



# User's Guide

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## CT6100

## Circular Chart Recorder



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**WARNING:** These products are not designed for use in, and should not be used for, human applications.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Overview

The CT6100 Chart Recorder is a microprocessor-controlled recorder which continuously monitors the output of one, two or three industry standard sensors and provides a permanent trace of the results on a rotating, removable chart.

Up to 6 relays are available, each independently configurable to provide full alarm and process control.

Operation of the chart recorder is via a five-function keypad with associated 2-line liquid crystal display (LCD). A bank of 6 light-emitting diodes (LED's) provide a quick visual indication of the status of the relays.

Modular construction makes upgrading easy and includes expansion options such as:

- Retransmission - output of a current proportional to the measured variable.
- Auxiliary Power Supply - 12 or 24V output to supply 2-wire current loop transmitters or direct powered transducers.

#### 1.2 Software Features

Menu-structured software makes operation easier and allows the recorder to be configured for any particular application.

Non-volatile memory is used to store all operational parameters which are then retained in the event of a power failure or switching off.

Settings in software are protected from unauthorised alteration by built-in software and hardware features.

The recorder has three main modes of operation:

- Set-up.
- Calibration
- Record (Normal operation ).

Each mode is fully explained in the relevant sections of this manual.

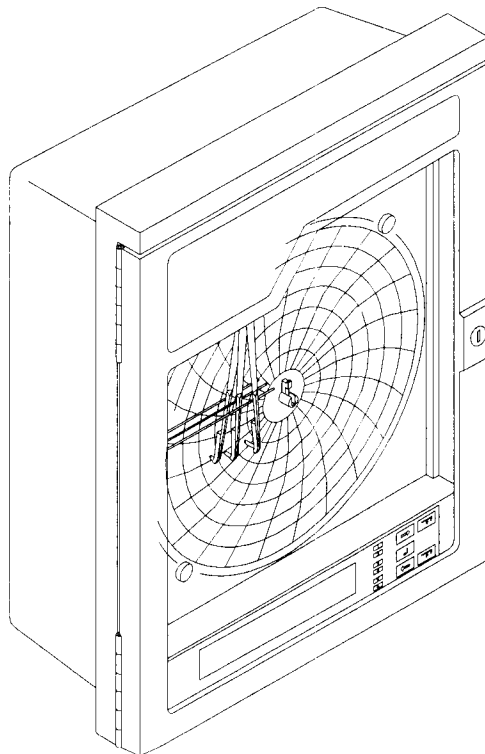


Figure 1.1 : CT6100 Circular Chart Recorder

## CHAPTER 2

### DESCRIPTION

#### 2.1 Operational Description

The CT6100 chart recorder is centred around an 8-bit microprocessor which controls the chart and pen positions, digital display, keypad, input stages and alarm relays.

Each pen has its own input stage which interfaces the signal to the microprocessor and may be of the analogue or event type. Event inputs accept a signal which is basically an on/off indication. Analogue input stages are universal and can accept industry-standard signals which are fed via an amplifier to an analogue-to-digital converter (ADC) connected to the microprocessor. Sensors with non-linear outputs, such as thermocouples and RTD's are linearised by the software. The microprocessor then controls the pen drive motors so that the signal is traced out on the chart providing a continuous, hard-copy record. In parallel with this a display shows the value of the input and the current status, while relays provide a means of controlling external equipment.

Chart rotation is also under the control of the microprocessor and this allows for a wide range of speeds.

Relays, which can be assigned to any pen, are configured to a desired value of the input signal and to register a specific alarm type, i.e. high, low or deviation. Associated with each relay is a LED which will be lit red under alarm conditions and green under normal conditions. The LEDs of unassigned relays are unlit.

The liquid crystal display shows the current input signal value and when requested displays all the relay settings on its bottom line.

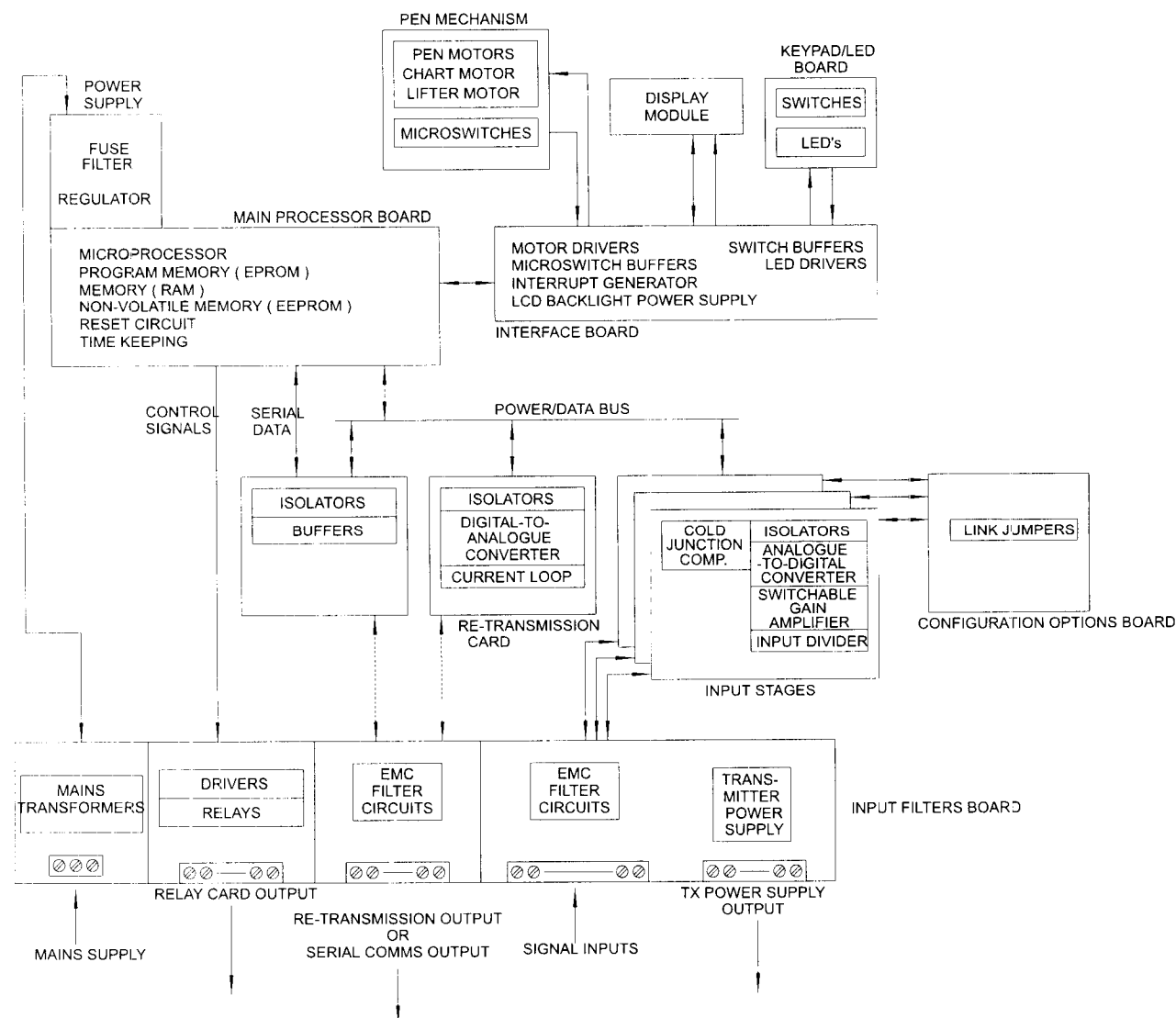


Figure 2.1 : Functional Block Diagram

## 2.2 Relays

The CT6100 recorder may be fitted with a relay card plugged into sockets on the left hand side of the main processor board (bay 1). The card can carry three or six single-pole relays of either electromagnetic changeover type or solid-state (triac) normally-open type. The status of each relay is given by colour-coded light-emitting diodes to the left of the front-panel keypad.

Electromagnetic relays are failsafe in that they are energised in the normal state and de-energised in the alarm state. In this way if the power to the recorder is interrupted the relays will automatically signal an alarm condition. Solid-state relays cause less electrical interference but break connection when the power is removed.

Arc suppression networks (snubbers) are fitted to each set of contacts and consists of a 22nF capacitor in series with a resistor. This network will protect its relay when inductive loads are switched and also minimise the emission of electromagnetic interference.

Each relay may be programmed to operate with any channel (pen) of the recorder. The switching action, setpoint, and hysteresis are also configured in this way. The procedure for configuring the relays is given in section 4.8.

The five possible switching actions are:

- High alarm
- Low alarm
- Deviation alarm
- Control low relay
- Control high relay

The characteristics and applications of each will be described in turn.

### 2.2.1 Hysteresis

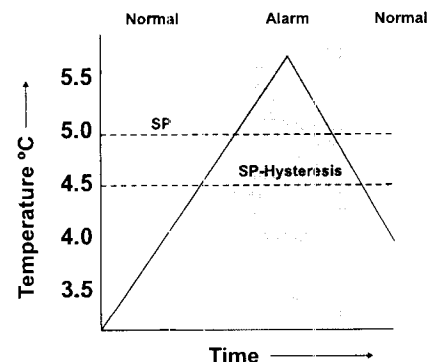
Hysteresis is used to eliminate rapid switching of a relay (so-called chattering) when the recorder's reading is close to the relay's setpoint. Chattering is particularly troublesome in applications where the process variable - the temperature of a fluid bath for example - changes slowly over time. Hysteresis overcomes chatter by shifting the relay's switching point by a small amount above or below the setpoint depending on whether the relay is on or off. In practice this means that the relay will switch from on-to-off and off-to-on at slightly different points: the greater the level of hysteresis the greater the difference between the switching points. The region between the switching points is the hysteresis band. If the hysteresis value is set to zero the relay will switch from on-to-off and off-to-on at the same point, this is generally not recommended.

In the CT6100 recorder the amount of hysteresis can be set by the user to be a percentage of the chart span.

### 2.2.2 High Alarm

High alarms (absolute) indicate when the recorder's measurement rises above a level known as the setpoint (SP). In the CT6100, high alarms have hysteresis below the setpoint only. This means, for example, that if the setpoint is 5°C and the hysteresis is 0.5°C (i.e. 1% of a -25 to +25°C chart) as the temperature rises the high alarm relay will go into the alarm state (de-energised) at precisely the setpoint value, 5°C, but will not return to the normal state (energised) until the temperature falls below 4.5°C.

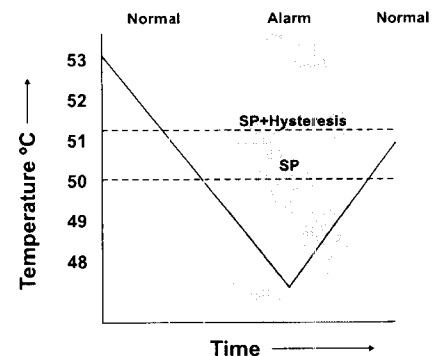
Typical application: To operate an over-temperature warning buzzer or protection device on a process which must not exceed a given temperature.



### 2.2.3 Low Alarm

Low alarms (absolute) indicate when the recorder's measurement falls below a level known as the setpoint. In the CT6100 low alarms have hysteresis above the setpoint only. This means, for example, that if the setpoint is 50°C and the hysteresis is 1°C (i.e. 1% of a 0 to 100°C chart) as the temperature falls the low alarm relay will go into the alarm state (de-energised) at precisely the setpoint value, 50°C, but will not return to the normal state (energised) until the temperature rises above 51°C.

Typical application: To operate an under-temperature warning buzzer or protection device on a process which must not go below a given temperature limit.

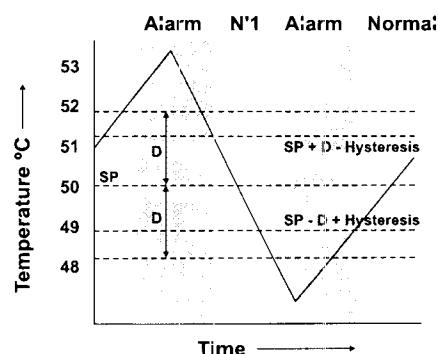


## 2.2.4 Deviation Alarm

A deviation alarm has a band or 'window' which is centred on a setpoint, an alarm indication is given whenever the process variable falls outside the limits of that band. The deviation alarm may therefore detect whether the process variable is either too high or too low.

The deviation value (shown as 'D' in the figure) is the difference above or below the setpoint at which the alarm is set. The figure shows a setpoint of 50°C with a deviation value of 1.5°C and 0.5°C of hysteresis. The total width of the deviation band is twice the value 'D' (3°C in the example).

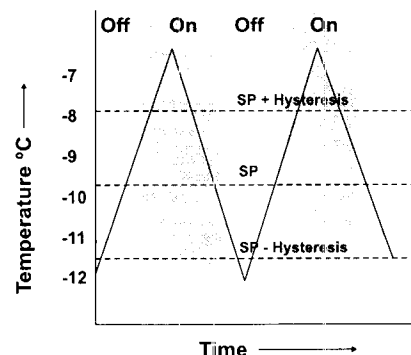
Typical application : To monitor whether a process is operating within its normal upper and lower limits.



## 2.2.5 Low Control Relay

Like a low alarm, a low control relay switches when the recorder's measurement falls below a certain level. A low control alarm however, has a hysteresis band either side of the setpoint. This means, for example, that if the setpoint is -10°C and the hysteresis is 1°C (i.e 2% of a -25 to +25°C chart) as the temperature rises the low control relay will switch the load on (relay energised) when the temperature reaches -9°C (setpoint + hysteresis) but will not return to the off state (relay de-energised) until the temperature falls to -11°C.

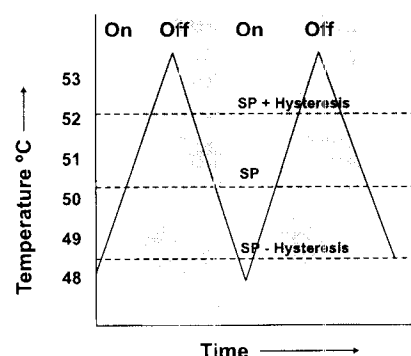
Typical application: To regulate the temperature of a cold store by switching on a refrigeration cooling unit above a certain temperature.



## 2.2.6 High Control Relay

Like a high alarm, a high control relay switches when the recorder's measurement rises above a certain level. A high control alarm however, has a hysteresis band either side of the setpoint. This means, for example, that if the setpoint is +50°C and the hysteresis is 1°C (i.e 1% of a 0 to 100°C chart) as the temperature rises the high control relay will switch the load off (relay de-energised) when the temperature reaches 51°C (setpoint + hysteresis) but will not return to the on state (relay energised) until the temperature falls to 49°C.

Typical application: To regulate the temperature of a water bath by switching on a heating element whenever the temperature falls below a certain level.



	Below Setpoint (SP) and hysteresis band				Above Setpoint (SP) and hysteresis band			
Relay Action	Relay Condition	LED	Closed Contacts	Open Contacts	LED	Relay Condition	Closed Contacts	Open Contacts
High Alarm	Normal - Energised	Green	B & COM	A & COM	Red	Alarm - De-energised	A & COM	B & COM
Low Alarm	Alarm - De-energised	Red	A & COM	B & COM	Green	Normal - Energised	B & COM	A & COM
Control Low Relay	OFF - De-energised	Green	A & COM	B & COM	Red	ON - Energised	B & COM	A & COM
Control High Relay	ON - Energised	Red	B & COM	A & COM	Green	OFF - De-energised	A & COM	B & COM

	Inside Deviation Band				Outside Deviation Band			
Relay Action	Relay Condition	LED	Closed Contacts	Open Contacts	LED	Relay Condition	Closed Contacts	Open Contacts
Deviation Alarm	Normal - Energised	Green	B & COM	A & COM	Red	Alarm - De-energised	A & COM	B & COM

Table 2.1 : Summary of electromagnetic relay actions



Relay Action	Below Setpoint (SP) and hysteresis band			Above Setpoint (SP) and hysteresis band		
	Relay Condition	LED	B & COM Contacts	Relay Condition	LED	B & COM Contacts
High Alarm	Normal - Energised	Green	Closed	Alarm - De-energised	Red	Open
Low Alarm	Alarm - De-energised	Red	Open	Normal - Energised	Green	Closed
Control Low Alarm	OFF - De-energised	Green	Open	ON - De-energised	Red	Closed
Control High Alarm	ON - Energised	Red	Closed	OFF - Energised	Green	Open

Relay Action	Inside Deviation Band			Outside Deviation Band		
	Relay Condition	LED	B & COM Contacts	Relay Condition	LED	B & COM Contacts
Deviation Alarm	Normal - Energised	Green	Closed	Alarm - De-energised	Red	Open

Table 2.2 : Summary of solid-state relay actions

## 2.3 Overall Physical Details

The chart recorder is housed in a steel case with glass-filled polyester resin door. A clear-panelled door, hinged at the left-hand side, allows access to the chart paper and control panel and enables these items to be seen when it is closed. The door can be locked. See figure 1.1.

Inside the door the chart paper and control panel are mounted on a chart plate which hinges at its right-hand side and is retained closed by a single screw at its left. Housed behind this are the circuit boards and drive mechanisms.

At the base of the recorder are five cable glands through which all power supply and signal cables enter. The chart recorder can be surface or panel mounted.

## 2.4 Chart Plate

This is located directly behind the door and consists of a moulded plate on which the following items are mounted:

- Chart Drive Assembly.
- Pen Drive Mechanism.
- Pen Lifter Arm and Motor.
- Control Panel.
- Interface PCB.

Figures 2.2 and 2.3 show the layout of the front and rear of the chart plate assembly.

### 2.4.1 Chart Drive Assembly

This consists of:

1. Stepper motor with 150:1 gearbox.
2. Chart centre locking hub.

The rotational speed of the chart is controlled by the microprocessor and is fully programmable in 1 hour steps from 1-24 hours and then in 1-day steps up to 31 days. Refer to Chapter 4: Setting up the Recorder.

### 2.4.2 Pen Drive Mechanism

This assembly comprises:

1. Frame.
2. Pen drive motor/motors.
3. 'Home' position microswitches.
4. Feedback potentiometer.
5. Pen lifter arm.
6. Pen arm assembly/assemblies.

#### Frame, Pen drive motor/motors, 'Home' position microswitches.

Depending on the model, 1, 2 or 3 stepper motors may be fitted within the frame, each with its associated worm and segment drive gearing. A bias spring ensures engagement of the worm and segment and eliminates backlash. Each drive segment carries a 'C'-shaped radial arm onto which the pen arm assembly fits. These parts comprise the pen drive assembly which is secured to the rear of the chart plate by three fixing screws.

Positioning of each pen is achieved by pulsing its stepper drive motor. Each pen is fitted with a microswitch which determines the limit of travel at the bottom of the chart scale. The microswitch closes when the pen travels just inside the lowest scale mark near the chart centre; this sets the 'home' position which is the reference (datum) point used for pen positioning. Position accuracy is checked periodically by re-positioning the pens.

In normal record mode the pens are positioned to trace the input signal levels. At certain times they may be driven to the special positions 'home', zero and full-scale.

#### Pen lifter arm.

Pivoting on a shaft on the frame is the pen lifter arm. On a complete chart plate this arm is attached to the pen lifter spine which projects through a hole to the front face of the chart plate and carries the comb: this comb acts against the pen arm(s). The pen lifter motor, fixed to the chart plate, carries a cam which pushes against a roller on the pen lifter arm moving it and so raises or lowers the pen(s). A bias spring maintains contact between the roller and cam.

Raising the pen(s) off the chart makes changing it easier and prevents spoiling of the trace during the recorder reset cycle. The extent of the comb movement is adjustable through set screws acting against microswitches.

#### Pen arm assembly/assemblies.

A pen arm assembly consists of a pen arm moulding, spring steel arm, and an ink capsule. The spring steel arm is fixed to the moulding which push fits onto the radial arm driven by the pen drive motor.

At the end of the spring steel arm is an ink capsule secured to it by means of a dovetail engaged in a slot. Each pen arm moulding is colour coded and the ink capsule fitted to the arm must match its colour.

### 2.4.3 Control Panel

The control panel consist of a liquid crystal display module held by four screws and a smaller keypad/LED PCB assembly held by three. Both are located in a recess at the bottom rear of the chart plate. A ribbon cable from each PCB connects to the interface board.

### 2.4.4 Interface PCB

The interface PCB provides the control and data interface between the main processor PCB and the modules mounted on the chart plate. The PCB is secured in position by five screws and a 34-way ribbon from the left hand side connects to the main processor PCB. Other connections from the interface PCB go to the control panel (two ribbon cables), the pen drive motor(s), the pen lifter motor, the chart drive motor and also to the microswitches.

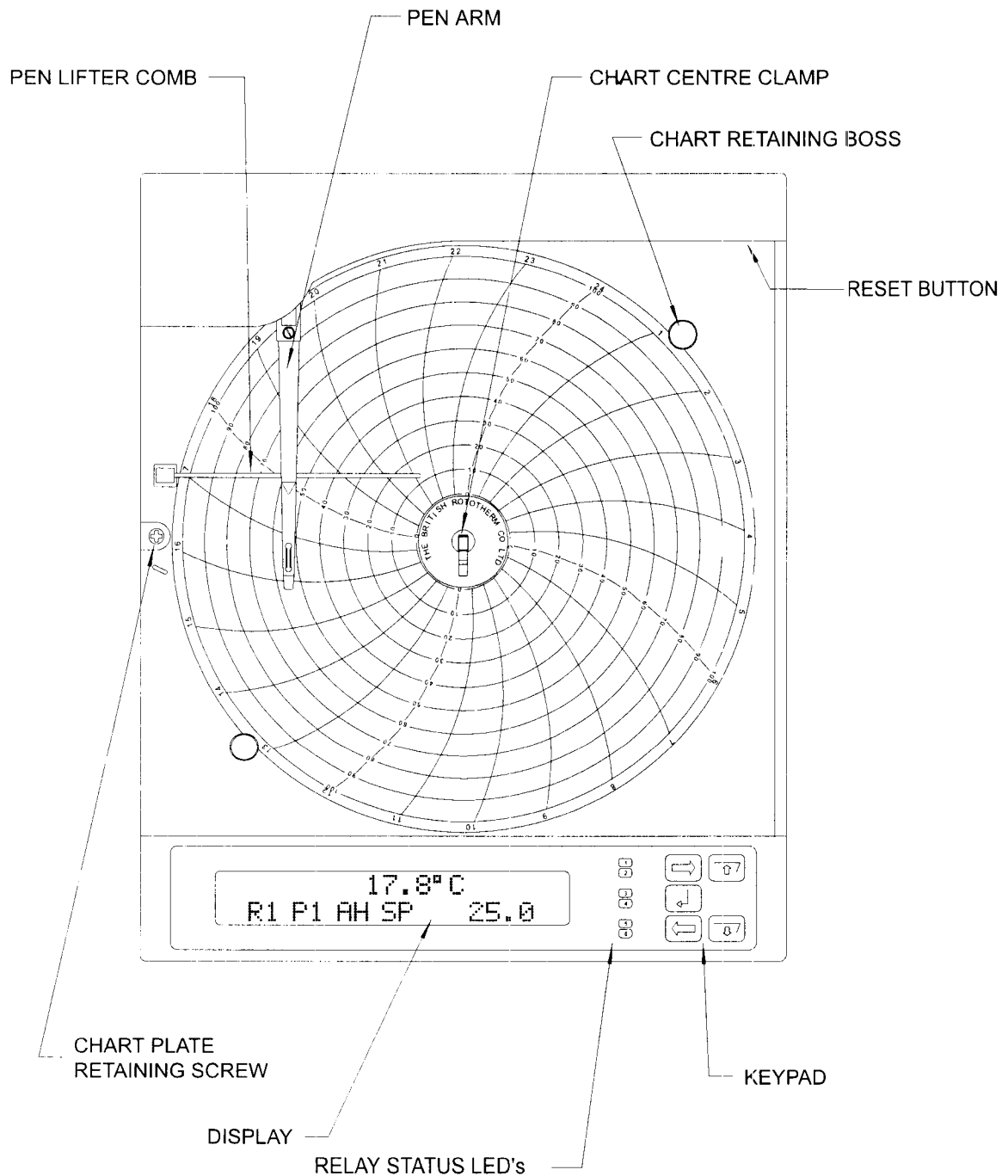


Figure 2.2 : Chart Plate - Front View

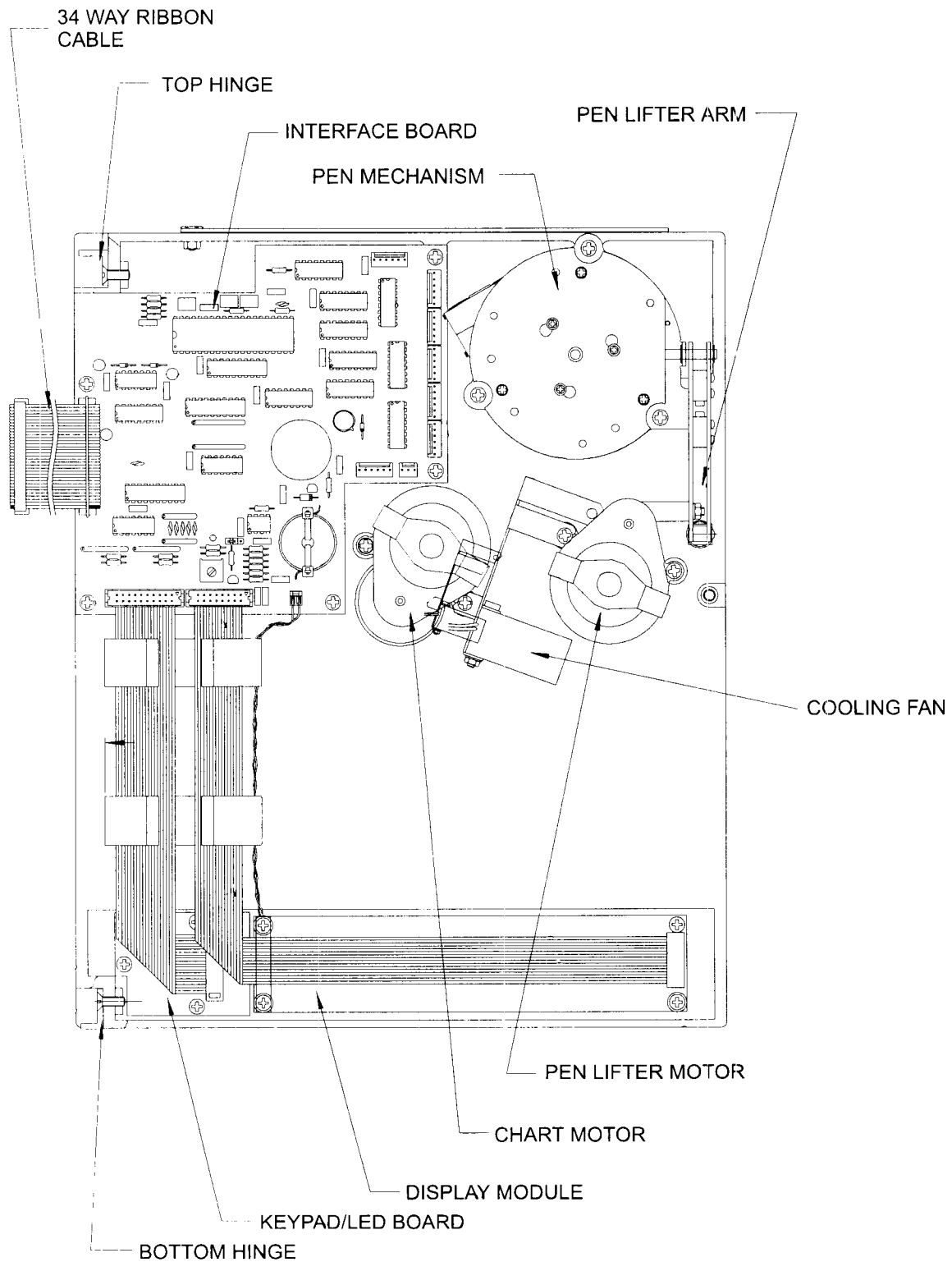


Figure 2.3 : Chart Plate - Rear View

## **2.5 Case Assemblies**

Figure 2.4 shows the internal layout of a standard single-pen recorder with the chart plate removed. On the inside left-hand side wall of the case is a bracket used to secure the chart plate in position and the cable entry glands are at the bottom.

Amongst others the following larger items are indicated:

1. Main Processor PCB.
2. Relay PCB Assembly.
3. Mains Transformer.

### **2.5.1 Main Processor PCB**

Mounted at the back of the recorder case is the large 'L'-shaped main processor PCB which provides power, control of the entire instrument, the input stage for Pen 1 (Channel 1) and sockets for option cards. At the right-hand side of this PCB is the 48-pin microprocessor itself and two sockets for the EPROM's which hold the software program.

To the right of the microprocessor are two jumper links, J5 and J6, which are important for security and are used during setup and calibration.

The input stage for Pen 1 is located on the lower right-hand corner of the main processor PCB where the row of input connections can be seen.

Three pairs of expansion sockets are provided for the connection of additional option cards. The centre sockets (bay 2) are reserved for re-transmission cards. Additional input cards required for 2- and 3-pen versions are fitted in bay 3 on the right.

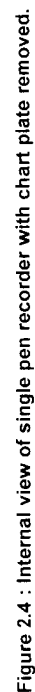
### **2.5.2 Relay PCB Assembly**

The Relay card plugs into an expansion socket located at the left of the input filters PCB and is secured in place by three screws.

This card holds up to six relays, controlled by drive lines from the main processor PCB. Each relay can be freely assigned to any pen and given one of several control and alarm configurations (see Chapter 4: Setting up the Recorder.) Each relay can be connected to external systems via its associated terminal block and electromagnetic types can switch up to 5A while solid-state types may switch up to 0.5A.

### **2.5.3 Input Cards**

On a single pen version of the chart recorder, the input stage is integrated onto the main processor PCB. Additional pens are easily added by plugging extra input cards into the pair of sockets on the card below: this results in a staggered stack of up to three levels. Installation of extra option cards (including input cards) is dealt with in Section 3.6. See also figure 3.18. By the use of opto-isolators each input stage is electrically isolated from the others. The input cards fitted to channels 2 and 3 may be one of two types - universal analogue or event. The input to channel 1 (via the motherboard) is analogue only.



## CHAPTER 3

### INSTALLATION

#### 3.1 General

Before proceeding with installation take note of the following points:

1. The CT6100 chart recorder is a mains operated instrument with voltages up to 250V ac inside the case. For safety it should only be installed by suitably qualified personnel.
2. Choose an installation site which is suitably clean and dry and where the recorder will not be subjected to unreasonable levels of temperature, humidity, vibration or be exposed to corrosive agents. See Chapter 10: Specification for details of the operating temperature range and case sealing.
3. When deciding on the mounting method consider the overall size and weight of the recorder and the need to route wiring into the bottom of the case.
4. No special tools are required for installation.
5. If there are many electrical connections to be made it is recommended that the chart plate is removed for ease of access. The procedure for removing the chart plate is described in section 3.10.

#### 3.2 Mounting

The recorder may be surface (wall) or flush panel mounted. Figure 3.1 shows the various mounting fittings which are provided at the back of the case.

The instrument weighs approximately 10 kg.

##### 3.2.1 Surface (wall) mounting.

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

##### 3.2.2 Flush panel mounting.

1. Cut a hole 356mm high x 288mm wide in the panel.
2. Remove the three fixing brackets from the top and sides of the case.
3. Insert the instrument in the cut-out.
4. Replace the brackets, locating each fixing screw in the slot appropriate to the panel thickness.
5. Press the brackets hard against the panel and tighten the fixing screws.

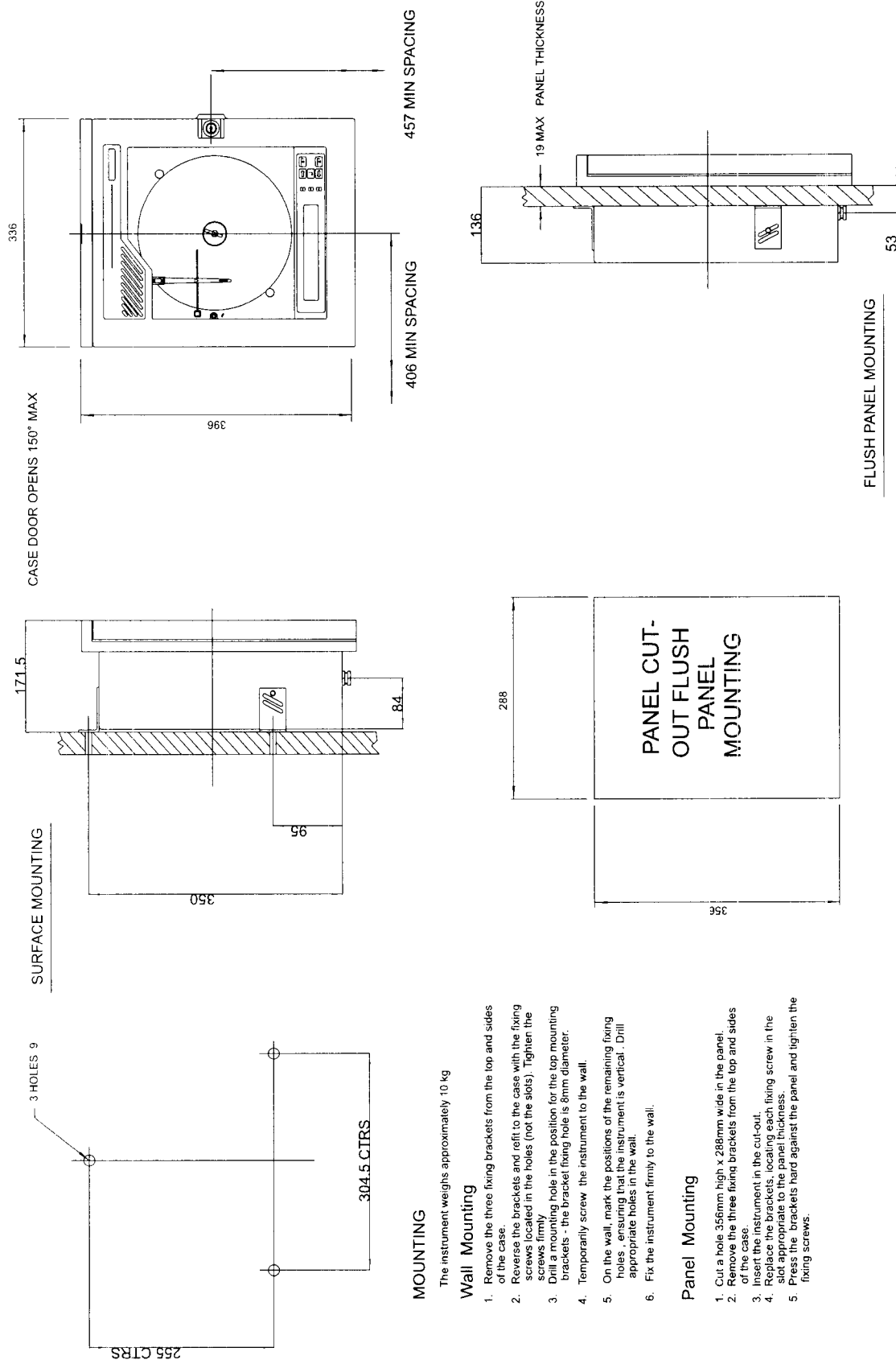


Figure 3.1: Recorder Mounting Fittings.



### 3.3 Power Supply Connections



**WARNING**  
**BEFORE MAKING ANY ELECTRICAL CONNECTIONS ENSURE THAT THE MAINS SUPPLY IS SWITCHED OFF.**

#### 3.3.1 Mains Cable

1. The maximum overall diameter mains power cable to fit the cable gland is 7.0mm.
2. The maximum conductor cross sectional area to fit the mains inlet terminal block is 2.5mm<sup>2</sup>.
3. The mains cable should be rated at 250V a.c. 3A or higher.

#### 3.3.2 Procedure

1. Set the voltage selector switch on the main processor PCB to the correct setting: 230V or 115V.
2. Feed the mains power cable up through a suitable gland at the bottom of the case. It may be easier to firstly remove the gland nut, washer and sealing grommet from the cable gland and to thread these along the cable before feeding it up through the gland body. See figure 2.4.
3. Prepare the end of the cable and make connections to the mains inlet terminal block at the bottom right-hand corner of the input filters PCB. See figure 3.4.
4. Tighten the cable gland to grip the cable firmly.

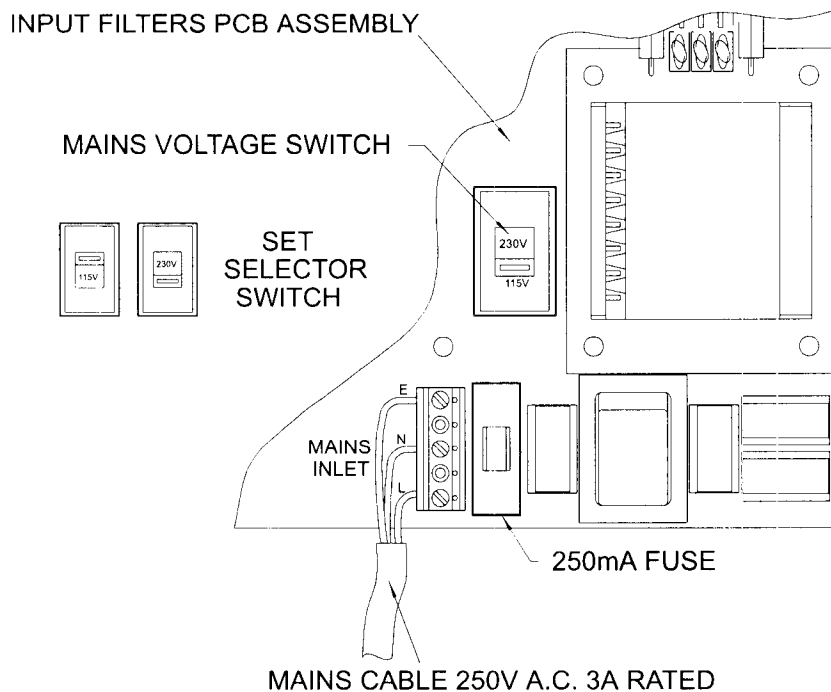


Figure 3.4 : Power Supply Connections

### 3.4 Input Signal Connections

Figure 3.5 shows the layout of the input terminals and associated options of the input stage for Pen 1, 2 and 3.

Multi-pen recorders have an input stage added for each pen and these plug into and lie above the one below forming a stack of cards up to three levels high. See figure 3.18. These additional input stages may be of the event type (dealt with later in section 3.7) or of the universal analogue type in which case the layout is the same as for Pen 1 and the following text applies.

Associated with the terminal block are jumpers where J1, J2, J3 and J4 determine the output voltage from the transmitter power supply (if fitted).

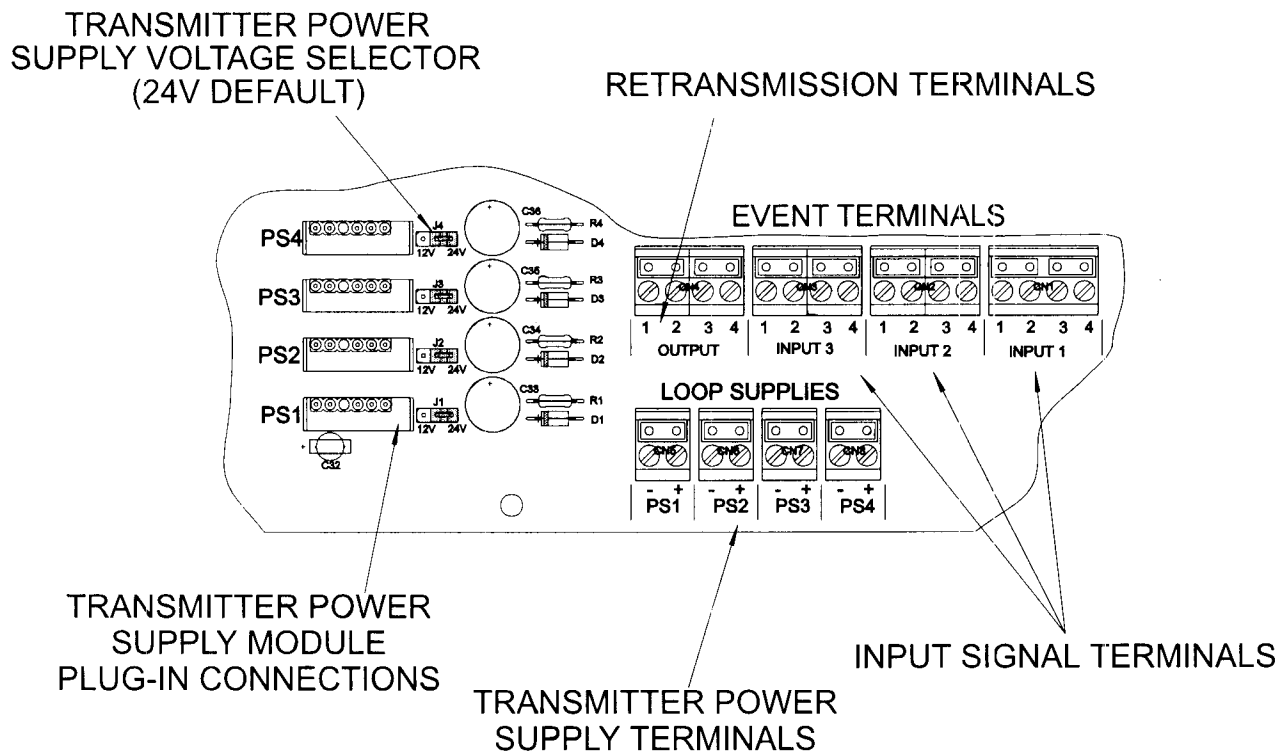


Figure 3.5 : Input Signal Connections

### 3.4.1 Input Signal Cable

1. The maximum overall diameter signal cable to fit the cable gland is 7.0mm.
2. The cable gland sealing grommet can be tightened down to approximately 3.0mm diameter.
3. Several smaller cables may be passed through a single cable gland but the sealing grommet, which is intended for circular section cable, may then be less effective.
4. The maximum conductor cross sectional area to fit the input terminal block is 1.5mm<sup>2</sup>.
5. It is important to use the correct type of cable/wire from the sensor and the manufacturer's specifications should be consulted. This is particularly important in the case of thermocouples and it is recommended that for highest accuracy the conductors of any extension cable used should be of the same material as the thermocouple itself. Alternatively, compensating cables may be used but operational temperature limits must be considered to maintain accuracy. Again the manufacturer's specifications should be consulted.

### 3.4.2 Procedure

To avoid repetition, the procedure for wiring input signal cables is broken down into the common details listed below followed by information specific to the type of signal source being wired.

Connection procedures deal with 'self-powered' sources first then cover transmitters which require power to be supplied.

### 3.4.3 Common Details

1. Feed the input signal cable(s) up through a suitable cable gland(s) at the bottom of the case. Try to use glands at the left-hand end of the row and keep signal cables as far away as possible from mains and relay cables.
2. It may be easier to firstly remove the gland nut, washer and sealing grommet from the cable gland and to thread these along the cable before feeding it up through the gland body. See figure 2-4.
3. Prepare the end of the cable and make connections to the input signal terminal block according to the type of sensor to be connected. Details for the various sensor types are given below with appropriate diagrams.
4. Route the cable neatly from the terminal block to the cable gland, keeping as large a distance as possible from mains and relay cables. The cable should not be pulled tight but neither should there be excessive slack.
5. Tighten the cable gland to grip the cable firmly.

### 3.4.4 Thermocouple Connections

See figure 3.6.

Thermocouple cable which conforms to BS4937 Part 30:1993 or IEC304 has the negative lead coloured white; the positive lead is the same colour as the sheath (except for intrinsically safe circuits).

1. Connect the negative lead to terminal 2 and the positive lead to terminal 3.
2. Set input type jumper to position 2-3.
3. Set thermocouple fail jumper depending on the required action to be taken in case of sensor burn-out (open-circuit)

Up-scale	:	Position 3 - 4
None	:	Position 2 - 3
Down-scale	:	Position 1 - 2

**PLEASE REFER TO FIG 3.11**

### 3.4.5 RTD Input (2-wire)

See figure 3.7.

Two-wire RTD's which conform to BS1904:1984 (IEC751) have one white lead and one red.

1. Link terminals 3 and 4.
2. Connect the lead wires from the RTD to terminals 2 and 4. If the leads are white and red, as above, the white one should go to terminal 2 and the red to terminal 4.
3. Set input type & T/C fail jumper to positions 2 - 3

**PLEASE REFER TO FIG 3.11**

Note: Lead wire resistance introduces errors in RTD measurement systems. The errors are particularly large in the 2-wire arrangement and for guaranteed accuracy the 3-wire or current-loop connections are recommended.

See section 3.4.7 for more information about approximate resistances for various lead wires and nulling.

### 3.4.6 RTD Input (3-wire)

See figure 3.8.

The paired leads of RTD's which conform to BS1904:1984 (IEC751) are coloured red, the single lead is white.

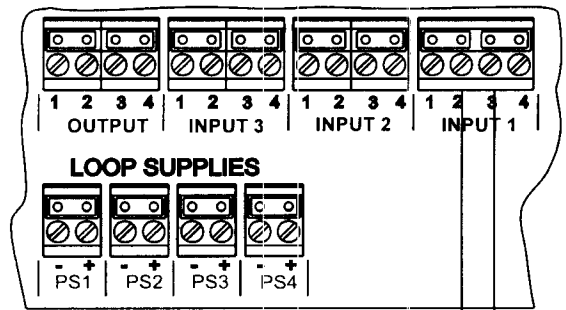
1. Connect the negative (single/white) lead wire from the RTD to terminal 2.
2. Connect the positive (paired/red) lead wires to terminals 3 and 4.
3. Set input type & T/C fail jumper to positions 2 - 3

**PLEASE REFER TO FIG 3.11**

Terminal 2 is ground (V-), terminal 3 is sense (S+) and terminal 4 is positive supply (V+).

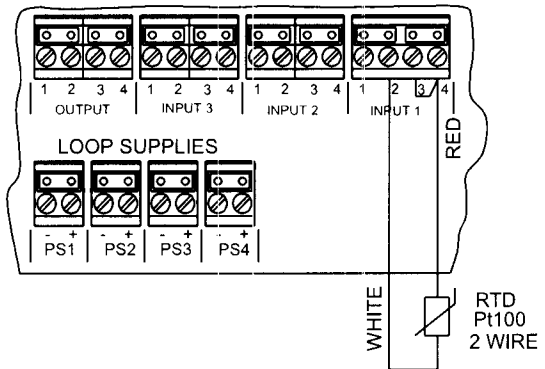
Note : For reasons explained in section 3.4.7 the three leads used to connect the RTD should all have the same resistance (length).

**THERMOCOUPLE CONNECTIONS**



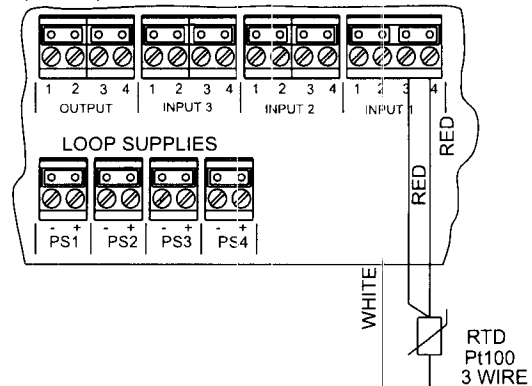
**Figure 3.6**

**RTD INPUT (2 WIRE)**



**Figure 3.7**

**RTD INPUT (3 WIRE)**



**Figure 3.8**

### 3.4.7 Notes on RTD Lead Wire Resistance.

In the two wire RTD arrangement the resistance of the lead wires is added to the resistance of the sensor and introduces an offset error. For a 1°C temperature change the resistance of the sensor will change by 0.39ohms approximately. Using pure copper wire this resistance represents the following length for each lead for the cross-sectional areas given. Conversely, leads of the following length introduce a 1°C offset.

7/0.2mm	0.22mm <sup>2</sup>	2.7m
16/0.2mm	0.50mm <sup>2</sup>	6.1m
	0.75mm <sup>2</sup>	9.1m
	1.0mm <sup>2</sup>	12.1m
	1.5mm <sup>2</sup>	18.1m
	2.5mm <sup>2</sup>	30.2m

The offset error can be nulled by means of the Calibration Shift facility (refer to section 4.6.1) with some residual linearisation error. It should be remembered that the resistance of copper (and most other) lead wires will vary with temperature and Cal. Shift will only be accurate at one, fixed temperature.

When the 3-wire arrangement is used the resistance of the lead wires is subtracted electronically and the maximum permissible lead resistance is increased to 10ohms (per lead). This is represented by the following lengths of pure copper wire:

7/0.2mm	0.22mm <sup>2</sup>	138m
16/0.2mm	0.50mm <sup>2</sup>	313m
	0.75mm <sup>2</sup>	469m
	1.0mm <sup>2</sup>	625m
	1.5mm <sup>2</sup>	938m
	2.5mm <sup>2</sup>	1563m

Accuracy, in the 3-wire arrangement is dependent on all three wires having the same resistance. Any error introduced will arise from differences between the lead resistances rather than their absolute resistance.

### 3.4.8 Voltage Input Connections : $\pm 2V$ and $\pm 20V$ ranges

See figure 3.9.

1. Connect the positive lead to terminal 1 and the negative lead to terminal 2.
2. Select the  $\pm 2V$  or  $\pm 20V$  range in Setup according to Section 4.6.2 (DC Current and Voltage (Linear) Inputs).
3. Set input type & T/C fail jumper to positions 2 - 3

**PLEASE REFER TO FIG 3.11**

VOLTAGE INPUT CONNECTIONS :  $\pm 2V$  AND  $\pm 20V$

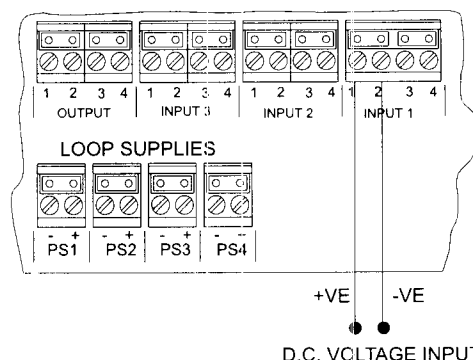


Figure 3.9

### 3.4.9 Current Input Connections : $\pm 2mA$ , 4-20mA and $\pm 20mA$ ranges

See figure 3.10.

1. Connect the positive (current out or current source) lead to terminal 1 and the negative (current return or current sink) lead to terminal 2.
2. Select the  $\pm 2mA$  or 4-20/ $\pm 20mA$  range in Setup according to Section 4.6.2 (DC Current and Voltage (Linear) Inputs).
3. Set input type & T/C fail jumper to positions 2 - 3
4. Set input type jumper depending on the required input range

$\pm 2 mA$  : Position 1 - 2  
 $\pm 20 mA$  : Position 3 - 4

**PLEASE REFER TO FIG 3.11**

CURRENT INPUT CONNECTIONS :  $\pm 2mA$ , 4-20mA AND  $\pm 20mA$  RANGES

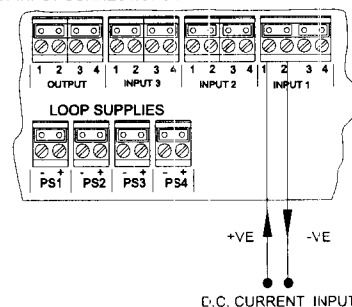


Figure 3.10

### 3.4.9.1 Configuration Options - PCB Assembly

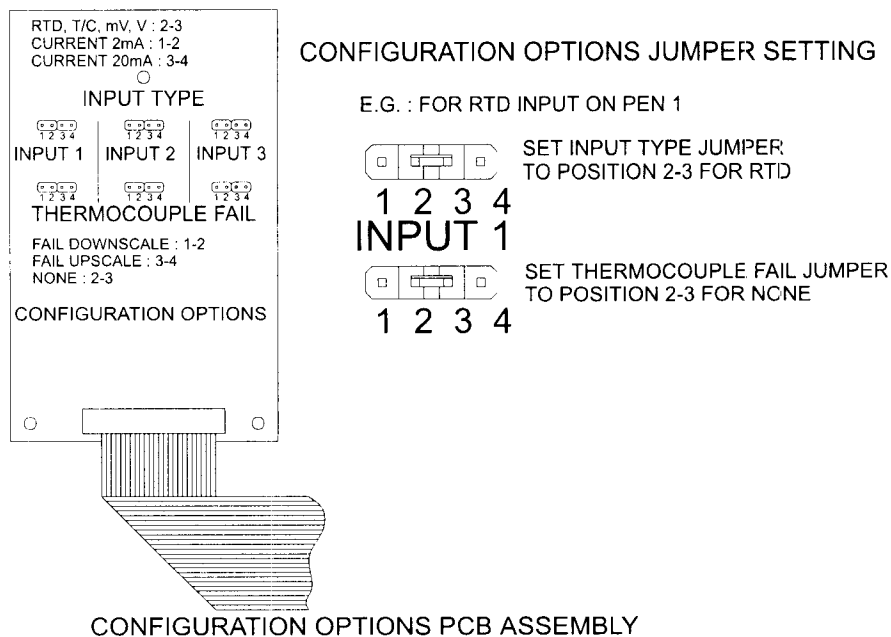


Figure 3.11 : Configuration Options - PCB Assembly

### 3.4.10 Transmitter Power Supply

The signal sources described below all require power to be supplied to them and provision for this has been made on the input filters PCB. Power is supplied by a small module (part no. 70079) which plugs into the sockets marked PS1, 2, 3 and 4 by means of five pins. See figure 3.5. Care should be taken to avoid damaging the pins when inserting them and to ensure that the module is fully seated on the PCB.

### 3.4.11 2-Wire 4-20mA Current Loops (Recorder-powered)

See figure 3.12.

1. Link PS1-VE and input terminal 2 (to connect the power supply negative to ground).
2. Connect the transmitter positive lead to PS1 +VE (supply positive) and the negative lead to terminal 1.
3. Set T/C fail jumper to position 2 - 3.
4. Set input type jumper for 4-20mA range to position 3 - 4.

**PLEASE REFER TO FIG 3.11**

5. Set jumper J4 according to the supply voltage required:

24V supply : Position 1 (right) - normally used  
12V supply : Position 2 (left)

2 WIRE 4-20mA CURRENT LOOPS (RECORDER - POWERED)

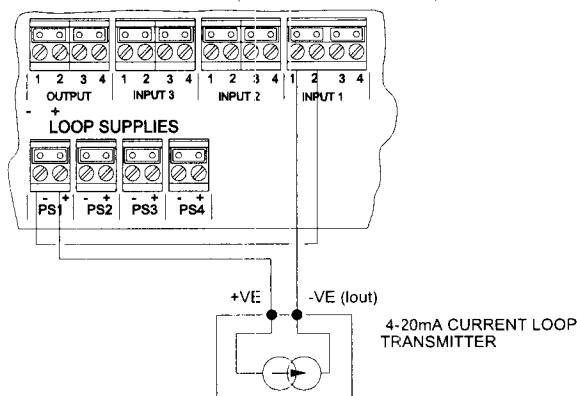


Figure 3.12

### 3.4.12 4-Wire Direct Powered Transmitter/Transducer

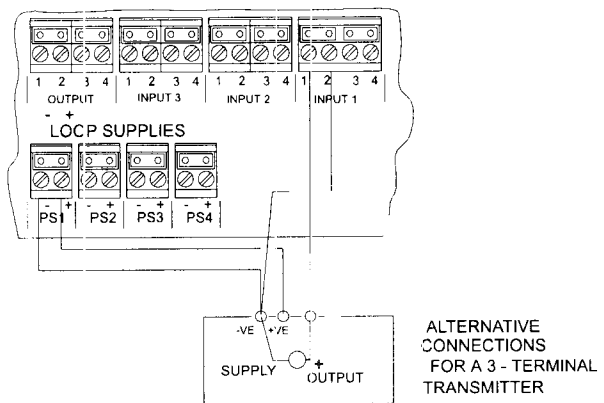
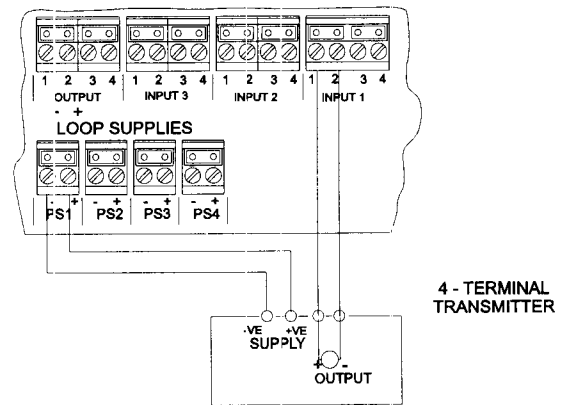
See figure 3.13.

Such transmitters are generally four-wire devices and require to be supplied with power. Typical outputs would be 0-1mA, 0-20mA or 0-1V. Whenever possible all four wires should be used. Sometimes the supply negative and output negative are connected at the transmitter and this can introduce errors because of voltage drops due to the supply current.

1. Connect the transmitter supply positive to PS1 +VE (supply positive) and the transmitter supply negative to PS1 -VE (supply negative).
2. Connect the transmitter output positive to terminal 1 and the transmitter output negative to terminal 2 (ground).
3. Set T/C fail jumper to positions 2 - 3
4. Set jumper J1 according to the supply voltage required:  
 24V supply : Position 1 (right)  
 12V supply : Position 2 (left) - normally used
5. Set input type jumper according to the output from the transmitter:  
 0-1mA : Position 1 - 2  
 0-20mA : Position 3 - 4  
 0-1V : Position 2 - 3

**PLEASE REFER TO FIG 3.11**

**4 WIRE DIRECT POWERED TRANSMITTER / TRANSDUCER**



**Figure 3.13**

## 3.5 Relay Connections

The relay card is located at the left-hand side of the input filters PCB, into which it plugs, and is retained by three screws. It can hold up to six relays, being generally fitted with either three or six, and their positions (1-6) are marked on the PCB together with the associated screw terminal block. The relays themselves can be either of the electromagnetic (mechanical) or solid-state (triac) type: these two types are described separately below.

### 3.5.1 Snubber Network

If a relay is connected to an inductive load high voltage generation and possibly arcing takes place when the relay contacts break. This can cause serious electromagnetic interference and damage to the relay contacts. Generally speaking, the problem may be overcome or reduced if snubber (arc suppression) networks are connected and therefore such networks are wired as standard to each relay of the CT6100 recorder.

Electromagnetic relays have changeover contacts and therefore two snubber networks are included for each of these relays, one for the normally-open and a second for the normally-closed contact. For the electromagnetic type the snubber comprises a 22nF capacitor (rated at 250V ac or 630V dc) with an in-built 100 ohm series resistor; these are connected between the terminals marked A and COM and between B and COM. Solid-state relays are provided with a single snubber network formed from a 22nF capacitor and separate 4.7k ohm resistor.

The connection of the snubber network across the relay contacts, rather than across the load, is a compromise solution and it must be remembered that the snubber will introduce a leakage path. The current flowing through this path (1.7mA at 250V ac) may be sufficient to energise low power loads such as sensitive relay coils or neon indicators even when the relay contacts are open. In such cases, or if the snubber is not required for some other reason, then it must be disconnected by physically removing it from the card. For the solid-state type it is sufficient simply to unsolder or cut out the resistor. The positions of the snubbers are shown in figure 3-17.

The decision on the snubber connection can only be taken by the installation engineer familiar with the load arrangement. An external snubber network, connected directly across the inductive load, is the most effective method of eliminating high voltage switching spikes, figure 3.15 illustrates such a connection.

### 3.5.2 Relay Connections - Electromagnetic Type

Each relay is able to switch non-inductive loads up to 1500VA ac (250V maximum) or 150W dc (30V maximum). Figure 3-14 shows how to connect the relay, load and supply for operation under alarm and normal conditions.

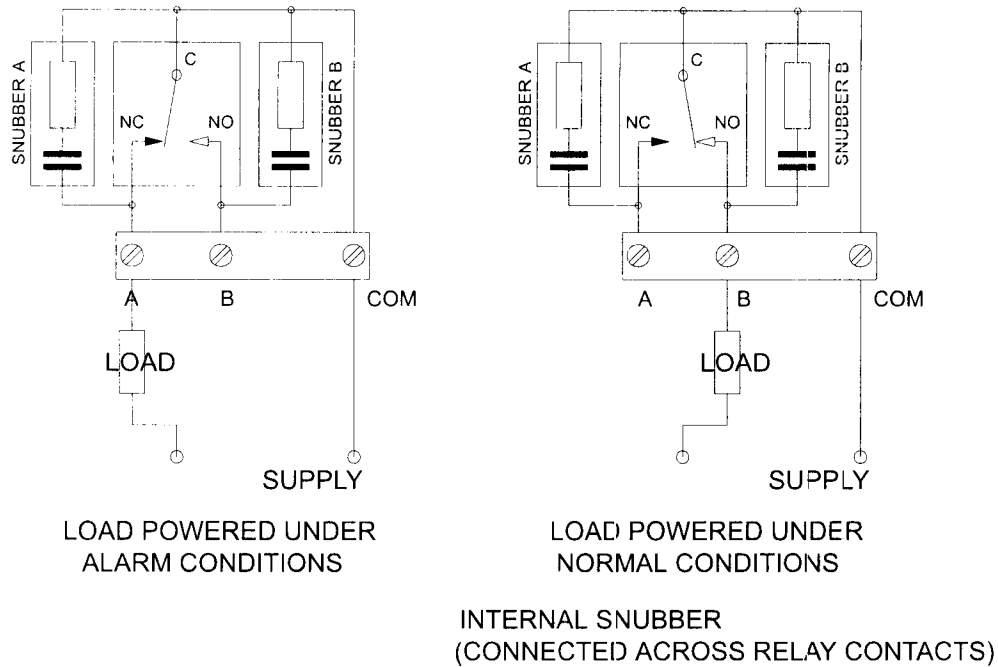


Figure 3.14: Relay Connections - Electromagnetic Type.

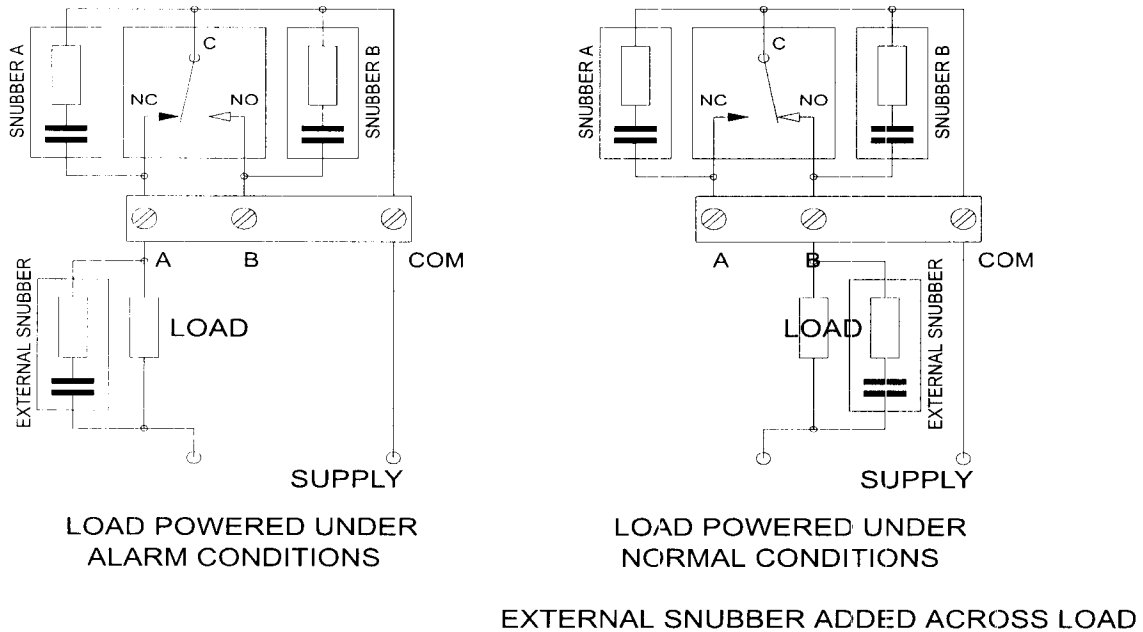


Figure 3.15: Additional external snubber across load, electromagnetic relay type.

### 3.5.3 Relay Connections - Solid-State Type

Each solid-state relay is able to switch loads up to 125VA ac (250V / 0.5A maximum). This relay arrangement, using triacs is NOT able to switch direct current. Figure 3.16 shows how to connect this type of relay, load and supply. Because the relay has only a normally-open contact the load can be powered only if the CT6100 recorder itself remains powered.

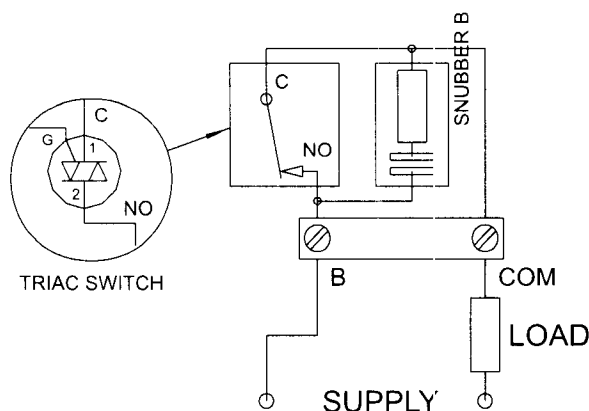


Figure 3.16: Relay Connections - Solid-state Type..

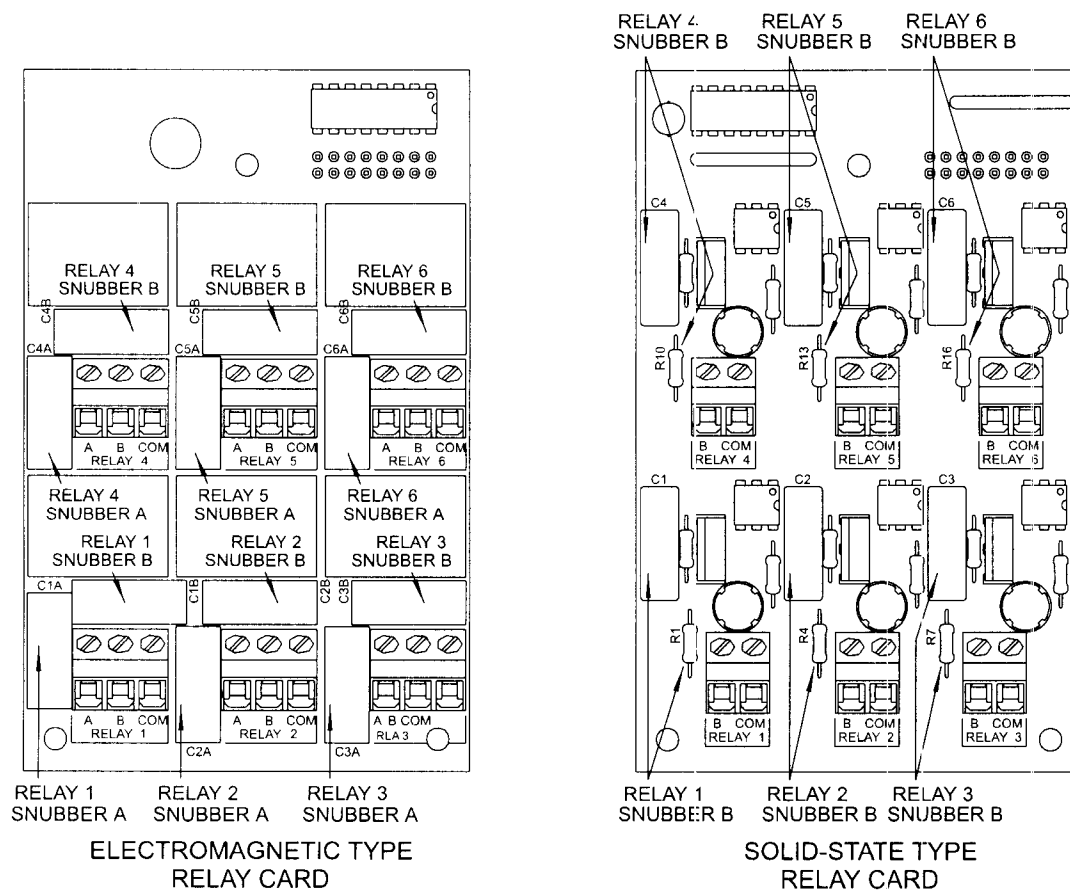


Figure 3.17 : Snubber Locations.



### 3.6 Installing Extra Option Cards

Option cards, including input cards, have connector pins projecting from their undersides and these plug into sockets on the board beneath. The main processor board provides the base level and has three 'bays' across its lower edge. Each bay comprises a pair of sockets with a fixing pillar between them. The right hand bay is effectively already taken up by a built-in input section. See figure 2.4 which indicates the positions of these bays.

Except for relay and event input cards, sockets on the upperside allow further option cards to be added. In this way a staggered stack of cards may be built up as shown in figure 3.18 below.



#### **WARNING**

**BEFORE INSTALLING EXTRA OPTIONS CARDS ENSURE THAT THE MAINS SUPPLY IS SWITCHED OFF.**

**TAKE CARE WHEN PLUGGING THE PINS UNDER AN OPTION CARD INTO THE SOCKETS BELOW. ENSURE THAT THE PINS ALIGN CORRECTLY AND ARE PUSHED HOME SQUARELY. FAILURE TO CONNECT CORRECTLY MAY CAUSE PERMANENT DAMAGE TO THE CARD WHEN POWER IS RE-APPLIED.**

If the alignment is correct holes on the card should line up with the tops of the pillars on the board below. Once an option card has been plugged-in it should be retained by three screws (M3 x 6 PAN HEAD) which pass through these holes into the pillars. Do not over-tighten.

Refer to sections 3.4.1, 3.4.2 and 3.4.3 above for general information on wiring option cards. See below for details relating to specific cards.

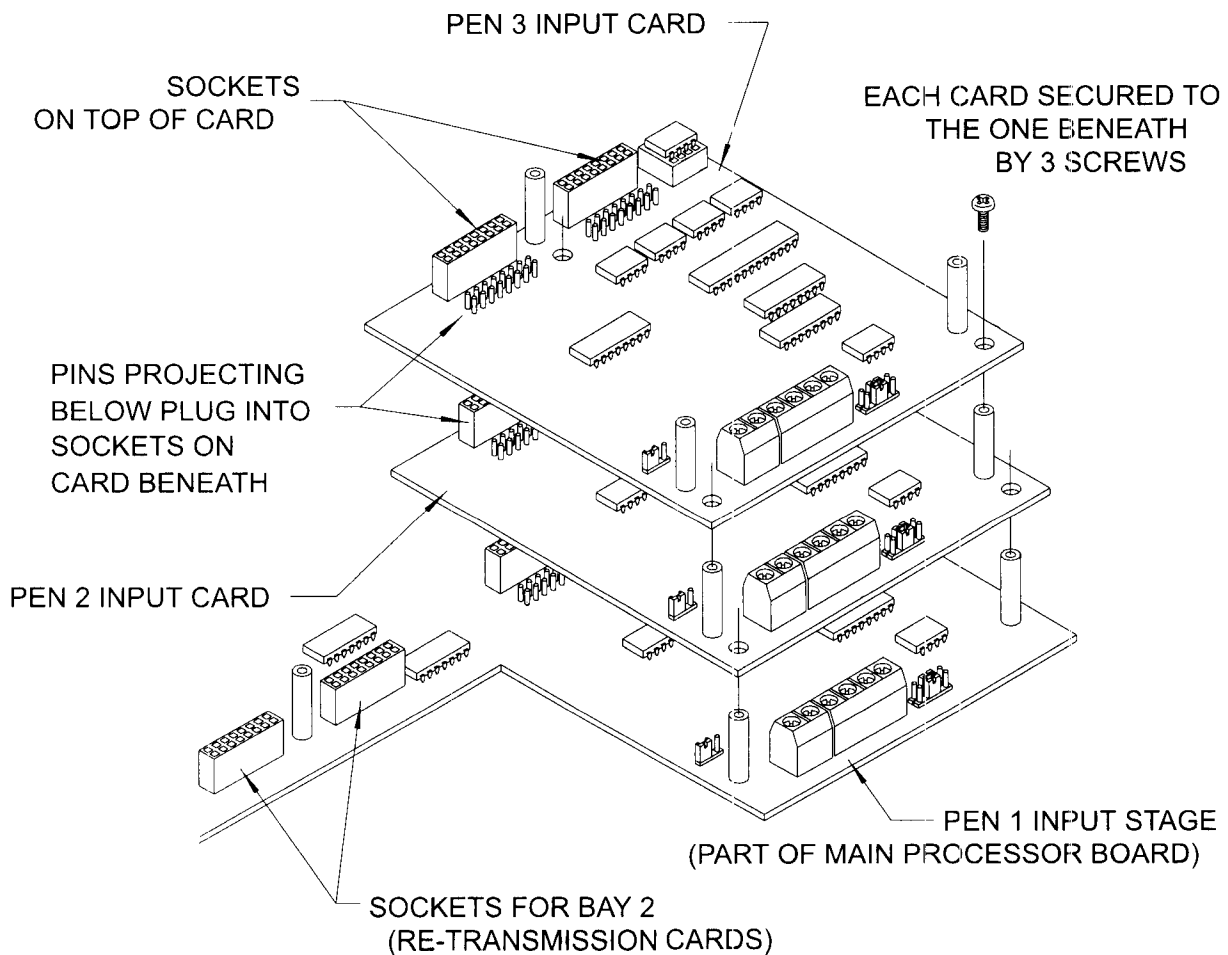


Figure 3.18: Installing Option Cards

### 3.6.1 Relay Card.

The relay card is fitted onto the input filters PCB and is generally installed in all new recorders. If not, one may be fitted, or an existing one may be exchanged for a different version.

Note that a relay card only has one group of connection pins underneath.

Figure 2.4 shows where a relay card fits in place and connections to the card are detailed in section 3.5 above.

### 3.6.2 Extra Analogue Input Cards and Event Input Cards.

These should be fitted in the right-hand bay above the Pen 1 (Channel 1) position. Two additional input cards may be fitted. If one of these is an event input card this must be fitted at the top of the stack because it does not carry sockets allowing further cards. Connections for universal analogue input cards are the same as for Pen 1 which is dealt with in Sections 3.4.4 to 3.4.12 above.

Event input cards are available in various versions and are dealt with below in section 3.7.

### 3.6.3 Re-transmission Card.

These are intended to be fitted in the middle options card bay (bay 2) and are plugged in as mentioned above. In general only one card would be fitted in this bay and if a second is required then it must be the appropriate (different) version with its own power supply and be fitted uppermost in the stack.

The same re-transmission card is used to provide current output (two different connection arrangements) and voltage output.

## 3.7 Event Input Cards

Several versions of the event input card are available. They can accept either 50-250V a.c. or 12-24V d.c. inputs and provide two or four event inputs. 12-24V d.c. versions can provide power for volt-free contacts. Connections for these are explained below.

**WARNING** IT IS MOST IMPORTANT THAT THE CORRECT VOLTAGE VERSION CARD IS USED. TO HELP ENSURE THIS THE VOLTAGE RATING IS MARKED NEAR THE INPUT TERMINALS.

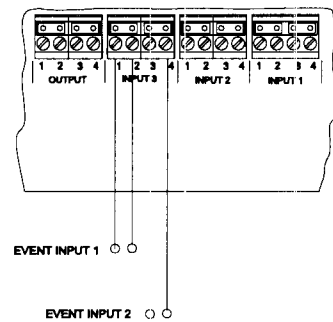
### 3.7.1 Event Input Card Connections : 50-250V a.c. voltage

See figure 3.19.

This event input card can provide up to two event inputs depending on version: each uses a pair of terminals. The polarity of the signal is not important. An input of 0V will represent a logic 0 and an input in the range 50-250V a.c. will represent a logic 1.

1. Connect event input 1 to terminals 1 and 2.
2. Connect event input 2 to terminals 3 and 4.

EVENT INPUT CARD  
50 - 250V a.c. VERSION



50 - 250V a.c. EVENT INPUTS

Figure 3.19

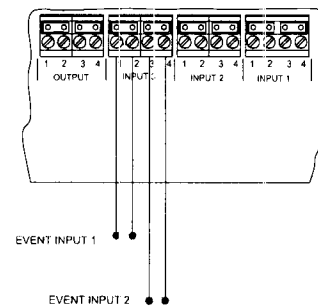
### 3.7.2 Event Input Card Connections : 12-24V d.c. voltage

See figure 3.20.

This event input card can provide up to two event inputs depending on version: each uses a pair of terminals. An input of 0V will represent a logic 0 and an input in the range 5-24V d.c. will represent a logic 1.

1. Connect event input 1 positive to terminal 1 and negative to terminal 2.
2. Connect event input 2 positive to terminal 3 and negative to terminal 4.

EVENT INPUT CARD  
12 - 24V d.c. VERSION



12 - 24V d.c. EVENT INPUTS

Figure 3.20

### 3.7.3 Event Input Card Connections : 12-24V d.c. volt-free contacts

See figure 3.21.

This event input card can provide up to two event inputs depending on version: each uses a pair of terminals. An on-card power supply can provide 12 or 24V d.c.

1. Connect PS1-VE (supply negative) to terminals 2 and 4.
2. Connect PS1+VE (supply positive) to one side of each of the event contacts.
3. Connect the second side of event contact 1 to terminal 1.
4. Connect the second side of event contact 2 to terminal 3.
5. Set jumper J1 according to the supply voltage required. See figure 3.5

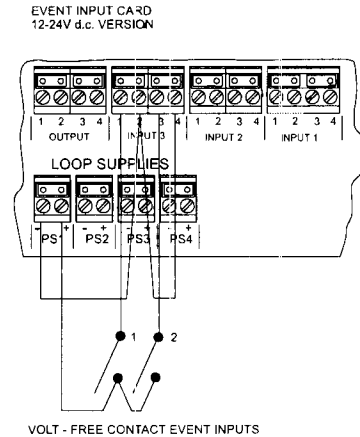


Figure 3.21

### 3.8 Retransmission Cards

These are intended to be fitted in the middle options card bay and are plugged in as mentioned in section 3.6. In general only one card would be fitted in this bay but if a second is required then it must be a different version with its own power supply and must be fitted uppermost in the stack.

The same re-transmission card is used to provide current output (two different connection arrangements) and by adding a resistor, voltage output. The re-transmission card can provide a current output of 0-20mA or 4-20mA which is specified in Setup. See Chapter 4. In all cases the maximum total loop resistance which can be accommodated is 750ohms. Connections are detailed below.

#### 3.8.1 Retransmission Card Connections : Current output (Recorder-powered)

See figure 3.22.

Use this arrangement where the receiving circuit does not provide the loop supply. The current output may be 0-20mA or 4-20mA as determined in 'Setup'.

1. Connect terminal 1 (positive) to the receiver positive input terminal.
2. Connect terminal 2 (I out/sink) to the receiver negative input terminal.

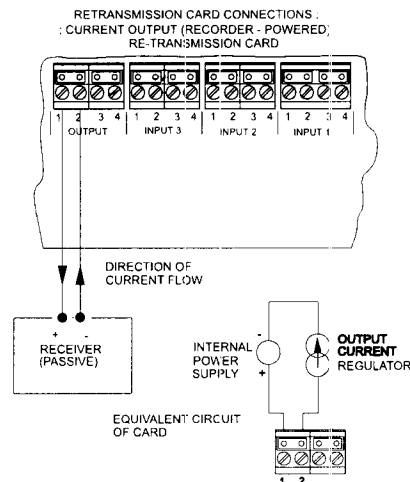


Figure 3.22

#### 3.8.2 Retransmission Card Connections : Current output (Externally-powered)

See figure 3.23.

Use this arrangement where the receiving circuit also provides the loop supply. The current output may be 0-20mA or 4-20mA as determined in 'Setup'.

1. Connect terminal 2 (I out/sink) to the receiver positive terminal.
2. Connect terminal 3 (I out/source) to the receiver negative terminal.

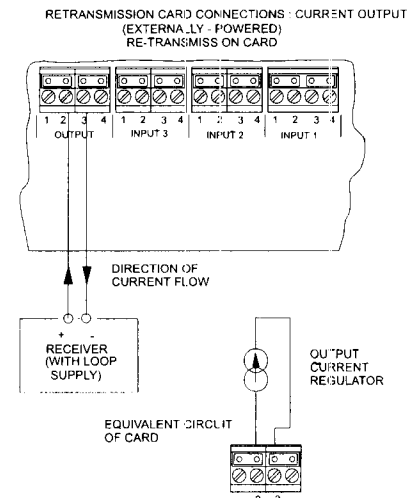


Figure 3.23

### 3.8.3 Retransmission Card Connections : Voltage output

See figure 3.24.

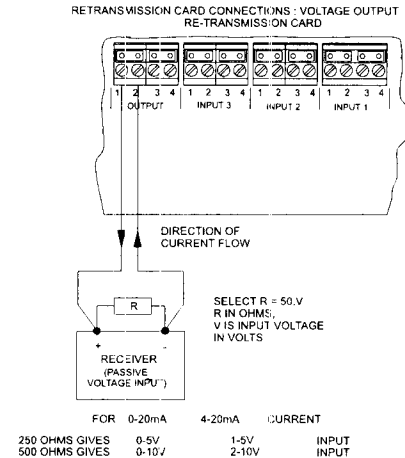
By using the self powered current output with an external resistance the re-transmission card can provide a voltage signal to the receiving circuit. Choose the resistance to give the required full-scale voltage according to the formula  $R=50.V$  where R is the resistance in ohms and V is the required voltage in volts. The following voltages are given according to the current output (determined in 'Setup') and resistance:

	<b>0-20mA</b>	<b>4-20mA</b>
R=250ohms	0-5V	1-5V
R=500ohms	0-10V	2-10V

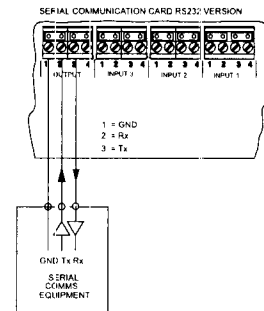
The receiving circuit should have an input impedance of about 1Mohm or greater.

1. Connect the resistance between the receiver positive and negative input terminals.
2. Connect terminal 1 (positive) to the receiver positive input terminal.
3. Connect terminal 2 (I out/sink) to the receiver negative input terminal.

**3.9.1** This section is intentionally blank



**Figure 3.24**



**Figure 3.25**

### 3.10 Removal of the Chart Plate

Fully undo (anticlockwise) the chart plate retaining screw and swing the plate out to its fully open position.

Disconnect the wide ribbon cable from the right-hand side of the main processor PCB. This is done by levering apart the latches that stand up on either side of the cable where it enters the connector. The lever action will separate the two halves of the connector.

Remove the plastic thumb nut from the stud which passes through the slot in the chart plate stay. Notice also a nylon washer between the case and its stay.

Once the stay is disconnected lift the chart plate upwards against its top hinge which acts as a spring. At the same time pull the bottom edge of the chart plate forwards away from the case. As the top hinge deflects upwards the bottom hinge will reach a narrow section in the hinge pin which will pass through a slot allowing the chart plate to swing clear, forwards. Finally, lower the chart plate away from its top hinge pin.

Re-fitting is the reverse procedure. Locate the pin of the top hinge in the bracket on the chart plate then lift the chart plate up against it so as to deflect the hinge. At the same time push the slot in the bottom hinge against its pin which will enter when it reaches the narrow section. Drop the chart plate down to fully engage this lower hinge on its pin. When re-attaching the stay remember to fit the nylon washer between the stay and case. Do not overtighten the plastic thumb nut.

To re-connect the ribbon cable carefully position the cable part of the connector on top of the pins in the PCB part. A 'bump' on the side of the cable part of the connector locates in a notch in the PCB part. The notch can be seen in the centre of the long side of the PCB part next to the wall of the case. When located push the connector parts together. As this is done the two latches on either side will snap together and trap the cable end of the connector.

# CHAPTER 4

## SETTING UP THE RECORDER

This chapter explains how to setup (configure) the CT6100 chart recorder to suit an application. In many cases the chart recorder will have been set up by the manufacturer prior to delivery and will be ready for use on completion of installation.

The procedures outlined in this chapter are for use by service engineers and personnel qualified to setup instrumentation and control equipment.

### 4.1 General

A special Setup operating mode is provided for recorder configuration, section 4.4 explains how this is invoked.






To setup all of the recorder's options the operator should follow the display menus and prompts from start to finish, the software will ensure that each option is set in the correct sequence. However, it is not necessary to go through the full setup in order to make small changes to the configuration, that can be done by selecting just the option to be changed from the main setup menu.

Some sections of the setup procedure call for numerical values which be may entered using the keypad as described in Section 5.1.4

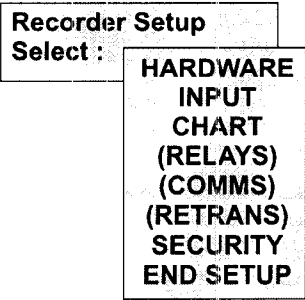
All Calibration and Setup data is stored in non-volatile memory and will be retained when the recorder is switched off.



### 4.2 Using the Menus



All of the following instructions in this chapter use the same basic key operations to step through and select options from display menus. As an example, the main Setup menu, shown below right, provides up to eight options. For each operation described in this manual, an example of the recorder's display and list of menu options will be given to the right of the text.

The words **Recorder Setup** on the top line show the mode of operation. The list box on the lower line gives all of the options which will be available, one of these will appear after the word **Select:** The  and  keys are used to cycle through the menu, press  to move down the list or  to move up. These keys are used in all instances to step through menu options. To select an option when it is displayed press the  key. The brackets around **RELAYS**, **COMMS** and **RETRANS** indicate that these options will only be shown if they have been specified in the hardware setup.

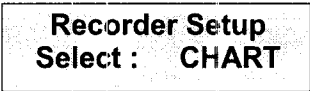
The main setup menu will start automatically at **HARDWARE**. If that option is selected a sub-menu will appear and the operator will be asked to enter the hardware details for the recorder. Once that has been entered the main menu will reappear and advance automatically to the next menu item, which would be **INPUT** in this case.



When the recorder prompts the operator to enter a value or pick an option from a list, the value or option which is currently stored in memory will be shown on the display. The entry may then be altered if necessary and the revised entry will be stored in memory when the  key is pressed. If the entry displayed is correct simply press , the value or option currently stored in memory will be unchanged and the display will go on to show the next prompt or menu. In this way it is possible to recall and check the setup which is currently stored but without having to alter it.


For example, if **CHART** is chosen from the main menu the **Chart Speed** sub-menu will be called up. In this case the chart speed currently stored in memory is 12 hours, that value can be changed to any one of the options given in the list box using the  and  keys

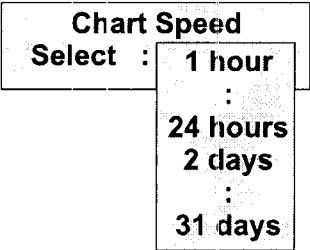
The current chart speed is:










The chart speed options are:



Pressing  picks the value displayed and returns to the main Setup menu.



At certain points in the Setup menus numerical values must be entered. The detailed procedure for this is covered in section 5.1.4, the key functions are summarised as follows:

- Move the flashing cursor beneath the digit to be altered by pressing the  and  keys.
- Increase the value at the cursor position by pressing the  key.
- Decrease the value at the cursor position by pressing the  key.
- By moving the cursor to the decimal point and pressing the  key the decimal point is moved to the right one position
- By moving the cursor to the decimal point and pressing the  key the decimal point is moved to the left one position
- The movement of the cursor when editing a numeric values is confined to the entry field.
- Editing is completed by pressing .

### 4.3 Power-up and Self-test Sequence

When the CT6100 recorder is either switched on or RESET by means of the pushbutton on the main PCB, the instrument will go through an initialisation and self-test sequence before it begins recording.

Initially, the pens will be raised from the chart and the start-up message will be shown for a period of two seconds. The recorder will check whether any of the front panel keys have been pressed.

Each pen in turn will be driven to a 'home' position close to the chart centre. For each pen the display will show the current input sensor type and chart scale together with the speed of chart rotation. The example given is for a pen whose input is a platinum resistance detector (RTD) matched to a chart range of 0 to 100°C with a 24 hour period of rotation.

If no front panel key was pressed at the start of the power-up sequence normal recording will begin.





**OMEGA CT6100**

**Pt100 0 / 100°C**  
**Chart Speed 24 hours**

**25.0°C**

### 4.4 Entering and Leaving the Setup Mode

Before the setup procedure can be carried out jumper J5 (right-hand edge of the main processor PCB) must be fitted and the chart recorder must be put into the Setup mode as follows:












1. Open the door.
2. Hold down either the  or  control panel keys and while doing this press and release the RESET pushbutton on the chart plate (see Fig. 2.2) When the pen(s) move, release the control panel key.
3. The pens are raised from the chart and driven to the 'home' position, and the display will show
4. Press the  key to obtain the main Setup menu (right)
5. To leave the Setup mode select END SETUP from the main setup menu and press . The recorder will then run through the power-up self-test sequence and then begin recording using the new setup.

**Select mode SETUP →**  
**mode CALIBRATE ←**

**Recorder Setup**  
**Select :**

- HARDWARE**
- INPUT**
- CHART**
- (RELAYS)**
- (RETRANS)**
- SECURITY**
- END SETUP**

**4.5 Hardware Setup**

1. Choose the Hardware menu option. Each successive operation of the  key will display the next item of the Hardware setup sub-menu.
2. Select the frequency of the mains supply to the recorder. It is important that this is correctly specified for optimum filtering of input noise.  
  
Toggle between 50Hz / 60Hz with the   keys.
3. Set the number of pens to be 1, 2 or 3. The default value is 1.
4. Select the number of relays fitted. Three are standard on single-pen recorders, six on multi-pen versions.
5. Specify whether an analogue output retransmission card is fitted. Toggle between YES/NO with the   keys.
6. Specify whether a serial communications card (RS232) is fitted. Toggle between YES/NO with the   keys.
7. Select whether pen feedback is required. This is normally set to ON so that the position of the pens will be checked periodically to verify that they are positioned correctly, improving reliability. In the event of damage to the feed back potentiometer wipers or circuit the recorder may be operated with the feedback switched OFF. Toggle between ON/OFF with the  and  keys.
8. If the number of pens has been set to either 2 or 3 specify whether the input channels 2 and 3 are standard analogue inputs or event inputs. If the input channel is to be used for analogue inputs (thermocouple, RTD etc) set this option to NO. Toggle between ON/OFF with the  and  keys.  
(Note - Channel 1 is always an analogue input and cannot be used for events.)
9. For 3-pen recorders only repeat step 8 for the third pen.

**4.6 Input Setup**

The input setup option is used to enter the following:

- Type of input signal or sensor that will feed the chart recorder
- Recording range of the chart
- Scaling of the linear input if used
- The measurement units of the digital displays
- Optional calibration shift (thermocouple & RTD)

1. Select **INPUT** from the main setup menu
2. Select which input channel number (pen number) to setup. The setup of each input may be different. Repeat the input setup procedure for each pen if necessary. Select End to return to the main setup menu.
3. The input setup sub-menu will appear, confirmed by the words Input Setup on the top line of the display. On multi-pen recorders these will be followed by the channel number 1, 2 or 3.

**Recorder Setup**  
Select : **HARDWARE**

**Hardware Setup**  
Supply freq **50Hz**  
**60Hz**

**Hardware Setup**  
Number or pens **1**  
**2**  
**3**

**Hardware Setup**  
Number or relays **0**  
**3**  
**6**

**Hardware Setup**  
Communications **YES**  
**NO**

**Hardware Setup**  
Event on pen 2? **YES**  
**NO**

**Hardware Setup**  
Event on pen 3? **YES**  
**NO**

**Recorder Setup**  
Select : **INPUT**

**Recorder Setup**  
Select channel **1**  
**2**  
**3**  
**End**

**Input Setup: Ch1**  
Input: **Thermocouple**  
**PT100 (RTD)**  
**Current (mA)**  
**Voltage (V)**




#### 4.6.1 Thermocouple & RTD Input Sensors

The procedure for setting up these input types is similar and the following applies to both except where stated. The example shown below right applies to channel 1 (pen 1) of a multipen recorder which is setup to record 0 to 100°C using thermocouple type K.

1. Select either **Thermocouple** or **Pt100 RTD** from the Input Setup menu, the one chosen will be displayed on the top line after the channel number.
2. For thermocouples only specify the type letter.

Input 1 Setup T/C  
Thermocouple type

K  
T  
J  
E  
N  
R  
S  
B

3. Select the units of temperature used by the display. Toggle between °C or °F using the  and  keys, press  when correct.

Input Setup T/C  
Display units

°C  
°F

4. The T/C & RTD ranging prompt will be displayed briefly :-

Input 1 Setup T/C  
T/C & RTD ranging

5. Enter the temperature corresponding to the lowest point of the chart scale. This value must be in degrees Celsius, fractions of a degree cannot be entered. (See 5.1.4 - Entering numerical values) The value must be within the measurement range for the thermocouple type or RTD.


Input 1 Setup T/C  
Pen low: +0 °C

6. Enter the temperature corresponding to the highest point of the chart as above. Normally, the Pen hi value will be greater than Pen low; if it is less the chart will be an 'outside zero' type (See 4.12 - Outside Zero Charts.) The difference between the Pen low and Pen hi values (i.e. the chart span) must be at least 5°C.




Input 1 Setup T/C  
Pen hi: +100 °C

7. The recorder will check whether the pen low and pen hi figures are permitted for the type of sensor, if either is wrong an error message will be issued and the program will return to step 4 to allow the error to be corrected.

Input 1 Setup T/C  
Accept ranging?

If both entries are valid the Accept ranging? prompt will be shown. Press the  key to accept the values, if any other key is pressed the program will return to step 4 and the entries may be revised. Note: To proceed with the setup a valid range must be entered and accepted. The recorder will select either the low or high resolution measurement range for the given chart range. See Table 5.3 for the range limits.

8. The calibration shift feature corrects the recorder's reading to compensate for offset errors in thermocouples and RTDs. The calibration shift figure is a constant value which will be added to each measurement. For example, if an RTD is reading 0.5°C lower than the true temperature the calibration shift figure should be set to +0.5°C which will cancel out that error to give the correct recorder indication.

When using an accurate sensor the calibration shift figure should be 0.0. To increase the value by 0.1°C press , the  key will reduce the value by that amount. When correct press  to move on. The maximum calibration shift is ±9.9°C.

Input 1 Setup T/C  
Cal. shift +0.0 °C

Note When the recorder is calibrated it is assumed that the sensors to which it will be connected are perfectly accurate. The calibration shift should be regarded as a separate correction factor which does not overwrite this ideal calibration. The calibration shift is reversible and the recorder may therefore be returned at any time to its ideal calibration by setting the shift figure to zero.

9. The input setup sub-menu is then complete and the program will return to the main setup menu.



#### 4.6.2 DC Current and Voltage (Linear) Inputs.





The procedure to set up the DC current input type is identical to that for a DC voltage input. Both types have high and low ranges, one of which must be specified. In addition, a hardware jumper link on the configuration options PCB must be set accordingly (refer to Chapter 3: Installation, section 3.4.8 and 3.4.9).

The rated full-scale input levels of the linear inputs are:

Linear Input Type	Full-scale level		Overscale level	
	Low Range	High Range	Low Range	High Range
DC current (mA)	±2mA	±20mA	±2.2mA	±22mA
DC voltage (mA)	±2V	±20V	±2.0V	±22V

Table 4.1 : Full-scale and Overscale levels of linear inputs

The example given is for channel 1 setup as a 4 to 20mA input with chart and display scaling set for 0 to 100%. In this case hardware jumper J1 would be set to position 1, J2 would be set to position 2.

1. Select either **Current (mA)** or **Voltage (V)** from the Input Setup menu.
2. Select the required range by toggling between the high and low range scales using the  and  keys. Set input type and thermocouple fail jumpers in the appropriate positions - refer to Fig 3.11.
3. Enter the value to be displayed at the bottom-scale input signal level, this should equal the lowest point on the chart. See section 5.1.4 for help on entering numerical values.
4. Enter the value of the input signal which will be applied to give the 'Display lo' reading i.e. to position the pen at the bottom of chart scale. The value entered must lie within the full-scale measurement limits set out in table 4.1. For current ranges the value should be in milliamps, for voltage ranges use volts.
5. Enter the value to be displayed at the full-scale input signal level, this should equal the highest point on the chart scale. The position of the decimal point is important: the number of digits after the decimal point when the 'Display hi' value is entered will set the display resolution when recording. For example, 100.00 should be entered if display resolution of 0.01 is needed in the record mode. See section 5.1.4 for help on setting the decimal point position.
6. Enter the value of the input signal which will be applied to give the 'Display hi' reading i.e. to position the pen at the top of chart scale. It is recommended that the difference between **Input hi** and **Input lo** be at least 10% of the range (2mA/V for the 20mA/V range and 0.2mA/V for the 2mA/V range).
7. If the values entered in steps 3 to 6 are correct press  to accept the ranging, the values will then be saved in memory. If you wish to change one or more of the values press a key other than , the program will then return to step 3. (It will not be necessary to key in all four values again, just edit the values which have been entered).
8. Select the measurement units used by the display, a choice of approximately 30 is available. If no measurement unit is wanted select **NONE**.
9. The input setup sub-menu is then complete and the program will return to the main setup menu.

Input 1 Setup Ch 1

Input: Thermocouple  
PT100 (RTD)  
Current (mA)  
Voltage (V)

Input 1 Setup Linear

Range: Low (2mA/V)  
High (20mA/V)

Input 1 Setup Linear  
Display lo : +0.0

Input 1 Setup Linear  
Input lo : +4.0

Input 1 Setup Linear  
Display hi : +100.0

Input 1 Setup Linear  
Input hi : +20.0


Input 1 Setup Linear  
Accept ranging?

Input 1 Setup Linear  
Display units

°C  
°F  
etc...




### 4.6.3 Event inputs.

If either channel 2 or channel 3 has been set to be an event input the positions of the pen on the chart for both input states can be set as follows. Note that the channel must first be configured as an event input during the HARDWARE setup (See section 4.5, point 8)

1. The example right shows the procedure for setting up the input of channel 2 (pen 2) to be an event pen. The standard input setup menu for an analogue input which allows the selection of either thermocouple, RTD, current or voltage signals is not given if an event input has been specified in the HARDWARE setup. The input type is fixed and for information only this is shown as **Event**. Press the  key to advance to the next stage of the event pen setup.

2. Select the units to be shown after the display of the event pen position. The event pen is positioned to a percentage of the programmed sweep according to the state of the two inputs for that pen, it is recommended that the display units should be set to % or **NONE**.



3. To set the sweep length of the event pen and its position on the chart it is necessary to specify the end points of the sweep. The sweep must lie within the calibrated range of pen movement but does not need to cover the full chart span. For clarity, it is recommended that the sweep of the event pen lies on a portion of the chart scale which is not used by the other measurement pens.

Set the 'non-event' position of the event pen. This will be the position held by the event pen when both event inputs to that pen are logic-0 (i.e. 0% of sweep). The pen will be moved to the non-event position currently stored in memory. Move the pen up or down the chart using the  and  keys, each step movement of the pen represents 1% of the calibrated pen movement. The non-event position does not have to lie closer to the centre of the chart than the event position - if required the event position may lie at the edge of the chart and the non-event position may be at the centre. Press  when the pen is positioned as desired, the new position will then be stored in memory.

4. Repeat step 3 for the 'event' position, the pen will be moved initially to the position currently stored in memory. The 'event' position corresponds to the pen position when both inputs of that pen are logic-1. (i.e. 100% of sweep).
5. Repeat the input setup described above for the second event pen if required.

### 4.7 Chart Setup

Select this menu option to set the desired chart rotation speed. Speeds are selectable between 1-24 hours and from 2 to 31 days.

1. Select **CHART** from the main setup menu.
2. Select required chart speed which must be specified as the number of hours or days for one revolution. Press  to increase the time or  to decrease it. The time changes in steps of one hour from 1 to 24 hours and steps of 1 day from 2 days to 31 days. Both keys auto-repeat if held down continuously.

**Input Setup Ch 2**  
**Input : Event**

**Input 1 Setup Linear**  
**Display units**

°C  
°F  
etc...

**Non-event position**  
**←→move ← when set**

**Event position**  
**←→move ← when set**

**Recorder Setup**  
**Select : CHART**

**Chart speed**  
**Select : 12 hours**

**Chart speed**  
**Select :**



1 hour  
:  
24 hours  
2days  
:  
31 days

## 4.8 Relay Setup

The relay setup sub-menu will not be displayed if the number of relays has been set to 0 in the hardware setup - see section 4.5. This setup option allows each relay to be configured as follows:




- Assign a relay to a pen (channel)
- Select relay function (switching action)
- Enter/revise the setpoint
- Enter/revise the hysteresis level (as % of scale).

Section 2.2 provides a technical description of the relay operation. In the example shown the recorder has 6 relays, a 0 to 200°C chart, relay 1 is a high control relay with a setpoint of 50.0 and 0.5% hysteresis.

1. Use the  and  keys to cycle through the main setup menu and select **RELAYS**.

2. Choose the number of the relay to configure. The maximum relay number will be as specified in the hardware setup.

3. Each relay may be assigned to operate with any pen (channel) of the recorder. To switch off (disable) a relay select **NONE**. If a relay is disabled the program will skip steps 4 to 7.


4. Select the relay action to suit the application, a description of each action may be found in section 2.2. Use the  and  keys to select from the menu, press  to proceed.

5. Enter a setpoint value (SP) for the relay. The setpoint value may be outside the chart scale but should lie within the measurement range of the chosen input sensor. For example, if a channel has been set for an RTD input with a chart of 0 to 100°C the relay setpoints must be within the low measurement range which is -200 to +200°C. A high alarm relay assigned to that channel with a setpoint of 110°C would switch whenever the temperature exceeded the chart scale by more than 10°C. (Refer to section 5.1.4 for help on entering numeric values.)

6. In the case of deviation alarms set the maximum deviation allowed for the process in the normal state. For example, to signal an alarm 5°C above or below the setpoint enter a deviation value (D) of 5°C (Refer to section 2.2.4 for a description of deviation alarms.)

7. Enter the hysteresis value to attribute to the relay setpoint as a percentage of the chart scale. For example, to give 1°C of hysteresis when the chart is scaled 0 to 200°C enter a figure of 0.5%. The hysteresis figure may lie in the range 0 to 10%, a value of zero is not recommended however as relay chatter is likely to occur close to the setpoint. The default hysteresis value is 1% but the optimum figure will depend upon the application. Refer to section 2.2 for further details of relay hysteresis.

8. Once a hysteresis figure has been entered the display will then show the points at which the relay will switch relative to the setpoint (SP). These switching points are given in the units of the chart, not as a percentage. For example, a control relay with 0.5% hysteresis and a chart of 0 to 200°C will switch 1°C either side of the setpoint (SP  $\pm$  1.0).

This display will be shown until the  key is pressed.

9. Repeat steps 2 to 7 for each relay as necessary.

10. To return to the main set up menu select **END relay setup**

**Recorder Setup**  
**Select : RELAYS**

**Relay setup**  
**Select : 12 hours**

**Relay number 1**  
**:**  
**6**  
**End relay setup**

**Relay 1 Setup**  
**Assign to pen : None**

**1**  
**2**  
**3**

**Relay 1 setup**

**High alarm**  
**Low alarm**  
**Deviation alarm**  
**Low control relay**  
**High control relay**

**Relay 1 setup**  
**Setpoint +50.0**

**Relay 1 Setup**  
**Deviation +5.0**



**Relay 1 Setup**  
**Hysteresis +0.5%**

**Relay 1 Setup**  
**Switch at SP $\pm$ 1.0**

#### 4.9 Retransmission Setup

The retransmission setup sub-menu will not be displayed if the retransmission entry has been set to NO in the hardware setup - see section 4.5. Note that the output of the retransmission card is a current of either 0/20mA or 4/20mA, voltage outputs are possible with suitable load resistors.

The following example sets up the retransmission card to output a current of 4 to 20mA which represents the temperature range 0 to 50°C for pen 1 a multi-pen recorder operating with a 0 to 100°C chart.

1. Select **RETRANS** from the main setup menu.
2. Multi-pen recorders only: Specify which channel (pen) is to be retransmitted.
3. Select either 0/20mA or 4/20mA current output. Use 4/20mA for 1/5V (250 ohm resistor) or 0/20mA for 0/10V (500 ohm resistor) Use the   keys to toggle between 0/20 and 4/20mA.
4. Enter the recorder reading at which the lowest output current level will be obtained. This figure does not have to be the lowest point on the chart scale (it is possible to retransmit part of the chart scale) but it must lie within the measurement range of the channel to which the retransmission card is assigned. Recorder readings below the Output lo figure will not reduce the output current below the minimum figure of 0 or 4mA.
5. Enter the recorder reading at which the highest output current level will be obtained. This figure is limited to the measurement range of the channel but is not restricted to the highest point on the chart. Recorder readings above the Output hi figure will not increase the output current beyond 20mA. For example, if the 4/20 mA retransmission output is over 0/50°C on a 0/100°C chart recorder readings above 50°C will give an output of 20mA. Similarly, 4mA will flow for temperatures below 0°C  
  
To reverse the action of the retransmission current i.e to give a current of 4mA at 50°C and 20mA at 0°C simply interchange the Output hi and Output lo entries.
6. The program will return to the main setup menu.

**4.10** This section is intentionally blank

**Recorder Setup**  
**Select: RETRANS**

**Retransmission setup**  
**Assign to channel** **1**  
**2**  
**3**

**Retransmission setup**  
**Select:** **0 / 20 mA**  
**4 / 20 mA**

**Retransmission setup**  
**Output lo : 0.0**

**Retransmission setup**  
**Output hi : 50.0**

## 4.11 SECURITY

The security feature restricts access to certain features in the record mode and before proceeding with this section of the setup the full details given in section 5.2 should be studied.

1. Select SECURITY from the main setup menu.

**Recorder Setup**  
**Select: SECURITY**

2. Select an access level 0, 1 or 2.

**Security setup**  
**Access level:** 0  
 1  
 2

3. If access level 1 is selected a 4-key access code must be chosen.  
 The code which is currently stored will be written to the top line, this is the only way that the code can be revealed.

**Current code << >>**  
**New**

4. To change the access code key in the sequence after the word **New**.  
 To retain the current code key in the code which appears on the top line: the code must be re-entered.

**Current code << >>**  
**New << << Confirm?**

In the example shown the current access code is the new code would be

When the 4-key sequence has been entered the prompt **Confirm?** will be displayed. Pressing will store the new code, press any other key to make further changes.

5. The program will then return to the main setup menu.

## 4.12 Outside Zero Charts

Applications such as refrigeration temperature recording, which require the best trace resolution at the lower end of the measurement range, frequently use 'outside zero' charts on which the lowest temperature is recorded at the edge of the chart where the scale is more open. On an outside zero chart the pen moves towards the centre with increasing temperature.

To configure the CT6100 to suit a chart of this type the pen low and pen high values should be entered in reverse order when setting up the input.

For example, to setup an input to use an RTD over the temperature range -20 to +20°C with the lower temperature at the chart edge the pen low and pen high values would be as shown:

**Input 1 Setup RTD**  
**Pen low : +20 °C**

When calibrating the pen travel for an outside zero chart the top and bottom positions of the chart scale should be the same as for a standard chart.

**Input 1 Setup RTD**  
**Pen hi : -20 °C**

## 4.13 Half Charts

A two-pen recorder with widely differing pen scales may use half charts. On such a recorder one pen will be setup to sweep over the lower half of the chart whilst the second traces over the upper half which is marked with a different scale. For half charts the inputs should be setup in exactly the same way as a standard full chart (i.e. the pen high value should be greater than pen low) but the pen should be calibrated to sweep over the top half or the bottom half of the chart - see section 6.4.3.

## 4.14 Protecting the Setup

Once the recorder has been fully commissioned and is operating correctly it is recommended that the setup be protected by means of software and hardware locks which will prevent unauthorised alteration. Removal of hardware jumper J5 (see figure 2.4 for location) prevents the recorder from entering either the Setup or Calibrate mode. If the application requires frequent changes of relay setpoint values it is recommended that the software security level be set to either level 1 or level 2, both of which allow such changes to be made from the front panel without putting the recorder into the Setup mode. If setpoints are fixed the security level should be set to the most secure level which is level 0. (See section 5.2)

## 4.15 Pen arm adjustments

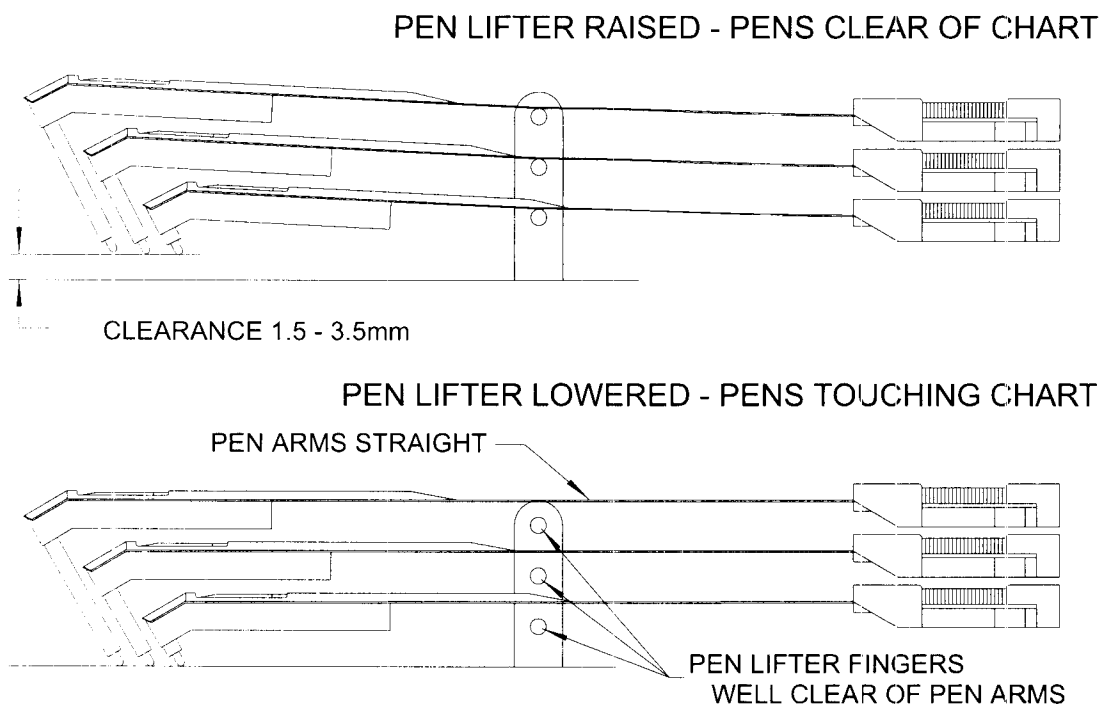
Before using the recorder check that the pen nib pressures and pen arm lengths are correct.

### 4.15.1 Pen nib pressure

To give clear traces on the chart the pen arms must be formed so that pen nibs are pressed into contact with the paper over their full travel. The correct pen arm form is also important for satisfactory operation of the pen lifter mechanism. Figure 4.1 shows their correct appearance when raised and lowered.

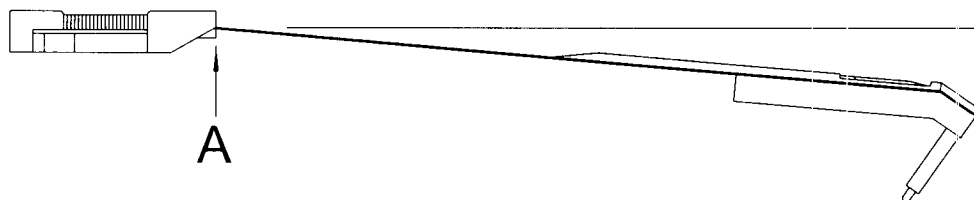
Note that in the lowered position the pen arms should be almost straight, that is, parallel to the chart plate. A slight downward bow is desirable but the arms should not be heavily bowed because the clearance between the pen capsules will be reduced and they might not pass freely. Each arm should be roughly 1.5 to 2.5mm above its pen lifter finger rod.

When raised the clearance between each nib and the paper chart should be in the range 1.5 to 3.5mm. (The height of the pen lifter fingers above the chart is factory set but may be adjusted if necessary. Separate adjustment screws are provided for the raised and lowered positions, these are identified in figure 6.2.)



**Figure 4.1 : Correct pen arm form in the raised and lowered positions**

To set the correct pen pressure it is recommended that the arm should be removed from the recorder and bent downwards gently at the point where the metal arm joins the attachment moulding, point A in figure 4.2. The figure shows a bend of 5° which will give the correct nib pressure in most cases when the arm is refitted.



**Figure 4.2 : Correct pen arm form, arm removed from mechanism.**

#### 4.15.2 Pen arm lengths

It is important that each pen arm is the correct length if the pen nibs are to pass without interference. When set to correct length the red pen will accurately track the arc of the chart scale as shown in figure 4.3. The blue pen should trace an arc which is 4mm ahead of the red pen, the green pen sweeps 4mm behind the red.

The pen arms are preset to the correct lengths during manufacture and should not require adjustment in service. If it appears that the lengths are incorrect check that the pen capsules are pushed right to the end of the pen arm slots and that the pen arm mountings are fitted fully onto the mechanism before making any adjustments.

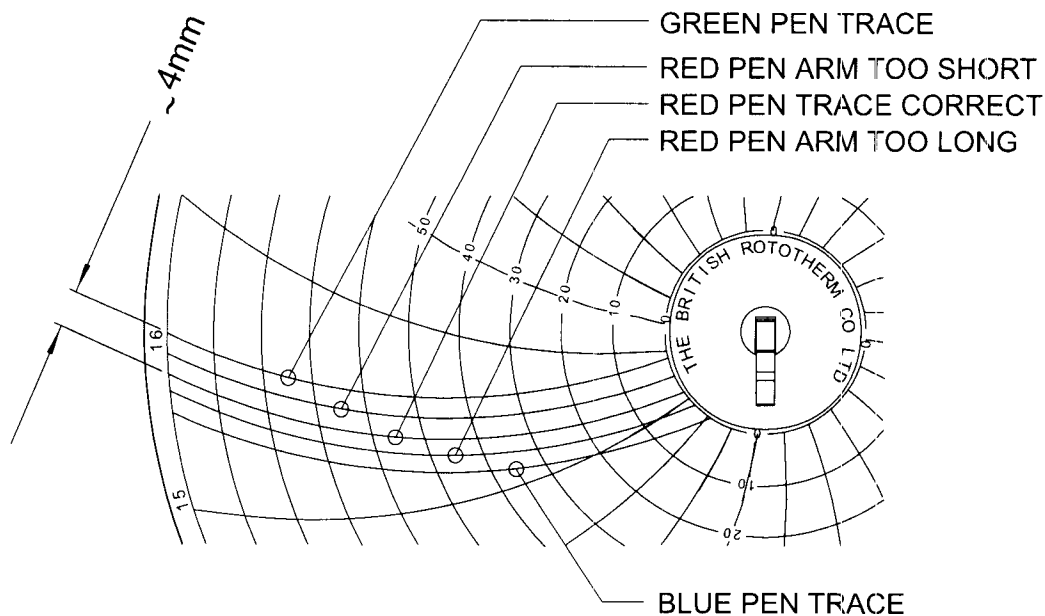


Figure 4.3 : Correct sweep positions of red, green and blue pens

To adjust the pen arm length remove the arm from the recorder and loosen the clamp screw as shown in figure 4.4. Slide the spring steel arm into or out of the moulding and tighten the screw. Refit the pen arm, check the distances between the pen nibs and ensure that there is sufficient clearance between the pen capsules to allow them to pass.

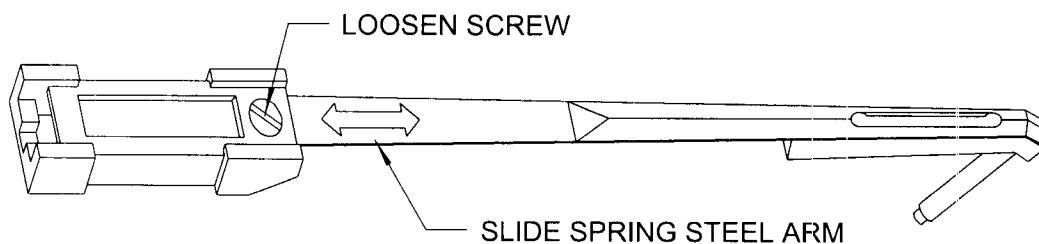


Figure 4.4 : Pen arm length adjustment

## CHAPTER 5

### OPERATION

This chapter gives instructions for changing charts and pens, alteration of relay setpoints and day-to-day operation of the recorder.

#### 5.1 Control Panel

The control panel comprises a keypad containing five keys, six light-emitting diodes (LEDs) which show the status of the relays, and a two-line, 20 character liquid crystal display (LCD) as shown in figure 5-1.

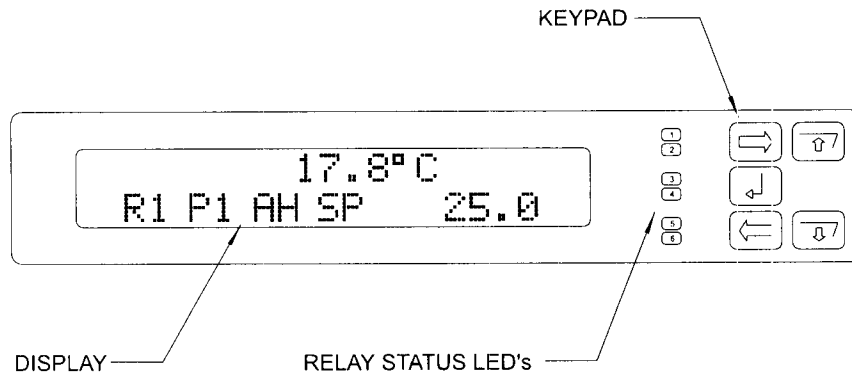


Figure 5.1 : Control panel

##### 5.1.1 LCD Display

The display is a two-line twenty-character dot matrix liquid crystal display (LCD) with a backlight for good visibility at all levels of illumination. The display shows the digital value of the process variable for each channel, the setup of each relay, help and error messages. It is possible to adjust the display contrast by means of a potentiometer mounted on the interface board inside the chart plate, this is factory set and should not normally require adjustment. The display circuit includes a compensator which gives the correct contrast over the ambient temperature range.

##### 5.1.2 Relay Status LEDs

The 6 colour-coded LED's indicate the status of each relay as follows :

UNLIT:	The relay is not installed in that position or is not assigned to a pen.
GREEN:	This is the 'normal' (non-alarm) condition in which the relay is energised.
RED:	This the 'alarm' condition in which the relay is de-energised.



### 5.1.3 Keypad

The function of each key is described below. It should be noted that some keys can be used in combination, providing further functions: these will be highlighted in the text as necessary:


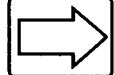
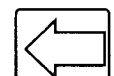
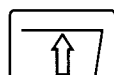
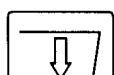












Key	Mode		
	Record	Setup	Calibration
	<ul style="list-style-type: none"> <li>Choose menu item</li> <li>Confirm entry</li> <li>Display relay setpoint</li> </ul>	<ul style="list-style-type: none"> <li>Choose menu item</li> <li>Confirm entry</li> </ul>	<ul style="list-style-type: none"> <li>Choose menu item</li> <li>Confirm entry</li> </ul>
	<ul style="list-style-type: none"> <li>Fast-forward chart (with pens raised)</li> <li>Go forward through menu</li> </ul>	<ul style="list-style-type: none"> <li>Go forward through menu</li> <li>Move cursor right (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Go forward through menu</li> <li>Move cursor right (when entering values)</li> </ul>
	<ul style="list-style-type: none"> <li>Fast-reverse (with pens raised)</li> <li>Go back through menu</li> <li>Move cursor left (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Go back through menu</li> <li>Move cursor left (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Go back through menu</li> <li>Move cursor left (when entering values)</li> </ul>
	<ul style="list-style-type: none"> <li>Raise pens from chart</li> <li>Increment number at cursor (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Increment number at cursor (when entering values)</li> <li>Move decimal point right (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Increment number at cursor (when entering values)</li> <li>Move decimal point right (when entering values)</li> </ul>
	<ul style="list-style-type: none"> <li>Lower pens onto chart</li> <li>Decrement number at cursor (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Decrement number at cursor (when entering values)</li> <li>Move decimal point right (when entering values)</li> </ul>	<ul style="list-style-type: none"> <li>Decrement number at cursor (when entering values)</li> <li>Move decimal point right (when entering values)</li> </ul>


Table 5.1 : Summary of control panel key functions

### 5.1.4 Entering Numerical Values

To calibrate the signal inputs, configure the recorder or change a relay setpoint it is necessary to enter a numerical value. To enable that to be done via the front-panel keypad the  and  keys are given alternate functions and are used in conjunction with the  and  keys.

When a numerical value is required the currently held value appears on the display and is then edited one character at a time. The cursor is positioned beneath one character of the entry and may be moved to the next character on the right by means of the  key and to the left with . The character at the cursor position is changed using the  and  keys, according to the sequence shown in the table 5.2. The sequence followed depends upon which character is displayed. The decimal point (DP) is a special case: when the cursor is positioned under the decimal point the  key moves the point one place to the right while  moves it to the left. The cursor cannot be moved outside the entry field.

It is possible to program the precision of an entry, that is, the number of digits following the decimal point. If a value lacks a decimal point one may be introduced by pressing the  button when the cursor is positioned after the last digit. A decimal point and a zero will be appended if there is sufficient space in the entry field, a second depression of the  key will remove the decimal point. The number of digits of precision specified is stored together with the value, when the entry is later recalled it will therefore be displayed in the same format.

Once correctly edited the value is entered by pressing the  key.

Character at cursor position	Result of key press				
	Left	Right	Raise	Lower	Enter
+ -	None	Moves cursor 1 digit to right	Toggle +/-	Toggle +/-	Number is entered
Digit 0 to 9	Moves cursor 1 digit to left	Moves cursor 1 digit to right	Increment digit in sequence 1234567890	decrement digit in sequence 9876543210	
SPACE	(Movement restricted to entry field)	(Movement restricted to entry field)	Add extra digit*	Add decimal point and 0**	
Decimal point (DP)			Moves DP one place to right	Moves DP one place to left	

\* Only if there is a digit to the left

\*\* Only if there is a digit to the left and there is sufficient room for the extra characters

Table 5.2 : Summary of control panel key functions

Example :

Display shows	1234	Cursor at '3'
Press RIGHT to give	1234	Cursor at '4'
Press RIGHT once more to give	1234_	Cursor at space after '4'
Press DOWN to give	1234.0	Decimal point added
Pressing DOWN once more gives	1234_	Decimal point removed
Pressing UP then adds a digit	12340	Extra digit added
Pressing UP once more gives	12341	Extra digit incremented

## 5.2 Security

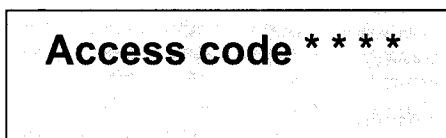
The CT6100 recorder has three levels of security to prevent access and protect the recorder's set-up information from unauthorised alteration. The security level must be selected when the recorder is in the Setup mode, it cannot be changed when recording.

Three levels of security are allowed, as follows:

- Level 0:** This is the most secure level which allows a minimum of actions to be effected via the control panel. For example pens may be raised, charts replaced, and the relay setpoints can be viewed on the display. Alteration of setpoints is not permitted.
- Level 1:** On entering of a user-selectable access code the operator may alter relay set-points. It is not possible to alter the relay action or hysteresis level.
- Level 2:** This is the lowest level of security. Access is permitted, without an access code, to vary relay set-points. It is not possible to alter the relay action or hysteresis level.

### 5.2.1 Access Code Security

When recording, security level 1 protects the recorder's set up by an access code which the operator must enter via the keypad before the setup can be altered. To gain access in security level 1 enter the 4-key code via the front panel keypad as follows:



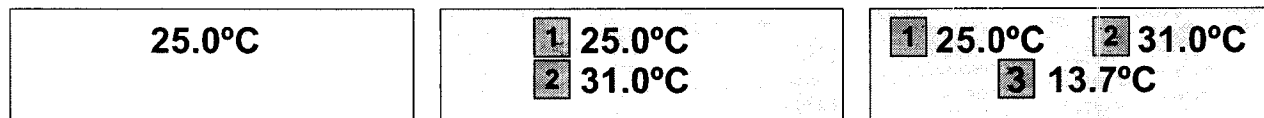
To maintain the secrecy of the code an asterisk character (\*) will be displayed as each key is pressed.

### 5.2.2 Changing the Security Level

The access code can only be specified when the recorder is in the Setup mode (See section 4.11)

## 5.3 Chart and Display Indications in Record Mode

Record mode is the normal state of operation. Provided that the input signal (the process variable) falls within the limits of chart scale (see Chapter 4, section 4.5) its value will be indicated by the position of the pen against the chart scale. In addition the value of each process variable will be shown on the liquid-crystal display, on multipen versions the value will be preceded by a channel identifier, 1, 2 or 3.



**Figure 5.2 : Digital displays of process variables in the record mode**

For a standard recorder the channel numbers correspond to the pen colours as follows:

- Single pen : Channel 1 - Red
- Two pen : Channel 1 - Red  
Channel 2 - Green
- Three pen : Channel 1 - Red  
Channel 2 - Green  
Channel 3 - Blue

### 5.3.1 Over and under range indications.

In the case of a process variable falling outside the set chart scale the pen will be driven to the minimum or maximum chart position, the display will continue to show the correct reading provided that the input remains within the measurement limits for the range. Should the input exceed the measurement limits an under range or over range indication will be given. For thermocouple inputs the CT6100 includes jumpers which select whether the indication should be upscale or downscale in the event of a broken sensor connection.

Table 5.3 gives the over and under-range limits for RTD, thermocouple and linear inputs. All temperatures are given in degrees Celsius.

#### RTD input

The over-range temperature depends on whether the low or high measurement range is used. The appropriate range is selected automatically to match the chart range specified during setup. Both measurement ranges have the same under-range temperature limit.

Examples:

(1) Pt100 RTD low-range (-200 to 200°C), chart span 0 to 50°C, input value 300°C.

Pen is driven to extreme maximum position on chart scale, display reads Over

(2) RTD high-range (-200°C to 850°C), Chart span 200°C to 400°C, input value 500°C

Pen is driven to extreme maximum position on chart scale, display reads 500°C.

#### Thermocouple input

The over-range temperature limit is dependent on the type of thermocouple and chart range selected during setup, the appropriate measurement range is selected automatically. Negative temperature limits are determined by the thermocouple type and providing the input lies within those limits its value will be displayed although the pen may be at the limit of its bottom scale travel.

Example:

(1) T/C type K low-range (-270°C to 535°C), chart span 200°C to 400°C, input value 600°C.

Pen is driven to extreme maximum position on chart scale and display reads Over

Input Type	Measurement Range	Under-range at	Over-range at
Pt100 RTD	Low	-200°C	+200°C
	High	-200°C	+850°C
Thermocouple Type K	Low	-270°C	+532°C
	High	-270°C	+1372°C
Thermocouple Type J	Low	-210°C	+400°C
	High	-210°C	+1200°C
Thermocouple Type T	Low*	-270°C	+400°C
Thermocouple Type N	Low	-270°C	+635°C
	High	-210°C	+1200°C
Thermocouple Type E	Low	-270°C	+312°C
	High	-270°C	+1000°C
Thermocouple Type R	Low	-50°C	+1763°C
Thermocouple Type S	High	-50°C	+1763°C
Thermocouple Type B	Low	+200°C	+1820°C
Linear mA	Low (±2 mA)	Bottom of chart -10% of span	Top of chart +10% of span
	High (±20mA)	Bottom of chart -10% of span	Top of chart +10% of span
Linear	Low (±2V)	Bottom of chart -10% of span	Top of chart +10% of span
	High (±2V)	Bottom of chart -10% of span	Top of chart +10% of span

\* All measurements performed using low range only

Table 5.3 : Under- and over-range levels



## Linear inputs


Linear inputs include all milli-amp, milli-volt and voltage input sources. When using linear inputs the sweep of the pen is restricted to the range of the chart scale specified in the set-up. However, the digital displays have an additional 10% overscale measurement 'headroom', this means that the over- and under-range limits of the digital displays are set 10% above and below the chart scale limits. The word **Under** will be displayed should the input level fall below -10% of the set chart scale, whilst **Over** will be displayed at 110% and above.

Example: Linear current input, high range (20mA).

Input low value	0mA
Display low value	0.0 (bottom of chart scale)
Input high value	20mA
Display high value	100.0 (top of chart scale)
Display over-range point	110.0 (input current = +22.0mA)
Display under-range point	-10.0 (input current = -2.0mA)
Range of pen travel	0.0 to +100 (i.e limited to the chart scale)

## 5.4 Relay Setpoint Display

In the record mode with the pens in the lowered position, the pen assignment, action and setpoint of each relay may be shown on the bottom line of the display by pressing the  key. If the key is pressed once and then released the relay setpoint will be shown for approximately 4 seconds after which time the bottom line will revert to the normal measurement display (blank line for single pen recorders, input (process) variable 2 or 3 for multipen versions.) To advance to the next relay press the  key once more when a setpoint is displayed..

If the  key is held down the display will step through the setup of each installed relay in sequence, showing each for a time of 2 seconds. If a relay is installed but not assigned to a pen (channel) the message "Rn : Relay not assigned" will be given, where n is the relay number.

An example of a setpoint display for a single-pen recorder is as follows.

**25.0°C**  
**R1 P1 AH SP 50.0**


The significance of the display is:

25°C:	Sensor temperature (pen 1 process variable).
R1:	Relay 1 (other options: R2 to R6 - relays 2 to 6 if fitted).
P1:	Relay is assigned to Pen 1 (other options: P2 and P3 - pens 2 and 3).
AH:	High alarm action. Other options: AL - low alarm; DA - deviation alarm; CL control low relay; CH - control high relay.
SP:	Relay has a setpoint of 50.0 units, 50.0°C in this example.






## 5.5 Changing Relay Setpoints

This action can only be carried out when the chart recorder is in either security level 1 or 2. Further, in security level 1, the correct access code must be entered before revision of the setpoints can take place. Refer to Section 5.2 concerning security level access. During revision of the setpoints, the recorder will continue to monitor the alarms and control relays using the setpoint values previously stored until these are overwritten by new entries.

The procedure to carry out changes to a relay setpoint is as follows:

1. Hold down the  key for 5 seconds.
2. If the recorder has been set to security level 1 an access code must be entered. Enter the 4-key access code, an asterisk is added to the display for each key press.

Note: If an incorrect code is entered or the correct code is not entered within a set time limit of 30 seconds recording will resume. The operator must also revise the relay setpoints within a time limit of 60 seconds. If that limit is exceeded the recorder will display a 'Timeout' message and carry on.

3. Following entry of the correct access code, if one is required, the following display is then shown:
4. Use the  and  keys to select number of the relay required.
5. Press the  key and the following setpoints display is shown for the relay selected (relay 1 is given as an example).
6. Edit the setpoint as necessary. This is done in the same way as numerical entries. Press the  key to store the new setpoint.
7. Repeat steps 2 to 6, as necessary, for other relay setpoints.
8. To return to the normal record mode display select **Adjust relay END** from the menu and press the  key.

**Access code \*\*\*\***




**Timeout**

**Adjust relay** 1  
:  
6  
**END**

**Adjust relay 1**  
**SP +50.0**

**Adjust relay** 1  
:  
6  
**END**







### 5.6 Raising and Lowering the Pens

To raise the pens above the chart press the  key, the following display message will be obtained. For ease of chart changing the pens may be moved to the edge of the chart by pressing . To lower the pens onto the chart and resume recording press the  key.

When raised, the pens will remain at the same position on the chart scale. The recorder will continue to perform measurements and the relays will operate normally but the pens will not be repositioned until they are lowered onto the chart.



### 5.7 Setting the Correct Chart Time

The CT6100 recorder includes a high-speed chart advance and reverse feature for setting the red pen to the correct time mark on the chart. This feature is activated in the record mode whenever the pens are raised above the chart paper.

1. Press the  key to lift the pens clear of the chart. To move the red pen to the edge of the chart press the  key.
2. To move the chart forward in time hold down the  key, to reverse the chart hold down . Both keys have two speeds, the higher speed is selected automatically if the key is depressed for two seconds or more. Using these keys rotate the chart until the nib of the red pen is positioned directly above the correct time mark on the chart scale. It is recommended that the final adjustment of the chart position before the pens are lowered should be made using the chart advance key (  ), that will take up any free movement in the chart drive mechanism and ensure that the chart will move immediately the pens are lowered.
3. Press the  key to lower the pens onto the chart and resume recording.

### 5.8 Changing a Chart




#### 5.8.1 Removal of chart

1. Press the  key to raise the pen(s) off the chart paper. The display shows:
2. Press the  key. To allow better access to the chart, the pen(s) will move to the 'parked' position at the edge of the paper.
3. Release the chart paper centre clamp.
4. Ease the chart paper edge out from under the two chart paper retaining bosses.
5. Remove the chart paper from the central chart paper clamp boss, and at the same time slide the chart paper from beneath the pen lifter.

**Park pens at edge?**

**Press  to resume**

#### 5.8.2 Fitting of chart

1. Assuming that the recorder is ready to accept a new chart paper, position the chart paper over the central chart clamp boss by sliding it under the pen lifter comb.
2. Push the chart paper fully to the base of the chart clamp, and close the clamp lever. Ensure that the lever is fully depressed so that the chart paper is pierced by the two location pips. Ensure also that the chart paper edge is underneath the two retaining bosses.
3. Using the keys  or  to rotate the chart paper in the forward or reverse directions respectively, move the chart paper until the time line is positioned beneath the red pen nib and in line with the time mark on the chart plate.
4. Press the  key to resume recording. The pens(s) will be driven to the chart centre to reset the positioning mechanism, and will then be lowered onto the chart paper at the appropriate point.

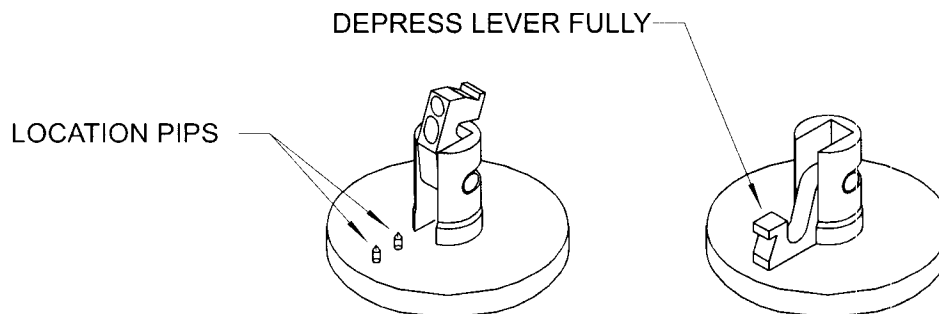




Figure 5.3 : Central chart clamp

## 5.9 Changing a Pen Capsule

Refer to figures 5.4 and 5.5 and follow these steps:

1. Press the  key to raise the pen(s) off the chart paper.
  2. Pull the complete pen arm off the radial arm (see figure 5.4) and slide it out between the combs of the pen lifter towards the centre of the chart.
  3. Remove the spent capsule from the pen arm by sliding it towards the arm moulding.
- CAUTION:** Care must be taken to ensure that the pen arm is not bent. A bent pen arm will result in reduced pen clearance and in the extreme case could cause one pen to strike another as they pass, or prevent the pen lifter from raising the pens clear of the chart paper.
4. Fit a new capsule of the correct colour to the pen arm by sliding the 'dovetail' on the capsule fully into and along the slot at the end of the pen arm.
  5. Replace the complete pen arm by sliding it back in through the pen lifter comb (at clamp end) and push firmly onto its radial arm.
  6. Press the  key to lower the pen(s) onto the chart paper at the appropriate point and resume recording.

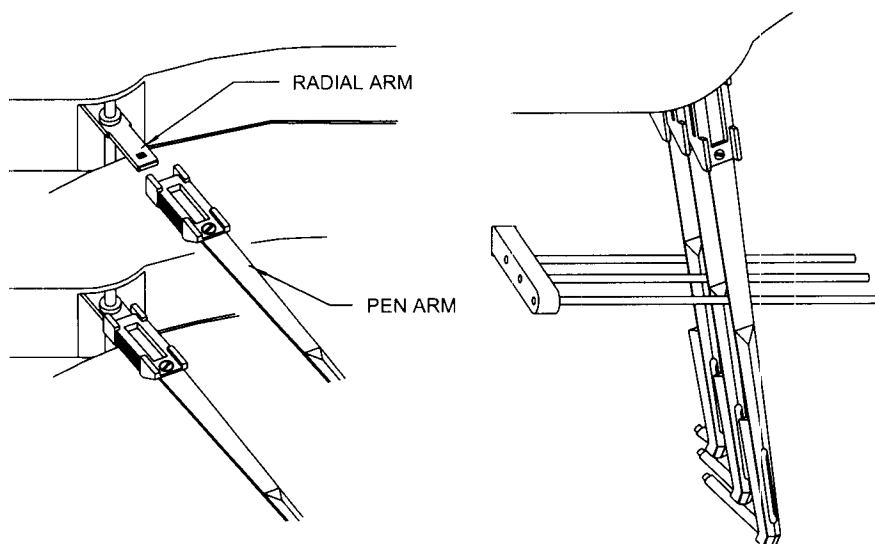


Fig 5.4 : Removal/Fitting of Pen Arm Assembly

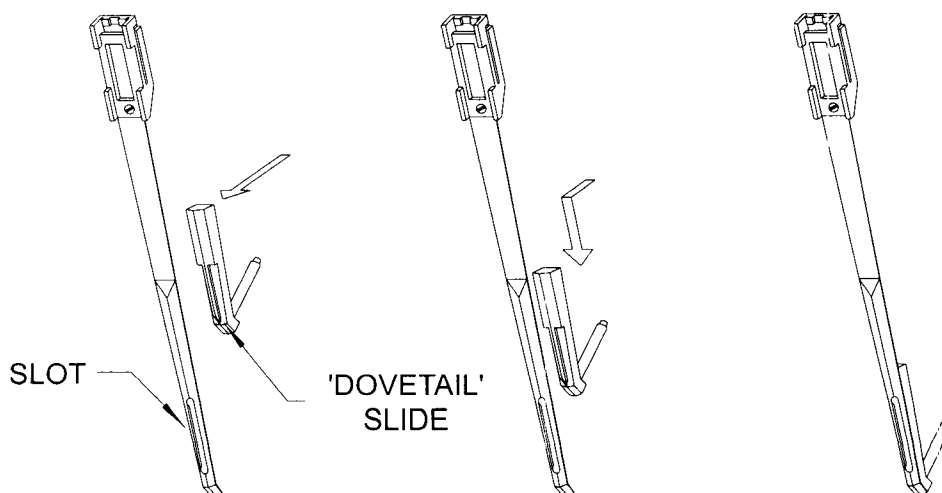


Fig 5.5 : Ink Capsule Removal and Fitting Details

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## CHAPTER 6

### CALIBRATION

This chapter sets out the calibration procedure which adjusts the reading of the chart recorder to bring into agreement with a reference instrument. The calibration accuracy should be checked at regular intervals and following a change of input sensor. Full calibration should follow a major repair or overhaul of the recorder.

Those unfamiliar with calibration procedures for process control equipment or the CT6100 in particular may find helpful background information in section 6.2 (Outline of Calibration Procedure).

For those who do not wish to undertake the task themselves, Omega provides a comprehensive factory recalibration service which is available via its distribution centres. Please contact Customer Services for details of this service.

#### 6.1 Checking the Calibration.

The CT6100 chart recorder is fully calibrated at the factory following manufacture, nevertheless its accuracy should be checked periodically as part of the quality assurance maintenance schedule for the installation. Accuracy checks should be done with the recorder in its normal recording mode, the Calibration mode is needed only if the checks show that the recorder requires some adjustment. It is recommended that the indication be checked against a reference instrument at three points:

- At or near the bottom of the chart scale.
- At or near the top of the chart scale.
- At a mid-scale point or the process operating point.

Should the indication of the recorder differ from that of the reference ensure that the discrepancy is not due to the signal source feeding the recorder (a 4/20mA transmitter for example). If all other possible sources of error have been eliminated the recorder should be recalibrated.

- If the digital readout is correct but the pen is not positioned at the correct point on the chart then recalibrate the pen.
- If the digital readout and pen indication differ from the reference by the same amount recalibrate the input (It is possible to correct small errors due to T/C and RTD inaccuracies without altering the recorder's calibration. See section 4.6.1 - calibration shift feature)
- Following repair work it is recommended that the pen and input are both fully recalibrated.

#### 6.2 Outline of the Calibration Procedure.

The calibration procedure must be undertaken carefully and precisely. The full procedure for the CT6100 chart recorder involves:


Calibration of the positioning mechanism to set the correct pen travel.

Calibration of the input circuit to give the correct digital display readings.

The recorder's display is used to guide the user through each calibration operation. Checks are made at key stages in the procedure to ensure that the calibration is valid.

The input circuit of the recorder may be calibrated by one of two methods according to the equipment and facilities available. If voltage and current sources, thermocouple and resistance simulators are available the calibration may be entirely electrical; in the absence of such equipment, thermal calibration is possible by holding the input sensor at two known reference temperatures, 0 and 100°C for example.

For each input the basic procedure is as follows:





- Apply an accurate signal to the input.
- Key-in the input value using the keypad.
- Allow time for the input signal to stabilise.
- Press  to perform a measurement.
- Repeat the above steps at a second signal level (two-point calibrations only).
- Verify the accuracy of calibration.

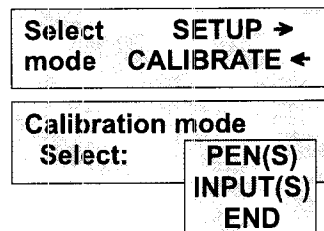
The following points should be noted:

- All calibration temperatures must be entered in °C.
- The pens are not positioned during calibration.
- During calibration the relays are not controlled and the plant should therefore be switched manually to a safe condition until calibration is completed.
- Jumper link J5 must be fitted to the main processor PCB to allow calibration (it may be removed to prevent unauthorised tampering).
- The RESET pushbutton on the main processor PCB may be pressed at any time to leave the Calibration mode.
- The calibration data will be stored automatically in non-volatile memory if the procedure is completed satisfactorily.

### 6.3 Entering and Leaving the Calibration Mode

Before the calibration procedure can be carried out jumper J5 (right-hand edge of the main processor PCB) must be fitted and the chart recorder must be put into the Calibration mode as follows:

1. Fully open the door and chart plate assembly.
2. Hold down either the  or  control panel keys and while doing this press and release the RESET pushbutton on the main processor PCB (see Figure 2.4). When the pen(s) move, release the control panel key.
4. The pens are raised from the chart and driven to the 'home' position, and the display will show
5. Press the  key to obtain the main calibration menu (right)
6. To leave the Calibration mode select END from the main setup menu and press . The recorder will then run through the power-up self-test sequence and then begin recording using the new calibration.






### 6.4 Pen Calibration.

Pen calibration matches the pen travel of the mechanism to the chart graduations. Three positions are established for each pen during calibration, two of these are stored in non-volatile memory and are used for all subsequent pen positioning operations. Pen calibration involves three stages, each of which must be done in sequence:

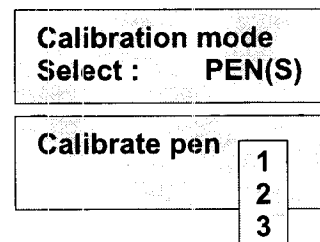
- Adjustment of the microswitch to set the home position.
- Setting the lowest pen position on the chart.
- Setting the highest pen position on the chart.

Before calibrating the pen travel it is important to check that the pen capsule is fitted correctly to the pen arm and that the arm is pushed fully onto the radial arm (refer to Section 5.9). A chart of the type to be used during recording should be fitted.

#### 6.4.1 Procedure

1. Enter the Calibration mode (Section 6.3) and select PEN(S) from the main menu
2. For 2 and 3-pen recorders only, use the  and  keys to choose which number pen to calibrate, then press  to continue.




Pen #1 (Red)  
Pen #2 (Green, 2 & 3 pen only)  
Pen #3 (Blue, 3 pen only)



#### 6.4.2 Setting the Pen Home Position

The designated pen will be driven towards the chart centre until its home limit microswitch is activated. This rest position of the pen nib should be approximately 2mm below the innermost chart graduation and the body of the pen should not foul the chart clamp, as shown in Figure 6.1.

The home position may be altered by means of the mechanism's microswitch adjustment nuts which are accessible if the pivoted chart plate is swung fully open.

1. With an M1.6 nut-spinner or box-spanner turn the relevant adjuster clockwise to move the home position towards the chart centre, counter-clockwise to take it towards the edge. Figure 6.2 identifies the three adjustment nuts.
2. After each adjustment press either the  or  key to establish the new home position. When satisfactorily positioned, press  to proceed.

**Adjust microswitch**  
**Press  when set**

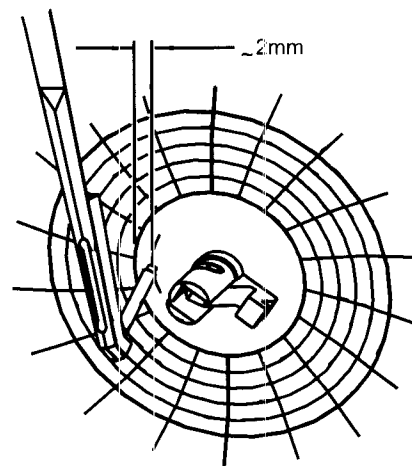








Fig 6.1 : Pen Home Position

**Note:** If the microswitch is adjusted subsequently the pen calibration procedure must be repeated since the zero and full-scale points are set relative to the home position.

### 6.4.3 Bottom of Chart Position

The bottom of chart position normally corresponds to the chart scale line closest to the chart centre and sets the lowest point of the pen's travel. To set this position the pen is moved across the chart by pressing the  and  keys. The keys should be held down to move a pen quickly across the chart.

- Initially, the nib will be moved to the current position stored in memory which should correspond with the lowest graduation of the chart as shown in Figure 6.3.  
If this is correct just press  to confirm it.

- If adjustment is necessary use the  and  keys to move the pen across the chart scale until it is correctly positioned, then press  to store the new location.

**Half-charts:** To set up a half chart on which the pen sweeps over the top half, the bottom of chart position should be set to a chart graduation at the mid-position of the chart.

### 6.4.4 Top of Chart Position

Figure 6.4 indicates the correct top of chart position of the pen nib. This position is set in the same way as the bottom of chart (Section 6.4.3).

Following this operation the recorder will return to the main calibration menu.  
For multi-pen versions of the CT6100 the procedure should be repeated for each pen.

**Bottom of chart**  
← → move ↵ when set

**Top of chart**  
← → move ↵ when set

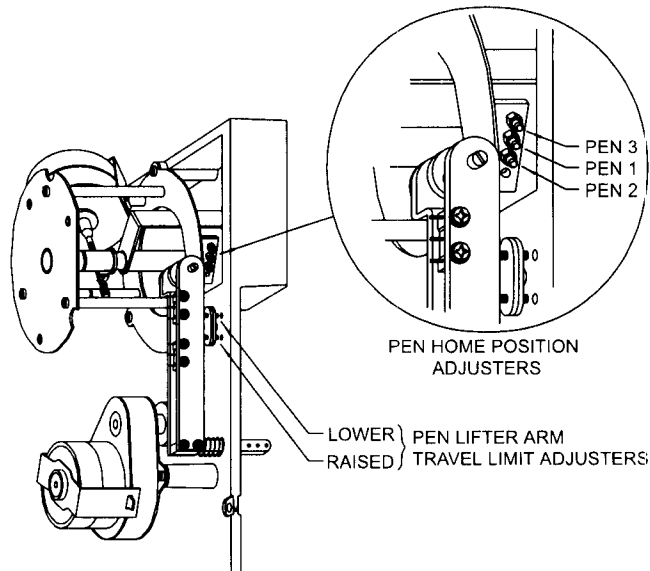


Figure 6.2 : Pen home position adjustment nuts

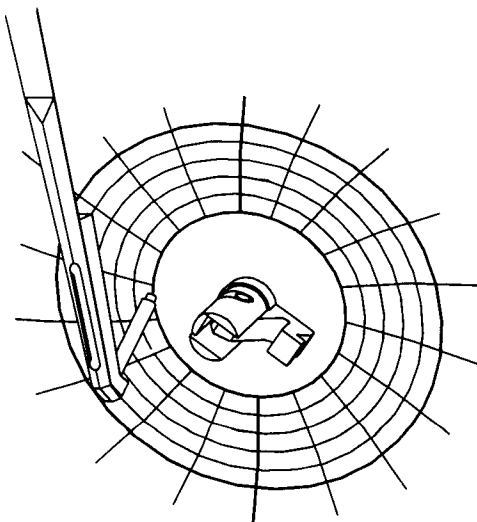


Figure 6.3 : Correct bottom of chart position

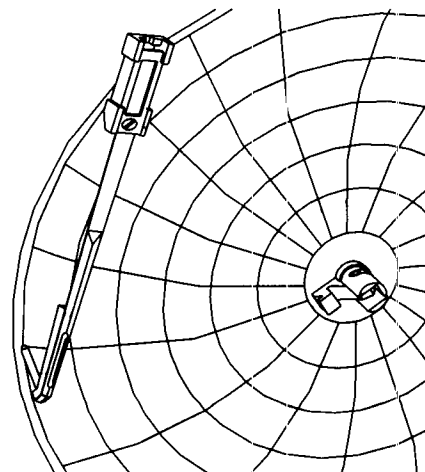






Figure 6.4 : Correct top of chart position

## 6.5 Inputs

Calibration of the analogue inputs may be performed either thermally using a sensor at appropriate reference levels (two precise temperatures for instance using a thermocouple or RTD) or electrically by application of an electrical signal which accurately simulates the sensor. The latter method should be used for calibration of the linear inputs and is also recommended for noble-metal thermocouples.

1. Call-up the main calibration menu (Section 6.3) then select INPUTS
2. Use the  and  keys to choose the range to calibrate then press  to proceed. Refer to the following sections for the detailed procedures.
3. On completion of a range calibration the menu will advance to the next.
4. To leave this menu and return to the main calibration menu, select **End input cal** and press .

**Calibration mode**  
**Select : INPUT(S)**

**Input calibration**

RTD lo range <200°C  
RTD hi range >200°C  
Cold junction  
T/C low range  
T/C high range  
2v dc range  
20v dc range  
2mA dc range  
20mA dc range  
20mV dc (T/C) range  
80mV dc (T/C) range  
**End input cal.**



### 6.5.1 RTD and Thermocouple Inputs - Thermal Method

These are two-point calibrations. Thermal calibration is not recommended for noble metal thermocouples (types S, R & B) for which electrical calibration is preferred - see Section 6.5.4.

Equipment needed:


- Reference temperature baths
- Calibrated thermometer


Note: Before calibrating the thermocouple inputs thermally the cold junction must be calibrated.

1. Connect either a 3-wire 100 ohm platinum RTD (FI 38.5 ohms) to terminals 4, 5 and 6 (Figure 3.6) or a thermocouple to terminals 4 and 5 (Figure 3.5) of the relevant input channel. In the case of thermocouples, compensating or extension cables must be used for these connections.
2. From the input calibration menu choose the appropriate input and range. For the thermocouple ranges only select the thermocouple type. The example which follows is for RTD low range below 200°C.
3. Place the sensor in the first reference temperature bath (one containing a stirred mixture of crushed ice and water to give 0°C for instance), with the probe of a reference thermometer if available. For best accuracy the probe of the recorder should be placed close to that of the reference thermometer and the bath should be stirred frequently. Use the keypad to set the display to equal the temperature of the first bath in °C. Do not press  at this stage.
4. For accurate thermal calibration it is important to allow sufficient time for the sensor to reach the temperature of the bath, this might take many minutes if the sensor is slow to respond. If successive readings vary by more than a certain amount the message 'WAIT' will be displayed, this indicates that the temperature of the recorder's sensor has not yet stabilised. When the sensor's temperature is close to that of the bath, 'WAIT' will be replaced by 'OK'.  
  
Press  when the temperature is stable, a calibration measurement will then be stored.
5. Transfer the sensor to a second higher temperature bath, and key-in the temperature.

**RTD low range WAIT**  
**Cal pt. 1      +0.0 °C**

**RTD low range WAIT**  
**Cal pt. 1      +0.0 °C**

6. Allow the reading to stabilise, when 'OK' is displayed press  to start a second measurement sequence.

At this stage the calibration scaling factors will be calculated, if these lie within the check limits they will be stored in memory and the recorder will automatically begin to measure the input temperature to allow the calibration to be verified (The pens will not be positioned but relays will be functioning.) Press  to proceed to the next input.

**Note:** Should the calibration scaling factors lie outside the check limits the values will not be stored and the following error display will be given:

If the calibration check reveals an error ensure that input signal connections are correct and repeat the calibration procedure for the chosen input, pay particular attention to entry of the calibration temperature points.

**RTD low range OK**  
**Cal pt. 2 +100.0 °C**

**RTD low range CHECK**  
**+100.0 °C**

**Err 3 : Cal. fault**  
**Not stored**




### 6.5.2 Cold Junction

Equipment required:

- Reference thermometer (ambient temperature range, 0.1°C resolution).

1. Locate the probe of the reference thermometer close to the signal input terminals 4 & 5 but avoid electrical contact with the terminals and other components.
2. Select 'Cold Junction' from the input calibration menu to call up the following display which indicates the ambient (cold junction) temperature, 19.8°C in this example.

Allow the reference thermometer probe to reach the same temperature as the input terminals. This might take some considerable time and the thermometer should be observed until a steady reading is obtained.

3. Press the  and  keys to increase or decrease the display reading until it agrees with the reference thermometer, then press .

**CJ. cal. Temp 19.8°C**  
**Adjust with ← → keys**

**CJ. cal. Temp 19.8°C**  
**Adjust with ← → keys**

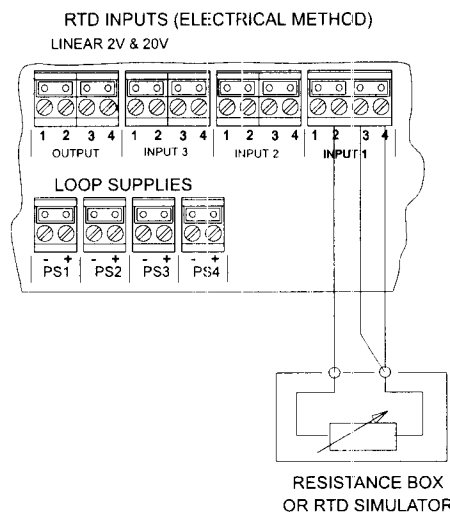
### 6.5.3 RTD Inputs (Electrical Method)

Equipment needed:

- 0 to 500 ohm resistance box (0.01 ohm resolution) or RTD simulator.

For electrical calibration a resistance box or RTD simulator should take the place of the RTD shown connected in Figure 6.5

The procedure is similar to that for thermal calibration (Section 6.4.1). The resistance box should be set to equal the resistance of the RTD at the calibration temperature. It is recommended that the calibration temperatures chosen for this method are the full-scale values.



**Figure 6.5 : Connection of resistance box for RTD input calibration.**


	Calibration point 1	Calibration point 2
RTD low range (<200°C)	0°C (100 ohms)	200°C (175.84 ohms)
RTD high range (>200°C)	0°C (100 ohms)	850°C (390.26 ohms)

#### 6.5.4 Thermocouple Inputs (Electrical Method) and Linear Inputs

This procedure covers the 2mA, 20mA, 2V and 20V dc linear inputs and also the thermocouple inputs. The low and high thermocouple ranges are treated as 20mV and 80mV dc linear inputs without cold-junction compensation. All of the above are single point calibrations.

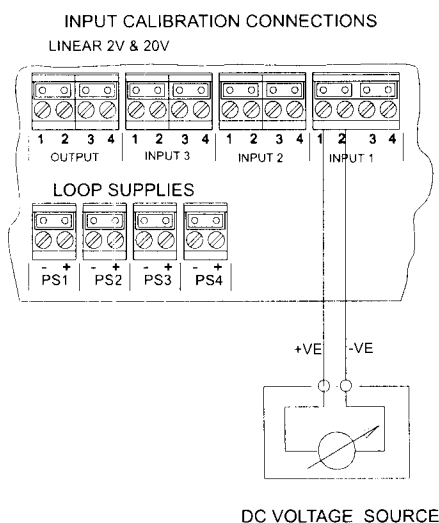
1. Connect a calibrated voltage or current source to the input terminals according to figure 6.6, 6.7 or 6.8 observing the correct polarity.

**Note:** Copper cables should be used to make connections to the thermocouple input. Thermocouple extension or compensating cables should not be used.

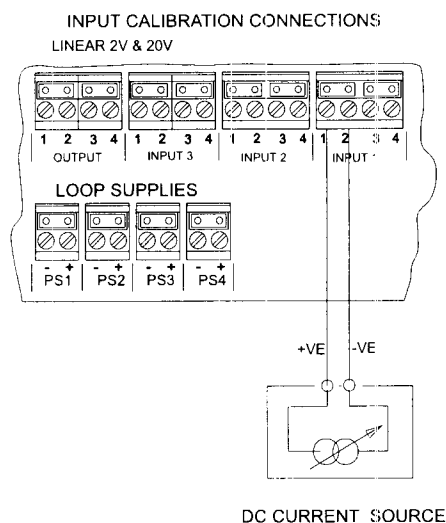
2. From the input calibration menu choose the input and range to calibrate. The example shows the 20mA current range.
3. Set the voltage or current source to the full-scale value of the input if possible, a level of at least half of the full-scale is recommended but not essential although accuracy might be affected. Enter the value using the recorder's keypad, allow several seconds for the input to stabilise then press  to begin the calibration measurement sequence.
4. The calibration factors are checked and if found to be within limits, accepted, and the recorder will begin measurements to check the calibration. Otherwise an error message will be given - see Section 6.5.1.

**20mA dc CHECK**  
**Cal pt. 1 +20.000 mA**

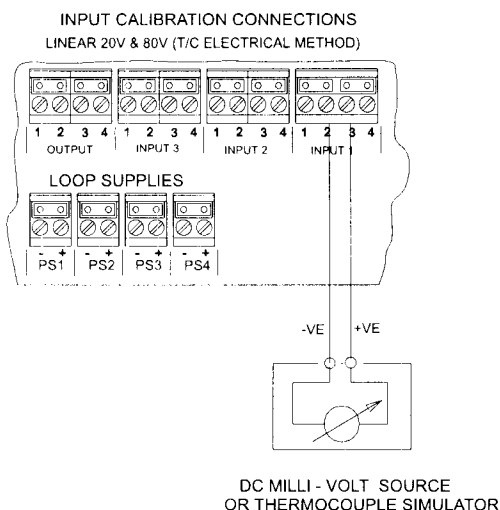
**20mA dc CHECK**  
**+20.000 mA**



**Figure 6.6 : Input calibration connections  
Linear 2V & 20V**



**Figure 6.7 : Input calibration connections  
Linear 2mA & 20mA**







**Figure 6.8 : Input calibration connections  
20mV & 80mV (T/C electrical method)**

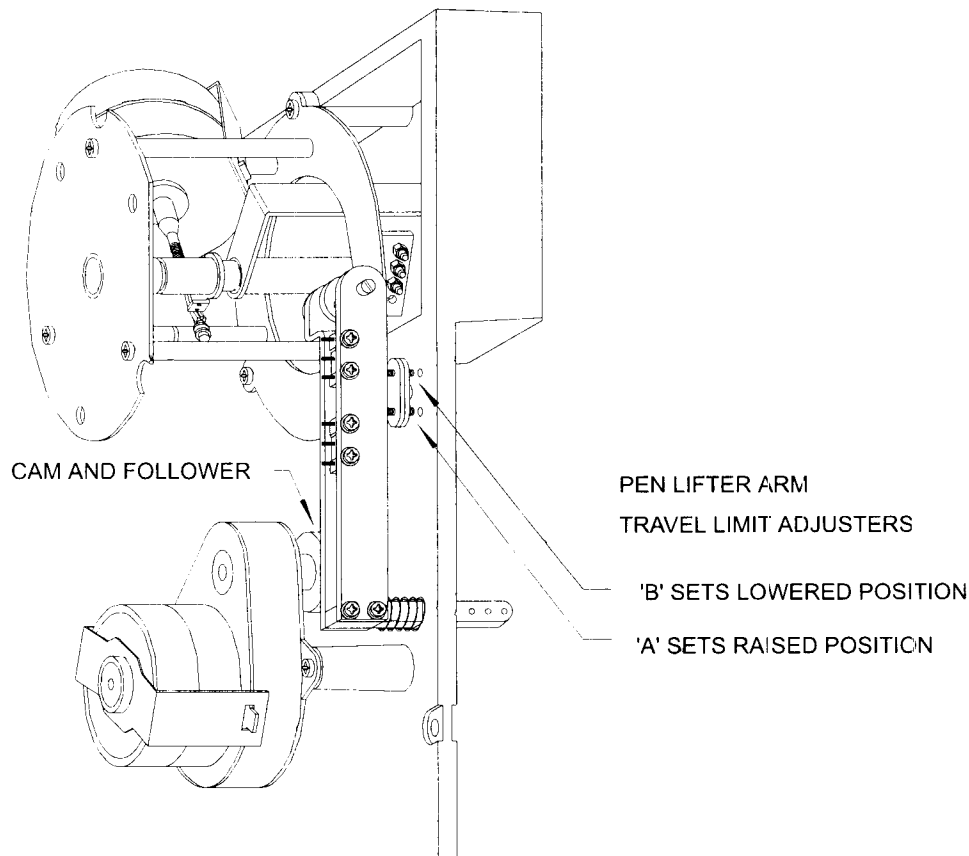
Input and Range	J1 position	J2 position
2 mA	3 - right	*
20 mA	1 - left	*
2V	2 - middle	*
20V	2 - middle	*
20mV (T/C) low	*	2 - middle
80mV (T/C) low	*	2 - middle

**Table 6.1 : Position of jumpers J1 & J2**

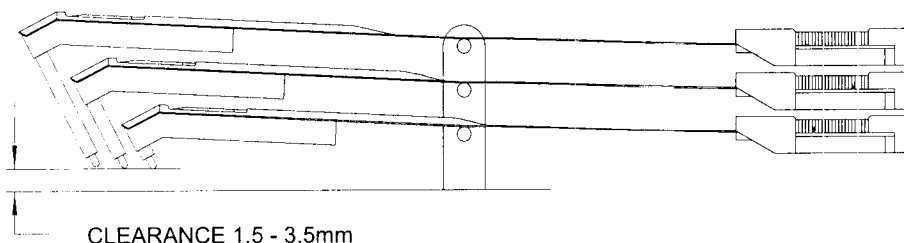
## 6.6 Pen Lifter Adjustment

The raised and lowered positions of the pen lifter are independently adjustable. These adjustments should be made when the CT6100 is in its normal recording mode of operation, the procedure is as follows:-

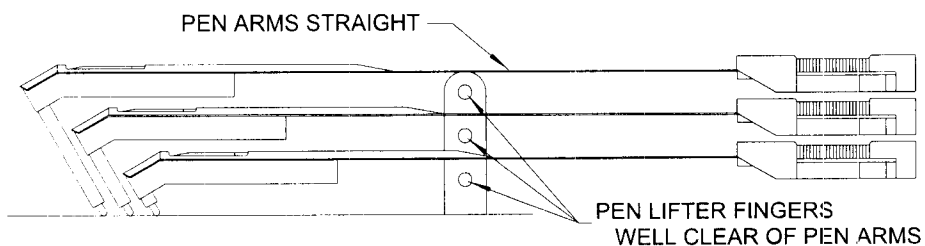
1. Firstly ensure that the pen arms are correctly formed as shown in figure 4.2 (refer to section 4.15). Check also that the ink capsules are properly seated in the slots of the pen arms and that the pen arms are pushed fully onto the radial arms of the pen positioning mechanism (refer to section 5.9).
2. Open the door of the recorder, release the chart plate retaining screw swing the hinged chart plate out as far as it will go. The pen mechanism adjustment screws, including those to adjust the pen lifter travel, will be revealed as shown in figure 6.9.
3. Press the  (raise pens) key on the front panel. The pen lifter will raise the pens away from the chart paper.
4. Two holes are provided in the chart plate to allow access to the hexagonal socket heads of the self-locking adjuster screws. The adjuster screw which sets the height of the pens in the raised position is identified as 'A' in figure 6.9. Using a 1.5mm A/F Allen key turn adjuster screw 'A' until the nibs of the pens are 1.5 to 3.5mm above the chart paper. After each movement of the screw it may be necessary to lower and raise the pens by pressing the  key followed by the  key in order to register the new pen raised position. The adjuster should be turned clockwise (i.e. screwed in) to reduce the height above the paper or counter-clockwise to increase the height.
5. Press the  on the front panel to lower the pens onto the chart. When the pens are lowered the correct position of the pen lifter 'fingers' should be as shown in figure 6.10. If the position is incorrect turn the adjuster screw 'B' until there is clearance of approximately 1.5 to 2.5mm between fingers of the pen lifter and the pen arm above.
6. The pen lifter cam follower should move over the central part of the cam and should not lie too close to the top or bottom of the cam when raised or lowered, as shown in figure 6.11. If the follower is too near to the top or bottom of the cam then the cam should be repositioned on the shaft of the pen lifter motor. To do this loosen the grub screw in the cam using a 1.5mm A/F Allen key, slide the cam along the motor shaft and retighten the grub screw. Check the operation of the pen lifter and adjust if necessary following steps 2, 3 and 4 detailed above.



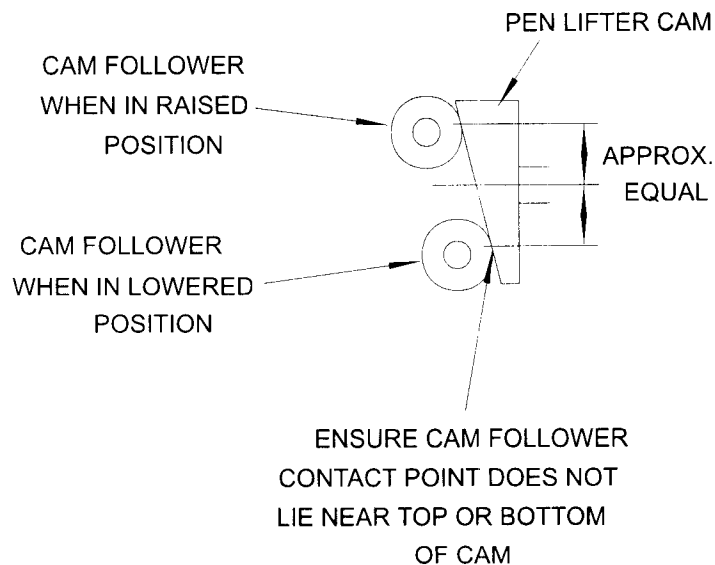
**PEN LIFTER RAISED - PENS CLEAR OF CHART**



**PEN LIFTER LOWERED - PENS TOUCHING CHART**



**Figure 6.10 : Correct pen lifter positions when raised and lowered**



**Figure 6.11 : Correct positions of the cam follower on the cam when raised and lowered**



## CHAPTER 7

### TROUBLESHOOTING GUIDE

This chapter provides information dealing with chart recorder faults which can be rectified by the user without the need for a service engineer. In the case of a fault not identified in the table, or a general enquiry, please contact Omega Engineering.

#### 7.1 Check points

PROBLEM	POSSIBLE CAUSE	REMEDY (SECTION)
Faint trace.	1. Pen pressure too low. 2. Ink capsule running out.	Bend pen arm correctly (4.2). Replace (5.9).
No trace.	1. Ink capsule empty. 2. Pen not touching chart.	Replace (5.9). 1. Check pen arm is positioned correctly in lifter comb (4.1 & 5.9). 2. Check that pen arm is bent correctly (4.15).
Chart not rotating.	1. Chart not clamped correctly.	Check that the pips on the chart boss pierce the chart and that the clamp lever is fully depressed (5.8).
Pens strike one another.	1. Pen arm(s) incorrectly 2. Pen arm(s) incorrectly fitted. 3. Pen arm(s) bent incorrectly.	Re-fit pen arm(s) in correct position in lifter comb. position (4.15 & 5.9). Re-fit pen arm(s) correctly (4.15 & 5.9). Bend pen arm(s) correctly (4.15).
Pens not lifting clear of chart.	1. Pen arm(s) incorrectly 2. Pen arm(s) bent incorrectly.	Re-fit pen arm(s) in correct position in lifter comb. position (4.15 & 5.9). Bend pen arm(s) correctly (4.15).
Loss of power.	1. Blown fuse.	1. Check voltage selector switch (3.3.2). 2. Check fuse (3.3.2).
Over/Under range indication.	1. Setup incorrect i.e. wrong sensor type selected. 2. Voltage/current range jumpers incorrectly set. 3. Broken sensor. 4. Sensor temperature beyond setup limit.	Correct setup (4.6). Set correctly (3.4.4 to 3.4.12 & 3.6). Replace. Change setup to widen range if appropriate (4.6).
Relay chatter.	1. Hysteresis too low.	Increase if appropriate (4.8).
Pens lift and move to centre of chart repeatedly.	1. Fault in pen position feedback system. 2. Pen travel calibration changed.	Look for mechanical damage. If present switch off pen feedback as temporary measure (4.5). Re-calibrate travel (4.6 & 6.4).
Recorder will not enter Setup or Calibrate mode	1. Jumper J5 not fitted.	Fit jumper J5 to (4.4, 6.3, see Fig 2.4)

## 7.2 Error Messages

Message	Operating Mode	Explanation	Corrective Action
ERR 1 : Self Test	Power-up	The self-test routines which check the recorder's hardware have detected a fault.	Refer to Service Engineer
ERR 2 : Position	Record	One or more of the pens is incorrectly positioned on the chart, the recorder cannot self-correct the error.	Check pen calibration or refer to Service Engineer
ERR 3 : Cal fault	Calibrate	During the input calibration routine the constants calculated by recorder were found to be outside the range of values expected. This could indicate a fault on the recorder or an error in the calibration procedure.	Check electrical connections between recorder and the calibration equipment (correct polarity is important). Check that the input reference levels are correct. Repeat calibration procedure, refer to Service Engineer if fault remains.
ERR 4 : Over range	Setup	Value entered is above measurement range for selected input	Re-enter correct value.
ERR 5 : Under range	Setup	Value entered is below measurement range for selected input	Re-enter correct value.
ERR 6 : Wrong code	Record	Incorrect security access code entered. Access denied.	Re-enter correct code.
ERR 7 : Span too low	Setup	The values entered for pen high (top of chart) is too close to pen low (bottom of chart). The difference between the two must be at least 5°C	Re-enter values.

## CHAPTER 8

### QUICK-FIND INDEX

How Do I . . . ?	See section
Add option cards	3.6
Adjust the relay setpoints	5.5
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Connect the recorder to the power supply	3.3
Connect input sensors	3.4
Change the chart scale	4.6
Change the chart speed	4.7
Change the chart paper	5.8
Change the pen capsules	5.9
Enter the Calibrate mode	6.3
Enter the Setup mode	4.4
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Panel mount the recorder	3.2.2
Raise the pens	5.6
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Set the correct chart time	5.7
Set the security level	4.11
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Wall mount the recorder	3.2.1

## CHAPTER 9

### SPARES PARTS LIST

	Item Description	Part Number
Consumables	Red pen capsule (packet of 3)	CT6100-RED
	Green pen capsule (packet of 3)	CT6100-GREEN
	Blue pen capsule (packet of 3)	CT6100-BLUE
	Charts (packet of 100)	Refer to number on chart or contact Omega Engineering
PCB Assemblies	Main processor PCB (non-isolated input)	CR0017-E
	Interface boards : Early single pen	CRA001-E
	2 or 3 pen, flow & later single pen	CR0010-E
	Keypad/LED board	CR0011-E
	Relay boards : 3 relays : electromagnetic type	CR0018-E
	6 relays : electromagnetic type	CR0019-E
	3 relays : solid-state type	CR0041-E
	6 relays : solid-state type	CR0039-E
	LCD display, 2 x 20 dot matrix.	CR0016-E
	Input card (T/C RTD & linear) - without Tx PSU	CR0020-E
	Event pen card, 2 input, 50 - 250V AC	CR0027-E
	Event pen card, 2 input, 5 - 24V DC	CR0031-E
	Analogue retransmission card - current output	CR0028-E
Power Supplies	Mains transformer assembly	CR0012-E
	Transmitter power supply module	70079
Pen Mechanism	Single-pen positioning mechanism (complete)	CR0013-F
	Two-pen positioning mechanism (complete)	CR0014-F
	Three-pen positioning mechanism (complete)	CR0015-F
	Pen arm assembly number 1 (red)	CR0031-F
	Pen arm assembly number 2 (green)	CR0032-F
	Pen arm assembly number 3 (blue)	CR0033-F
	Pen 1 stepper motor (excl. worm)	CR0004-E
	Pen 2 or 3 stepper motor (excl. worm)	CR0005-E
	Worm assembly	CR0029-F
	Bias spring	CR0056-C
	Microswitch assembly (1 pen)	CR0030-E
	Microswitch assembly (2 pen)	CR0035-F
	Microswitch assembly (3 pen)	CR0036-F
	Feedback potentiometer disc assembly (1 pen)	CR0022-E
	Feedback potentiometer disc assembly (2 pen)	CR0024-E
	Feedback potentiometer disc assembly (3 pen)	CR0025-E
	Feedback potentiometer wiper assembly	CR0023-E
	Pen lifter spine / comb assembly (1 pen)	CR0025-F
	Pen lifter spine / comb assembly (2 pen)	CR0009-F
	Pen lifter spine / comb assembly (3 pen)	CR0008-F
	Pen lifter stepper motor and gearbox	CR0008-E
Chart Drive	Chart drive stepper motor and gearbox	CR0007-E
	Chart clamp	CR0007-F
Miscellaneous	Acrylic door window	CR0015-C
	Door label	CR0072-C
	Display / keypad overlay	CR0078-C
	Door lock	24834-11
	Cable gland	16381-11

## CHAPTER 10

### STANDARD SPECIFICATION

#### INPUTS

Number:	1, 2 or 3.
Input signals:	Thermocouples K, T, J, N, E, B, R & S
(Standard)	Platinum RTD (Pt100) 3-wire
	DC voltage $\pm 2V$ , $\pm 20V$
	DC current $\pm 2mA$ , $\pm 20mA$
Temp. ranges:	Thermocouples to BS4937 (type B minimum temp 200°C) RTD to BS1904:1984 High and low measurement ranges for each input
Cold-junction comp.	Automatic, using Pt1000 temperature detector and software correction
Linearisation:	Automatic software linearisation to BS4937 (thermocouples) and BS1904: 1984 (RTD)
Input resistance:	T/C: 10 Mohms $\pm 2mA$ : 200 ohms $\pm 20mA$ : 20 ohms $\pm 2V$ , $\pm 20V$ : >1 Mohms
Minimum span:	5°C (Thermocouples K,J,T,E,N & RTD)
T/C burn-out:	Pull-up or pull-down, link selectable
RTD current:	1mA approximately
RTD lead resistance:	3-lead connection, compensated up to 10 ohms maximum per lead
Input protection:	$\pm 50Vdc$ on signal inputs
Input isolation:	Optoelectronic on 2 and 3 input versions 500Vrms channel-to-channel, 500Vrms channel-to-earth
Transmitter PSU:	Optional extra. Isolated output, voltage 12/24V link selectable

#### PERFORMANCE

Accuracy:	RTD: Low range (<200°C) $\pm 0.2^\circ C$ , high range (>200°C) $\pm 0.8^\circ C$
(Ambient 20°C)	T/C: $\pm 0.25\%$ FS
	Linear: $\pm 0.2\%$ FS
Temp. stability:	$\pm 0.02\%$ FS/ $^\circ C$
CJ comp. stability:	$\pm 0.02^\circ C/^\circ C$
Linearisation	T/C: Types J, K, T, N, E $\pm 0.1^\circ C$ -50/200°C, $\pm 1^\circ C$ max
accuracy:	Types R & S $\pm 0.2^\circ C$ -50/200°C, $\pm 1^\circ C$ max, type B $\pm 1^\circ C$ max.
	RTD: Pt100 Better than $\pm 0.1^\circ C$ -200/850°C
Calibration shift:	$\pm 9.9^\circ C$ user programmable to eliminate sensor errors (T/C & RTD)
A-to-D converter:	Integrating, 16-bit resolution with 50/60Hz noise rejection
Conversion rate:	2 per second
Noise rejection:	>120dB common-mode, 60dB normal-mode 50/60Hz

#### CHART & DISPLAY

Chart size:	244mm (9.6") circular paper chart
Chart divisions:	40, 50, 60, 70 or 80 linear divisions
Chart drive:	DC stepper motor
Chart speeds:	Software selectable. 1 to 24 hours in steps of one hour, 2 to 31 days in steps of 1 day
Writing method:	Disposable ink cartridges. Pen 1 Red Pen 2 Green Pen 3 Blue
Pen positioner:	DC stepper motor with feedback
Positioning resolution:	Better than 0.1% of full-scale
Pen response time:	Zero to full-scale in 4.5 seconds
Pen lift:	Motorised, activated from front panel. Chart fast time advance possible with pens raised.
Display type:	2 line x 20 character dot matrix liquid crystal with backlight and automatic temperature compensation. Character height 9.6mm.

## CT6100 Chart Recorder

### User Manual

#### Page 10.2

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Display resolution: Temperature ranges 0.1°C, linear ranges software programmable  
Alarm display: Relay status shown by red and green front panel LEDs

#### RELAYS

Number: 3 on single pen, 6 on two and three-pen versions.

Relay actions: Software selectable from:-

High alarm

Low alarm

Deviation alarm

Control relay (high)

Control relay (low)

Electromagnetic type relays de-energise in alarm state.

Solid-state type relays energise in alarm state provided that power is available to the CT6100.

Assignment: Relays freely assignable to any channel

Hysteresis level: User programmable 0.0% to 10% of span

Ratings:	Electromagnetic type	Solid-state type
Relay contacts:	SPCO silver alloy	Triac
Switched load:	150W dc, 1660VA ac non-inductive	125V ac only
Switched current:	6A max	0.5A max
Switched voltage:	30Vdc, 250Vac	250Vac
On-state voltage	N/A	1.7V max
Snubber network	22nF & 100 ohms across each contact	22nF & 4700 ohms

#### GENERAL

Security: 3-level software lock including password protection, internal hardware jumper lock, lockable door

Power supply: 115Vac or 230Vac  $\pm 10\%$ , switch selectable, 50/60Hz.

Power requirements: <25W

Fuse: 250mA type T, size 20mm x 5mm

Operating temp: 0 to 55°C

Operating humidity: 0 to 90% RH (noncondensing)

Case: Glass-filled polyester resin with acrylic door window

Protection: IP55

Mounting: Panel or surface

Weight: 7kg (single pen) 7.7kg (three pen)

Dimensions (overall): 336 x 396 x 120 (w x h x d)

Panel cutout: 288 x 356 (w x h)

#### OPTIONS

##### Retransmission

Output current: 0 to 20mA or 4 to 20mA.

Resolution: 12 bits (0.024%)

Output compliance: 20V approx.

Isolation: Optoelectronic

Assignment: Card assignable to any channel

Retransmission range software selectable anywhere within chart range

Action: Direct or reverse.

##### Event Pen

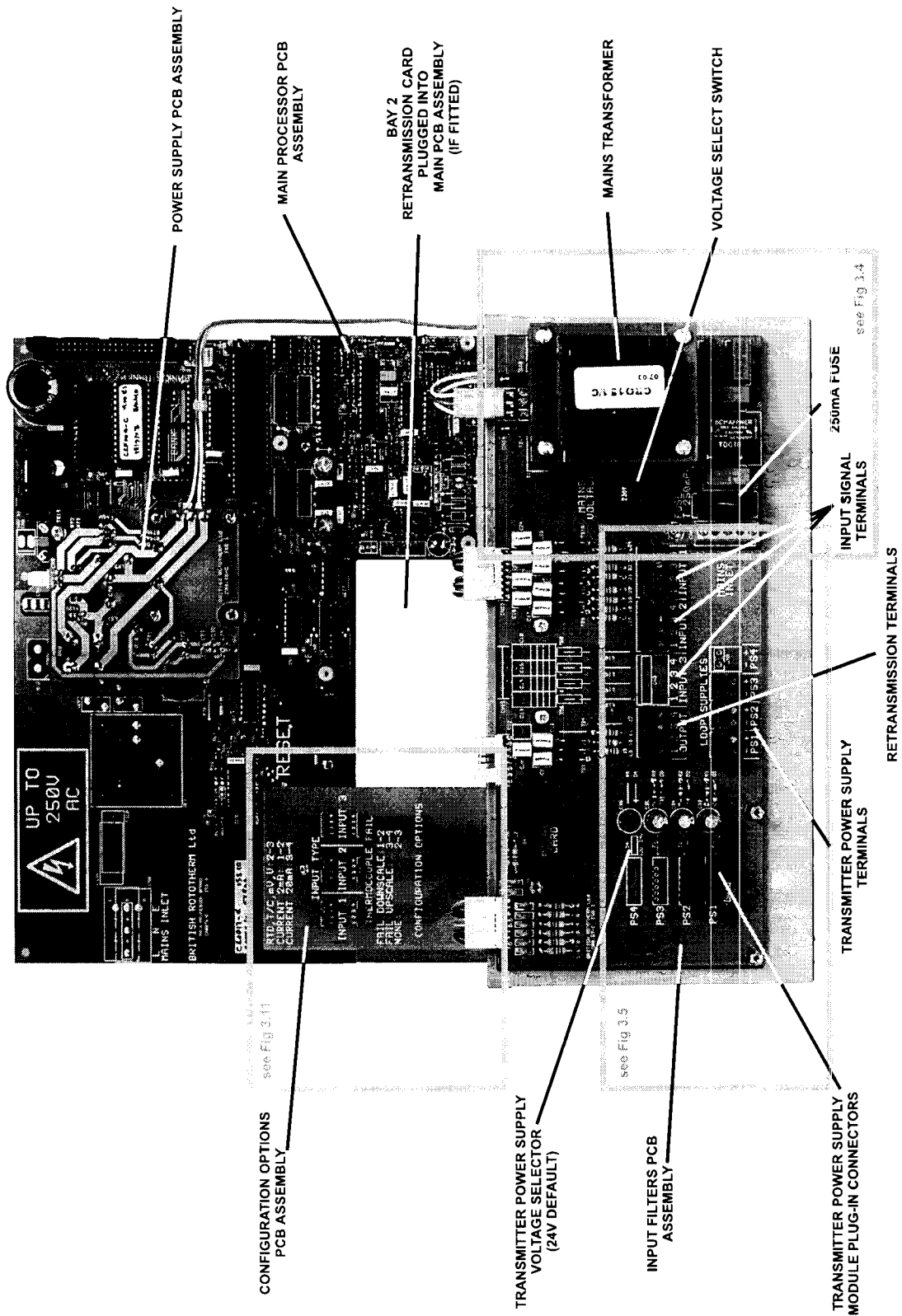
Number of inputs: Two

Pen positions: Four, 0, 33, 66, 100% of pen sweep

Sweep: Position on chart user configured, forward or reverse.

Input voltage: 48 - 250Vac (card CR0027-E)

5 - 24Vdc (card CR0031-E)



## WARRANTY/DISCLAIMER

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

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

**OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.**

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

## RETURN REQUESTS/INQUIRIES

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

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

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

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

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

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

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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