Eurotherm®

by **Schneider** Electric

392 Circular chart recorder

Installation and Operation Manual

Consumables part numbers

Pens (Pack of two)

Channel 1 (blue)	LA203211
Channel 2 (red)	LA203212
Channel 3 (green)	LA203213
Channel 4 (black)	LA203214

Standard charts

12 hour	GD239347Uxxx
24 hour	GD239347Uxxx
7 day	GD239347Uxxx

(xxx = number of chart divisions
= 050, 060, 070, 080, 100, 150.)
Example: GD239347U100
is a 24 hour chart, marked 0 to 100.

Associated Manuals

HA204393	Controller and Setpoint Generator manual
HA204394	Serial communications manual

100 mm CIRCULAR-CHART RECORDER

INSTALLATION AND OPERATION MANUAL

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SAFETY NOTES

WARNING

1. The Safety, EMC and other compliance requirements of the system incorporating this instrument is the responsibility of the installer (assembler) of the system.
2. 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. See also note 10 and 11 below.
3. Live sensors: The unit is designed to operate if the temperature sensor is connected directly to an electrical heating element. It must be ensured that service personnel do not touch connections to such inputs whilst the inputs are live. With live sensors, all cables, connections and switches for connecting the sensor must be mains rated for use in 240V Cat II.
4. Grounding the temperature sensor shield: Where it is common practice to replace the temperature sensor whilst the instrument is live, it is recommended that the shield of the temperature sensor be grounded to safety earth, as an additional protection against electric shock.
5. The instrument must not be wired to a three-phase supply with an unearthed star connection, because, under fault conditions, such a supply could rise above 240V RMS with respect to ground, thus rendering the instrument unsafe.
6. 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.

Notes:
1. Safety requirements for permanently connected equipment state:
    a. A switch or circuit breaker shall be included in the building installation.
    b. It shall be in close proximity to the equipment and within easy reach of the operator.
    c. It shall be marked as the disconnecting device for the equipment.
2. Disconnecting the mains supply means isolating all current carrying conductors associated with the equipment.

1. This instrument has no serviceable parts, with the exception of any listed consumables. Please contact your supplier for advice.
2. This instrument is intended for industrial temperature, process control and/or monitoring/recording applications within the requirements of the European directives on safety and EMC.
3. Installation may be carried out by qualified and suitably trained personnel only.
4. To prevent hands or metal tools coming into contact with parts that are electrically live the instrument must be installed in a panel or enclosure.
5. Where conductive pollution (e.g. condensation, carbon dust) is likely, adequate air conditioning/ filtering/ sealing etc. must be installed in the enclosure.
6. If the instrument is fitted with an internal mains supply fuse it is not replaceable. If it is suspected that the fuse is faulty, the manufacturer's local service centre should be contacted for advice.
7. In all cases the instrument must be protected by an externally supplied fuse. The recommended external fuse rating is 3 Amp, Type T; 250 V.
8. Whenever it is likely that protection has been impaired, the unit shall be made inoperative, and secured against accidental operation. The manufacturer's nearest service centre should be contacted for advice.
9. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.
10. Before any other connection is made, the protective earth terminal shall be connected to a protective conductor. The protective earth connection must always be the first to be connected and the last to be disconnected. The mains (supply voltage) wiring must be terminated in such a way that, should it slip, the Earth wire would be the last wire to become disconnected. The protective earth terminal must remain connected if any of the I/O circuits are connected to hazardous voltages* (even if the equipment is isolated from the mains supply).

* A full definition of 'Hazardous' voltages appears under 'Hazardous live' in BS EN61010. Briefly, under normal operating conditions, hazardous voltages are defined as being > 30V RMS (42.2V peak) or > 60V dc.

11. The instrument must be wired in accordance with data given in this manual or the Installation and wiring instructions which are supplied with the instrument. Always use copper cables unless otherwise stated. Wiring must comply with all local wiring regulations, e.g. in the UK, the latest IEEE wiring regulations (BS7671) and in the USA, NEC class 1 wiring methods.

12. Mains supply cables must comply with the requirements of IEC60227 or IEC60245.

> Note: The minimum recommended mains supply wire size is 20AWG equivalent to 16/0.2 (0.5 mm^2).

13. 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.

14. Flexbile metal conduit should be used for all external wiring wherever there is a risk of mechanical damage.

15. The maximum continuous voltage applied between any of the following terminals must not exceed 240Vac:

   a.   Relay output to logic, dc or sensor input connections
   b.   Any connection to ground.

   THE AC SUPPLY MUST NOT BE CONNECTED TO SENSOR INPUT OR LOW-LEVEL INPUTS OR OUTPUTS.

16. Instrument labels may be cleaned using iso-propyl alcohol, or water or water-based products. A mild soap solution may be used to clean other exterior surfaces.

REMARQUES CONCERNANT LA SÉCURITÉ   (F)

AVERTISSEMENT

1.   Il appartient à l'installateur du système de s'assurer que le système intégrant cet instrument est conforme aux exigences de sécurité, à la compatibilité électromagnétique et autres exigences de conformité.

2.   Toute coupure du conducteur de protection, à l'intérieur ou à l'extérieur de l'appareil, ou la déconnexion de la borne de mise à la terre de protection risque de rendre l'appareil dangereux lors de certaines anomalies de fonctionnement. Toute coupure intentionnelle est interdite. Voir aussi les notes 10 et 11 ci-dessous.

3.   Capteurs sous tension : Ce régulateur est conçu pour fonctionner avec le capteur de température directement relié à un élément de chauffage électrique. Veillez à ce que le personnel d'entretien ne touche pas ces connexions lorsqu'elles sont sous tension. Tous les câbles, connexions et commutateurs de connexion d'un capteur sous tension devront être calibrés en fonction de la tension du réseau de 240 V CATII.

4.   Mise à la terre du blindage du capteur de température : Lorsqu'on a l'habitude de remplacer le capteur de température pendant que l'instrument est sous tension, il est recommandé de mettre le blindage du capteur de température à la terre comme protection supplémentaire contre les chocs électriques.

5.   L'instrument ne doit pas être câblé sur une alimentation triphasée comportant une connexion étoile non mise à la terre car en cas de défaillance cette alimentation pourrait dépasser 240 V RMS en ce qui concerne la terre, ce qui rendrait l'instrument dangereux.

6.   Toute coupure du conducteur de protection, à l'intérieur ou à l'extérieur de l'appareil, ou la déconnexion de la borne de mise à la terre de protection risque de rendre l'appareil dangereux lors de certaines anomalies de fonctionnement. Toute coupure intentionnelle est interdite.

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Notes :
1. Les consignes de sécurité applicables aux équipements connectés en permanence stipulent que :
   a. Un interrupteur ou disjoncteur doit être inclus dans l'installation.
   b. Ce dernier doit être situé à proximité immédiate de l'équipement et être facilement accessible pour l'opérateur.
   c. Il doit être clairement identifié comme dispositif de sectionnement de l'équipement.
2. Débrancher le secteur signifie que tous les conducteurs porteurs de courant associés à l'équipement seront isolés.

1. Cet instrument ne dispose pas de pièce réparable, à l'exception des consommables indiqués. Veuillez contacter votre fournisseur pour tout conseil.
2. Cet instrument est conçu pour des applications industrielles de régulation des procédés et/ou de surveillance/enregistrement de la température et satisfait aux exigences des directives européennes en matière de sécurité et de compatibilité électromagnétique.
3. L'installation ne peut être effectuée que par un personnel formé qualifié et approprié.
4. Pour éviter que les mains ou des outils en métal n'entrent en contact avec les pièces sous tension, l'instrument doit être installé sur un tableau ou dans une armoire.
5. Dans les situations où une pollution conductrice (condensation, poussière de carbone) est probable, un dispositif de conditionnement/filtrage d'air ou d'étanchéité doit être installé dans l'armoire.
6. Si l'instrument est muni d'un fusible d'alimentation secteur interne, il n'est pas remplaçable. Si l'on soupçonne que le fusible est défectueux, s'adresser impérativement au service après-vente du fabricant pour la marche à suivre.
7. Dans tous les cas, l'instrument doit être protégé par un fusible externe fourni. Le fusible externe conseillé doit avoir une capacité de 3 A, de type T; 250 V.
8. Lorsqu'il est probable que la protection a été endommagée, l'unité doit être mise hors service et protégée contre toute utilisation accidentelle. S'adresser impérativement au service après-vente du fabricant pour la marche à suivre.
9. Si l'équipement est utilisé autrement que de la manière spécifiée par le fabricant, la protection assurée par l'équipement risque d'être compromise.
10. Avant d'effectuer tout autre raccordement, la borne de mise à la terre de protection sera raccordée à un conducteur de protection. La prise de terre doit toujours être la première connectée et la dernière déconnectée. Le câblage secteur (tension d'alimentation) doit être borné de manière à ce qu'en cas de glissement, le fil de terre soit le dernier à se déconnecter. La borne de mise à la terre doit rester connectée si les circuits E/S sont connectés à des tensions dangereuses* (même si l'équipement est isolé de l'alimentation secteur).
* Une définition complète des tensions « dangereuses » est fournie dans « Hazardous live » dans la norme BS EN61010. Pour résumer, dans les conditions de fonctionnement normales, les tensions dangereuses sont définies comme celles qui correspondent à 30 V RMS (42,2 V crête) ou 60 V cc.

11. L'instrument doit être raccordé conformément aux données indiquées dans le présent manuel ou aux instructions d'installation et de câblage fournies avec l'instrument. Toujours utiliser des câbles de cuivre, à moins que ce ne soit spécifié autrement. Le câblage doit respecter toute la réglementation locale en la matière, par exemple au Royaume-Uni la réglementation de câblage IEEE la plus récente (BS7671) et aux États-Unis les méthodes de câblage NEC Classe 1.
12. Les câbles d'alimentation secteur doivent être conformes aux exigences des normes IEC60227 ou IEC60245.

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> Note : La taille minimale conseillée pour le câble d'alimentation secteur est 20AWG, équivalent à 16/0.2 (0.5 mm^2).

13. Les câbles de puissance doivent être séparés de ceux d'alimentation. Si ceci n'est pas possible pour des raisons pratiques, des câbles gainés doivent être utilisés pour les câbles de commande.

14. Une gaine métallique souple doit être utilisée pour tous les câbles externes, partout où demeure un risque d'endommagement mécanique.

15. La tension maximale appliquée en régime continu aux bornes suivantes ne doit pas dépasser 240 V CA:

    a. Sortie relais vers raccordements logiques, CC ou capteur

    b. Raccordements à la terre.

L'ALIMENTATION CA NE DOIT PAS ÊTRE RACCORDÉE À UNE ENTRÉE DE CAPTEUR OU À DES ENTRÉES OU SORTIES DE NIVEAU BAS.

16. Les étiquettes des instruments peuvent se nettoyer à l'alcool isopropyl ou avec de l'eau ou des produits à base d'eau. Utiliser une solution savonneuse douce pour nettoyer les autres surfaces extérieures.

SYMBOLS USED ON THE RECORDER LABELLING

One or more of the symbols below may appear as a part of the recorder labelling.

Symbol	Description	Symbol	Description
⚠	Refer to the Manual for instructions	C N1981	C-Tick mark for Australia (ACA) and New Zealand (RSM)
⚡	Risk of electric shock	cUL US LISTED 74B5 E86160 / cUL US LISTED 13DO E57766	Underwriters laboratories listed mark for Canada and the U.S.A.
	Precautions against static electrical discharge must be taken when handling this unit	40	For environmental reasons, this unit must be recycled before its age exceeds the number of years shown in the circle.
⏚	Protective earth (ground) terminal		Ethernet connector
▣	Protected by DOUBLE INSULATION	⇒	USB connector
CE	This unit is CE approved	🗑	Dispose of properly

WARRANTY STATEMENT

This product is warranted against defects in materials and workmanship for the specified period from the date of shipment. During the warranty period the manufacturer will, at its option, either repair or replace products which prove to be defective.

Warranty service at the buyer's facility can be provided only under prior agreement by the manufacturer or its representative, and the buyer may be required to pay round-trip travel expenses.

In all cases, the buyer has the option of returning the product for Warranty service to a facility designated by the manufacturer or its representatives. The buyer shall prepay shipping charges for products returned to a service facility, and the manufacturer or its representative shall pay for the return of the product to the buyer.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects arising from:

- Improper or inadequate maintenance by the user
- Improper or inadequate site preparation
- Unauthorized modification or misuse
- Operation of the product in unfavourable environments, especially, high temperature, high humidity, corrosive or other damaging atmospheres

DISCLAIMER

No other warranty is expressed or implied. The manufacturer specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

EXCLUSIVE REMEDIES

The remedies provided are the buyer's sole and exclusive remedies. The manufacturer shall not be liable for any direct, indirect, special incidental or consequential damages.

CALIBRATION ACCURACY

This product was thoroughly tested to ensure compliance with the published specifications. All instruments used in production and final test are regularly inspected to maintain accuracy of calibration traceable to the National Bureau of Standards. The user should be satisfied that the performance of the product as received meets expectations and, as part of a programme of planned maintenance, should periodically check calibration accuracy against reliable standards.

1 INTRODUCTION

This manual is intended to familiarise the user with the basic installation, operations and routine maintenance of a 100 mm continuous-trace circular-chart recorder. For details of other manuals associated with this recorder, please refer to the list of associated manuals on the inside front cover.

1.1 MANUAL LAYOUT

This manual is divided into a number of sections as follows:

Section 1   This describes the manual and its organisation and gives a brief description of the recorder

Section 2   Installation. Gives mechanical and electrical installation details.

Section 3   Operation. Gives details of the operating displays of the recorder.

Section 4   Configuration. Gives details of how to set the recorder up to measure and record the required inputs.

Section 5   Calibration. Gives details of how to calibrate input and output channels and how to align the pens with the chart.

Section 6   Diagnostics. This section gives diagnostic and fault-finding details.

Annex A   The technical specification for the recorder.

1.2 RECORDER DESCRIPTION

The recorder is a user-configurable 1, 2, 3 or 4-pen instrument producing traces on a circular chart of 100 mm calibrated width. The operator interface is an integral membrane keyboard and associated vacuum fluorescent display (two lines, each of twenty characters).

Configuration is divided into a number of sections, with logical menu-driven steps displayed in plain English. The sectional nature of the menu structure allows the user to select only those items required for a particular application.

Modular construction and the use of surface-mount technology produce a compact design which is easy to maintain and to upgrade.

Figure 1.3a Door catch

1.3 UNPACKING AND INSPECTION

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.

Open the door of the recorder by lifting up the bottom of the catch and pulling it outwards and upwards (figure 1.3a). Open the door and loosen the captive Platen locking screw (figure 1.3b) to release the chart platen. Ensure the adjacent earth screw is not accidentally loosened in the process. Open the platen, and inspect the recorder for mechanical integrity. Re-secure the platen and latch the door shut. If the recorder is to be stored before use, return it to the packing in which it was received. If not, the recorder may now be mounted as described below.

Once the recorder has been installed, any internal packing should be removed, and stored with the external packing against future transport requirements.
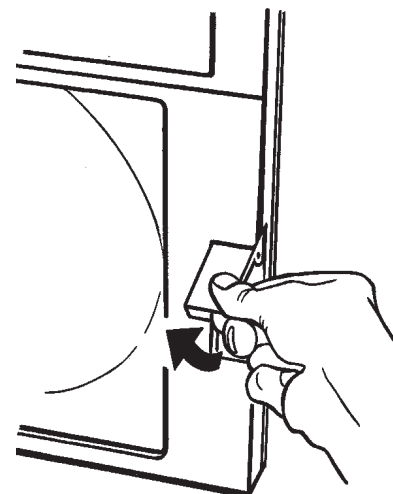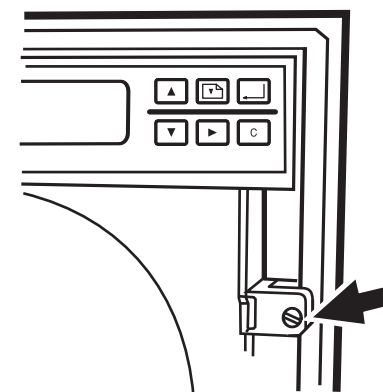
Figure 1.3b Platen securing screw

2 INSTALLATION

2.1 MECHANICAL INSTALLATION

Mechanical installation details are shown in figure 2.1

2.1.1 Panel mounting

The recorder is inserted through the panel aperture from the front of the panel. With the weight of the recorder supported, the recorder is secured using the two clamp brackets supplied , either at the top and bottom or at the right and left sides of the recorder.

2.1.2 Wall mounting

The clamp brackets are reversed for wall mounting.
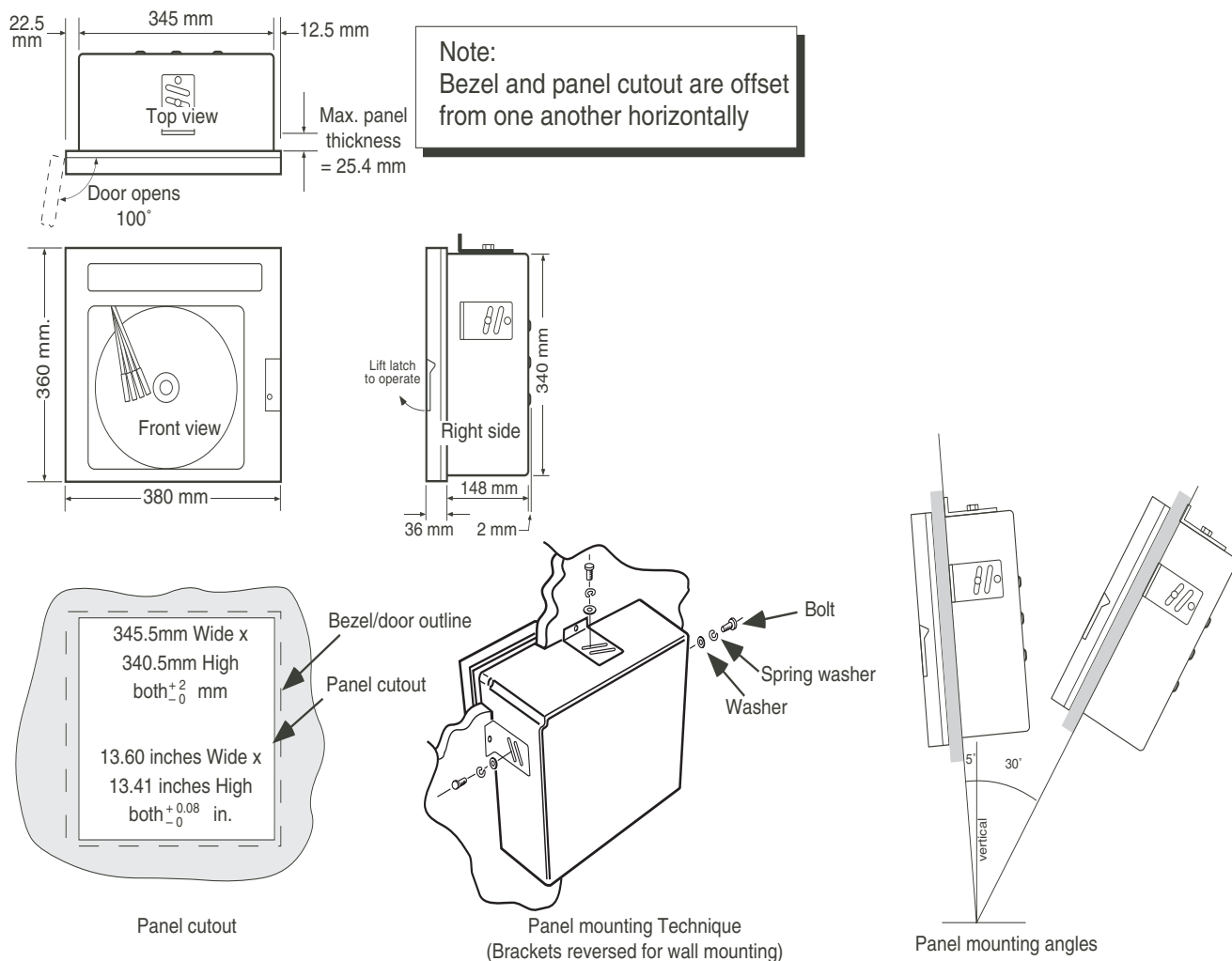
Figure 2.1 Mechanical installation

2.2 ELECTRICAL INSTALLATION

Details for connecting the line supply and for signal wiring are shown in figure 2.2.1

2.2.1 Supply voltage and case heater option wiring

There are two mains connectors on the board wired in parallel. One is intended for supply voltage connection - the other is for the case heater option (now obsolete). As they are in parallel, either connector can be used. The connector for supply voltage connection is in two parts; one part mounted on the main circuit board, the other (mating) part is supplied in the recorder accessory pack. The wiring details for this connector are shown in figure 2.2.1. It must be ensured that the bared ends of the wires are fully inserted before the clamping screws are tightened. The safety earth connection is to be made to the earthing point located in the bottom right hand corner of the case using an M5 ring terminal clamp with the fixing tightened to 2Nm. The safety earth conductor must be connected independently, as a separate cable and be of such a length that it would be the last conductor to become disconnected should the mains (line) cord be pulled out of the connector.

The earth connector pin on the main board connector is the same length as the Line and Neutral pins; local codes of practise should be consulted before making an earth connection to this point.
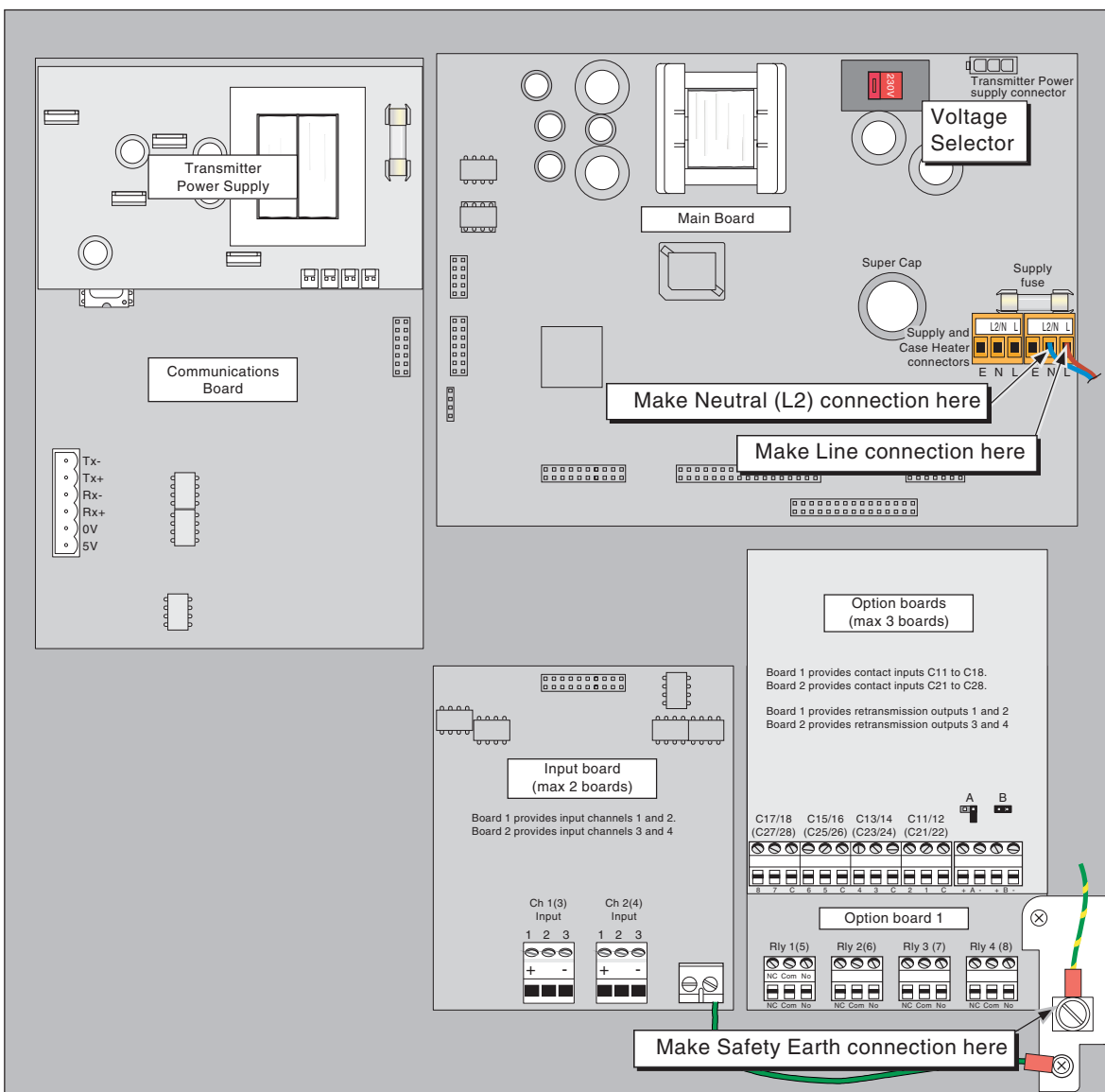
Figure 2.2.1 Circuit board location and Supply Voltage connection (communication board now obsolete)

2.2.2 Supply Voltage selection

The supply voltage selector is located on the main circuit board, near the top wall of the case, as shown in figure 2.2.1. Ensure that the slider is in such a position that the number displayed (115 or 230) matches the supply voltage that is to be connected. The supply frequency range for both voltage settings is 48 to 62 Hz.

The '115' position is suitable for supply voltages of between 90 and 132 V ac and must be fused with a slow blow, 1 Amp, 20 mm fuse link.

The '230' position is suitable for supply voltages of between 180 and 264 V ac and must be fused with a slow blow, 1/2 Amp (500 mA), 20 mm fuse link.

2.2.3 Signal wiring

The recorder can be connected and configured to operate with a variety of signal sources such as thermocouples, resistance thermometers (RTDs), dc current, dc voltage etc.

The configuration of the recorder may require the moving of one or more 'jumpers' on the input amplifier board, and / or the use of input conditioning boards to provide shunts or attenuators.

ATTENUATOR EXAMPLE

A voltage of 2 to 10 V dc is to be applied across a channel input. As the maximum input voltage is 5 Volts the 100:1 attenuator must be used, resulting in a recorder input range of 20 mV (2V/100) to 100 mV (10V/100).

PINOUTS

The locations of the input and option boards are shown in figure 2.2.1.

Signal wiring termination for the input board is shown in figure 2.2.3a. Signal wiring termination for retransmission outputs, relay outputs and event inputs is shown in figure 2.2.3b.

Notes
1. When wiring RTDs, lead length and diameter must be chosen such that lead lengths are equal and that each lead exhibits no more than 10 ohms resistance between the recorder and the RTD.
2. For event input closures, high quality, low resistance contacts must be used which are suitable for dry (i.e. non-powered) operation.

Caution
The input circuitry is protected against over-voltage up to 24 V dc. Voltages above this can cause damage to the input board.
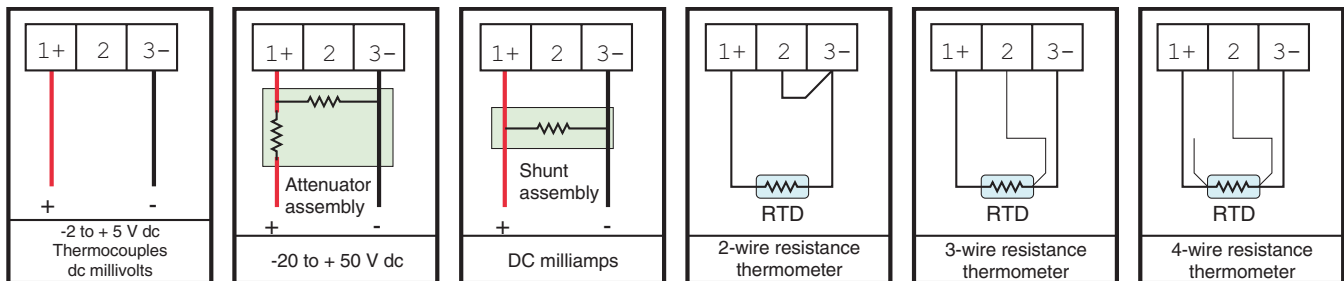
Figure 2.2.3a Input board wiring

2.2.3   SIGNAL WIRING (Cont.)
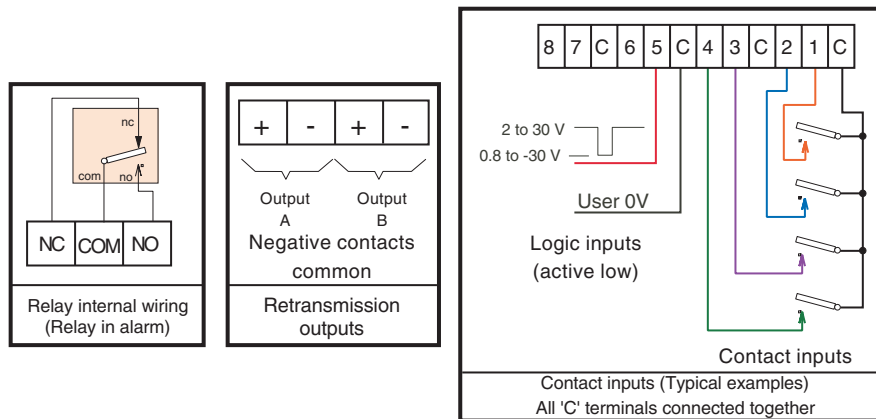
Figure 2.2.3b Option wiring

TRANSMITTER POWER SUPPLY WIRING

Transmitters can be powered by an internal 24V nom. power supply, or by an external supply. Typical wiring for a single channel is given in figure 2.2.3c.

Caution

A transmitter in a current loop must not be shorted. If it is, the transmitter power supply is essentially connected directly across the input shunt. In such a case the shunt will almost certainly suffer damage.
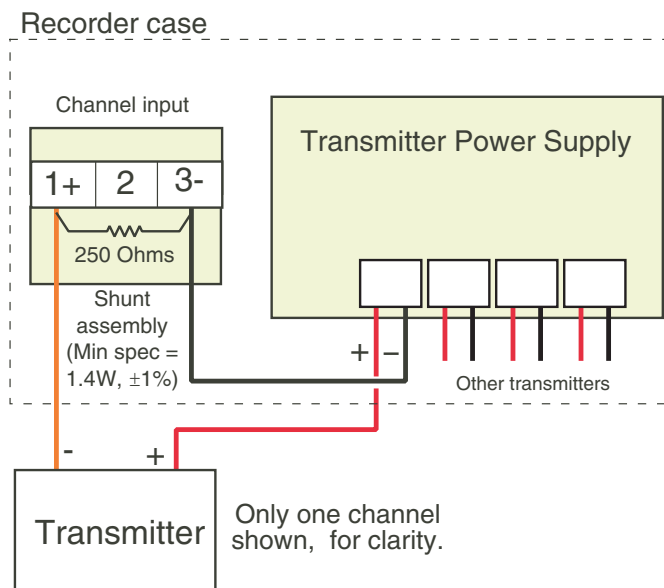
Figure 2.2.3c Typical transmitter power supply wiring

2.2.4 Termination details

The screw terminals accept single wires in the range 0.14 to 2.08 mm2 (26 to 14 AWG) inclusive. Screw terminals should be tightened to a torque not exceeding 0.6Nm (5.31 lb in)

2.2.5 Wiring installation

In order to ensure maximum recorder performance, proper wiring installation practises must be followed. Failure to do so can result in a range of problems, from loss of configuration to component failure, caused by transmitted or radiated electrical noise. Proper consideration must be given to local noise sources and appropriate suppression steps taken to minimise any potential problems. Among the most common sources of noise are: Relays, SCRs, valve solenoids, electric motors, power line disturbance, wire-to-wire coupling, electrostatic discharge (ESD) and radio-frequency interference (RFI).

To achieve the best results, the following notes should be considered:

1. Low level signal wiring such as that associated with thermocouples, RTDs and current loops should always be kept separate from power and control output wiring.
2. Signal input wiring should be twisted pairs/triplets etc. and the conductors should be stranded rather than solid in construction. All signal wiring should use ground-shielded wires, or be routed through grounded conduit. This minimises the effects of RFI and ESD.
3. Special care should be taken when wiring to relay or solenoid coils, as large transients are produced when coils (or any other inductive devices) are switched. This problem can be eliminated by the use of suitable suppression devices across the coil. Coil transients can also be transmitted through the air, so the recorder itself should be mounted as far as possible from power control devices and/or wiring.
4. When line power is poorly regulated and / or subject to voltage surges or transients, consideration should be given to the use of a line conditioning/transient suppressing line power regulator. Process control motors, valves, relays and heaters should not be connected to the same power lines that are used for instrumentation.
5. The connection of the recorder to a proper safety earth ground is essential. Such a connection not only reduces the possibility of electric shock, but also provides the required return for the recorder line power filters,
6. All local electrical codes of practise must be followed when installing any instrumentation.

2.3 CIRCUIT BOARD LOCATION

The input boards and option boards are located as shown in figure 2.3. There are a number of different types of option board, as listed below, any three of which may be used in any of the three available positions. The card types are as follows:

Two relay board containing either relays 1 and 2 or relays 5 and 6.

Four relay board containing either relays 1 to 4 or relays 5 to 8

Combined board - 8 Event inputs and 1 retransmission channel

Combined board - 8 Event inputs and 2 retransmission channels

The serial communications board (now obsolete) and transmitter power supply option board are mounted separately, as shown.
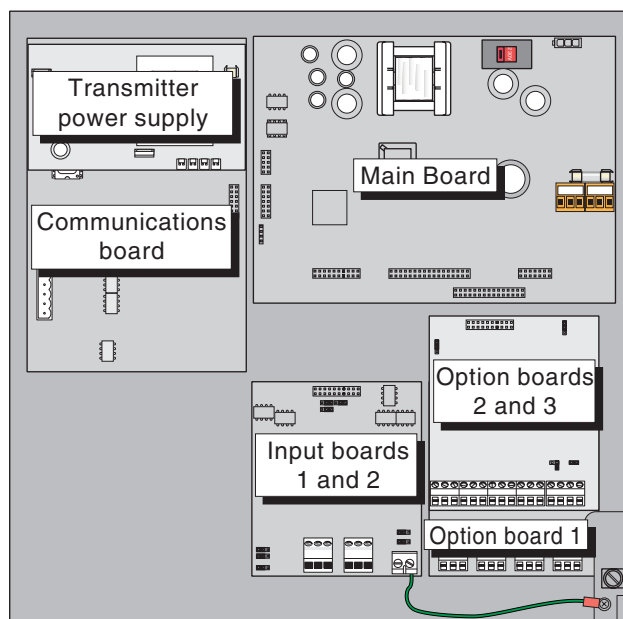
Figure 2.3 Circuit board locations
(communications board now obsolete)

2.4 INPUT BOARD HARDWARE CONFIGURATION

On each input board, there are eight links to be checked or set. The screen printing on the board surface identifies the link positions.

2.4.1 Board number

This is set by three links (JP2, JP3, JP4) near the top end of the circuit board, Board 1 (channels 1 and 2) is the lower of the two cards with Board 2 (channels 3 and 4) (If fitted) set above Board 1 on standoffs.

Each of the three links must be fitted across the centre and right-hand pin to define this as board 1.

Each of the three links must be fitted across the centre and left-hand pin to define this as board 2.

2.4.2 CJC/RTD

This link (JP1) must be set to RTD if channel 1 (3) is to be used for RTD input, or to CJC for any other input type. This link must be used in a way appropriate to the TC/RTD links described below.
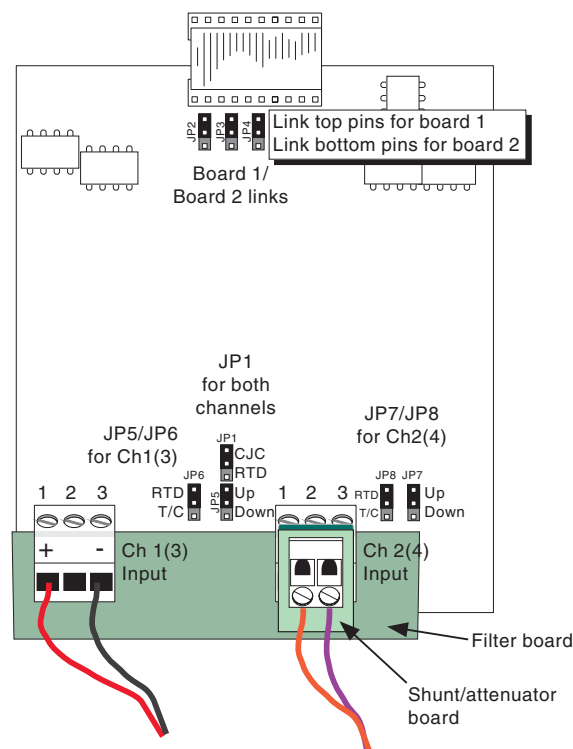
Figure 2.4 Input board link locations

Notes:
1. If the link is set to RTD neither channel can be used for anything other than RTD inputs.
2. If the link is set to CJC, channel 2 (4) may be used for RTD or T/C etc. inputs, but channel 1 (3) cannot be used for RTD measurements.

2.4.3 TC/RTD

This link must be set for each channel. Channels with this link set to RTD can be used only for RTD inputs. Channels with this link set to TC, are suitable for all other input types. The setting of the CJC/RT (above) link must be appropriate to the setting of this TC/RTD link.

2.4.4 Upscale/Downscale drive

These links define the behaviour of the channel in the case of a broken thermocouple input circuit. Locating the link to 'Upscale' means that if the recorder detects an open circuit, the channel will drive to the full scale position and remain there until the problem is solved. Locating the link to 'Downscale' is similar, but the recorder drives the trace to chart zero instead of full scale.

Note:
If the associated TC/RTD link is set to RTD, the link must be removed. It is recommended that, for safekeeping, the link be 'parked' sideways on the centre pin of the connector.

2.5 CHART FITTING

1. Open the recorder door as described in section 1.3.
2. Move the pen-lift lever to its top (lift) position. The pens lift off the chart and swing over to the left of the chart.
3. Rotate the paper-locking tab at the centre of the chart hub upwards. The chart can now be removed by lifting it off the hub and out from under the hold-down tabs.
4. Without operating the locking tab, fit the new chart over the hub and under the three hold-down tabs.
5. Turn the chart so that the current time, as printed on the chart, is aligned with the Chart Time Index mark.
6. Rotate the locking tab downwards to fix the chart.
7. Move the pen lift lever to the mid (Run Lifted) position, until the pens have moved to their tracing positions, then, move the pen lift lever to the lowest (Run) position to resume tracing.
8. Close and latch the door.

Figure 2.5 Pen/Chart replacement items

2.6 PEN FITTING

> **Caution**
> Pens may be changed only whilst parked, as described below. An attempt to change pens whilst 'live', will result in damage to the recorder and may cause injury to the operators fingers.

> Note: It is recommended that the operator wear plastic gloves whist handling pens, in order to avoid ink contamination of the hands and to protect against any sharp edges.

> Note: Channel 1 (blue) is the bottom- most pen. Channel 2 (red) is next, followed by channel 3 (green) and channel 4 (top-most) is black.

1. Open the recorder door as described in section 1.3.
2. Move the pen lift lever as shown in figure 2.5, to the 'Lift' position. With recorder power on, and the recorder initialised, press the right arrow key. Press the Page key repeatedly until 'Pen Park' appears at the display. Use the up or down arrow to change 'Off' to 'On', then press the enter key. This causes recording to stop and the pens to fan for easy access.
3. Carefully, whilst supporting the pen arm, pull the exhausted pen off the relevant pen arm. Remove the replacement pen from its packaging. Remove the tip protector from the pen tip.
4. Carefully, whilst supporting the pen arm slide the new pen onto the pen arm, sliding the pen into the clip until it stops.
5. When all the pens have been replaced, use the up or down arrow key, followed by 'Enter' to set Pen Park to off. The pens swing over to the left edge of the chart.
6. Move the pen lift lever to the mid (Run Lifted) position, until the pens have moved to their tracing positions, then, move the pen lift lever to the lowest (Run) position to resume tracing.
7. Operate the 'C' key to return to the background display, then close and latch the door.

3 OPERATION

3.1 OPERATING DISPLAYS

The operating display at the operator interface normally scrolls through all the active channels (where 'channels' includes input channels, totalisers and maths channels) at nine second intervals. To override this scrolling process, the up and/or down arrow keys can be used to step through the 'channels' manually. Operating the 'Enter' key stops the scrolling process, leaving the current 'channel' permanently displayed. Operation of the up or down arrow key restarts the scrolling process.
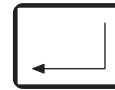
Enter key

Note: Refer to the Control Loop and Setpoint Generator manual for details of Control loop and Setpoint Generator displays.

3.1.1 INPUT/MATHS CHANNEL VALUES

Individual displays show the 16-character descriptor, channel number, value, units and alarm information as shown, for an input channel, in figure 3.1.1. Maths channels are similar, except that the channel number 'Ch1' is replaced by 'DV1' (DV = Derived Variable).

Channel descriptor

Alarm Status
1 2 3 4

```
Boiler Temp No1          ↑  ^^
 Ch1    98.34   deg F    I⚹
```

Channel number

Channel value   Units

Global Channel alarm

Instrument alarm

Figure 3.1.1 input channel display

3.1.2 Totaliser displays

Totaliser displays (figure 3.1.2) are similar to other channel displays, but contains only the totaliser descriptor, its value, units and global/instrument alarm symbols.
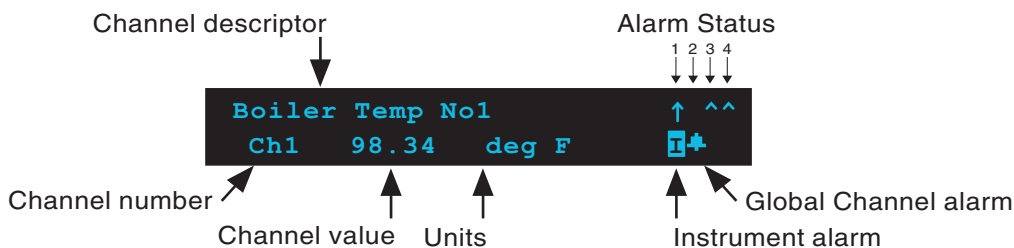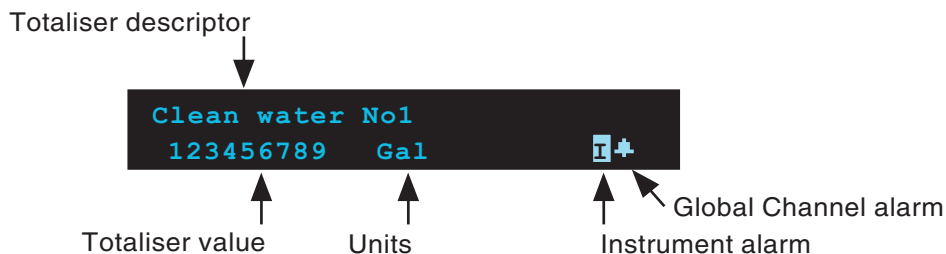
Totaliser descriptor

```
Clean water No1
 123456789   Gal        I⚹
```

Totaliser value   Units

Global Channel alarm

Instrument alarm

Figure 3.1.2 Totaliser display

3.1.3 Alarm information

INDIVIDUAL CHANNEL ALARMS

Each input/derived channel can have up to four alarms configured. As shown in figure 3.1.1 above, each alarm has a status icon towards the right-hand end of the top line of the display. These icons can be of one of five types, as shown in table 3.1.3.

The different types are described in 'Alarm Configuration' in section 4.6 of this manual.

⋀	Absolute high
⋁	Absolute low
↑	Rate-of-change (rising)
↓	Rate-of-change (falling)
⊬	Deviation

Table 3.1.3 Alarm symbols

GLOBAL ALARM SYMBOL

This bell-like symbol (figure 3.1.1) appears on the lower line of the display if any channel etc. is in an alarm state.

INSTRUMENT ALARM

This 'I' symbol in inverse video, appears if any one (or more) of the alarms listed below is active. The alarm may also flash for approximately 5 seconds after initialisation is complete. To view the instrument alarms, the 'Inst Alarms ?' menu item in the Operator Menu (section 3.2) is accessed.

The following messages may appear at the top line of the display, with the word 'Lost' below. For example:

```
Input Prog 3
     Lost
```

Alarm Prog XY.	This alarm becomes active for any alarm for which configuration data has been lost. 'X' represents the channel associated with the alarm, whilst 'Y' represents the relevant alarm number. E.G. Alarm Prog 13 would mean that there was a problem with the configuration data for alarm 3 on channel 1. See section 4.6, below for alarm configuration details.
CJC Cal X	This alarm becomes active if there is a problem with the Cold Junction Compensation calibration for input board X (where X = 1 or 2). See section 5.2 for calibration details.
Channel Adj X	Active if channel adjust data for channel X is lost.
Chan Desc X	This alarm is active if the descriptor data for channel X is lost.
Chan Prog X	This becomes active if Chart high/low limits have been lost for channel X. See section 4.3 for channel configuration.
Chart Prog	This alarm becomes active if there is a problem with the pen servo calibration data.
Comms Prog	(Now obsolete). Active if problem with serial communications configuration.
Control Prog X	If controllers are fitted, this alarm becomes active if there is a problem with data for Control loop X (X = 1 or 2). Refer to the Controller manual for details.
Custom Curve	This becomes active if custom curve data (section 4.5.3) is lost.
DV Prog X	Active if there is a problem with the configuration data associated with derived channel X. See section 4.4 for derived channel information.
Fact Cal X	This alarm is active if the factory calibration data for channel X has been lost. If this alarm appears, the recorder supplier should be contacted for advice.
Input Cal X	This alarm becomes active if calibration data is lost for input channel X. See section 5.1 for channel calibration details.
Input Prog X	Active if any configuration data (Input Type, Hi/Lo limits, Range Hi/Lo limits, Units and CJC Type) is lost for input channel X. See section 4.3 for channel configuration details.
Misc Prog	This alarm is active if any item of Instrument configuration (External CJC, Password or Alarm Access) has been lost. See section 4.5 for Instrument configuration.
Relay Prog X	Active if configuration data for Relay X has been lost.
Retrans Prg X	This alarm becomes active if configuration data for retransmission channel X has been lost.
Soft Key Prg	Active if Soft key configuration data (section 4.5.1) has been lost.
Timer Prog X	The alarm becomes active if configuration data for Timer X (section 4.9) has been lost.
Total Prog X	The alarm becomes active if configuration data for Totaliser X (section 4.8) has been lost.

In addition to these 'Lost' displays, the instrument alarm 'ROM Bad' becomes active if a problem is detected in the recorder software. If this message appears, the recorder supplier should be contacted for advice.

3.2 OPERATOR MENUS

The operator menu (figure 3.2) is entered from the normal operating display (the background display) by operating the right arrow key.

Right arrow key
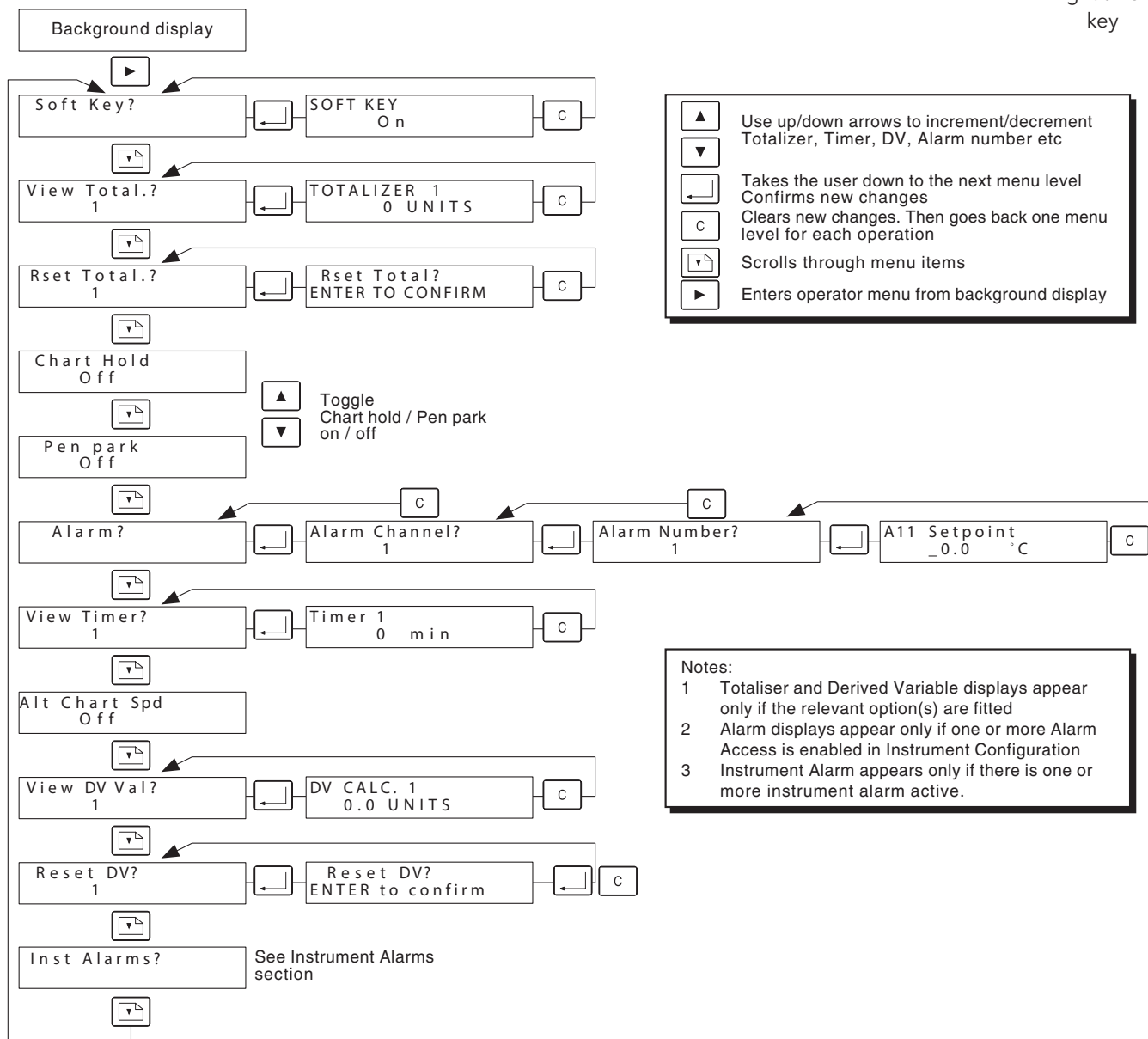
Figure 3.2 Operator menu

3.2.1 Operator menu items

Soft Key?   This appears only if 'Soft Key' has been enabled in the Instrument Configuration. Operation of the enter key allows the user to set the soft key on or off. When On, the key initiates all action equations (section 4.5.2) which include 'KEY' in their action list, either with a single trigger or continuously, according to action type. For example, a single trigger would be sent for a Totaliser Reset equation, but a continuous on-state is sent to equations such as relay outputs for as long as the softkey is 'On'.

3.2.1 OPERATOR MENU ITEMS (Cont.)

View Total.?	This menu item appears only if the Totaliser option is fitted. The up/down arrow keys are used to select the required totaliser. The Enter key is then used to display the selected totaliser's value. See section 4.8 for totaliser details.
Rset Total.?	This menu item appears only if the Totaliser option is fitted. The up/down arrow keys are used to select the required totaliser. The Enter key is then used to reset the selected totaliser.

> Note: The resetting of a totaliser can be used as an input (TTX where X is the totaliser number) to an action equation, and can thus have an effect on the recorder operation.

Chart Hold	The up/down arrow and Enter keys are used to set Chart Hold On or Off. When On, chart rotation is stopped, but pen motion is not. This may eventually lead to the chart becoming worn through.
Pen Park	The up/down arrow and Enter keys are used to set Pen Park On or Off. When on, the chart is stopped and the pens are lifted from the chart and 'fanned' for easy access during replacement.
Alarm?	This appears only if 'Alarm Access' is set to 'On' in Instrument configuration. Enter calls the Alarm Channel display:
Alarm Channel	The up/down arrow and Enter keys are used once, to select a channel, then again, to select an alarm number for that channel. Once this has been done, the user can edit the Setpoint value of the selected alarm using the up/down and right arrow keys, followed by Enter. Hysteresis/deadband values cannot be edited from the Operator menu - see section 4.6
View Timer?	The up/down arrow keys are used to select the required timer. The Enter key is then used to display the selected timer's remaining countdown time. See section 4.9 for Timer details
Alt Chart Spd	The up/down arrow keys, followed by "Enter' are used to toggle the alternative chart speed on and off. The alternative chart speed is set up in Instrument configuration (Section 4.5). This operator selection overrides any action equation selections.
View DV Val?	This appears only if the Maths option is fitted. The up/down arrow keys are used to select the derived channel. The Enter key is then used to display the selected channel's value.
Reset DV Val?	This appears only if the Maths option is fitted. The up/down arrow keys are used to select the derived channel. The Enter key is then used to reset the selected channel's value.

4 RECORDER CONFIGURATION

4.1 INTRODUCTION

The configuration of the recorder is carried out in a number of areas, depending on the options which are fitted. Figure 4.1 shows the top level menu structure, entered from the normal measuring (background) display by using the Page key.

Page Key

Background display

Enter Password
_0

Password is set to 10 when dispatched from the factory

Channel?
1

Use up/down arrows to increment/decrement Channel, Totalizer, Timer, DV, Alarm number etc.

Instrument?

Takes the user down to the next menu level. Confirms new changes

Alarm?

Clears new changes. Then goes back one menu level for each operation

Relay?
1

Enters configuration menu from background display. Scrolls through menu items

Totalizer?
1   Option

Text cursor

Timer?
1

DV Calc.?
1   Option

Comms?   Option

See Separate Manual

Retrans?
1

Controller?
1   Option

See Separate Manual

Set Point Gen?   Option
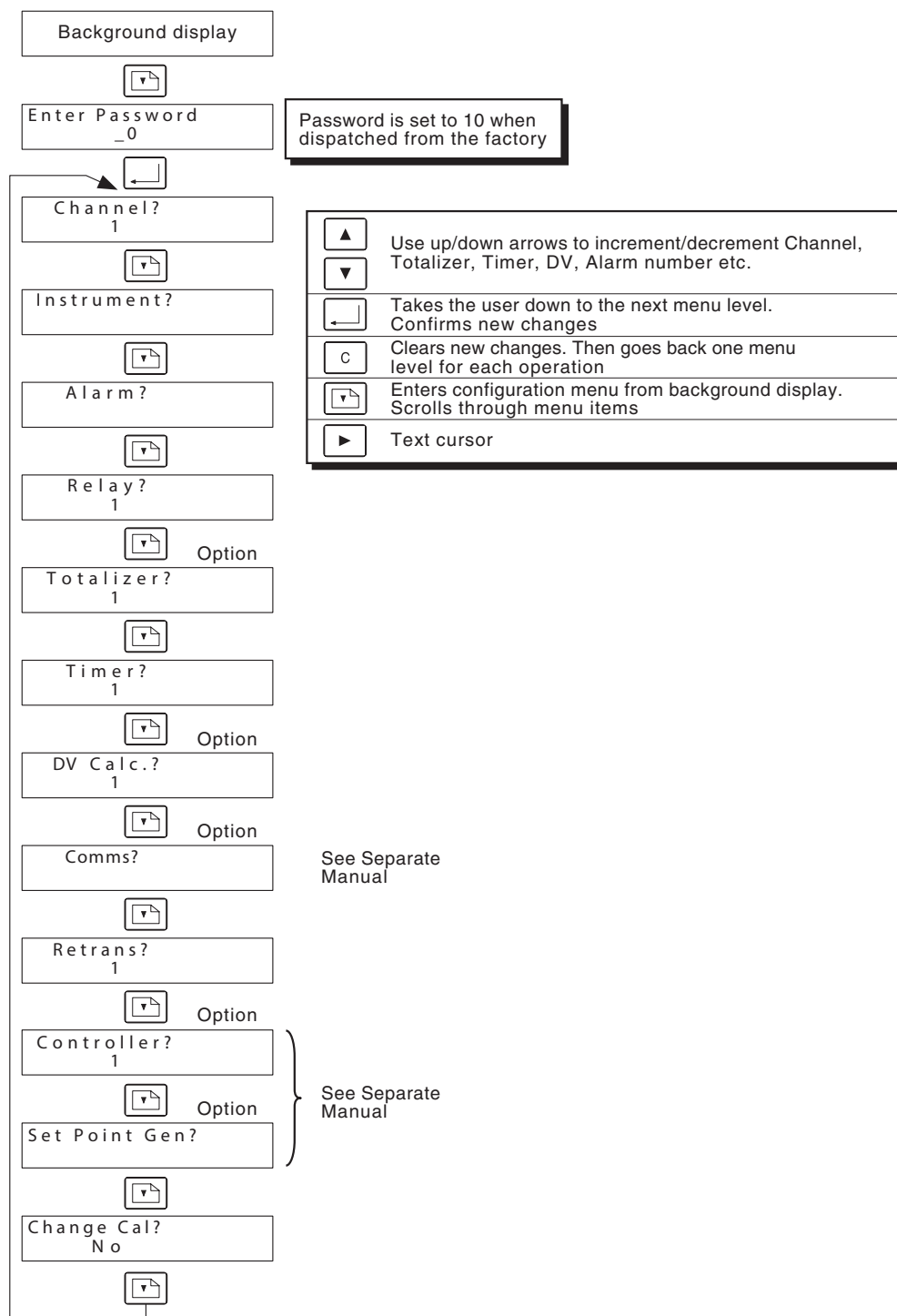
Change Cal?
No

Figure 4.1 Top level configuration menu

4.1 CONFIGURATION INTRODUCTION (Cont.)

Note: It is not necessary to use any part of the Calibration menu whilst setting up the recorder to measure and record an input. Improper use of Calibration will affect recorder accuracy.

The configuration areas shown in figure 4.1 are each described, in the order in which they appear, in following subsections of this manual.

4.1.1 Operator interface

Figure 4.1.1 depicts the operator interface, which consists of a vacuum fluorescent display containing two lines, each of 20 characters, and six navigation keys.
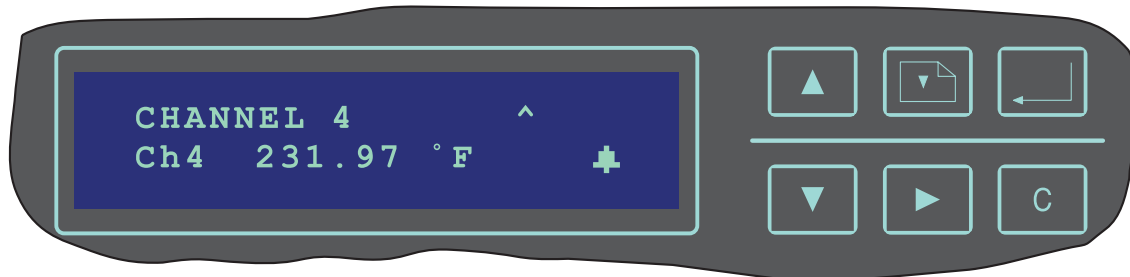
Figure 4.1.1 Operator interface

KEY FUNCTIONS

▲
▼
Up and down keys.

These keys are used to change selections, and to scroll through the character set when entering text strings

Page key
Used to enter configuration mode and to move between successive menu items

►
Right arrow key
This key is used to enter the Operator top level menu (section 3) and also acts as a cursor whilst entering text strings or numerical values.

Enter key
Used to move one step down in menu structures, and also to confirm changes.

C
Clear
Used to move one step upwards in a menu structure. Also resets any changes that have been made since the last 'Enter'.

CONFIGURATION DISPLAY

The basic configuration display format is that the top line contains the configuration item, and the bottom line contains either the current selection of a scroll list of values which are appropriate to that configuration item, or a text or numeric string for editing. Such strings are identified by the cursor symbol displayed to the left of the first character - for example:

```
Pri. Chart Spd
    _24 hr/rv
```

4.1.1 OPERATOR INTERFACE (Cont.)

ENTRY OF ALPHANUMERIC DATA

The recorder uses a scroll and select method of entry. When a word or number entry is required, a cursor (underscore) is displayed at the left end of the lower line. The right-arrow (cursor) key is used to move the cursor to the character to be edited, and the up and down arrow keys used to scroll through the character set until the required character is reached.

CHARACTER SET

The following lists show the available character set. With numeric entries, only numeric characters appear. With text entries, the following characters make up the standard set. The sequence starts with a blank character, and appears in up-arrow sequence:

Space **! " # $ % &** apostrophe **( ) * + , - . / 0 1 to 9 : ; < = > ? @ A to Z [\ } ^ _** single opening quote **{ | } ~** Block Space.

The following 'special' characters then appear:

Ä Æ ß É Ñ Ö Û Ü § ç ¿ ¢ δ ε θ ϕ π μ ω ∫ Σ ≠ Å 0123456789 √ ± ° × ÷ ° ⊬ ⊢⊣ £ ≶ ⌄ ♣ ← → ↓ ↑ ≪ ≫ ∀ ∧ 0123456789

before the standard set starts again.

Notes:
1. Numeric strings which include spaces will pack (spaces are removed, and the whole string right justified).
2. When scrolling through the character set, the scroll speed increases after the sixth character, and again after the 12th character.
3. The non-standard character set should not be used in character strings to be sent over the Serial comms link (if fitted). Use of such characters will result in corruption of text strings such as Channel descriptors.

4.2 CONFIGURATION ACCESS

Before any configuration changes can be made to the recorder, the Configuration Enable switch must be set to Enable. This switch (SW1) is located on the same circuit board that holds the display (figure 4.2), and is accessible once the door and platen have been opened.

WARNING

Opening the platen exposes the user to circuitry that may be carrying hazardous voltages. Ensure the power supply is switched off before opening the platen. All local safety regulations and practices must be observed Only qualified service personnel may open the platen whilst hazardou-voltages (supply or signal) are connected to the recorder.

F

AVERTISSEMENT

Ouvrir le support expose l'utilisateur aux circuits et à des tensions dangereuses. S'assurer que l'alimentation est coupée avant d'ouvrir le plateau. Toutes les pratiques et réglementations de sécurité locales doivent être respectées. Seul le personnel d'entretien qualifié peut ouvrir le plateau quand des tensions dangereuses (alimentation ou signal) sont raccordées à l'enregistreur.

Slide left to Enable
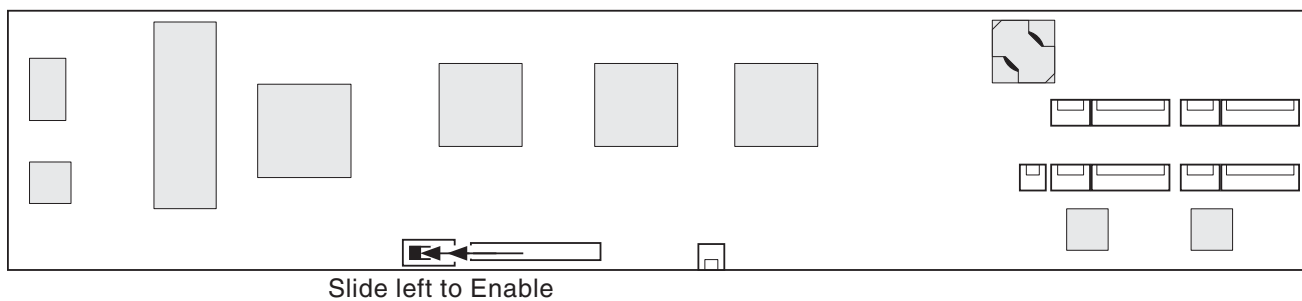
Figure 4.2 Configuration enable switch location

With the recorder in its normal channel value 'background' display, operate the Page key. This calls the password request display:

```
Enter Password
        _0
```

All instruments are shipped with password 10, so, unless the password has been edited (instrument configuration - section 4.5), operating the Up Arrow key twice, followed by 'Enter' gives access to the first item in the Top-level configuration menu - Channel?. Operating the Page key repeatedly, scrolls through the menu items as shown in figure 4.1 above.

To return to the background display from any point in the configuration process, the Clear (C) key is used as many times as is necessary.

4.3 INPUT CHANNEL CONFIGURATION

The Input channel Configuration menu is shown in figure 4.3, below. Note that the menu is context sensitive, so, for example, CJC type appears only if Input Type = thermocouple.

Enter Password
_0

Channel?
1

Use up/down arrows to select channel number.
Channels 1 to 4 are input channels. Channels 5 to 6 (if fitted) are maths channels (section ?)

C1 Lin Funct
Linear

C1 Units
Prog. Units

If Prog. Units selected, a custom unit string can be entered in Prog Units, below.

C1 Dec Point
XXX.XX

C1 Prog Units
UNITS

This item appears only if Prog. units selected in Units configuration, above.

C1 Input Type
Volts

C1 Range Low
_0.00 UNITS

C1 Range High
_5.00 UNITS

These menu items do not appear if Input Type = Thermocouple.

C1 Input Low
_0.00 UNITS

C1 Input High
_5.00 UNITS

C1 Chart Low
_0.00 UNITS

C1 Chart High
_5.00 UNITS

This item appears only if Input Type = Thermocouple

C1 Filter Time
1 second

C1 C.J. Type
Internal

C1 Ch Desc
CHANNEL 1

▲
▼   Use up/down arrows to increment/decrement Channel, Totalizer, Timer, DV, Alarm number etc.

↵   Enters configuration menu from background display. Takes the user down to the next menu level. Confirms new changes

C   Clears new changes. Then goes back one menu level for each operation

⬋   Scrolls through menu items

►   Text cursor

C1 Ch Adjust
_0.00 UNITS

Figure 4.3 Input channel configuration menu structure

4.3.1 Configurable items

Lin Funct	Selectable from: Off, Linear, square root, 3/2 power, 5/2 power. Log_{10}, Custom curve, Comms. Thermocouple types: B, C, E, J, K, L, N, Ni/NiMo, R, S, T RTD types: Cu10, Pt100A, PT100D, Ni100, Ni120,
Units	Select from ˚C, ˚F or Programmable units (see Prog Units, below)
Dec.Point	Use up/down arrow keys to set the number of decimal places (choose none to four). Some thought should be given to this selection, to avoid displaying spurious accuracy, and to avoid rapidly changing numbers that can cause fatigue and confusion.
Prog Units	This field appears only if 'Prog. Units' was selected in the Units configuration item, above. The up/down/cursor keys are used to enter a units string of up to five characters.
Input type	Use the up/down arrow keys to select Volts, Millivolts, Ohms or Thermocouple.
Range Low/High	Range Low and high values include the highest and lowest values to be measured in the Engineering units to be used. Range high and low values must be entered for all inputs, to allow the recorder to select the appropriate internal operating range. The recorder will normally operate beyond the specified range values, but the specified recorder accuracy is guaranteed only when the recorder is wo rking within the entered range settings. See table 4.3.1 for details of the recorder's internal ranges.
Input Low/High	These fields do not appear for Input type = Thermocouple. Input low/high settings define the electrical input that represents the range inputs entered in Range Low/high configuration. Input values are unnecessary if Input type = Ohms and Lin Funct. is set to one of the RTD tables. The recorder will normally operate beyond the specified input values, but the specified recorder accuracy is guaranteed only when the recorder is working within the entered values.
Chart Low/High	These inputs define what part of the input signal is to be represented by chart zero to chart full scale. If Chart Low and High values match the Range Low and High values, then chart zero and chart full scale will match Range Low and Range High respectively.
Filter time	Input filtering slows the normal zero-to-full scale response of 0.5 second (Filter time = 0) to the selected value of seconds. All functions, including alarm sensing are affected by this filtering.
CJC type	The cold junction compensation site (where the signal wire changes from thermocouple wire or thermocouple compensation wire to copper) can be defined as internal or external. If external is selected, a temperature for the remote site must be entered in Instrument configuration (Ext CJC Temp) (section 4.5).
Ch Desc	A 16 character (max.) string may be entered here as a channel descriptor to appear in the background display.
Ch Adjust	In some cases, it might be necessary to adjust the displayed/recorded value to agree with other measurements. For example, Channel adjust can be used to 'zero' an input, such as a load cell, which has a non-zero output for a zero reading The adjust value is not limited. Positive values add to, and negative values subtract from the measured values.

Input range	Resolution
- 4 to + 20 mV	2 µV
- 12 to + 60 mV	6 µV
- 16 to + 80 mV	8 µV
- 40 to + 200 mV	20 µV
- 80 to + 400 mV	40 µV
- 0.34 to + 1.7 V	170 µV
- 0.5 to + 2.5 V	250 µV
- 1 to + 5.0 V	500 µV

Table 4.3.1 Input ranges and resolutions

4.3.2 Examples and application notes

Notes:
1. If Input Type = Millivolts, the Input High value must not be greater than 400mV because the recorder will automatically measure inputs greater than 400mV in Volts, not millivolts. See example 1 below.
2. For direct thermocouples, set Input type to thermocouple, and select the thermocouple type in Lin. Funct.
For indirect thermocouples, set Input type to Volts or Millivolts and select the thermocouple type in Lin. Funct. input Low/High define the actual electrical input.

EXAMPLE 1: mV RANGING

Input ranges greater than 400mV are always measured using one of the Voltage ranges. Thus, a signal of 250 mV applied to a channel ranged 0 to 500 mV, will display a value of 0.25 units, not 250 units, as might be expected. Further, the resolution of the measured value is lower with a voltage range than it is with a millivolt range (see table 4.3.1, above).

EXAMPLE 2: MEASURING NEGATIVE VALUES

The negative portion of each input range is 20% of the positive portion. This means that when measuring signals whose negative and positive excursions are equal, a higher range may have to be used. For example, if an input of -1 to +1 Volts is to result in a reading of between -100 and +100, the recorder range must be configured as -100 to +500 with an input range of -1 to +5 Volts.

EXAMPLE 3: THERMOCOUPLE RANGES

A type J thermocouple range of 0 to 500 ˚F represents a span of 14.993 mV, causing the recorder to select range 1 (-4 to + 20 mV see table 4.3.1, above). Should the temperature exceed 663 ˚F (span = 20mV) input range 1 limits are exceeded and the accuracy of the displayed/recorded temperatures will not remain within the specified accuracy.

EXAMPLE 4: CURRENT LOOP MEASUREMENTS

A transmitter ranged for 0 to 1000 litres/min produces a 4 to 20 mA signal. This is converted to a 1 to 5 Volt signal by a 250Ω shunt across the channel inputs. The channel input values should be set to Input low = 1V; Input high = 5V, Range Low = 0; Range high = 1000, Units = l/min.

EXAMPLE 5: CHART RANGE

In example 2, only the -100 to +100 portion of the input range is required on the chart. This can be achieved by setting the Chart range low and high values to -100 and +100 respectively.

Similarly, it is possible to compress the input range and trace it on a particular portion of the chart, by setting the chart range greater than the input range. In our example, if the chart range is set to -100 to +500, then the input range of
-100 to +100 would be compressed into the 'bottom' 20% of the chart.

4.4 DERIVED CHANNEL CONFIGURATION

The Derived channel Configuration menu is shown in figure 4.4, below. Derived channels (if fitted) are channels 5 and 6, and are used to display the values of Derived Variable calculations. It is also possible to allocate a pen to each derived channel, so the computed values may be traced on the chart.
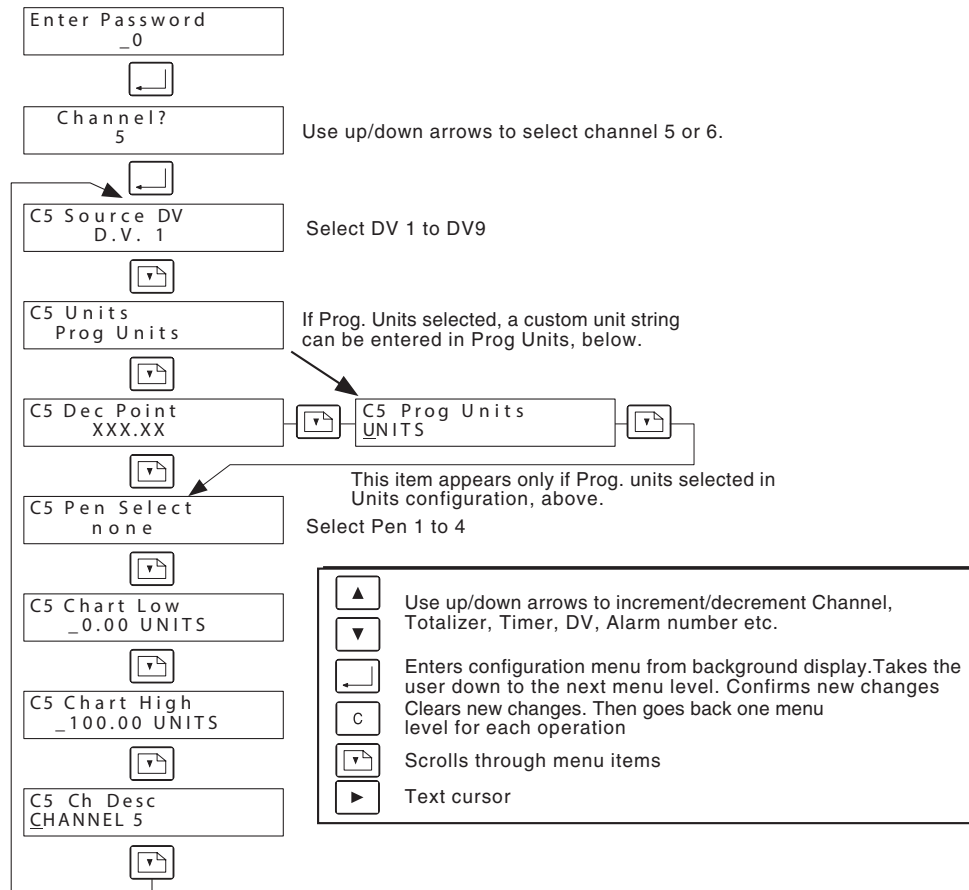

Figure 4.4 Derived channel configuration menu structure

4.4.1 Configurable items

Source DV   Select DV1 to DV9 as the channel source
Units   Select from ˚C, ˚F or Programmable units (see Prog Units, below)
Dec.Point   Use up/down arrow keys to set the number of decimal places (choose none to four). Some thought should be given to this selection, to avoid displaying spurious accuracy, and to avoid rapidly changing numbers that can cause confusion.
Prog Units   This field appears only if 'Prog. Units' was selected in the Units configuration item, above. The up/down/cursor keys are used to enter a units string of up to five characters.
Pen Select   Select none, or pens 1 to 4 for chart trace.
Chart Low/High   These inputs define what part of the input signal is to be represented by chart zero to chart full scale. If Chart Low and High values match the Range Low and High values, then chart zero and chart full scale will match Range Low and Range High respectively.
Ch Desc   A 16 character (max.) string may be entered here as a channel descriptor to appear in the background display.

4.5 INSTRUMENT CONFIGURATION

Figure 4.5 shows the instrument configuration items. For the sake of clarity, the Custom Curve menu items have been drawn separately, and appear as figure 4.5.3.
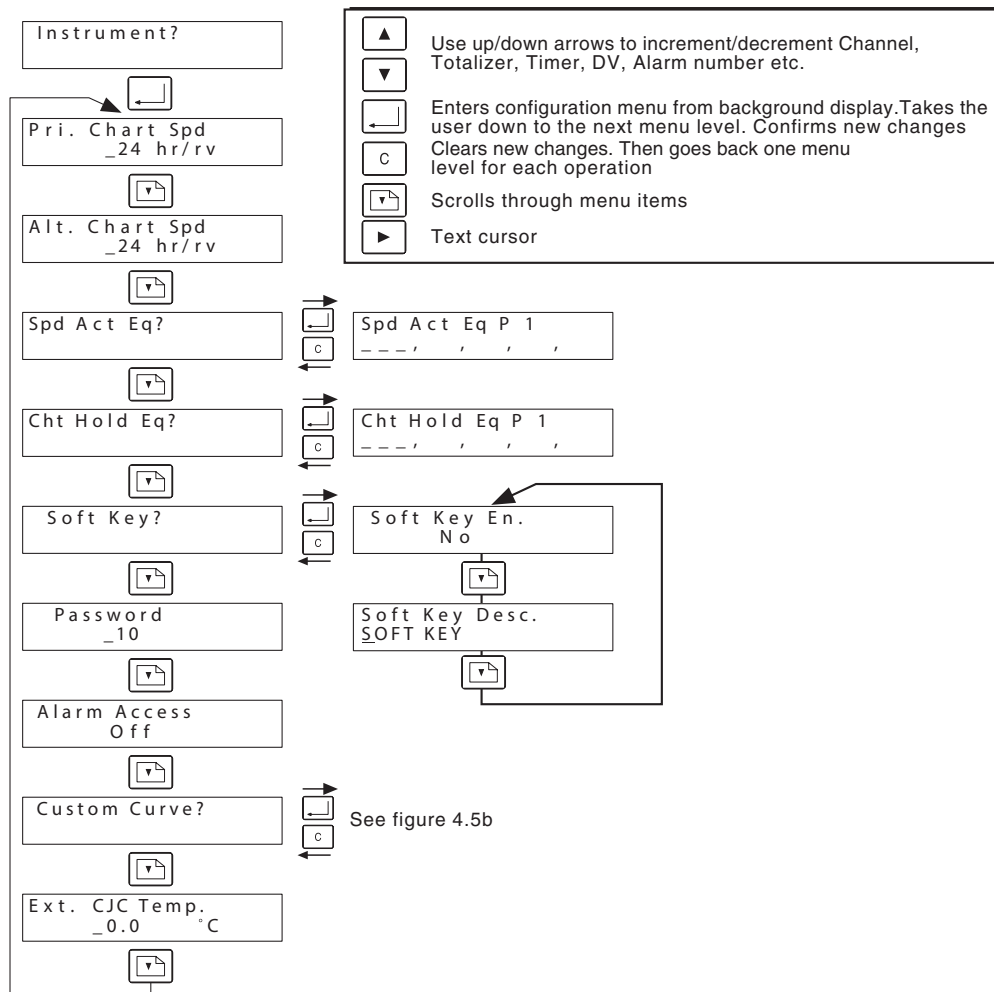

Figure 4.5 Instrument Configuration menu

4.5.1 Configurable parameters

Pri Chart Spd   Allows the user to enter a chart speed of between 1 and 4096 hours/rev. in increments of 1 hour, to be used as the normal chart speed.

Alt. Chart Spd   Allows the user to enter a chart speed of between 1 and 4096 hours/rev. in increments of 1 hour, to be used as an alternative chart speed for use whenever the Chart Speed action equation becomes active.

Spd Act Eq   Enter allows the user to define a number of internal triggers, which if any one of them is 'true', changes the speed of the chart from the primary chart speed to the alternative chart speed. The items are entered from a scroll list. See section 4.5.2 for a description of the scroll list.

Cht Hold Eq   Enter allows the user to define a number of internal triggers, which if any one of them is 'true', stops the chart. The items are entered from a scroll list. See section 4.5.2 for a description of the scroll list.

Soft Key   Enter allows the Soft Key to be enabled/disabled. When enabled, the Soft Key appears in the Operator menu (section 3). The Soft Key is an internal trigger which appears in the Action equation scroll list (KEY). Operation of the Page key allows a descriptor for the Soft Key to be entered.

4.5.1 INSTRUMENT PARAMETERS (Cont.)

Password | As shipped, the instrument password is 10. This can be edited here, permissible entries being 1 to 127. Access to the configuration menus is not possible without this password.

Alarm Access | This setting determines whether or not an operator can access alarm information from the Operator Menu (section 3). If access is 'On', alarm setpoints can be edited from the Operator menu. If access is 'Off', alarm menu items do not appear in the Operator menu.

Custom Curve | This allows a user generated linearisation table to be entered as a number of segments, as described in section 4.5.3, below. This linearisation table appears in the list of Functions in Channel 'Lin Funct' configuration described in section 4.3.1, above.

Ext CJC Temp | If CJC type is set to 'External', for any channel (section 4.3.1 above), the temperature at which the external CJC is maintained is entered here.

4.5.2 Action Equations

Many of the standard and optional features of the recorder can be reset, started, stopped etc. in response to internal triggers, or external (contact closure) events. The list of triggers, as they appear in the (up arrow) scroll list, is as follows:

C11 to C18	Event input
C21 to C28	Event input
TT1 to TT4	Totaliser reaching its preset value
D1H/L, D2H/L	Controller deviation alarms
A11 to A64	Alarms Channel 1 Alarm 1 to Channel 6 Alarm 4
SP1 to SP8	Setpoint generator events 1 to 8
COM	Trigger settable via the Comms port
KEY	Soft Key set 'On' by the operator
INA	Instrument alarm
GLA	Global alarm
TM1 to TM4	Timer 1 to Timer 4 reaching its preset time

Notes
1 The above list includes all options. If an option is not fitted then its triggers do not appear in the scroll list.
2 Soft Key operation is context sensitive, and will either result in a single trigger or a continuous state change depending on the action equation.

The action equation is a 'Logical OR' of all the triggers included in the equation. The number of triggers is unlimited, and if there are more than can be include in one page, the page key can be operated to go to the next page. (The enter key might need to be operated before progressing to further pages when adding new triggers in configuration mode.)

ACTION EQUATION EXAMPLE

The following entries would be made to cause the chart speed to change to the alternative chart speed when one or more of the following triggers is active:

Alarm 1 on channel 1; Alarm 2 on channel 2, Alarm 1 on channel 3, Softkey 'On'.

```
Spd Act Eq? P1
A11,A22,A31,KEY
```

4.5.3 Custom curve

A custom curve is defined by five segments, each of three points, where the third point of one segment is also the first point of the next segment. Thus, segment one consists of points one, two and three; segment two of points three, four and five, segment three of points five, six and seven, and so on, up to point 11. A 3rd order polynomial fit is then applied to the 11 points.

Each point is defined as a pair of values (a point pair) consisting of the signal input value, and an associated % value as shown in the example below. Because the curve can be used as the linearisation function for any input channel, percentage of full scale is used, rather than specific units.

Figure 4.5.3 shows the configuration menu.

> Note: Value must be entered for all eleven point pairs, otherwise the polynomial fit will not be accurate. If a fewer number of segments are required, then imaginary values must be entered for the unused points. Values for these 'spare' points must always increase.

EXAMPLE

A particular linearisation curve (defined by the user) is to be made up of three segments (points 1 to 7). The signal value for point 1 is 4.0 mA (= 0%); the full scale value (point 7) is 20 mA (100 %). These values are converted to a signal range of 1 to 5 Volts by a 250Ω shunt across the channel input. The point pair data is as listed in the table below:

	Input (ma)	Input V	Units %	Segment number(s)	Point pair
Defined points	4.0	1.000	0.00	1	1
	4.5	1.125	2.22	1	2
	5.0	1.250	6.67	1 2	3
	5.5	1.375	11.11	2	4
	6.0	1.500	20.00	2 3	5
	13.0	3.250	60.00	3	6
	20.00	5.000	100.0	3 4	7
Added points	N/A	6.000	200.0	4	8
	N/A	7.000	300.0	4 5	9
	N/A	8.000	400.0	5	10
	N/A	9.000	500.0	5	11

Table 4.5.3 Custom curve entry example
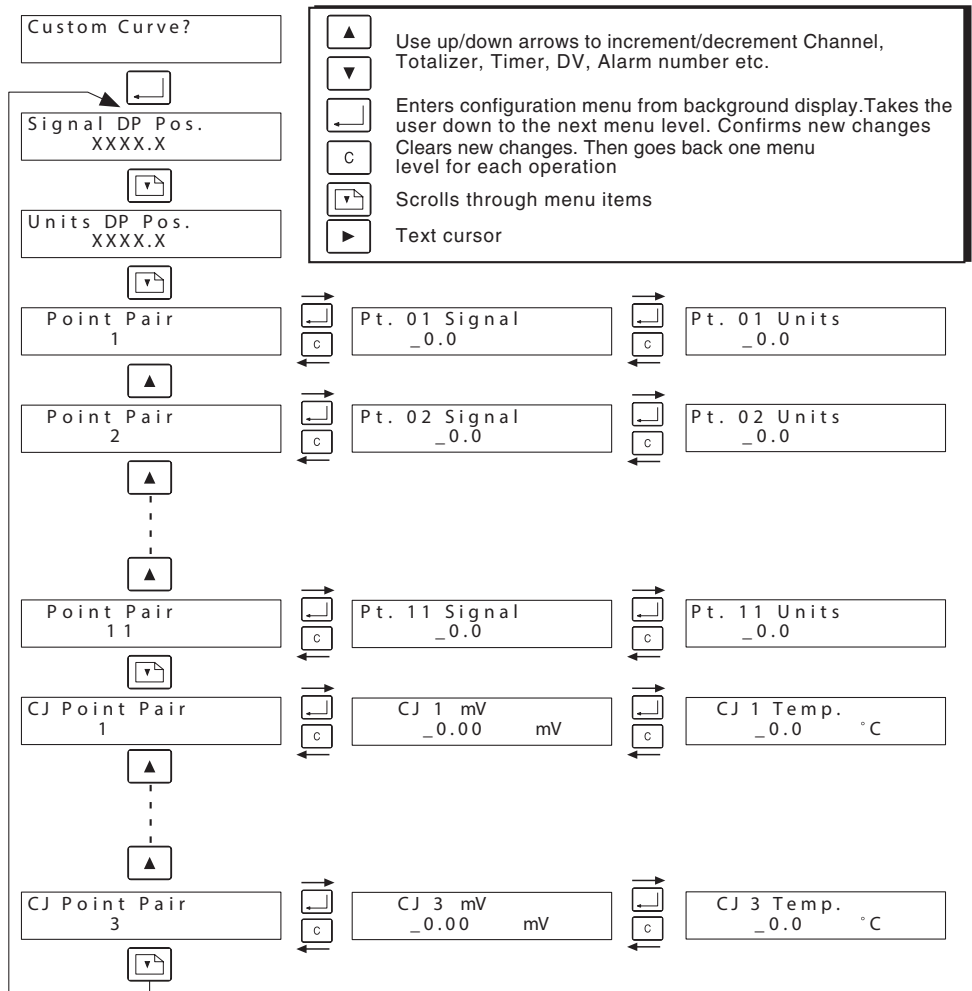
4.5.3 CUSTOM CURVE (Cont.)

Figure 4.5.3 Custom curve configuration menu

CONFIGURABLE ITEMS

Signal DP Pos	Allows the number of decimal places to be chosen for the input signal
Unit DP Pos	Allows the number of decimal places to be chosen for the curve units input
Point pair	Allows 11 point pairs to be defined as described in the example above. ALL 11 sets MUST BE ENTERED, whether used or not.
CJ point pair	Use the up/down arrow keys to select 1, 2 or 3, then 'Enter to call the CJX mV menu item:
CJX mV	Used only if the Input Type for the channel running the custom curve is set to 'Thermo-couple'. Allows entry of the millivolt equivalents of the lowest (CJ1), midpoint (CJ2) and highest (CJ3) ambient temperatures that the recorder is likely to be subjected to, whilst using the custom curve entered above, according to the thermocouple type being used. The Page key calls 'CJ1 Temp' menu item:
CJX Temp	Used only if the Input Type for the channel running the custom curve is set to 'Ther-mocouple'. Allows entry of the Celsius values of the lowest (CJ1), midpoint (CJ2) and highest (CJ3) ambient temperatures that the recorder is likely to be subjected to, whilst using the custom curve entered above. These values must be the same as their millivolt equivalents entered in the CJ mV pages.

4.6 ALARM CONFIGURATION

Figure 4.6 shows the configuration menu for alarms. Up to four alarms can be defined for each channel. The figure shows the three types of alarm - Absolute (High, Low), Deadband and Rate-of-change (Rate - Rising / Rate - Falling).
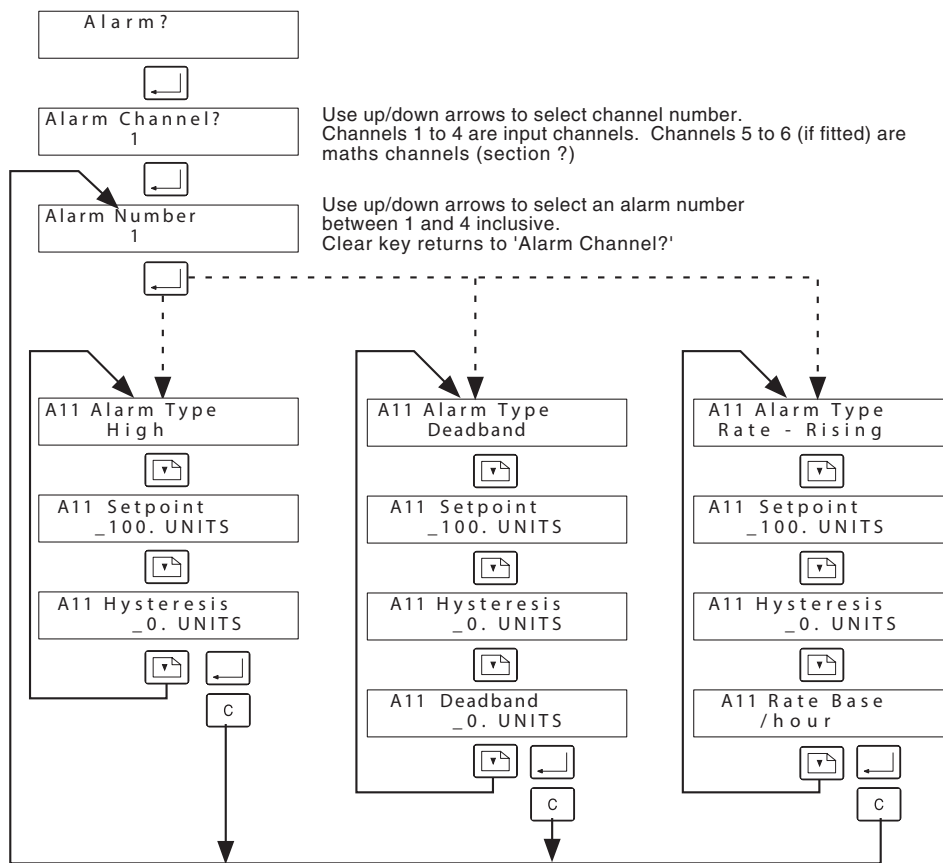

Figure 4.6 Alarm configuration menu

4.6.1 Alarm Types

For the purposes of this document, alarms are described as being of three types - Absolute, Deadband and Rate-of Change.

ABSOLUTE ALARMS

Absolute High alarms become active when the measured value exceeds the Setpoint value, and remain active until the Measured value falls below the value given by (Setpoint - Hysteresis).

Absolute Low alarms become active when the measured value falls below the Setpoint value, and remain active until the Measured value rises above the value given by (Setpoint + Hysteresis).

DEADBAND ALARMS

A deadband alarm is active:

1   If the measured value rises above the value given by (Setpoint + Deadband). In this case, the alar remains active until the measured value falls below the value (Setpoint + Deadband - Hysteresis)
2   If the measured value falls below the value given by (Setpoint - Deadband). In this case the alarm remains active until the measured value rises above the value (Setpoint - Deadband + Hysteresis).

4.6.1 ALARM TYPES (Cont.)

RATE OF CHANGE ALARMS

Rate-Rising alarms become active if the measured value increases by more than the Setpoint within the specified unit time (Rate Base). Such alarms remain active until the rate of change falls below (Setpoint - Hysteresis) per unit time.

Rate- Falling alarms become active if the measured value decreases by more than the Setpoint within the specified unit time (Rate Base). Such alarms remain active until the rate of change rises above (Setpoint + Hysteresis) per unit time. A filter setting of 1 second is recommended for use with rate of change alarms. Without filtering, step changes may prove too fast for the recorder to measure a rate. With larger values of filter time, the input signal may be slowed too much for the alarm to be useful.

EXAMPLE 1: RATE OF CHANGE ALARMS

When a large piece of rotating machinery is 'cold started', it is important to know if any of the bearings are overheating. An absolute high alarm is not always adequate, because by the time the bearing has tripped the alarm the damage may already have been done. A rate-rising alarm can detect any unusually rapid rise in temperature, and give warning of impending failure.

EXAMPLE 2: HYSTERESIS

Hysteresis is used to ensure nuisance trips are filtered out from situations where the measured value is hovering about the setpoint value. For example, an absolute high alarm set to 450 °C becomes active at 450 °C and returns to an inactive state at 449.9 °C. This leads to the alarm rapidly going on and off if the temperature is hovering at 450 °C This situation can be remedied by introducing a hysteresis value of (say) 10 °C, so the alarm still becomes active at 450 °C but remains active until the temperature falls below 440 °C

4.6.2 Configurable items

Alarm channel	The up/down arrow keys, then 'Enter' are used to select the required channel
Alarm number	The up/down arrow keys, then 'Enter' are used to select the required alarm number
Alarm type	Select Alarm type from scroll list (see section 4.6.1, above).
Setpoint	The trip value for absolute and rate-of-change alarms, or the centre value for deadband alarms.
Hysteresis	Used to eliminate nuisance trips if the measured value hovers near the trip point .
Deadband	The value which lies each side of the setpoint in Deadband alarms. Alarm is active if the measured value lies outside the band defined by (Setpoint ± deadband). I.E. Total width of the non-active area = twice Deadband entry.
Rate Base	For rate-of-change alarms only, this defines the unit time within which the measured value may not change by more than the Setpoint value. Select from: per hour, per minute, per second.

4.7 RELAY OPTION CONFIGURATION

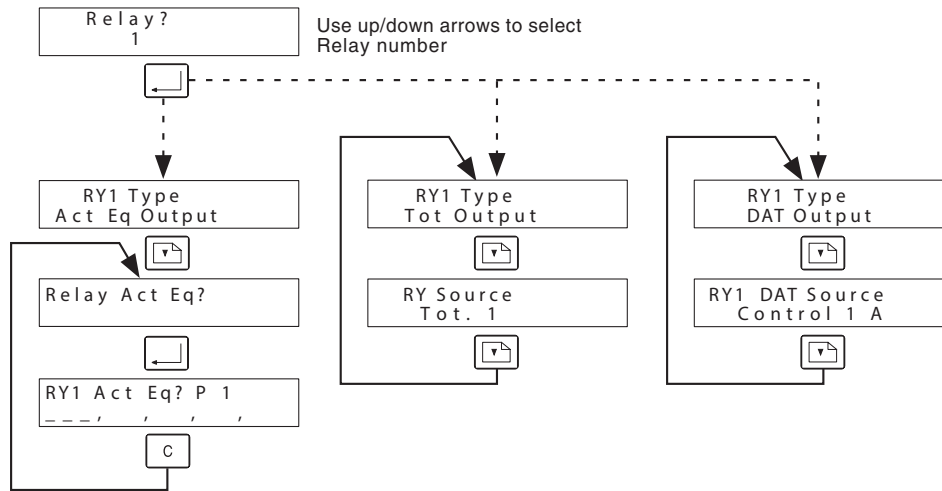Figure 4.7, shows configuration menus for the different relay 'Types' that can be selected.

Figure 4.7 Relay Configuration pages

4.7.1 Configurable items

Relay Number	There can be up to two relay boards, each containing up to four relays. Board 1 contains relays 1 to 4; board 2 contains relays 5 to 8, as shown in figure 4.7.1 below. Where board two is fitted, it is always fitted above board 1. Board number is automatically determined by the recorder. (Note 3)
Relay Type	This refers to how the relay is switched on and off as follows:

	Off	The relay is not used
	Act Eq	The specified relay is operated by action equation (see section 4.5.2 for details).
	Tot X	The relay is operated by a totaliser output signal - see section 4.8
	Dat Output	The relay is operated by an output from controller 1 or 2 - see separate manual.

Notes:
1 Fail-safe operation
   Relays which are specified as 'Off' are always energised (common to normally open)
   Action equation and totaliser operated relays are normally energised (common to normally open), but de-energise (common to normally closed) when their driving source becomes active.
   DAT operated relays are normally de-energised (common to normally closed) and are energised (common to normally open) during the ON part of the cycle.
2 Relays are SPDT (single pole double throw) form C. For ratings see specification in Annex A.
3 On previous models, board number was defined by a link on the board, set to either Brd 1 or Brd 2.
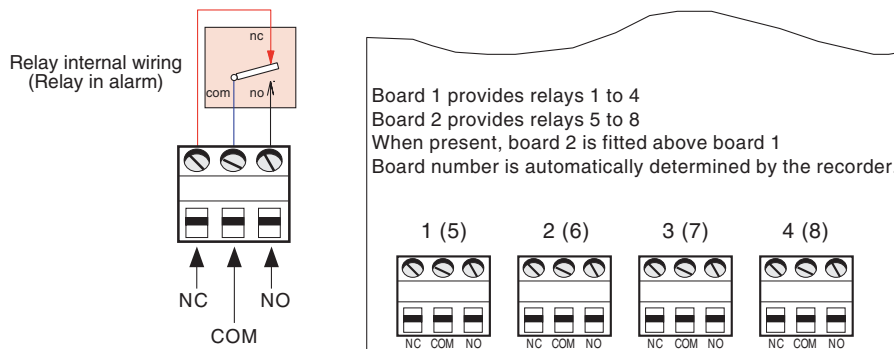

Figure 4.7.1 Relay board details

4.8 TOTALISER OPTION CONFIGURATION

A totaliser is an electronic integrator, primarily used to record a numeric total, over time, of a measured value that is expressed as a rate (e.g. the number of cubic metres since last reset, based on a flow rate of cubic metres per hour).

The totaliser function reads the numeric input from its source once a second. This reading is divided by the totaliser factor and added to the total. The totaliser factor is normally the number of seconds in the measured value's time base. Thus, for example, if the input is in cubic metres per hour, the totaliser factor would have to be the number of seconds in an hour = 3600.

Totalisers can also be configured to count contact closures at a maximum rate of 8 per second.

A further option (Counter output) allows an output relay to 'retransmit' totaliser counts with a 50 msec. closure for each count. Outputs can be one-to-one with inputs, or can be divided by a scaling value (e.g. one output count for evert 1000 totaliser counts).

Figure 4.8 shows the totaliser menu structure, including the counter output option.

> Note: During power off conditions, totaliser values are retained for 100 hours by a 'super cap' on the CPU board.

4.8.1 Factor Entry

For totalisers with channel sources, the factor is entered in terms of the time base of the source channel in seconds. If the source is a contact closure, the factor defines a ratio of input counts: displayed counts. In either case, the factor is entered as two parts, the mantissa (Man) and the exponent (Exp).

For example 1760 can be expressed as 1.760 x 1000 or 1.760×10^3. In this case the mantissa is 1.760 and the exponent is 3. 1769000 can be expressed as 1.769 x 1000000 or 1.769×10^6. In this case, the mantissa is 1.769 and the exponent is 6. An exponent of 0 means multiply by 1.

SCALING

Because the display has only five characters, source values that would normally be expressed in more than five digits (e.g. 0 to 3,000,000 litres/day) must be ranged as a ration of that number (e.g. 0 to 3000 with a description of litres/day x 1,000). The totaliser will then count in steps of 1,000 gallons, so that 3,000,000 gallons would add 3,000 counts.

To make the totaliser count more slowly, the exponent can be altered. For example, directly totalising 30,000 litres/minute (Factor = 60 = 6.0000×10^1) would add 43,2000,000 counts per day. This would overflow the totaliser in 23 days. If the factor were changed so that the readings were not in litres, but in thousands of litres, (i.e. by changing the exponent from 10^1 (exp = 1) to 10^4 (exp = 4)), only 43,200 counts would be added each day and the totaliser would take over 60 years to overflow.

> Note: If a source is ranged 0.0 to 3.0 and the totaliser is scaled up by a 1000, each change in the least significant digit (LSD) represents 100 counts, with a potentially large rounding error. If the Source's range is set to 0.000 to 3.000, each change in the LSD represents only 1 count.

It is also possible to make the totaliser count faster than the rate being received from the source. E.G. to make the count 10 times faster, reduce the exponent by 1; to make it 100 times faster, reduce the exponent by 2.
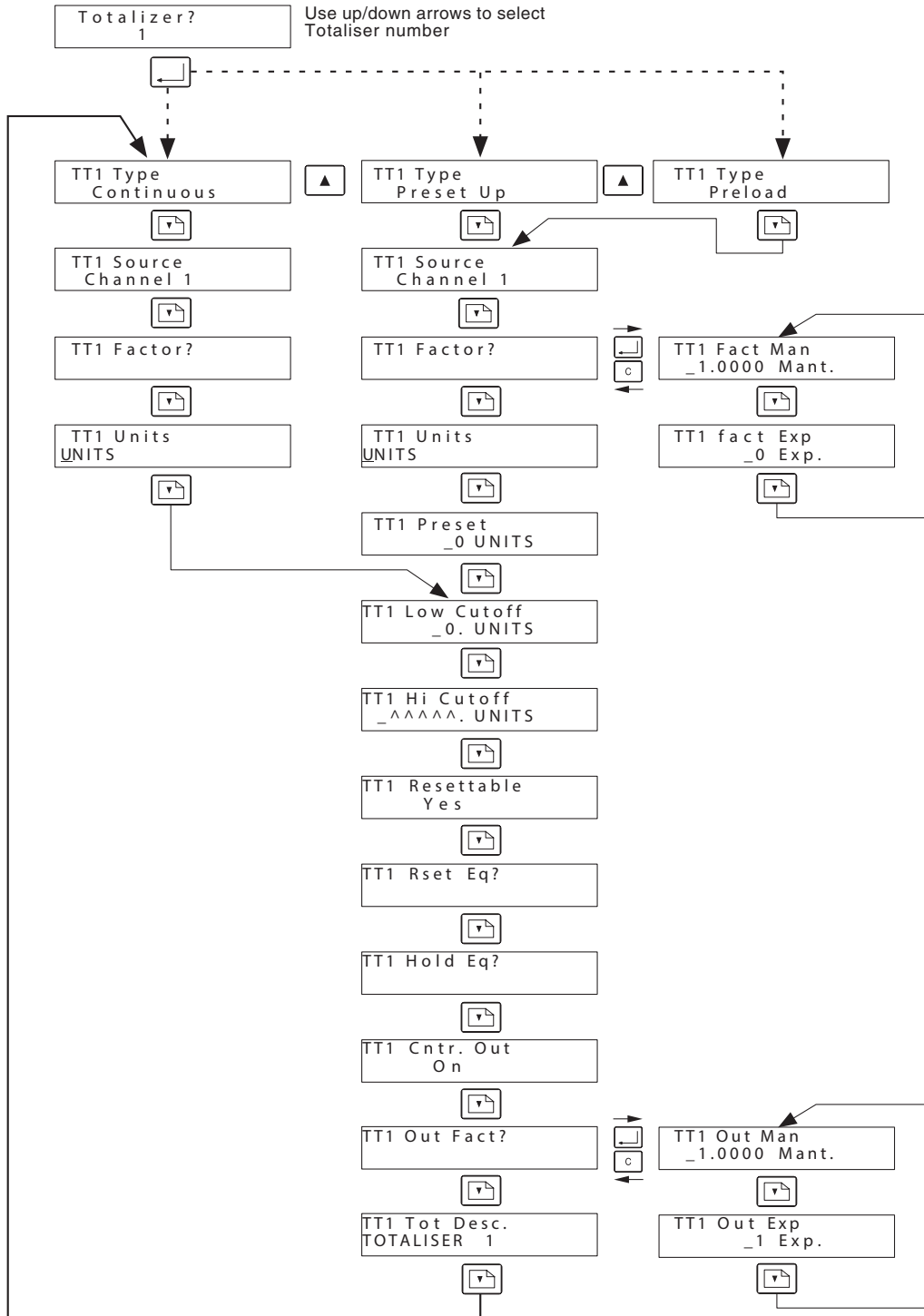
4.8.2 Configurable items

Totalizer?
1

Use up/down arrows to select
Totaliser number

TT1 Type
Continuous

TT1 Type
Preset Up

TT1 Type
Preload

TT1 Source
Channel 1

TT1 Source
Channel 1

TT1 Factor?

TT1 Factor?

TT1 Fact Man
_1.0000 Mant.

TT1 Units
UNITS

TT1 Units
UNITS

TT1 fact Exp
_0 Exp.

TT1 Preset
_0 UNITS

TT1 Low Cutoff
_0. UNITS

TT1 Hi Cutoff
_^^^^^. UNITS

TT1 Resettable
Yes

TT1 Rset Eq?

TT1 Hold Eq?

TT1 Cntr. Out
On

TT1 Out Fact?

TT1 Out Man
_1.0000 Mant.

TT1 Tot Desc.
TOTALISER 1

TT1 Out Exp
_1 Exp.

Figure 4.8 Totaliser menu structure

4.8.2 TOTALISER CONFIGURABLE ITEMS (Cont.)

Note: Any change in the configuration of a totaliser resets that totaliser.

Totaliser number		The up and down arrow keys and the Enter key are used to select a totaliser for configuration
Type		Select Off, Continuous, Preset up/down or Preload
	Off	The totaliser is disabled
	Continuous	Totaliser value increases continuously unless reset by the operator or by action equation. Totaliser value returns to zero and starts again after 999,999,999 counts have been exceeded.
	Preset up/down	A Preset Up totaliser counts up to the Preset value. When this value is reached the totaliser stops and an internal trigger is set for use in action equations. A preset down totaliser counts to zero from the preset value. When zero is reached the totaliser stops and an internal trigger is set for use in action equations. The totaliser reset equation can be used to reset the totaliser as a result of such a trigger.
	Preload	This type of totaliser is a continuous totaliser that restarts from a user-entered value (Preload). Useful when totalising must be paused for some reason, and then restarted from a known value.
Source		The up and down arrow keys and the Enter key are used to select an input or derived channel, or a contact closure source.
Factor		Enter the mantissa and exponent for the totaliser scaling as described in section 4.8.1. Table 4.8.2 contains some commonly used factors.
Units		Enter a string of up to 5 characters to describe the totalised units.
Preset		For preset and preload totalisers only, enter the preset/preload value here.
Low/Hi cutoff		Allows the user to set values below which and above which the totaliser will not totalise. The default High cut off value is 'Overrange', and all five of the caret (^) symbols must be replaced or deleted if a different value is entered.
Resettable		The up/down arrow keys are used to select the totaliser as resettable or not. When set to 'Yes', the totaliser can be reset by the operator (section 3), or by action equation. When set to 'No', the totaliser all requests to reset the totaliser are ignored.
Rset Eq		Allows the totaliser reset equation to be set up. - See section 4.5.2 for a description of action equations.
Hold Eq		Allows the totaliser hold equation to be set up. - See section 4.5.2 for a description of action equations.
Cntr. Out		When selected on, this option outputs a trigger every time a specifiable number of counts has been added to the totaliser value. This trigger can be used to operate a relay.
Out Fact		'Enter' allows the ratio between totaliser counts and output counter triggers to be set. For example, a factor of 1 (1.0000×10^0) means that there is a trigger every time the totaliser value changes; a factor of 10 (1.000×10^1) means that there is one trigger for every 10 totaliser counts, and so on. See section 4.8.1 for details of factor entry.
Tot Desc.		Allows a descriptor for the totaliser to be entered.

	Seconds	Mantissa	Exp
Per sec	1	1.0000	0
Per min	60	6.0000	1
per hour	3600	3.6000	3
Per day	86400	8.6400	4

Table 4.8.2 Common totaliser factors

4.9 TIMER CONFIGURATION

There are four internal timers which can be set to count down from a preset number of minutes. When this time has elapsed, the timer sets an internal trigger (TM1 to TM4). The timer starts when reset through its reset equation. If the timer output trigger is used as a source for the reset action equation, then the timer becomes a repeating interval timer.

Notes
1. Because of the iteration rate of the recorder, there is a delay of approximately one second between a counter's reaching zero and it restarting.
2. After power losses of up to a few seconds, timers reset to zero. After longer periods without power, timers restart their count from the entered number of minutes (Duration).

Figure 4.9 shows the menu structure.
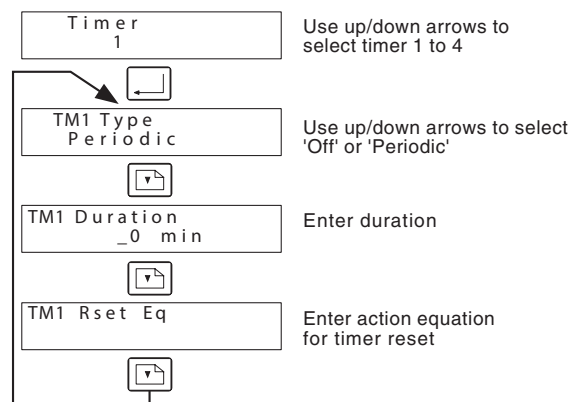
Figure 4.9 Timer configuration menu

4.9.1 Configurable items

Type	Select Off or Periodic. Periodic timers output a trigger after counting down from the operator entered Duration (number of minutes).
Duration	Allows the user to set the count-down time to between 1 and 999,999,999 minutes.
Rset Eq	Allows the action equation triggers to be entered for starting the timer. See section 4.5.2 for details of action equations.

4.10 DERIVED VARIABLES

4.10.1 Introduction

This feature provides basic and specialised maths functions. Each recorder may have one or two optional derived channels which are displayed as channels 5 and 6. There are a total of nine derived variable which can be used by either or both derived channels.

A derived channel can be traced on the chart by assigning a pen to it in its configuration (section 4.4). The channel from which the pen is 'taken' continues to act as configured (i.e. its value is still displayed, alarms still acted on, it can still be totalised etc.), but it does not appear on the chart.

Although the results of only two calculations can be assigned to channels - and therefore appear in the normal background scrolling of channel values - the values of all Derived Variables (DVs) can be viewed from the operator manu (section 3).

AVAILABLE MATHS FUNCTIONS

The following is a list of the available maths functions.

'BASIC' FUNCTIONS

Function	Equation
Add	$A + B$
Subtract	$A - B$
Divide	$A \div B$
Multiply	$A \times B$
Lin. Slope	$(A \times B) + C$
High Select	If $A > B$, then use A
Low Select	If $A > B$, then use B
High Peak*	Highest value since reset
Low Peak*	Lowest value since reset
Average*	Single point average - cumulative since reset
Polynomial	$A0 + A1x + A2x^2 + A3x^3$

'SPECIALISED' FUNCTIONS

Log 10	$B\log_{10}x$
Power 10	$AB \times 10^x$
Flow, Sq.Rt.	Mass flow (square root) - see section 4.10.2
Flow, Linr.	Mass flow (linear) - see section 4.10.2
F Value*	Sterilization constant (F_0 value since reset) - see section 4.10.2
RH	Relative Humidity - see section 4.10.2
ZrO2 Sensor	Zirconia O_2 probe - see section 4.10.2

Notes:
1. Because of processing time allocations, a maximum of two specialised functions may be running at any one time.
2. DV calculations work in Engineering units. For example, If a 4 to 20 mA input is converted to 1 to 5 Volts at the channel input and scaled 0 to 400 Bar, any DV calculation with this channel as a source will return a value in Bar.
3. Functions marked with an asterisk (*) have their values retained for 100 hours, under power off conditions, by a supercap located on the CPU board.

4.10.2 Configuration

Fig 4.10.2 shows a generalised version of Derived Variable configuration. As indicated, the number of inputs varies from function to function, and wherever possible, the inputs are given names to identify them. The functions are fully described in the subsections below.
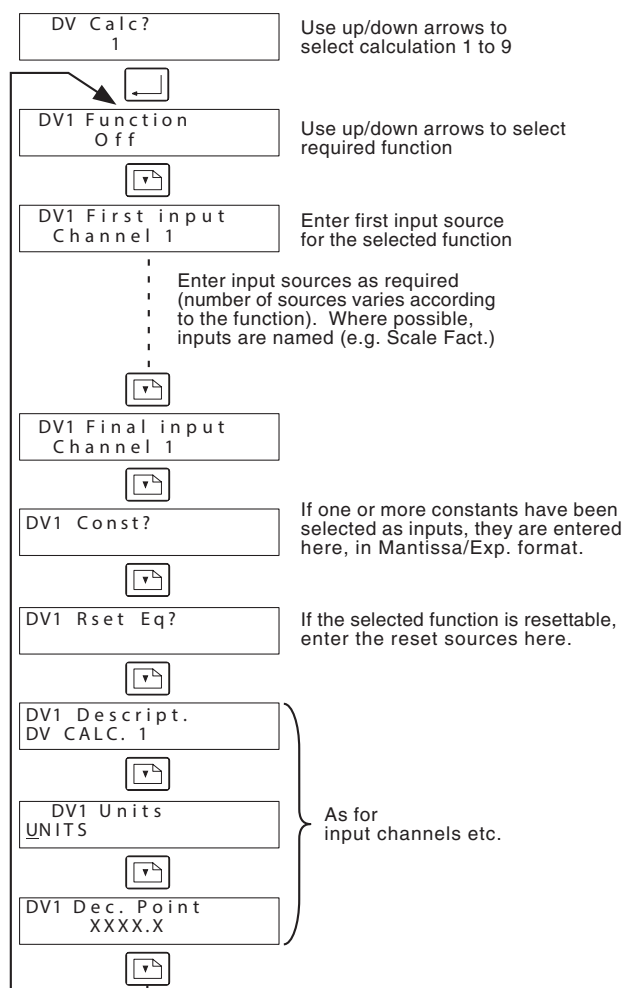

Figure 4.10.2 Derived Variable Menu structure

FUNCTION DETAILS

Add	Adds Input 1 and Input 2
Subtract	Subtracts Input 2 (Subtractor) from Input 1
Divide	Divides Input 1 (Numerator) by Input 2 (Denominatr). If Denominatr = 0, output = 99999
Multiply	Multiplies Input 1 by Input 2.
Lin. Slope	Calculates the function y = ax + b, where the variable x is Input 1, 'a' is Input 2 (Slope) and 'b' is Input 3 (Offset). Slope and offset should be set to 'Constant', and their values entered in the 'DVx Constant?' part of the configuration.
High Select	The output from the function copies whichever is the higher of Input 1 and Input 2
Low Select	The output from the function copies whichever is the lower of Input 1 and Input 2
High Peak	The output is the highest value that Input 1 has reached since last reset. The value is retained under power down conditions.
Low Peak	The output is the lowest value that Input 1 has reached since last reset. The value is retained under power down conditions.

4.10.2 MATHS FUNCTION CONFIGURATION (Cont.)

Average
The cumulative average value of Input 1 (Input), with samples taken every Input 2 (Sec/Sample) seconds. Each sample is added to the previous total, and the result is divided by the total number of samples.

Minimum sample period = 5 secs; maximum sample rate = 32,767 seconds
Maximum number of samples = 65536 (= 91 hours at 5 Sec/Sample). After this, the value is replaced by the current value, and the averaging starts again.
When reset, the output goes to the current value, and averaging restarts.

Polynomial
Calculates the equation $y = A0 + A1x + A2x^2 + A3x^3$, where x is a variable and A0 to A3 are constants.
Input 1 (Input) is the variable. The remaining inputs (A0 to A3) are each set to 'Constant', and their values entered in the 'DVx Constant?' configuration.

Log_{10}
Solves the equation $y = Alog_{10}x$ (where A is a 'scaling factor'). If x = 0, y = -99999

Power 10
Solves the equation $y = A.10^x$ (where A is a 'Scaling factor'). If x >30 or x < -30, y = 0000.0

Flow, Sq.Rt.
Basic AGA3 Gas flow. Solves the equation:

$$QM_t = \sqrt{A} \times \sqrt{\frac{DeltaP_t \times AbsP}{Temp_t \times Z}}$$

where: QM_t = Mass flow, at time t (in the same units as the measured flow, below).
                   A = Measured flow x Scaling factor
            $DeltaP_t$ = the differential pressure (inches of water) at time t
            $AbsP_t$ = The absolute pressure (Static Pressure) in PSI(A) at time t
            $Temp_t$ = The flow temperature in degrees Rankine
                   Z = Compressibility factor

Notes:
1. Differential pressure input can be a constant, if the channel uses sq. root to measure raw flow.
2. PSI(A) = PSI(G) + 14.7
3. °R = (°F + 459.67) or {(1.8 x °C) + 491.67}

Flow, Linr.
Linear AGA3 Gas flow. Solves the equation

$$QM_t = A \times \frac{Flow_t \times AbsP_t}{Temp_t \times Z}$$

where: QM_t = Mass flow at time t (in flow meter units).
                   A = Scaling factor
            Flowt = Output from flow meter
            $AbsP_t$ = The absolute pressure (Static Pressure) in PSI(A) at time t
            $Temp_t$ = The flow temperature in degrees Rankine
                   Z = Compressibility factor

Notes:
1. PSI(A) = PSI(G) + 14.7
2. °R = (°F + 459.67) or {(1.8 x °C) + 491.67}

4.10.2 MATHS FUNCTION CONFIGURATION (Cont.)

Fvalue

Outputs F_o in minutes. Solves the equation

$$Fval_t = Fval_{t-1} + \left(0.01666666 \times 10^{\left(\frac{ma_t - Target\ temp}{Z}\right)}\right)$$

where:
$Fval_t$ = F value at time 't'
$Fval_{t-1}$ = F value last iteration
ma_t = Value of temperature measuring channel (Input Temp) at time 't'.
Target temp = Sterilization temperature = 249.98 °F (121.1°C)
Z = Z value = 50°F (10°C)

Note: Reset sets $Fval_t$ to 0. If Z set to zero, $Fval_t$ = 99999

RH

Calculates % relative humidity from the following inputs.
Wet temp = wet bulb temperature in °C
Dry Temp = dry bulb temperature in °C
Atm Press = Atmospheric pressure in Bar.
Psy K = Psychrometric constant = 6.66×10^{-4}

ZrO2 Sensor

Calculates partial pressure of oxygen, from a zirconia oxygen probe, using the equation:

$$P1 = \frac{P2}{10^{\frac{E}{0.0496 \times T}}}$$

where:
P1 = partial pressure of oxygen (%) in the sampled gas
P2 = partial pressure of oxygen (%) in the reference atmosphere (20.95% for air)
(Ref O2 %)
E = Probe electromotive force (emf) in mV
T = Probe temperature in Kelvins (K = °C + 273.18)

4.10.3 Examples

HIGH AND LOW SELECT

Figure 4.10.3a shows how two flow-rate transmitters, measuring the same flow, can be used to improve measurement resolution and accuracy at low flow levels.

Transmitter 1 is set up to measure flows between 0 and 100 gallons/minute.

Transmitter 2 is set up to measure flows between 0 and 1000 gallons/minute.

To trace the value on the chart, Channel 5 or 6 can be set up with Chart Range = 0 to 1000 gpm, Source DV = DV4
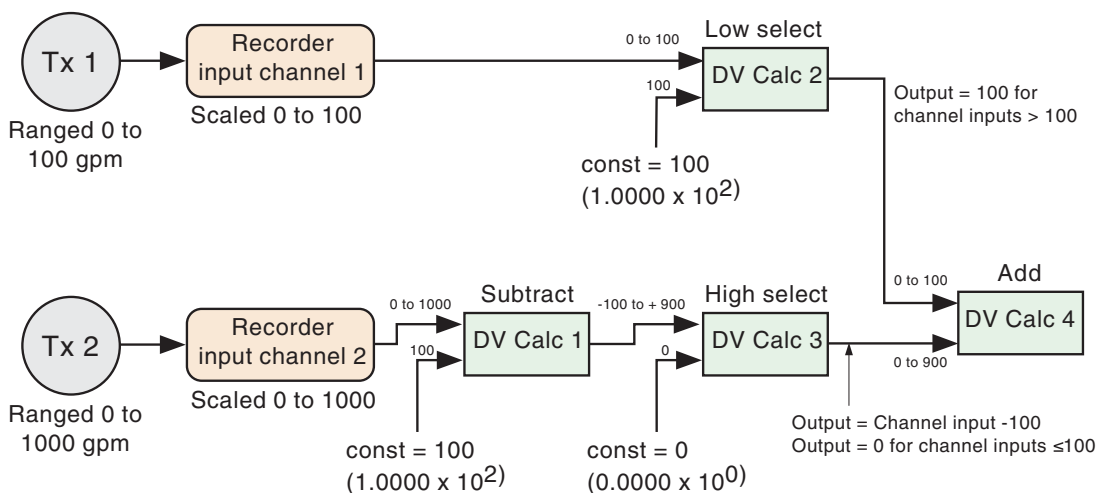
Figure 4.10.3a High/Low select application

4.10.3 EXAMPLES (Cont.)

MASS FLOW WITH PRESSURE AND TEMPERATURE COMPENSATION

Figure 4.10.3b, below, shows a square root mass flow implementation, including the facility to use a fixed temperature input instead of the measured temperature. DV Calc 4 to DV Calc 8 are used in this switching process, which is initiated by the user setting the input 1 constant of DV Calc 6 to 1.0000 (to use measured temperature) or to 0.000 (to use the fixed temperature entered as a constant at DV calc 8).

DV Calc 6 is used only for convenience: the same effect can be achieved by setting the relevant constants of both DV Calc 4 and DV Calc 7 to 0 or 1, individually.
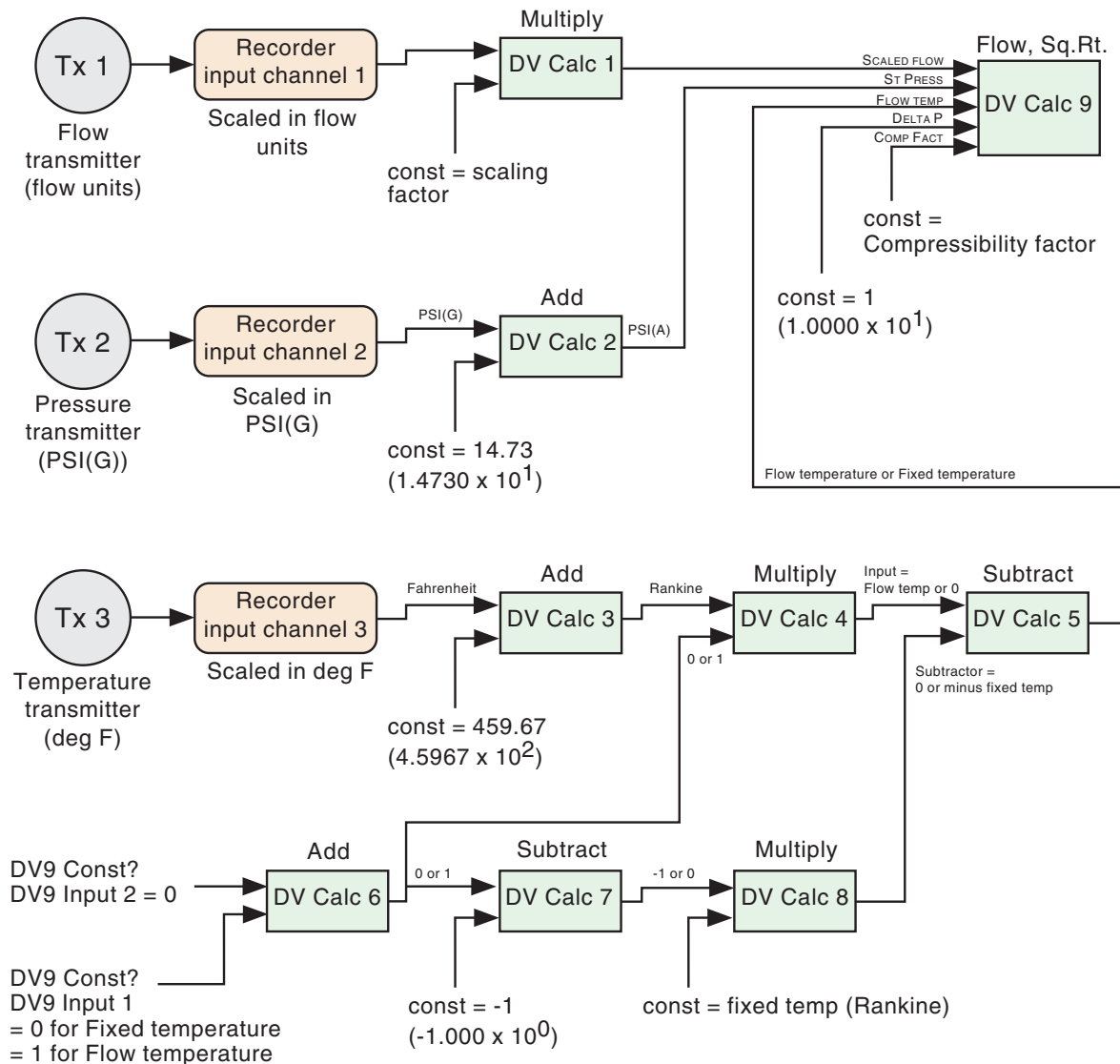
Figure 4.10.3b Square root mass flow with selectable temperature input

4.10.3 EXAMPLES (Cont.)

FINDING THE AVERAGE OF A NUMBER OF INPUTS

Figure 4.10.3c, produces the instantaneous average value of all four channel inputs by adding them all together and dividing by four.
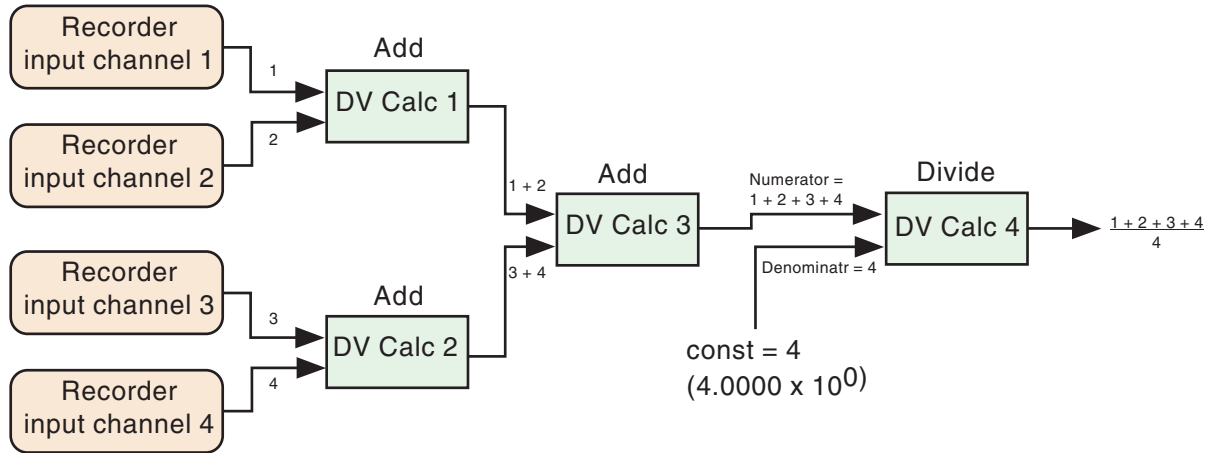
Figure 4.10.3c Multi-channel average

4.11 RETRANSMISSION OPTION

Note: This option shares an option board with event inputs, described in **section 4.12**, below.

Up to two retransmission boards may be fitted, providing up to four retransmission outputs. These, scalable, outputs may be directly proportional to the linearised value of any of channels 1 to 4, to any of the DV Calc. values or to a setpoint generator trace 1 or 2 value. Retransmission outputs must be used when a Controller current (CAT) output is specified. Board number is automatically determined by the recorder (but see note 5).

When PID control loops are present, the following assignment represents the default setup. The assignments can be changed during configuration. Outputs not used for control loops can be used as normal.

Loop 1 output = Board 1, output A

Loop 2 output = Board 1, output B

Loop 1 duplex = Board 1 outputs A and B

Loop 2 duplex = Board 2 outputs A and B

4.11.1 Hardware configuration

Each circuit board has two links to define whether their associated retransmission output is to be Voltage or Current. The relevant positions for these links is shown in figure 4.11.1, below, which also shows the pinout.

Notes:
1   All three board definition links must be set to the same position
2   Voltage outputs can be set to either 0 to 5V or 1 to 5V in software configuration (section 4.11.2)
3   Current inputs can be set to 0 to 20 mA or 4 to 20 mA in software configuration (section 4.11.2)
4   For each board, the retransmission negative outputs are common.
5.   On previous board versions, the board number was defined by three links on the board, all of which had to be set to board 1, or all set to board 2 position.
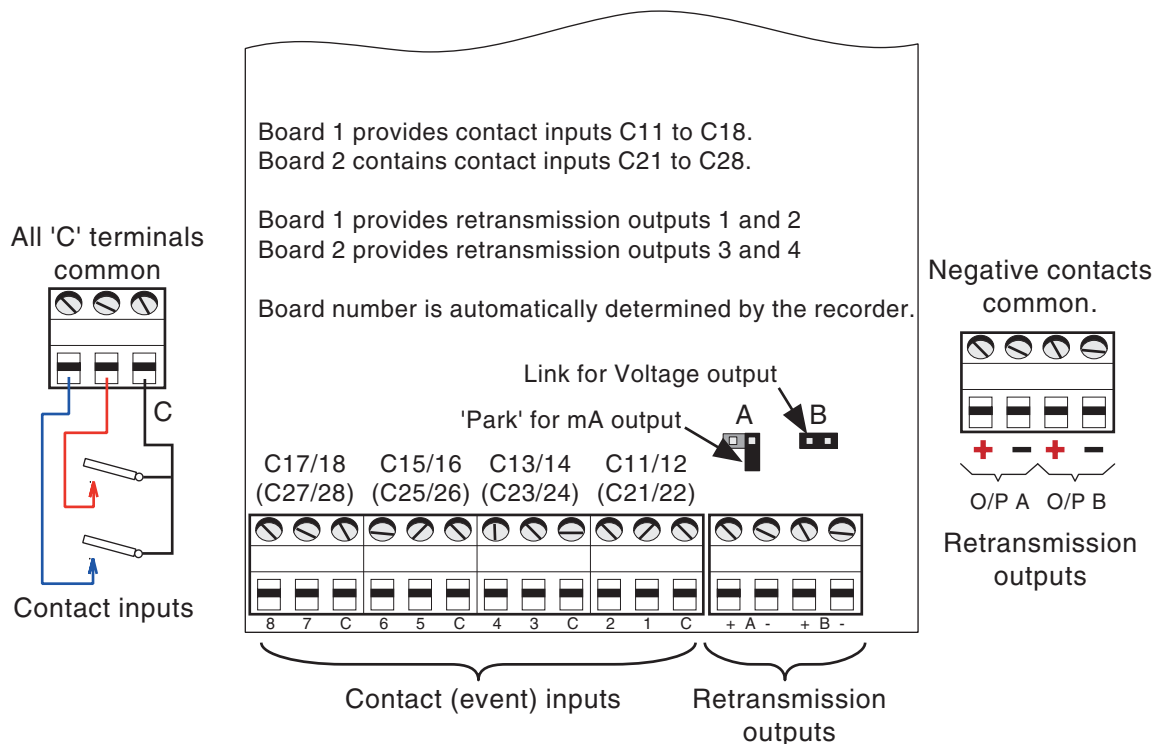

Figure 4.11.1 Retransmission/contact input: Hardware configuration and pinout

4.11.2 Software configuration

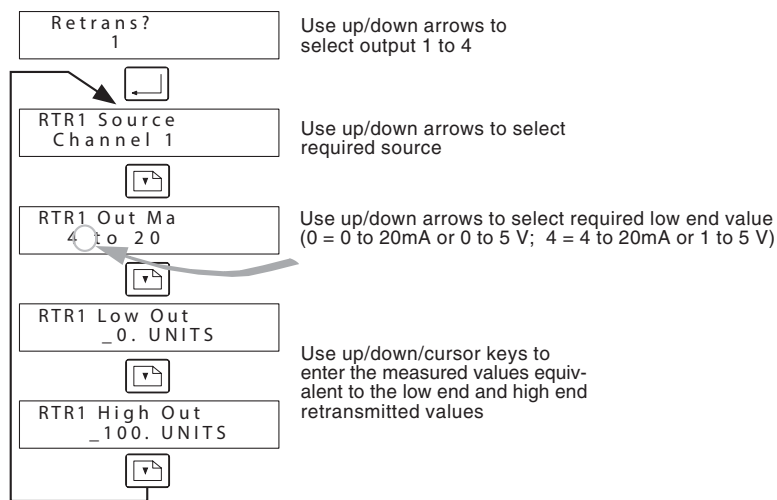Figure 4.11.2 shows the retransmission menu structure.

| Retrans?
1 | Use up/down arrows to select output 1 to 4 |

| RTR1 Source
Channel 1 | Use up/down arrows to select required source |

| RTR1 Out Ma
4 to 20 | Use up/down arrows to select required low end value (0 = 0 to 20mA or 0 to 5 V; 4 = 4 to 20mA or 1 to 5 V) |

| RTR1 Low Out
_0. UNITS | |

| RTR1 High Out
_100. UNITS | Use up/down/cursor keys to enter the measured values equivalent to the low end and high end retransmitted values |

Figure 4.11.2 Retransmission configuration menu structure

CONFIGURABLE ITEMS

Source	Select retransmission source from: Channels 1 to 4, DV1 to DV9, Controller 1 or 2, Setpoint Generator 1 or 2.
Out Ma	Allows a low value to be selected for the output range. 0 selects 0 to 20 mA or 0 to 5 Volts; 4 selects 4 to 20 mA or 1 to 5 Volts.
Low Out	Allows the user to enter the measured value equivalent to the 'zero' retransmission output.
High Out	Allows the entry of the measured value equivalent to the full scale retransmission output.

Note: Displayed units are those of the source.

4.12 CONTACT (EVENT) INPUTS

This option is shared with the Retransmission Output option described in section 4.11, above. The hardware configuration is the same as described in section 4.11.1, except that the positions of the Volt/mA links are not relevant.

Each option board provides 8 inputs, which can be either contact closure or logic levels (low = active). The termination is arranged such that there is one common contact for every two contact inputs. This is for wiring convenience only, as all the 'C' contacts are commoned together on the circuit board. Figure 4.12, below shows typical wiring configurations.

Contact inputs are used only as sources for action equations. Board one inputs are denoted C11 to C18; board two inputs have the designation C21 to C28.
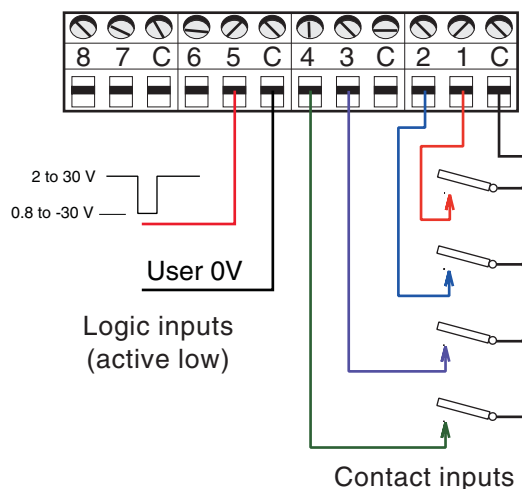
Figure 4.12 Contact input wiring

4.13 EVENT PEN

This option uses pen 3 or 4* to act as an event marker. The pen normally traces at 100% chart, but moves in by 10% when a contact (e.g. switch or relay), wired to the input channel, is closed by the user. The input channel is fitted with a 250Ω shunt resistor.

* Notes:
1   It is not possible to have four recording channels and an event marker,
2   Pen 4 is used if there are three recording channels fitted.; pen 3 is used if there are only two recording channels fitted.

5 CALIBRATION

Note: Amongst other things, the calibration function offers the means of calibrating input channels and cold junction compensation using precision signal standards. Calibration should not be used to set up a recorder to measure a particular input - this should be done using the configuration menus described in section 4, above.

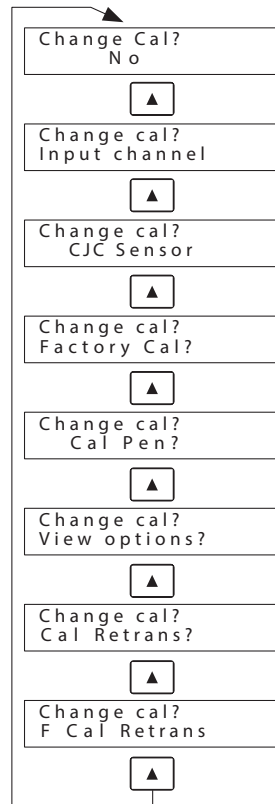Figure 5 shows the top level calibration menu. Lower levels are described in later sub-sections.

```
        ┌──────────────────────┐
        │ Change Cal?          │
        │       No             │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │ Input channel        │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │    CJC Sensor        │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │ Factory Cal?         │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │    Cal Pen?          │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │ View options?        │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │ Cal Retrans?         │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
        ┌──────────────────────┐
        │ Change cal?          │
        │ F Cal Retrans        │
        └──────────────────────┘
              ┌─────┐
              │  ▲  │
              └─────┘
```

Figure 5 calibration manu

5.1 INPUT CHANNEL CALIBRATION

Input channel calibration allows all the ranges of all the input channels to be calibrated against precision input signals. Figure 5.1 shows the menu structure.

INPUT RANGE	NOTES
0 to 20mV	
0 to 60mV	Calibrate this before the CJC
0 to 80mV	
0 to 200mV	Calibrate this before Ohms
0 to 400mV	
0 to 1.7 Volts	Calibrate this before the CJC
0 to 2.5 Volts	
0 to 5 Volts	
Ohms	300 Ohms recommended
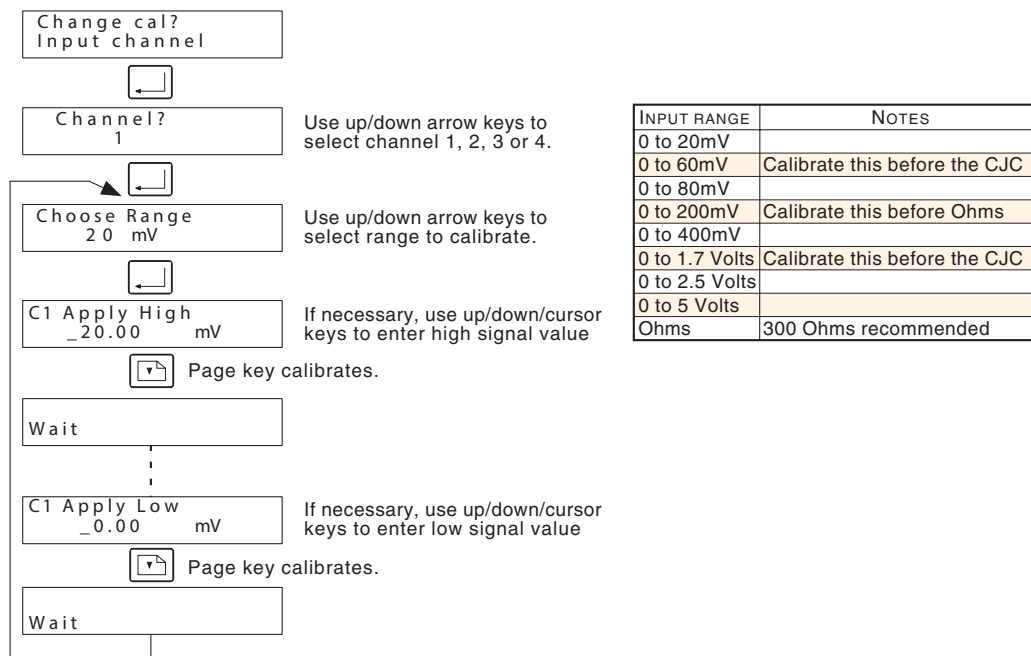
Figure 5.1 Input channel calibration

5.1.1 Input channel calibration procedure

For each channel, there are nine ranges to calibrate, as shown in the table above. The procedure is the same for each, as follows:

1. Select a channel for calibration, as described in figure 5.1 above. Press Enter.
2. Select a range, using the up/down arrow keys, then press Enter.

   Note: It is recommended that all ranges be calibrated, in the order that they appear in the picklist. In particular, the 60 mV and 1.7 V ranges should be calibrated before CJC calibration, and the 200 mV range before Ohms calibration.

3. Apply the requested calibrating signal high value* (e.g. 20mV) across the channel terminals, then press the page key.
4. After the 'Wait' message has disappeared, apply the requested calibrating signal low value* (e.g. 0 mV) across the channel terminals, then press the page key.
5. After the 'Wait' message has disappeared, select a new range and repeat the procedure.
6. Repeat for all required channels.

   *Note: If it is not possible to apply exactly the requested value of calibration signal, then use the up/down/cursor keys to enter the value of a signal that is available. This should be as close to the requested value as possible.

5.2 CJC SENSOR CALIBRATION

This procedure calibrates the cold junction compensation which is applied to the recorder input signals when thermocouple inputs are configured for use. The procedure should be applied to both input boards if more than one is fitted.

The procedure requires a Type J thermocouple, maintained at a known temperature, (or a Type J thermocouple simulator) to be connected across input 1 of the board whose CJC sensor is to be calibrated (i.e. channel 1 or channel 3).

Figure 5.2 shows the CJC calibration menu.
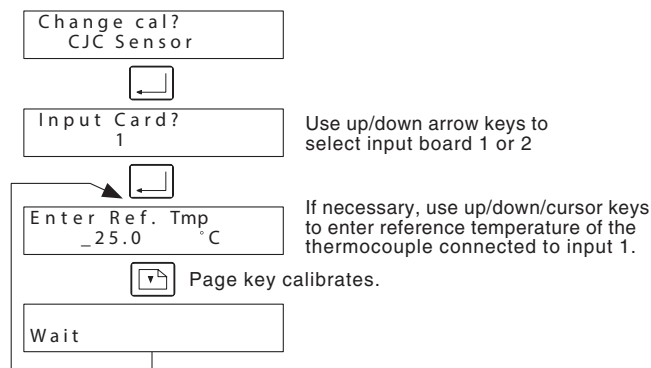
Figure 5.2 CJC Calibration menu

5.2.1 CJC sensor calibration procedure

1. Select board 1 or 2 (if fitted). Press 'Enter'
2. Connect a type J thermocouple, maintained at a known temperature, or a Type J simulator to input 1 of the subject board.
3. If necessary, use the up/down/cursor keys to enter the thermocouple temperature. Press the Page key.
4. After the 'Wait' message has gone, repeat for the other board.

5.3 RESTORE FACTORY CALIBRATION

This allows all user calibrations to be discarded on a channel-by-channel basis.

5.3.1 Restore factory calibration procedure

1. Use the up/down arrow keys to select the required channel, then press 'Enter'
2. Press Enter again, in response to the 'ENTER to confirm' message which appears. (Press the 'Clear' key to quit).
3. After the 'Wait' message has gone, select a further channel if required.

5.4 PEN CALIBRATION

This allows the user to set the pens to align with the chart zero and full scale markings. It is recommended that a new chart be used to ensure good trace visibility. Figure 5.4 shows the calibration menu.
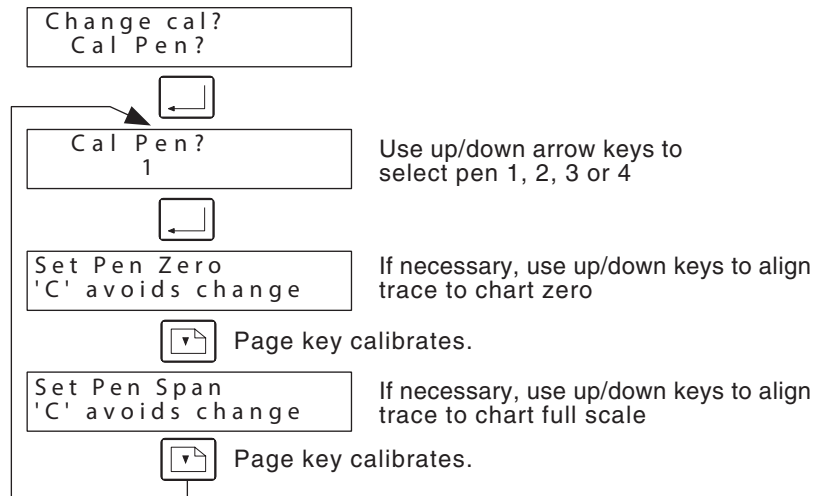
Figure 5.4 Pen calibration menu

5.4.1 Pen calibration procedure

1. Use the up/down arrow keys to select the required pen, and press 'Enter'.
2. The selected pen moves towards the centre of the chart, and stops where it believes chart zero to be. If necessary, use the up/down keys to adjust the pen tip position to chart zero. When the pen tip and chart zero are aligned, press the Enter key.
3. Press the Page key. The pen moves towards the outside edge of the chart, and stops where it believes chart full scale to be. If necessary, use the up/down keys to adjust the pen tip position to chart full scale. When the pen tip and chart full scale are aligned, press the Enter key.
4. Press the Page key, and select another pen for calibration. (The pen just calibrated moves to its normal tracing position.

5.5 VIEW OPTIONS

This displays a 16 character number which can be decoded to determine which options are fitted to the recorder.
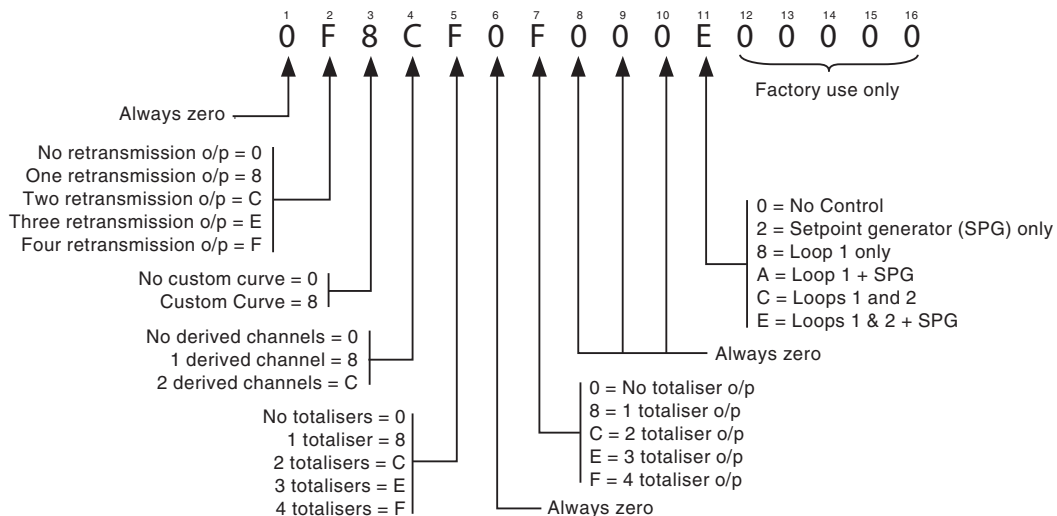
Figure 5.5 Option fit decoding

5.6 RETRANSMISSION OUTPUT CALIBRATION

This allows the user to calibrate the retransmission output channels.

5.6.1 Retransmission calibration procedure

1. Use the up/down arrow keys to select the output for calibration, but do not press enter yet.

2. Connect the output to be calibrated to channel 1 input (+ to +, - to -), using a 250Ω shunt if the output is set up as a current output (ref. section 4.11)

3. Press Enter to calibrate. After 'Wait' message, select another output, if required, and repeat.

5.7 RETURN RETRANSMISSION OUTPUT TO FACTORY CALIBRATION

This allows all user retransmission calibrations to be discarded on a channel-by-channel basis. Input channel calibration is not affected.

5.7.1 Restore factory calibration procedure

1. Use the up/down arrow keys to select the required channel, then press 'Enter'
2. Press Enter again, in response to the 'ENTER to confirm' message which appears. (Press the 'Clear' key to quit.)
3. After the 'Wait' message has gone, select a further channel if required.

ANNEX A SPECIFICATION

Inputs

Number of inputs	1, 2, 3 or 4
Input types Thermocouples:	Types B, C, E, J, K, L, N, R, S, T, Ni-NiMo
Resistance thermometers:	100Pt, 10Cu, 100Ni, 120Ni.
Voltage:	4mV to 5V dc
Current:	250Ω shunt
Contact closure option:	One or two sets of eight. Contact closure or logic low = active
Zero offset	-20% to +100% of the gain step selected by the recorder - see table A1 for range steps.
Linearisation types	Thermocouple, RTD, Square root, 3/2 power, 5/2 power, log_{10}, Custom curve
Linearisation error	± 0.3˚C
Scan rate	Each channel scanned every 500 msec.
CJC rejection ratio	25:1
CJC accuracy	± 0.5 ˚C at 25 ˚C reference
Input ranges	Selected automatically by the recorder using the configured high input value as the criterion. See table A1.
Input resolution	See table A1.
Input impedance	>20 MΩ
Rejection Common mode:	120 dB at 50/60 Hz
Series mode:	60 dB at 50/60 Hz
Isolation Isolated input boards:	Each input to 250 Vac
Non-isolated input boards:	Two channels with common negative connection: to 250V ac from ground.

Gain step	Input range	Resolution
20 mV	- 4 to + 20 mV	2 µV
60 mV	- 12 to + 60 mV	6 µV
80 mV	- 16 to + 80 mV	8 µV
200 mV	- 40 to + 200 mV	20 µV
400 mV	- 80 to + 400 mV	40 µV
1.7 V	- 0.34 to + 1.7 V	170 µV
2.5 V	- 0.5 to + 2.5 V	250 µV
5 V	- 1 to + 5.0 V	500 µV

Table A1: Gain steps, ranges and resolutions

Writing system

Pen colours	Blue (channel 1), Red, Green and black (channel 4)
Pen type	Fibre-tipped disposable (FTD) - line length >450 metres (1500 ft.)
Pen positional accuracy	1.0% of chart range
Pen positional resolution	0.2% of chart range
Pen response	5 seconds, 0 to full scale.
Chart type	Circular, 100 mm calibrated chart width
Chart rotation speeds	Configurable between 1 and 4096 hours per rev.
Standard chart periods	24 hour, 7 day.

Non-volatile memory

Configuration:	Saved in EEPROM
Active values:	Retained for 100 hours by 'supercap'.

See section 6.1 for more details

Display

Basic accuracy	0.05% of gain step + 0.5% of reading

Environmental

Operating temperature range	0˚C to 45°C (0°C to 40°C for CE compliant recorder) -20˚C Minimum Temp with Case Heater option (now obsolete)
Altitude (maximum)	<2000 metres
Humidity	10 to 90% RH, non-condensing
Exposure	Protect from direct sunlight.

Note: The bezel vertical centre line is offset from panel cutout vertical centre line - see figure 2.2.1

Physical

Bezel	380 mm (W) x 360 mm (H)
Panel cutout	345 mm (W) x 340 mm (H)
Depth behind bezel	148 mm
Weight	7 kg (approximate - depends on options fitted.

ANNEX A: SPECIFICATION (Cont.)

Power requirements

Supply voltage	Standard:	Operator selectable switch 120 V or 240 V (both -25% + 10%; 48 to 62 Hz)
Power	AC supply:	<50 VA
Fuses	Main board:	240 V supply = 500 mA
		120 V supply = 1 A
	Supply power line:	≤ 3 A
Transmitter power supply option:		240 V supply = 63 mA, 120 V supply = 100 mA, (both 'slow blow')

Electrical safety

BS EN61010. Installation category II; Pollution degree 2 (See panel below)

Relay outputs

Maximum number of relays	Up to two sets of four, individually assignable.
Contact rating	
Maximum switching power:	150 W or 250 VA (resistive)
Maximum switching voltage:	250 V (resistive)
Maximum switching current:	1.0 A (resistive) providing the maximum switching power is not exceeded

Communications option   (Now obsolete)

Standard	EIA 422

Retransmission option

Number of outputs	Up to 2 boards, each with two outputs.
Output type	Scaled 0 to 20 mA or 4 to 20 mA (600 Ω max) or 0 to 5 V or 1 to 5 Volts. Isolated from recorder supply, but with common negative outputs per board.
Output accuracy	Displayed measured value ± 0.1% retransmitted span

Transmitter power supply

Output:	Four isolated, 28 V dc supplies, sourcing up to 24 mA each.

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.

INDEX

Eurotherm: International sales and support   www.eurotherm.com

Contact information

Eurotherm Head Office
Faraday Close
Durrington
Worthing, West Sussex,
BN13 3PL

Worldwide Offices
www.eurotherm.com/worldwide

Scan for local contacts

Represented by:

Sales Enquiries	**General Enquiries**
T +44 (0)1903 695888	**T** +44 (0)1903 268500
F 0845 130 9936	**F** 0845 265982