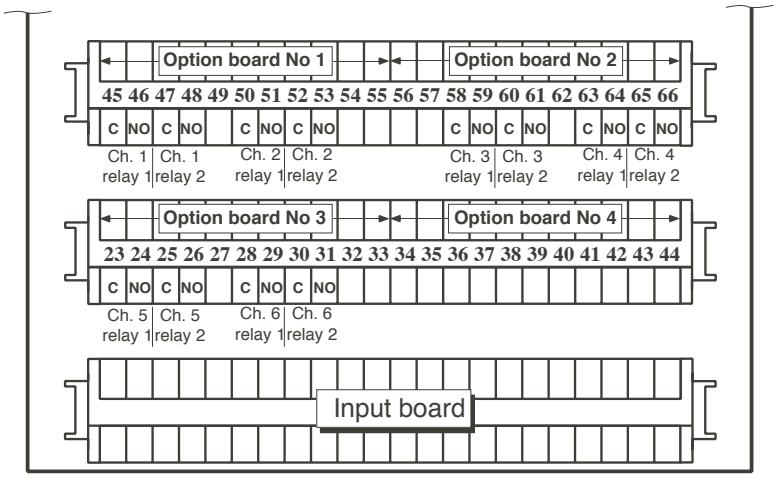


Figure 3.1.2 Normally-open relay wiring (alarm / power off state)

3.1.3 Four normally-closed relays board

This 1/2 board supplies four relays with common and normally closed contacts. In alarm or power off conditions, the common and normally closed contacts are closed. Figure 3.1.3 below, shows wiring details for 12 relays located at option board positions 1, 2 and 3.

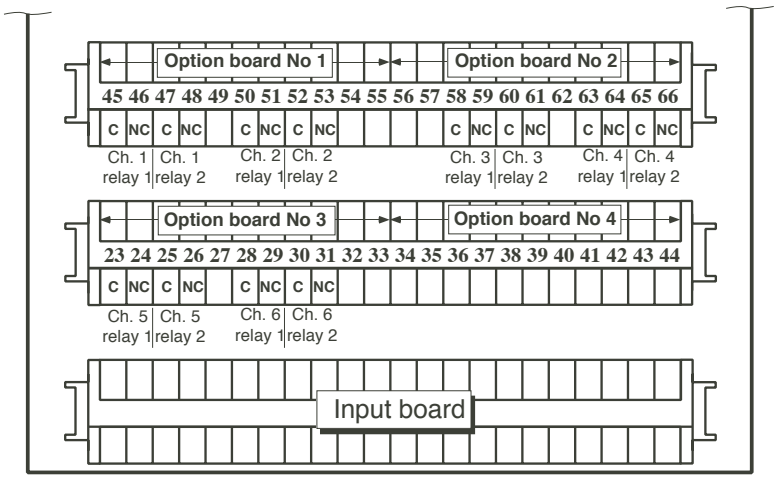


Figure 3.1.3 Normally-closed relay wiring (alarm / power off state)

3.2 TRANSMITTER POWER SUPPLY OPTION

3.2.1 Introduction

This option supplies one or two sets of three isolated 25 Volt outputs wired to terminal blocks for user connection. Each output is intended to supply power to a remote transmitter in order to run a 0 to 20 mA or a 4 to 20 mA current loop.

Figure 3.2.1 shows an overall view of a transmitter power supply option fitted in the rear terminal cover.

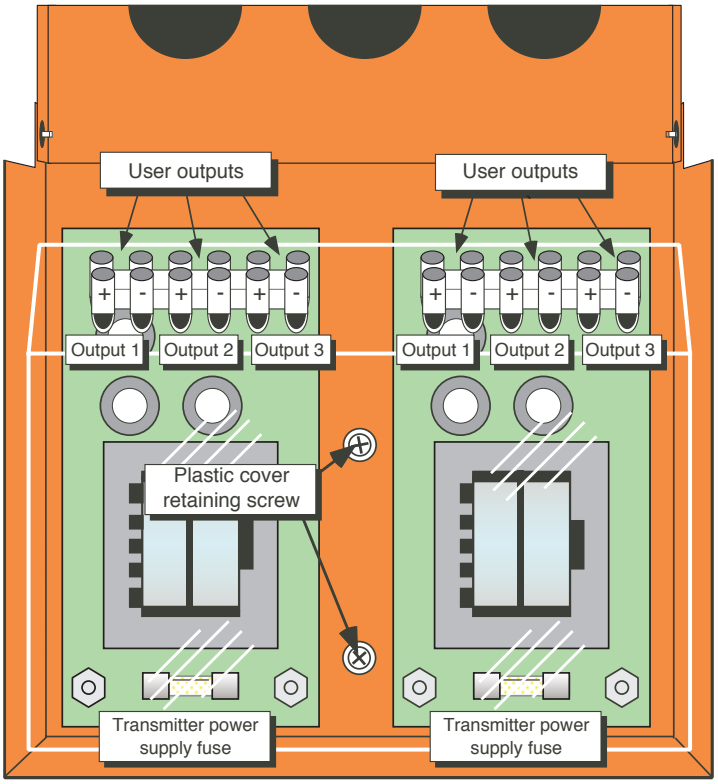


Figure 3.2.1 Transmitter power supply

FUSES

The fuse is a 63mA (220/240V) or 100mA (110/120V), 20mm anti-surge type located on the circuit board as shown in figure 3.2.1 above. Spare fuses are available from the manufacturer.

SAFETY ISOLATION

Isolation (dc to 65 Hz; BS EN61010) Installation category II; Pollution degree 2. (See specification section for definitions.)
Channel to channel = 100V RMS or dc (double insulation); Channel to ground = 300V RMS or dc (basic insulation)

3.2.2 Signal wiring

Each set of outputs is terminated at a terminal block as shown below.

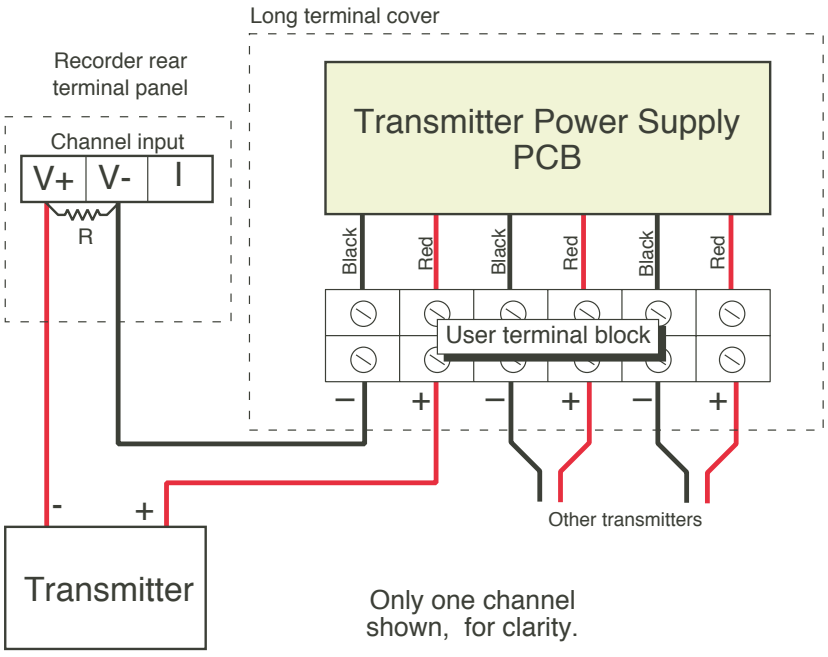


Figure 3.2.2 Transmitter power supply signal wiring

3.3 EVENT INPUT OPTION

This option offers four inputs to control chart on/off and annotation of events. Each event is initiated by a contact closure (or opening) applied between the 'C' terminal and input terminals one to four.

3.3.1 Contact input 1

With the contact closed, the chart runs normally, at its selected chart speed.

When the contact is opened, pens are parked at zero (continuous-trace recorders) or tracing is stopped (multipoint recorders), the chart winds forward eighty mm. and stops.

Contact input 1 may not be closed if contact input 2 (below) is closed.

3.3.2 Contact input 2

This function applies only to annotating recorders.

At closure, the current time and date is printed on the chart. For as long as the contact is closed, the chart runs at its selected speed, but annotation of scales, time, date and chart speed is inhibited.

At contact opening, pens are zeroed (contiuous-trace recorders) or tracing is inhibited (multipoint recorders), time, date, scales and chart speed are printed on the chart, the chart is wound forwards 80 mm. and is then stopped.

Contact input 2 may not be closed if contact input 1 is closed.

3.3.3 Contact input 3

This function applies only to annotating recorders, and is effective only if contact 1 or 2 is closed.

On closure, the message "EVENT START HH:MM:SS" is printed at the left-hand side of the chart, where HH:MM:SS shows the time of closure in hours, minutes and seconds.

On contact opening, the message "DURATION HH:MM:SS" is printed at the left edge of the chart, where HH:MM::SS shows how long the contact has been closed to the nearest second. Should the duration of closure reach 100 hours, the duration re-sets to zero.

3.3.4 Contact input 4

If contact 1 or 2 is closed, then channel four (continuous trace) or channel six (multipoint recorders) is used to show the status of contact closure 4. Whilst contact 4 is open, the trace is at 100% of chart span; whilst closed, the trace moves to 96% of span.

If neither contact 1 or 2 is closed, pen four (continuous-trace recorders) moves to chart zero or tracing by channel 6 (multi-point recorders) is stopped.

3.3.5 Event input wiring

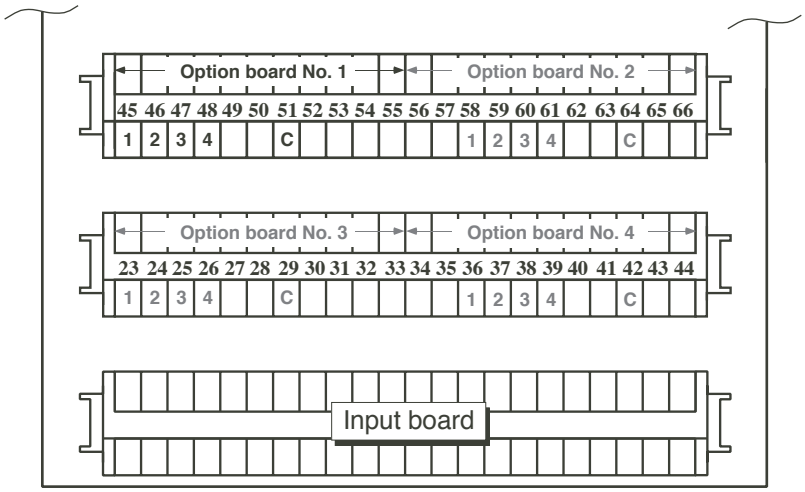


Figure 3.3.5a Event input terminations

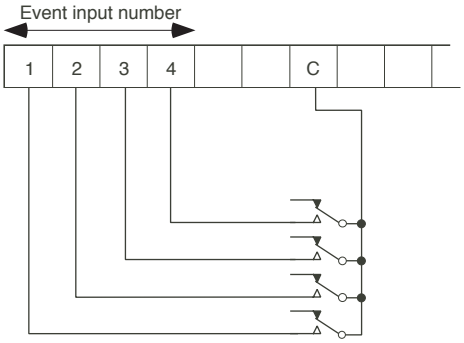


Figure 3.3.5b Event input wiring

3.3.6 Safety Isolation

Isolation (dc to 65 Hz; BS EN61010)	Installation category II; Pollution degree 2 (see specification section for definitions) Event input to ground = 100V RMS or dc (double insulation); Event input to event input = 0V RMS or dc (basic insulation)

4 COSHH DATA

4.1 RECORDING PENS

The COSHH data presented here is derived directly from data sheets produced by the manufacturer to cover all its products. This is reflected in the fact that the list of part numbers includes more than those items relevant to this product,

Product:	RECORDING PENS

Part numbers:

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

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Formamide	25 to 30	Not available	Not established
Acid dyes	1.5 to 3	Not available	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	
		LEL Not applicable	UEL Not applicable
Extinguishing media	Use medium appropriate to primary cause of fire.		
Special fire-fighting procedures	None		
Unusual fire and explosion hazards	None		

HEALTH HAZARD DATA

Threshold limit value	Not established		
LD 50 Oral	Not established	LD 50 Dermal	Not established
Skin and eye irritation	None in normal use		
Over-exposure effects	Unknown		
Chemical nature	Solution of dyestuffs in water and organic solvents		

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	Normal ventilation is adequate
Protective clothing	Use gloves when handling pens to avoid stains on skin/clothing
Other	All colours contain dyes which are suspected carcinogens

4 COSHH DATA (Cont.)

4.2 PRINTHEAD INKS

Product:	WATER BASED INKS NOT CONTAINING FORMAMIDE
Part numbers:	LA248163 LA249556

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Acid dye	1 to 4	Not available	Not established

PHYSICAL DATA

Boiling point	>212 ˚ C	Specific gravity	1.05 to 1.1
Vapour pressure	<20 mm Hg	Solubility in water	Complete
Odour	None	Colours	Various

FIRE AND EXPLOSION DATA

Flash point (deg C) (Method used)	Not flammable	FLAMMABLE LIMIT	
		LEL Not available	UEL Not available
Extinguishing media	Use medium appropriate to primary cause of fire.		
Special fire-fighting procedures	None		
Unusual fire and explosion hazards	None		

HEALTH HAZARD DATA

Threshold limit value	Not established		
LD 50 Oral	> 5g/kg	LD 50 Dermal	Not established
Skin and eye irritation	None in normal use		
Over-exposure effects	Slight irritation of mucus membrane		

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		Strong oxidising agents and temperatures above 90˚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	Normal ventilation is adequate
Protective clothing	Use gloves when handling printheads to avoid stains on skin/clothing
Other	When printheads are being used for recording purposes, there are no known deletarious effects arising from the inks or pen tips.

4 COSHH DATA (Cont.)

4.3 NI-CAD BATTERIES

Product:	NICKEL-CADMIUM BATTERY PACKS
Part numbers:	PA244816 PA250002 PA250188

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Negative electrode (cadmium metal, cadmium hydroxide, nickel sinter)	15 to 25	Not available	Highly toxic
Positive electrode (nickel hydroxide, cobalt hydroxide, nickel sinter)	5 to 15	Not available	Highly toxic if ingested
Electrolyte (potassiun hydroxide)	5 to 15	Not available	Highly toxic, Highly corrosive.

PHYSICAL DATA

Boiling point	Not applicable	Specific gravity	Not applicable
Vapour pressure	Not applicable	Solubility in water	Not applicable
Odour	Not applicable	Colours	Not applicable

FIRE AND EXPLOSION DATA

Flash point (deg C) (Method used)	Not applicable	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	Batteries might explode due to excessive pressure build-up which might not be self-venting. Toxic fumes (cyanogen) might be generated.		

HEALTH HAZARD DATA

Threshold limit value	Not applicable		
LD 50 Oral	Not applicable	LD 50 Dermal	Not applicable
Skin and eye irritation	Should cells leak, the leak material will be a caustic solution. Avoid contact.		
Over-exposure effects	Not applicable		
Chemical nature	See above. There are no risks in normal use.		

FIRST AID PROCEDURES

Eyes and skin	If leakage occurs, wash the affected area withplenty of water and cover with dry gauze. If eyes are affected, wash with plenty of water. Seek medical assistance.
Ingestion	If ingestion of leak material occurs, DO NOT induce vomiting. Give plenty of milk to drink. Obtain immediate medical assistance, stating 'nickel-cadmium battery'.
Inhalation	Not applicable

REACTIVITY DATA

STABILITY				Conditions to avoid
Stable	Yes	Unstable		Mechanical damage, overcharging, short circuiting terminals, storage temperatures outside the range 0 to 40° C
Hazardous decomposition products	None			
Hazardous polymerisation	Will not occur			

SPILL OR LEAK PROCEDURES

In normal use there is no risk of leakage. If batteries are abused, this may lead to the leaking of a caustic alkaline solution which will corrode aluminium and copper. The leak material should be neutralised using 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	Not applicable
Ventilation	Not applicable
Protective clothing	Not applicable
Other	In addition to the electrolyte (potassium hydroxide), nickel-cadmium batteries contain cadmium, cadmium hydroxide and nickel hydroxide, all of which are highly toxic.

4 COSHH DATA (Cont.)

4.4 NICKEL METALHYDRIDE BATTERIES

Product:	NICKEL METAL-HYDRIDE (NiMH) batteries
Part numbers: PA250331 (mounted on circuit board assembly AH249812) PA261437 (mounted on circuit board assembly AH261438)	

HAZARDOUS INGREDIENTS

Name	% Range	TLV	Toxicological data
Nickel hydroxide	10	Not established	Highly toxic if ingested
Nickel metal	20 - 26	Not established	
Misch metal alloy	10-11	Not established	
Potassium hydroxide	8	Not established	Highly toxic, Highly corrosive.

PHYSICAL DATA

Boiling point	Not applicable	Specific gravity	Not applicable
Vapour pressure	Not applicable	Solubility in water	Not applicable
Odour	Not applicable	Colours	Not applicable

FIRE AND EXPLOSION DATA

Flash point (deg C) (Method used)	Not applicable	FLAMMABLE LIMIT	
		LEL	UEL
Extinguishing media	Any	Not applicable	Not applicable
Special fire-fighting procedures	Not applicable		
Unusual fire and explosion hazards	Batteries might explode due to excessive presure build-up which might not be self-venting. Toxic fumes might be generated.		

HEALTH HAZARD DATA

Threshold limit value	Not applicable		
LD 50 Oral	Not applicable	LD 50 Dermal	Not applicable
Skin and eye irritation	Should cells leak, the leak material will be a caustic solution. Avoid contact.		
Over-exposure effects	Not applicable		
Chemical nature	See above. There are no risks in normal use.		

FIRST AID PROCEDURES

Eyes and skin	If leakage occurs, wash the affected area withplenty of water and cover with dry gauze. If eyes are affected, wash with plenty of water. Seek medical assistance.
Ingestion	If ingestion of leak material occurs, DO NOT induce vomiting. Give plenty of milk to drink. Obtain immediate medical assistance, stating 'nickel/metal-hydride battery'.
Inhalation	Not applicable

REACTIVITY DATA

STABILITY				Conditions to avoid
Stable	Yes	Unstable		Mechanical damage, overcharging, short circuiting terminals, charging temperatures outside the range 0 to 65˚ C, direct soldering.
Hazardous decomposition products	None			
Hazardous polymerisation	Will not occur			

SPILL OR LEAK PROCEDURES

In normal use there is no risk of leakage. If batteries are abused, this may lead to the leaking of a caustic alkaline solution which will corrode aluminium and copper. The leak material should be neutralised using 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 according to current local regulations. Batteries should not be discarded with normal refuse.

SPECIAL PROTECTION INFORMATION

Respiratory	Not applicable
Ventilation	Not applicable
Protective clothing	Not applicable
Other	

5 TECHNICAL SPECIFICATION

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.

5.1 TECHNICAL SPECIFICATION (Recorder)

I/O Board types

	Universal input / control board (standard)
	3- Change-over relay output board, 4 Normally open relay output board, 4 Normally closed relay output board

Option boards	
	Transmitter power supply
	Event input board
	Annotator board (Continuous pen recorders only)

Environmental Performance	
Temperature limits	Operation: 0 to 50˚C. Storage: –20 to + 70˚C
Humidity limits	Operation: 5% to 80% RH (non-condensing). Storage: 5% to 90% RH (non condensing)
Protection	Door and Bezel: IP54. Sleeve: IP20. Transmitter Power Supply option rear cover: IP10
Shock	BS EN61010 part 1
Vibration	2g peak at 10 Hz to 150Hz
Altitude (max.)	<2000 metres

Electromagnetic compatibility (EMC)		
	Emissions	BS EN50081-2
	Immunity	BS EN50082-2
Electrical safety		BS EN61010. Installation category II; Pollution degree 2

Physical	
Panel mounting	DIN43700
Bezel size	144 x 144 mm.
Panel cutout dimensions	138 x 138 (both – 0 + 1 mm)
Depth behind bezel rear face	220 mm (No terminal cover); 236 mm (with terminal cover)
Weight	< 3.5kg
Panel mounting	Vertical ± 30˚

5.1 TECHNICAL SPECIFICATION (Recorder) (Cont.)

Printing system (continuous trace)

Pen type: Disposable fibre-tipped pens

Pen resolution: 0.15 mm

Pen colours:

Channel	Colour	Channel	Colour
1 (top)	blue	4 (bottom)	violet
2	red	annotator	black
3	green		

Pen life: 1.2 km (channel pens); 7.5 x 10^5 dots (annotator)

Update rate: 4 Hz

Response time (10 to 90%): 2 sec max.

Annotator characters per line: 38

Printing system (multipoint)

Pen type: Six-nib cartridge

Print resolution: 0.2 mm

Trace colours:

Channel	Colour	Channel	Colour
1	violet	4	green
2	red	5	blue
3	black	6	brown

Printhead life: 1.5 x 10^6 dots per colour

Update rate: 2 Hz

Print rate (maximum): 1 pass every 5 seconds

Characters per line: 42

Paper transport

Type: Stepper motor driving sprocket tube

Chart speeds: Off + 4 user selectable chart speeds defined at time of order. Table below gives available ranges.

Chart type: 16- metre z-fold (standard) or 32 - metre roll (option)

Transport accuracy: 0.5 cm in 16 metres (0.03% approx.)

Range	Speed (mm/hr) 1	2	3	4	5	Recorder type
1	Off	5	20	60	120	Continuous and multipoint
2	Off	10	20	60	120	
3	Off	10	30	60	120	
4	Off	20	30	60	120	
5	Off	30	60	120	300	Continuous only. Annotation (if fitted) inhibited above 300 mm/hr.
6	Off	20	120	600	1200	
7	Off	20	300	1200	3600	
8	Off	20	3600	18000	36000	

Table 5.1 Chart speeds

Power requirements

Line voltage — Standard: 90 to 264V; 45 to 65 Hz.

Enhanced interrupt protection: 90 to 132V; 45 to 65 Hz.

Low voltage option: 20 to 53V dc or ac (RMS) (ac frequency range: 45 to 400 Hz.)

Power (Max): 100VA

Fuse type: None

Interrupt protection — Standard: 40ms at 75% max. instrument load

Enhanced: 120msec at 75% max. instrument load

5.2 TECHNICAL SPECIFICATION (Input board)

General

Termination	Edge connector / terminal block
Maximum number of inputs	Continuous trace recorder = 4. Multipoint recorder = 6.
Input ranges	- 30 to + 150 mV; - 0.2 to + 1 Volt; - 2 to + 10 Volts.
Input types	dc Volts, dc millivolts, dc milliamps (with shunt), thermocouple, 2 / 3-wire resistance temperature detector (RTD) **(Channel 1 can be RTD only if no other channel is thermocouple)**
Input type mix	Set by manufacturer as per customer order.
Noise rejection (48 to 62 Hz)	Common mode: >140dB (channel - channel and channel - to - ground). Series mode: >60dB.
Maximum common mode voltage	250 Volts continuous
Maximum series mode voltage	180 mV at lowest range; 12 Volts peak at highest range.
Isolation (dc to 65 Hz; BS EN61010)	Installation category II; Pollution degree 2 (See section 5 above for definitions) 300V RMS or dc, channel to channel (double insulation), channel to common electronics (double insulation) and channel to ground (basic insulation)
Dielectric strength (BS EN 61010)	Channel to ground =1350 Vac; Channel to channel = 2300 Vac. (Both 1 minute type tests)
Insulation resistance	>10MΩ at 500 V dc
Input impedance	150 mV and 1 V ranges: >10 MΩ; 10 V range: 68.8 kΩ
Over voltage protection	50 Volts peak (150V with attenuator)
Open circuit detection	± 57 nA max.
Recognition time	Continuous trace = 250 msec; Multipoint = 500 msec
Minimum break resistance	10 MΩ

DC Input ranges

Shunt	Externally mounted resistor modules
Additional error due to shunt	0.1% of input
Additional error due to attenuator	0.2% of input

Performance

Low Range	High Range	Resolution	Maximum error (Instrument at 20˚C)	Worst case temperature performance
-30 mV	150mV	5.5μV	0.084% input + 0.053% range	80ppm of input per deg C
-0.2 Volt	1 Volt	37μV	0.084% input + 0.037% range	80ppm of input per deg C
-2 Volts	10 Volts	370μV	0.275% input + 0.040% range	272ppm of input per deg C

Thermocouple data

Temperature scale	ITS 90
Linearisation accuracy	0.05% of user selected span.
Bias current	0.05 nA
Cold junction types	Off, internal, external as specified at time of order
CJ error	1˚C max; instrument at 25˚C
CJ rejection ratio	50:1 minimum
Upscale / downscale drive	High, low or none as specified at time of order

Types and ranges

T/C Type	Overall range (˚C)	Standard
B	0 to + 1820	IEC 584.1
C	0 to + 2300	Hoskins
D	0 to + 2495	Hoskins
E	- 270 to + 1000	IEC 584.1
G2	0 to + 2315	Hoskins
J	- 210 to + 1200	IEC 584.1
K	- 270 to + 1372	IEC 584.1
L	- 200 to + 900	DIN43700:1985 (To IPTS68)
N	- 270 to + 1300	IEC 584.1
R	- 50 to + 1768	IEC 584.1
S	- 50 to + 1768	IEC 584.1
T	- 270 to + 400	IEC 584.1
U	- 200 to + 600	DIN 43710:1985
Ni/NiMo	0 to + 1406	Ipsen
Platinel	0 to + 1370	Engelhard

5.1 TECHNICAL SPECIFICATION (Recorder) (Cont.)

Resistance inputs

Ranges (including lead resistance)	0 to 600 Ω, 0 to 6k Ω
Linearisation accuracy	0.05% of user entered span.
Influence of lead resistance	Error = negligible; Mismatch = 1 Ω/Ω
Temperature scale	ITS90

Resolution and performance

Low Range	High Range	Resolution	Maximum error (Instrument at 20°C)	Worst case temperature performance
0Ω	600Ω	22mΩ	0.045% input + 0.065% range	35ppm of input per deg C
0Ω	6000Ω	148mΩ	0.049% input + 0.035% range	35ppm of input per deg C

RTD types and ranges

RTD Type	Overall range (°C)	Standard
JPT100	-220 to + 630	JIS C1604:1989
Ni100	- 60 to + 250	DIN43760:1987
Ni120	- 50 to + 170	DIN43760:1987
Pt100	-200 to + 850	IEC 751
Pt100A	-200 to + 600	Eurotherm Recorders SA
Pt1000	-200 to + 850	IEC 751

6 GLOSSARY OF TERMS

Alarm A function which is triggered when an *input signal* or a signal derived from it reaches a certain value. Once triggered, the alarm can cause a *relay output* to change state.

Analogue input An input which changes in a smooth (non-stepped) way (e.g. thermocouples, resistance thermometers).

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 and, the instrument's response to an open circuit can be defined as 'None', 'Drive high' or 'Drive low' at time of order. 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) junction depends on the temperature difference between the actual 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.

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)'. For this recorder, most of the configuration is done by the manufacturer, leaving only simple selections (such as chart speed) to be made by the user.

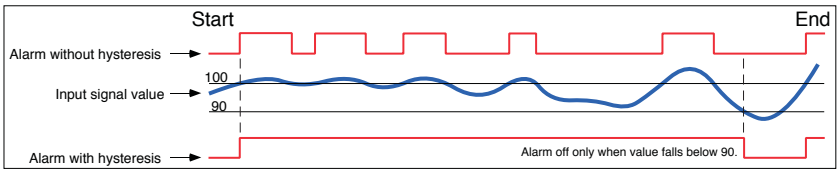
Continuous trace This is used to describe recorders which have a single *pen* associated with each *process variable*, and this pen *traces* the value continuously. See also multipoint recorder.

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.

6.GLOSSARY OF TERMS (Cont.)

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 the cause of which can be dealt with if necessary. To avoid this, a 'hysteresis' value of 1% span is applied, which effectively puts a dead band round the set point. For example with a span of 0 to 1000 an absolute high alarm with a set point of 100 will have a hysteresis value of 10. The alarm is triggered when the input signal value rises above 100, but will not re-trigger until after the alarm has 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.

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*.

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.

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 printhead 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) 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 tray — With modular recorder designs, each *pen* has its own mechanical system (including motor and feedback device) associated with it to 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 multipoint 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 an alarm becoming active. 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.

6 GLOSSARY OF TERMS (Cont.)

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.
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.

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