4001

250mm Chart recorder

Maintenance Manual

invensys
EUROTHERM

Useful Part Numbers	
GD236721U080 ..... 80 division chart (35m)	CH050023 ... 2 Amp Line fuse (110V supply)
GD236721U100 .... 100 division chart (35m)	CS236673 ... 1 Amp Line fuse (240V supply)
GD236721U120 .... 120 division chart (35m)	CS237285 ..... 5A protection fuse
GD236721U140 .... 140 division chart (35m)	PA239247 ..... Clock support battery (Mk1*)
GD236721U150 .... 150 division chart (35m)	PA234093 ..... RAM support battery (Mk1*)
LA232380 ..... Ink ribbon cartridge	PA235482 ..... Support battery (Mk2*)

* Notes:

1 Mk1 refers to the Mark 1 version of the control board.

2 Mk2 refers to the Mark 2 version of the control board.

3 Two off PA235482 required for Mark 2 control board

Model 4001

Maintenance Manual

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1 INTRODUCTION

This manual is intended for use by maintenance personnel when servicing and maintaining the 4001 recorder. It is assumed that those using this manual are familiar with the Installation and Operation Manual supplied with the recorder.

The manual is divided into a number of sections, as follows:

1. Introduction. This gives a brief introduction to the manual and to the recorder.
2. Principles of operation. This section describes how input data is accessed and processed, and how the control board operates on the resulting signal to provide traces on the chart, alarm outputs etc. Also described are communications between the control board and the display and keyboards.
3. Preventive maintenance. This section contains details of the periodic checks which may be made in order to ensure trouble-free operation. Included in this section is a procedure for checking the calibration of input boards.
4. Fault diagnosis. Section 4 is a basic fault-finding guide, intended to be used in locating faulty any area of the recorder.
5. Corrective Maintenance. Section 5 provides disassembly, re-assembly and replacement procedures for the mechanical assemblies which make up the recorder.
6. Electronic Subsystems. This section contains circuit board schematics and layouts for the printed circuit boards used in the 4001 recorder.
7. Spare Parts. This gives a list of those spare parts which are available for the 4001 recorder.
8. Parts lists. A complete list of parts for the recorder.

Note: As the recorder has been obsolete for some years, most spare parts are no longer available.

1.1 MECHANICAL DESCRIPTION

Mechanically, the recorder is in two parts:

1. Writing and display systems
2. Case and card cage

1.1.1 Writing and display systems

Figures 1.1.1 a, b and c show the major functional elements of the writing system.

The writing system mechanical assembly is located on guide rails secured to the inner sides of the case. With the case door open, the writing system may be pulled forwards on the rails, until it is arrested by safety stops. To change chart or ribbon cartridge, or to gain access to certain of the mechanical sub-assemblies, the top part of the writing system may be opened upwards, about a horizontal hinge system. To gain access to the major electronics sub-systems, the writing system may be swung open on a vertical hinge.

The writing system contains two stepper motors, one to drive the chart; the other to drive the print head and ribbon cartridge assemblies. Under normal recording conditions, chart speed is as defined by the customer configuration, entered via the display/keyboard (see Installation and Operation manual). Fast forward and rewind facilities are also available, and are controlled via the Chart Control panel located to the bottom right of the chart. In order to carry out a fast forward or rewind operation, the print function has first to be disabled by the use of an On/Off line key, also located on the chart control panel.

Full operating procedures are given in the Installation and Operation manual supplied with the recorder.

1.1.1 WRITING AND DISPLAY SYSTEMS (Cont.)

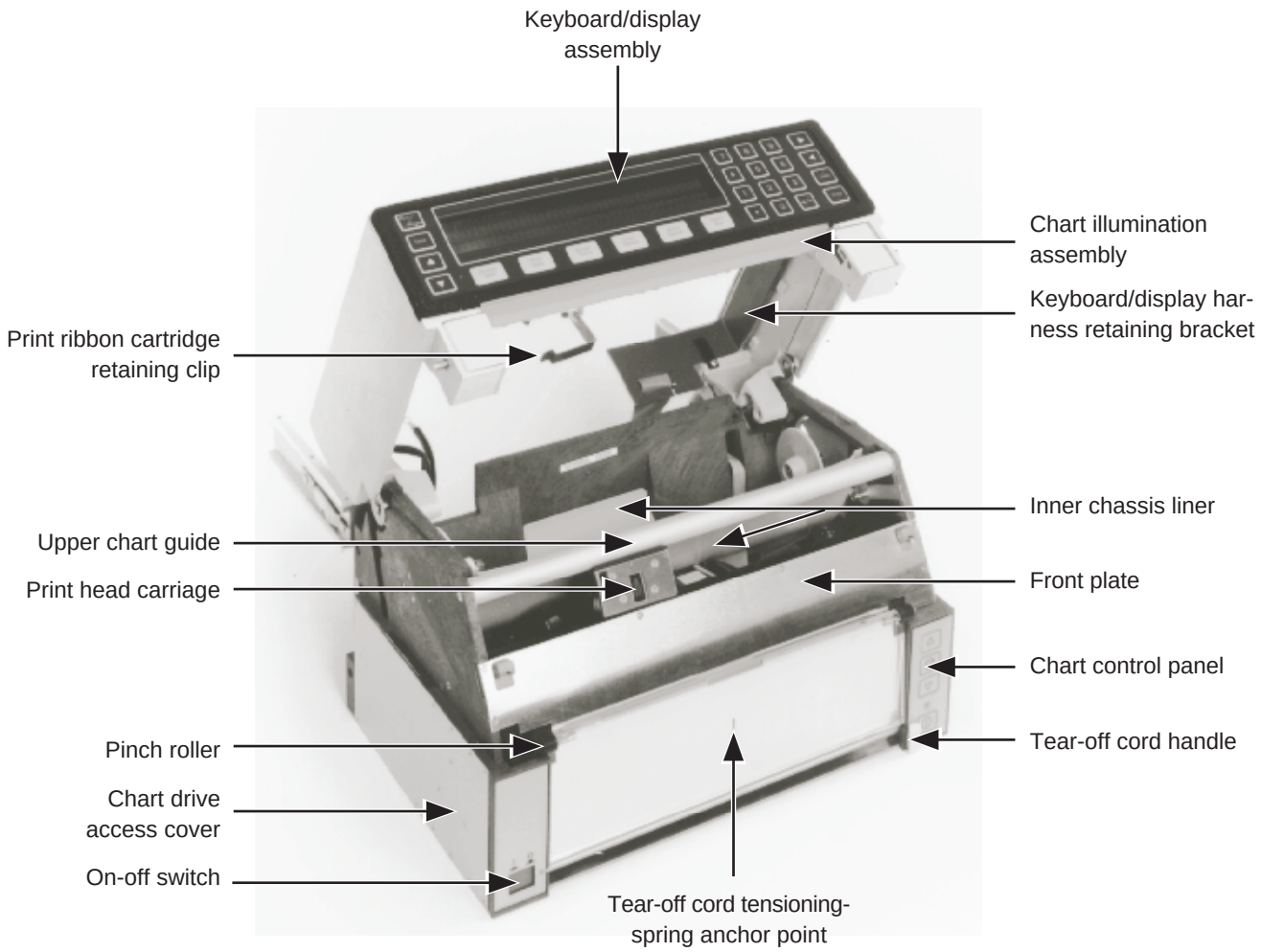


Figure 1.1.1a Writing system front view

1.1.1 WRITING AND DISPLAY SYSTEMS (Cont.)

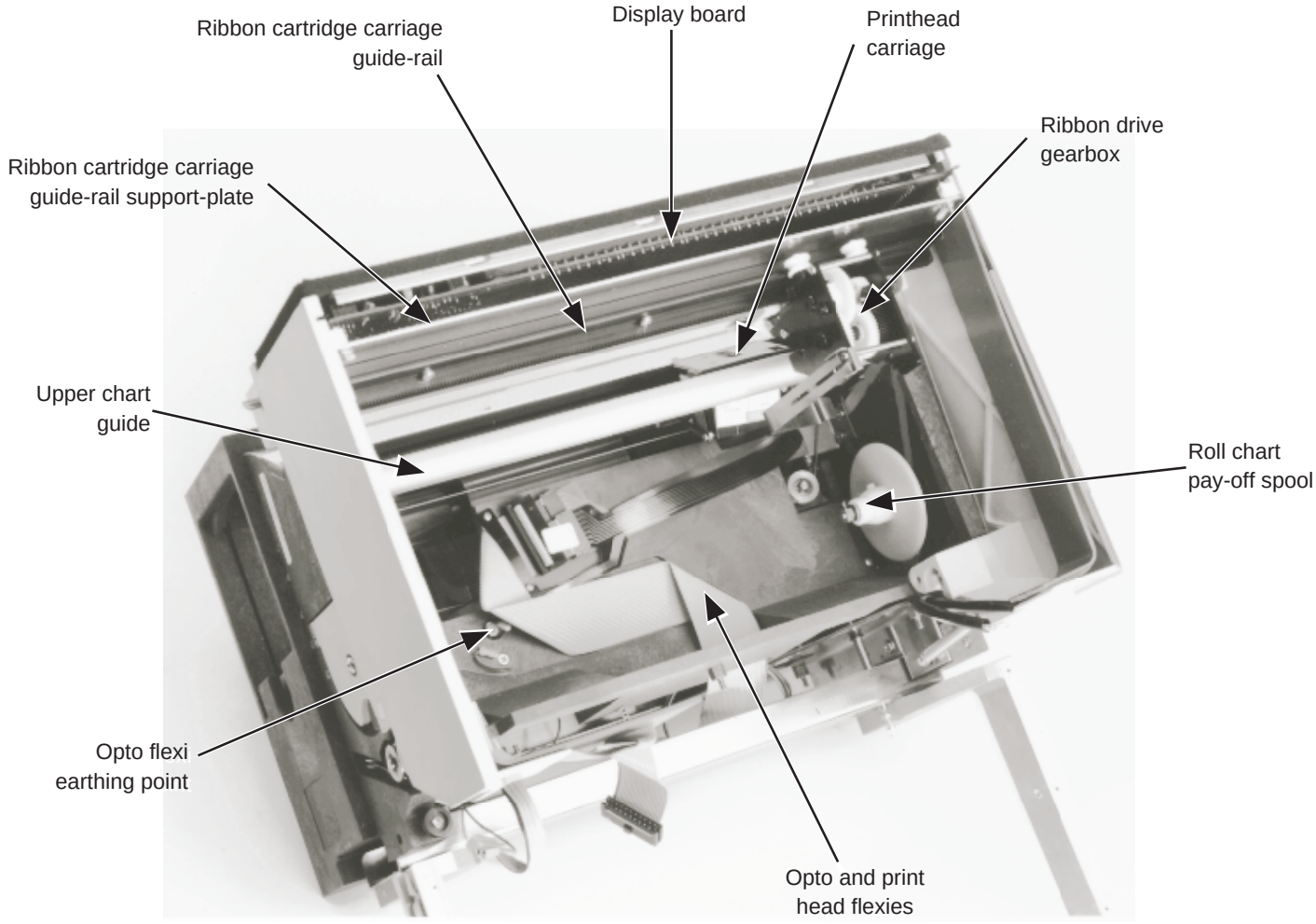


Figure 1.1.1b Writing system top view

1.1.1 WRITING AND DISPLAY SYSTEMS (Cont.)

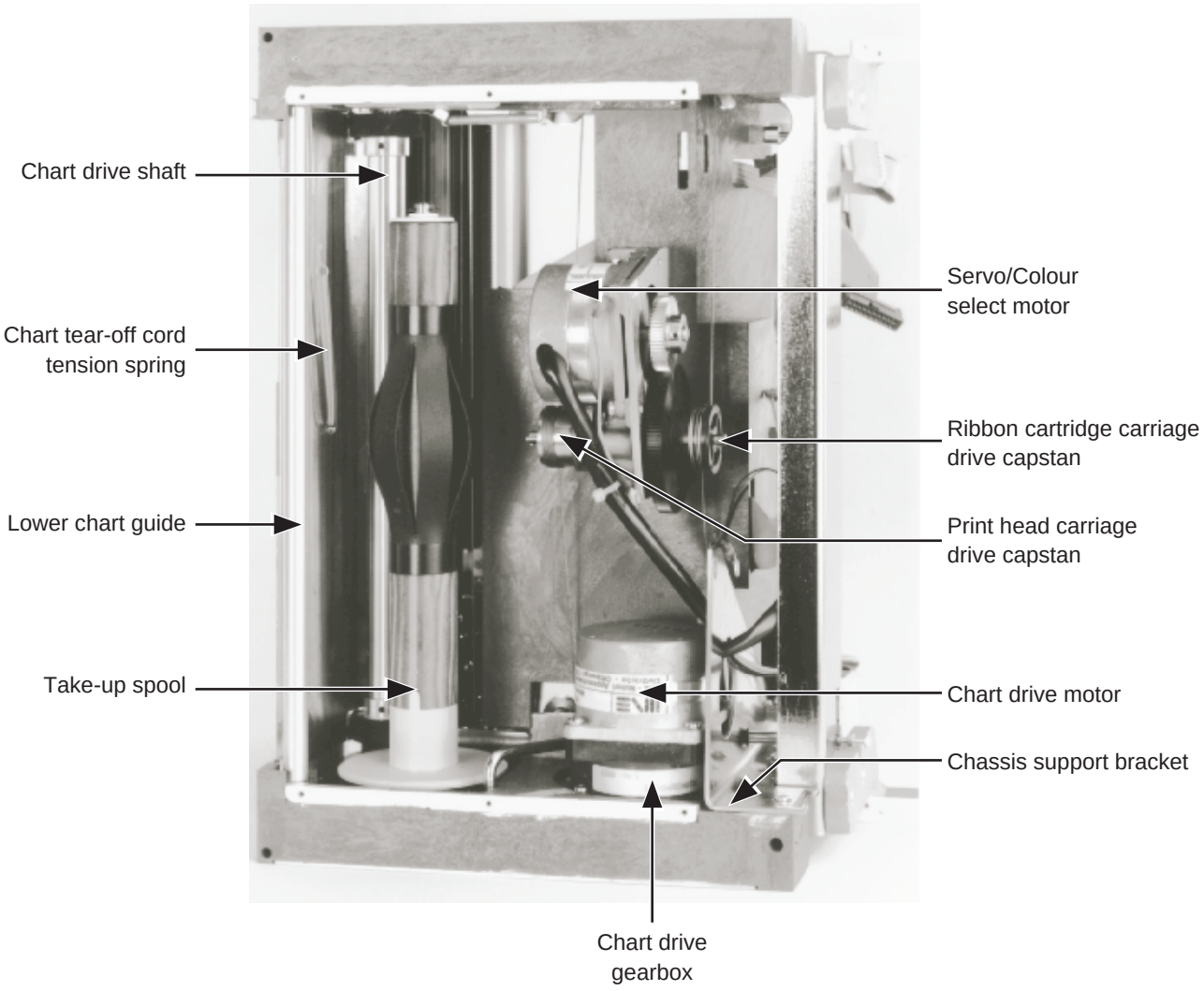


Figure 1.1.1c Writing system view on underside

1.1.1 WRITING AND DISPLAY SYSTEMS (Cont.)

TRACE PRODUCTION

Traces are produced on the chart by a nine-needle print head (carried on a guide rail behind the chart) in conjunction with a six-colour continuous ribbon held in a cartridge. This cartridge is clipped to a carriage carried on a second guide rail, above the chart.

The print head carries nine needles arranged in a vertical line. The number of needles used depends on chart speed. At high chart speeds all nine needles are used, with the position for each of the nine dots being calculated separately. The number of needles used at any particular chart speed is detailed in the Installation and Operation manual, supplied with the recorder.

The ribbon is advanced by means of a mechanical gearbox, driven by a rack associated with the ribbon cartridge carriage guide rail. Each of the 30 input channels is allocated one of the six colours, as shown in table 1.1.1. The colour-select system prints all the traces for colour 1 first, followed by those for colour 2 and so on. (The colour sequence is that of the ribbon viz: red, orange, green, violet, blue, black.)

When an instruction to print a dot is received, the correct colour for the dot is selected by moving the ribbon cartridge relative to the print head. The print head and cartridge carriages are now moved to the correct position for the dot, and the relevant needle is energised by means of an associated solenoid, The needle strikes the under side of the chart, such that the area of chart above the needle is forced into contact with the ribbon, producing a coloured dot.

The correct position for the dot is determined by optical means, using the edge of the chart as a datum, and a feedback grating strip, located on the rear of the print head carriage guide rail, to determine the precise position of the print head.

Chan-nel	Colour	Chan-nel	Colour	Chan-nel	Colour
1	Red	11	Blue	21	Green
2	Orange	12	Black	22	Violet
3	Green	13	Red	23	Blue
4	Violet	14	Orange	24	Black
5	Blue	15	Green	25	red
6	Black	16	Violet	26	Orange
7	Red	17	Blue	27	Green
8	Orange	18	Black	28	Violet
9	Green	19	Red	29	Blue
10	Violet	20	Orange	30	Black

Table 1.1.1 Channel colour allocation

DISPLAY/KEYBOARD

This assembly consists of a sealed, membrane keyboard mounted on the writing system chassis above the chart. The eighty-character vacuum fluorescent display unit is mounted on a printed circuit board (Display board AH232100), located behind the keyboard assembly.

The keyboard is used to enter or to alter the instrument's configuration. The display shows either the measured values of channels, or the 'pages' used during configuration (see the Installation and Operation manual).

CHART ILLUMINATION

Chart illumination is by means of a chart illumination assembly containing a number of low-voltage lamps. The assembly is located below the display/keyboard, and is accessed by removing the keyboard.

1.1.2 Case and card cage

The recorder case houses the writing and display systems, and a printed-circuit card-cage. The card cage holds the Power Supply Unit (PSU) and the input/output (I/O) circuit boards. Signal Interface Modules (SIMs), which allow the connection of customer equipments to be made to the recorder, are clipped to the rear of the card cage.

The PSU and I/O boards are all plugged into a backplane (mother board) by means of which the control board communicates with the I/O boards. A second connector on each I/O board mates with a matching connector mounted on an associated SIM, accessible by removing the rear (terminal) cover of the instrument. SIMs associated with DC input boards also contain a temperature sensor which is used to provide cold junction compensation (CJC).

1.2 ELECTRONICS DESCRIPTION

Figure 1.2 is an overall block diagram of the recorder electronics systems.

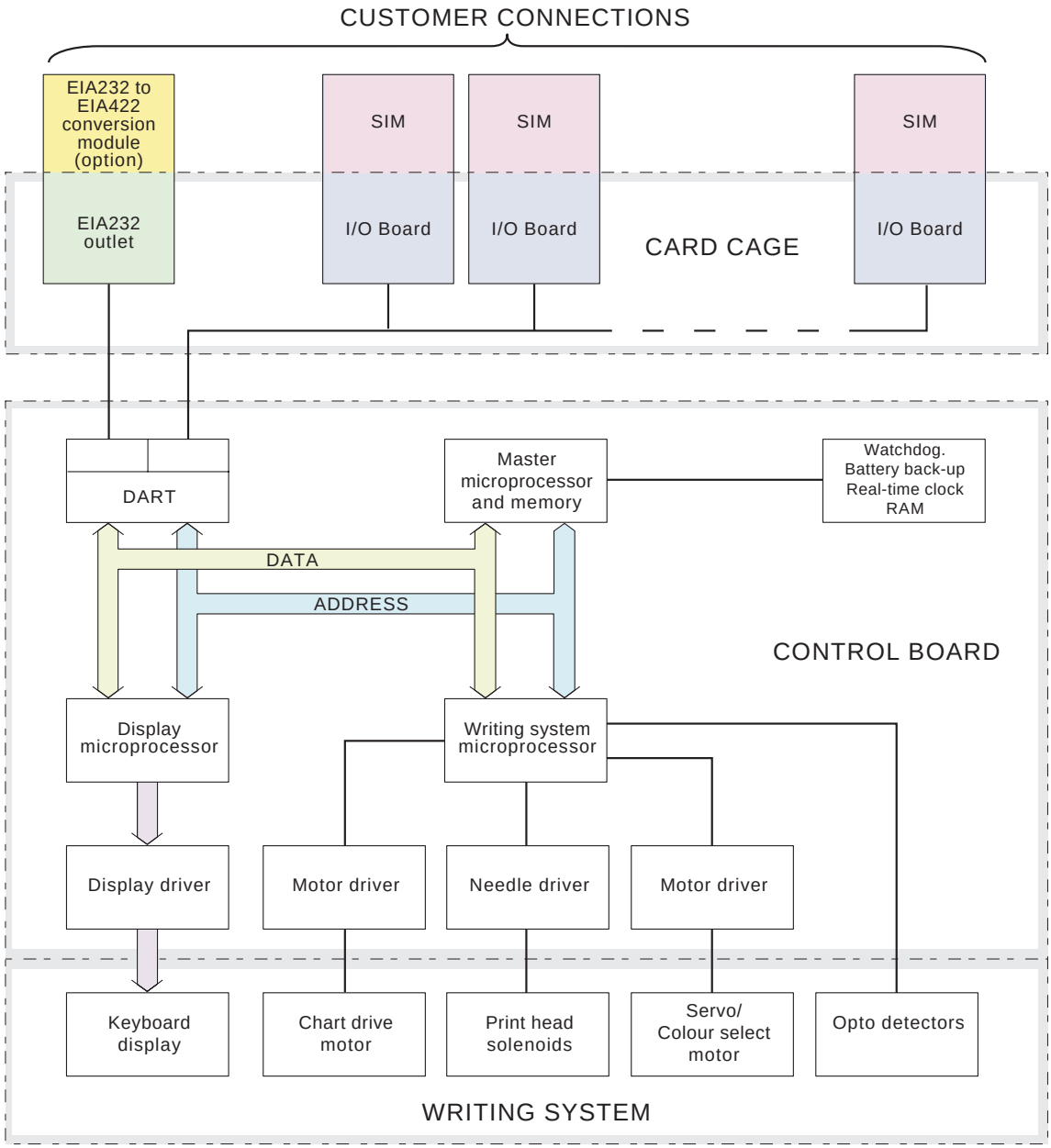


Figure 1.2 4001 Block diagram

1.2 ELECTRONICS DESCRIPTION (Cont.)

The recorder receives voltage or current signals from external transducers (thermocouples, resistance thermometers, pressure transducers etc.) and scales and linearises them, as programmed via the keyboard. After processing, the resulting data is used to produce traces on the chart, to display the measured value ant to generate alarm signals as required.

The recorder carries out a self-checking routine and produces error and/or warning messages if, for example, the chart is missing or if there is a fault in the drive mechanism for he print head etc.

The electronics sub-systems are located in three areas of the recorder:
a. The control board
b. The Display/keyboard assembly
c. The card cage

1.2.1 Control board

The control board contains three microprocessors and associated circuitry to control the operation of the recorder. The microprocessors are arranged as a master and two slaves. The master microprocessor controls the slave microprocessors and is also responsible for communicating with the I/O boards and for supporting external communications, if the EIA232/EIA422 serial data link is installed.

One of the slave processors is used to control the writing system (chart drive, print head/ribbon cartridge, print needles etc.). The other slave is used to control the display and to poll the keyboards. (Reading the keyboards is done by the master processor - see section 2.3.3.

1.2.2 Display/keyboard

Writing to the display is performed using two data streams: anode data and grid data. Thee data is sent from the display slave microprocessor as a serial data stream to latch/driver ICs on the display board. The anode data consists of 72 bits, sufficient to drive one vertical pair of characters. The grid data consists of 40 bits, only one of which is ‘on’ at any one time.

Data from the display keyboard and the chart control panel is polled by the slave microprocessor, which pulls each of the polling lines high, in turn. This results in one of the data lines going high, should one of the keys happen to be pressed at that time. The data lines are read by the master microprocessor.

1.2.3 Card cage

The card cage is an integral part of the recorder case, and holds the PSU and the I/O boards with their associated Signal Interface Modules (SIMs). Each I/O board is fitted with two connectors - one of which connects with the mother boards; the other with the SIM.

SIGNAL INTERFACE MODULE (SIMS)

The SIM is the means by which (non-comms) signals enter and leave the recorder.

Input boards have six channels and the SIM provides the means of terminating customer pinouts from thermocouples, RTDs or other suitable transducer type.

Relay output boards provide the necessary drive signals to relays located in either of the two types of Relay Output SIM. One type of Relay Output SIM contains four high power relays; the other contains eight medium power relays.

1.2.3 CARD CAGE (Cont.)

INPUT BOARDS

The input boards accept up to six inputs via the relevant type of SIM. The channels are isolated from one another and from the remainder of the input board circuitry by means of independent transformer secondaries for each channel. The gain, scaling and linearisation applied to the input signals are determined by a slave processor on the input board, under the control of the control board master microprocessor.

For each channel, an analogue-to-digital converter (ADC) is used to produce a digital value for the input signal. This value is applied to a number of look-up tables to produce a scaled and linearised version of the input signal. This is output serially to the control board master microprocessor once a second.

RELAY OUTPUT BOARD

The relay output board contains a slave processor under the control of the control board master microprocessor. The outputs from this slave are passed via a latch to relay drivers, which drive the relays located in the SIM.

The relay coils are energised for power on and non alarm conditions. Thus, if power fails, the relays go into there alarm state.

The recorder allows a maximum of 60 alarm set-points to be allocated freely amongst the 30 possible input channels. In other words, the relay outputs can each be activated by any of the 60 set points.

Relay configuration is ‘Form C’.

POWER SUPPLY UNIT (PSU)

WARNING!

WITH LINE POWER APPLIED, LARGE AREAS OF THE CIRCUIT BOARD WITHIN THE PSU ARE AT A HIGH VOLTAGE. THIS PRESENTS A HAZARD TO THE USER IF THE CARD IS EXPOSED.

DC power for the recorder electronics is generated by a switched-mode PSU located in the card cage. This PSU supplies two voltage rails: 24 Volts and 5 Volts.

Power for the serial communications link is generated on the control board from the 24 Volt rail.

The power to drive the vacuum fluorescent display is generated on the display board.

Input channel power is generated on each input board from the 24 Volt rail.

2 PRINCIPLES OF OPERATION

The operation of the recorder is under the control of the control board located at the rear of the writing system. The control board contains three microprocessors set up as a master and two slaves. The software to run the recorder is held in a pair of Programmable, read Only Memories (PROMS). The customer entered configuration data (held in a battery-backed Random Access Memory (RAM)) provides the master processor with the information necessary to process the input signals as appropriate.

The input/output (I/O), external communications (if implemented) and the Real Time Clock (RTC) functions are all controlled directly by the master processor. The writing system is controlled by one of the slaves; the display and keyboard are under the control of the other.

The writing system slave outputs data which is used to energise the chart drive motor, the print head/ribbon carriage motor and to actuate the print head needles.

The display system slave is responsible for providing anode and grid data to the display, and for polling the display and chart-control keyboards.

Each I/O board is located in a slot in the card cage. Each slot has a unique address which is permanently set up on the mother board. Thus, providing that the correct board type for each slot is entered during the configuration of the recorder, any I/O board can be placed in any slot. It should be noted, however, that for proper operation of the recorder, slot one may not have an output board fitted.

2.1 DC INPUT BOARD

Figure 2.1 is a block diagram for the dc input board.

2.1.1 Data acquisition

The input signal (from a transducer) is filtered by a two-pole RC circuit before being routed to an analogue-to-digital converter (ADC) (IC2; IC4) via an attenuation/amplification select circuit (IC1, IC2, IC3). The gain or attenuation selected depends on the customer-entered configuration, and is passed to the input board microprocessor at initialisation, and whenever the configuration is edited.

The output of the ADC is a bit stream in which the proportion of logic 1s represents the amplitude of the input signal. The signal is compressed by counting the number of zeros in a given number of ADC clock pulses, the output of the counter then being transmitted serially across a Galvanic isolation barrier, consisting of an opto-isolator (IC5; IC6).

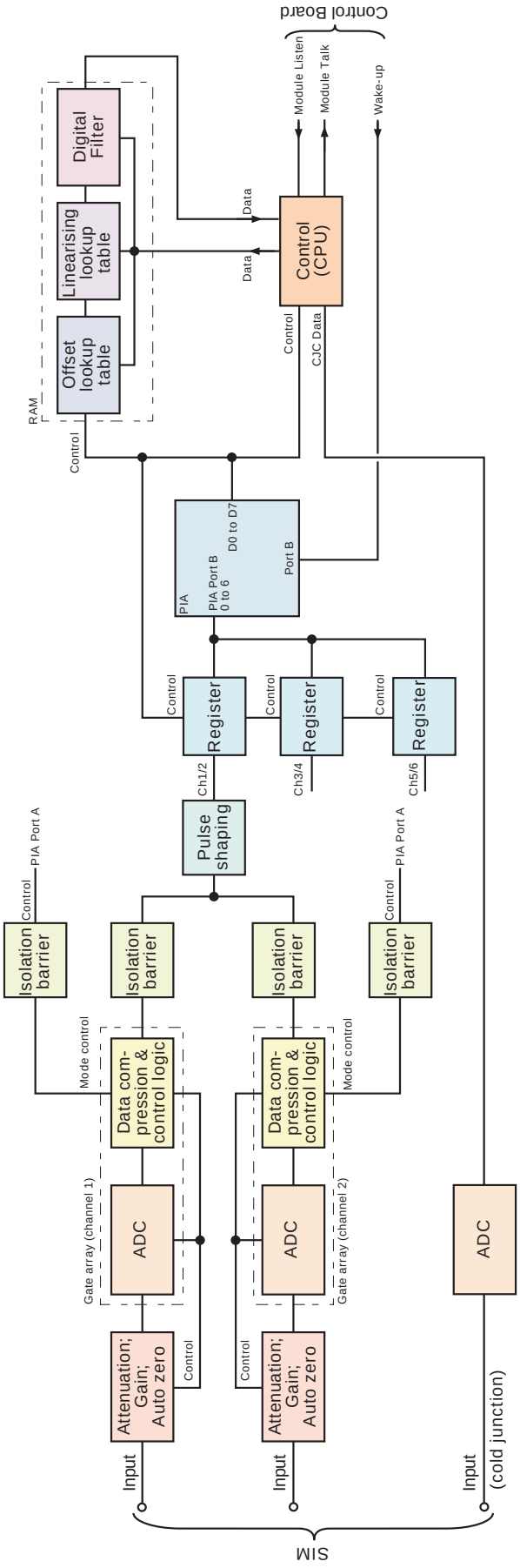
The ADC and data compression functions are implemented using a gate array (IC4) which additionally controls the communication of attenuation/gain information to the relevant channel elements.

The dc input board contains six identical channel circuits as described above.

The timing of the transmissions across the barrier is such that adjacent channels' data do not appear at the outputs of their opto-isolators at the same time. This allows the outputs of channels 1 and 2, of channels 3 and 4 and of channels 5 and 6 to be wired together in pairs. The three resulting data streams are reconstructed by voltage comparators (IC16) before being presented to three serial input registers (IC13, IC14 and IC15) - one for each pair of channels.

The data in the registers is read, one channel at a time, and presented to a number of look-up tables held in RAM. The tables apply offset, scale and linearisation to the data stream. The offset table contents are calculated from auto zero and cold junction compensation inputs.

2.1.1 DATA ACQUISITION (Cont.)



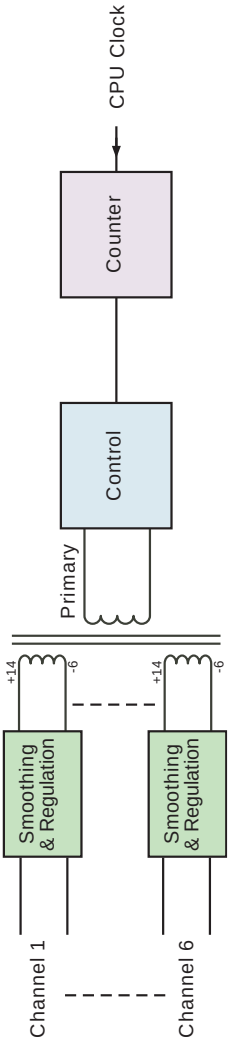


Figure 2.1 DC input board - block diagram

2.1.1 DATA ACQUISITION (Cont.)

The rate at which the input data is sampled in this way is once per millisecond for each channel. These 1 msec samples are filtered by a software implemented two-pole digital filter (settling time = 1.5 secs) before being transferred, serially, to the control board microprocessor, in response to a poll.

2.1.2 Cold junction compensation

A temperature sensor is thermally bonded to an isothermal surface which is in close thermal contact with the SIM terminal block. This provides a cold junction reference for any thermocouple terminated at the SIM. The signal from this sensor is passed via an ADC (IC9, IC10, IC11) to the dc input board microprocessor (IC1). The microprocessor uses this input to modify the contents of the offset look-up table, to allow for any variation in temperature (within the range 0 to 60˚C) at the SIM.

2.1.3 Auto-zero

Every four minutes (approximately), the input signal to each channel's ADC is removed, and the ADC inputs shorted together via an analogue switch. The resulting output from the ADC represents any voltage offsets being produced by the ADC. This signal is processed in the same way as a normal input signal, but the result is used to modify the contents of the offset look-up table, to compensate for any drift in the ADC or following circuitry.

2.1.4 Channel element power supplies

The dc input board receives 5 Volt and 24 Volt dc power from the PSU. These are used to power the non-channel elements of the dc input board.

In order to provide full inter-channel isolation, each channel has its own power supply. These six supplies are all generated from the 24 Volt rail, by switching the primary of a transformer which has six independent secondaries (one for each channel). The switching rate for the transformer is derived from the microprocessor clock.

The output from each secondary is rectified and smoothed to give outputs of approximately +14 Vdc and approximately -6 Vdc. The power and reference voltage for the DC is derived from the 14 Volt rail by means of a temperature compensated 5 Volt zener diode (RD1).

2.2 RESISTANCE TEMPERATURE DETECTOR (RTD) INPUT BOARD

The RTD input board is suitable for use with two-, three- or four-wire RTDs, the relevant signal routing taking place within the SIM.

The operation of the board is identical with that of the dc input board described in section 2.1, above, with the following exceptions:

1. The RTD board contains a constant current generator for each channel.
2. The input and auto-zero circuitry is slightly different.
3. There is no cold junction compensation.

2.2.1 Constant current generator

Each of the constant current generators consists of an operational amplifier with a reference voltage applied at its inverting input. The constant current output (approx. 0.5 mA) from the operational amplifier is applied to the resistance thermometer terminations via a 100 Ohm resistor.

2.2.2 Input circuitry

The voltage generated across the 100 Ohm resistor is summed with the lead resistances (for 3- or 4-wire RTDs), and the voltage across the RTD element is subtracted from this sum using an operational amplifier configured as an adder/subtractor. The output from this amplifier is passed to the input of the ADC via a programmable gain amplifier.

2.2.3 Auto zero

During the auto-zero cycle, the constant current is switched off. The resulting error signal is processed in the same way as an ordinary input signal, and is used to modify the contents of the offset look-up table. T his compensates for any offsets or gain drifts in the input amplifier, ADC and following circuitry, and for emfs thermally generated in the external measuring circuit.

2.3 CONTROL BOARD

The main function of the control board is to read scaled and linearised data from the input boards, and to process this data in such a way that it may be used to:

a, Produce traces on the chart
b. Display information relating to channel or instrument status
c. Provide output data to relay output boards.

The control board electronics are arranged in three area, as follows:

1. Master microprocessor
2. Writing system microprocessor
3. Display control microprocessor

2.3.1 Master microprocessor

The master microprocessor system consists of the microprocessor itself, together with a number of ancillary integrate circuits. The software is held in a pair of EPROMS. The recorder configuration data, look-up tables and general memory area, are held in a pair of RAMs which are supported by a battery which is switched into circuit whenever the supply voltage drops below a defined level. The RAMs may be accessed singly (byte mode) or together (word mode) as dictated by the processor. A parallel input output (PIO) device, a real-time clock (RTC), a counter timer (CTC) and a dual, asynchronous receiver-transmitter (DART) complete the major functional elements of the system.

The PIO interfaces with the RTC, allowing the microprocessor to read time from and write time to the clock IC. Additionally, the PIO receives data from the keyboards, monitors the ‘handshakes’ with the writing and display control systems, controls the tri-state status of the EIA422 communications link (if fitted) and controls the status of the chart control panel LED.

The CTC is used to provide general clocking and countdown timing for the system. The DART is used to transmit and receive data to and from the I/O boards, and the serial communications link if applicable.

2.3.2 Writing system microprocessor

Data concerning chart speed and the dot positions for each channel are sent to the writing system microprocessor via an eight-bit data bus. An EPROM associated with the microprocessor holds the software necessary to translate the master microprocessor output data into signals suitable for use by the stepper motor drivers for chart drive and ribbon cartridge/print head motors, for the colour select clutch and for the print head needle drivers

PRINT HEAD AND RIBBON CARTRIDGE DRIVE

The mechanical components for producing traces on the chart are in two parts (print head and ribbon cartridge) as described in section 1.1.1, above. The print head and the ribbon cartridge are mounted on carriages, which are driven along their respective guide rails (by means of drive cords) by a single stepper motor.

The print head can be disconnected from the drive motor by an electro-mechanical clutch, forming an integral part of the motor gear head. This allows the ribbon cartridge to be moved (over a limited range) relative to the print head in order to position the selected ribbon colour over the print needles.

In addition to the print head itself the print carriage assembly carries three optical emitter-detector pairs (optos) - see figure 2.3.2. Details of the operation of these optos appear in section 2.3.5, below, but essentially, one (edge detect) opto is used to locate the edge of the chart and to set the position of the ribbon cartridge relative to the print head, whilst the other two, working in quadrature, determine the position of the print head relative to the edge of the chart.

2.3.2 WRITING SYSTEM MICROPROCESSOR (Cont.)

PRINT HEAD AND RIBBON CARTRIDGE DRIVE (Cont.)

This position is determined optical fringes produced by the interaction between the gratings in front of the optos and a fixed non-contacting feedback strip attached to the rear of the print head carriage guide rail.

A reflective strip, with a black area at one end, is attached to the underside of the ribbon cartridge. The reflective part of the strip allows the edge detect opto to locate the edge of the chart and to determine whether the ribbon cartridge or the chart is missing. The edge of the black area allows the edge detect opto to determine a datum position for the cartridge so that it may subsequently be driven to place the red portion of the ribbon over the print needles (see section 2.3.5).

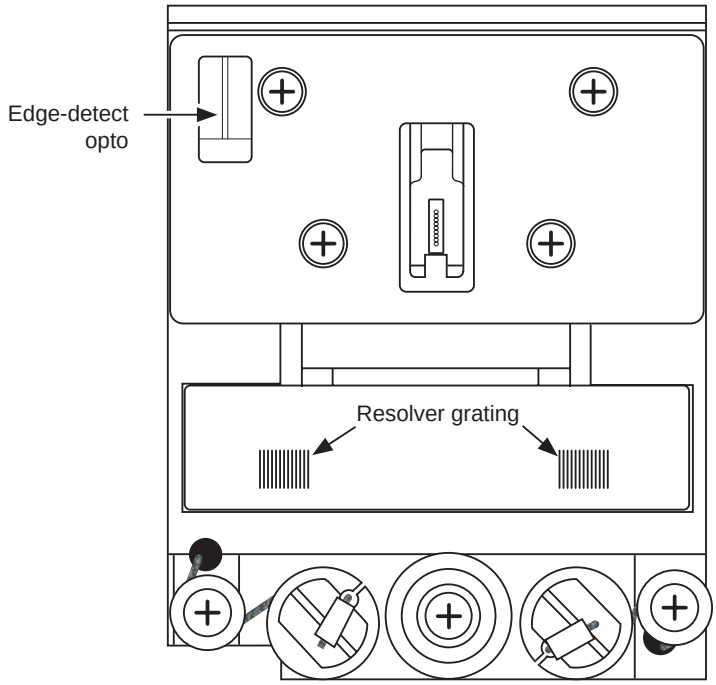


Figure 2.3.2 Print head carriage opto locations

Instructions to print a dot are sent by the master microprocessor to the writing system microprocessor. These instructions are interpreted and the relevant data output via a Peripheral Interface Adaptor (PIA) to the stepper motor drivers.

In the case of trace printing, this causes:

a. The chart to advance by an amount appropriate to the selected chart speed
b. The ribbon cartridge position to be set
c. The edge of the chart to be found
d. The relevant colour to be selected
e. The carriages to be moved to the selected dotting position
f. The relevant needle solenoid to be energised.

When all the traces for one colour have been printed, the carriages are stopped, the next colour selected and the new races printed. When all the required traces have been printed, the carriages return to a ‘rest’ position near the left edge of the chart.

When text is being printed, the sequence of events is similar to the above, but the chart is advanced after the text line has been printed, rather than before. When printing multiple text lines, the chart is advanced a fixed amount which is independent of chart speed.

2.3.2 WRITING SYSTEM MICROPROCESSOR (Cont.)

PRINT HEAD AND RIBBON CARTRIDGE DRIVE (Cont.)

NEEDLE DRIVE

Print needle data is sent from the writing system microprocessor to the PIA, which produces nine needle data lines - one for each needle. These data lines are gated to the driver ICs by a 400 µsec pulse to control the duration off the solenoid energisation. A separate discharge circuit ensures that the stored energy in the solenoid is dissipated rapidly, to reduce the heating effect on the print head.

CLUTCH DRIVE

The clutch solenoid is driven by a darlington pair, switched on by a signal from the PIA. Instructions to energise and de-energise are generated as described in section 2.3.5.

In order to ensure reliable operation, a small reverse current is passed through the solenoid whenever it is disengaged.

CHART DRIVE

Thee chart drive motor is controlled by data lines output via the PIA to the motor drivers. These drivers provide full drive current to the motor whilst the chart is being advanced, and a lower (1/3) holding current whilst the chart is stationary.

The selected chart speed is read from configuration data in the master processor's RAM. With the printer off-line, the chart may be advanced or rewound using the keys on the chart control panel.

2.3.3 Display system microprocessor

The display system microprocessor receives the data necessary to illuminate the required elements of the display from the aster microprocessor. Anode data and grid data are sent separately, as discussed in the display description later in this section.

KEYBOARDS

The display system is also responsible for polling the display keyboard and the chart control panel switches. The display keyboard is arranged as a 6 x 5 matrix, whose polling lines are labelled KA0 to KA5 (table 2.3.3). The chart control panel is arranged as a 1 x 4 matrix, the polling line for which is labelled LK0.

The data from the two sets of switches are connected in parallel and labelled KB0 to KB4 (KB0 not used for the chart control panel).

Each polling line in turn is driven high by the display system microprocessor, and the data lines are monitored by the master microprocessor, via the PIO. The data lines are normally held low by pull-down resistors.

The complete matrix is shown in table 2.3.3, below. If for example the numeric key 6 were pressed, all data lines (KBn) would be low except that, when KA3 is polled, data line KB1 would be high.

	KA0	KA1	KA2	**KA3** (Example ↓)	KA4	KA5	LK0
KB0	7	8	>	9		PGM	
Example → **KB1**	4	5	<	**6**		Time	RWND
KB2	1	2	Chan	3		↑	STOP
KB3	.	0	Enter	+/-	Print	↓	ADV
KB4	Chart speed	Alm Srch		Alm Ack	Single trace	Disp Hld	ON/ OFF

Table 2.3.3 Keyboard matrix

2.3.4 Other control board functions

The control board circuitry also includes circuitry to provide the following:
a. Watchdog and reset facilities
b. Battery back-up switch
c. System clock
d, communications link power.

WATCHDOG AND RESET FACILITIES

These facilities provide a means of starting and stopping control board activity.

The watchdog circuit prompts the master microprocessor at 16 Hz.. On receipt of a prompt the microprocessor carries out a system integrity check which, if successful, causes the 16 Hz counter to be reset. Should the counter not be reset, a system error will occur.

The reset circuit is controlled by a signal (NOT RESET) which is at logic zero for the period of the reset. The NOT RESET signal is low (that is, the reset is carried out) under the following conditions:

a. Power up
b. Voltage valid line low
c. Watchdog not correctly serviced

The operation of the reset circuit is based on a 128 Hz signal generated by the RTC. At power up, as soon as the Voltage Valid line goes high (that is, the recorder voltage rails are established), a counter starts counting the 128 Hz pulse stream. After about 25 msec, the output of the counter causes the NOT RESET signal to go high, allowing board activity to commence.

The reset carries out the following:
a. It disables the control board microprocessors, the DART and the CTC.
b. It write protects the RAMs and the RTC
c. It disables address and data decoding
d. It protects the print head by disabling the solenoid drives.

BATTERY BACK UP SWITCH

The purpose of this switch circuitry is to protect the content of the RAMs at any time when the supply rails from the PSU are too low to sustain reliable operation of the master microprocessor and its associated circuits.

The switch consists of a voltage reference, a comparator and a switching transistor to supply power to, and enable the RAMs.

SYSTEM CLOCK

The system clock is a 4 MHz square wave, created by dividing the output from an 8 MHz crystal by two, using a D-type flip-flop. The divide-by-two function ensures a 50% duty cycle, as required by the microprocessor.

EIA232 LINK POWER

The required + and - 12 Volt lines are derived from the 24 Volt supply rail. The +12 Volt supply is derived directly by means of a voltage regulator. The negative supply is generated by ‘pumping’ a capacitor from the output of an oscillator which consists of a pair of invertor gates with appropriate resistive and capacitive elements.

2.3.5 Print head carriage optos

There are three print head carriage optos as described in section 2.3.2, above. The operation of thee optos is described under the following headings:

a. Initialisation
b. Recalibration
c. Ribbon positioning

INITIALISATION

During recorder initialisation, or after a master reset or a failure in the recalibration checks (described below), the following are carried out:

1. Calibration of the feedback and edge-detect optos
2. Checking for the presence of chart and ribbon cartridge
3. (If the cartridge is present) setting the first colour (red) over the print needles.

Feedback Strip optos

Firstly, the carriages are linked, and moved to the right and then to the left.

During this process, the outputs of the feedback optos are read and a reference level is set for each one, according to its measured output level. These reference levels are input to comparators on the control board. The output from each comparator switches level whenever its associated opto level passes through the reference. This provides a level change for each optical fringe detected by the opto.

The clutch is then disengaged, and the ribbon cartridge is moved to the right with respect to the print head. This ensures that the ribbon carriage does not protrude beyond the left-hand edge of the print head carriage during the next part of the process.

Both carriages are moved left until a motor stall is detected (that is, the print head carriage reaches its mechanical end of travel).

Both carriages are now moved 2560 motor steps to the right and the number of steps is compared with the position derived by reading the feedback strip. If the positions do not agree to within 20 motor steps, the carriages are moved to approximately the centre of the chart, a SERVO SYSTEM FAILURE warning flag is set, and the motor is switched off.

If the readings do agree, then the Edge Detect opto setup procedure (described below, is entered.)

Edge Detect Opto

If the position check, described above, is successful, the carriages are both moved left to ensure that the chart (if present) passes between the two carriages. The edge detect opto output level (dark level) is read. The carriages are then moved to the left, beyond the edge of the chart, and the new opto output level (bright level) is read. If the two levels differ significantly, a comparator setting halfway between the two levels is established.

Should both levels be low, then it is assumed that the ribbon cartridge is missing, and the appropriate error flag is set. If both levels are high, it is assumed tat the chart is missing and the appropriate error flag is set. In either case, the motor is switched off.

2.3.5 PRINT HEAD CARRIAGE OPTOS (Cont.)

EDGE DETECT OPTOS (Cont.)

If the opto levels are satisfactory (that is, both ribbon cartridge and chart are present) then the clutch is disengaged and the ribbon cartridge carriage is moved to the left, until the edge of the dark area of the reflector is found (note 1). The ribbon cartridge is then moved by the correct number of steps to place the red portion of the ribbon over the print needles.

The clutch is re-engaged and both carriages moved to the right until the opto detects the edge of the chart (note 2), whereupon the motor switches off, leaving the carriages at the edge of the chart with the red portion of the ribbon above the print needles.

Notes
1. If the edge of the black area is not detected, the recorder assumes that the clutch has failed to disengage. The SERVO SYSTEM FAILURE flag is set and the motors are switched off.
2. If the edge of chart is not detected, it is assumed that the chart is missing, the appropriate error flag is set.

RECALIBRATION

Before each trace print-pass, or, in text printing, after every 10 colour select requests (even if the requested colour is the same as the current colour), the recorder carries out a realignment of the ribbon cartridge with respect to the print needles, and relocates the print head relative to the edge of the chart. The process is as follows:

The clutch is disengaged and the ribbon cartridge is moved to the right to ensure that the reflector on the ribbon cartridge nose is not over the edge detect opto. The clutch is then re-engaged, and both carriages are moved to the left, to a position known to be beyond the edge of the chart.

The clutch is again disengaged and the ribbon cartridge is moved left until the edge of the dark area is detected. (If this edge is not detected, re-calibration is suspended and the initialisation checks, described above, are carried out.) When the edge is found, the ribbon cartridge is moved the correct number of steps to position the red area of the ribbon over the print needles.

The clutch is then re-engaged and both carriages are moved to the right until the edge of the chart is found, The motor is then switched off, leaving both carriages at the edge of the chart, with the colour red selected, awaiting instructions to print.

If the chart edge is not detected, re-calibration is suspended and the initialisation checks, described above, are carried out.

2.4 DISPLAY BOARD

The display board contains the 80-character vacuum fluorescent display, four latch/drivers, a buzzer used to confirm keystrokes made at the display keyboard, together with the circuitry necessary to generate the power supplies required by the display.

Note: the buzzer may also be configured to sound under channel alarm conditions,

2.4.1 Display

The 80 - character display includes the following mechanical parts:

a. Six cathodes, wired in parallel, running across the width of the display. The cathodes are powered from an ac source to reduce the voltage drop along the cathodes, thus ensuring uniform brightness of all characters.
b. 2880 anodes, arranged as eighty 7 x 5 arrays, + an underline anode per character. The arrays are arranged as 40 columns of two characters.
c. Forty grids. These are used to switch the character columns on and off, there being one grid per column.

Figure 2.4.1 is a block diagram of the display driving system

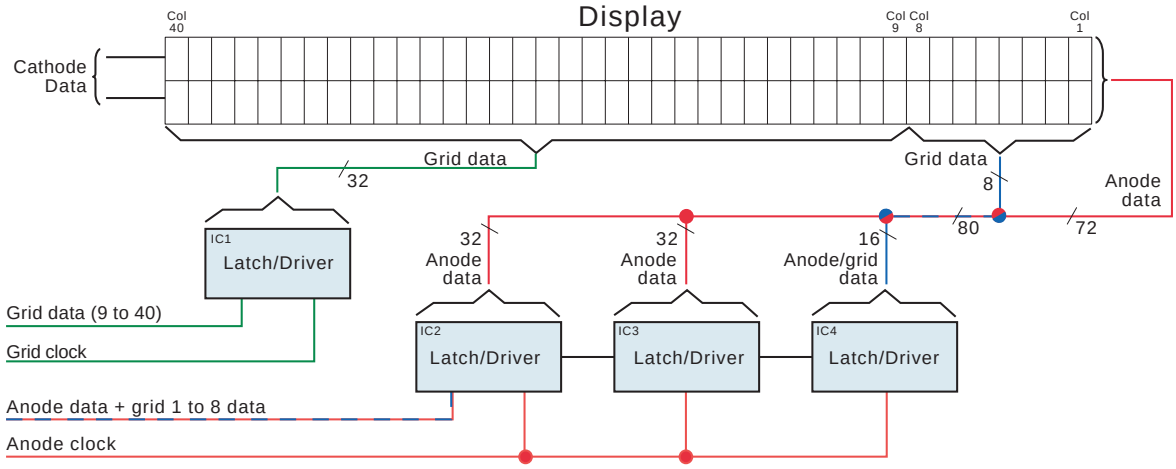


Figure 2.4.1 Display drive block diagram

ANODE ADDRESSING

Electronically, each two-character column may be considered as a ‘super character’ consisting of 72 anodes. Each anode is connected in parallel with the corresponding anode in all the other ‘super characters’. To display the characters, 72 bits of anode data for the first character are sent to the latch drivers. Once this data is stable the relevant grid is turned on for a short period. The anode data for the next character is then sent, and once stable, its grid is turned on, and so on. The sequence starts at column 1 and ripples through until the fortieth column is reached.

The 31 Volt rail for the display is generated, along with the ac cathode drive, from the recorder 24 Volt rail. A pulse generator is used to switch the primary of a transformer, the output of which a) supplies the cathodes, and b) is rectified and smoothed to provide approximately 31 Volts for the anode drive.

2.4.2 Buzzer

The buzzer is a piezo-electric device which, when activated, is switched on and off at 1.25 kHz, for approximately 400 milliseconds. Activation occurs as a response a keyboard keystroke having been read by the master microprocessor. The on time for the buzzer is controlled by an output from the display microprocessor under instructions from the master microprocessor.

The buzzer also sounds if a channel is in an alarm condition and has been configured to sound the buzzer in alarm. In such a case, the buzzer will continue to sound until the alarm is acknowledged.

3 PREVENTIVE MAINTENANCE

Under normal circumstances, the following checks and procedures should be carried out annually. If, however, the recorder is used continuously as a data logger, it is recommended that the frequency of the checks be increased.

3.1 EDGE DETECT OPTO

Remove any paper dust that has accumulated in the print head, or in the edge detect resolver slot. Use low pressure, dry air, and if necessary, a small brush.

3.2 DRIVE CORDS

Carry out a visual inspection of the print head carriage and the ribbon cartridge carriage drive cords. If any signs of excessive wear are evident, replace the relevant cord. Carry out a cord tension check and adjust cord tensions as necessary. See section 5.4 for procedures.

3.3 PRINT HEAD POSITIONING

Carry out the colour select procedure detailed in section 5.4.9

3.4 CHART DRIVE

See section 5.7 for procedures.

Remove the chart drive access cover and carry out a visual check on the toothed drive belt. If signs of excessive wear are evident, replace the belt. Check the belt tension and adjust if necessary. Replace the access cover.

Check that the pinch rollers are free running. Clean or replace as necessary.

Check the pay-off and take-up spool clutch torques.

3.5 SAFETY EARTH CONTINUITY

Check the continuity of the safety earthing between the earthing pin of the power supply plug and all areas of the card cage metalwork.

3.6 CALIBRATION

This section describes a method by which the calibration of the dc input board and the RTD input board may be checked to determine whether or not they are within specification.

It is recommended that before the checks are carried out, a configuration dump be performed, so that the original configuration may be easily restored after completion of the checks.

Notes:
1. It is recommended that the keyboard glass be removed before these checks are started.
2. The calibration checks are to be carried out with the recorder located in an area in which the ambient temperature is maintained at 20 ± 1 degrees Celsius. The checks may be carried out only after the recorder as been switched on for a minimum of 1 hour with the rear terminal cover fitted and with the recorder door closed.
3. The recorder has no customer accessible adjustments to modify the calibration of the boards. Should the checks detailed below imply that the board is out of calibration, the supplier, or agent should be contacted.

3.6.1 DC input board

This subsection describes a method for checking the calibration of the dc input board, including the CJC in the SIM. The accuracies quoted against the test equipment listed below are necessary to demonstrate that the input board is performing to specification. If appropriate, these accuracies may be relaxed according to customer requirements.

EQUIPMENT REQUIRED

a. Voltage reference (absolute accuracy ± 2.5 µV)
b. Reference temperature in the range 0 to 60 ˚C (absolute accuracy better than ± 0.05 ˚C)
c. Suitable connecting cables, including compensation cable for CJC check.

CHANNEL CALIBRATION CHECK

For dc input boards with up-scale / downscale fail-safe drive links fitted, each channel must be checked separately. If such links are not fitted, all channels may be commoned together to the precision voltage source.

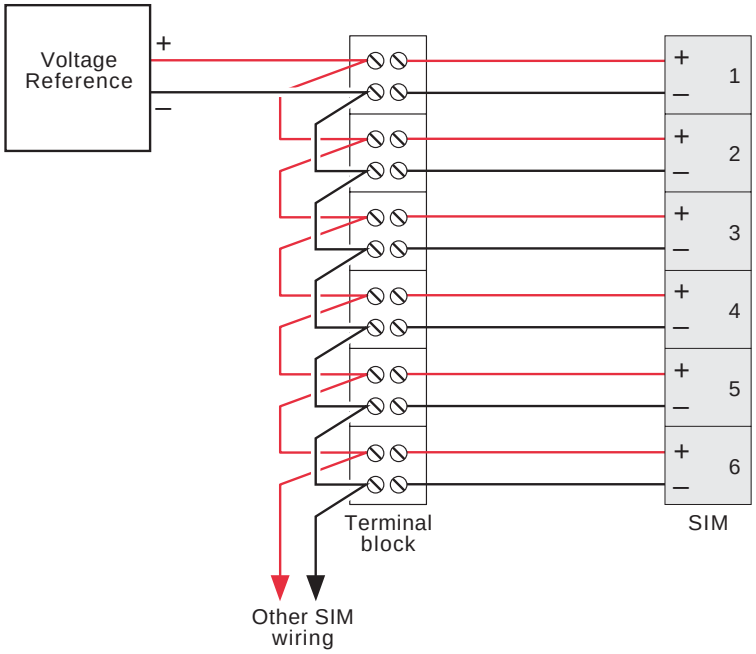


Figure 3.6.1 dc input board calibration check wiring

3.6.1 CHANNEL CALIBRATION CHECK (Cont.)

Fail-safe links not fitted

1. Connect all channels to be checked to the voltage reference, as shown in figure 3.6.1.

Note: The figure shows one SIM connected. In practise, all similar SIMs may be connected in parallel

2. Use the copy facility (refer to the Installation and Operation manual if necessary) to set up the scale, input and function pages for all relevant channels. These settings should be as follows:
   Function = Linear for all ranges to be checked.
   Scales and inputs = the first value of input range given in table 3.6.1, below.
3. Set the output of the voltage reference to the first checkpoint value. After the required time period (note 2 above) check that each of the channels' values is within the specified tolerance.
4. Repeat for each checkpoint, in turn.
5. Set the relevant inputs and scales to the next value of input range and repeat steps 3 and 4.
6. Repeat step 5 until all the input ranges have been checked.

Note: The above procedure is time consuming, and it is suggested that, unless a specific problem is suspected, only checkpoints 1, 6 and 10 are tested for each hardware range.

Fail-safe links fitted

The procedure for checking calibration for dc input boards with fail-safe links fitted is identical with that given above, except in that the channels may not be commoned together, but must be checked individually.

Point	Input range (mV)	Check points (mV)										Max. Tol (mV)
		1	2	3	4	5	6	7	8	9	10	
1	- 2 to + 10	- 2.0	- 0.8	0.4	1.6	2.8	4.0	5.2	6.4	8.6	10.0	0.03
2	- 4 to + 20	- 4.0	- 1.6	0.8	3.2	5.6	8.0	10.4	12.8	17.2	20.0	0.06
3	- 8 to + 40	- 8.0	- 3.2	1.6	6.4	11.2	16.0	20.8	25.6	34.4	40.0	0.12
4	- 16 to + 80	- 16.0	- 6.4	3.2	12.8	22.4	32.0	41.6	51.2	68.8	80.0	0.24
5	- 32 to + 160	- 32.0	- 12.8	6.4	25.6	44.8	64.0	83.2	102.4	137.6	160.0	0.48
6	- 64 to + 320	- 64.0	- 25.6	12.8	51.2	89.6	128.0	166.4	204.8	275.2	320.0	0.38
7	- 128 to + 640	- 128.0	- 51.2	25.6	102.4	179.2	256.0	332.8	409.6	550.4	640.0	0.76
8	- 256 to + 1280	- 256.0	- 102.4	51.2	204.8	358.4	512.0	665.6	819.2	1101	1280	1.54
9	- 512 to + 2560	- 512.0	- 204.8	102.4	409.6	716.8	1024	1331	1638	2202	2560	3.07
10	- 1024 to + 5120	-1024	- 409.6	204.8	819.2	1434	2048	2662	3277	4403	5120	6.14
11	-2048 to + 10240	-2048	- 819.2	409.6	1638	2867	4096	5325	6554	8806	10240	12.29

Table 3.6.1 Calibration checking points - dc input board

Note: in table 3.6.1, all values are in mV; specified tolerances are + or -

3.6.1 CHANNEL CALIBRATION CHECK (Cont.)

COLD JUNCTION COMPENSATION CHECK

Note: This procedure is applicable to thermocouple types E, K and J only.

These checks are carried out by placing the relevant type of calibrated thermocouple junction in a temperature reference (a triple-point device for example) and connecting it to the SIM using temperature compensated cable or thermocouple material. The channel's output is then checked at the display to confirm that the channel reading is equal to the reference temperature to within the specified tolerance.

1. Access each relevant channel's function page and set the function to the relevant type of thermocouple.

2. For each SIM to be checked, place the relevant channel's thermocouple in the temperature reference. After a suitable time (see note 2 above) check that the selected channel values on the display are equal to the temperature reference to within (0.8 ˚C (types E and J), 0.9 ˚C (type T) or 1.1 C (type K)) ± thermocouple accuracy.

3.6.2 RTD Input board channel calibration check

INTRODUCTION

This sub-section gives two methods of checking the calibration of the Resistance Temperature Detector (RTD) input board. The first method is a full calibration check. This, whilst giving a comprehensive calibration check, is time consuming. The second method is a shorter check designed to establish confidence in the accuracy of the RTD input board, without being a full calibration check.

In either case, a configuration 'dump' should be carried out before starting, so that the original configuration may be restored after completion of the check.

Notes:
1. It is recommended that the keyboard glass be removed before these checks are started.
2. The calibration checks are to be carried out with the recorder located in an area in which the ambient temperature is maintained at 20 ± 1 degrees Celsius. The checks may be carried out only after the recorder as been switched on for a minimum of 1 hour with the rear terminal cover fitted and with the recorder door closed.
3. The recorder has no customer accessible adjustments to modify the calibration of the boards. Should the checks detailed below imply that the board is out of calibration, the supplier, or agent should be contacted.
4. The calibration checks listed below are for use with four-wire RTDs. A similar check may be carried out with two- or three-wire RTDs, but in such cases the degradation in performance due to lead resistances must be taken into account.
5. Each RTD channel must be checked individually. If more than one recorder channel is connected across the resistor box, errors will occur.
6. When an RTD goes open-circuit, the RTD input card loses configuration. This fact is not communicated to the control board (or thus to the display). If the identical configuration is re-entered, the control board assumes that nothing has changed, and therefore takes no action. In order to correct this situation, a new configuration must be entered, and then the correct configuration re-entered.

3.6.2 RTD INPUT BOARD CALIBRATION CHECKS (Cont.)

FULL CALIBRATION CHECK

Equipment required

resistance box (10 to 500 Ohms); absolute accuracy 5 mΩ,

It is recommended that, in order to reduce the time taken to complete this calibration check, the SIM terminations are effectively extended outside the recorder using a short length of 24-way cable. The use of such a cable means that the rear terminal cover needs to be removed only once per SIM, rather than once per channel (see note 2, above).

1. Use the copy facility (refer to the Installation and Operation manual if necessary) to configure all the relevant channels as follows:
   Function = Linear
   CJC = Off
   Units = mV
   All relevant scales and ranges = 100 to 200
2. Connect the resistance box across channel one's terminations and set the resistance value to the first checkpoint value (table 3.6.2).
3. Set the range for channel 1 to the first hardware range in table 3.6.2
4. Check that the displayed value is correct within the tolerance stated in the table.
5. Set the resistance box to checkpoints 2 to 10 in turn, checking he displayed values for each setting.
6. Repeat for the remaining hardware ranges.
7. Disconnect the resistance box from channel 1 and connect it across channel 2.
8. Repeat checks 3 to 6 for channel 2.
9. Repeat for all channels in the SIM.
10. Repeat for all further RTD SIMs.

Hardware Range (Ω)		Check points (Ω)										Max. Tol (Ω)
		1	2	3	4	5	6	7	8	9	10	
1	97 to + 119	97	99	102	104	107	109	111	114	116	119	0.050
2	93 to + 138	93	98	103	108	113	118	123	128	133	138	0.095
3	81 to + 194	81	94	106	119	131	144	156	169	181	194	0.094
4	61 to + 280	61	85	110	134	159	183	207	232	256	280	0.280
5	19 to + 432	19	65	111	157	203	249	294	340	386	432	0.432

Table 3.6.2 RTD input board calibration checkpoints

SHORT CHECK

Equipment required

Six of each of the following resistor values. The required tolerance of the resistors depends on the accuracy to which it is required to check the RTD inputs.

1. 119 Ohms
2. 138 Ohms
3. 194 Ohms
4. 280 Ohms
5. 432 Ohms.

The short check method depends on the number of RTD boards to be checked.

3.6.2 RTD BOARD CALIBRATION SHORT CHECK (Cont.)

One board check

1. Fit all the six resistors of the first value quoted in 'Equipment required', above to the SIM. Fit the SIM, and use the copy facility (refer to the Installation and Operation manual if necessary) to configure all the relevant channels as follows:
   Function = Linear
   CJC = Off
   Units = mV
   All relevant scales and ranges = first hardware range in table 3.6.2, above.
2. After an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table ± resistor tolerance.
3. Remove the SIM and replace the six resistors with resistors of the next value, as quoted in the Equipment Required list , above.
4. Re-fit the SIM and reconfigure the scales and ranges to the next hardware range (table 3.6.2).
5. After an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table ± resistor tolerance.
6. Repeat steps 3 to 5, until all the five resistor values have been checked.

Two board check

1. Fit all the six resistors of the first value quoted in 'Equipment required', above to SIM1 . Fit the SIM, and use the copy facility (refer to the Installation and Operation manual if necessary) to configure all the relevant channels as follows:
   Function = Linear
   CJC = Off
   Units = mV
   All relevant scales and ranges = first hardware range in table 3.6.2, above.
2. Fit all the six resistors of the second value quoted in 'Equipment required', above to SIM2 . Fit the SIM, and use the copy facility (refer to the Installation and Operation manual if necessary) to configure all the relevant channels as follows:
   Function = Linear
   CJC = Off
   Units = mV
   All relevant scales and ranges = second hardware range in table 3.6.2, above.
3. Fit both SIMs, and after an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table for the relevant hardware range ± resistor tolerance.
4. Swap the SIMs, and reconfigure the channels' ranges and scales as appropriate.
5. After an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table for the relevant hardware range ± resistor tolerance.
6. Remove SIM 1 and replace the 6 resistors with resistors of value 3.
7. Remove SIM 2 and replace the 6 resistors with resistors of value 4.
8. Re-fit the SIMs and reconfigure the scales and ranges to the next hardware range (table 3.6.2).
9. After an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table ± resistor tolerance.
10. Swap the SIMs, and reconfigure the channels' ranges and scales as appropriate.
11. After an appropriate time (note 2, above) check that the displayed values for each relevant channel are equal to the resistor value ± tolerance quoted in the table for the relevant hardware range ± resistor tolerance.

3.6.2 RTD TWO BOARD SHORT CHECK (Cont.)

12. Remove both SIMs. Remove all the resistors. Fit resistors of value 5 to SIM 1.
13. Fit SIM 1 to RTD board 1, reconfigure the channels' ranges and scales as appropriate and repeat step 11
14 Fit SIM 1 to RTD board 2, reconfigure the channels' ranges and scales as appropriate and repeat step 11

THREE, FOUR AND FIVE BOARD CHECKS

These are carried out using a similar method to that described above for the two-board check.

For example, the four-board check would be carried out as follows:

1. Fit all resistors of values 1 to 4 to SIMs 1 to 4 respectively.
2. Fit SIMs 1 to 4 to RTD input boards 1 to 4 respectively.
3. Configure the channels and check the displayed values.
4. Remove all SIMs. Fit SIM 1 to RTD board 2; SIM 2 to RTD board 3; SIM 3 to RTD board 4 and SIM 4 to input board 1.
5. Re-configure all the channels and check the displayed values.
6. Remove all SIMs. Fit SIM 1 to RTD board 3. Fit SIM 2 to RTD board 4; SIM 3 to RTD board 1, and SIM 4 to input board 2.
7. Re-configure the channels and check the displayed values.
8. Remove all SIMs. Fit SIM 1 to RTD board 4. Fit SIM 2 to RTD board 1; SIM 3 to RTD board 2, and SIM 4 to input board 3.
9. Configure the channels and check the displayed values.
10. Remove all SIMs. Remove all resistors. Fit resistors of value 5 to, say, SIM 1.
11. Fit SIM 1 to all input boards in turn, reconfiguring the channels and checking the displayed values for each board.

3.7 TENSIONS AND TORQUES

The following table contains the tensions and torques which should appear at various points of the recorder, along with a recommended way of measuring them.

ITEM	MEASURED BY	MEASURED AT	ACCEPTABLE VALUES
Printhead carriage drive cord tension	Correx gauge	Midway between the carriage and the right-hand side-plate, with carriage at its mid point of travel (figure 5.4.4b)	1 cm. deflection gives reading between 440 and 500 cN
Ribbon carriage drive cord tension	Correx gauge	Midway between the carriage and the right-hand side-plate, with carriage at its mid point of travel and with the writing system closed (figure 5.4.5a)	1 cm. deflection gives reading between 550 and 600 cN
Pinch roller pressure	Correx gauge	Transparent chart guide retaining clips (figure 3.7a)	Guide just lifts at between 450 to 750 cN
Ribbon Cartridge nose pressure	Correx gauge	Cartridge nose (figure 3.7b)	Nose just lifts at between 80 to 100 cN

Table 3.7 Tensions and torques

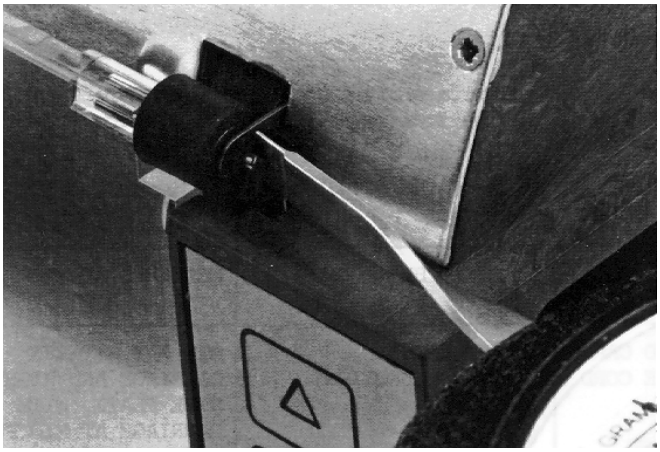


Figure 3.7a Pinch roller pressure

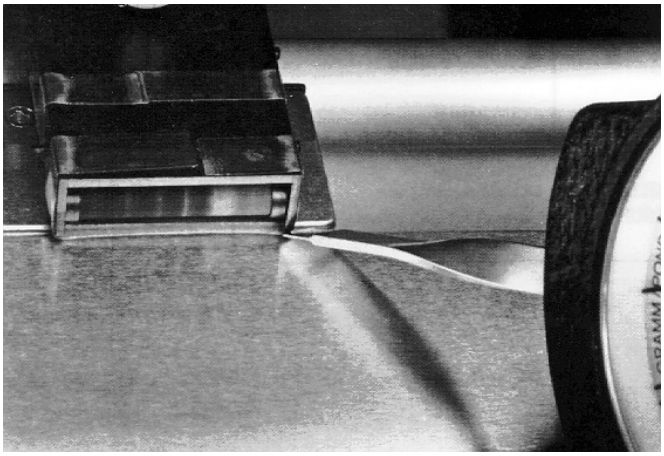


Figure 3.7b Ribbon cartridge nose pressure

3.8 RETURN TO SERVICE CHECKS

Before the recorder is returned to service, it is recommended that the following checks be carried out:

1. Check each type of board fitted against the configuration, to ensure that the recorder is set up for the right type of board in each slot.
2. Check that each board has the correct type of SIM fitted.
3. Check that all links and connectors on the control board are secure, and that both batteries are correctly fitted (figures 3.8a and 3.8b).
4. If the serial communications options is fitted, check that the correct software version EPROMS are in place (refer to the Channel Print 2 Page description in the Installation and Operation manual) and that the communications switch (figure 3.8a/b) is set to 'ON'.
5. If necessary, restore the recorder configuration.

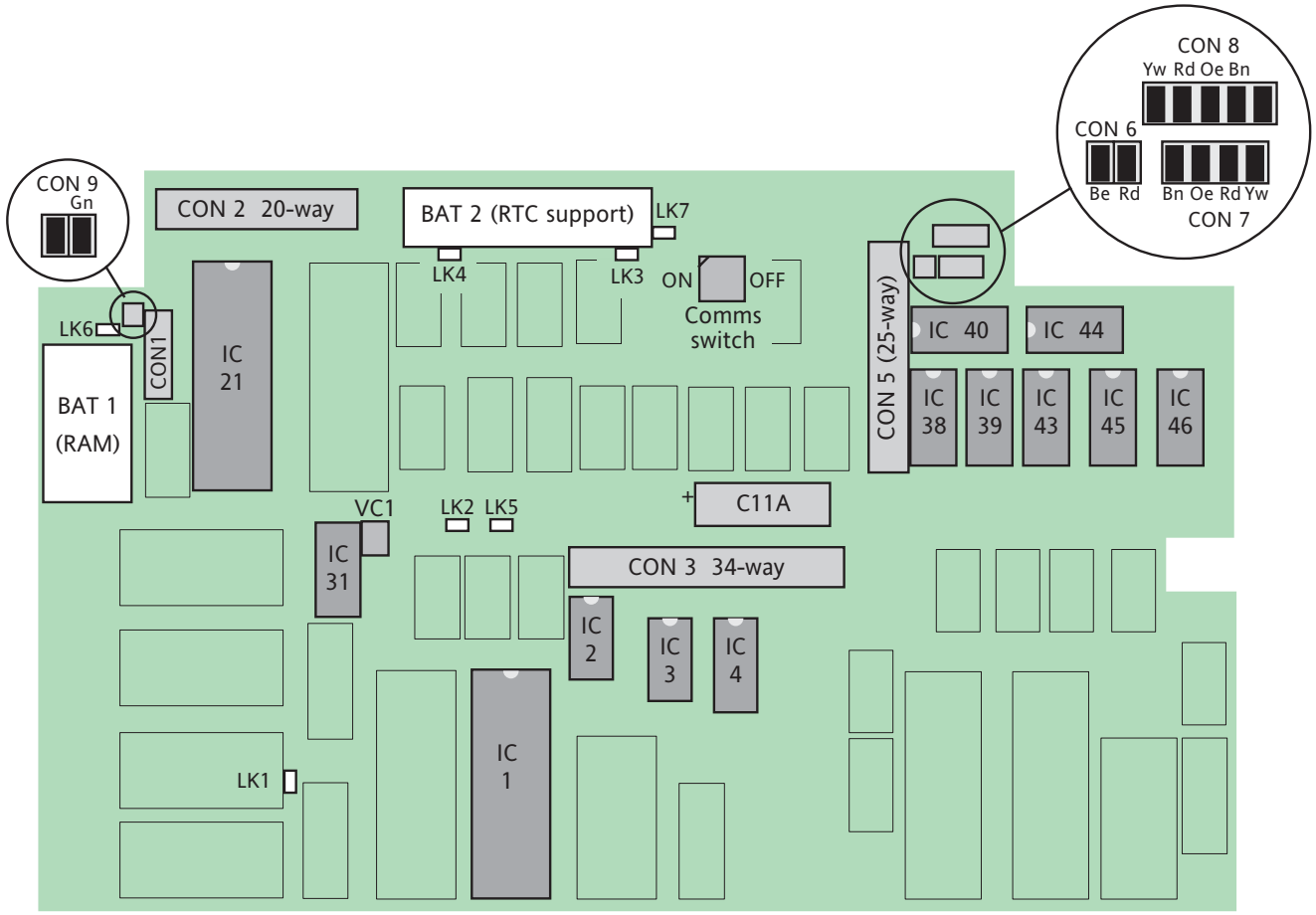


Figure 3.8a Control board connector and link positions (Mark I control board)

3.8 RETURN TO SERVICE CHECKS (Cont.)

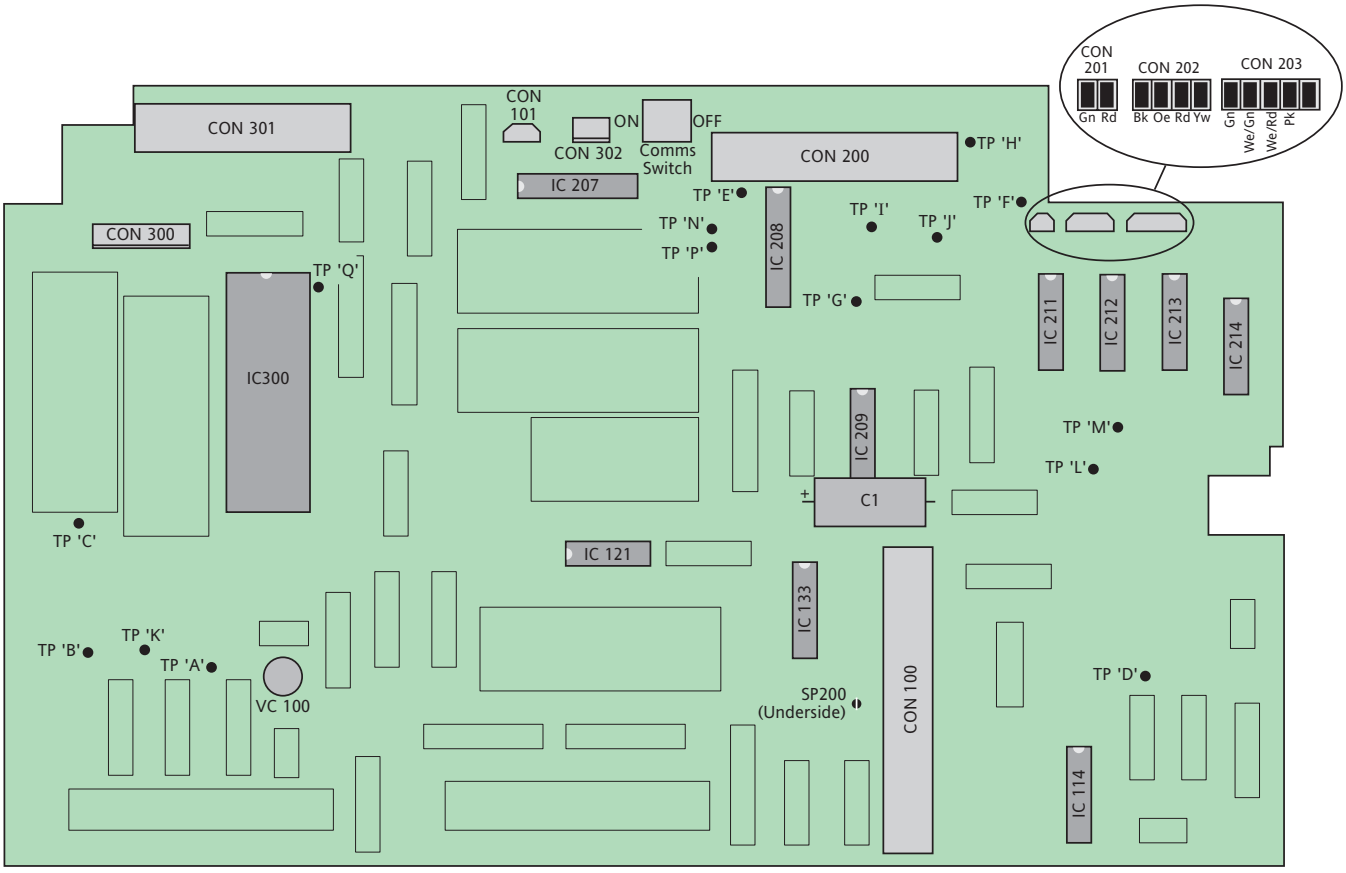


Figure 3.8b Control board connector and test-point positions (MarkII control board)

4 FAULT FINDING GUIDE

This section is intended as an aid to fault finding and is divided into the following sub-sections:

WARNING!

Voltages applied to SIM terminations appear close to the front* edge of the dc input and RTD input boards. It is therefore essential that any potentially hazardous voltages are isolated from the SIMs before any attempt is made to replace, or in any other way, to come into contact with such boards

* That edge nearest the front of the recorder.

Note: The printed circuit boards associated with the model 4001 recorder are not intended to be user serviceable. The user will invalidate the manufacturer's warranty if repairs are attempted by unauthorised personnel. Repair and calibration services for circuit boards are available at designated service locations for boards both within and outside the warranty period.

4.1 CONTROL BOARD VERSION

The current control board (fitted since serial number 1188/416380) is called the Mark II control board, and all connector and integrated circuit references within this fault finding guide refer to the Mark II version. Tables 4.1a and 4.1b give cross references.

The Mark I control board contains a number of links (described in section 4.1.1 below) which do not appear on the Mark II board. The Mark II control board contains a number of test points (described in section 4.1.2 below) which were not included in the Mark I design.

The Mark II board is fitted with a data pack (for customer configuration), a ROM pack (recorder software) and a battery pack (for the clock), each mounted on a daughter board which plugs into the control board.

Mark II control board	Mark I control board	Connector usage
CON 100	CON 3	Mother board connector
CON 200	CON 5	Print head connector
CON 201	CON 6	Servo / colour select clutch connector
CON 202	CON 7	Servo / colour select motor connector
CON 203	CON 8	Chart drive motor connector
CON 300	CON 1	Chart control panel connector
CON 301	CON 2	Display / keyboard connector
	CON 9	Battery back-up connector

Table 4.1a Connector cross-reference table

4.1.1 Mark I Control board

Figure 4.1.1 shows the positions of links, connectors and other components which are mentioned in the fault finding guide. Refer to tables 4.1a and 4.1b, above, as necessary.

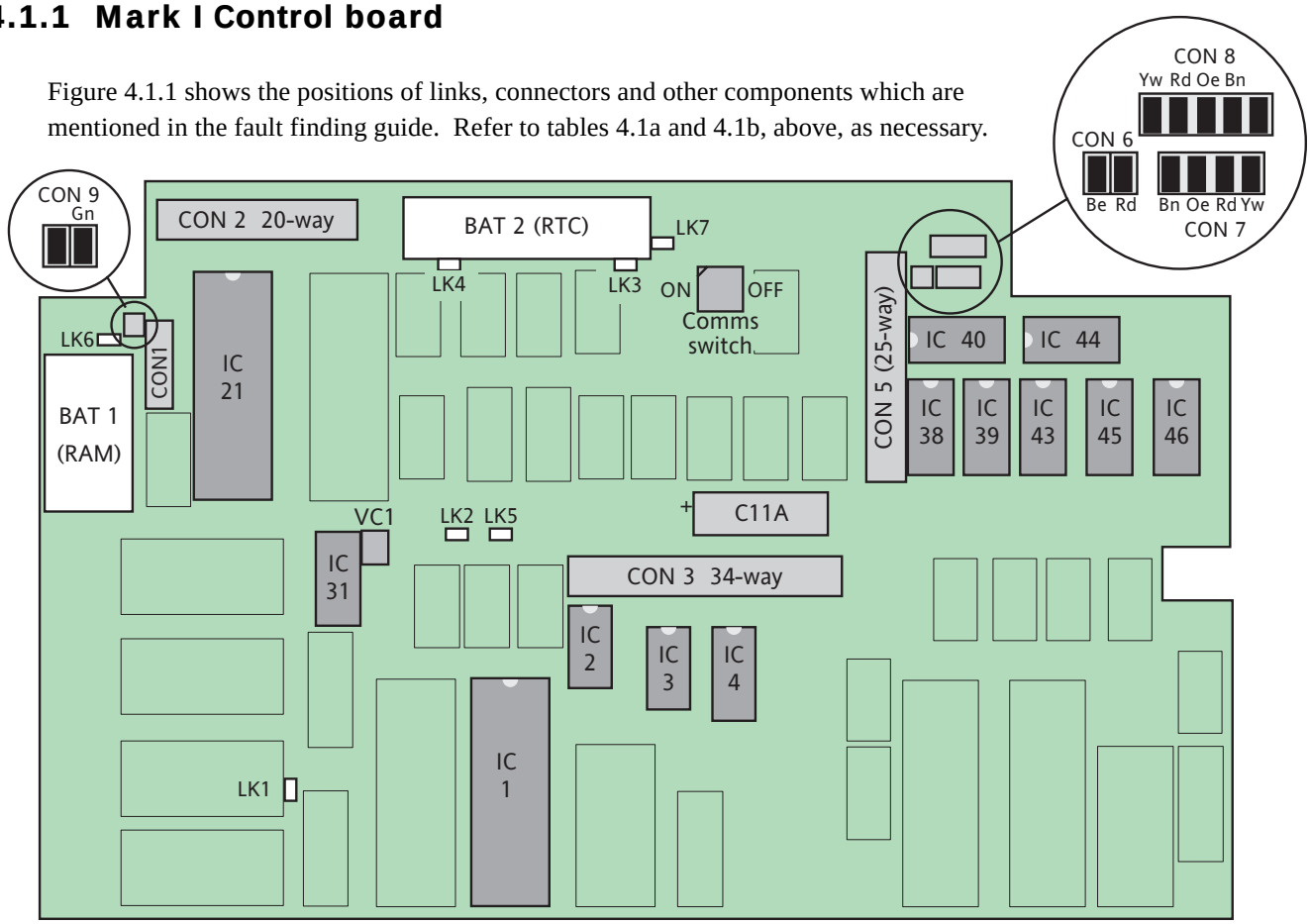


Figure 4.1.1 Component locations (Mark 1 Control board)

LINKS

LK1 ROM Select. Used to allow alternative PROM sizes to be fitted.

LK2 Non-vectored interrupt. This link must be fitted for normal recorder operation.

LK3 Write Enable. Inserting this link write-enables that portion of RAM which should normally be write protected. This link should NOT befitted except when linearisation tables, legends etc, are being updated via the serial link.

LK4 Watchdog. This link must be in place for normal recorder operation

LK5 Read-only RAM select. Used to define whether 1kB (link between pins 1 and 2) or 2kB (link between pins 2 and 3) of RAM are to be write protected. This link must be fitted for normal recorder operation (unless Link 3 is fitted).

LK6 BAT1 Save. Disconnecting this link has the same effect as disconnecting the RAM support battery. The link should always be fitted, except if the control board is to be stored for an extended period. In such a case, the link may be removed to save battery drain.

LK7 BAT2 Save. Disconnecting this link has the same effect as removing the RTC support battery. The link should always be fitted, except if the control board is to be stored for an extended period. In such a case, the link may be removed to save battery drain.

CAUTION

This link must not be removed whilst the recorder has power applied.

4.1.2 Mark II Control board

Figure 4.1.2 shows the positions of test points, connectors and other components which are mentioned in the fault finding guide.

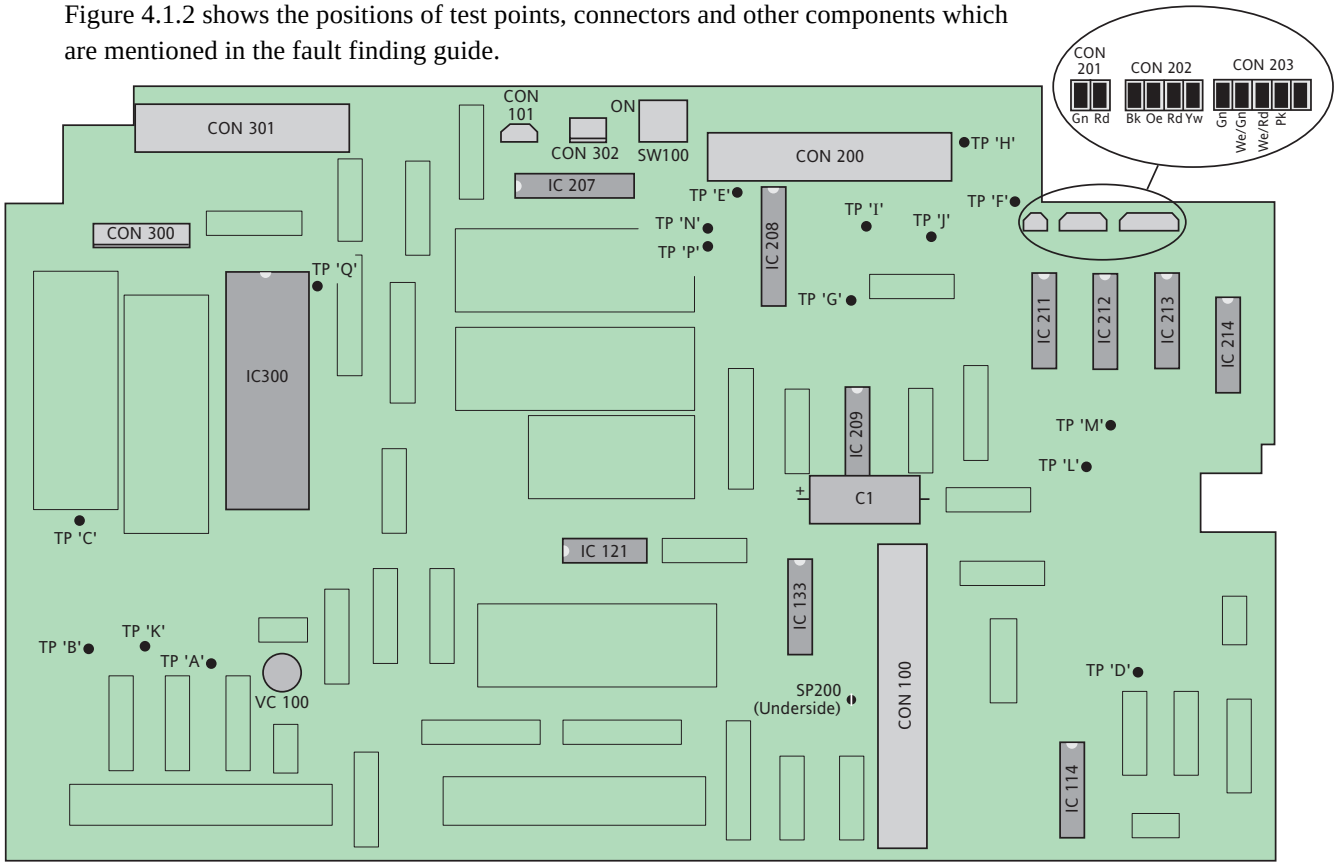


Figure 4.1.2 mark II control board component locations

TEST POINTS

The following test points are available on the Mark II board:

A	1 Hz square wave from Real Time Clock. Used to monitor clock frequency (adjust using VC100)
B	Real Time Clock back-up voltage (2 to 4 volts with power off).
C	Battery voltage (2.7 to 3.2 Volts)
D	2.5v reference. Adjusted to ± 1 mV using P200
E	Photo transistor 1 output (1 to 4 Volt waveform).
F	Photo transistor 2 output (1 to 4 Volt waveform).
G	Edge detection output (0.5V or 4.5V (typical)).
H	Infra-red LED 1 current drive level (0.2 to 2.0 Volts)
I	Infra-red LED 2 current drive level (0.2 to 2.0 Volts)
J	Infra-red edge-detect current drive level (0.2 to 2.0 Volts)
K	Display processor clock (1.2MHz square wave).
L	+ 24 Volts
M	0 V (24V return)
N	+5 Volts
P	0V (5 Volt return)
Q	SC2 output from display microprocessor

4.1.3 Connector pinouts

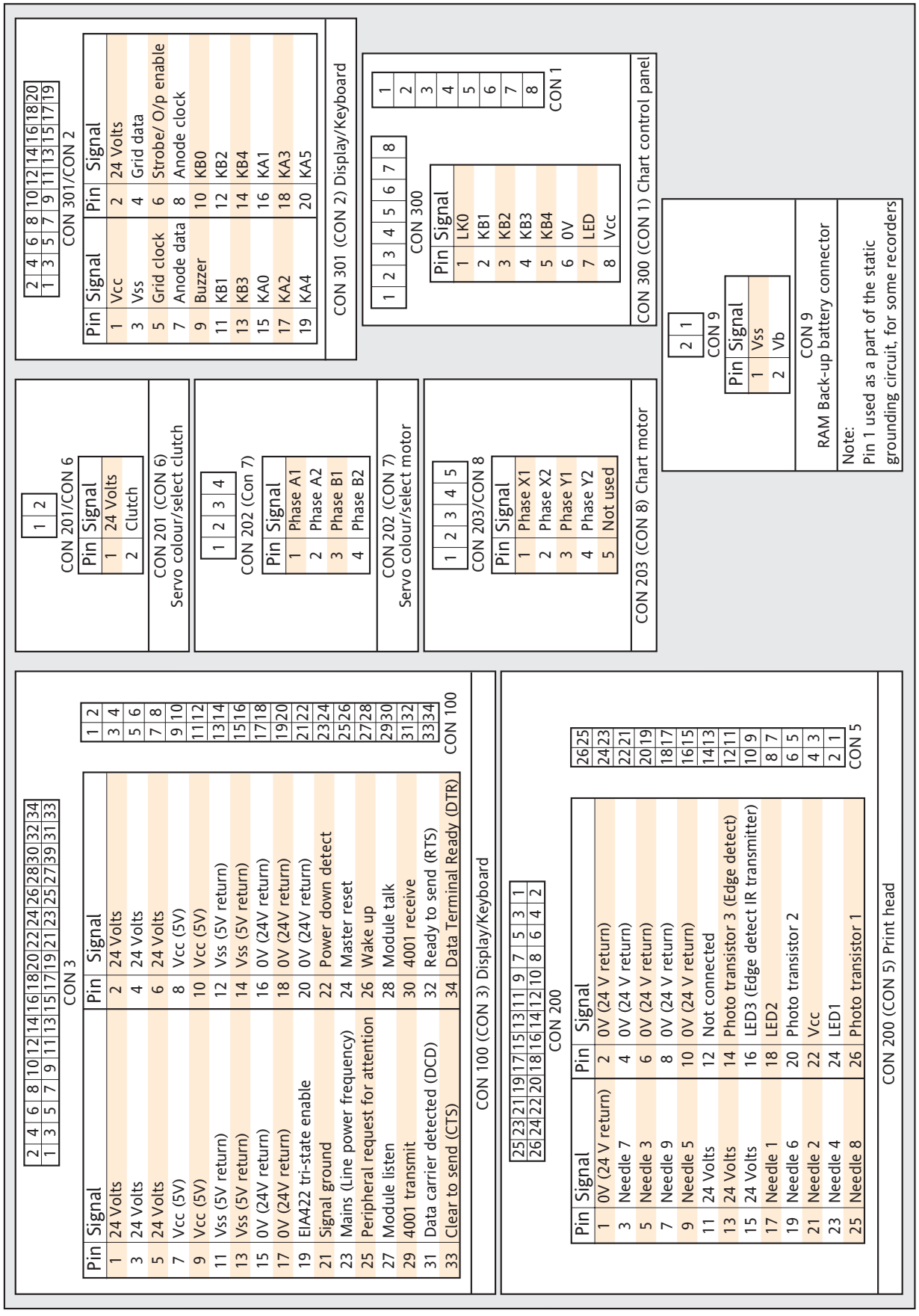


Figure 4.1.3 Connector pinouts (Mark I and Mark II)

4.2 ERROR/WARNING MESSAGES

4.2.1 Paper misfeed (Edge detector not detecting edge of chart)

Possible causes	Curative action
a) Chart damaged	Remove damaged section of chart
b) Cartridge missing and opto out of adjustment	Replace cartridge and carry out opto setting up procedure (section 5.4.7)
c) Misalignment of ribbon and printhead carriages	Carry out colour select setting-up procedure (section 5.4.7)
d) Faulty edge detect opto	Carry out opto setting-up procedure (section 5.5)
e) Electrical fault in opto wiring	Check the integrity of flexi/ribbon cable connector. Check solder joints between opto flexi and optos. Check for short circuits between opto and printhead heatsink. After making any repair, carry out the opto setting-up procedure (section 5.5).

4.2.2 Cartridge missing (Edge detect opto receives no reflections)

Possible causes	Curative action
a) Cartridge reflector damaged	Replace cartridge
b) Misalignment of ribbon and printhead cartridges	Carry out colour select setting-up procedure (see section 5.4.7).
c) Paper dust in edge detect resolver	Clean using dry air and, if necessary, a small brush
d) Chart missing and optos out of adjustment	Fit new chart and carry out opto setting-up procedure (section 5.5)
e) Electrical fault in opto wiring	Check the integrity of flexi/ribbon cable connector. Check solder joints between opto flexi and optos. Check for short circuits between opto and printhead heatsink. After making any repair, carry out the opto setting-up procedure (section 5.5).

4.2.3 Servo system failure (No. of steps moved, not = feedback position)

Possible causes	Curative action
a) Ribbon jam	Check Ribbon cartridge and ribbon cartridge carriage assembly gearbox. If the ribbon is jammed and cannot be freed, replace the cartridge. Remove any foreign matter from the gearbox. If any gears are damaged, replace the ribbon cartridge carriage assembly
b) Printhead carriage cord broken, or cord tension incorrect	Carry out cord replacement procedure (section 5.4) Check cor tensions of ribbon cartridge and printhead carriage assemblies (section 5.4.6)
c) Carriage mis alignment	Check for squareness of the ribbon cartridge and printhead carriage assemblies. Run the carriages from one end of their travels to the other and ensure that neither carriage is impeded in its movement (for example by wire harness or transparent-chart guide spring clips).
d) Feedback position not being properly detected	Carry out opto setting-up procedure (section 5.5) Check flexi/ribbon cable connector integrity Check continuity between the flexi connector and the optos. Check the solder joints between the flexi and the optos. Check for short circuit between the printhead heatsink and the opto flexi. Rectify any short circuits and carry out the opto setting-up procedure (section 5.5). Remove the printhead carriage assembly and clean the resolver grating of any paper dust etc. Examine the feedback strip, and if necessary , clean it with a minimal quantity of 'lighter' fluid on a lint-free cloth*. If the feedback strip is corroded, replace the printhead carriage and guide rail (with integral feedback strip). Carry out the opto setting-up procedure (section 5.5)

(Continued)

* Caution

Under no circumstances may any abrasive material be used to clean the feedback strip, or irreparable damage will be caused.

4.2.3 SERVO SYSTEM FAILURE (Cont.)

Possible causes	Curative action
e) Motor/clutch failure	Check the integrity of the control board connectors CON 201 and CON 202 (figure 4.1.2) Check for foreign matter in the gearing between the carriage-drive motor gear and the capstan gear. Disconnect the clutch and motor connectors (CON 201 and CON 202 respectively) and check that the motor gearhead is free to rotate. If not, replace the assembly. Check the resistances between pins 1 and 2, and between pins 3 and 4 of the motor connector (CON 202). These resistances should be approximately 7.5 Ohms. If a short circuit is detected, replace the motor assembly. If an open circuit is detected, check the integrity of the motor loom. Check the resistance between the pins of he clutch connector (CON 201). The value should be approximately 100 Ohms. If this value is correct, connect 24 Volts dc across the pins (positive to pin 1), and observe resulting clutch action. If the value is incorrect, or if the clutch fails to pull in when 24 Volts is applied, replace the motor assembly.
	Note: if any of the above checks indicates a short circuit, it is likely that the relevant driver IC has been destroyed. The relevant control board locations are: Motor driver = IC211 or IC212; Clutch driver = IC 209.
f) Message appears only when the access system is pulled forwards out of the case.	Support springs at the rear of the writing system missing.
4.2.4 I/P capabilities exceeded	Check that the input fields are not beyond the limits of the specified transducer. Check that the CJC flag is not 'ON' or 'EXT' for an input board or transducer that does not support or require CJC. If these checks do not solve the problem, reduce the span/suppression ratio.
4.2.5 Invalid alarm parameter	Numerical data is out of range of the scale of the instrument. Alarm values are measured in scale units, not input units. The sum of reference ± deviation must be with the range of the display.
4.2.6 Invalid keystroke	The last keystroke was invalid for the field selected. Use numeric data if scroll was last activity, or scroll, if numeric data was last activity.

Message	Curative action
4.2.7 Replace Link 3 (Mark I Control boards only)	Ensure that Link 3 is correctly fitted (figure 4.1.1) Check the RAM back-up battery voltage on the control board. Check the integrity of the battery holder connections Check the 5 Volt rail (across C85) on the control board. If this voltage does not lie between 4.9 and 5.25 volts, check the 5 Volt rail on the mother board. If this is valid, check the integrity of the ribbon cable between the mother board and the control board. If the 5 Volt rail on the mother board is not valid, check that the power supply module is correctly seated. If seated correctly, replace the power supply module.

4.3 WIRING AND CONFIGURATION FAULTS

Symptom	Curative action
4.3.1 ?????? Remains at the display after the channel is updated	The input capabilities have been exceeded, or the input configuration was not acceptable to the input board. Check the following: Channel configuration Circuit board retention SIM connector pins for damage RTD circuit has been open circuit. Change the configuration, then re-enter the correct configuration If possible, swap input boards. If the fault changes channel, the fault lies in the channel element area of the input board. Repair or replace the input board.
4.3.2 Channel reading independent of associated input signal	The wire links fitted inside the SIM are loose, missing or incorrectly fitted. The board retaining bar is lose, missing or incorrectly fitted The SIM pins are damaged.
4.3.3 RTD board readings become erroneous after time	Should the connections to an RTD board go open circuit during any auto-zero cycle, the board loses calibration until the next power-up, or until the channel is re-configured.

Symptom	Curative action
4.3.4 Instrument alarm flashing	The I/O boards fitted do not correspond with the setting in channel 0. Check the following: a) Channel configuration b) All boards are fully pushed home and that the retaining bar is fitted If no fault is found, remove the mother board and inspect the connectors and circuit tracks for damage. Check the integrity of the mother board ribbon cable. If no faults are found, it is likely that the DART (IC112) or one of its associated buffers (ICs 114, 1213 and 133) (all on the control board) has failed.
4.3.5 Alarm symbol flashing without an active alarm	The cause of the alarm has returned to a non-alarm condition before the alarm has been acknowledged. Use ALARM ACK to acknowledge
4.3.6 Alarm will not unassign	Alarms are held sequentially in the recorder, and if any are removed, the remaining alarms are re-numbered accordingly. For example were alarms 1 to 15 to be assigned, and alarm 10 subsequently removed, then those alarms which were previously numbered 11 to 15 would be re-numbered 10 to 14. Thus, at first sight, it might appear that alarm 10 has not been unassigned.
4.3.7 Login number not accepted	The recorder saves only the first 6 digits of a new login number. If more are entered, only the entry of the first six will subsequently allow access.
4.3.8 Input data not accepted	Invalid data causes an error or warning message to occur. See above, and the installation and operation manual supplied with the recorder. For Mark I boards only, if data appears to have been accepted (no warning or error message appears), check that the control board write-protect link (LINK 5) is correctly fitted.
4.3.9 Communications not operating	Check that communications software is fitted (see the Installation and Operation Manual 'Channel Print Page 2' description. If so, check that switch 1 on the control board is set to 'ON'. If so, check the integrity of the mother board ribbon cable. For EIA422 only, check that none of the tri-state lines in the system has failed. Check the integrity of the connections into the RS232-RS422 converter module. If none of the above reveals a fault, consult the communications instruction manual to ensure that the communications protocol being used is suitable.

4.4 PRINT QUALITY

4.4.1 Incorrect colour

Symptom	Curative action
Ribbon and Ribbon cartridge fault	1. Ink smudge on the ribbon. If ink builds up on the ribbon cartridge the colours can become mixed. Clean or replace the cartridge. 2. Ribbon exhausted beyond useful life. Replace the cartridge. 3. Fold in the ribbon. Replace the cartridge. 4. Damage to the ribbon cartridge reflector, particularly if the black area is damaged. Replace the cartridge.
Ribbon cartridge drive fault	1. Carry out the ribbon carriage and printhead carriage cord tension checks described in section 5.4.6. Carry out the colour-select setting-up procedure (section 5.4.7). If no fault is found, check the integrity of the clutch control board connector CON 201. If no fault is found, check the clutch gap for ingress of foreign matter. If no fault is found, check clutch operation (see 4.2.3 e, above). 2. Worn bevel gear in the ribbon cartridge carriage gearbox. If a 'clicking' sound is heard when running the ribbon cartridge assembly along its guide rail, the bevel gear should either be shimmed, or the ribbon cartridge carriage assembly should be replaced (section 5.3.3). 3. Motor stall due to a temporary jam in the ribbon or to ingress of foreign matter into the motor capstan/gearhead. This results in printing being in red, immediately after the stall has cleared. Check the servo/colour select motor and capstan gears, and the ribbon carriage gearbox, for cleanliness. 4. Inadequate retention of the cartridge or ribbon carriage assembly. Locate play, and replace the defective item. 5. Ribbon carriage or printhead carriage incorrectly corded. Re-cord according to section 5.4. 6. Edge detect opto not being read properly. See Cartridge missing warning section, above. 7. Configuration slot 1 set to EMPTY. Reconfigure to DC or RTD Input.

Symptom	Curative action
4.4.2 Incorrect print position	1. Check that the chart and channel zeros and spans are compatible. 2. Check that the reflector on the ribbon cartridge is un-damaged and in particular, that the black area is intact. 3. Carry out the ribbon carriage and printhead carriage cord tension checks described in section 5.4.6. Carry out the colour-select setting-up procedure (section 5.4.7). 4. If no fault is found, carry out the checks detailed in the Cartridge Missing (section 4.2.2) and Servo system Failure (section 4.2.3) Warning message sections above.
4.4.3 Poor print Quality	Poor print quality may be the result of a number of causes as follows: 1. Ribbon exhausted - replace 2. Failed print head _ replace. See also 3, below. 3. Failed print head driver ICs (IC207 and IC208 on the control board). May be caused by failed print head - check printhead before fitting new drivers. 4. 24 Volt rail below 20 Volts 5. Printhead flexi damage. Repair the damage or replace the print head assembly 6. Print head/opto ribbon cable damaged, or connectors not mated correctly 7. Print needle position relative to the print head carriage shield incorrect (section 5.2.3) 8. Incorrect shield position relative to the front plate. Check to ensure that the shield is flush with the front plate, or projects by up to 0.1 mm. 9. Ribbon cartridge or print head cartridge assembly is not square with its guide rail. 10. Damage to cartridge skid, or to the cartridge leaf-spring. Repair, or replace the cartridge.
4.4.4 Reset during printer operation, or during rapid paper transit	1. Check static grounding continuity (section 5.12). 2. Check that the 24 Volt rail (across Test points L (+) and M on the control board) for noise. Note: the 24 Volt rail has a high frequency (approx. 50kHz) ripple of about 0.8 Volts superimposed on it.

4.5 PAPER TRANSPORT

Symptom	Curative action
4.5.1 Chart does not drive	1. Check that the printer is on line (LED illuminated) and that 'Print Skip' is not enabled for all channels. 2. Check the integrity of the chart drive motor connector at he control board (CON 203). 3. Check that the toothed drive belt is intact and that no teeth are missing or worn. If necessary replace the belt (section 5.7) 4. Check the resistances between pins 1 and 2 and between pins 3 and 4 of the motor lead connector. The resistances should both be in the order of 7.5 Ohms. If a short circuit is evident, the motor should be replaced. In such a case, it is likely that the motor-driver ICs (IC213 and IC214) have been damaged and will also need to be replaced. If an open circuit is detected, check the integrity of the motor loom. If necessary, replace it or (if the loom is undamaged), replace the motor. 5. Check the condition of the motor pinion, where it meshes with the gearbox. If necessary, replace the motor and/or its gearbox.
4.5.2 Incorrect functioning of chart drive	Check the following items: 1. The take up door is closed. 2. Pinch wheel pressure (section 3.7) 3. The freedom of rotation of the pinch wheels 4. The condition of the pinch wheel and drive shaft rubber. (I.e. it has not become unusually soft or hard, or perished.)

4.6 OPERATOR INTERFACE

Caution

The keyboard must not be disconnected whilst power is applied to the recorder.

Symptom	Curative action
4.6.1 No Display	May be caused by lack of power to the display 1. If the buzzer sounds when a keystroke is made, then 24V power is available. If the chart illumination loom is fitted with 5 Volt (frosted glass) bulbs, and these are illuminated, then the 5 Volt rail is available. See note below. If either power rail is missing, check the integrity of the keyboard/display ribbon cable and its associated control board connector (CON 301). If no fault is found: 2. Check for 24V across test points L(+) and M on the control board. Check for 5 Volts across test points N(+) and P on the control board. If either rail is missing, check the mother board ribbon cable and its associated control board connector. Replace the power supply unit if necessary. 3. If no fault is found, the failure may be due to the following: a. Failure of the 7555 timer (IC5 on the display board) which generates the cathode power for the display. b. Failure of one or more of the display latch/driver ICs (ICs 1, 2, 3, 4) on the display board. c. Failure of the display controller (IC300) on the control board. 4. Ingress of air to the display. Check the display for signs of physical damage. If any of the above possible IC failures (a, b or c) is found to have occurred, a static grounding continuity check (section 5.12) should be carried out before the faulty item is repaired or replaced.

Note: For recorders which are fitted with chart illumination assemblies containing clear glass (24Volt) bulbs, check the 5 Volt rail across pins 20 (0V) and 40 (+5 V) of any of the display latch/drivers on the display board.

Symptom	Curative action
4.6.2 Partial display	Switch the recorder off. After a minimum of 20 seconds, switch it back on again. A partial display failure not cured by this power cycling procedure may be caused by the following: 1. Failure of one or more of the display latch/drivers (ICs 1, 2, 3, 4) on the display board. A static grounding continuity check (section 5.12) should be carried out before the faulty item is repaired or replaced. 2. Failure of the control board/display board ribbon cable, or a failure in CON301 on the display board.
4.6.3 Display keyboard Caution The keyboard must not be disconnected whilst power is applied to the recorder.	1. If only one key has failed, the key itself has failed. Replace the keyboard assembly. 2. If four or more keys are not working, check that the keyboard flexi connector is correctly mated with the connector on the display board (figure 5.9.4b), and is properly retained by its adhesive pad. If correctly mated, check the integrity of the display/keyboard ribbon cable and its control board connector (CON301). 3. If most of the keys have failed, disconnect the chart control panel connector from the control board (CON300). If this cures the problem, replace the chart control board.
4.6.4 Ticking display See 'Control Board', below.	
4.7 CONTROL BOARD	
4.7.1 Ticking display	Ticking of the display board is caused by the control board's continually resetting, causing the display board buzzer to 'tick' once each reset. 1. Check the seating of all socketed ICs on the control board. 2. Check the power supply rails across test points L(+) and M (23 to 25 V dc) and across testpoints N(+) and P (4.9 to 5.25 V dc). If no fault is found, then it is likely that the fault lies in the low-voltage detector threshold. Carry out the setting up procedure described in section 6.3.1.

Symptom	Curative action
4.7.2 Loss of configuration or user-entered data	1. Carry out the 'ticking display' check detailed in 4.7.1 above. 2. For Mark I boards only, check that links 3 and 6 are correctly fitted (figure 4.1.1, above). 3. Check the RAM back-up battery voltage, and the integrity of the battery holder contacts. 4. Carry out a static grounding continuity check as detailed in section 5.12.
4.7.3 Recorder inoperative, but chart illuminated	1. Carry out the 'ticking display' check detailed in 4.7.1 above. 2. Carry out the low-voltage detector circuit setting-up procedure, described in section 6.3.1. 3. If the fault remains, it is possible that the Real-time-clock (IC115) has failed.
4.7.4 Display clock not accurate WARNING! The negative terminal of the RTC battery is not connected to signal ground. The terminal must not be used as a ground for an oscilloscope (or any other device) which might have its signal ground connected to safety earth, as to do so causes 5V to be applied directly across the battery, presenting a hazard to the operator. Caution The clock battery must not be removed from circuit whilst the control board has power applied to it. See section 5.13.2	The recorder synchronises the software clock with the RTC. If the RTC is not updating, check the battery voltage, the integrity of the battery holder connections and (for Mark 1 boards only) that link 7 (figure 4.1.1) is fitted. If the RTC is updating, but at the wrong rate, check the battery voltage. Check the 1 Hz square wave at test point A (Mark II boards) or the RTC 128 Hz output (IC11, pin 3) (Mark I boards). If no fault is found, then it is likely that the variable capacitor, VC1 (VC100), on the control board needs adjusting.
4.7.5 No printhead movement at power-on (Mark II control boards only)	1. Check that the writing system lid is closed. 2. Check lid open detector 3. Check that a ROM Pack is fitted 4. Check that the ROM pack PROMS are securely fitted and that the daughter board connections are clean and undamaged.

Symptom	Curative action
4.7.6 Loss of user entered data (Mark II control boards only)	1 Ensure that the data pack is correctly fitted 2 Check the data pack for dirty contacts and dry joints.
4.7.7 Configuration not updated (Mark II control boards only)	1. Check that data pack is fitted 2. Check data pack for dirty contacts and dry joints 3. If no faults found, the data pack EEPROM is faulty. The configuration should be saved using the configuration terminal, and the datapack cleaning software used. Part number = LA242710/11/12 for English / French /German language. All configured data is lost during the 'cleaning' operation.
4.7.8 Battery low warning (Mark II control boards only)	1. Replace battery/batteries 2. Check that the battery contacts are clean and grip the cell. 3. Check that the battery board contacts are clean and undamaged.

4.8 MECHANICAL **Symptom**	**Curative action**
4.8.1 Door difficult to open, close or lock	1. Check the door lock latch, the latch spring and the catch post. Replace as necessary (see section 5.11). 2. Check the squareness of the case. If out of true, correct and re-check.
4.8.2 Access system catch inoperative or stiff	1. Replace the catch (see section 5.11)

5 CORRECTIVE MAINTENANCE

This section contains disassembly and re-assembly instructions for the major mechanical parts of the model 4001 recorder, as follows:

1. Print head carriage - section 5.2.
2. Ribbon cartridge carriage - section 5.3.
3. Carriage re-cording, including tension checks and colour select setting up procedure - section 5.4.
4. Optical assembly (opto) setup - section 5.5.
5. Servo / colour select motor replacement - section 5.6.
6. Chart drive maintenance - section 5.7.
7. Chart control panel replacement - section 5.8.
8. Keyboard, display unit and chart illumination assembly replacement - section 5.9.
9. Recorder case, including mother board - section 5.10.
10. Door and access system catch replacement - section 5.11.
11. Static grounding continuity checks - section 5.12.
12. Battery replacement - section 5.13.
13. Display board modification for 5 Volt operation - section 5.14.
14. Display sideplate replacement - section 5.15.

It should be noted that in order to carry out some of these procedures, it is necessary to remove (amongst other items) the control board fitted to the rear of the access system. It is recommended that when this board is removed, it is placed directly into a static-safe bag. This minimises the possibility of a short circuit occurring across the back up batteries (with associated loss of customer configuration) as has the additional advantage of preventing damage due to static discharge, occurring to the static sensitive components located on the board.

If the control board is to be stored in a static-safe bag for more than a month, it is possible that the batteries will discharge through the slightly conductive bag material. Therefore, for extended storage periods, it is recommended that the batteries be removed before the board is placed in the bag.

5.1 STATIC ELECTRICITY

5.1.1 Introduction

High voltages (10s of kilo-volts) can be generated on the human skin through a number of mechanisms, such as friction between dissimilar materials (e.g. nylon and skin) and the separation of similar materials (e.g. masking tape, polythene sheeting).

The gate oxide region of all metal oxide semiconductor (MOS) devices is extremely thin and may be damaged by voltages as low as 60 Volts. Modern MOS devices have built-in clamp diodes, which reduce the incidence of obvious static damage considerably. It is nevertheless possible, even with such clamping diodes, to produce a small rupture in the oxide layer. This may not destroy the device immediately, but may result in a gradual reduction in the performance of the device until, eventually, it fails.

For this reason, the precautions given in section 5.1.2 should be taken when handling any circuit board associated with a Model 4001 recorder.

5.1.1 STATIC ELECTRICITY (INTRODUCTION) (Cont.)

Figure 5.1.1 shows a typical static prevention kit consisting of parts easily available from many manufacturers and distributors of electronic components. The kit comprises the following items:

1. Conductive mat, incorporating connections for a grounding wire and wrist strap. The grounding wire shown allows the mat to be connected to the 0V line or to the chassis of the recorder. Many mats have a 13-Amp plug attached to their grounding wire allowing the mat to be connected (via a high value integral resistor) to local safety earth.
2. Wrist strap and associated coiled cord
3. Static safe bag. (Control board dimensions are 203.2 x 254 mm.)

TERMINOLOGY

Anti-static

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

Static Safe

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

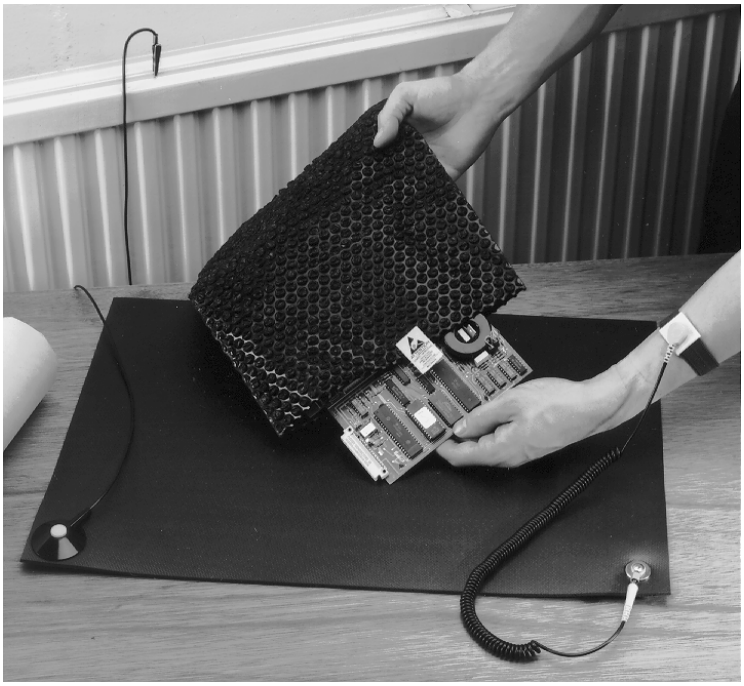


Figure 5.1.1 Typical static prevention kit

5.1.2 Precautions against static discharge

1. Clothing made from anti-static materials, such as cotton, should be worn by those handling MOS devices, or circuit boards containing them. Nylon clothing should be avoided.
2. All bench tops should be covered with conductive material (10^4 to 10^5 Ohms per square) maintained at recorder ground potential.

Caution

The control board is fitted with back-up batteries. Should these batteries be shorted, any customer configuration held in RAM would be lost.

3. Circuit board removed from the recorder should be placed immediately into a static-safe bag.
4. Those handling MOS devices, or circuit boards containing them, should wear a wrist strap connected (via a safety resistor) to the bench top, or if appropriate, to a suitable grounding point on the recorder chassis.
5. Leads of MOS devices should, when removed from the circuit, be shorted together using conductive foam or similar, at the same potential as the device leads.
6. MOS device should not be inserted or extracted when the circuit board has power applied to it.

5.2 PRINT HEAD CARRIAGE ASSEMBLY REMOVAL/REPLACEMENT

5.2.1 Equipment required

1. Pozidriv screwdrivers, numbers 1 and 2
2. Slotted-head screwdrivers 3mm. and 6mm (1/4 inch).
3. Nut runners or open-ended spanners (wrenches) to fit M3 and M4 nuts.
4. Pair of small ‘snipe-nosed’ pliers
5. Self-adhesive insulating tape; 12 mm wide, black.
6. Meter capable of measuring Ohms.
7. Feeler gauges; 0.1mm and 0.2 mm.
8. ‘Correx’ gauges with 100cN and 600cN.
9. Static-safe bag suitable for the control board.

5.2.2 Disassembly procedure

Retain all fixings for use in re-assembly.

> Note: Earlier models of the recorder have a discrete grounding wire running from the print head to the chassis. This wire is routed alongside the print head flexi cables, and is secured to the narrower flexi by means of self-adhesive tape. It is recommended that any such recorder has its print head carriage replaced by one of the latest design, in which this discrete wire is replaced by a grounding link integral with the flexi.

Isolate the recorder from hazardous voltages (both line power and signal), and pull the access system forwards out of the case, until its meets the safety stops. Open the writing system and remove the chart and the ribbon cartridge.

Remove the curved plastic inner chassis liner to reveal the flexible cables to the print head carriage assembly.

For recorders fitted with flexi cables that have an integral grounding lead, remove the screw securing this lead to the chassis. After making a careful note of the positions of the removable parts of the connectors (ref. figure 5.2.4), disconnect the flexi cables.

For recorders with a discrete grounding wire from the print head to the chassis, remove the insulating tape securing the grounding wire to the narrower of the flexi cables, and remove the grounding wire from the carriage assembly, taking care not to lose either of the associated shake-proof wires.

Use pliers to release the spring-loaded clips which hold the transparent chart guide in place.

Remove all the screws which hold the front plate in position and release the tear-off cord from its tensioning spring at the rear of this plate. Remove the plate.

Prepare two 3 cm lengths of insulating tape, and lightly attach them, by one end, to a convenient point that can be readily accessed during the next stages.

5.2.2 DISASSEMBLY PROCEDURE (Cont.)

FEEDBACK STRIP

Release the two screws holding the guide rail to the chassis. Carefully slide the print head carriage off it, and lay the feedback carefully to one side. This should be done whilst maintaining tension on the cord, carefully avoiding finger contact with the feedback strip.

Whilst holding the print head carriage assembly in one hand, secure the cord to the upper chart guide (figure 1.1.1a) using the two lengths of adhesive tape previously prepared. The carriage may now be oriented so as to allow access to the print head, optical assemblies etc.

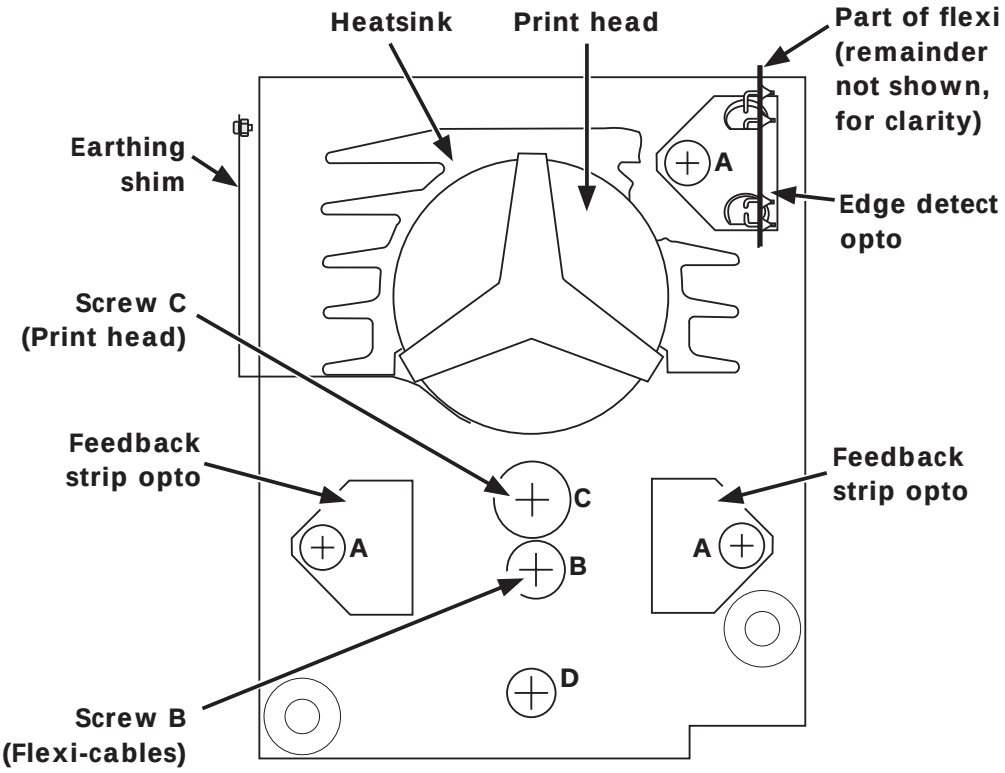


Figure 5.2.2 Print head carriage assembly - component locations

OPTICAL ASSEMBLIES

Release screw B (figure 5.2.2) which secures the flexi cables to the back of the assembly.

Release the three screws A which secure the optical assemblies to the print head carriage, and ease the assemblies out, rotating the heat sink if necessary.

Remove the grounding wire or flexi-cable connection from the earthing shim.

PRINT HEAD

Remove the four screws holding the shield and shims in place, and carefully lay them to one side. Remove the shield and shims, ensuring that the earthing shim is not damaged in the process, and lay these carefully to one side.

Release Screw C, holding the print head to the assembly. Work the print head/heat sink assembly up and out of the carriage assembly. Care should be taken to ensure that the spacer washers between the print head and the carriage assembly do not fall when the print head is removed. If the print head is to be re-used, care must be taken not to separate the print head from the heat sink to which it is glued.

5.2.3 Re-assembly procedure

PRINT HEAD

Insert the print head, ensuring that the spacer washers are in place, and that the new print head ‘clicks’ into place. Secure using screw C (figure 5.2.2).

Re-fit the print head shims and shield, ensuring that the grounding part of the lower shim ‘clicks’ into position between the print head and the carriage. Ensure that the grounding shim makes contact with the print head and with the print head heat sink, so that the resistances between the shim and the print head and between the shim and the heat sink are both less than 10 Ohms.

Use feeler gauges to check that the print needles are under flush with the top shim by between 0.1 and 0.2 mm. Add or remove shims as necessary.

EDGE DETECTOR AND FEEDBACK STRIP OPTICAL ASSEMBLIES

Insert the three optical assemblies into their correct positions. Secure them using the three screws A (figure 5.2.2).

Secure the flexies using screw B, and if applicable, remake the grounding connection to the earth shim. Otherwise, reconnect the discreet grounding wire to the Earth shim.

FEEDBACK STRIP

ASSEMBLY STILL CORDED

If the print head carriage assembly is still corded, then, whilst maintaining tension on the cord, remove the insulating tape securing the cord and re-fit the print head carriage assembly to its guide rail. The screw holes in the front of the guide rails are towards the top.

Check for any rotational or up-down movement of the print head carriage relative to the guide rail. If such movement exists, tighten screw D (figure 5.2.2) by small increments, until movement disappears. (The lower guide bearing is mounted on an eccentric which is rotated by screw D.)

Carefully remove any paper dust etc., from the feedback strip, and, avoiding any finger contact with the feedback strip, re-fit the guide rail to the recorder.

ASSEMBLY NOT CORDED

If the drive cord is not in place, check the side force required to move the print head carriage along the guide rail is within the range 40 to 60 cN. If not, use screw D (figure 5.2.2 above) to adjust.

Carefully remove any paper dust etc., from the feedback strip, and, avoiding any finger contact with the feedback strip, re-fit the guide rail to the recorder.

Carry out the re-cording procedure (section 5.4).

5.2.4 Finishing off

If a discrete grounding wire is fitted, check that this is attached to the grounding shim.

Use three lengths of insulating tape to secure the grounding wire to the narrower of the flexi cables.

Ensuring correct orientation and positioning (figure 5.2.4), reconnect the flexible cable connectors. If the narrower flexi cable has an integral grounding 'lead', secure this lead to the chassis.

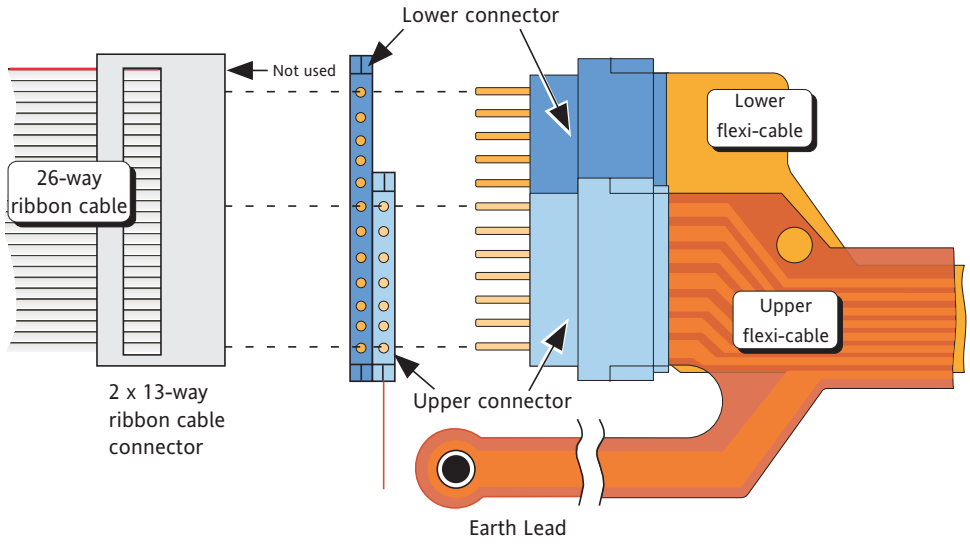


Figure 5.2.4 Print head carriage flexi-cable connectors

Refit the front plate and re-attach the tear-off cord to its tensioning spring.

Refit the clips which hold the transparent chart guide in position.

Run the print head assembly to its left and right mechanical stops, whilst checking that the grounding wire (if fitted) is not strained at any point, and that the carriage assembly is free to move over the length of the guide rail.

Re-fit the curved plastic inner chassis liner, ensuring that the tabs at the back engage in their slots, and that the 'ears' at the front locate into their slots.

Use a 'Correx' gauge to ensure that the side force necessary to move the carriage within its clutch movement is between 80 and 100 cN. If necessary, use screw D (figure 5.2.2) to adjust.

Slide the print head carriage to approximately the centre of its travel along the guide rail. Use a 'Correx' gauge to deflect the cord 10 mm at a point half way between the print head carriage and the right-hand side plate (figure 5.4.4a). The reading should be between 440 and 500 cN. If the tension is incorrect, adjust it as described in section 5.4. When the tension is correct, carry out the colour select setting up procedure given in section 5.4.9.

Fit a chart and ribbon cartridge, and reapply line power.

Carry out the opto setting up procedure as described in section 5.5.

Slide the writing system back into the case, ensuring that the ribbon cable connecting the mother board (in the case) to the control board is not fouled.

5.3 RIBBON CARTRIDGE CARRIAGE ASSEMBLY REMOVAL / REPLACEMENT

5.3.1 Equipment required

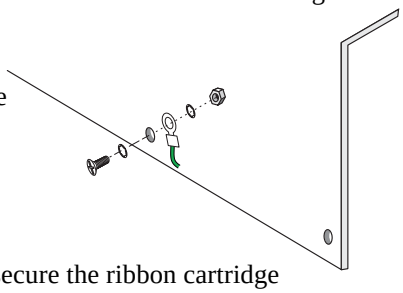
1. Pozidriv screwdrivers, numbers 1 and 2
2. Slotted-head screwdrivers 6mm (1/4 inch).
3. ‘Correx’ gauge to measure 100 to 130 cN
4. ‘Correx’ gauge to measure 600 cN
5. Small quantity of isopropyl alcohol and a lint free cloth.

5.3.2 Disassembly procedure

Retain all fixings for use in re-assembly.

Isolate the recorder from hazardous voltages (both line power and signal), and pull the access system forwards out of the case, until its meets the safety stops. Open the writing system and remove the chart and the ribbon cartridge.

Close the writing system and swing the access system open. Remove the grounding wire from the inside of the top cover, taking care not to lose any of the fixings.



Remove the top cover.

Open the writing system, and release the two screws (‘A’ in figure 5.3.2) which secure the ribbon cartridge gearbox to the ribbon carriage cord clamping assembly.

Close the writing system, and rotate the recorder chassis to gain access to the rear of the ribbon carriage guide rail. Remove the three screws securing the guide rail to its support plate. This allows the ribbon cartridge gearbox to be removed from the rail.

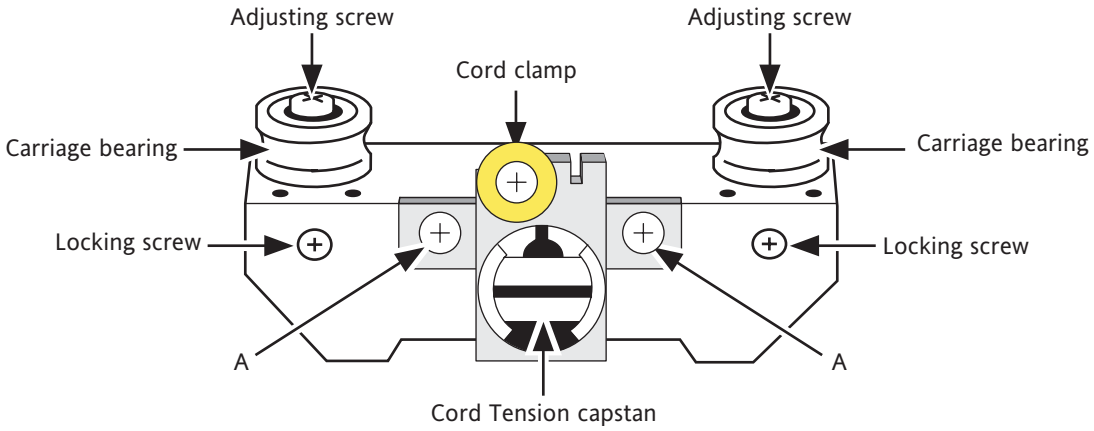


Figure 5.3.2 Ribbon cartridge carriage adjustment

5.3.3 Replacement of the ribbon cartridge carriage assembly

If necessary, clean the guide rail using a small amount of alcohol on a lint-free cloth.

Fit the ribbon cartridge assembly onto the slide rail (rack towards the bottom).

Use a ‘Correx’ gauge to determine the side force necessary to slide the ribbon cartridge along the slide rail. The force should be between 100 and 130 cN. If necessary, release the two locking screws (figure 5.3.2) and adjust the fit of the assembly using the adjusting screw at the centre of each bearing (figure 5.3.2). When the correct force has been achieved, ensure that there is no ‘play’ between the carriage and the rail. If there is ‘play’, re-adjust the carriage bearings. When all is satisfactory, tighten the locking screws.

BEVEL GEAR SHIMMING

Run the ribbon cartridge to both ends of the guide rail, and ensure that no ‘clicking’ sound is audible. Should clicking be heard, release the four screws ‘A’ in figure 5.3.3. Taking care not to break either of the plastic locating pegs, prise the bearing block (‘B’) out from between the gearbox sides.

Slide the bevel gear off its stud, and place an M2.5 plain washer (0.5 mm (0.02 in) thick) onto the stud. Re-fit the bevel gear and reassemble the gearbox. Ensure that no clicking sound is heard as the assembly is moved from one end of its travel to the other.

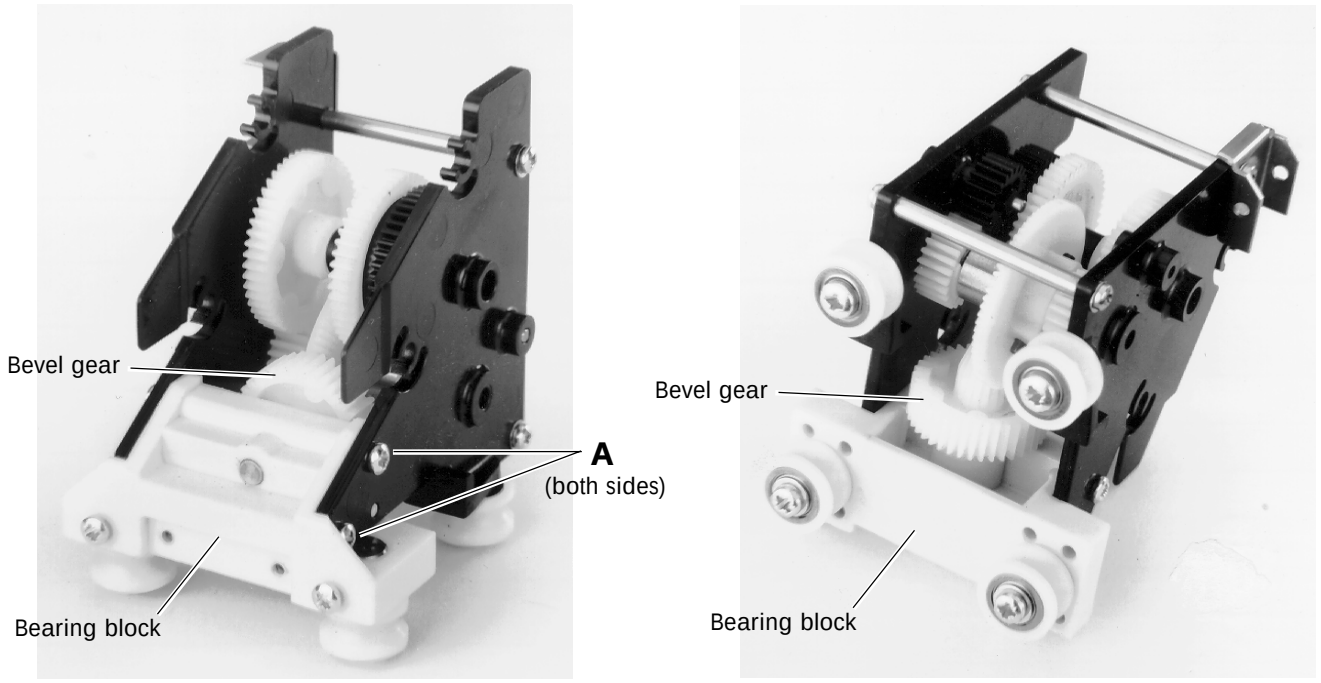


Figure 5.3.3 Ribbon cartridge carriage gearbox (two views)

5.3.4 Re-assembly

Re-fit the guide rail onto its support plate using the three screws and washers removed at the disassembly stage.

Re-connect the gearbox assembly to the cord clamping assembly, using screws A (figure 5.3.2).

Close the writing system and position the ribbon cartridge carriage assembly such that the right-hand edge of the carriage is 150 mm (6 inches) from the inside of the right-hand side plate of the recorder.

Rotate the instrument such that access can be gained to the cord.

At a point halfway between the right-hand sided of the case and the carriage (figure 5.4.5a*) use the Correx gauge to deflect the cord by 10 mm. The reading should lie between 440 and 500 cN. If the reading is not within this range, release the clamp, and adjust the tension using the capstan. Tighten the clamp and re-check. Repeat until the correct reading is achieved.

*Note: For the sake of clarity, figure 5.4.5a shows the cord routing with the writing system open. This check must, however, be carried out with the writing system closed.

Re-fit the top cover and reinstall the grounding wire, ensuring that both shake-proof washers are refitted.

5.4 RE-CORDING THE CARRIAGES

Caution

Refer to sections 5 and 5.1 for information regarding static handling and back-up battery precautions

Note: Unless otherwise stated, directions (left, right, front back etc. are relevant to the recorder when standing on its base, facing the operator.

5.4.1 Equipment required

LATER INSTRUMENTS

1. Pozidriv screwdrivers Nos 1 and 2
2. Slotted head screwdrivers, 2mm and 5mm
3. Allen key (hex wrench) 2mm across flats
4. Open-ended spanner (wrench) 6 mm. across flats
5. Self-adhesive tape (e.g. masking tape)
6. Static safe container (approx. 35 x 25 cm) capable of holding the control board.
7. Pair of snipe-nosed pliers
8. Steel rule or other means of measuring up to 12 cm.
9. Correx Gauges to measure up to 150cN (gm.) and up to 600 cN (gm.)

ORIGINAL DESIGN

1. Pozidriv screwdrivers numbers 1 and 2
2. Slotted head screwdriver; 6mm (1/4 inch)
3. Nut runner suitable for M3 nuts (5.5 mm across flats)
4. Pair of tweezers
5. Correx gauge to measure 100 to 130 cN
6 Correx gauge to measure up to 600 cN
7. Small pair of pliers with cutting edge.

5.4.2 Parts required

LATER INSTRUMENTS

1. BH239336 Print head carriage cord ..... 1 off
2. BH243697 Ribbon cartridge carriage cord ... 1 off
3. BK236704 Ferrule ..... 3 off

ORIGINAL DESIGN

1. CM236701 Carriage cord ..... 2 off (1 per carriage)
2. BK236704 Ferrule ..... 5 off (2 for the print head; 3 for the ribbon cartridge)

5.4.3 PREPARATION

Isolate the recorder from supply power and pull the access system forwards out of the case, until it meets the safety stops. Open the writing system and remove the chart and ribbon cartridge (see Installation and Operation manual if necessary).

Close the writing system, and swing the access system out on its hinged bar, to reveal the control board. Release the ribbon cable connector which connects the ribbon cable from the mother board (in the case) to the control board. Remove the 'Fast-on' earth-wire connection.

Lift the latch in each side-runner and gently pull the access system forwards out of the case.

Disconnect all the flying leads to the control board.

Remove the control board from the writing system, and place the control board in a static safe container.

Remove the top cover and the chassis base (taking care to retain all fixings for use in re-assembly.

Note:
It is recommended that, before the actual re-cording process starts, the opportunity be taken to clean the various moving parts of the print head/ribbon cartridge assemblies, and to lubricate the pulleys.

5.4.4 Print head carriage re-cording (later recorders)

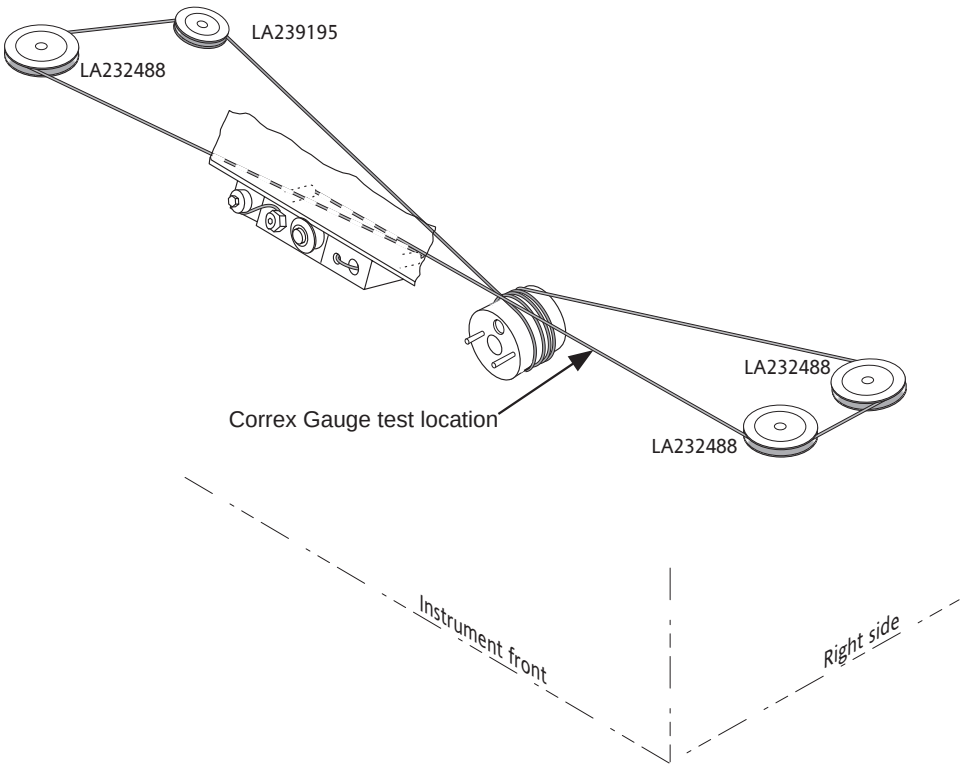


Figure 5.4.4a Print head carriage cord routing

5.4.4 PRINT HEAD CARRIAGE RE-CORDING (later recorders) (Cont.)

EXISTING CORD REMOVAL

Open the writing system. Use self-adhesive tape to secure the print head carriage assembly to its guide rail, at approximately its centre of travel. Undo the cable clamp, release the screw in the tension adjustment assembly and remove the cord from the carriage.

Use pliers to release the sprung clips which hold the plastic chart guide in place.

Release the screws holding the front plate in position and release the tear-off cord from the tensioning spring at the rear of the plate. The plate can now be removed, giving screwdriver access to the lower carriage capstan.
Rotate the capstan such that the cord securing screw can be accessed. Remove the securing screw and pull the cord out of the slot in the capstan.

NEW CORD INSTALLATION

Take the new cord (if both carriages are to be re-corded, this is the shorter of the two cords) and fold it in half. Insert the fold into the slot in the capstan and secure it with the screw (M2.5 x 6mm Pan Pozi) previously removed (figure 5.4.4b).

Rotate the capstan such that the securing screw is towards the top of the recorder. Cross the cord ends as shown and, using a length of adhesive tape, secure cord A to the motor housing so that the capstan cannot rotate anti (counter) clockwise.

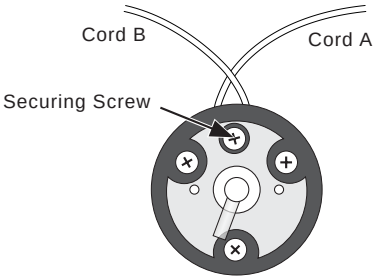


Fig 5.4.4b Cord securing detail

Wind cord B three complete anti-clockwise turns towards the black flange, then tape the cord to the chassis at the left hand side, ensuring that the capstan cannot rotate clockwise.

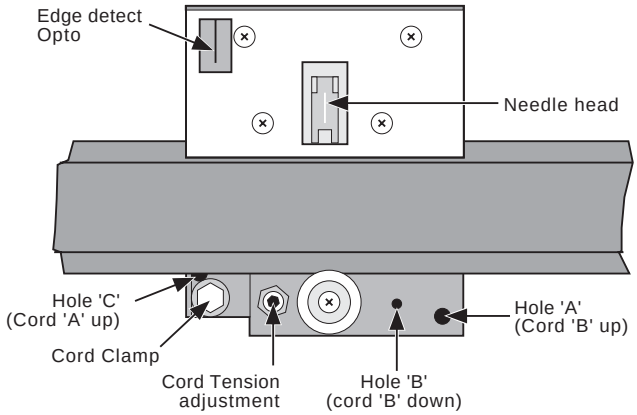


Figure 5.4.4c Print head carriage cord clamping

Remove the adhesive tape securing cord A to the motor body, and, keeping the cord taut, wind cord A three complete clockwise turns round the capstan, away from the black flange (i.e. towards the rear of the recorder).

Carefully tape both cords to the capstan so that neither of them can unwind.

Release cord B from the chassis side, and thread it round the two pulleys in the left side of the chassis. Draw the cord across to the ***right-hand*** side of the print head, and feed it through the hole marked ‘A’ in figure 5.4.4c, to the front of the carriage, and then back to the rear of the carriage via hole ‘B’.

5.4.4 PRINT HEAD CARRIAGE RE-CORDING (later recorders) (Cont.)

Remove the adhesive tape securing the print head carriage to its guide rail, and carefully slide the carriage to the left hand end of its travel, whilst maintaining tension on the cord by pulling it through hole 'B' as the carriage moves.

With the carriage at the left-hand travel limit, crimp a ferrule onto the cord, 12 cm from where it emerges from the rear of the carriage. Cut off any excess cord.

Slide the carriage back towards the centre of travel, until it is stopped by the ferrule 'hitting' the rear of the carriage body. Tape the carriage to its guide rail again.

Take cord A and thread it round the two pulleys in the right-hand side of the chassis. Draw the cord across to the left-hand side of the print head, and feed it through to the front of the carriage, via the hole marked 'C' in figure 5.4.4c.

Pass the cord under the cord clamp, and then through the hole in the cord tensioning assembly. Cut off excess cord, leaving 20 to 25 mm protruding. Carefully pull the cord back through the cord tensioning hole, and clamp the cord at its very end, holding the tensioning assembly with a spanner and tightening the clamp with the Allen key (hex wrench).

Remove the adhesive tape from the capstan and from the print head carriage, and with the cord clamp released, rotate the whole tensioning assembly using the Allen key to take up the slack and apply tension to the cord. Tighten the cord clamp sufficiently to secure the cord, but not enough to damage it. If a torque driver is available, this should be set to 0.4 Nm.

Run the carriage from one end of its travel to the other 10 times. Ensure that the cords wind neatly round the capstan without overlapping, and that the carriage moves to the full extent of its travel in both directions.

Set the carriage to its mid position, and apply the arm of a Correx gauge to a point half way between the carriage and the right-hand side plate (as viewed from the front of the recorder). Use the Correx gauge to deflect the cord 10 mm The correct reading should be between 440 and 500 cN. Use the cord clamp and tensioning assembly to adjust the reading until the tension is correct.

RE-ASSEMBLY

Re-attach the tear-off cord to the spring at the rear of the front plate. Refit the front plate, taking care not to over-tighten any of the screws. Using the pliers, re-attach the sprung clips which hold the transparent plastic chart guide in place.

Continue at section 5.4.5 (RE-ASSEMBLY), below.

5.4.5 Ribbon cartridge re-cording (later recorders)

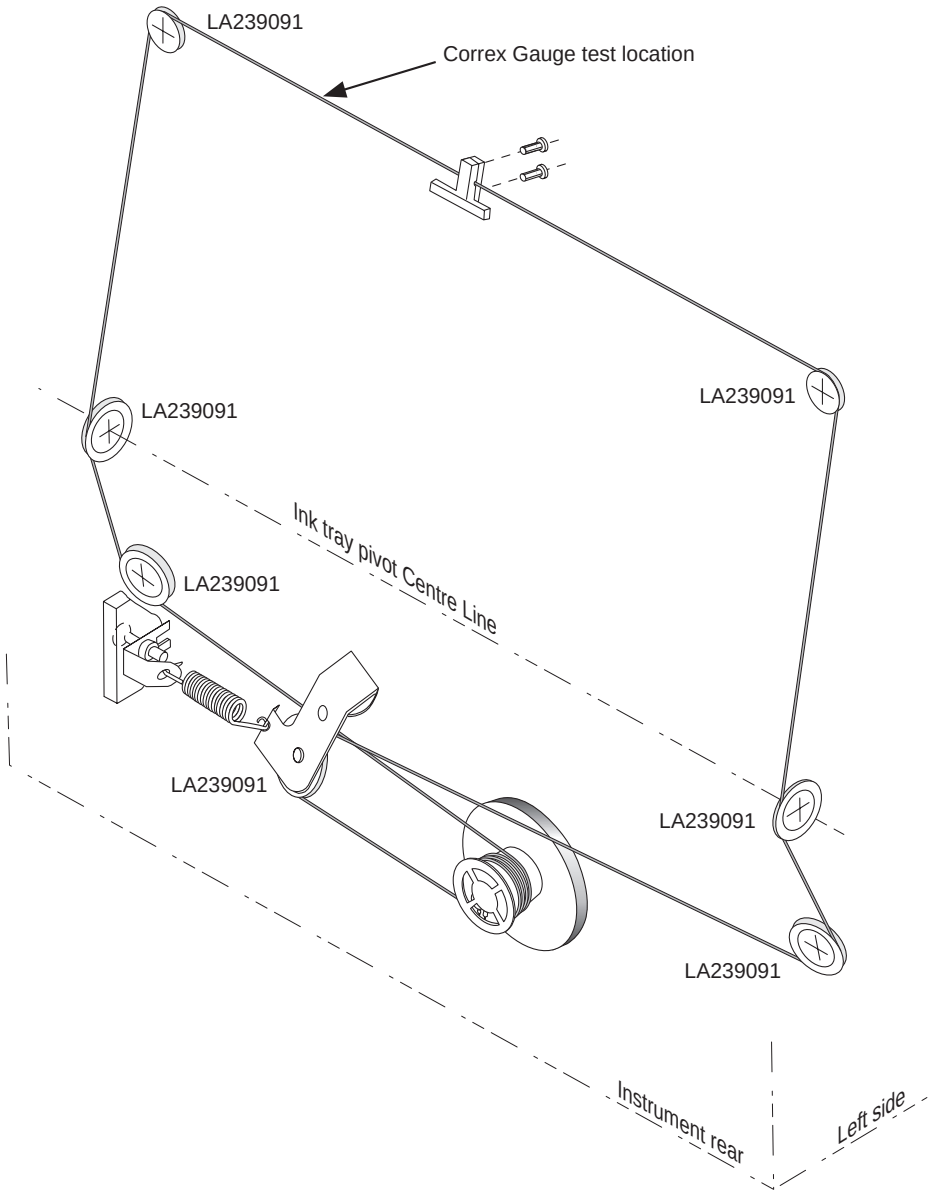


Figure 5.4.5a Ribbon cartridge carriage cord routing

5.4.5 RIBBON CARTRIDGE RE-CORDING (later recorders) (Cont.)

EXISTING CORD REMOVAL

Open the writing system and, on the under side of the ribbon cartridge carriage, remove the two screws and shake proof washers holding the cord clamp to the location block (figure 1.5.1). Close the writing system, and turn the unit round to gain access to the ribbon cartridge capstan.

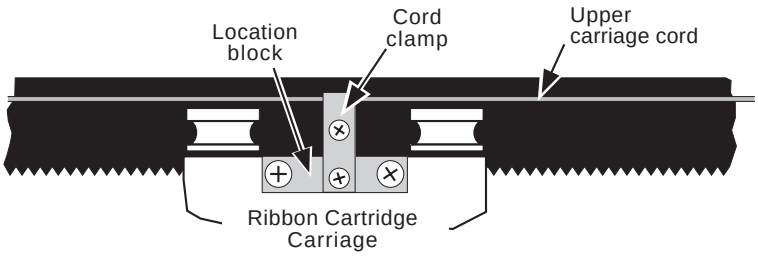


Figure 5.4.5b View on underside of the ribbon cartridge carriage.

Using pliers, withdraw the ferrule from the capstan, cut the ferrule off and remove the cord. Remove the tension adjustment screw (figure 5.4.5c) to allow the jockey arm and spring to hang freely.

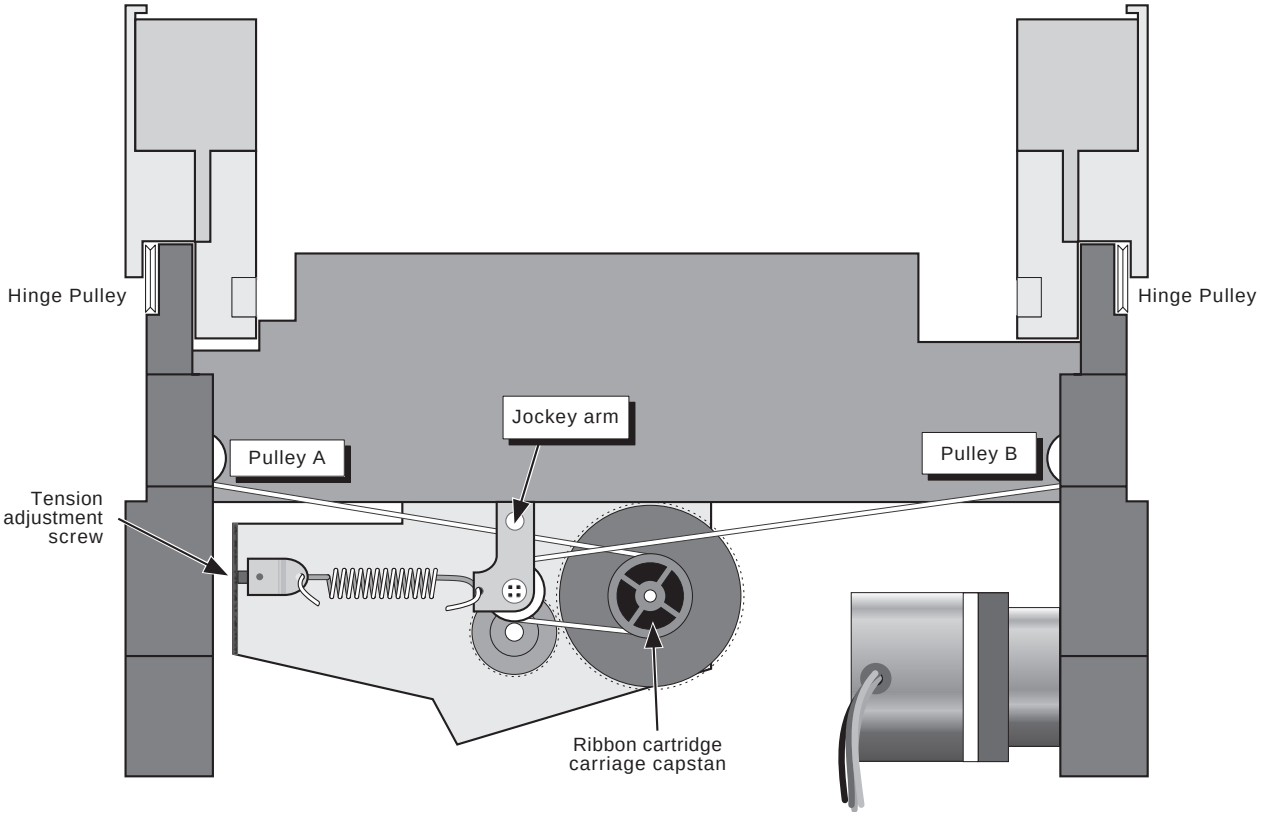


Figure 5.4.5c View on the rear of the recorder

5.4.5 RIBBON CARTRIDGE RE-CORDING (later recorders) (Cont.)

NEW CORD INSTALLATION

Note: As this operation takes place from the rear of the recorder, all directions (e.g. left, right, clockwise etc.) are given as viewed from the rear of the recorder. 'Front' and 'Rear', however, retain their normal meanings.

Take the new cord and feed it round the two pulleys fitted to the front plate, behind the display. Feed the cord round the hinge pulleys at each side of the writing system (figure 5.4.5c), and ensuring that the cord is approximately central (i.e. both ends are approximately the same length), tape the two cords at the hinge pulleys.

Rotate the capstan such that the hole in its curved surface is facing towards the bottom of the recorder, and use adhesive tape to secure the capstan gearwheel to the casting.

Release the adhesive tape holding the left-hand cord to the chassis.

Feed the cord round the pulley marked 'A' in figure 5.4.5c, pass it behind the jockey arm to the top of the capstan, as close as possible to the gear wheel. Wind the cord two and a half turns round the capstan, away from the gearwheel (i.e. towards the rear of the recorder).

Feed the end of the cord through the hole in the capstan, and crimp a ferrule at the end of the cord.

Release the adhesive tape from the right-hand cord, and gently pull the cord such that the ferrule at the other end is pulled into the body of the capstan. Ensure that the cord remains located in all the pulleys, and that the cord is wound neatly on the capstan, with no 'overlaps'.

Pass the cord round the pulley marked 'B' in figure 5.4.5c, and feed it through the hole in the capstan (from outside the capstan). Crimp a ferrule on the end of the cord, then pull the cord so that the ferrule is pulled into the body of the capstan. Ensure that both ferrules are hard up against the inside of the capstan body.

Open the writing system and, using the slack in the cord, wind two complete clockwise turns round the capstan, from the hole towards the capstan flange (i.e. towards the rear of the recorder).

Loop the cord round the jockey arm pulley, and re-attach the tensioning mechanism using the tension adjustment screw previously removed.

Remove the adhesive tape holding the gearwheel to the casting, and with the writing system still open, use the tension adjustment screw to adjust the overall length of the spring coils (excluding hooks) to between 29 and 31 mm.

Note: For illustrative purposes only, figure 5.4.5c shows the jockey arm vertical. The eventual angle of the jockey arm depends on the actual ferrule-to-ferrule length of the cord, on mechanical tolerances and so on.

Turn the writing system round, and locate the new cord in the groove in the location block. Loosely refit the cord clamp, using the screws and shake-proof washers previously removed. Ensure that the clamp is loose enough to allow the ribbon cartridge cassette to slide easily on the cord without damaging its coating.

Note: This operation takes place from the front of the recorder, so all directions (e.g. left, right, clockwise etc.) are as viewed from the front of the recorder.

5.4.5 RIBBON CARTRIDGE RE-CORDING (later recorders) (Cont.)

Carefully slide the carriage to the left end of its travel, and fit a ribbon cartridge (referring to the Installation and Operation manual as necessary).

Slide the carriage to a position central with the print head carriage, and tighten the cord clamp sufficiently to stop the ribbon cartridge carriage sliding on the cord.

Close the writing system, and move the ribbon cartridge carriage between its left and right travel limits (with respect to the print head). For correct ribbon colour selection, the print head needles must appear an equal distance each side of the ribbon cartridge at each travel limit (figure 5.4.5d). If this is not the case, open the writing system and adjust the ribbon cartridge position on the cord as appropriate. When the carriage is correctly aligned, open the writing system, and fully tighten the cord clamp.

With the writing system closed, run the carriages from side to side, ensuring that both carriages can move the full extent of their travels, and that their cords wind on and off the capstans neatly.

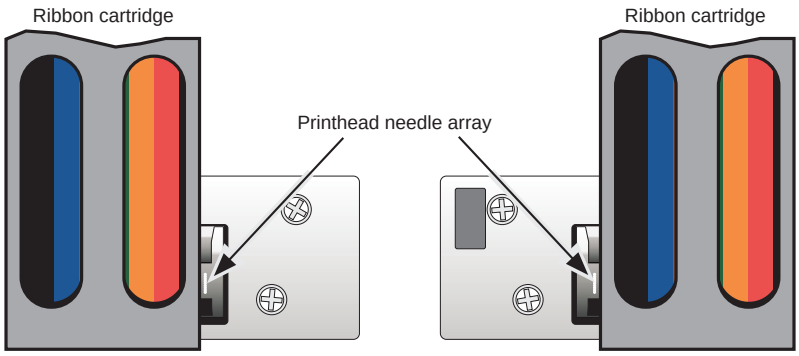


Figure 5.4.5d Checking the ribbon cartridge is central with respect to the print head needles

RE-ASSEMBLY

Refit the base plate of the recorder, ensuring that the curved paper guide fits round the take-up spool.

Taking appropriate static precautions, refit the control board and re-mate all the connectors except the one that connects with the mother board in the case.

Refit the writing system lid, ensuring that the earthing link is secure.

Re-fit the writing system onto the case runners. Reattach the ‘fast on’ earth connection and re-make the ribbon cable connection with the mother board.

Make a final check that all earthing components are in place, then fit a chart and apply power.

Check that the carriages are operating correctly, with appropriate colour selection.

Return the recorder to service.

5.4.6 Print head carriage re-cording (Original design)

PREPARATION

Isolate the recorder from supply power and pull the access system forwards out of the case, until it meets the safety stops. Open the writing system and remove the chart and ribbon cartridge (see Installation and Operation manual if necessary).

Close the writing system, and swing the access system out on its hinged bar, to reveal the control board. Release the ribbon cable connector which connects the ribbon cable from the mother board (in the case) to the control board. Remove the 'Fast-on' earth-wire connection (if fitted).

Release the clamp which secures the ribbon cable to the access system. Lift the latch in each side-runner and gently pull the access system forwards out of the case.

Make a careful note of all the control board connectors and disconnect them.

Use an M3 nut runner to remove the control board from the writing system, and place the control board in a static safe container.

Remove the top cover and the chassis base (taking care to retain all fixings for use in re-assembly).

Note:
It is recommended that, before the actual re-cording process starts, the opportunity be taken to clean the various moving parts of the print head/ribbon cartridge assemblies, and to lubricate the pulleys.

EXISTING CORD REMOVAL

Open the writing system. Use self adhesive tape to secure the print head carriage assembly to its guide rail, at approximately the centre of its travel.

With reference to figure 5.4.6a, release clamps 'A' and 'B'. Rotate the cord tensioning capstans 'C' and 'D' as necessary to allow the removal of the cords. Remove the brass ferrules clamped to the ends of the cords, and disengage the cords from the pulleys.

Remove the cord clamping screw from the drive capstan (figure 5.4.6b); remove and discard the cord.

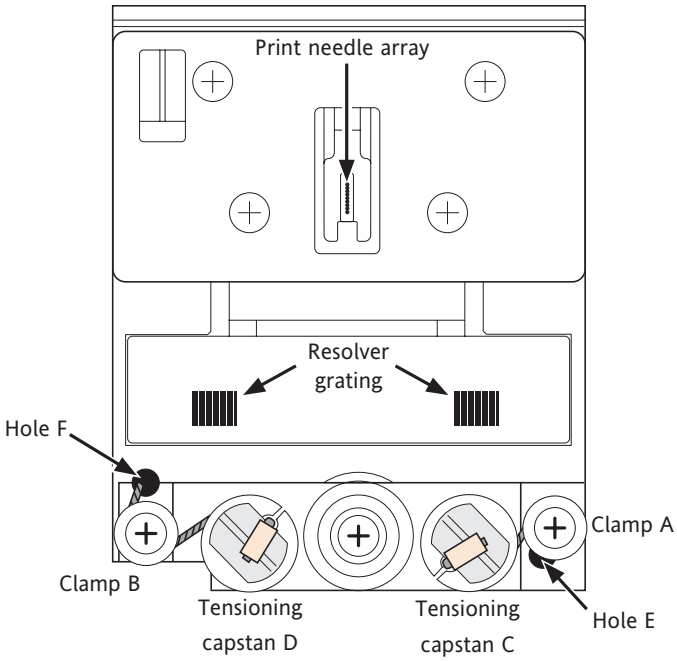


Figure 5.4.6a Print head carriage assembly (front view)

5.4.6 PRINT HEAD CARRIAGE RE-CORDING (Original design) (Cont.)

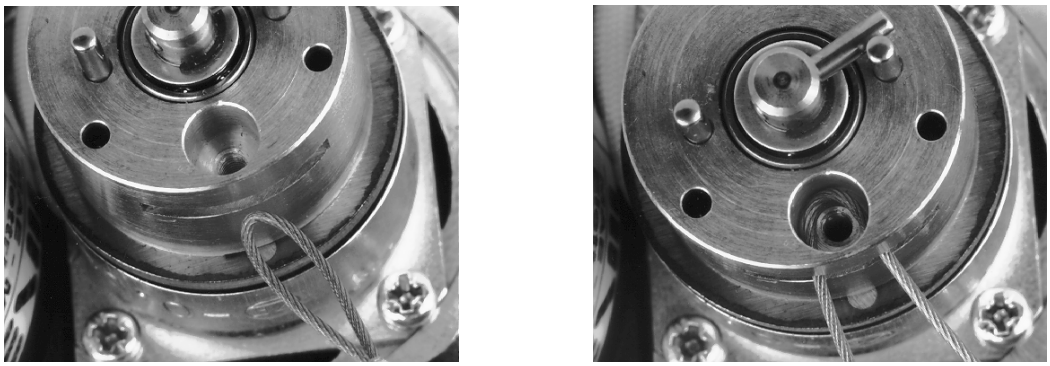


Figure 5.4.6b Drive capstan cord clamping

NEW CORD INSTALLATION

Ensure that the print head carriage is secured to its guide rail with adhesive tape, at approximately the centre of travel.

With reference to figure 5.4.6b, take the new cord and fold it at its centre. Insert the fold into the slot in the side of the capstan. Re-fit the cord clamping screw, such that it passes through the fold. Rotate the drive capstan such that the slot is at the top.

Viewing the recorder from the front, take that end of the cord which emerges from the right-hand side of the drive capstan slot and, winding towards the rear of the instrument, make 3 complete, anti-clockwise turns of the cord about the capstan, exiting the capstan at the top.

Use adhesive tape to secure the cord to the motor housing, under sufficient tension to prevent it unwinding or slipping off.

Take that end of the cord which emerges from the left-hand side of the drive capstan slot and, winding towards the front of the instrument, make 3 complete, clockwise turns of the cord about the capstan, exiting the capstan at the top.

With reference to figure 5.4.6d, below, pass this end of the cord clockwise round the rear and front right-hand pulleys, and across the rear of the print head carriage assembly.

With reference to figure 5.4.6a, above, pass the free end of this cord forwards through hole ‘F’, and pass it anti-clockwise round clamp B, about 1/2 a turn. Gently tighten clamp ‘B’.

Crimp a brass ferrule onto the end of the cord (figure 5.4.6c shows an example). Rotate tensioning capstan ‘D’, until its slot faces downwards. Insert the cord into this slot, such that the ferrule is in contact with the face of the tensioning capstan (figure 5.4.6a). Rotate the tensioning capstan clockwise to take up the slack.

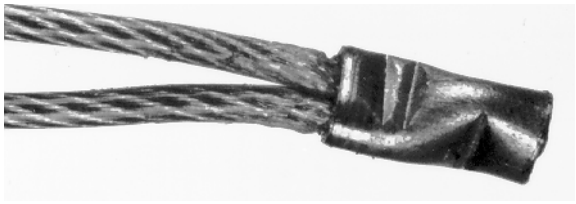


Figure 5.4.6c Crimp example

5.4.6 PRINT HEAD CARRIAGE RE-CORDING (Original design) (Cont.)

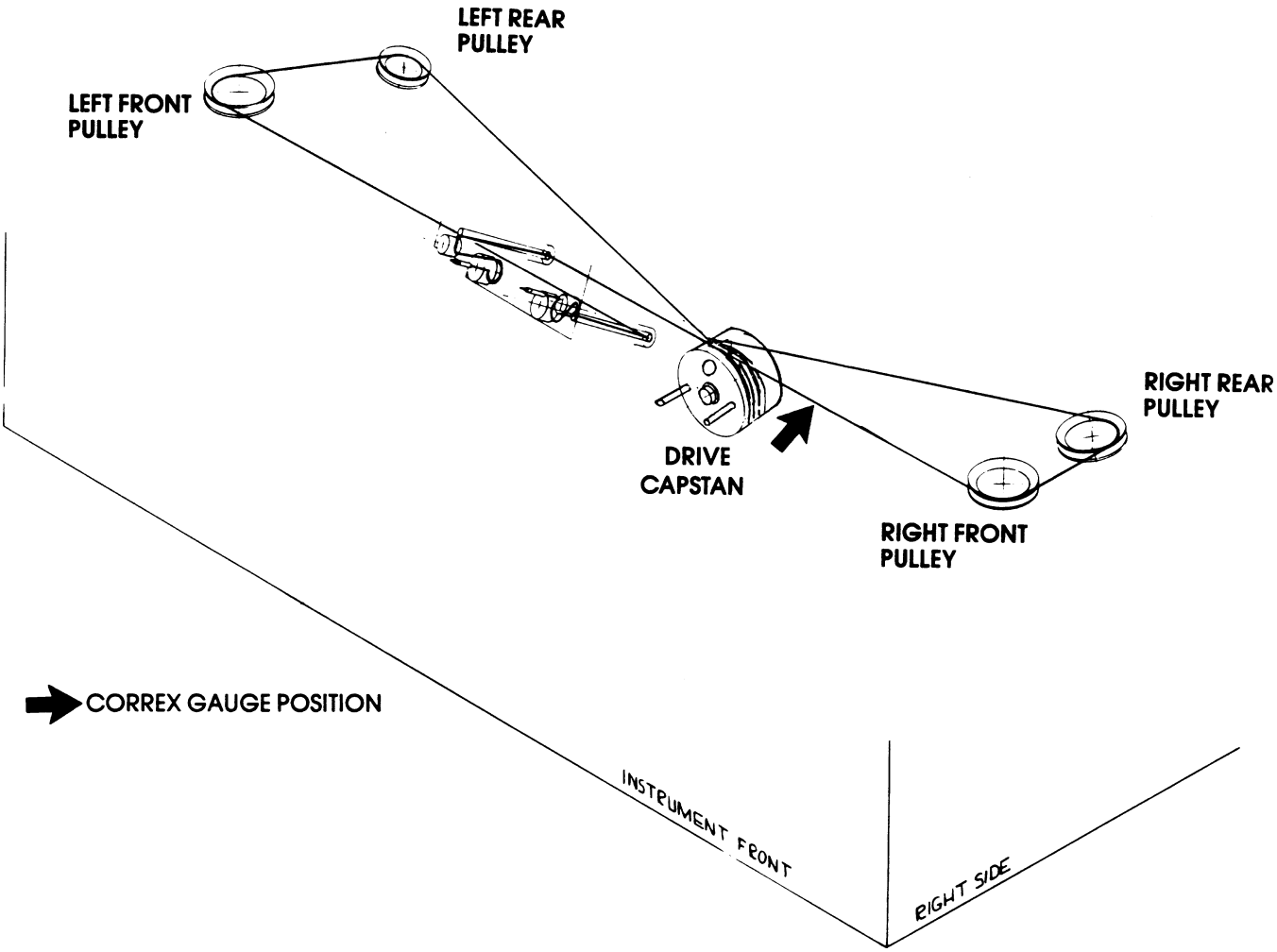


Figure 5.4.6d Print head carriage cord routing

Release the other half of the cord from the motor and, with reference to figure 5.4.6d, pass this end of the cord anti-clockwise round the rear and front left-hand pulleys, and across the rear of the print head carriage assembly.

With reference to figure 5.4.6a, above, pass the free end of this cord forwards through hole ‘E’, and pass it anti-clockwise round clamp A, about 1/2 a turn. Gently tighten clamp ‘A’.

Crimp a brass ferrule onto the end of the cord (figure 5.4.6c shows an example). Rotate tensioning capstan ‘C’, until its slot faces downwards. Insert the cord into this slot, such that the ferrule is in contact with the face of the tensioning capstan (figure 5.4.6a). Rotate the tensioning capstan clockwise to take up the slack.

Tension the cord as described in section 5.4.8 below.

5.4.7 Ribbon Cartridge Carriage re-cording (Original design)

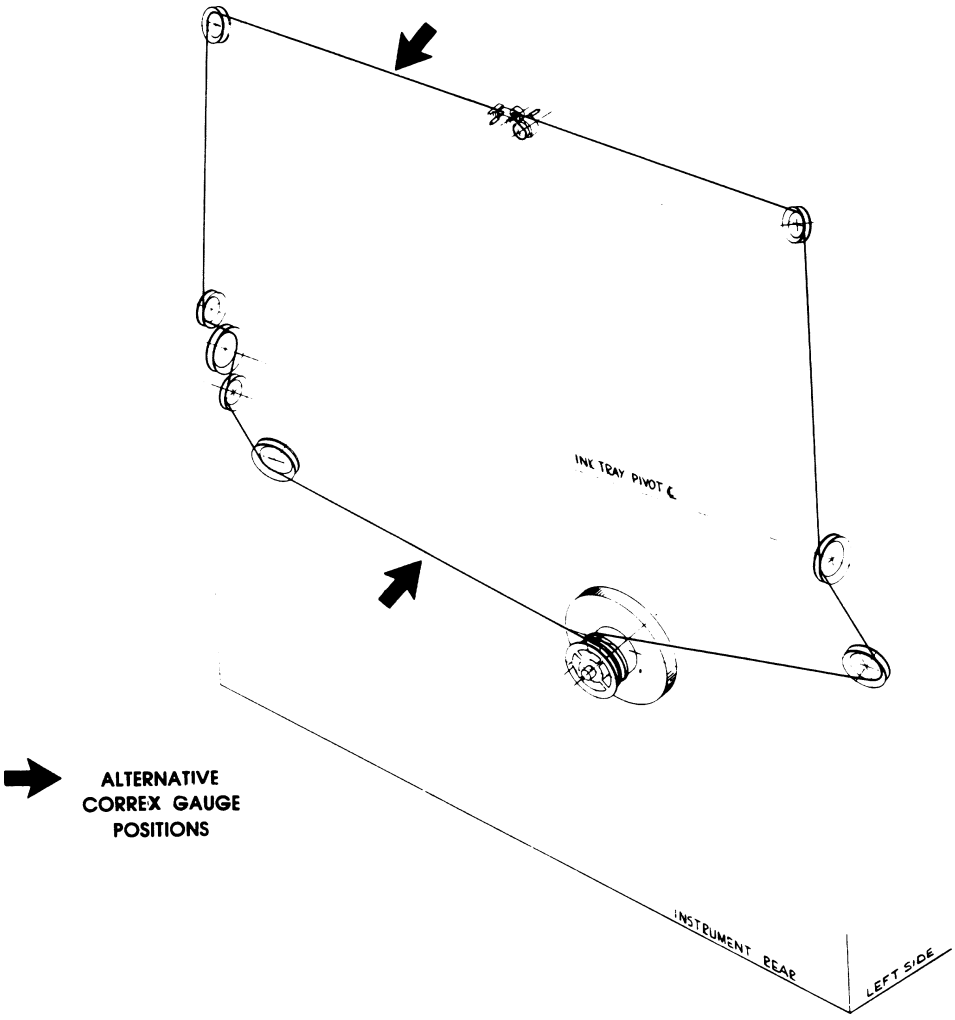


Figure 5.4.7a Ribbon cartridge cording

EXISTING CORD REMOVAL

The ribbon cartridge carriage cord is anchored at the carriage (two places) and at the colour select capstan, accessible from the rear of the chassis.

Release the cord clamp (figure 5.4.7b) and release the left-hand end of the cord by rotating the cord tension capstan clockwise. Un-crimp or cut off the brass ferrule attached to the cord. Remove the other end of the cord from its anchoring slot, and remove its ferrule.

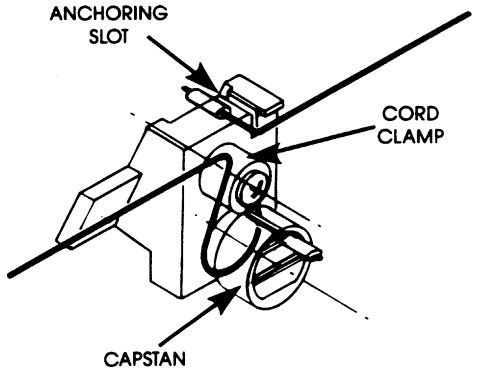


Figure 5.4.7b Cord anchoring

5.4.7 RIBBON CARTRIDGE CARRIAGE (Original design) (Cont.)

Rotate the chassis to gain access to the colour select capstan. Work the ends of the cords out of the capstan, pull them clear and discard them.

Inspect the ribbon cartridge carriage assembly and if necessary, remove and clean the guide rail and carriage bearings. Check that the side force necessary to move the ribbon cartridge carriage assembly along the length of the guide rail lies within the range 100 to 130 cN. If not, adjust the fit by releasing the locking screws and rotating the adjustment screws. Ensure that there is no 'rock' between the carriage and the guide rail, then tighten the locking screws. Re-fit the guide rail.

NEW CORD INSTALLATION

Fold the new cord 2 cm from its centre, to give a 4cm difference in the length of the two sections. Use pliers to obtain as small a fold as possible.

Work a brass ferrule over the fold, until the fold just appears at the outer end of the ferrule. Use pliers to crimp the ferrule to the cord (figure 5.4.6c, above shows an example).

> Note: It may assist in the above operation if, once the cord fold has been partially inserted by hand, the cord is gripped in pliers, about 3 mm below the ferrule; then whilst the pliers are held on a hard surface, with the ferrule vertical, the ferrule is tapped home.

Pass the ends of the cord through the hole in the colour select capstan, starting from inside the capstan.

Take the shorter end of the cord, and with the capstan hole 'pointing' upwards, make two complete turns anti-clockwise (as viewed from the rear of the instrument) round the capstan. The cord should be wound from the capstan hole towards the rear of the instrument (i.e. away from the motor support plate), and should leave the capstan at the top.

Use a length of self-adhesive tape to fix the cord to the capstan, temporarily.

Pass the end of the cord through the pulley slot on the right hand side of the instrument (as viewed from the front) such that the cord passes clockwise round the pulley.

Viewing the right hand side of the instrument, and with the writing system open, wind the cord round the three constant tension pulleys as shown in figure 5.4.7a, and crimp a ferrule onto the end of the cord.

Take the cord round the front right hand pulley, and whilst maintaining tension, and using tweezers as necessary, insert the cord into its anchoring slot on the underside of the ribbon cartridge carriage assembly, as shown in figure 5.4.7b, above.

Slide the carriage to the left, to tension the cord sufficiently to prevent its slipping out of the pulleys, and temporarily fix the carriage to the guide rail using adhesive tape.

Take the longer end of the cord, and with the capstan hole 'pointing' upwards, make two complete turns clockwise (as viewed from the rear of the instrument) round the capstan. The cord should be wound from the capstan hole towards the front of the instrument (i.e. away towards the motor support plate), and should leave the capstan at the top.

Use a length of self-adhesive tape to fix the cord to the capstan, temporarily.

Pass the end of the cord through the pulley slot on the left hand side of the instrument (as viewed from the front) such that the cord passes clockwise round the pulley.

5.4.7 RIBBON CARTRIDGE CARRIAGE (Original design) (Cont.)

Pass the cord round the front, left-hand, hinge pulley and the front left-hand pulley and, whilst maintaining tension on the cord, crimp a ferrule onto the cord end.

With reference to figure 5.4.7b above, wind the cord clockwise round the cord clamp, and with the slot in the cord tensioning capstan pointing downwards, inset the cord into the slot.

Rotate the tensioning capstan anti-clockwise to take up the tension in the cord.

Remove the adhesive tape from the colour select drive capstan and from the ribbon cartridge carriage assembly. Use the cord tensioning capstan to take up any slack in the cords. Tighten the cord clamp.

5.4.8 Cord tension checks (original design)

Note: Although figure 5.4.7a shows alternative Correx gauge positions with the writing system open, the checks detailed below must be carried out with the writing system closed (both cords).

RIBBON CARTRIDGE CARRIAGE

Close the writing system and slide the carriage assembly to approximately the centre of travel. Rotate the instrument to gain access to the colour select capstan.

At a point half way between the capstan and the left side-plate (as viewed from the rear of the instrument) use a Correx gauge to deflect the cord 10 mm. The Correx reading should lie between 550 and 600 cN.

If the reading lies outside this range, re-tension the cord, using the cord clamp and tensioning capstan on the carriage assembly. Re-test, ensuring that the writing system is closed.

Repeat until the cord tension lies within the specified range.

PRINT HEAD CARRIAGE ASSEMBLY

Set the print head carriage to mid travel on the guide rail. At a point mid-way between the print head carriage and the right-hand side plate (as viewed from the front) use a Correx gauge to deflect the cord 10 mm. The Correx reading should lie between 440 and 500 cN.

If the tension is incorrect, adjust it using either clamp A/ tensioning capstan C or clamp B/tensioning capstan D

Refer to the following Colour Select setting up procedure, (section 5.4.9 below).

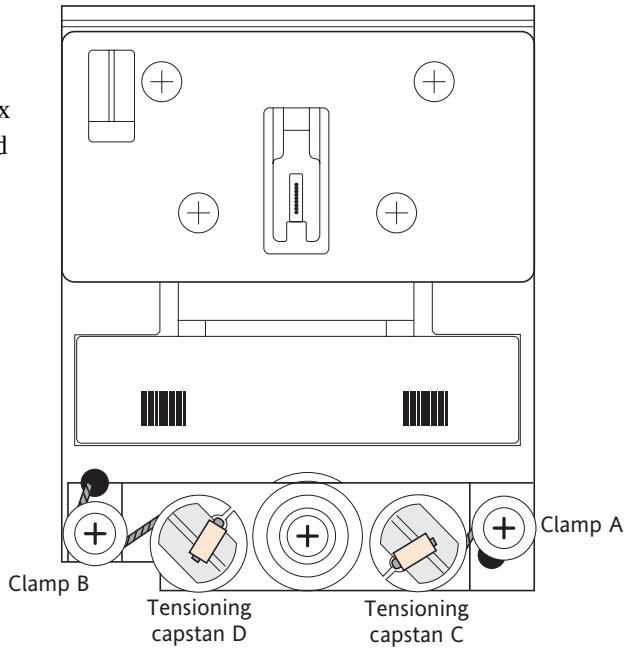


Figure 5.4.8 Cord tension components

5.4.9 Colour select setting up procedure

This procedure is valid only when the two carriages are corded, and the cords correctly tensioned, as described in sections 5.4.1 to 5.4.8 above.

Fit a ribbon cartridge, close the writing system and move the carriages to approximately their centre of movement.

Carefully slide the print head carriage assembly to both ends of its clutch travel, and observe the end-of-travel positions of the needle array relative to the edge of the ribbon cartridge. When correctly set up, the needle head should stop an equal distance from the nearest edge of the ribbon cartridge, both sides. (See figure 5.4.9.)

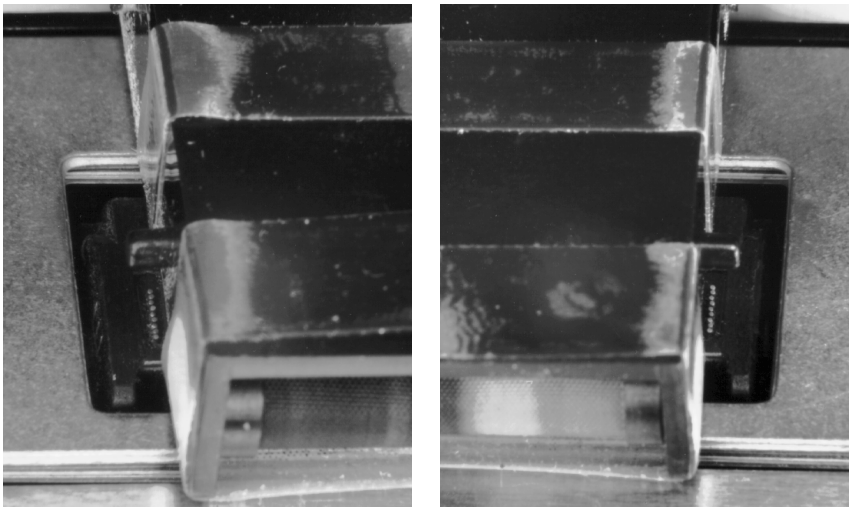


Figure 5.4.9 Print needle array location *versus* ribbon cartridge edge

PRINT NEEDLES TOO MUCH TO THE LEFT

Refer to figure 5.4.8 as necessary.

If the print head moves too much to the left, rotate capstan ’C’ anticlockwise. Release clamps ‘A’ and ‘B’ and rotate capstan ‘D’ clockwise to take up the slack. Whilst maintaining tension, tighten clamps ‘A’ and ‘B’ and re-check.

Repeat the procedure as necessary.

Check the print carriage cord tension, and adjust if necessary.

Repeat the above, until both print head position and cord tension are correct.

PRINT NEEDLES TOO MUCH TO THE LEFT

Refer to figure 5.4.8 as necessary.

If the print head moves too much to the right, rotate capstan ’D’ anticlockwise. Release clamps ‘A’ and ‘B’ and rotate capstan ‘C’ clockwise to take up the slack. Whilst maintaining tension, tighten clamps ‘A’ and ‘B’ and re-check.

Repeat the procedure as necessary.

Check the print carriage cord tension, and adjust if necessary.

Repeat the above, until both print head position and cord tension are correct.

5.4.10 Re-assembly

Re-fit the top cover and re-install the grounding wire, ensuring that the shake-proof washers are correctly positioned.

Carry out a continuity check between the chassis base plate and the following areas:

1. Inside of writing system top cover
2. Keyboard backing plate
3. Ribbon cartridge guide rail and its support plate.
4. Print head and the print head heatsink
5. Servo colour select motor housing.

Should any of the above checks show a resistance value of more than 10 Ohms, the reason for this should be investigated and the cause rectified before the instrument is returned to service (see section 5.12).

Taking all necessary precautions against damage due to static electrical discharge, re-fit the control board. With reference to section 3.8 of this manual, as necessary, re-make all the control board connectors except that which connects the control board to the mother board (in the case assembly), ensuring correct position and orientation.

Fit the access system onto the slider rails in the case, and pull it forwards until it is stopped by the safety stops. Swing the access system open and re-fit the ribbon cable clamp.

> Note: On some versions of the recorder, this ribbon cable clamp (for the mother board cable) is not fitted. The ribbon cable is held by a cut out in the recorder chassis, instead.

Reconnect the mother board ribbon cable, and swing the access system shut.

Fit a chart, and carry out the opto setting up procedure described in section 5.5, below.

5.5 SETTING UP THE OPTICAL ASSEMBLIES

5.5.1 Original design

The setting up procedures described below, require the status of the recorder to be as follows:

1. Recorder fully assembled
2. Line power applied
3. Ribbon cartridge and print head carriage assemblies correctly corded
4. Chart and ribbon cartridge fitted
5. Access system swung out to allow access to the control board, and to the power on-off button on the power supply
6. Printer switched off at the chart control panel.

EQUIPMENT REQUIRED

1. Single channel oscilloscope (1MHz min.) fitted with x1 or x10 probe.
2. Trimming tool for adjusting circuit board mounting potentiometers
3. Acrylic-based sealing compound.

EDGE DETECTOR

Referring to figure 5.5.1a, locate potentiometer P5, Test point TP1 and capacitor C32.

Rotate P5 adjustment fully anti-clockwise.

Connect the oscilloscope probe between the lower (negative) end of C32 (signal ground) and TP1. set the oscilloscope controls to 1V/division an 0.5msec/division.

Carefully remove any paper dust etc. from the edge detector. Slide the top carriage to the extreme left of its travel.

Adjust P5 to give a reading of approximately 4 Volts on the oscilloscope.

Slide the carriage assemblies to approximately the centre of the chart, ensuring that the ribbon cartridge is centred about the print head carriage assembly.

Adjust P5 to give 1 Volt at TP1, or to the maximum possible if 1 Volt cannot be achieved. If the voltage at TP1 is greater than 1 Volt, the edge detector is faulty and the optical system should be replaced.

When adjustment is complete, seal P5 with an acrylic-based sealing compound.

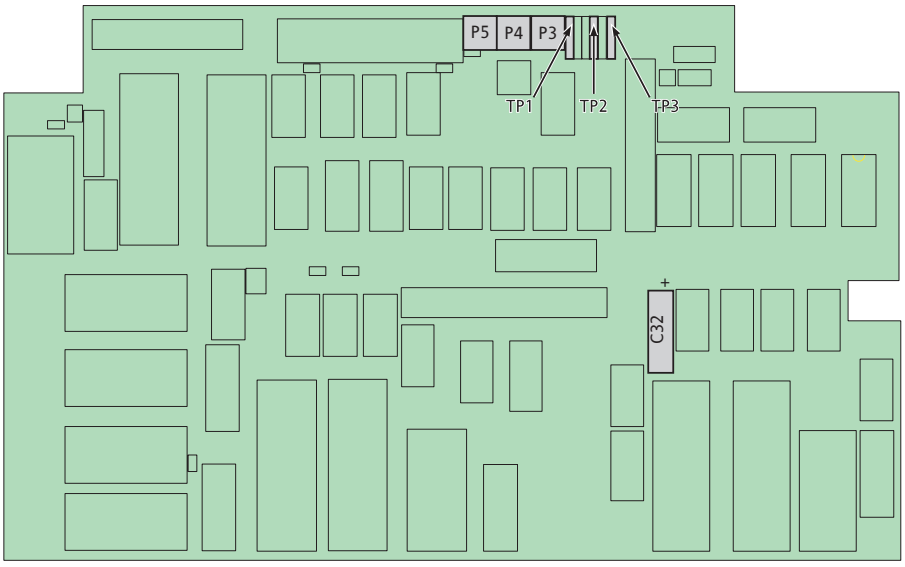


Figure 5.5.1a Potentiometers and test points on the Mark I control board

5.5.1 ORIGINAL DESIGN (Cont.)

FEEDBACK STRIP

Referring to figure 5.5.1a, locate potentiometer P4, test point 2 and capacitor C32.

Rotate P4 adjustment fully anti-clockwise. Connect the oscilloscope probe between the lower (negative) end of C32 (signal ground) and TP2. Adjust P4 to give a wave form of approximately four volts peak-to-peak, when the ribbon carriage and print head carriage assemblies are moved from one end or their travels to the other, by hand, taking about 2 seconds in each direction.

Ensuring that the carriage movement is not impeded by the operator, switch the recorder off, then on again by operating the push button on the front of the power supply unit. Observe the oscilloscope trace as the print head traverses the chart. Adjust P4 such that the discontinuity in the waveform (figure 5.5.1b) occurs at a point between 1.5 v and 2.5 V. Power cycle the recorder as necessary, in order to complete this adjustment.

Note: Adjustments to P4 are read by the recorder only at power up. Thus, in order to see the effects of any adjustment the instrument must be power cycled after the adjustment.

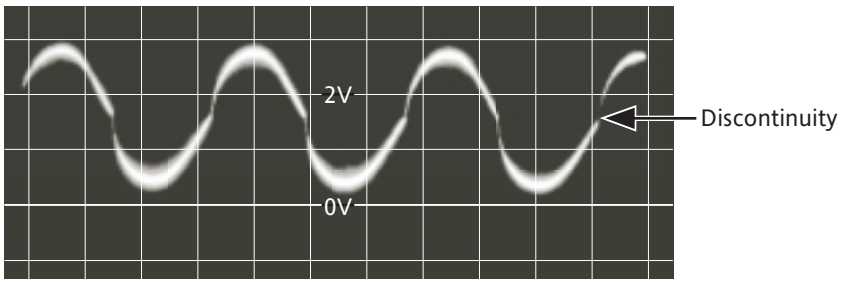


Figure 5.5.1b Opto wave form

Repeat the above for Potentiometer P3 and test point TP3

When adjustment is complete, seal P3 and P4 with an acrylic-based sealing compound.

5.5.2 Current design

There are no setting up procedures for the current design of control board. The waveforms and voltage outputs can however be checked, by use of test points E, F, G and P, as detailed in section 3.8, above.

Test point P is 0V (5V ground)

Test points E and F monitor the feedback strip opto returns, which should have a waveform similar to that shown in figure 5.5.1b, above.

Test point G represents the edge-detect opto output and should be 4.5V at the extreme left of travel, and 0.5 V at, say, chart centre.

Test points H, I and J (edge detect), monitor the voltage supply to the opto devices.

5.6 SERVO / COLOUR SELECT MOTOR REPLACEMENT

5.6.1 Equipment required

1. Allen (hex socket) key: 1.5mm AF
2. Pozidriv screwdriver No.2
3. Slotted-head screwdrivers, 2 mm. and 4 mm. blade width
4. Nut runners or open ended spanners (wrenches) to fit M3 and M4 nuts.
5. Ohms-measuring meter to read to less than 10 Ohms
6. Static-safe bag, suitable for the control board
7. Snipe-nosed pliers
8. Tweezers
9. Correx gauge to measure up to 600 cN

5.6.2 Removal

Remove the drive cords from the ribbon cartridge and the print head carriage assemblies, as described in the relevant parts of section 5.4, above. Ensure that the grounding lead (if any) and the motor and clutch cable harnesses are free to move.

Remove the servo / colour select motor assembly by removing its four securing screws, retaining all fixings for use in re-assembly.

5.6.3 Replacement

Fit the new motor assembly, feeding the motor/clutch cable harness through the aperture in the rear support bracket (located directly behind the chart drive motor). Secure the motor using the fixings previously removed.

Re-cord the ribbon cartridge and print head carriages as described in section 5.4, above. Carry out the cord tension checks, colour select setting up procedure etc., described in the relevant parts of that section.

5.7 CHART DRIVE MAINTENANCE

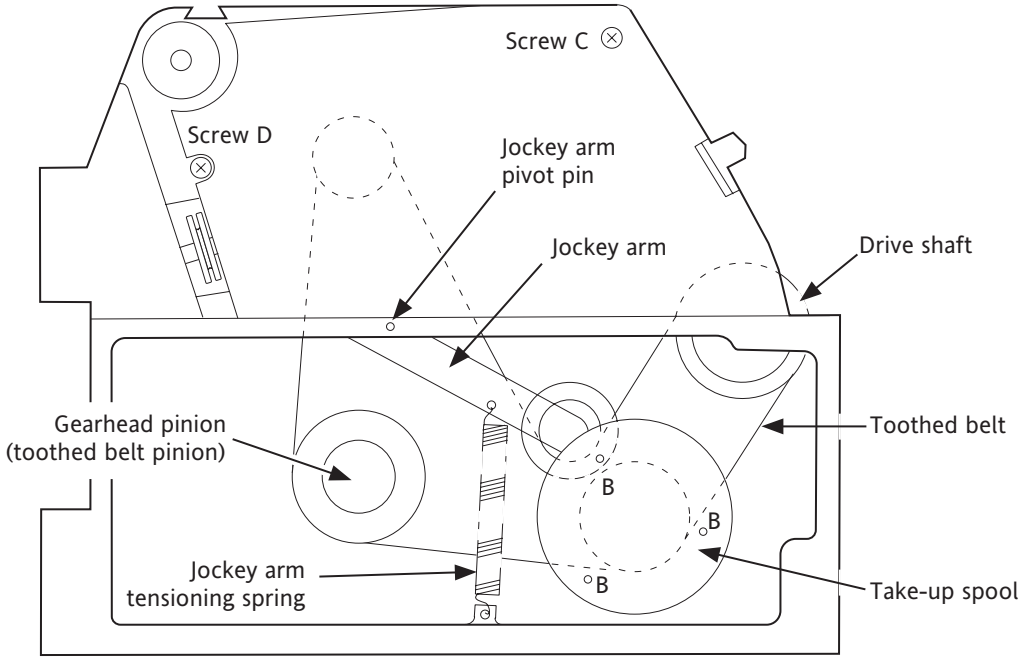


Figure 5.7 Chart drive arrangement (cover plate removed)

5.7.1 Equipment required

1. Nut runners, or open ended spanners (wrenches) to fit M3 and M4 nuts.
2. Pozidriv screwdrivers Nos 1 and 2.
3. Slotted-head screwdriver, 4 mm blade width
4. Slotted-head 'Stubby' screwdriver, 4 mm blade width
5. Pin Punch (2 mm) diameter
6. Allen (hex socket) key: 1.5mm AF

Notes
1. Directions (left, right, front, rear etc.) are with the instrument standing on its base, facing the operator.
2. This procedure describes the dismantling of the chart drive area of the recorder. Only those parts of the procedure which are relevant to the user's needs should be followed. Section 5.7.3 provides replacement/ re-assembly instructions.

5.7.2 Disassembly procedure

Isolate the recorder from line power and pull the access system forwards out of its case, until it meets the safety stops. Open the writing system and remove the chart and ribbon cartridge.

Close the writing system, and swing it out on its hinged bar to reveal the control board. Release the ribbon cable connector which connects the ribbon cable (from the mother board) to the control board. Release the clamp which holds the ribbon cable to the access system, and remove the access system from the recorder case.

Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

Disconnect the control board connectors from the control board. Remove the control board, retaining all fixings, and place the control board in a static-safe bag. Remove the chassis base plate.

5.7.2 DISASSEMBLY PROCEDURE (Cont.)

CHART DRIVE MOTOR

The chart drive motor may now be removed by disconnecting the control board connector, and removing the four screws securing the motor to the adapter plate.

TAKE-UP SPOOL

Refer to figure 5.7, as necessary.

With the chassis lying on its right side plate, remove the screws holding the side plate to the chassis, and the screws ('B' in figure 5.7) which secure the take-up spool to the cover plate.

Remove the cover plate, ensuring that any shims are retained for use in re-assembly. Disengage the jockey arm spring from the jockey arm. Disengage the take-up spool from the toothed belt.

CHART DRIVE GEARHEAD

If required, the adapter plate and the chart drive gearhead may now be removed. To remove the toothed-belt pinion from the gearhead spindle, use a 1.5 mm AF Allen key.

DRIVE SHAFT, CHART GUIDE AND TOOTHED BELT

Refer to figure 5.7, as necessary.

Remove the inner chassis liner by springing it out of its locating slots.

Release the spring-loaded clips holding the transparent chart guide to the front of the instrument.

Remove the screws which retain the front plate. Release the tear-off cord from its retaining spring behind the front plate. Remove the front plate.

Release the left end of the print head guide rail by removing the screw which secures it to the left hand chassis side plate.

Remove the screws ('C' and 'D') which secure the chassis side plate to the upper chart guide and to the chassis.

The drive shaft and/or chart guide can now be replaced, if required.

If the toothed belt is to be replaced, use a 2mm pin punch to remove the pin securing the jockey arm to the side plate and remove the jockey arm. Remove the drive shaft, to allow the new belt to be inserted (see figure 5.7 for belt routing).

Re-fit the jockey arm, using the pin previously removed.

5.7.3 Re-assembly procedure

DRIVE SHAFT AND CHART GUIDE

Refer to figure 5.7, as necessary.

Work the non-toothed end of the drive shaft into its right hand bearing. Ensuring that the transparent chart guide and the lower chart guide are retained, re-fit the drive shaft into its left hand bearing.

Secure the left-hand side-plate using screws ‘C’ and ‘D’, previously removed.

Re-fit the print head guide-rail securing screw and the front plate. Re-fit the spring loaded retaining clips to the transparent chart guide, and re-attach the chart tear-off cord to the spring located on the rear face of the front cover.

Check that the pinch rollers attached to the chart guide are in position and are free to rotate (when the chart guide is eased away from the drive shaft).

Re-fit the inner chassis liner, ensuring that it fits into all its retaining slots.

CHART DRIVE GEARHEAD/MOTOR

If previously removed, re-fit the drive-motor gearhead to the chassis. Re-fit the toothed-belt pulley to the gearhead shaft, ensuring that it is securely fixed by its securing screw.

Fit the adapter plate to the gearhead.

Caution

The following procedure must be carried out with care and delicacy to ensure that neither the motor pinion nor the first-stage gearhead teeth are damaged during the assembly process.

Refit the drive motor to the adapter plate, taking care not to damage the motor pinion or the first stage gearhead teeth when inserting the motor pinion into the gearhead.

TOOTHED BELT

Refer to figure 5.7, as necessary.

Re-fit the toothed belt round the gearhead, drive-shaft, pay-off spool and jockey-arm pinions.

TAKE-UP SPOOL

Work the take-up spool in between the jockey arm and the drive shaft, taking care to engage the toothed belt with the teeth on the take-up spool pinion. Re-fit the jockey-arm spring.

Fix the cover plate to the take-up spool, ensuring that any shims previously removed are re-fitted. Reattach the cover plate to the side of the chassis.

5.7.4 Finishing off

Re-fit the chassis base.

Taking note of the static handling precautions outlined in section 5.1, re-fit the control board, and referring to section 3.8 as necessary, re-make all the control board connectors (except that which connects with the mother board inside the recorder case).

Re-fit the access system to the slider rails in the case, and pull it forward until it is stopped by the safety stops. Swing the access system open and re-fit the ribbon cable clamp to the access system.

> Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

Refit the ribbon cable connector and swing the access system shut.

Fit a chart and a ribbon cartridge and push the access system into the case.

5.8 CHART CONTROL PANEL REPLACEMENT

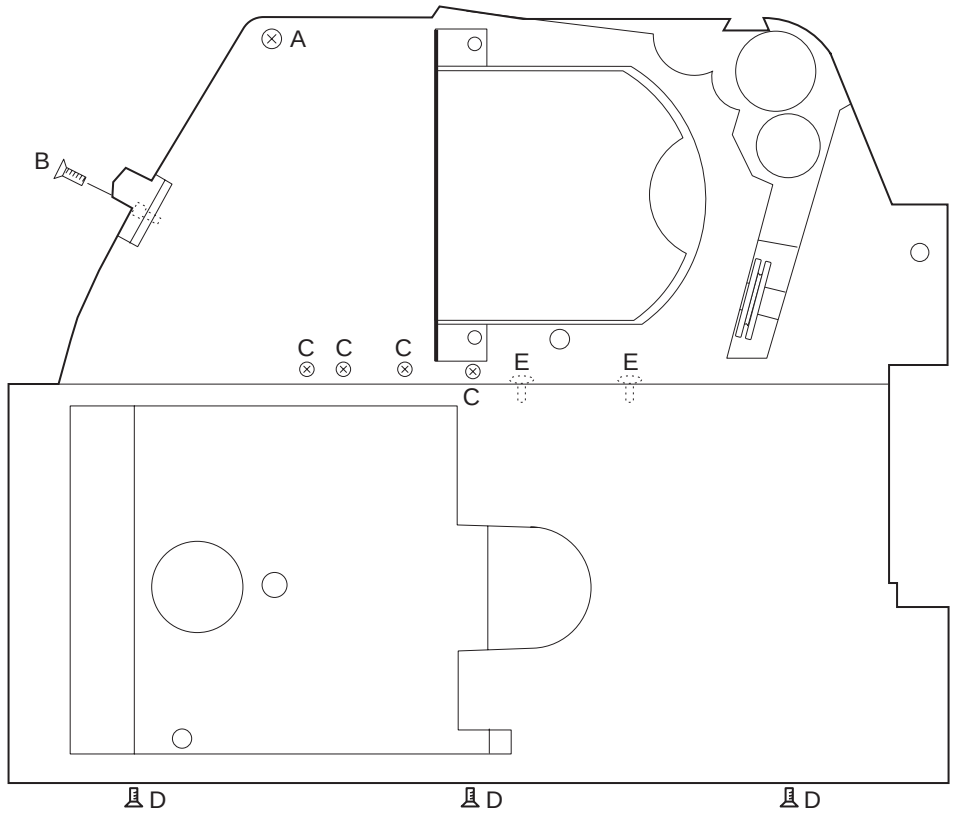


Figure 5.8 Writing system - right-hand side

5.8.1 Equipment required

1. Pozidriv screwdrivers Nos 1 and 2.
2. Slotted-head screwdriver, 2 mm blade width
3. Tweezers (or similar) to remove chart control panel label
4. Snipe-nosed pliers (small)

5.8.2 Removal procedure

Note: Unless otherwise stated, directions (left, right, front, rear etc.) are with respect to the instrument standing on its base, facing the operator.

Caution

Please refer to section 5.1 regarding static handling precautions

Isolate the recorder from line power and pull the access system forwards out of its case, until it meets the safety stops. Open the writing system and remove the chart and ribbon cartridge.

Close the writing system, and swing it out on its hinged bar to reveal the control board. Release the ribbon cable connector which connects the ribbon cable (from the mother board) to the control board. Release the clamp which holds the ribbon cable to the access system, and remove the access system from the recorder case.

Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

5.8.2 REMOVAL PROCEDURE (Cont.)

Disconnect the chart control panel connector (CON 300 or CON 1) from the control board (section 3.8).

Remove screws D (figure 5.8) which secure the chassis base plate to the right-hand side plate,

Release the spring loaded clips holding the transparent chart guide.

Remove the front plate, releasing the spring that holds the tear-off cord to the front plate.

Using pointed tweezers, or similar, peel off the self-adhesive chart control panel label.

Gently push the chart control panel forwards off its adhesive tape, and out of the aperture. If a discrete grounding wire is fitted, release this wire from the rear of the chart control panel.

Remove the screw (‘B’ in figure 5.8) which holds the print head guide rail to the writing system right hand side plate.

Remove the upper chart guide securing screw (‘A’ in figure 5.8).

Slacken screws ‘C’ by about three turns each.

Ease the writing system right-hand side plate outwards, sufficiently to allow the drive shaft to be released from its right-hand bearing. Care should be taken to ensure that the lower chart guide and the transparent chart guide are retained in their bearings.

Release the chart control harness fro the retaining slots in the chassis side plate, noting the way in which the ribbon cable is folded along its length.

The chart control panel can now be removed by pulling the panel and its harness forwards through the panel aperture.

5.8.3 Replacement procedure

Note: Later versions of the chart control panel have the static grounding link incorporated as a part of the chart control panel harness. Thus if a chart control panel of the original design (i.e. with a discrete grounding wire) is being replaced by one of the later design, the existing grounding wire may be dispensed with. The later design may be recognised by the existence of a grounding link between the chart control panel and the chart control circuit board.

If a discrete grounding wire is to be retained, clamp this wire behind the new chart control panel using the top circuit board retaining screw.

Pass the replacement chart control panel through the aperture in the chassis, and secure it using double-sided adhesive-tape, if necessary.

Fold the chart control harness in half, along its length, and route the folded harness as shown in figure 5.8.3. If a discrete grounding wire is fitted, ensure that his wire is in place, between the ribbon cable and the chassis side plate.

Pass the chart control harness connector through its aperture in the rear of the chassis and make the connection with CON 300 (CON 1) on the control board.

Re-fit the drive shaft into its right-hand bearing. Re-fit screws ‘A’ and ‘B’, and re-tighten screws ‘C’ (figure 5.8).

5.8.3 REPLACEMENT PROCEDURE(Cont.)

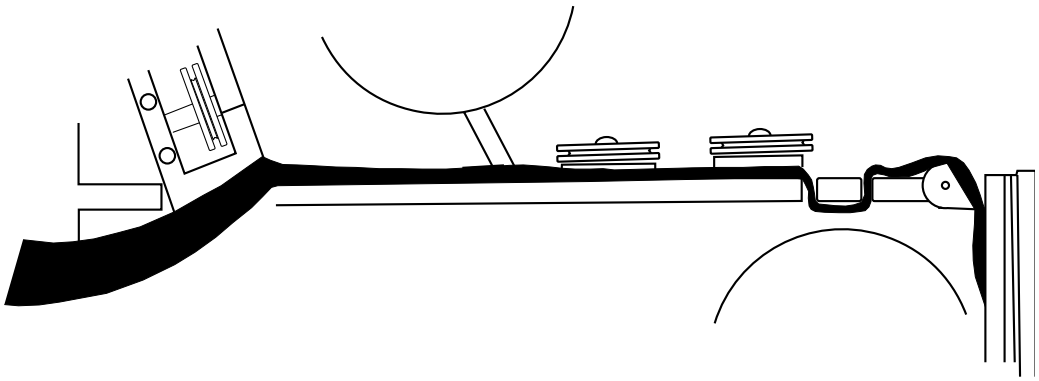


Figure 5.8.3 Chart control harness routing

5.8.4 Finishing off

Re-fit the front plate and re-attach the tear-off cord to the front plate spring. Re-engage the spring -loaded clips to secure the transparent chart guide.

Re-fit screws ‘D’ (figure 5.8) to secure the chassis base plate to the right hand side plate. Ensure that the chassis is square whilst tightening these screws.

Carry out a continuity check between the chassis base plate and a) the chart control panel and b) the inside of the writing system top cover. Should either check show a resistance of more than 10 Ohms, the reason for this must be investigated and the cause rectified before the instrument is returned to service (see section 5.12).

Re-fit the access system onto its slider rails in the case, and pull it forwards until it is stopped by its safety stops. Swing the access system open and re-fit the ribbon cable clamp to the access system.

Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

Refit the ribbon cable connector and swing the access system shut.

Re-fit the Chart Control Panel label.

5.9 KEYBOARD, DISPLAY AND CHART ILLUMINATION ASSEMBLY REPLACEMENT

5.9.1 Equipment required

1. Pozidriv screwdrivers Nos 1 and 2.
2. Slotted-head electrician's screwdriver, 2 mm blade width
3. Meter capable of reading resistances of less than 10 Ohms.
4. Lint-free cloth
5. Small quantity of iso-propyl alcohol

5.9.2 Keyboard panel and chart illumination assembly removal

Isolate the recorder from line power, open the case door and pull the access system forwards out of the case until it meets its safety stops.

Peel back the corners of the foam rubber bezel which surrounds the front surface of the keyboard panel, to reveal a screw at each corner.

Remove these screws and gently pull the keyboard panel away from the chassis, allowing the left-hand end of the panel to rest on the work bench, in front of the recorder.

CHART ILLUMINATION ASSEMBLY REPLACEMENT

If the chart illumination assembly is to be replaced, the following should be noted:

Caution

Earlier versions of the chart illumination assembly (DN236678) are fitted with 24 Volt clear glass bulbs to illuminate the chart. Later chart illumination assemblies (DN238760) contain long-life, 5V, frosted bulbs.

If the assembly to be replaced is fitted with frosted bulbs, then the recorder is of the later design, or it has already been modified, in which case, the rest of this section (5.9) should be followed.

If the assembly to be replaced is fitted with clear bulbs, than a modification to the display circuit board is necessary before the new chart illumination assembly may safely be installed. Refer to the display modification procedure given in section 5.14.

PROCEDURE

Ease the assembly extrusion away from the chassis, starting at the right-hand end.

Fit the new extrusion onto the chassis and connect the harness connector to the display board. It should be noted that this two-way connector can be connected to any adjacent pair of the four pins which form the fixed part of the display board connector.

5.9.3 Removal of the keyboard and the display board

Use a small screwdriver or similar to release the keyboard panel flexi cable connector from the adhesive pad that secures it to the display board. Disconnect the connector and remove the keyboard panel.

Open the writing system and remove the ribbon cartridge. Close the writing system.

Swing the access system open on its hinged bar. Remove the writing system top cover, ensuring that the fixings associated with the grounding wire are retained.

Release the three screws which secure the ribbon cartridge carriage assembly guide rail to its support plate. Slide the rail out of the ribbon cartridge carriage assembly, and lay the rail to one side. The ribbon cartridge carriage may be allowed to hang from its drive cord.

Remove the display board ribbon cable connector (CON 2 - 20-way) from the control board.

Unclip the plastic, cable-retaining bracket and remove the display board ribbon cable and grounding harness from the adhesive pads which secure them to the inside of the writing system right-hand side plate. Disengage the ribbon cable from the slots in the retaining bracket (figure 5.9.3), and lay the bracket to one side for use in re-assembly. Close the access system on its hinged bar.

Figure 5.9.3 Ribbon cable retaining bracket

Disconnect the chart illumination harness connector from the display board.

Work the display board ribbon cable forwards through the aperture in the support plate, ensuring that the cable is not damaged by chafing against the aperture sides. Pull the ribbon cable connector through the aperture and remove the display board by lifting it out of its retaining slots.

5.9.4 Re-assembly procedure

DISPLAY BOARD

After ensuring that the display is the right way up, and facing forwards, slide the display board into its supporting slots. Carefully pass the ribbon cable connector and the ribbon cable through the aperture in the guide rail support plate, ensuring that the cable is not damaged by chafing against the sides of the aperture.

Re-fit the ribbon cable retaining bracket, ensuring that the ribbon cable and any grounding harness are fully retained. Feed the ribbon cable through the slots in the retaining bracket (figure 5.9.3), and connect the ribbon cable connector to the control board (Con 2).

RIBBON CARTRIDGE CARRIAGE ASSEMBLY

Inspect the ribbon cartridge carriage guide rail and if necessary, clean it with a lint-free cloth, moistened with a small amount of iso-propyl alcohol.

Inspect the ribbon cartridge carriage assembly guide rollers, and clean them if necessary.

Slide the guide rail into the ribbon cartridge carriage assembly and secure the guide rail to the display board backing plate.

KEYBOARD

Re-fit the top cover, ensuring that the grounding wire is correctly fitted.

Swing the access system closed on its hinged bar.

If not already fitted, fit the chart illumination assembly to the chassis and make the connection to the control board. This two-way connector may be fitted to any adjacent pair of the four pins which make up the fixed part of the display board connector.

Connect the flexi-cable connector of the keyboard panel to the display board. Press the cable connector onto the adhesive pad to ensure that the connector is retained.

Caution

The ‘flexi’ cable half of this connector has 12 ways. The fixed part of the connector (on the display board) has 11 ways. Ensure, when making this connection, that the connector halves line-up at the bottom end, and thus that the spare (12th) way of the flexi cable is at the top (figure 5.9.4)

Note: Top and bottom of the flexi-cable connector are defined with the keyboard panel upright and with no twists in the flexi-cable.

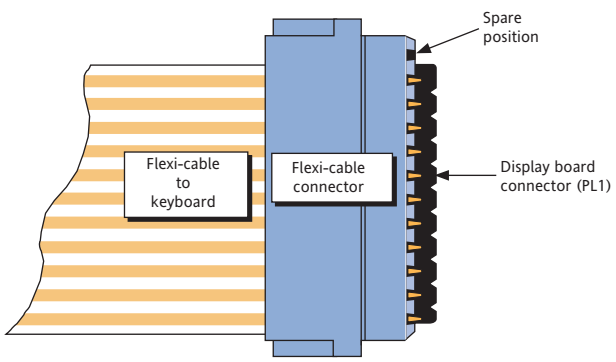


Figure 5.9.4 Keyboard flexi connector location

5.9.4 Re-assembly PROCEDURE (Cont.)

Re-fit the screws in the corners of the keyboard panel to secure the panel to the chassis. Ensure that the grounding wires are secured as before disassembly.

5.9.5 Finishing off

Carry out a continuity check between the recorder base plate and the following areas:

1. Inside of top cover
2. Display board backing plate
3. Ribbon cartridge guide rail.

If any of these checks reveals a resistance of >10 Ohms, the cause must be identified and the situation rectified before proceeding further (see section 5.12).

Fit a ribbon cartridge. Close the writing system and return the access system to the case, ensuring that the mother board ribbon cable is not fouled.

5.10 RECORDER CASE

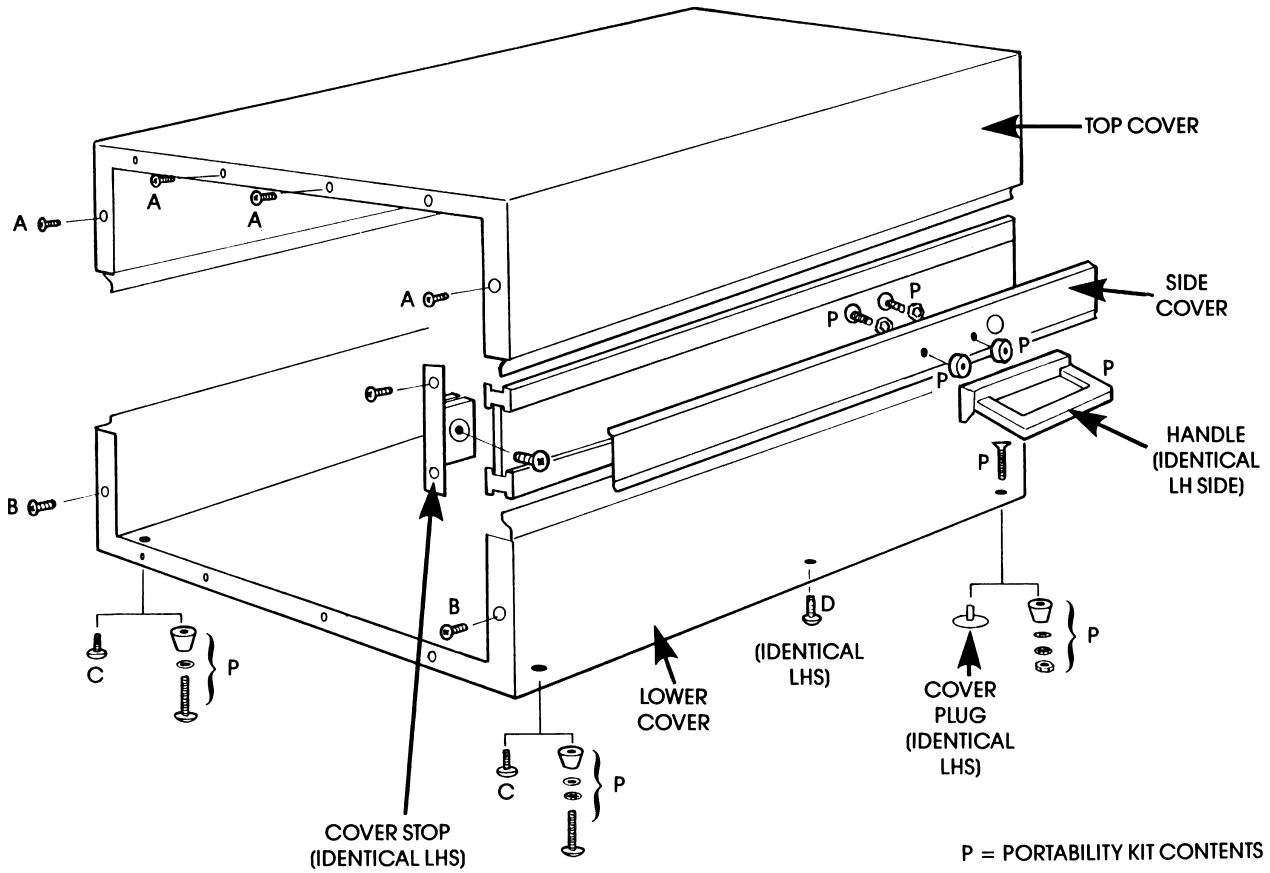


Figure 5.10 Case - exploded diagram (Rear view)

5.10 RECORDER CASE (Cont.)

WARNING!

Voltages applied to Signal interface module (SIM) terminations appear close to the front* edge of the dc input and RTD boards. It is thus essential that any hazardous voltages applied to the SIMS be isolated before any attempt is made to remove, to replace, or in any other way to come into contact with, such boards.

*That edge which is nearest the front of the recorder,

5.10.1 Introduction

This section (5.10) describes how to replace the top and bottom case cover parts of the case, and how to convert one case type (panel mount or portable) to the other.

5.10.2 Equipment required

1. Pozidriv screwdrivers Nos 1 and 2
2. Countersink bit - hand or power, as available.

5.10.3 Parts required

1. Portability kit (required only if converting the case to portable version.

5.10.4 Top cover replacement

Refer to figure 5.10 (above) as required.

In the new top cover, locate the holes for screws ‘A’ and countersink them if necessary.

Remove the recorder rear terminal cover and disconnect the line power connector.

Remove screws ‘A’ and retain for use in reassembly. Remove the left-hand and right-hand cover stops. Lift the rear end of the top cover slightly and pull it away from the recorder front bezel.

Take the new cover and guide it into the slots in the chassis side plates. Slide the new cover towards the front of the recorder until it locates into the front bezel.

Secure the cover using the screws ‘A’ previously removed.

Re-fit the cover stops. Re-connect the line power cord and re-fit the rear terminal cover.

5.10.5 Lower cover replacement

If the case is of the panel mounting type, follow the ‘Panel Mounting Case’ instructions below. If the case is of the portable kind (with rubber feet and side handles), follow the ‘portable’ case; procedure.

PANEL MOUNTING CASE

Refer to figure 5.10 (above) as required.

In the new lower cover, locate the holes for screws ‘`B’, ‘C’ and ‘D’ and countersink them if necessary (six holes altogether).

Remove the recorder rear terminal cover and disconnect the line power connector.

Refer to the Warning in section 5.10, above, before continuing.

Remove all SIMs from their mounting rail, and remove the recorder gland plate.

Remove the left-hand and right-hand cover stops.

Carefully turn the recorder onto one side and remove screws ‘B’, ‘C’ and ‘D’. Retain the screws for use in reassembly. Lift the rear end of the cover slightly and pull it away from the recorder front bezel.

Take the new cover and guide it into the slots in the chassis side plates. Slide the new cover towards the front of the recorder until it locates into the front bezel.

Secure the cover using the screws ‘B’, ‘C’ and ‘D’ previously removed.

Re-fit the cover stops, the gland plate and the SIMs. Re-connect the line power cord and re-fit the rear terminal cover.

PORTABLE CASE

In the new lower cover, locate the holes for screws ‘`B’ and countersink them if necessary (two holes altogether).

Remove the recorder rear terminal cover and disconnect the line power connector.

Refer to the Warning in section 5.10, above, before continuing.

Remove all SIMs from their mounting rail, and remove the recorder gland plate.

Remove the left-hand and right-hand cover stops.

Carefully turn the recorder onto one side and remove screws ‘B’ and ‘D’. Retain the screws for use in reassembly.

Unscrew the rearmost pair of rubber feet, and retain them for use in re-assembly.

Lift the rear end of the cover slightly and pull it away from the recorder front bezel.

Transfer the remaining (front) pair of rubber feet from the old cover to the new one.

5.10.5 LOWER COVER REPLACEMENT (Cont.)

Take the new cover and guide it into the slots in the chassis side plates. Slide the new cover towards the front of the recorder until it locates into the front bezel. Refit the rear-most pair of rubber feet.

Secure the cover using the screws ‘B’ and ‘D’ previously removed.

Re-fit the cover stops, the gland plate and the SIMs. Re-connect the line power cord and re-fit the rear terminal cover.

5.10.6 Case conversion

Refer to the WARNING in section 5.10, above, before proceeding.

Refer to figure 5.10 as necessary.

PANEL MOUNTING TO PORTABLE

Remove the writing system from the case, and place it safely to one side for use in re-assembly.

Remove the plastic cover plugs located towards the front edge of the lower cover, and replace them with rubber feet.

> Note: As shown in figure 5.10, the countersunk-head securing screw for each of these feet, is introduced from the inside of the cover, passes through the hole in the rubber foot and is secured by a washer, a toothed (shake-proof) washer and a nut. These screws are smaller than the rear foot screws

Carefully turn the case onto one side, remove screws ‘C’ and replace them with rubber feet.

> Note: As shown in figure 5.10, each securing screw is first passed through a toothed (shake-proof) washer, then through a plain washer and then through the hole in the rubber foot before being screwed into the case assembly.

Remove the rear terminal cover and the left-hand and right-hand cover stops. Slide the side covers out of their slots, and fit the carrying handle as shown (for the right-hand handle) in figure 5.10. (The left handle is fitted in an identical fashion.)

Return the side covers to their slots and re-fit the cover stops.

Re-fit the rear terminal cover and return the writing system to the case.

PORTABLE TO PANEL MOUNTING

Remove the writing system from the case, and place it safely to one side for use in re-assembly.

Remove the rear terminal cover, and the left-hand and right-hand cover stops. Slide the side covers out of their slots and remove the carrying handles. Return the side covers to their slots and re-fit the cover stops and rear terminal cover.

Remove the front pair of rubber feet and replace them with plastic cover plugs. Remove the rear pair of rubber feet and replace them with M2.5 x 12mm countersunk head or M3 x 30mm Pan Pozi screws, according to recorder version.

Return the writing system to the case.

5.10.7 Mother board replacement

Refer to the WARNING in section 5.10 before proceeding

EQUIPMENT REQUIRED

1. Long bladed Pozidriv screwdriver No. 1
2. Pozidriv screwdriver No. 2
3 Small tube of quick-setting adhesive

MOTHER BOARD REMOVAL

Note: This procedure involves the removal of recorder signal interface modules (SIMs) and I/O boards. Whilst bearing in mind that all circuit boards contain elements that are susceptible to damage from static electrical discharge, it is recommended that a means of identifying SIMs and I/O boards be used, in order to simplify the re-fitting process when reassembling the recorder.

Isolate the recorder and pull the access system forwards until it meets its safety stops. Open the writing system and remove the chart and ribbon cartridge.

Close the writing system, and swing the access system open on its hinged bar to reveal the control board. Release the ribbon cable connector which connects the ribbon cable from the mother board to the control board. Release the clamp* which secures the ribbon cable to the access system. Remove the access system and place it safely to one side.

*Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

At the rear of the case, remove the rear terminal cover. Remove the power cord connector. Unclip all SIMs. Remove the gland plate.

Inside the case, remove the circuit board retaining bar (figure 5.10.7). Release the power supply locking screw and remove the power supply module. After taking suitable precautions against damage due to static electrical discharge, remove all I/O boards, and place them in a static safe area.

Remove the case lower cover, as described in section 5.10.5.

Using the long-shafted screwdriver, and working from the front of the case, remove the eight screws which secure the mother board to the case. Ensure that any spacing washers are retained for use in reassembly.

Remove the mother board, together with its ribbon cable and connector.

Figure 5.10.7 Circuit board retaining bar - front view

5.10.7 MOTHER BOARD REPLACEMENT (Cont.)

REPLACEMENT MOTHER BOARD INSTALLATION

Take the spacing washers (if originally fitted) and using the minimum amount of adhesive possible, attach them to the two mother board mounting holes adjacent to the 25-way D-type connector.

Feed the ribbon cable connector and ribbon cable through the aperture at the rear left of the card cage. Use the eight screws previously removed to fit the new mother board to the inside of the case, but do not yet tighten the screws.

Insert an I/O board into slot 1 and, if necessary adjust the position of the mother board such that the I/O board connector mates correctly with associated mother board connector. With the I/O board still in place, repeat this process with the power supply module.

With the I/O board and the power supply module still in place, tighten those mounting screws that are still accessible. Remove the power supply module and the I/O board, and tighten the remaining screws.

Re-fit the case lower cover ensuring that the ribbon cable runs neatly between the side of the lower cover and the card cage.

Re-fit the power supply module and the I/O boards, ensuring that they are all pushed fully home. Re-fit the circuit board retaining bar, ensuring that this is correctly oriented (figure 5.10.7, above).

Re-fit the SIMs, the power supply cord connector, the gland plate and the rear terminal cover.

Re-fit the access system onto its slider rails in the case, and pull it forwards until it meets the safety stops. Swing the access system open to reveal the control board. Connect the mother board ribbon cable to the control board.

Re-fit the ribbon cable clamp to the access system.

> Note: This cable clamp is not fitted to all versions of the recorder. Where it is not fitted, the ribbon cable is held by a cut-out in the recorder chassis.

Fit a chart and ribbon cartridge and return the access system to the case, ensuring that the mother board ribbon cable is not fouled.

5.11 DOOR AND ACCESS SYSTEM CATCH REPLACEMENT

5.11.1 Door replacement

Note: If the replacement door proves difficult to latch closed, refer to the 'Door Catch Easing' subsection, following. The door should not be forced, as to do so will make the it extremely difficult to re-open.

Move the recorder to the edge of a bench, such that the front bezel overhangs. Locate the hole in the underside of the bezel, directly beneath the door lower pivot. Open the door, and whilst holding the door with one hand, insert a small screwdriver blade, or similar, into the hole, and push gently upwards to release the door.

To fit a new door, insert the upper pivot pin of the new door into its locating hole. Whilst gently pushing the door lower pivot towards its locating hole, use a small screwdriver blade, or similar, to maintain an upward pressure on the lower pivot pin, to allow it to slide into position.

DOOR CATCH EASING

Should the new door prove to be difficult to latch, the latch spring (figure 5.11.1a) in the door may be adjusted by inserting a 4 mm. or 5 mm. slotted head screwdriver between the arms of the spring and rotating the blade in order to widen the spring. This process should be continued until the door latches easily and opens without undue force having to be applied.

In certain circumstances, the door might not latch because of the thickness of the foam-rubber seal fitted round the recorder bezel. In such cases, a spacer should be inserted between the catch post (figure 5.11.1b) and the bezel.

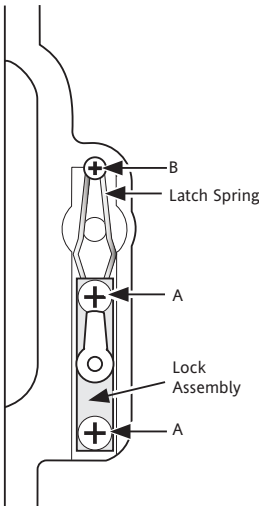


Figure 5.11.1a Door catch detail

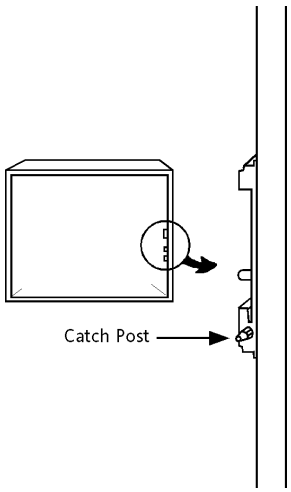


Figure 5.11.1b Catch post location

5.11.2 Latch Spring Replacement

Remove the door lock, by undoing the securing screws A (figure 5.11.1a). The spring can now be removed by undoing its securing screw 'B'. To re-assemble, the new spring is clamped using screw B, and the door lock is re-fitted (latch upwards) using screws 'A' to retain it.

5.11.3 Door lock replacement

Remove the door lock, by undoing the securing screws A (figure 5.11.1a). The new door lock is fitted (latch upwards) into the door and screws 'A' used to retain it.

5.11.4 Access system catch replacement

Note: The following procedure assumes that the access system can be withdrawn from the recorder case. Should this not be possible, as a result of the catch having failed locked, the removal of the catch can be carried out without removing the access system from the case.

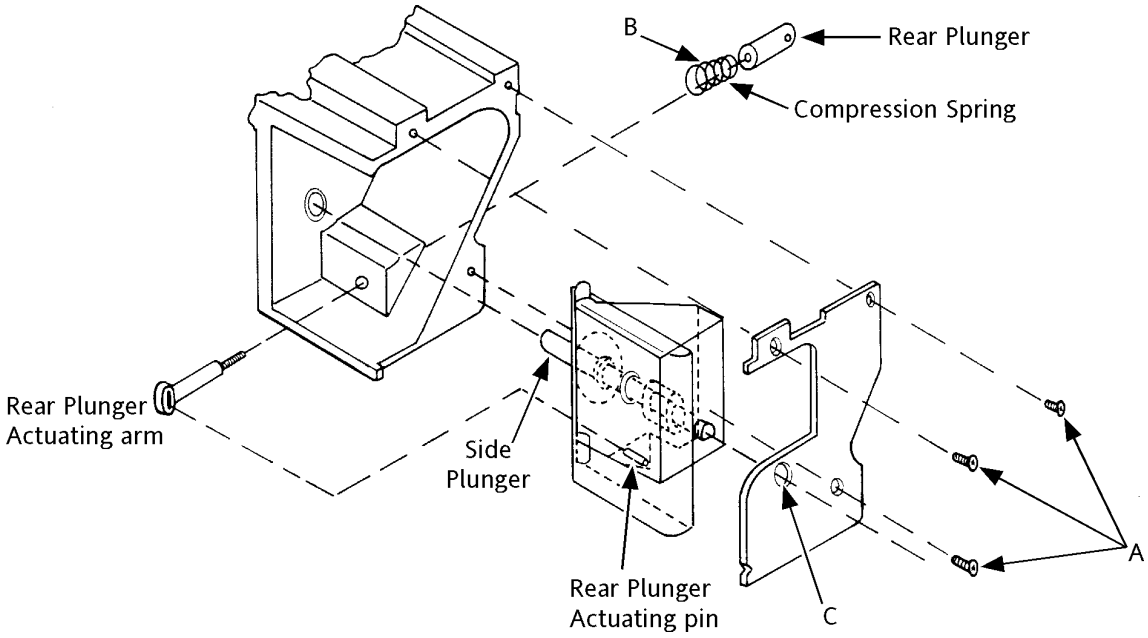


Figure 5.11.4a Left hand catch assembly (right hand similar)

EQUIPMENT REQUIRED

1. Pozidriv screwdriver No. 1
2. Ohms-measuring meter to read to less than 10 Ohms

REMOVAL PROCEDURE

Open the recorder door and pull the access system forwards out of its case, until it meets its safety stops.

Peel back the corners of the foam rubber bezel around the face of the display, to reveal four screws. Remove these screws and allow the left end of the display to rest on the bench, in front of the recorder.

Carefully ease the keyboard connector away from the adhesive pad which secures it to the display board. Disconnect this connector, and lay the keyboard safely to one side.

Disconnect the chart illumination assembly, remove it and lay it safely to one side. Open the writing system and remove the three screws ‘A’ (figure 5.11.4a) which secure the catch end plate. Ease the side plunger out of its bearing and discard the rest of the catch.

REPLACEMENT PROCEDURE

Ensure that the rear plunger is free to move, and that its spring loading is working properly. If not, the rear plunger may be unscrewed from its actuating arm, and the reason investigated. (If this procedure is carried out, care should be taken to retain the compression spring (‘B’ in figure 5.11.4a) which acts on the rear plunger.)

5.11.4 ACCESS SYSTEM CATCH REPLACEMENT (Cont.)

Rotate the rear plunger actuating arm such that its slot is vertical (figure 5.11.4a). Fit the new catch assembly, ensuring that the side plunger enters its bearing and that the rear plunger actuating pin passes through the slot in the actuating arm.

Re-fit the catch end plate, ensuring that the side plunger fits through its locating hole 'C' in the end plate.

Close the writing system and check that the catch is operating correctly.

Return the access system to the case and check that the catch is operating correctly.

Pull the access system out of the case until it meets the safety stops.

Re-fit the chart illumination extrusion to the chassis and connect the harness connector to the display board. It should be noted that the two pin harness connector may be fitted to any adjacent pair of the four pins which form the fixed part of the display board connector.

Caution!

Before carrying out the next part of the procedure, please note that the 'flexi' cable half of the connector had 12 ways but the fixed part of the connector (mounted on the display board) has 11 ways. Ensure, when mating these connectors that the connector halves line up at the bottom end, thus leaving the spare, 12th, way at the top. See figure 5.11.4b.
Top and bottom are defined with the keyboard panel upright and with no twists in the flexi cable.

Connect the 'flexi' cable connector of the keyboard panel to the display board. Press the connector onto the adhesive pad, to ensure that the connector is retained.

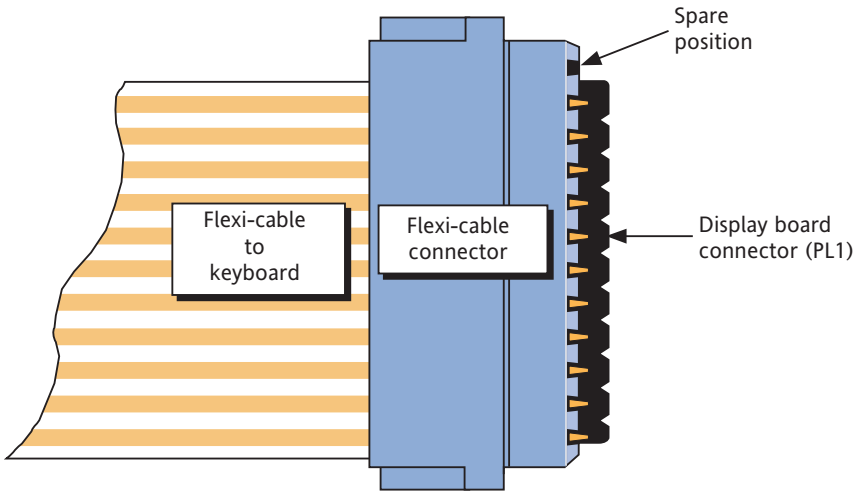


Figure 5.11.4b Keyboard flexi connector detail

Re-fit the screws in the corners of the keyboard panel, to secure the keyboard to the chassis. Ensure that any grounding wires are re-fitted.

Open the writing system and make a continuity check between the keyboard backing-plate and the recorder front plate. If this gives a reading of more than 10 Ohms, the cause should be investigated and rectified before the recorder is returned to service (see section 5.12).

Close the writing system and return the access system to the case, ensuring that the mother board ribbon cable is not fouled.

5.12 RECORDER STATIC GROUNDING CONTINUITY

5.12.1 Introduction

As with all equipment that transports paper, static electricity is generated within the recorder. This has a number of undesirable effects, including the attraction of dust into moving areas.

Later versions of the recorder solved his problem by coating the relevant plastic parts of the framework with a conductive film, adding extra traces to ribbon cables etc., this reducing the number of grounding wires to a minimum. Earlier versions of the recorder had conductive traces applied to relevant areas, and a number of grounding wires, to complete the circuit.

The grounding wire and conductive trace arrangements for earlier versions of the recorder are shown in figures 5.12.1a and 5.12.1b respectively.

The remainder of section 5.12 consists of a static grounding continuity check.

5.12.2 Equipment required

Low voltage Ohms-measuring meter to measure to less than 25 Ohms.

5.12 RECORDER STATIC GROUNDING CONTINUITY (Cont.)

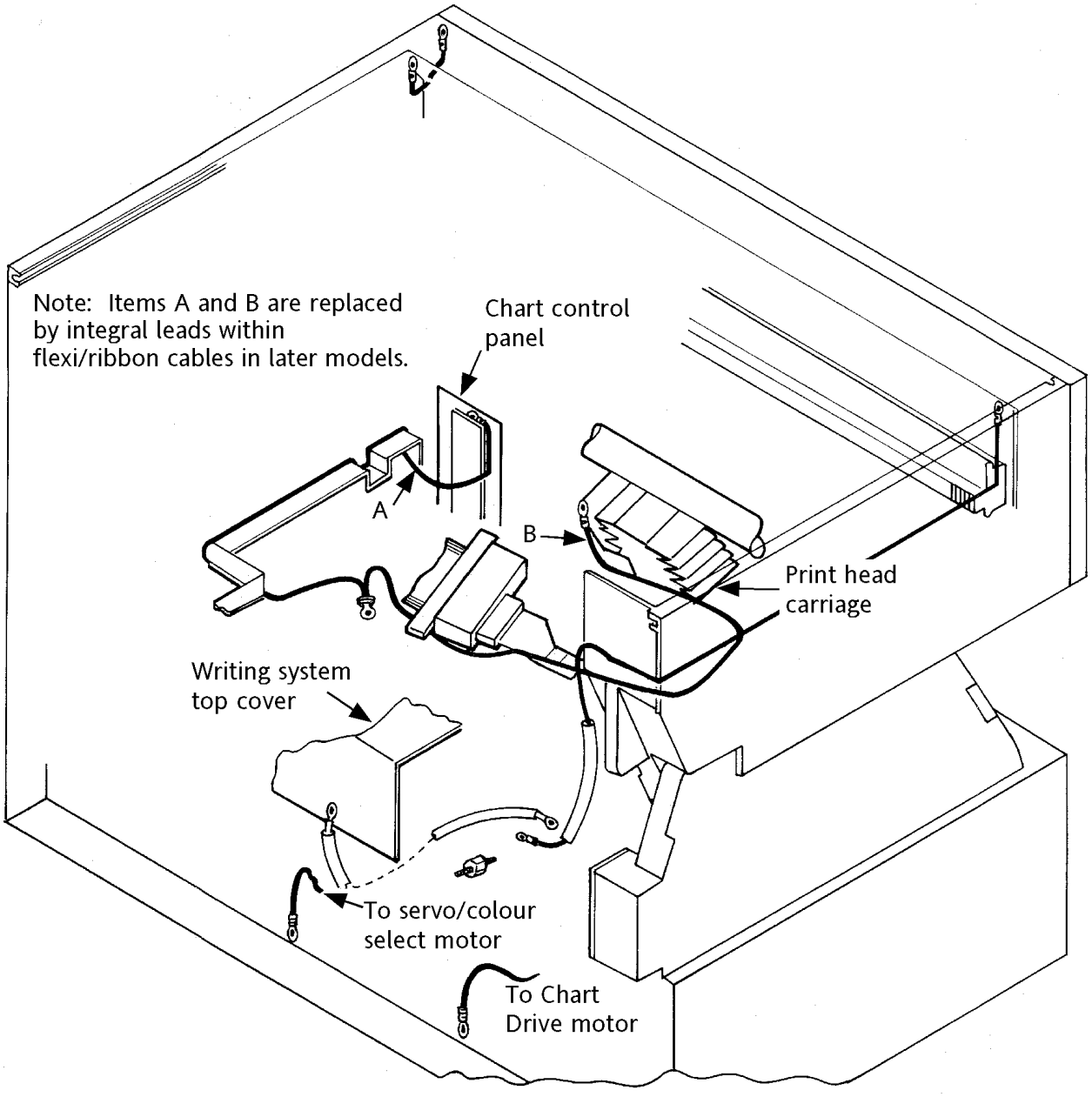
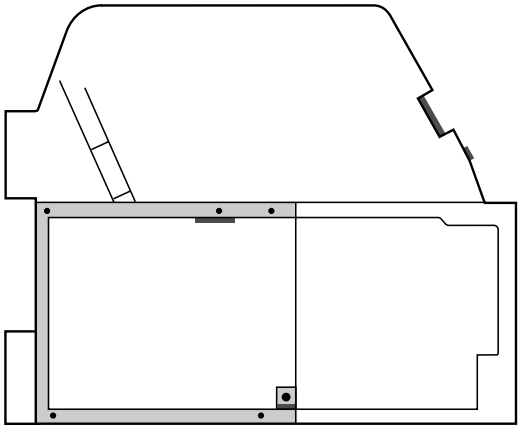
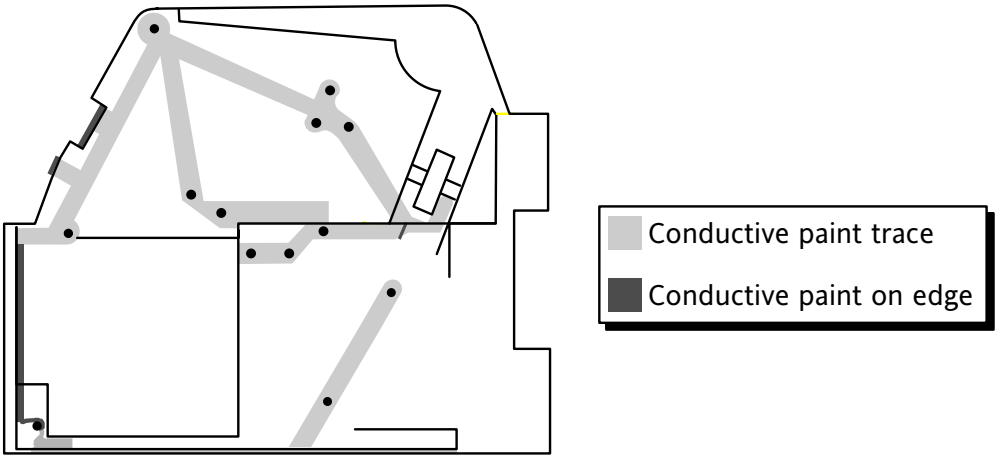


Figure 5.12.1a Grounding wire arrangement

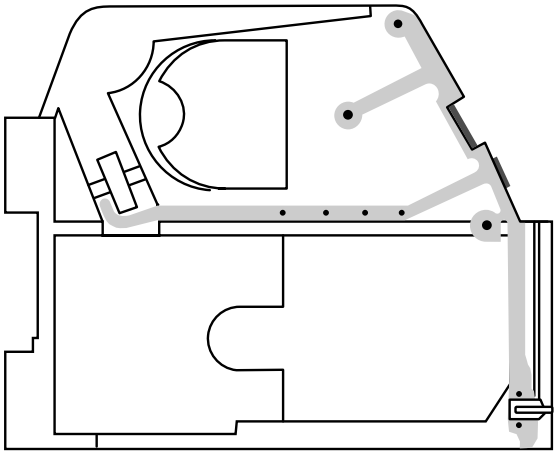
5.12 RECORDER STATIC GROUNDING CONTINUITY (Cont.)



a) View on inside of left-hand chassis side plate



b) View on inside of left-hand chassis plate



c) View on inside of right-hand chassis side plate

Figure 5.12.1b Conductive traces

5.12.3 Continuity check

Isolate the recorder from line power. Remove the recorder rear terminal cover. Remove the chart and (for convenience) the ribbon cartridge.

Remove the writing system from the case, ensuring that the mother board ribbon cable remains connected to the control board. Connect one probe of the meter to the earthing link at the rear of the instrument (figure 5.12.3j).

Remove the writing system front cover and the recorder front plate. Carry out continuity checks between the earthing link and the following points:

a Any one of the ribbon cartridge guide rail fixing screws (figure 5.12.3a)
b Ribbon cartridge carriage support plate (figure 5.12.3a)
c Keyboard backing plate (figure 5.12.3a)

Replace the writing system top cover. Carry out continuity checks between the earthing link and the following points:

d Inside the writing system top cover (figures 5.12.3b and d)
e Both print head carriage guide rail fixing screws (figure 5.12.3b)
f Chart drive motor casing (figure 5.12.3b)
g Servo/colour select servo motor casing (figure 5.12.3b)
h Jockey-arm bush (figure 5.12.3c)

Replace the recorder front plate and re-attach the tear-off cord to its tensioning spring. Carry out continuity checks between the earthing link and the following points:

i Any one of the front plate fixing screws (figure 5.12.3d)
j Lower chart guide (figure 5.12.3d)
k Chassis base plate (figure 5.12.3d)
l Print head shield (figure 5.12.3e)
m Print head grounding shim (figure 5.12.3f)
n Print head (figure 5.12.3f)
o Print head heatsink (figure 5.12.3f)
p Upper chart guide fixing screws (2 places) (figures 5.12.3g and h)
q Drive cord pulley fixing screws (3 places) (figures 5.12.3g and h)
r Pay-off spool stub shaft and access door fixing screws (2 places) (figures 5.12.3g and h)
s Pay-off door access spring and roll pin (figure 5.12.3i)
t Chart control access cover (figure 5.12.3h)
u Negative end of control board capacitor C11A (figure 5.12.3a)

Disconnect the mother board ribbon cable from the control board. Turn the recorder case onto one side. Carry out continuity checks between the earthing link and the following points:

v Power supply unit casing (figure 5.12.3j)
w Gland plate (figure 5.12.3j)
x Case fixing screws (2 places) (figure 5.12.3j)

5.12.3 CONTINUITY CHECK (Cont.)

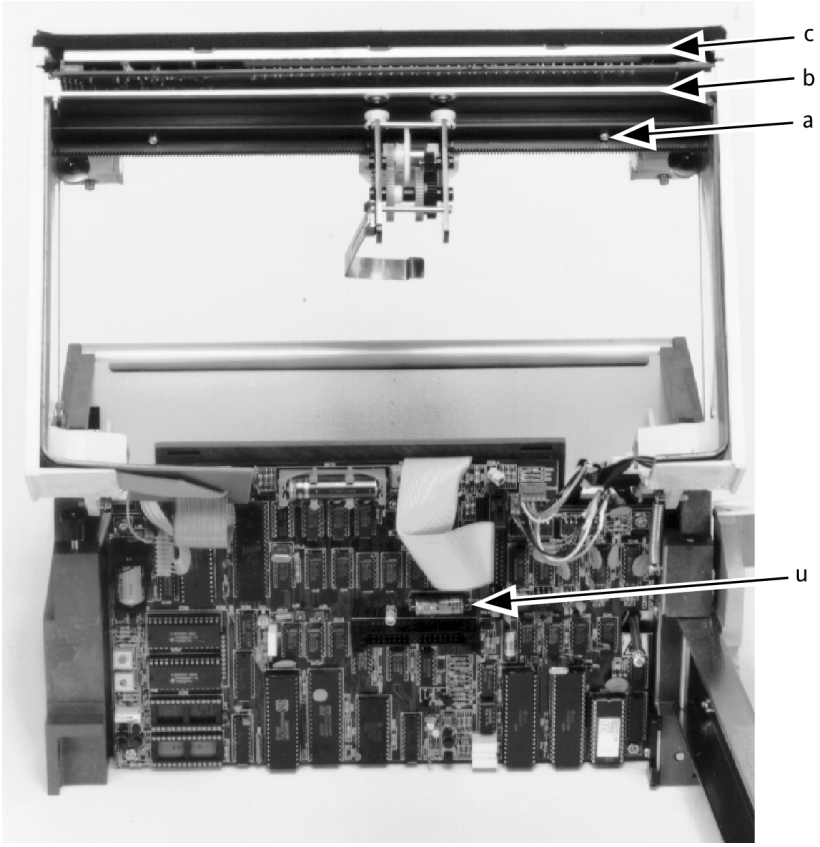


Figure 5.12.3a

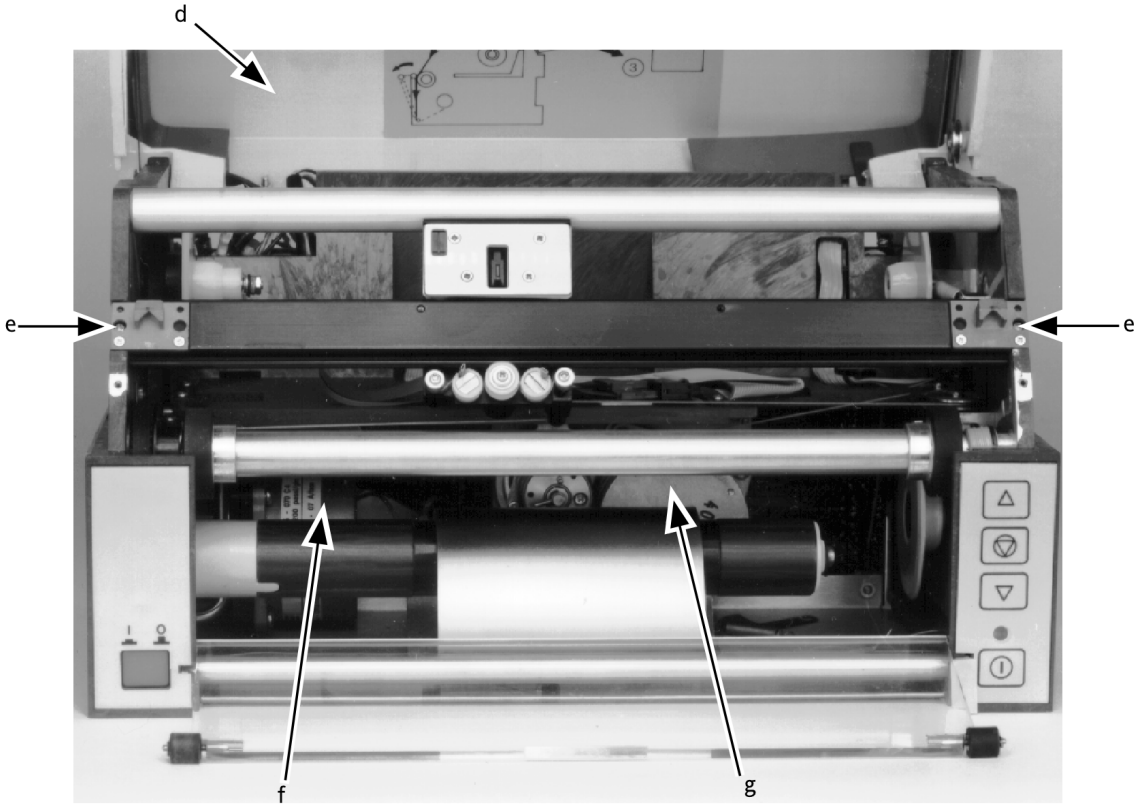


Figure 5.12.3b

5.12.3 CONTINUITY CHECK (Cont.)

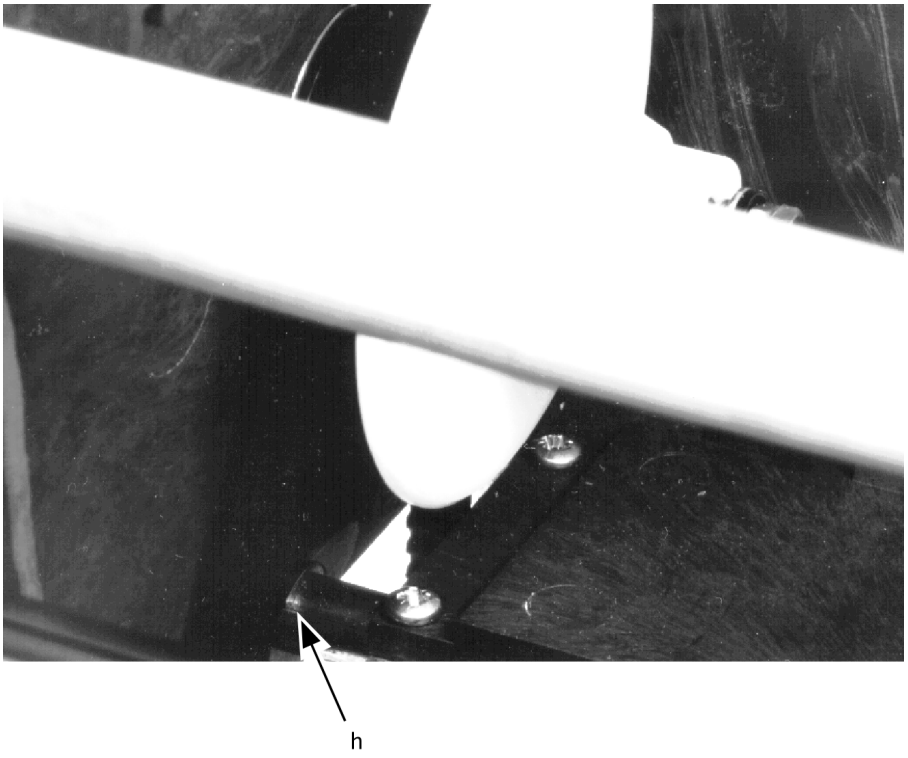


Figure 5.12.3c

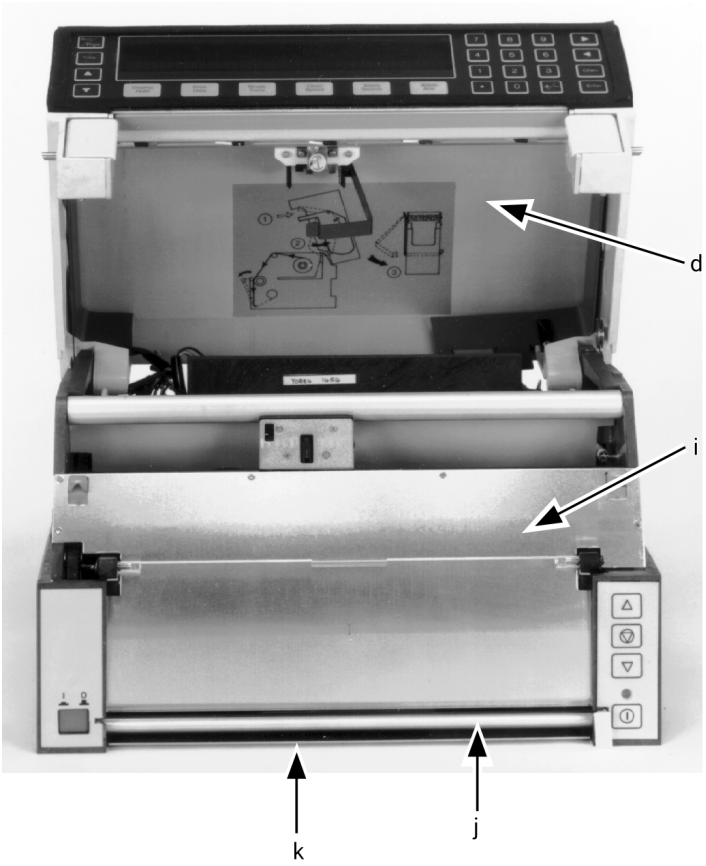


Figure 5.12.3d

5.12.3 CONTINUITY CHECK (Cont.)

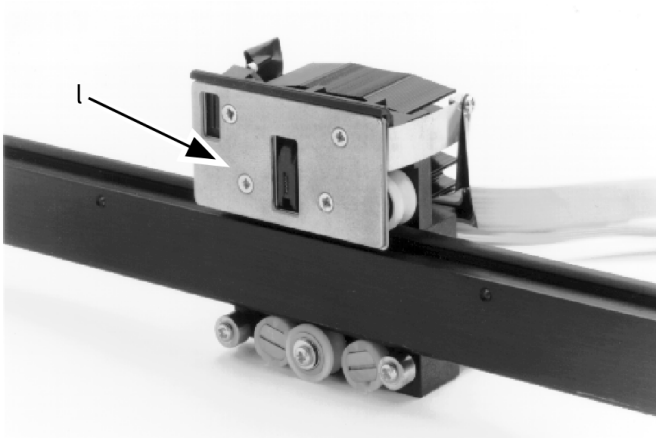


Figure 5.12.3e

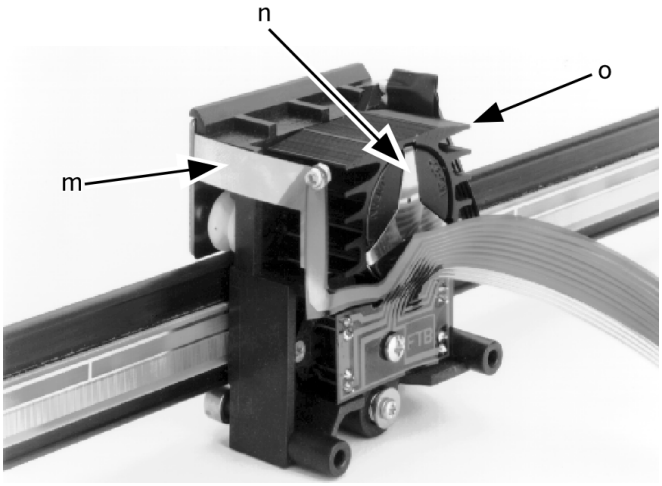


Figure 5.12.3f

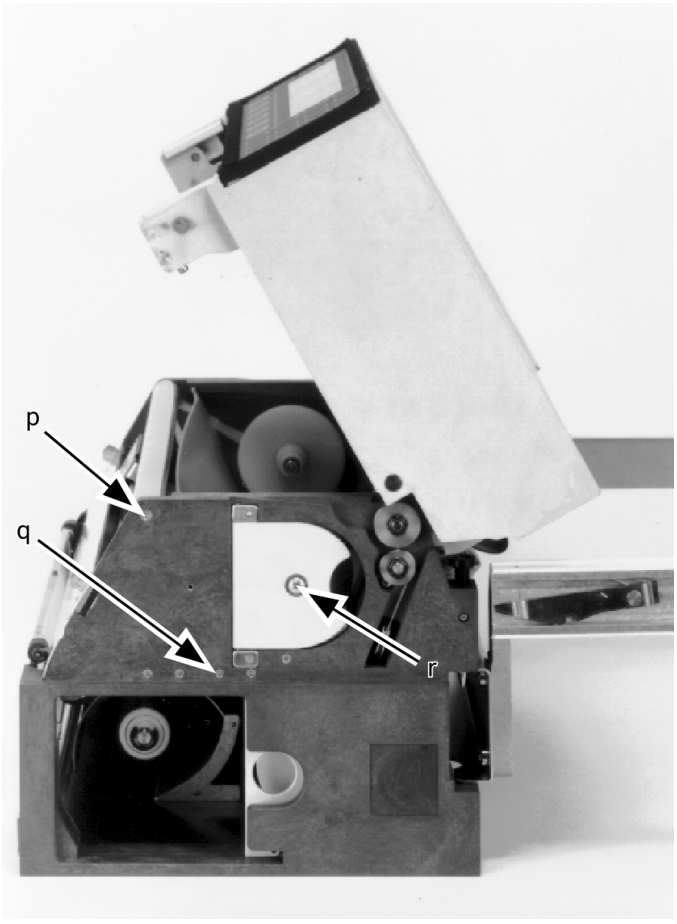


Figure 5.12.3g

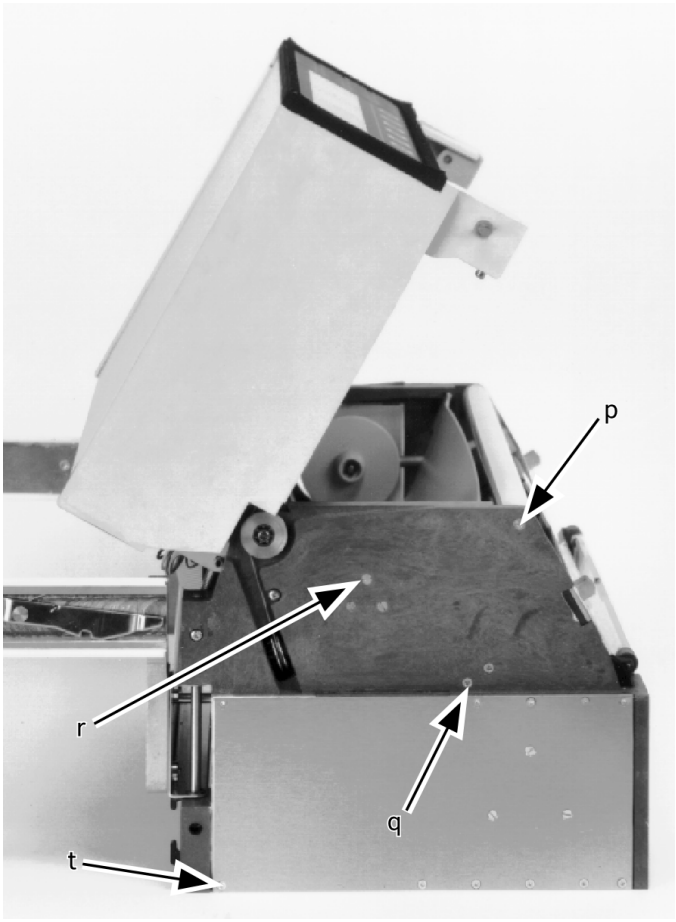


Figure 5.12.3h

5.12.3 CONTINUITY CHECK (Cont.)

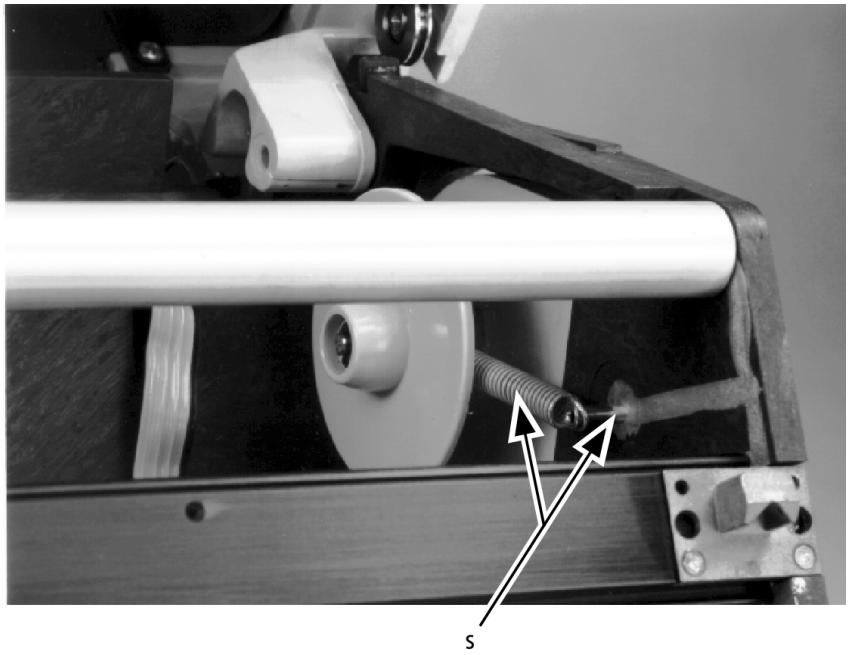


Figure 5.12.3i

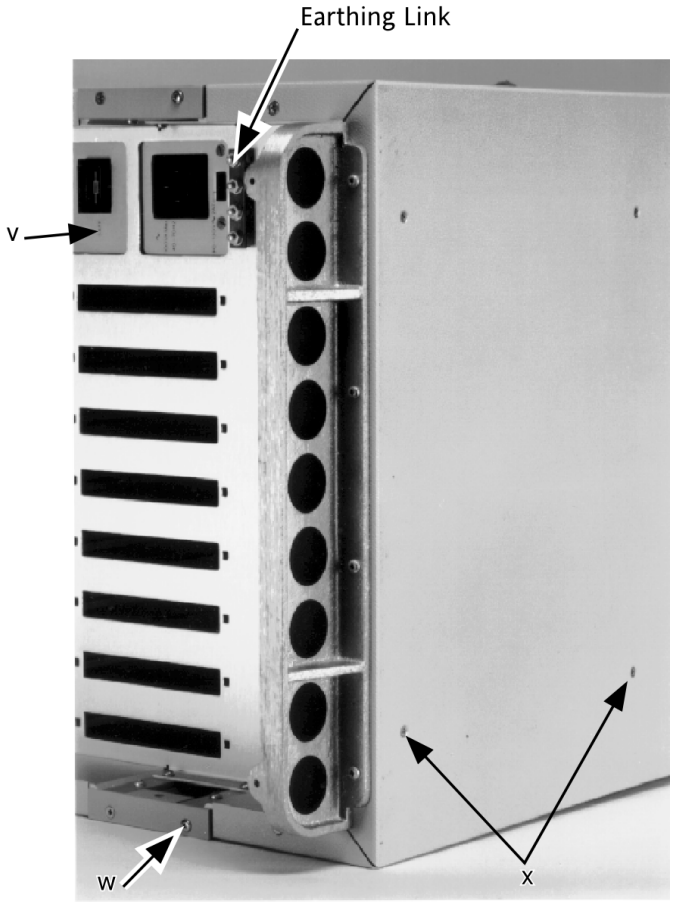


Figure 5.12.3j

5.13 BATTERY REPLACEMENT

Notes:
1 These instructions apply only to the Mk1 Control board.
2 It is recommended that a configuration dump be performed, as described in the Installation and Operation manual, before any attempt is made to replace either battery.

5.13.1 RAM back-up battery replacement

Caution!
When replacing the RAM back-up battery, care must be taken to ensure that the battery is inserted with the correct orientation.

WITH POWER ON

Caution!
This procedure applies only to the RAM back-up battery. Any attempt to change the clock support battery whilst power is applied, will result in damage to the clock IC. Refer to section 5.13.2.

Carefully ease the battery out of its clips, and insert the replacement.

WITH POWER OFF

Isolate the recorder from line (mains) power.

As shown in figure 5.13, the connector CON9 on the control board may be used to supply an external back-up voltage to the RAM, whilst the battery is out of circuit. The external (auxiliary) supply must be capable of supplying 3.5 to 5V dc at 5mA, and it must be free of any transients etc. which might damage the control board integrated circuits.

If CON 9 already has a connector fitted to it, remove this connector.

Ensuring correct polarity (figure 5.13) attach a suitable connector (e.g. LA238987) to the output supply lines from the auxiliary power supply.

With the auxiliary power supply switched off, connect it to CON 9. Switch the auxiliary power supply unit on.

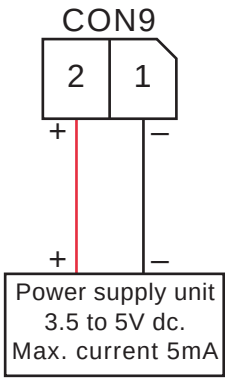


Figure 5.13
Auxiliary power supply connection

Carefully ease the battery out of its clips and, ensuring correct polarity, insert the replacement.

Swatch of the auxiliary power supply and disconnect from CON 9.

Replace the original (static earthing) connector previously removed (if any).

Caution!
For those recorders where CON9 is used as a part of the static grounding circuit (single green wire made to connector) this static connection must be re-made after the battery has been replaced. Failure to re-establish this connection will render the recorder susceptible to damage due to electrostatic discharge.

5.13.2 Clock support battery

Caution!

Any attempt to change the clock support battery whilst power is applied, will result in damage to the clock IC.

Caution!

When replacing the clock support battery, care must be taken to ensure that the battery is inserted with the correct orientation.

Ensure that recorder power is isolated.

Ease the old batter out of its mounting clips, and fit the replacement.

Switch the recorder power on and reset the clock to the correct time and date.

5.13.3 Battery disposal

The RAM support and clock back-up batteries contain small amounts of lithium metal. Lithium metal spontaneously combusts in contact with air, and it reacts violently with water. Further, the electrolyte used is thionyl chloride which is highly reactive (corrosive) and which produces toxic fumes (sulphur and chlorine compounds for example) when ignited.

It is for the above reasons that the disposal of such batteries must be undertaken with care. Local regulations should be determined and followed.

For safe disposal, the batteries must be packaged as follows:

1. Insulate the terminations at both ends with self-adhesive tape.
2. Seal the battery, together with a neutralising agent such as dry powdered chalk ($CaCo_3$), into a strong polythene bag. If powdered chalk is used as the neutralising agent, the recommended quantity is 3 grammes per battery.
3. Seal this bag inside a second polythene bag.

5.14 DISPLAY BOARD MODIFICATION FOR 5V CHART ILLUMINATION

This section should be followed only if the chart illumination assembly currently fitted to the recorder contains 24 Volt bulbs (with plain glass envelopes), and the replacement assembly contains 5 V bulbs (with frosted glass envelopes).

See section 5.9 for replacement procedure.

The following instructions detail how a display board may be modified to accept a 5 Volt chart illumination assembly. The actual procedure depends on the version of display board fitted, so the first step is to determine display board version. Once this has been determined, the appropriate set of instructions should be followed.

Caution!

Operators working on the display board must wear a grounded wrist strap in order to prevent damage due to static discharge.

5.14.1 Display board version

There are four versions of the display board, distinguishable as follows:

1. C6 fitted; C7 fitted (figure 5.14.1a). This is an original design board - follow procedure 'A'
2. C6 fitted; C7 not fitted (figure 5.14.1b). Test pins at top end of C7 location and at PL2 pin 6 NOT linked - follow procedure 'B'.
3. C6 fitted, C7 not fitted (figure 5.14.1c). Link fitted between top end C7 location and PL2 pin 6 - follow procedure 'C'.
4. C6 Not fitted; C7 fitted (figure 4.14.1d). This is the latest version designed for 5V bulbs. No modification required.

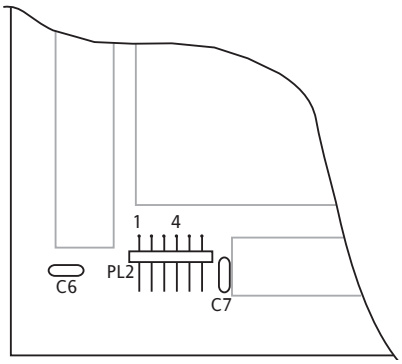


Figure 5.14.1a C6 and C7 fitted

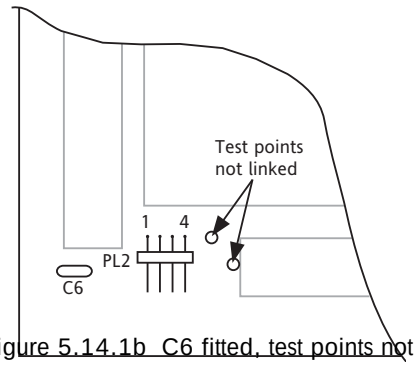


Figure 5.14.1b C6 fitted, test points not linked

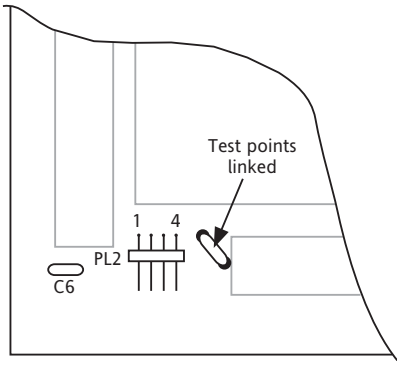


Figure 5.14.1c C6 fitted, test points linked

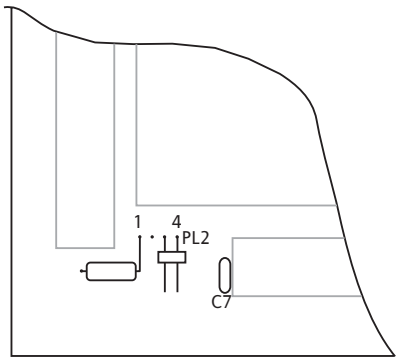


Figure 5.14.1d C7 fitted, C6 not fitted

5.14.2 Modification procedures

GENERAL

Ensure that the recorder is disconnected from line power.

Peel back the foam gasket at the corners of the display to reveal 4 off securing screws. Remove these screws, and ease the keyboard assembly away from the display board. Ease the flexi-cable connector away from its adhesive retaining pad and disconnect from the display board. Lay the keyboard assembly carefully to one side.

Disconnect the old lighting assembly and remove it from the recorder by pulling the grey plastic moulding forwards.

Place the recorder on a conductive mat which is connected to recorder 0 Volts at the rear of the recorder. Remove the writing system top cover ensuring that the grounding wire fixings are retained for use in reassembly.

Disconnect the display / keyboard ribbon cable header from CON 2 on the Control board. Remove the plastic retaining guide, and release the ribbon cable from the adhesive pads that retain it.

Ease the cable through the slot in the upper guide rail support plate and, using a small screwdriver, or similar, guide the ribbon cable between the keyboard backing plate and the upper guide rail support plate as shown in figure 5.14.2a. Sufficient cable should be folded in this way as to allow the display board to be lifted clear of its retaining slots.

Lay the circuit board on a conductive mat.

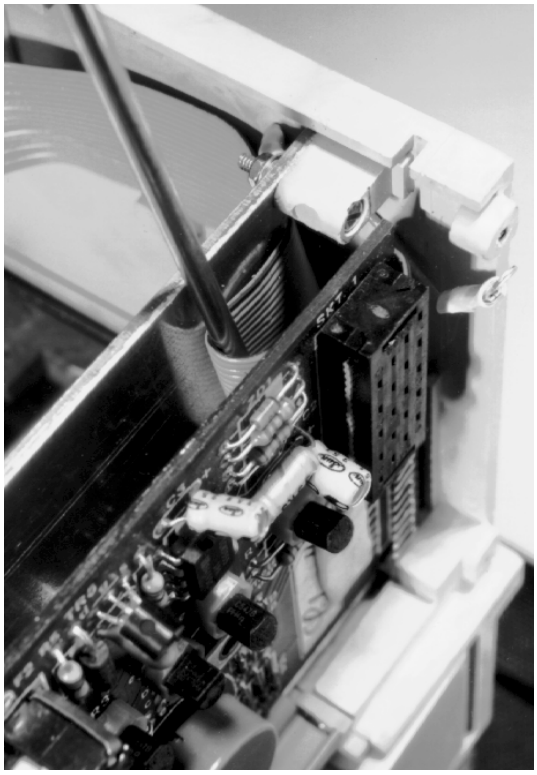


Figure 5.14.2a Ribbon cable manipulation

5.14.2 DISPLAY BOARD MODIFICATION PROCEDURES (Cont.)

PROCEDURE A

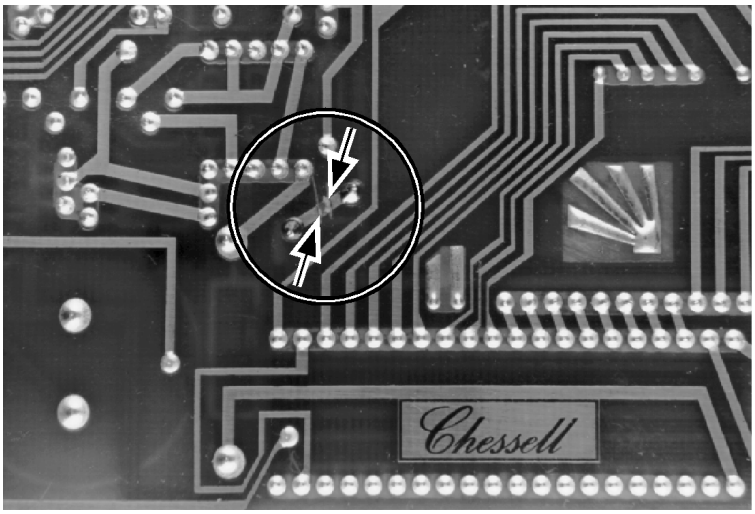


Figure 5.14.2b Track cut location

1. Cut the track on the non-component side of the display board as shown in figure 5.14.2b. Use a continuity meter to ensure that the cut in the track is complete.
2 Remove C6 (figure 5.14.1a)
3. Remove PL2 (four- or six-way connector) (figure 5.14.1a) and replace it with the two-way version, fitted at locations 3 and 4 (figure 5.14.1d)
4. Fit the 1 Ohm resistor supplied, between the right hand end of old C6 position and what was pin 2 of PL2. (figure 5.14.1d). Use ceramic spacers to stand the resistor away from the board.
5. Fit C7.
6. Ensure that the link shown in figure 5.14.2c (below) is NOT FITTED.

Caution!

If this link is fitted, it will connect recorder 24 Volt and recorder 5 Volt supplies together. This may lead to the recorder's circuitry being damaged.

7. Re-fit the display board, and reassemble the recorder.
8. Should the recorder fail to initialise, the low-voltage detect threshold should be adjusted as described in section 6.3.1.

Figure 5.14.2c Unwanted link location

5.14.2 DISPLAY BOARD MODIFICATION PROCEDURES (Cont.)

PROCEDURE B

1. Cut and remove the wire link located adjacent to the glass 'pip' at the right hand end of the vacuum fluorescent display module (figure 5.14.2c above).
2. Remove C6 (figure 5.14.1a)
3. Remove test pins (figure 5.14.1b)
4. Remove PL2 (four- or six-way connector) (figure 5.14.1a) and replace it with the two-way version, fitted at locations 3 and 4 (figure 5.14.1d)
4. Fit the 1 Ohm resistor supplied, between the right hand end of old C6 position and what was pin 2 of PL2. (figure 5.14.1d). Use ceramic spacers to stand the resistor away from the board.
5. Fit C7.
6. Ensure that the link shown in figure 5.14.2c (above) is NOT FITTED.

> Caution!
> If this link is fitted, it will connect recorder 24 Volt and recorder 5 Volt supplies together. This may lead to the recorder's circuitry being damaged.

7. Re-fit the display board, and reassemble the recorder.
8. Should the recorder fail to initialise, the low-voltage detect threshold should be adjusted as described in section 6.3.1.

PROCEDURE C

1. Remove C6 (figure 5.14.1a)
2. Remove the link between PL2 position 6 and the top end of C7 location, and any test pins fitted (figure 5.14.1c).
4. Remove PL2 (four- or six-way connector) (figure 5.14.1a) and replace it with the two-way version, fitted at locations 3 and 4 (figure 5.14.1d)
4. Fit the 1 Ohm resistor supplied, between the right hand end of old C6 position and what was pin 2 of PL2. (figure 5.14.1d). Use ceramic spacers to stand the resistor away from the board.
5. Fit C7.
6. Ensure that the link shown in figure 5.14.2c (above) is NOT FITTED.

> Caution!
> If this link is fitted, it will connect recorder 24 Volt and recorder 5 Volt supplies together. This may lead to the recorder's circuitry being damaged.

7. Re-fit the display board, and reassemble the recorder.
8. Should the recorder fail to initialise, the low-voltage detect threshold should be adjusted as described in section 6.3.1.

5.15 DISPLAY SIDEPLATE REPLACEMENT

5.15.1 Introduction

In order to prolong the life of the ribbon carriage cord, two pulley assemblies have been re-located. These assemblies, previosly located one on each display system side plate, are now mounted on the aluminium support plate behind the display.

This means that when a side plate has to be replaced, the replacement will not have the relevant pulley attached to it, and it is therefore necessary to replace both side plates and the support plate. It is this procedure which is described in the following subsections.

Note: The right hand side plate now comes complete with an actuating cam for use with the MarkII control board. It is recommended that this cam be removed for recorders fitted with a Mark I control board.

5.15.2 Kit contents

A kit of parts is available from the manufacturer, containing the following items:

	Part Number	Description	Quantity
1.	LA234492	Side plate assembly - left hand	1
2.	LA234493	Side plate assembly - right hand	1
3.	LA236035	Support plate assembly	1
4.	LA239141	Upper carriage cord assembly	1
5.	BK236704	Brass ferrule	2
6.	BA239134	Pulley bracket	2
7.	FB003J05	Screw: M3 x 5mm countersunk pozidriv head	4
8.	FB001J06	Screw: M3 x 6 pan pozidriv head	2
9.	FC12303J	Washer: M3, plain	2
10.	FC12306J	Washer: M3, internal tooth	2
11.	LA239195	Pulley assembly (small)	2
12.	LA239090	Pulley assembly (large)	2
13.	BE239584	Pulley insert	2
14.	BE236432	Plastic spacer	2
15.	BE234499	Friction washer	2
16.	FJ236772	Circlip	2
17.	EA238395	Self-adhesive pads.	10

5.15.3 Equipment required

1. Pozidriv screwdrivers Nos 1 and 2.
2. Spanners (wrenches) to suit M2 (4 mm across flats) and M3 (5.5mm AF) nuts
3. Lint-free cloth
4. Small quantity of iso-propyl alcohol (also known as iso-propanol or IPA)
5. Static safe container (min. 35 x 25 cm) to hold the control board.

5.15.4 Disassembly procedure

Caution

Refer to section 5.1 for static handling and battery back-up precautions.

Notes

1. The numbers in parenthesis refer to the numbered items in figure 5.15.4.
2. All directions (left. right, up, down etc.) are given relative to the writing system sitting on its base plate with the display, chart etc. facing towards the operator.

1. Open the recorder and remove the chart. Remove the ribbon cartridge.
2. Isolate the recorder from mains (line) power, and from any hazardous voltages applied to the SIMs.
3. Remove the writing system from the case, after disconnecting (at the control board) the ‘umbilical’ ribbon cable connecting the control board to the mother board (located within the case). Place the writing system in a suitable, static-safe working area.
4. Remove the access slide assembly (item 16 in figure 8,4 of his manual).
5. Disconnect all ribbon cables and oher cable forms from the control board (located at the rear of the writing system).
6. After ensuring all relevant anti-static precautions have been put in place, reove the control board, and place it in a suitable static-safe environment.
7. Remove the writing system top cover (1), ensuring that all the fixings are retained for use in re-assembly.
8. Remove the existing cord from the upper carriage assembly (3), and discard the cord.
9. Remove the plastic cable retainers (2) from the left and right side plates by peeling them from their self-adhesive pads.
10. After ensuring all relevant anti-static precautions have been put in place, reove the keyboard (7), the chart illumination unit (6A) and the display circuit board. Place the circuit board in a suitable static-safe environment, and store the other items safely for use in re-asembly.
11. Remove all wiring from the support plate, but retain all relevant wires and fixings are retained for later re-assembly.
12. Remove both tension springs (5A, 8A).
13. Carefully remove the left (10) and right hand pivot shafts, ensuring that all fixings are retained. Discard the pulleys.
14. Remove the display system (side plates, support plates etc.) from the rest of the chassis, and lay the rest of the chassis to one side for later use.
15. Carefully remove the support plate (6), ensuring that the ribbon cartridge carriage (3) does not slide off its guide rail (4). Remove the ribbon cartridge carriage from the guide rail, and lay the cartridge to one side for later use.
16. Remove the guide rail (4) from the support plate (6).
17. Discard the side plates (5, 8) and the support plate (6).

5.15.4 DISASSEMBLY PROCEDURE (Cont.)

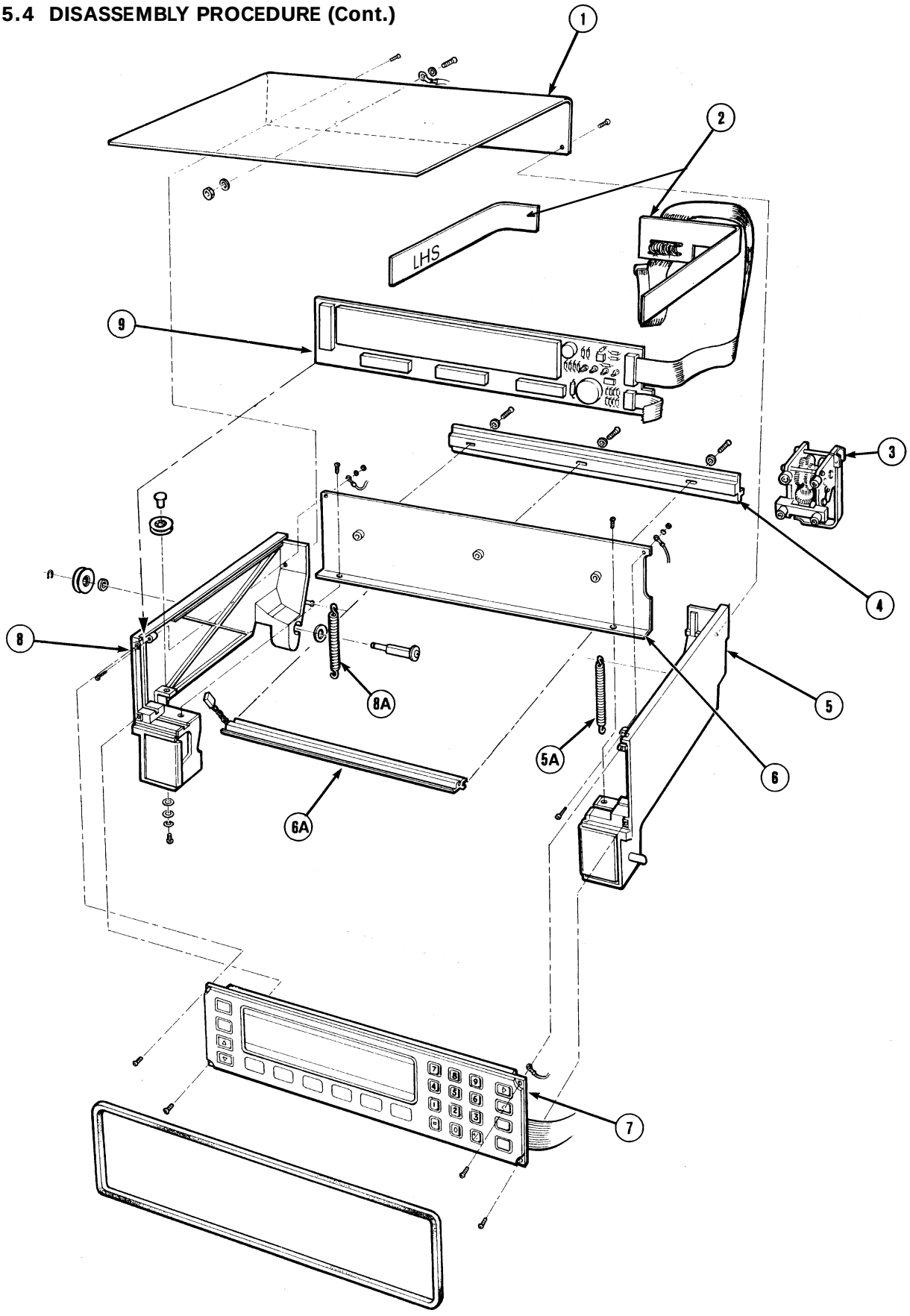


Figure 5.15.4 Display system exploded view

5.15.5 SUPPORT PLATE PULLEYS

Before the replacement support plate is used, it is first necessary that the pulleys and pulley brackets be fitted, as follows:

FITTING THE BRACKETS

1. Locate the support plate, pulley brackets and four M3 x 5 mm countersink head screws supplied as a part of the kit. Note that the new support plate has two rectangular apertures cut in it: one closed (left hand side); the other open (right hand side).
2. Take one of the pulley brackets, and with reference to figure 5.11.5a, below, insert it (from the front face of the support plate) through the closed slot. Use two of the M3 x 6 screws to secure the bracket securely to the support plate, ensuring that the screw heads fit neatly into the countersunk holes on the rear face of the plate.
3. Similarly, fit the second pulley bracket through the open slot at the right hand end of the support plate.

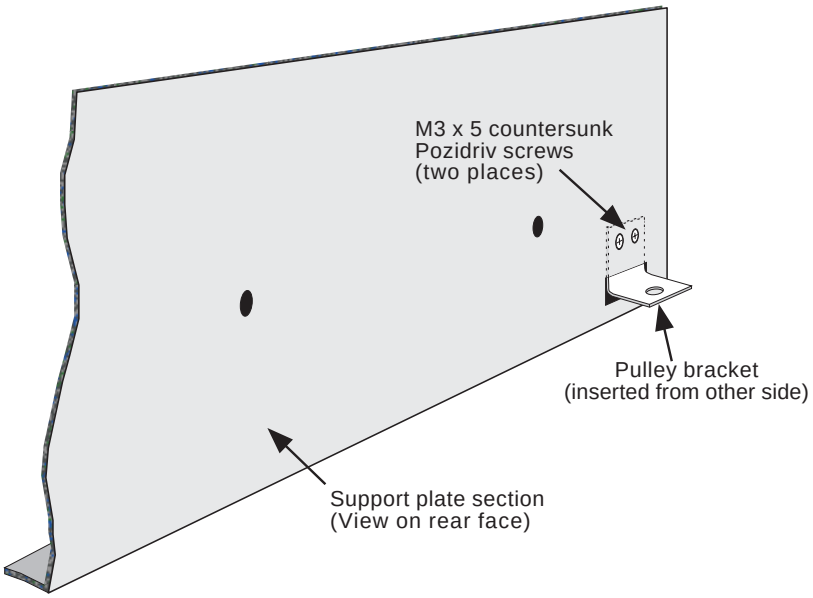


Figure 5.15.5a Pulley bracket fixing

FITTING THE PULLEYS

1. Take the two (smaller) pulleys LA239195 and fit one of these pulleys to each of the support brackets, as shown in figure 5.15.5b. For each pulley, use: 1 M3 x 6mm pan-head screw, one M3 internal tooth washer, one M3 plain washer, a plastic spacer and an insert, all supplied with the kit.

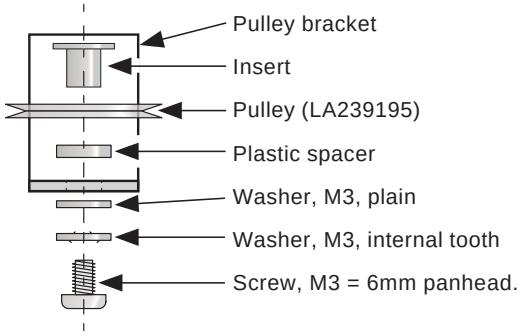


Figure 5.15.5b Assembly of the pulley to the pulley bracket

5.15.6 Reassembly procedure

1. Fit the new left- and right-hand side plates to the new support plate (after it has been fitted with pulleys as described in the previous section).
2. After taking appropriate static precautions, re-fit the display board and the chart illumination assembly. Connect the chart illumination loom to the connector pins on the display board.
3. Re-fit the keyboard assembly, ensuring that the flying lead connector mates correctly with the display board connector (section 5.9.4).
4. Re-fit the left- and right-hand pivot shafts, previously removed, using the (larger) pulley assemblies (LA239090), supplied with the kit. Spare friction washers are provided with the kit, in case the originals are lost or damaged.

Note: Figure 5.16.6, below, is a rear view of the right-hand side of the recorder, showing the locations of the various components of the pivot system. The left-hand pivot system is identical (but reversed).

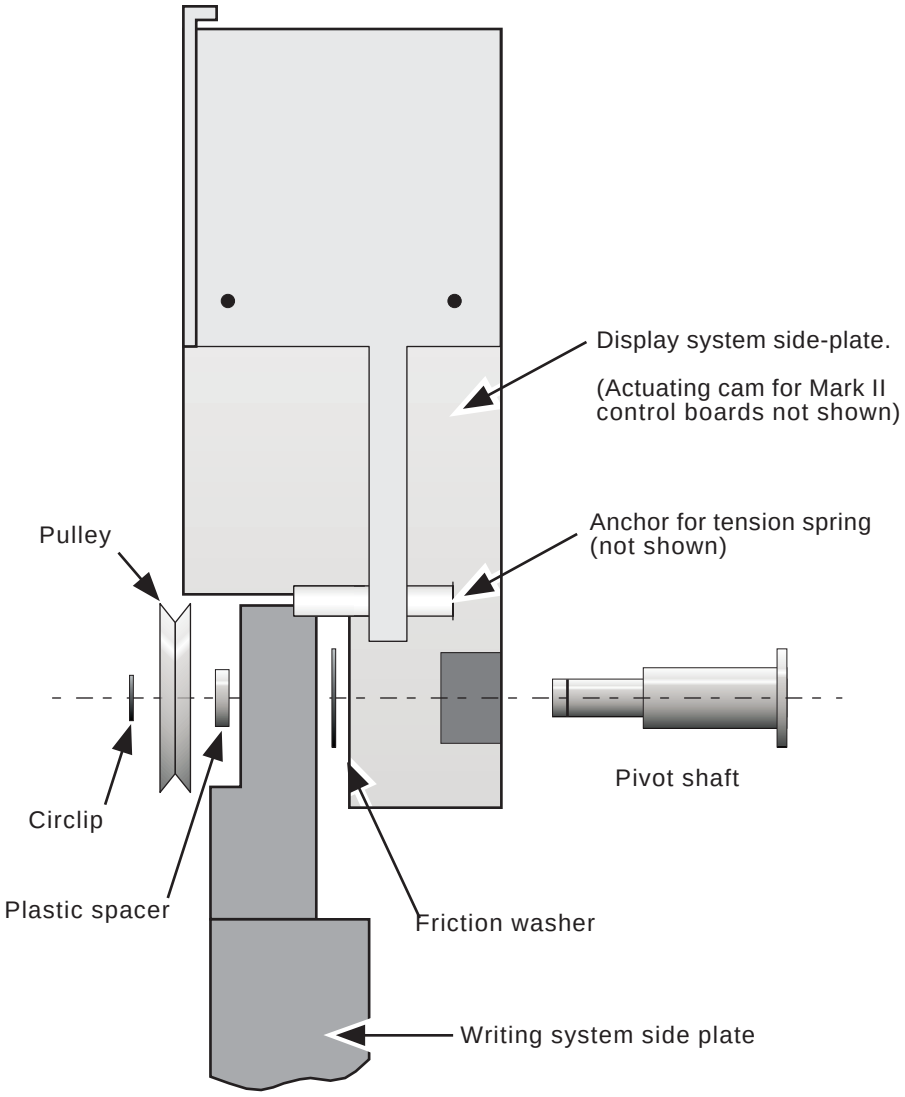


Figure 5.5.16 Right-hand pivot assembly (rear view). Left-hand similar.

5.15.6 REASSEMBLY PROCEDURE (Cont.)

5. Re-fit the tension springs.
6. Re-connect the wiring to the new support plate.
7. Refit the plastic cable retainers, using new adhesive pads, as required.
8. Secure the grounding wire to the left-hand side plate, using self-adhesive cable clips, ensuring that the wire will not impede the movement of the upper carrriage at its left-hand end of travel.

9. Take the ribbon cartridge carriage, prevously removed, and clean the bearings of any accumulations of paper dust etc. Thoroughly clean the ribbon cartridge carriage guide rail using a lint-free cloth, moistened with iso-propyl alcohol.
10. Fit the carriage to the guide rail. The guide-rail rack teeth face downwards when the guide rail is fitted correctly to the support plate. Slide the carriage backwards and forwards along the guide rail, carry out the side-force and ‘play’checks and adjustments detailed in section 5.3.3.
11. Fix the guide rail (with carriage) to the support plate, ensuring that the rack is to the bottom.
12. Re-cord the ribbon cartridge carriage as described in the relevant part(s) of section 5.4, using the new cord and the ferrules supplied with the kit.

13. Re-fit the writing system top cover, ensuring that the earthing (grounding) connection is securely made.
14. Re-fit the inner chassis liner, ensuring that the connections to the print head flexies are secure.
15. After taking the appropriate static precautions, re-fit the control board to the chassis, and remake all connections (except the’umbilical’ from the mother board in the case).
16. Re-fit the access slide system and return the writing system to the case.
17. Re-make the umbilical connection from the mother board.
18. Connect the recorder to mains (line) power, and switch on. Check that the recoder initialises. Disconnect from mains power.

19. Fit a chart and a ribbon cartridge and return the writing system to the case.
20. Re-establish any signal wiring which was previously removed, apply mains (line) power, and switch the recorder on.
21. Check that te recorder initialises and starts operating as expected. If necessary, carry out the Colour Select Setting up procedure, detailed in section 5.4.9.

6 ELECTRONICS

This section contains lay-outs and schematics for the printed circuit boards listed below. Where appropriate, any setting up procedures not described elsewhere in this document are included.

1. AH232128 DC input board. Section 6.1
2. AH234434 RTD input board. Section 6.2
3. AH237399 Control board (Mark I). Section 6.3
4. AH247413 Power Supply board. Section 6.4
5. AH232122 Mother board. Section 6.5
6. AH232123 Relay output board. Section 6.6
7. AH232100 Display board. Section 6.7
8. AH237134 RS232 to RS422 conversion module board. Section 6.8.
9. AH239670 Control board (Mark II).

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6.1 DC INPUT BOARD

6.1.1 DC input board component layout

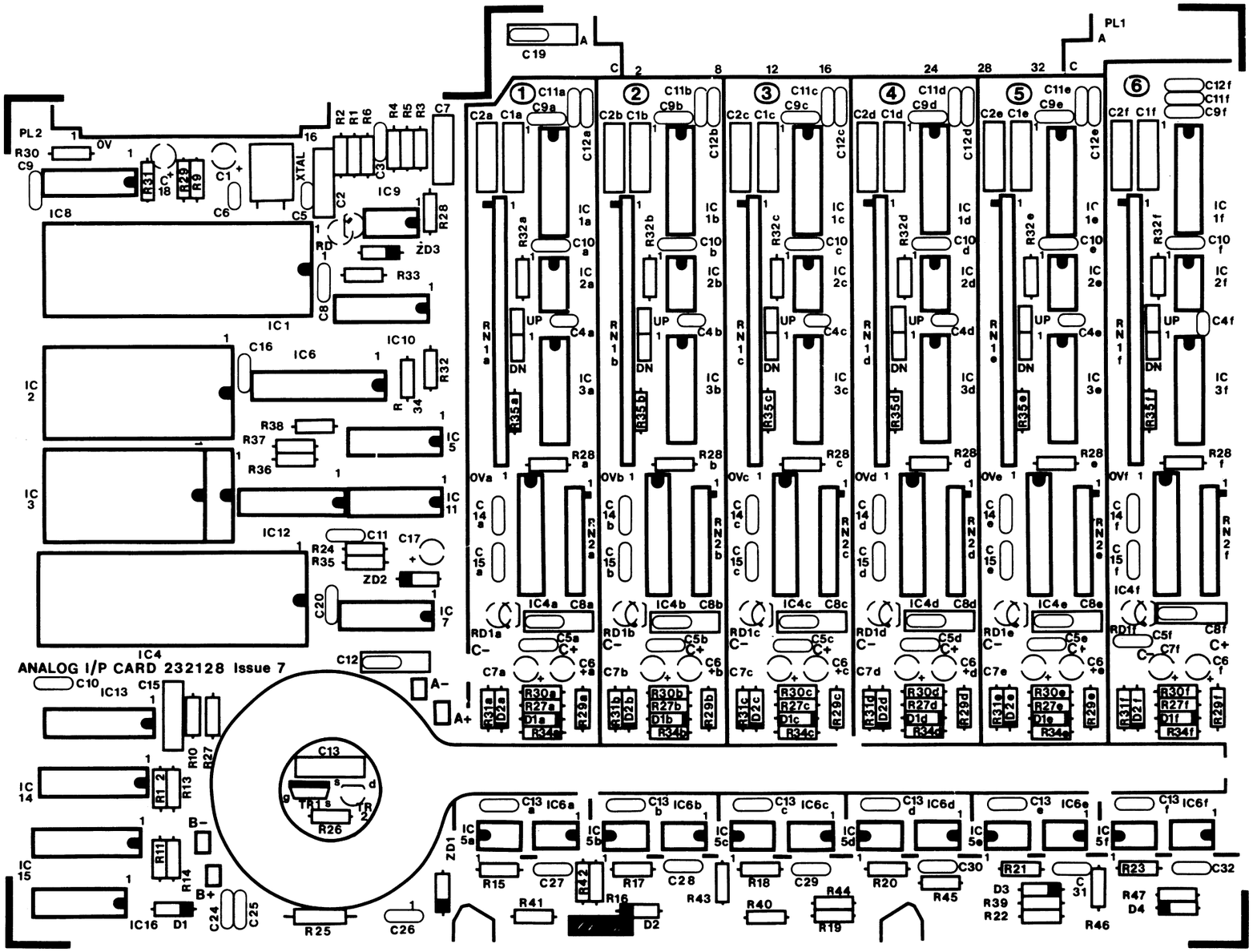

Figure 6.1.1 DC input board component layout

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6.1.2 Schematic disagram

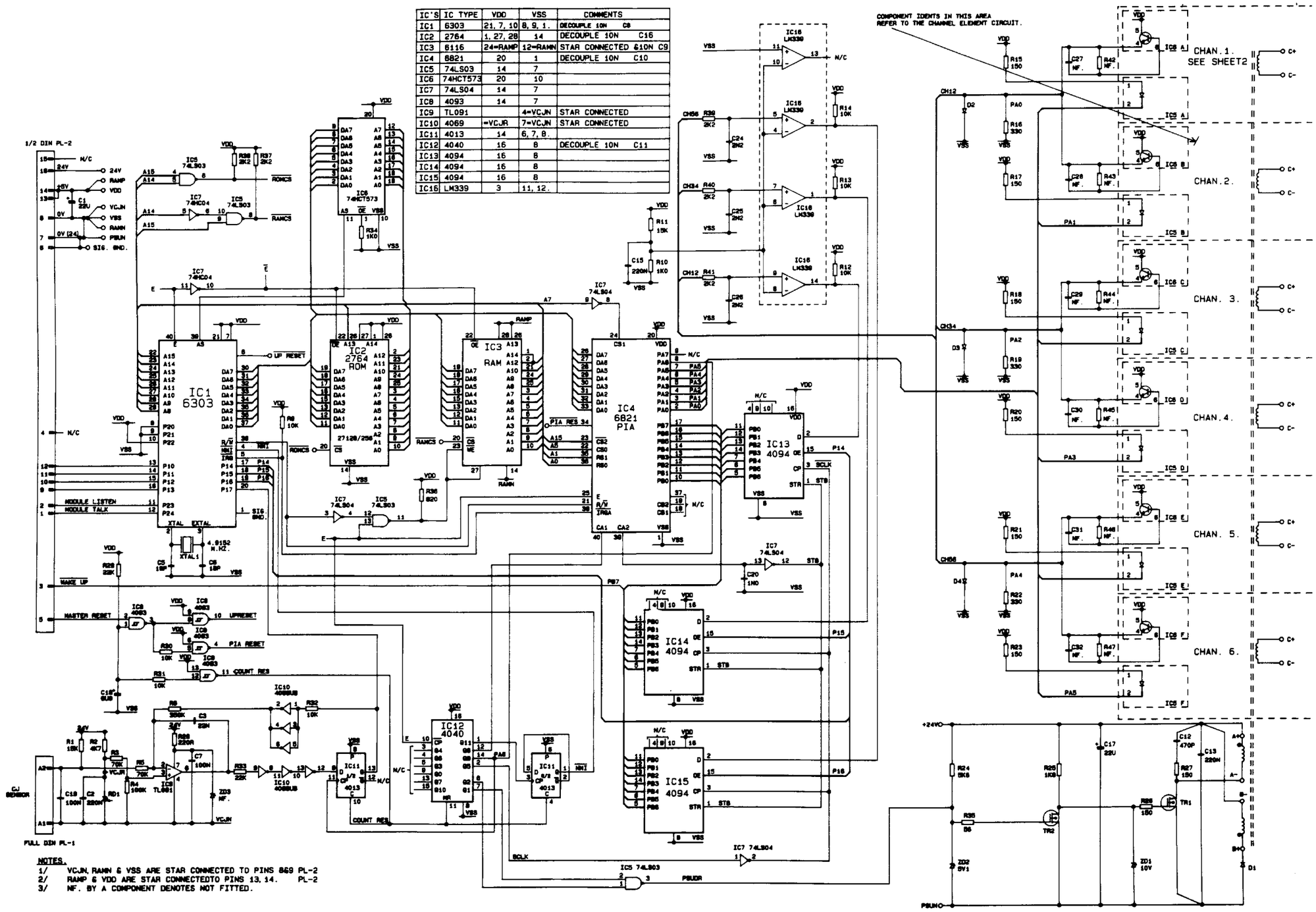

Figure 6.1.2a DC input board schematic (sheet 1)

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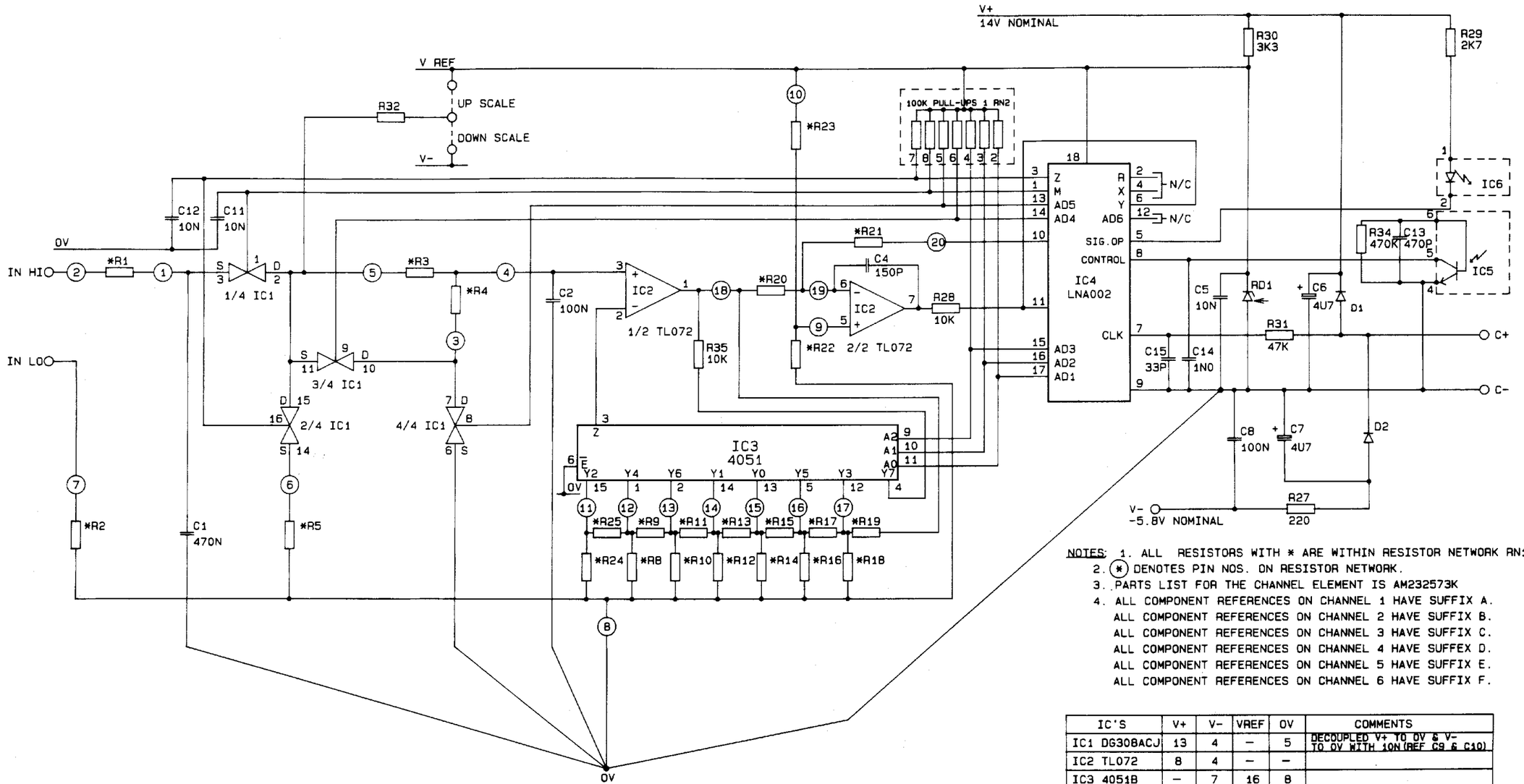
6.1.2 DC INPUT BOARD SCHEMATIC DIAGRAM (Cont.)



NOTES: 1. ALL RESISTORS WITH * ARE WITHIN RESISTOR NETWORK RN1.
2. (*) DENOTES PIN NOS. ON RESISTOR NETWORK.
3. PARTS LIST FOR THE CHANNEL ELEMENT IS AM232573K
4. ALL COMPONENT REFERENCES ON CHANNEL 1 HAVE SUFFIX A.
ALL COMPONENT REFERENCES ON CHANNEL 2 HAVE SUFFIX B.
ALL COMPONENT REFERENCES ON CHANNEL 3 HAVE SUFFIX C.
ALL COMPONENT REFERENCES ON CHANNEL 4 HAVE SUFFEX D.
ALL COMPONENT REFERENCES ON CHANNEL 5 HAVE SUFFIX E.
ALL COMPONENT REFERENCES ON CHANNEL 6 HAVE SUFFIX F.

IC'S	V+	V-	VREF	OV	COMMENTS
IC1 DG308ACJ	13	4	–	5	DECOUPLED V+ TO OV & V- TO OV WITH 10N (REF C9 & C10)
IC2 TL072	8	4	–	–	
IC3 4051B	–	7	16	8	
IC4 LNA002	–	–	18	9	

DIN CONNECTOR PIN ASSIGNEMENT (PL-1)						
	CHANNEL 1	CHANNEL 2	CHANNEL 3	CHANNEL 4	CHANNEL 5	CHANNEL 6
IN.HI.	A9	A13	A17	A23	A27	A31
IN.LO.	A8	A12	A16	A24	A28	A32

Figure 6.1.2b DC input board schematic (sheet 2)

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6.2 RTD INPUT BOARD

6.2.1 RTD input board component layout

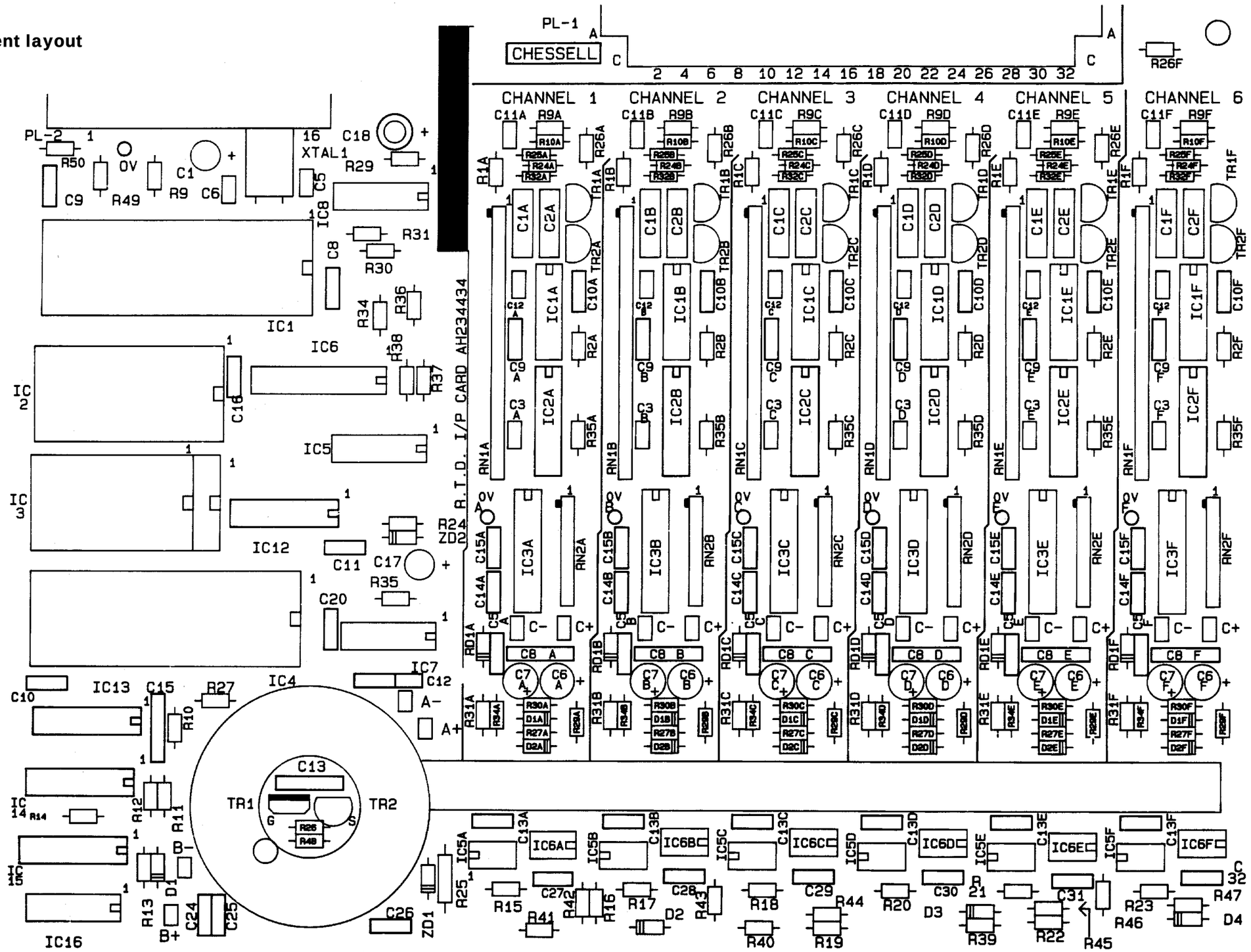

Figure 6.2.1 RTD input board component layout

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6.2.2 RTD Input board schematic diagram

IC'S	IC TYPE	VDD	VSS	COMMENTS
IC1	6303	21, 7, 10	8, 9, 1.	DECOUPLE 10N C8
IC2	2764	1, 27.28	14	DECOUPLE 10N C16
IC3	6116	24=RAMP	12=RAMN	STAR CONNECTED (0.C.10N C9)
IC4	6821	20	1	DECOUPLE 10N C10
IC5	74LS03	14	7	
IC6	74HCT573	20	10	
IC7	74LS04	14	7	
IC8	4093B	14	7	
IC12	4040	16	8	DECOUPLE 10N C11
IC13	4094	16	8	
IC14	4094	16	8	
IC15	4094	16	8	
IC16	LM339	3	11, 12.	

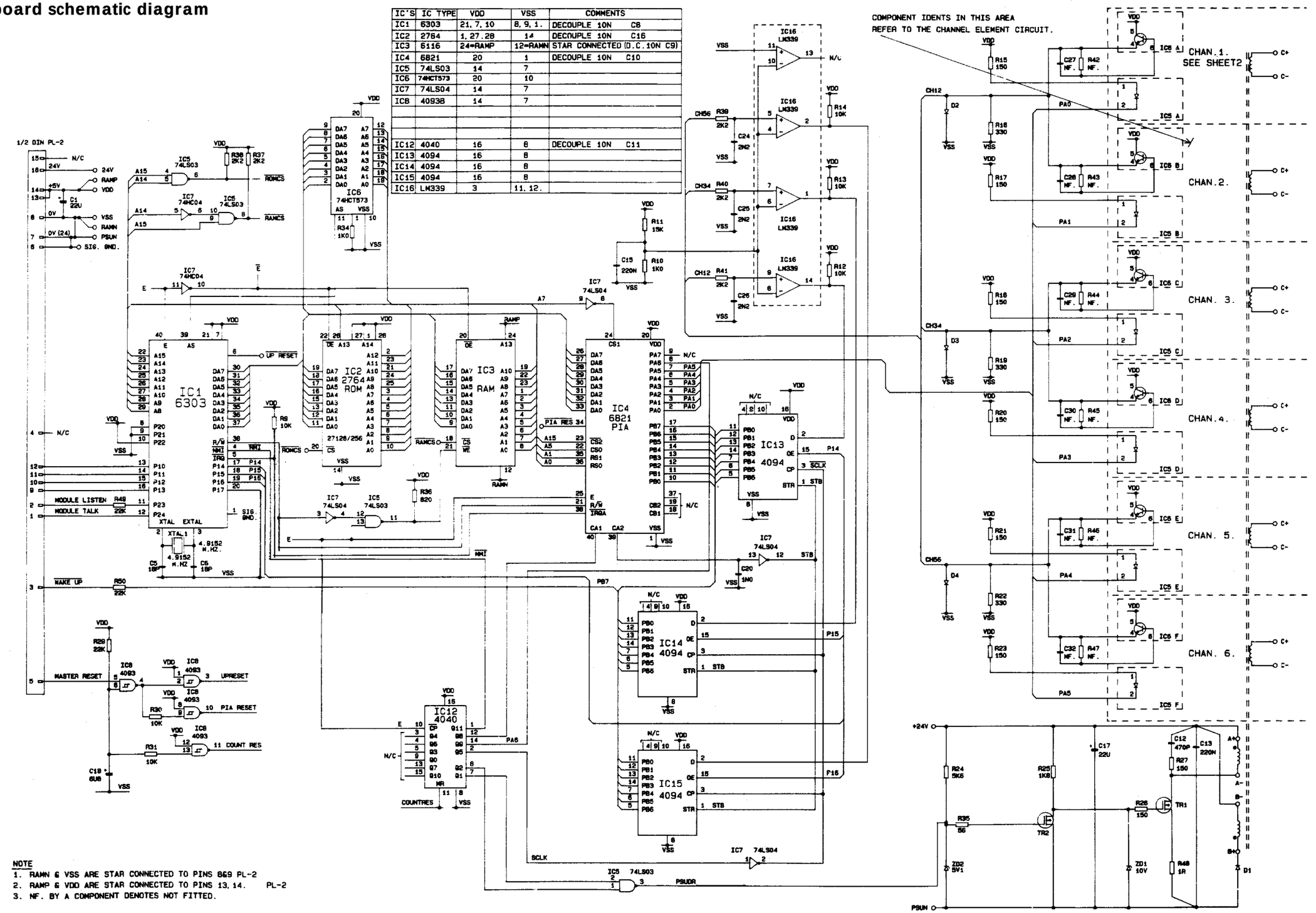

Figure 6.2.2a RTD input board schematic (sheet 1)

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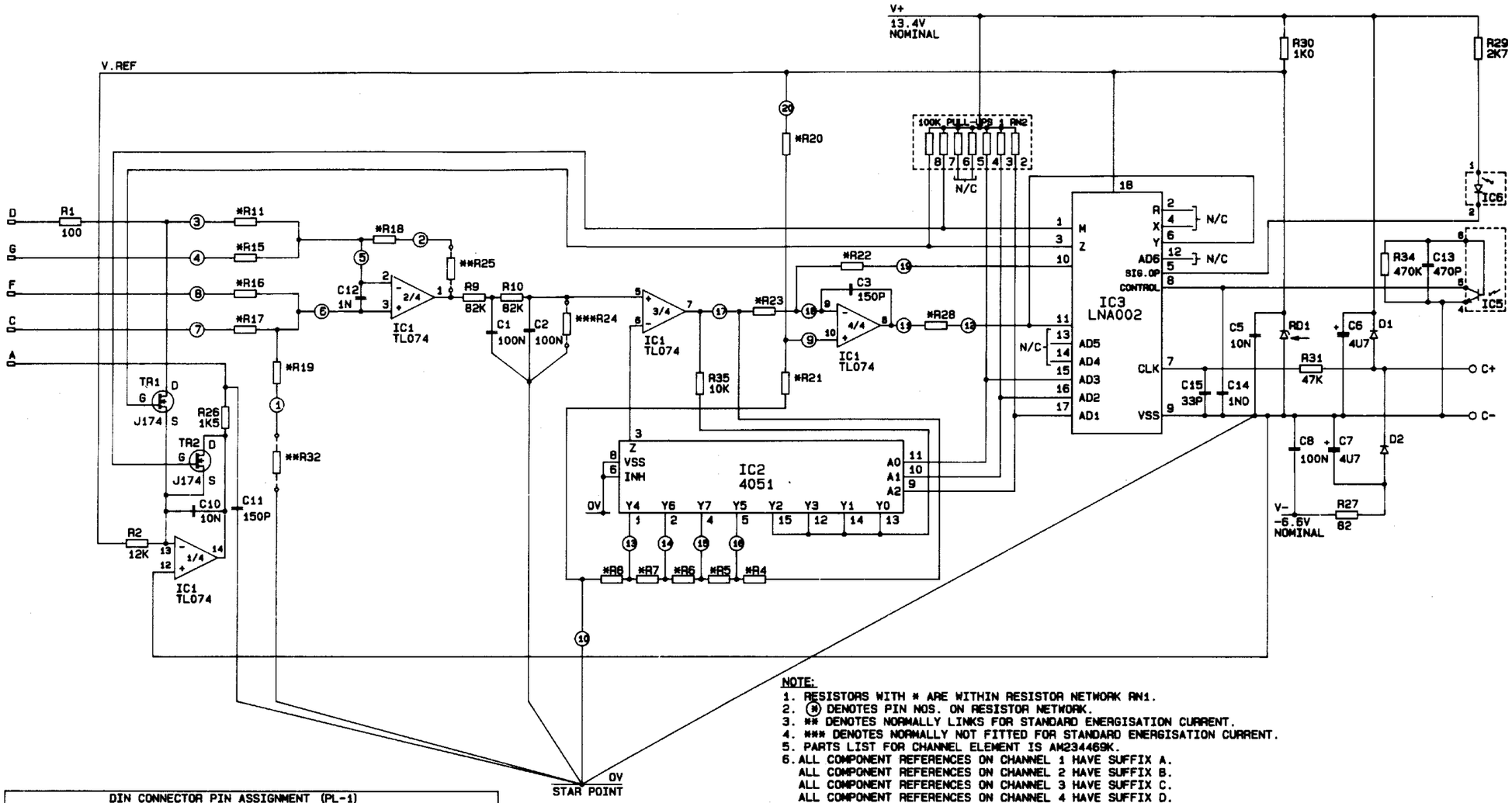
6.2.2 RTD INPUT BOARD SCHEMATIC DIAGRAM (Cont.)



DIN CONNECTOR PIN ASSIGNMENT (PL-1)						
	CHANNEL 1	CHANNEL 2	CHANNEL 3	CHANNEL 4	CHANNEL 5	CHANNEL 6
A	4C	10A	16A	22A	26A	32A
G	6A	6C	12C	18C	24C	30C
C	4A	10C	16C	22C	28C	30A
D	2C	8C	14C	20C	26C	32C
F	2A	8A	14A	20A	24A	28A

NOTE:
1. RESISTORS WITH * ARE WITHIN RESISTOR NETWORK RN1.
2. (M) DENOTES PIN NOS. ON RESISTOR NETWORK.
3. ** DENOTES NORMALLY LINKS FOR STANDARD ENERGISATION CURRENT.
4. *** DENOTES NORMALLY NOT FITTED FOR STANDARD ENERGISATION CURRENT.
5. PARTS LIST FOR CHANNEL ELEMENT IS AM234469K.
6. ALL COMPONENT REFERENCES ON CHANNEL 1 HAVE SUFFIX A.
   ALL COMPONENT REFERENCES ON CHANNEL 2 HAVE SUFFIX B.
   ALL COMPONENT REFERENCES ON CHANNEL 3 HAVE SUFFIX C.
   ALL COMPONENT REFERENCES ON CHANNEL 4 HAVE SUFFIX D.
   ALL COMPONENT REFERENCES ON CHANNEL 5 HAVE SUFFIX E.
   ALL COMPONENT REFERENCES ON CHANNEL 6 HAVE SUFFIX F.

IC, S	V+	V-	V REF	OV	COMMENTS
IC1 TL074	4	11	-	-	DECOUPLED V+ TO OV (C9)
IC2 4051B	-	7	16	8	
IC3 LNA002	-	-	18	9	

Figure 6.2.2 RTD input board schematic (sheet 2)

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6.3 CONTROL BOARD

6.3.1 Setting the low voltage threshold

EQUIPMENT REQUIRED

1. Digital voltmeter (DVM) to measure up to 10 Volts dc to an accuracy of 1 mV.

CAUTION!

This DVM must be fitted with fully insulated probes in order to avoid shorting the measuring points (defined below) to the printed circuit board tracking.

PROCEDURE

Note: Voltages V_1, V_2 and V_3 are measured between points 1+ and 1-; 2+ and 2- and 3+ and 3-, respectively, on figure 6.3.1, below.

1. Measure V_1. If the voltage lies outside the range 5.00 to 5.15 Volts dc, the power supply will have to be recalibrated by a service engineer.
2. Measure V_2. If this voltage lies outside the range 2.498 Vto 2.502 V dc, use P2 to bring the voltage within this range.
3. Calculate V_3 from the equation $V_3 = 0.5$ (V1 - 4.82). Measure V_3, and if necessary, use P1 to set V_3 to within ±10mV of the calculated value.

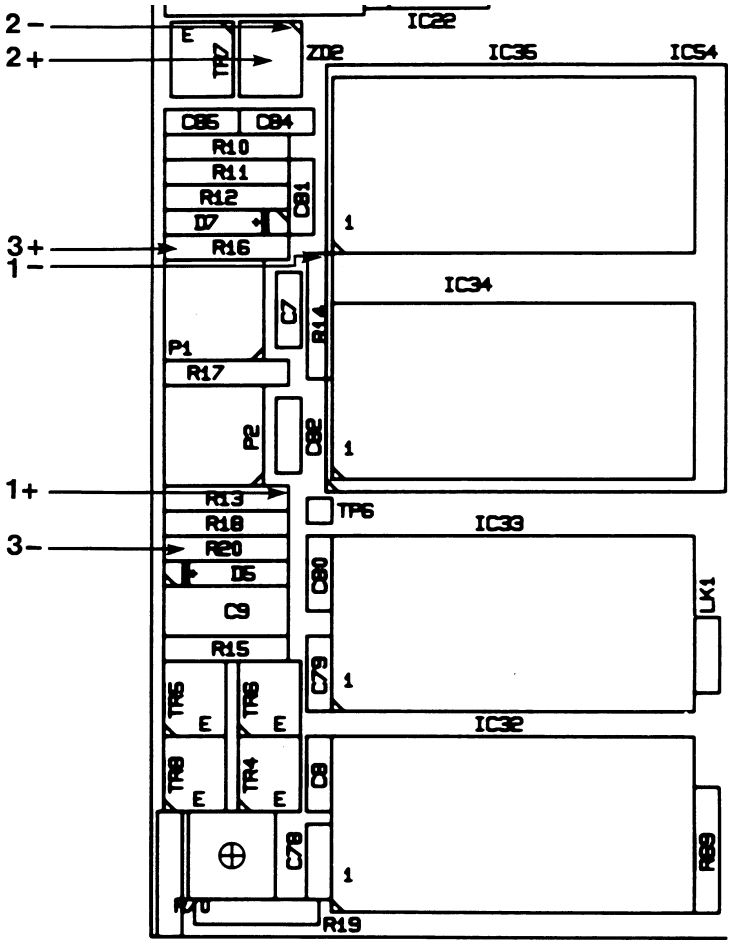

Figure 6.3.1 Control board measuring points

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6.3.2 Mark I Control board layout

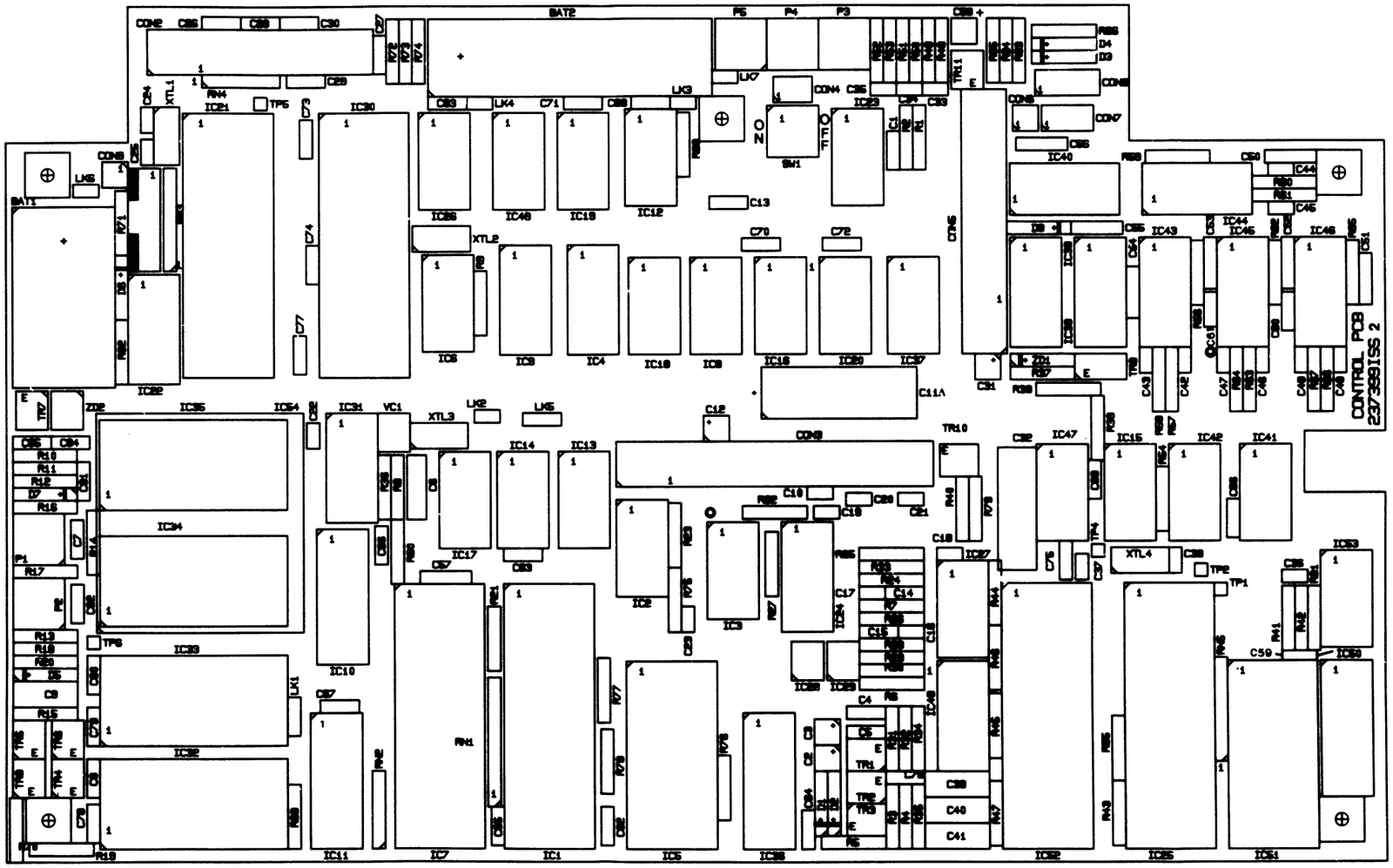

Figure 6.3.2 Mark I Control board layout

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6.3.3 Mark I Control board schematic diagram

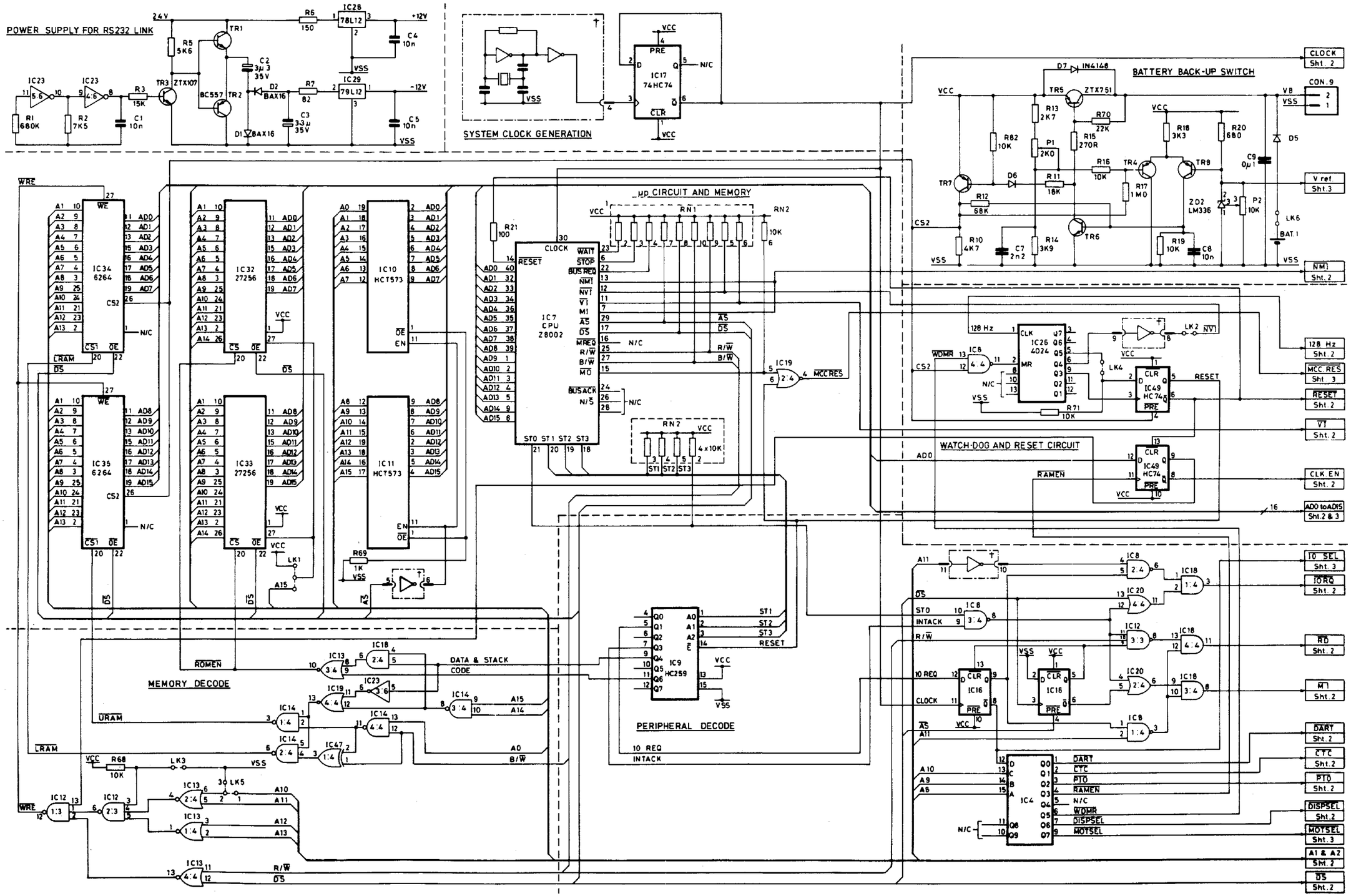

Figure 6.3.3a Mark I Control board schematic (sheet 1)

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6.3.3 MARK I CONTROL BOARD SCHEMATIC (Cont.)

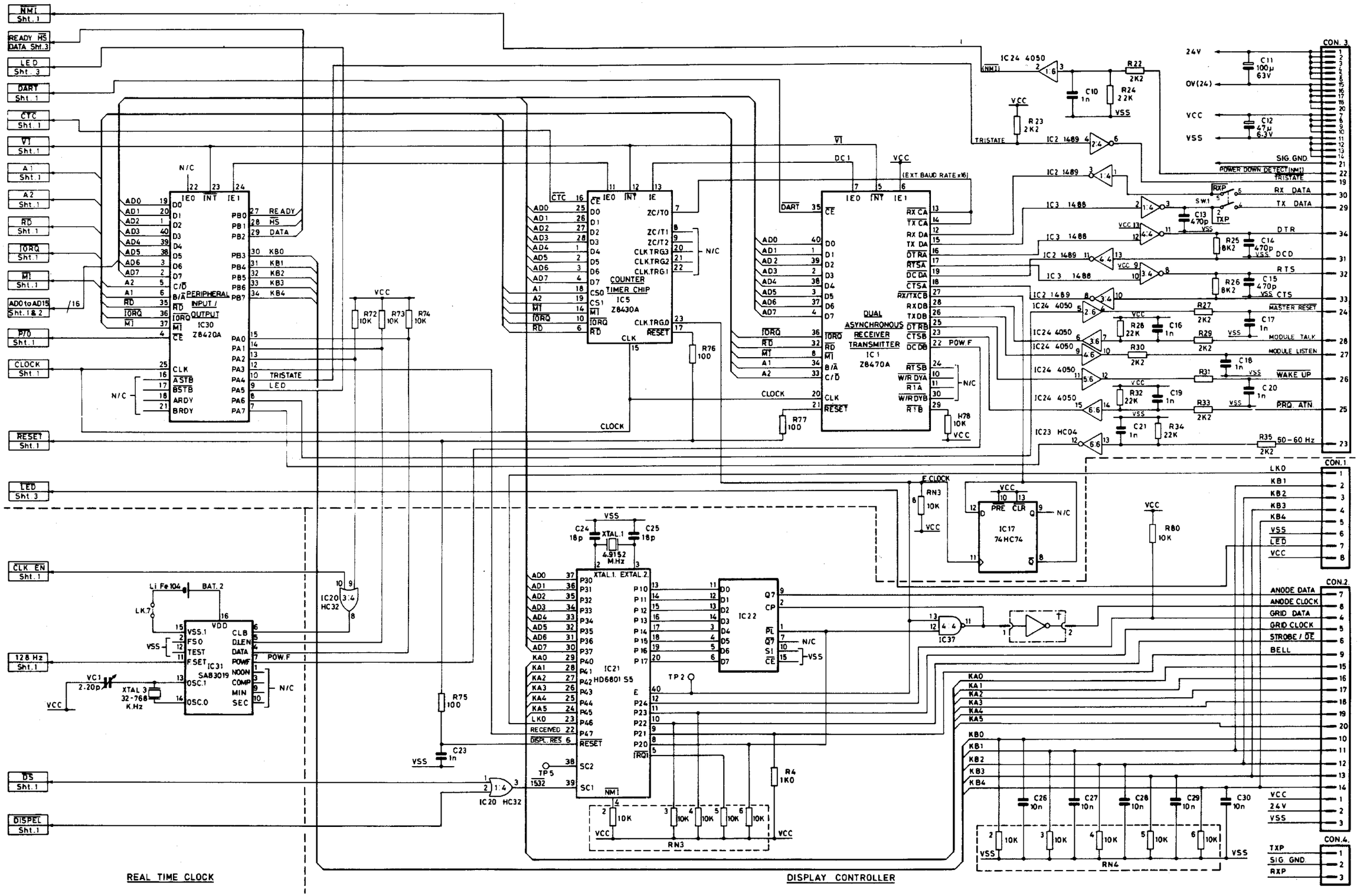

Figure 6.3.3b Mark I Control board schematic (sheet 2)

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6.3.3 MARK I CONTROL BOARD SCHEMATIC (Cont.)

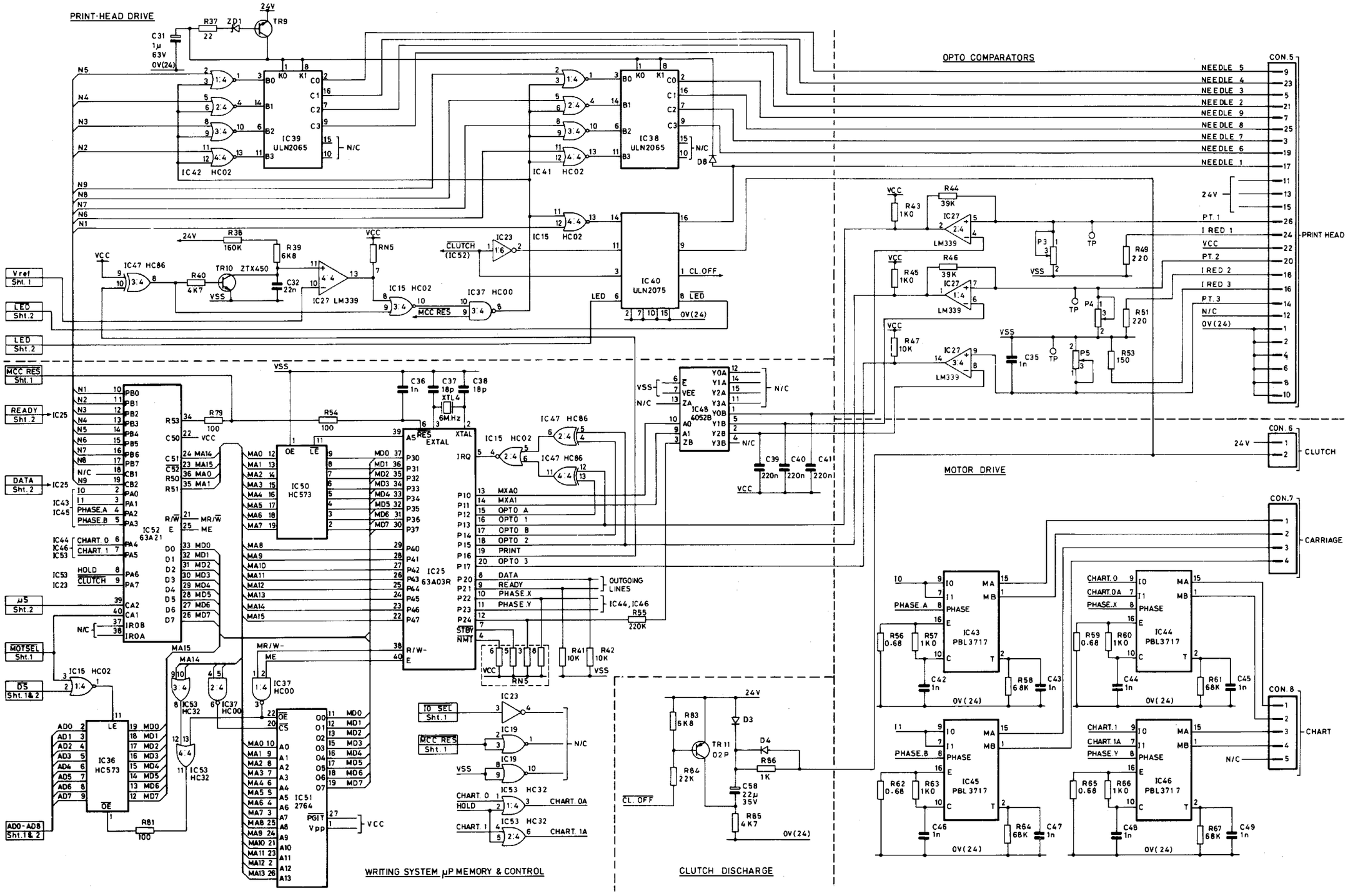

Figure 6.3.3c Mark I Control board schematic (sheet 3)

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6.3.3 MARK I CONTROL BOARD SCHEMATIC (Cont.)

IC Ref	IC Type	24V	0V (24V)	+12V	Vcc (5V)	VB	Vss (0V)	Signal Ground	-12V	Decoupling capacitors	Comments
1	Z8470A				Pin 9		Pin 31			C62 (10nF)	
2	1489				Pin14			Pin 7			
3	1488			Pin 14				Pin 7	Pin 1		
4	74HC42				Pin 16		Pin 8			C63 (10nF)	
5	Z8430A				Pin 14		Pin 7			C64 (1onF)	
6	74HC04				Pin 14		Pin 7				
7	Z8002				Pin 10		Pin 31			C65 (10nF)	
8	74HC00				Pin 14		Pin 7				
9	74HC259				Pin 16		Pin 8				
10	74HCT573				Pin 20		Pin 10			C66 (10nF)	
11	74HCT573				Pin 20		Pin 10			C67 (10nF)	
12	74HC10				Pin 14		Pin 7			C68 (10nF)	
13	74HC02				Pin 14		Pin 7				
14	74HC00				Pin 14		Pin 7				
15	74HC02				Pin 14		Pin 7			C69 (10nF)	
16	74HC74				Pin 14		Pin 7			C70 (10nF)	
17	74HC74				Pin 14		Pin 7			C57 (100nF)	
18	74HC08				Pin 14		Pin 7				
19	74HC02				Pin 14		Pin 7			C71 (10nF)	
20	74HC32				Pin 14		Pin 7			C72 (10nF)	
21	HD6801S5				Pin 7, 21		Pin 1			C73, C74 (10nF)	TP5 and TP2 on pins 38 and 40
22	74HCT165				Pin 16		Pin 8				
23	74HC04				Pin 14		Pin 7				
24	4050B				Pin 1		Pin 8				
25	63A03R				Pin 21		Pin 1			C75 (10nF)	TP4 and TP1 on pins 38 and 40
26	4024B				Pin 14		Pin 7				
27	LM399	Pin 3					Pin 12			C76 (10nF)	
28	78L12			Pin 3			Pin 2				+12V o/p from pin 3
29	79L12						Pin 3		Pin 1		-12V o/p from pin 1
30	Z8420A				Pin 26		Pin 11			C77 (10nF)	
31	SAB3019				Pin 16		Pin 8				
32	27256				Pin 28		Pin 14			C78 (10nF)	
33	27256				Pin 28		Pin 14			C79, C80 (10nF)	
34	6264					Pin 28	Pin 14			C81 (10nF)	Between VB and Vss. T6 on VB
35	6264					Pin 28	Pin 14			C82 (10nF)	Between VB and Vss. T6 on VB
36	74HCT573				Pin 20		Pin 10				
37	74HC00				Pin 14		Pin 7				
38	ULN2064		Pin 4, 5, 12, 13							C56 (100nF)	Between 24V and 0V(24)
39	ULN2064		Pin 4, 5, 12, 13							C55 (100nF)	Between 24V and 0V(24)
40	ULN2075		Pin 4, 5, 12, 13							C54 (100nF)	Between 24V and 0V(24)
41	74HC02				Pin 14		Pin 7			C86 (10nF)	
42	74HC02				Pin 14		Pin 7				
43	PBL3717	Pin 3, 14	Pin 4, 5, 12, 13		Pin 6,11					C53 (100nF), C61 (10nF)	C53 between 24V and 0V(24); C61 between Vcc and 0V(24)
44	PBL3717	Pin 3, 14	Pin 4, 5, 12, 13		Pin 6,11					C50 (100nF)	C50 between 24V and 0V(24)
45	PBL3717	Pin 3, 14	Pin 4, 5, 12, 13		Pin 6,11					C52 (100nF), C60 (10nF)	C52 between 24V and 0V(24); C60 between Vcc and 0V(24)
46	PBL3717	Pin 3, 14	Pin 4, 5, 12, 13		Pin 6,11					C51 (100nF)	C51 between 24V and 0V(24)
47	74HC86				Pin 14		Pin 7				
48	4052B				Pin 16		Pin 8				
49	74HC74				Pin 14		Pin 7			C83 (10nF)	
50	74HC573				Pin 20		Pin 10			C71 (10nF)	
51	2764				Pin 28		Pin 14				
52	63A21				Pin 20		Pin 1				
53	74HC32				Pin 14		Pin 7				
RN1	10k				Pin 1						
RN2	10k				Pin 1						
RN3	10k				Pin 1						
RN4	10k						Pin 1				
RN5	10k				Pin 1						
										C84 (10nF)	Between 24V and 0V(24) to decouple ± 12V generation
										C85 (10nF)	Decouples voltage sensing circuit for CS2

Figure 6.3.3d Mark I Control board schematic (sheet 4)

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6.4 PSU BOARD

6.4.1 PSU Board component layout

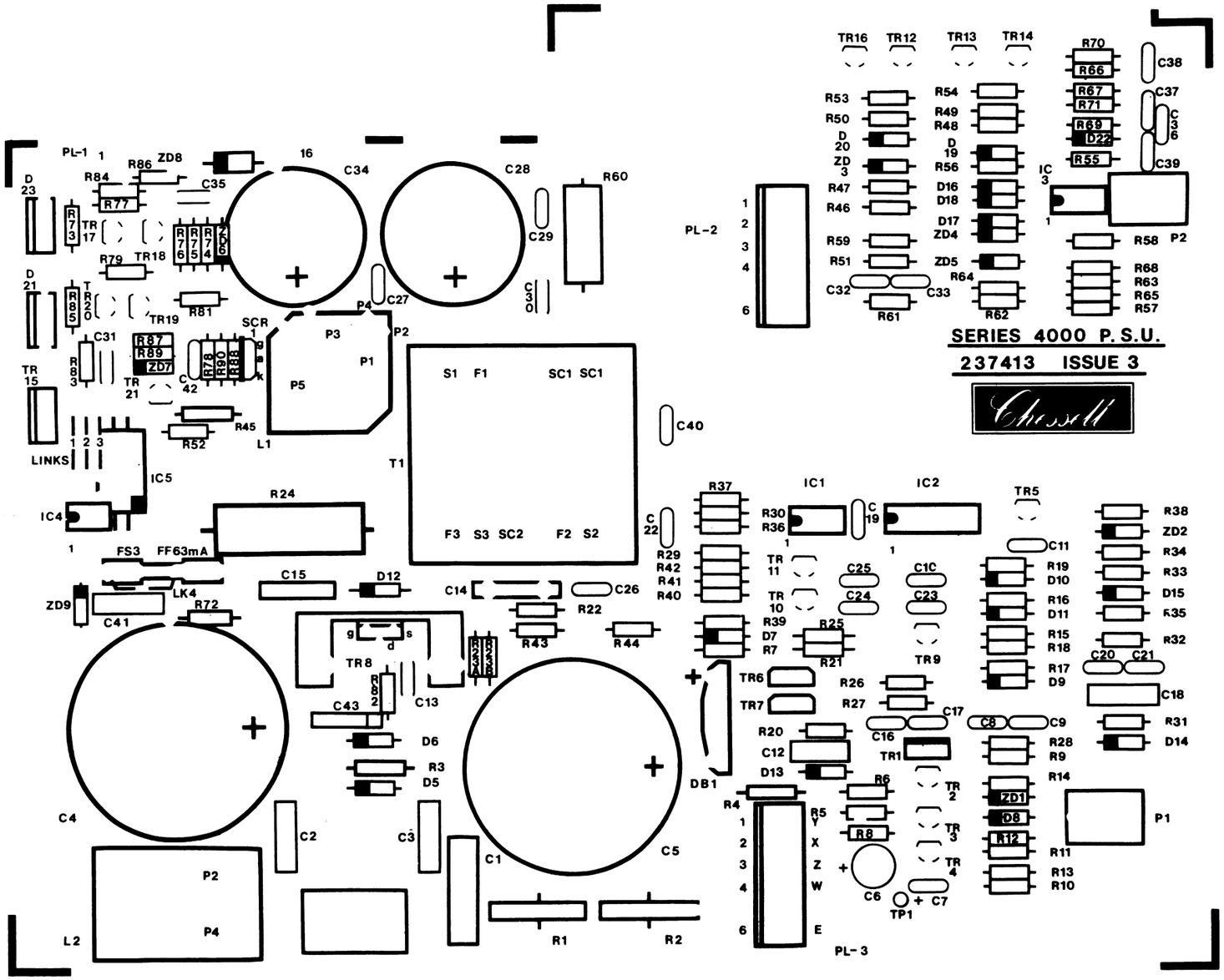

Figure 6.4.1 PSU Board component layout

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6.4.2 PSU Board schematic diagram

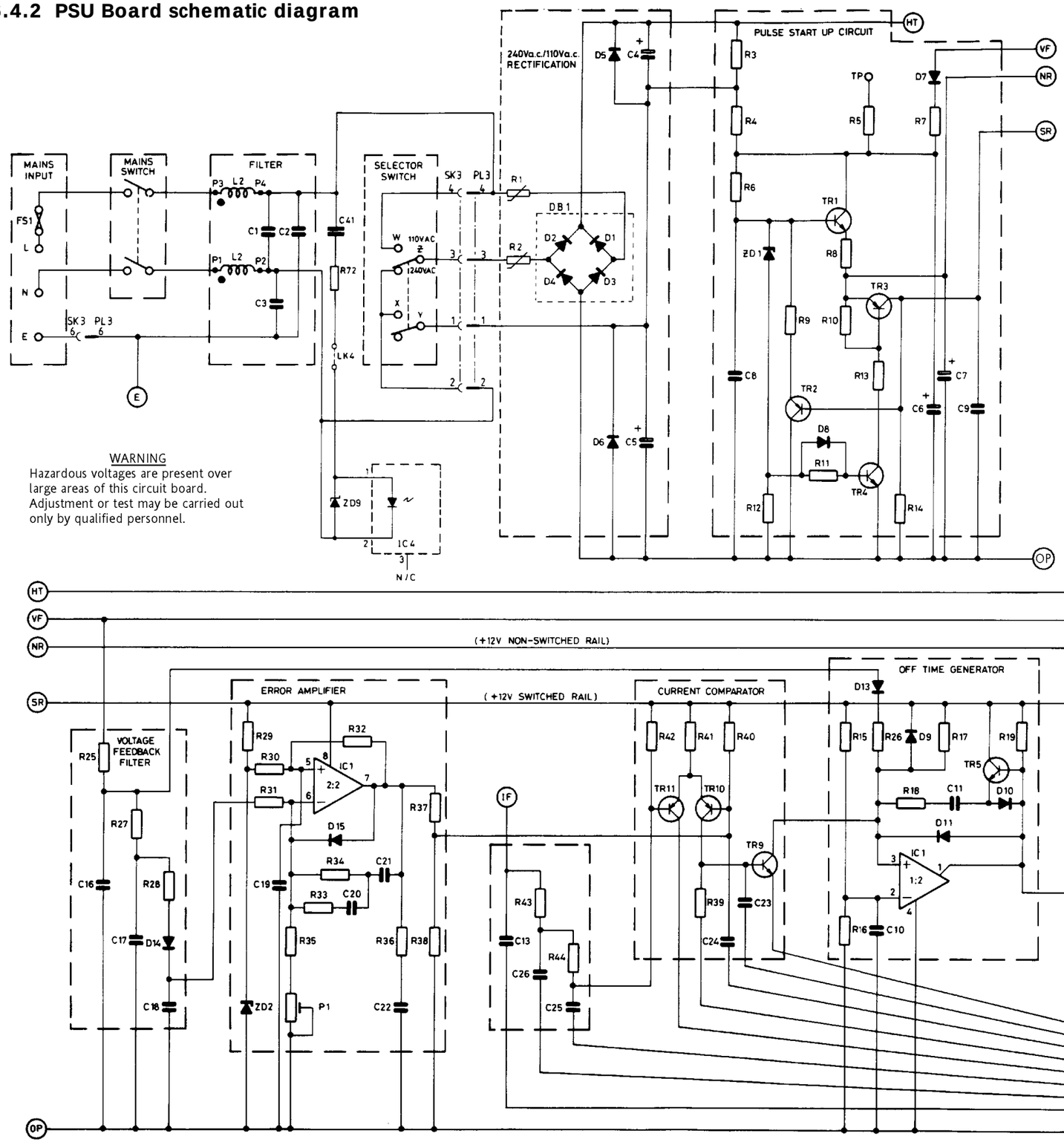

Figure 6.4.2a PSU board schematic (sheet 1)

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6.4.2 PSU BOARD SCHEMATIC DIAGRAM (Cont.)

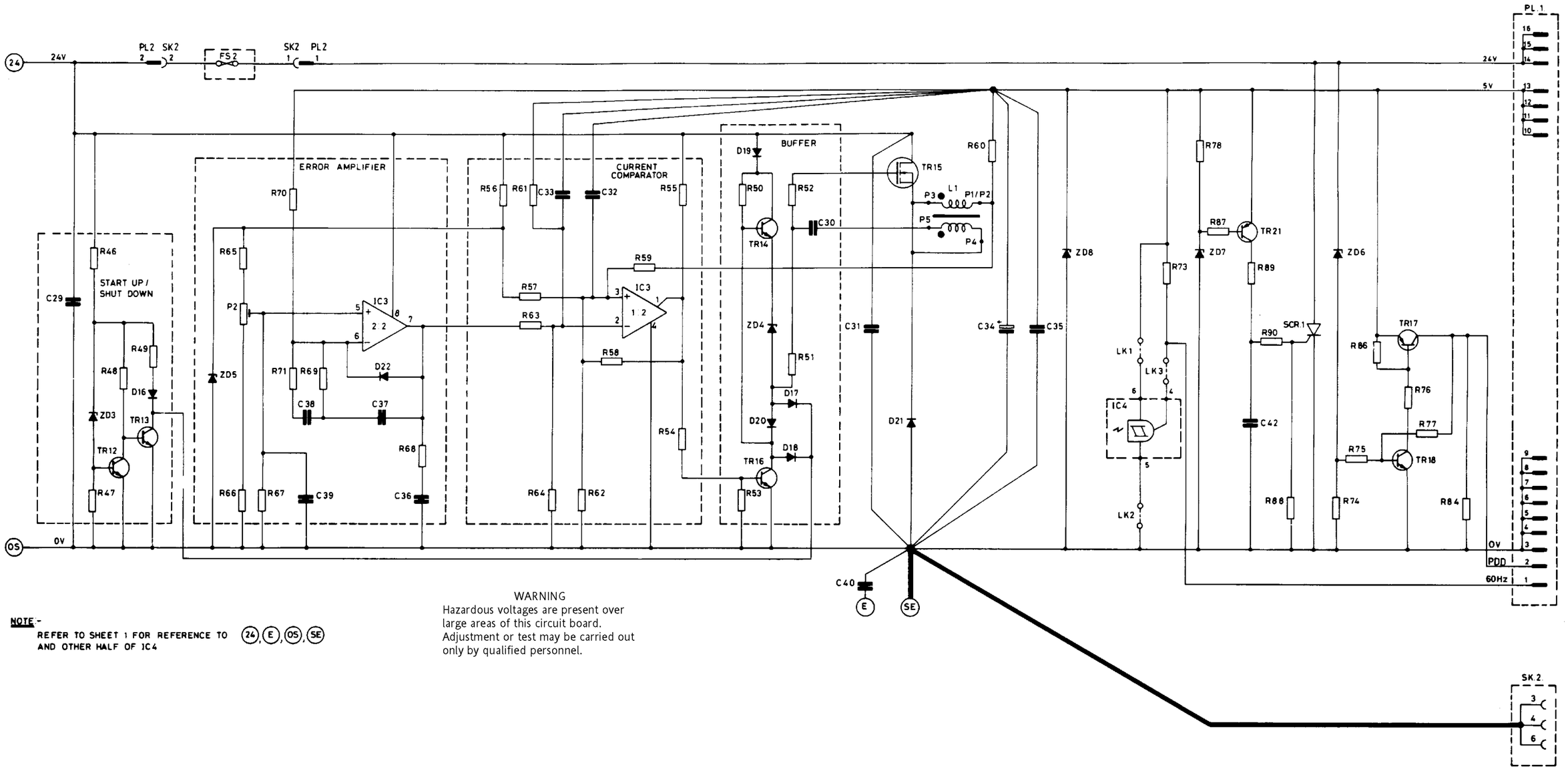

Figure 6.4.2b PSU board schematic (sheet 2)

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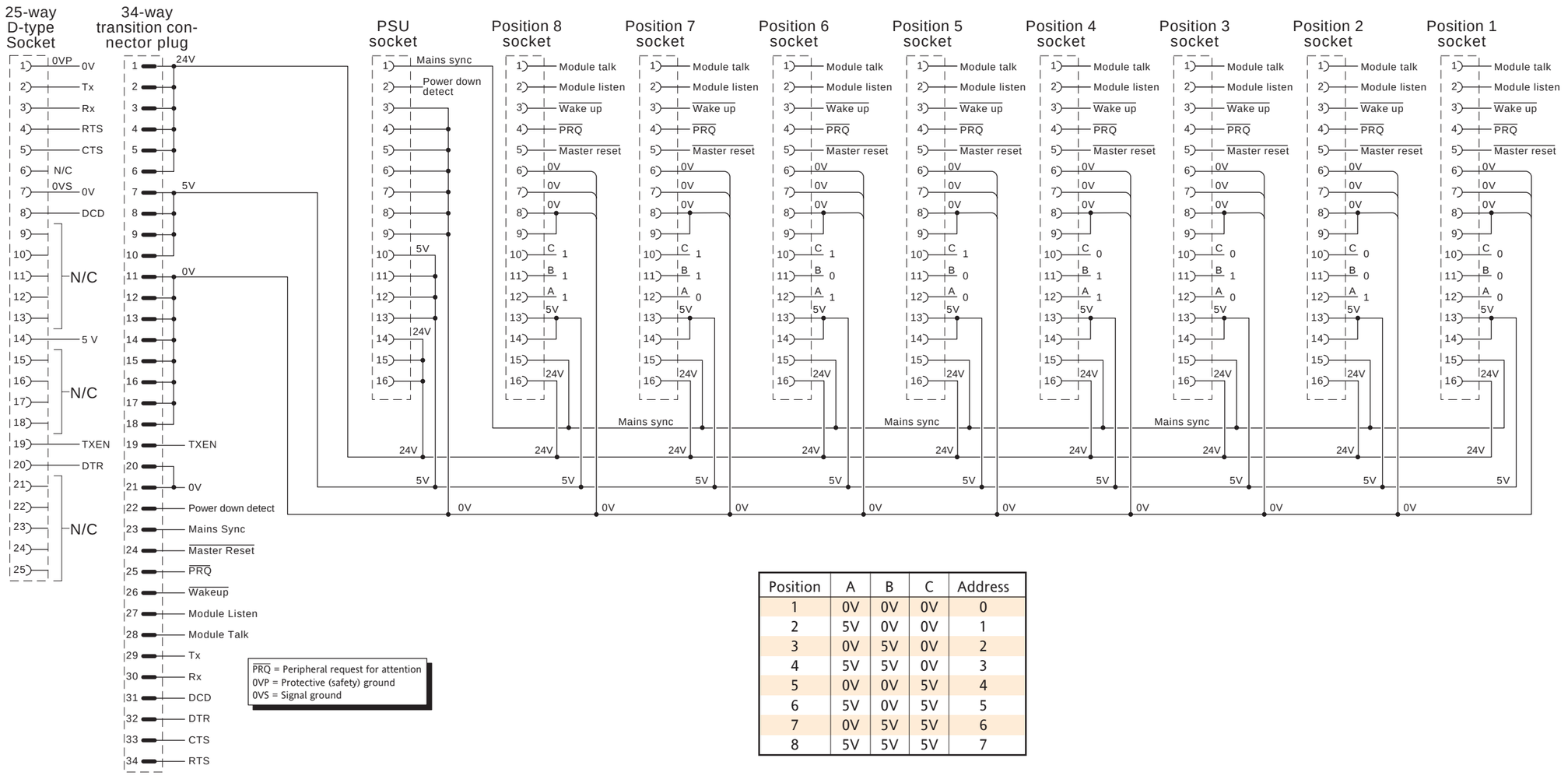
6.5 MOTHER BOARD

6.5.1 Mother board schematic diagram



Position	A	B	C	Address
1	0V	0V	0V	0
2	5V	0V	0V	1
3	0V	5V	0V	2
4	5V	5V	0V	3
5	0V	0V	5V	4
6	5V	0V	5V	5
7	0V	5V	5V	6
8	5V	5V	5V	7

Figure 6.5.1 Mother board schematic

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6.6 RELAY OUTPUT BOARD

6.6.1 Relay output board component layout

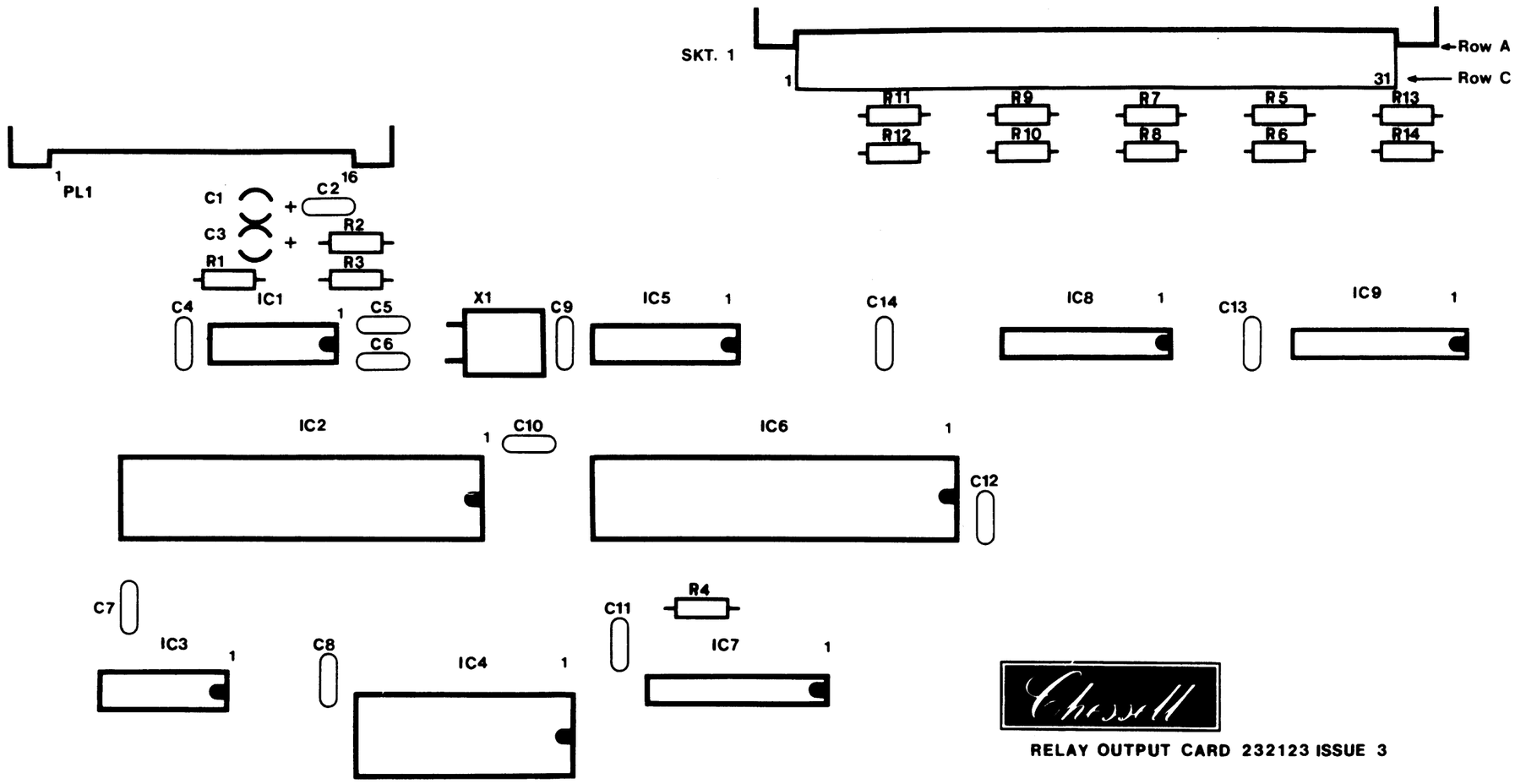

Figure 6.6.1 Relay output board component layout

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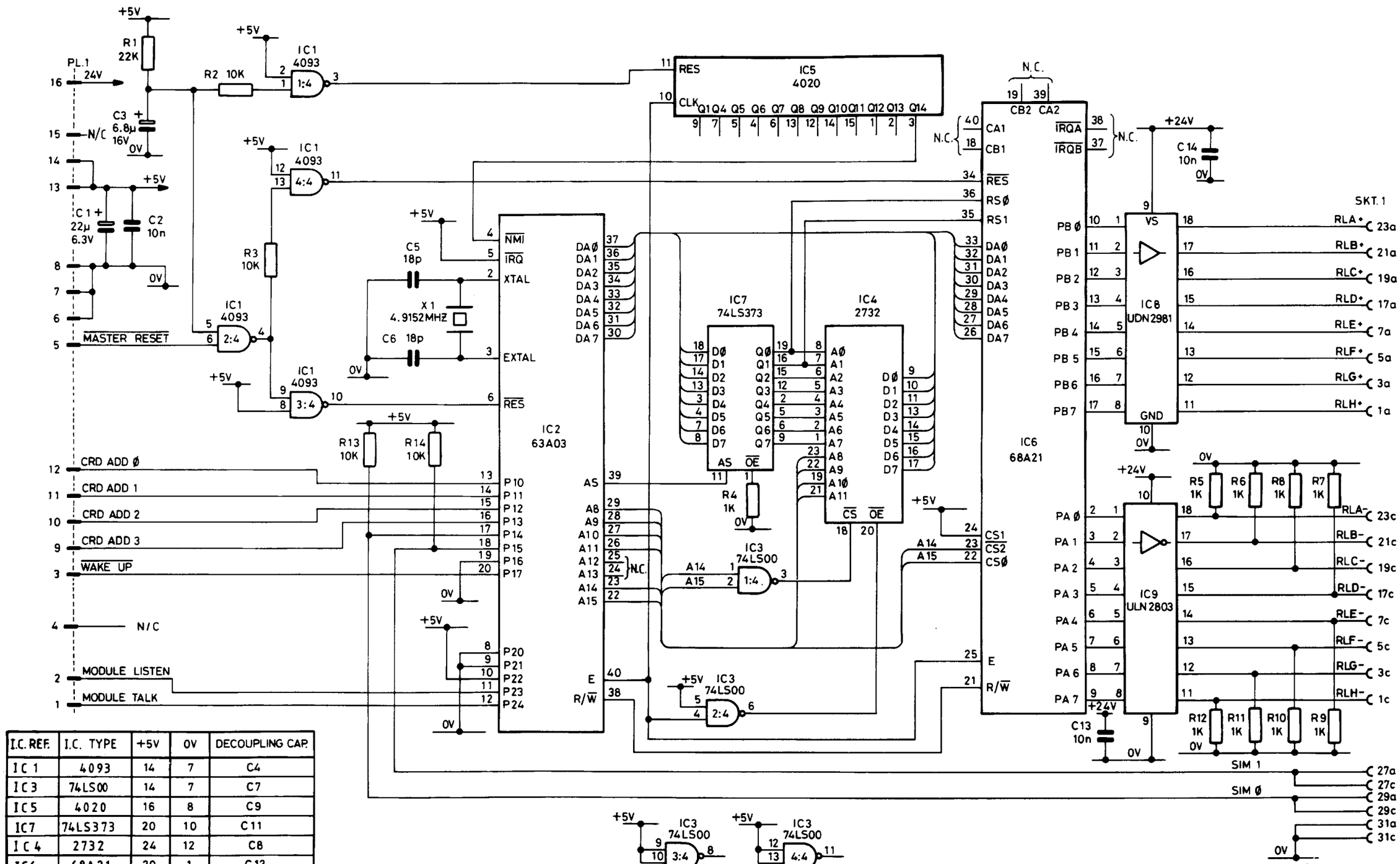
6.6.2 Relay output board schematic



I.C. REF.	I.C. TYPE	+5V	0V	DECOUPLING CAP.
IC 1	4093	14	7	C4
IC3	74LS00	14	7	C7
IC5	4020	16	8	C9
IC7	74LS373	20	10	C 11
IC 4	2732	24	12	C8
IC6	68A21	20	1	C 12
IC2	63A03	7, 21	1	C 10

Figure 6.6.2 Relay output board schematic

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6.7 DISPLAY BOARD

6.7.1 Display board component layout

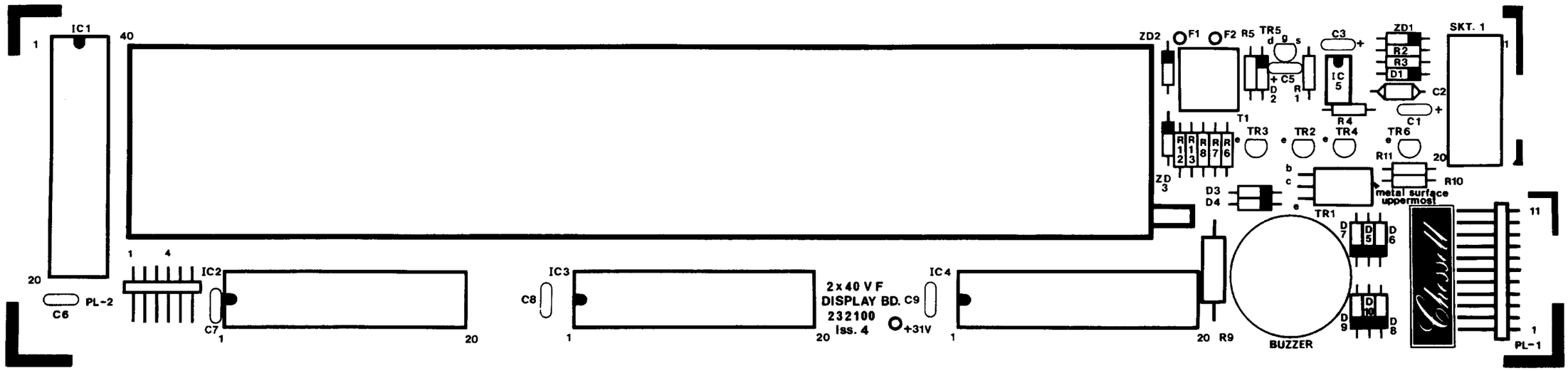

Figure 6.7.1 Display board component layout

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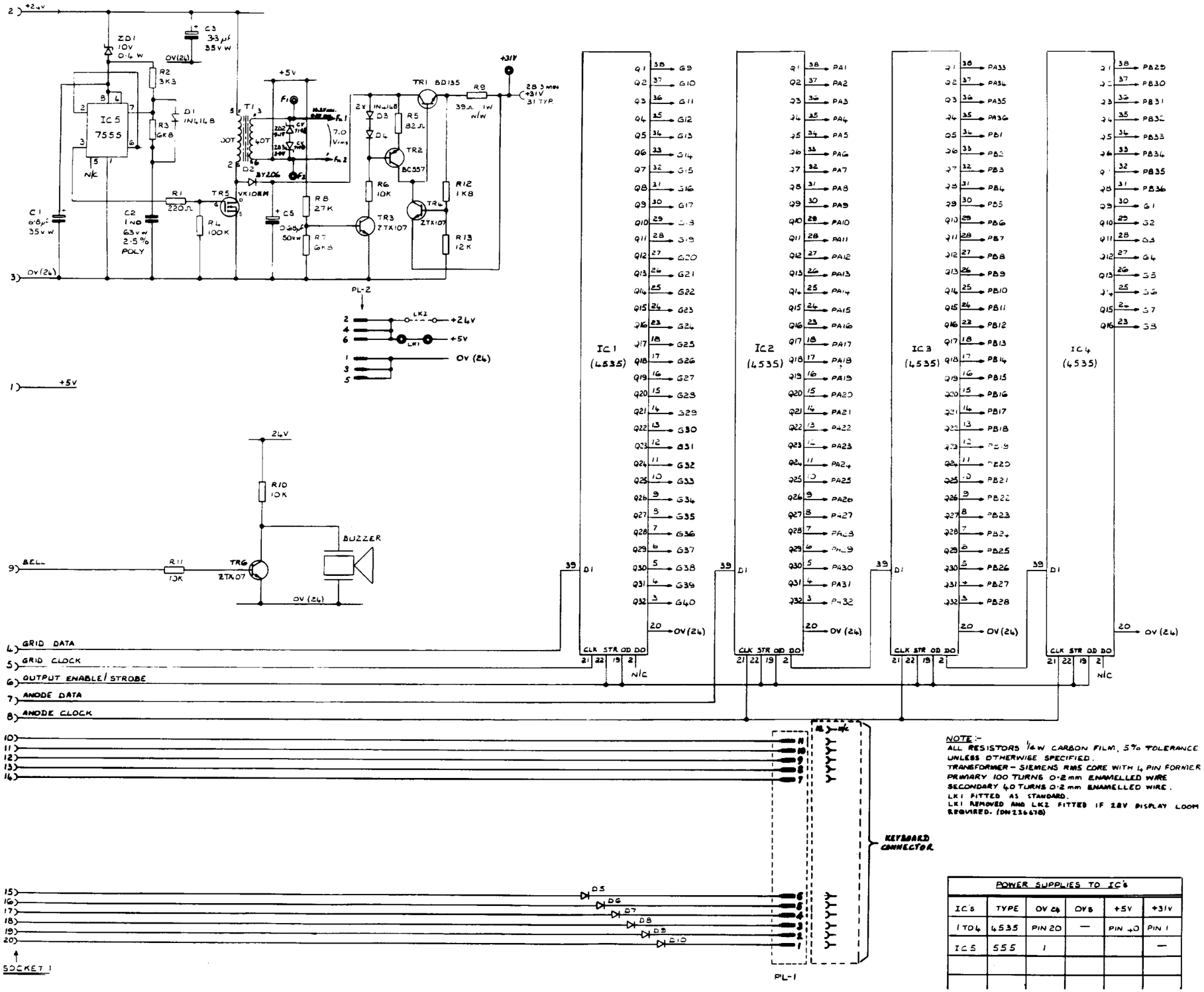
6.7.2 Display board schematic diagram



NOTE :-
ALL RESISTORS 1/4W CARBON FILM, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.
TRANSFORMER – SIEMENS RM5 CORE WITH 4 PIN FORMER
PRIMARY 100 TURNS 0·2mm ENAMELLED WIRE
SECONDARY 40 TURNS 0·2mm ENAMELLED WIRE.
LK1 FITTED AS STANDARD.
LK1 REMOVED AND LK2 FITTED IF 28V DISPLAY LOOM REQUIRED. (DN236678)

POWER SUPPLIES TO IC's

IC's	TYPE	0V 24	0V5	+5V	+31V
1 TO 4	4535	PIN 20	—	PIN 40	PIN 1
IC5	555	1			—

Figure 6.7.2 Display board schematic

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6.8 EIA232 TO EIA422 CONVERSION MODULE

6.8.1 Conversion module component layout

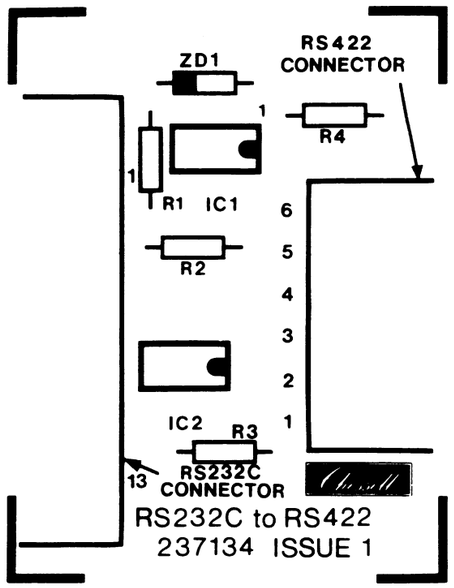
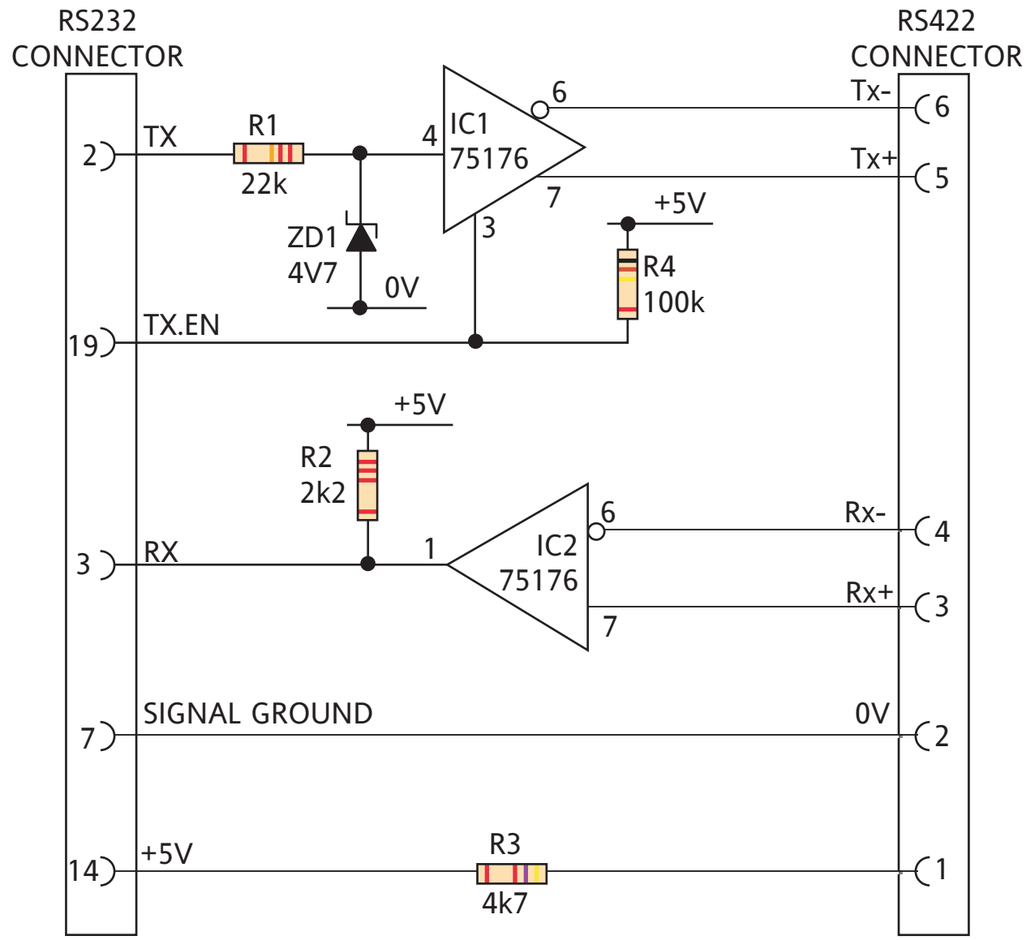


Figure 6.8.1 Conversion module component layout

6.8.2 Conversion module schematic diagram



IC Ref	+5V	0V
IC1	Pins 2 & 8	Pin 5
IC2	8	Pins 2, 3, 4, & 5

Figure 6.8.2 Conversion module schematic diagram

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6.9 MARK II CONTROL BOARD

6.9.1 Mark II Control board layout

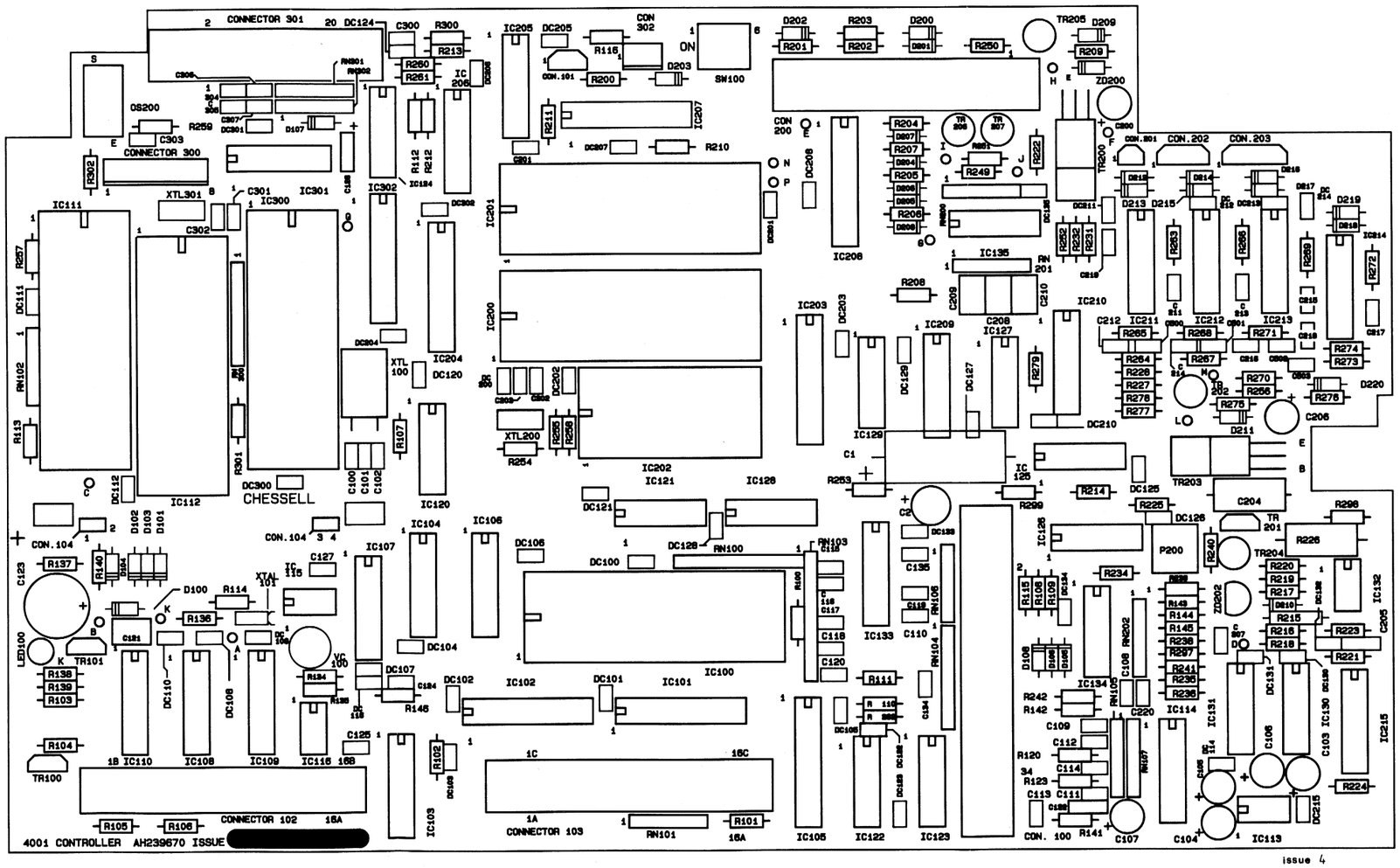

Figure 6.9.1 Mark II Control board layout

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6.9.2 Mark II Control board schematic diagram

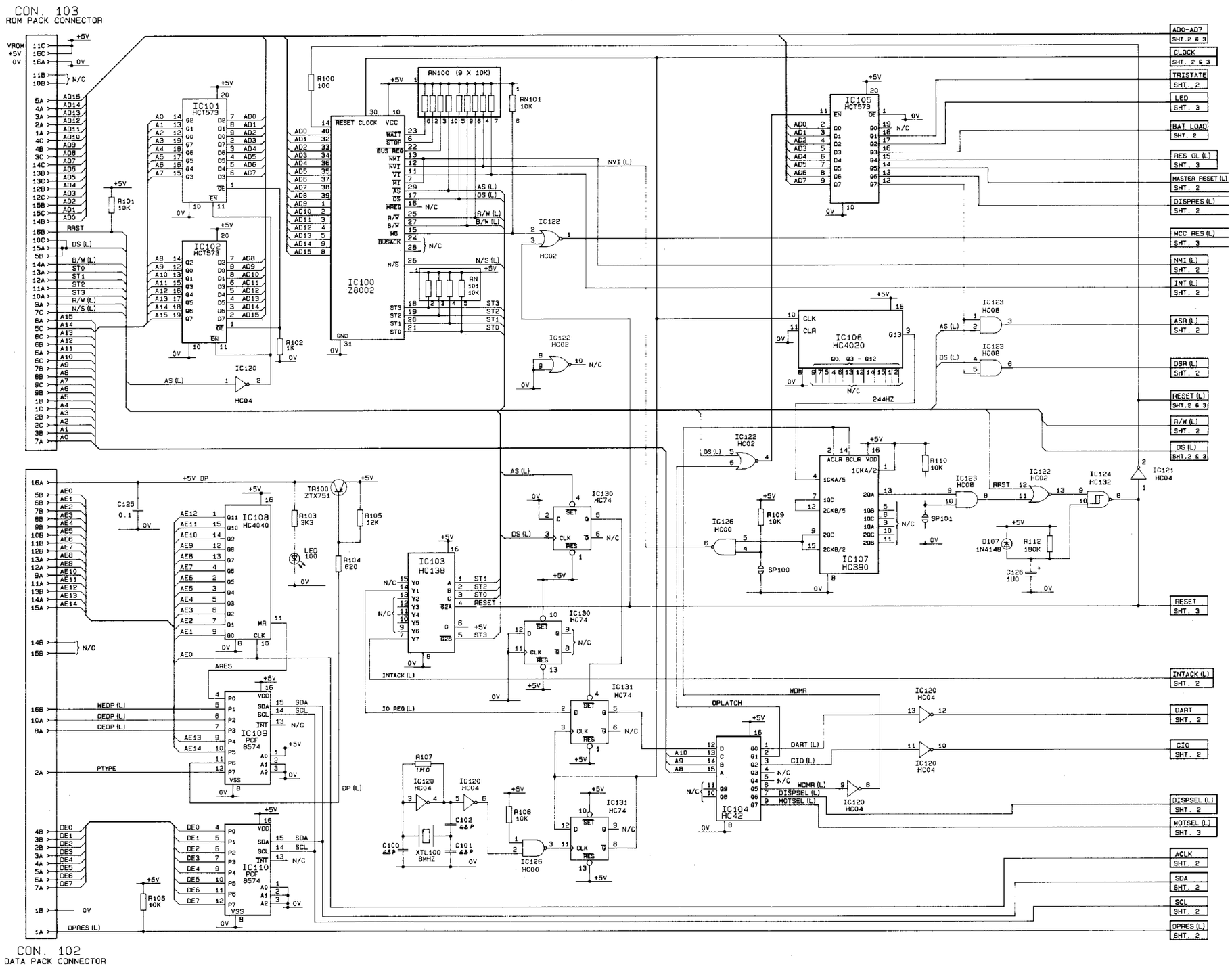

Figure 6.9.2a Mark II Control board schematic (sheet 1)

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6.9.2 MARK II CONTROL BOARD SCHEMATIC (Cont.)

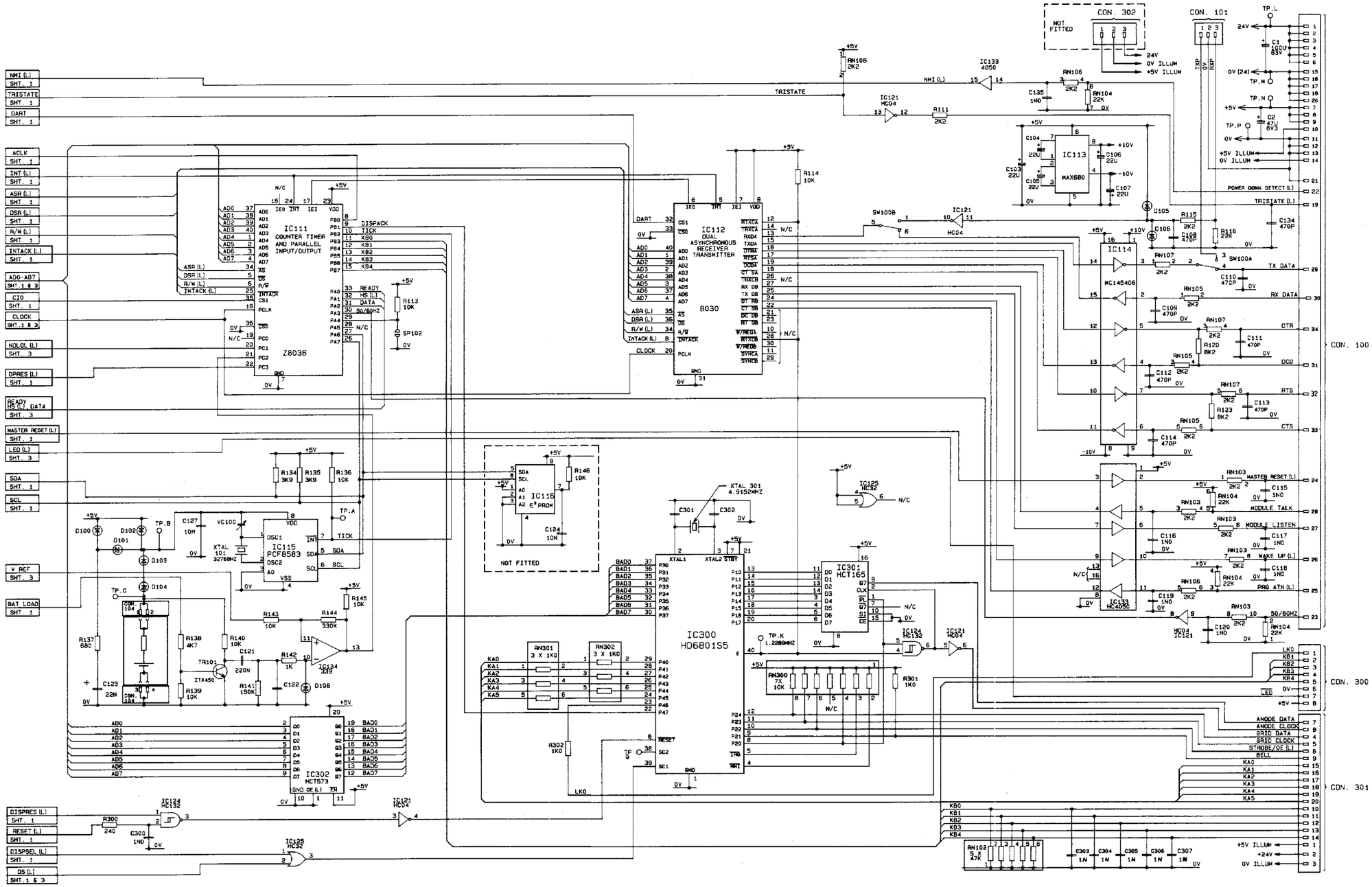

Figure 6.9.2b Mark II Control board schematic (sheet 2)

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6.9.2 MARK II CONTROL BOARD SCHEMATIC (Cont.)

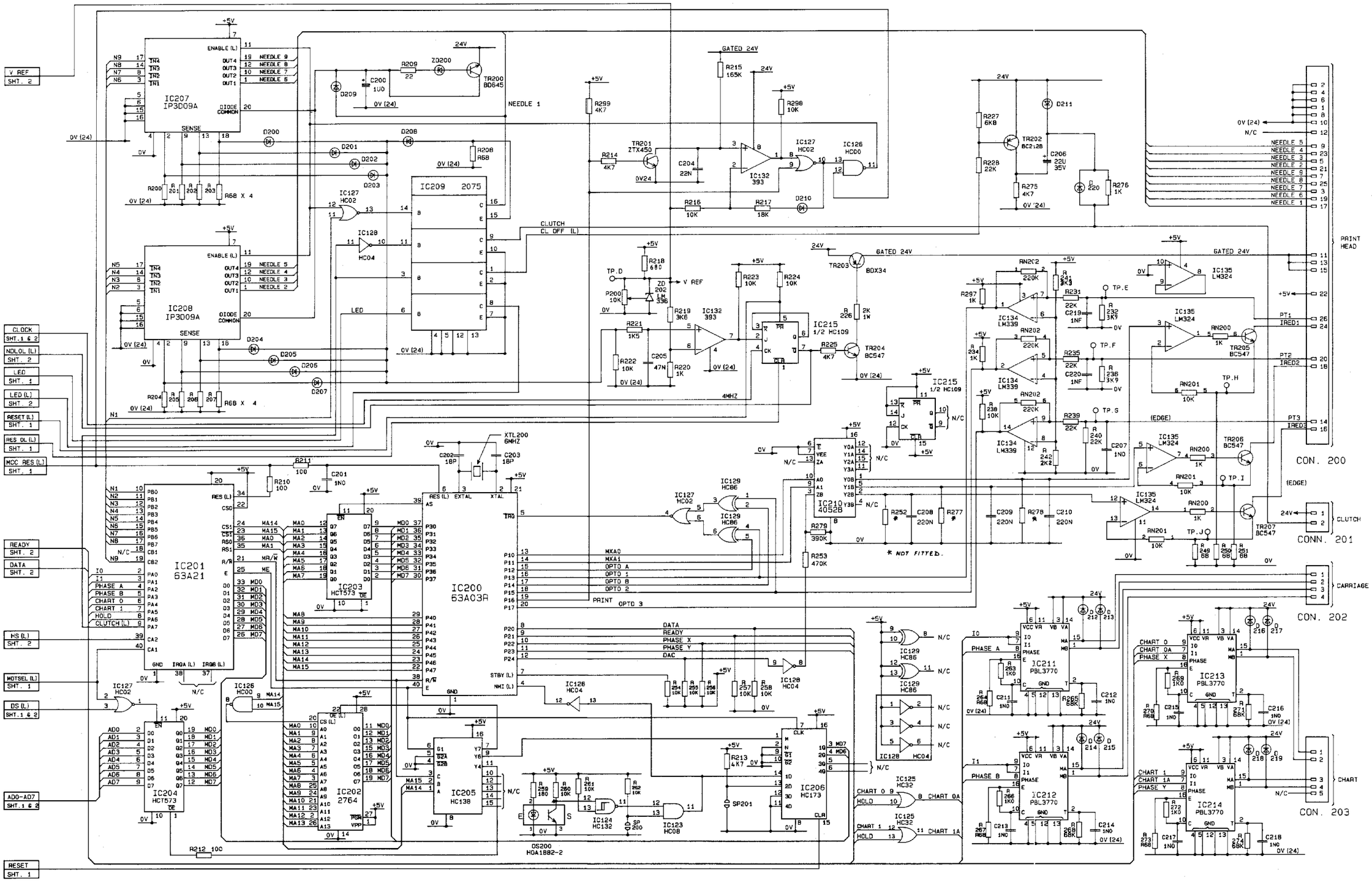

Figure 6.9.2c Mark II Control board schematic (sheet 3)

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6.9.2 MARK II CONTROL BOARD SCHEMATIC (Cont.)

IC. REF.	IC. TYPE	+5V	0V	24V	0V (24)	+10V	-10V	DECOUPLING CAPACITOR	REMARKS
IC100	Z8002	10	31					DC100 ACROSS +5V & 0V	
IC101	HCT573	20	10					DC101 ACROSS +5V & 0V	
IC102	HCT573	20	10					DC102 ACROSS +5V & 0V	
IC103	HC138	16	8					DC103 ACROSS +5V & 0V	
IC104	HC42	16	8					DC104 ACROSS +5V & 0V	
IC105	HCT573	20	10					DC105 ACROSS +5V & 0V	
IC106	HC4020	16	8					DC106 ACROSS +5V & 0V	
IC107	HC390	16	8					DC107 ACROSS +5V & 0V	
IC108	HC4040	16	8					DC108 ACROSS +5V & 0V	
IC109	PCF8574	16	8					DC109 ACROSS +5V & 0V	
IC110	PCF8574	16	8					DC110 ACROSS +5V & 0V	
IC111	Z8036	23	7					DC111 ACROSS +5V & 0V	
IC112	Z8030	9	31					DC112 ACROSS +5V & 0V	
IC113	MAX680	6	5						
IC114	MC145406	16	9			1	8	DC114 ACROSS +5V & 0V	
IC115	PCF8583		4					C127 ACROSS +5V & 0V	
IC116	E² PROM	8	4					DC116 ACROSS +5V & 0V	
IC120	HC04	14	7					DC120 ACROSS +5V & 0V	
IC121	HC04	14	7					DC121 ACROSS +5V & 0V	
IC122	HC02	14	7					DC122 ACROSS +5V & 0V	
IC123	HC08	14	7					DC123 ACROSS +5V & 0V	
IC124	HC132	14	7					DC124 ACROSS +5V & 0V	
IC125	HC32	14	7					DC125 ACROSS +5V & 0V	
IC126	HC00	14	7					DC126 ACROSS +5V & 0V	
IC127	HC02	14	7					DC127 ACROSS +5V & 0V	
IC128	HC04	14	7					DC128 ACROSS +5V & 0V	
IC129	HC86	14	7					DC129 ACROSS +5V & 0V	
IC130	HC74	14	7					DC130 ACROSS +5V & 0V	
IC131	HC74	14	7					DC131 ACROSS +5V & 0V	
IC132	393			8	4			DC132 ACROSS 24V & 0V (24)	
IC133	HC4050	1	8					DC133 ACROSS +5V & 0V	
IC134	339	3	12					DC134 ACROSS +5V & 0V	
IC135	LM324	4	11					DC135 ACROSS +5V & 0V	
IC200	63A03R	21	1					DC200 ACROSS +5V & 0V	
IC201	63A21	20	1					DC201 ACROSS +5V & 0V	
IC202	2764	28	14					DC202 ACROSS +5V & 0V	
IC203	HCT573	20	10					DC203 ACROSS +5V & 0V	
IC204	HCT573	20	10					DC204 ACROSS +5V & 0V	
IC205	HC138	16	8					DC205 ACROSS +5V & 0V	
IC206	HC173	16	8					DC206 ACROSS +5V & 0V	
IC207	IP3D09A	7	4					DC207 ACROSS +5V & 0V	
IC208	IP3D09A	7	4					DC208 ACROSS +5V & 0V	
IC210	4052B	16	8					DC210 ACROSS +5V & 0V	
IC211	PBL3770	6, 11		3, 14	4, 5, 12, 13			DC211 ACROSS 24V & 0V (24) C500 ACROSS +5V & 0V	
IC212	PBL3770	6, 11		3, 14	4, 5, 12, 13			DC212 ACROSS 24V & 0V (24) C501 ACROSS +5V & 0V	
IC213	PBL3770	6, 11		3, 14	4, 5, 12, 13			DC213 ACROSS 24V & 0V (24) C502 ACROSS +5V & 0V	
IC214	PBL3770	6, 11		3, 14	4, 5, 12, 13			DC214 ACROSS 24V & 0V (24) C503 ACROSS +5V & 0V	
IC215	HC109	16	8					DC215 ACROSS +5V & 0V	
IC300	HD60801S5	21	1					DC300 ACROSS +5V & 0V	
IC301	HCT165	16	8					DC301 ACROSS +5V & 0V	
IC302	HCT573	20	10					DC302 ACROSS +5V & 0V	

Figure 6.9.2d Mark II Control board schematic (sheet 4)

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7 SPARE PARTS

7.1 CONSUMABLES

GD236721Uxxx 35 metre roll chart
(xxx = no of chart divisions = 080, 100, 120, 140, 150)
LA232380 Ink Ribbon Cartridge

7.2 ACCESSORIES

FI237732	DIN door key
LA232457	Panel mount clamp
CI236786	Re-wirable mains plug

7.3 CASE ASSEMBLY

LA232448	Complete case assembly excluding door and rear terminal cover.
LA232450	Complete door assembly (glass)
LA236302	Complete door assembly (perspex)
LA236303	Complete door assembly (NR glass) (Note 1)
BT232206	Upper door window (glass)
BT232205	Lower door window (glass)
BT232207	Upper door window (NR glass) (Note 1)
BT232208	Lower door window (NR Glass) (Note 1)
BT232579	Upper door window (perspex)
BT232580	Lower door window (perspex)
GA239213	Door legend plate (without legend) (Note 2)
LA237208	DIN Door lock assembly
BE239018	Door pivot pin
BE239019	Door pivot bush
BH236100	Spring
BA236097	Upper case cover
BA232203	Lower case cover
LA232459	Gland plate
LA232461	Rear case cover assembly
BA237113	Card retaining strap
BA236316	Earth Link
LA236298	Access system catch assembly (left-hand)
LA236299	Access system catch assembly (right-hand)
AH232122	Mother board assembly

7.4 POWER SUPPLY

LA232545	Power supply module
CH050023	Line fuse 2AT (for 110V working)
CS236673	Line fuse 1AT (for 240V working)
CS237285	Protection fuse 5AFF
DC 236626	Line supply switch

7.5 INPUT/OUTPUT (I/O) BOARDS

7.5.1 Two-wire dc input

AH232128	2-wire dc input module (note 3)
LA238781	SIM assembly (2-wire dc) (note 3)
LA237067	Shunt resistor kit (100 Ohm)
LA238101	Shunt resistor kit (250 Ohm)
LA237068	Attenuator kit (100:1, 990k and 10k)
CI169127	Fail-safe link

7.5.2 Resistance thermometer input

AH234434	RTD input module (note 3)
LA237686	SIM assembly (2-wire termination) (note 3)
LA237687	SIM assembly (3-wire termination) (note 3)
LA237688	SIM assembly (4-wire termination) (note 3)

7.5.3 Relay output

AH232123	Relay output board (note 3)
LA236885	SIM Assembly (8 relays) (note 3)
LA236886	SIM Assembly (4 relays) (note 3)

7.6 CONTROL BOARD

7.6.1 Mark I

PA239247	Clock support battery
PA234093	RAM support battery
CI069127	Link

7.6.2 Mark II

AH239670	Control board Mark II (including data pack and battery board, but no software)
AH239672	Data Pack
AH239745	Battery board
PA235482	Batteries, Silver oxide (two required)
LA242831	Retrofit kit for Mark II board

Notes:
1. NR = Non-reflective
2. A stencilling service for the legend plate is available. Details are to be supplied on form IA238756.
3. I/O boards and SIMs are supplied separately as break-down spares. If the recorder is to be upgraded by adding extra facilities, the I/O board, the appropriate SIM and any signal conditioning items must all be ordered as separate items. The relay output board interfaces with both 4-relay and 8-relay SIMs.

7.7 DISPLAY ASSEMBLY

LA236038	Keyboard assembly (English)
LA236322	Keyboard assembly (French)
LA236323	Keyboard assembly (German)
AH232100	Display PCB
LA238760	Lighting loom assembly (5 Volt)
CJ238760	Lamp
BO237761	Display bezel seal
BO237762	Display strip seal
LA234492	Left hand side plate
LA243788	Right-hand side plate
LA238760	Display board/lighting loom upgrade kit

7.8 WRITING SYSTEM

	Writing system complete
LA236675	Line key and loom assembly
GA236455	Line key label
GA232434	Power switch label
LA237125	Chart drive motor assembly
BQ232428	Chart drive belt
LA238704	Servo-colour select assembly
BD239040	Capstan flange
FB321H06	Screws for capstan flange (three required)
LA232384	Upper carriage assembly
BA237385	Cartridge retaining clamp
BA237376	Mounting bracket for cartridge retaining clamp
LA232422	Lower carriage assembly (original design)
LA243783	Lower carriage assembly (current design)
LA238183	Lower carriage, rail and feedback strip assy.
LA232438	Printhead assembly
DN232437	Opto loom assembly
BH239336	Drive cord for lower carriage
BH243697	Drive cord for upper carriage
BK236704	Brass ferrule for drive cord
LA232407	Auto take-up assembly
LA232424	Drive shaft
LA232425	Paper guide window assembly
LA236282	Tear-off cord assembly
BH232416	Ink tray support spring (left-hand)
BH232429	Ink tray support spring (right-hand)
LA239338	Drive cord kit (original design)
LA245304	Drive cord kit (current design)

7.8 DATAPACK CLEANING SOFTWARE

(Complete ROM pack)

LA242710	English
LA242711	French
LA242712	German

7.9 OPTION UP-GRADE KITS

LA238094	Portability kit (handle and feet)
LA237582	EIA232C to EIA422 converter (see Note below)
LA237619	Padded carrying case
BE238097	19 inch rack mounting-plate

7.10 SERVICE ACCESSORIES

	1000 cN Correx gauge
LA239009	Tool kit

7.11 CONFIGURATION EQUIPMENT

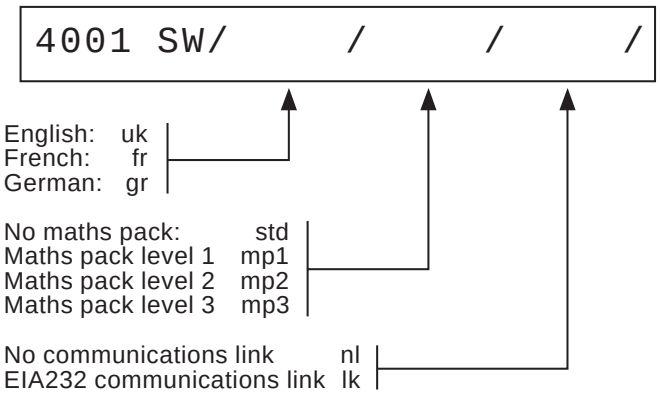
LA239717	Message-configuration-terminal kit
LA239724	Blank 16kB data pack
LA239719	Blank 32kB data pack
LA239720	Programmed 32kB data pack
DN239747	Psion communications harness, with plug for 4001
HA239691	Application program manual

7.12 LITERATURE

HA237229	Installation and operation manual
HA237231	Serial communications manual
HA238377	Maintenance manual
HA239142	Maths pack operation instructions
HA239951	Configuration guide

7.13 SOFTWARE ROM PACKS

Order 4001 ROM packs using the following code sequence:



Example: To order a ROM pack to provide English language displays, level 2 maths pack functions and communications link, the following order code would be used: 4001 SW/uk/mp2/lk

Note

The default 4001 communications standard is EIA232C. To convert to EIA422, a converter module (LA237582) must be used.

Before either communications standard can be used, the recorder must be fitted with communications software. See 'Software ROM packs' above, for ordering details.

7.14 SPARE PART IDENTIFICATION

This section consists of a number of drawings showing the locations of many of the spare parts listed in previous sections.

7.14.1 Electronics

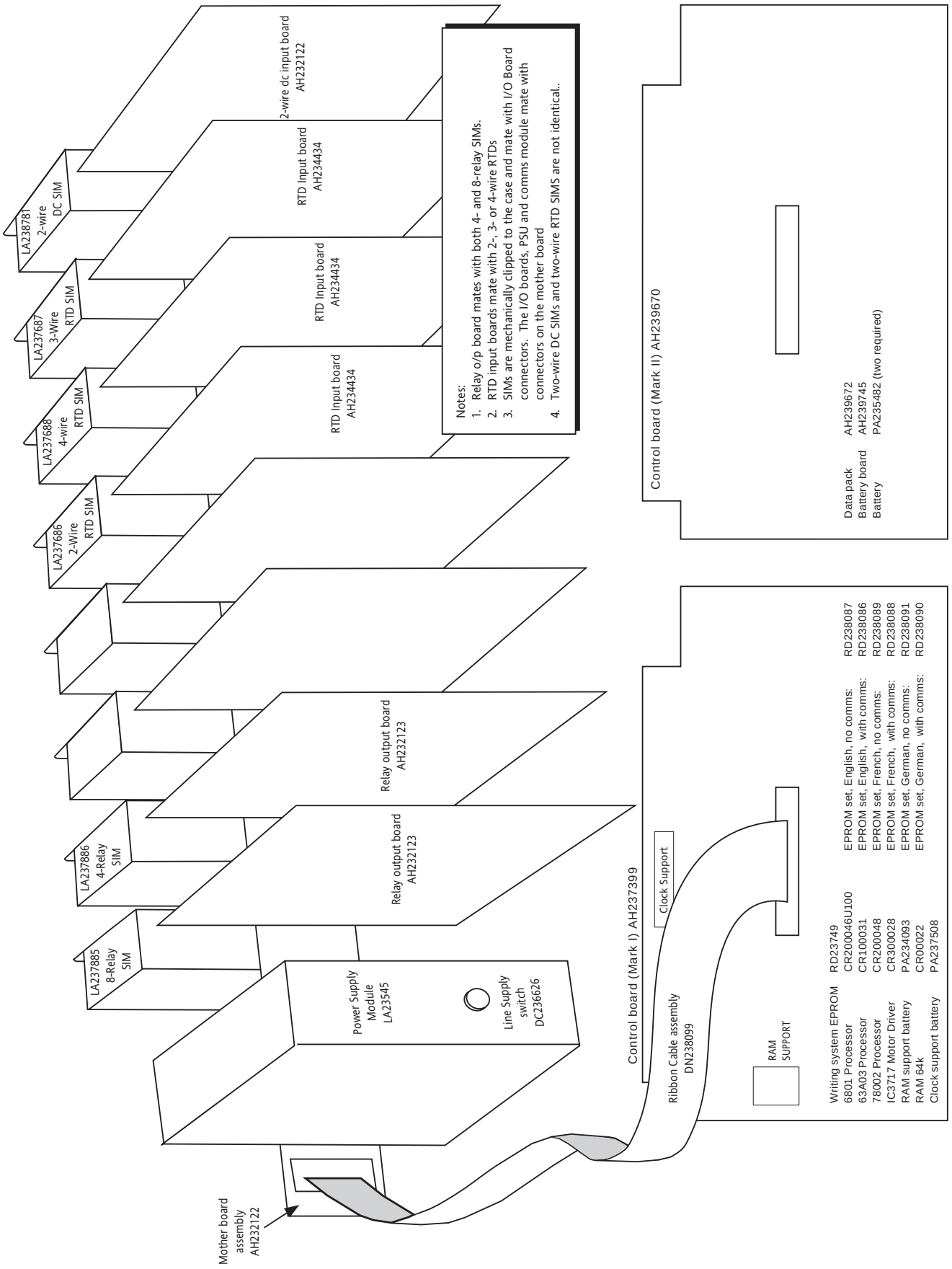


Figure 7.14.1 Electronics spare parts.

7.14.2 Writing system

OVERVIEW

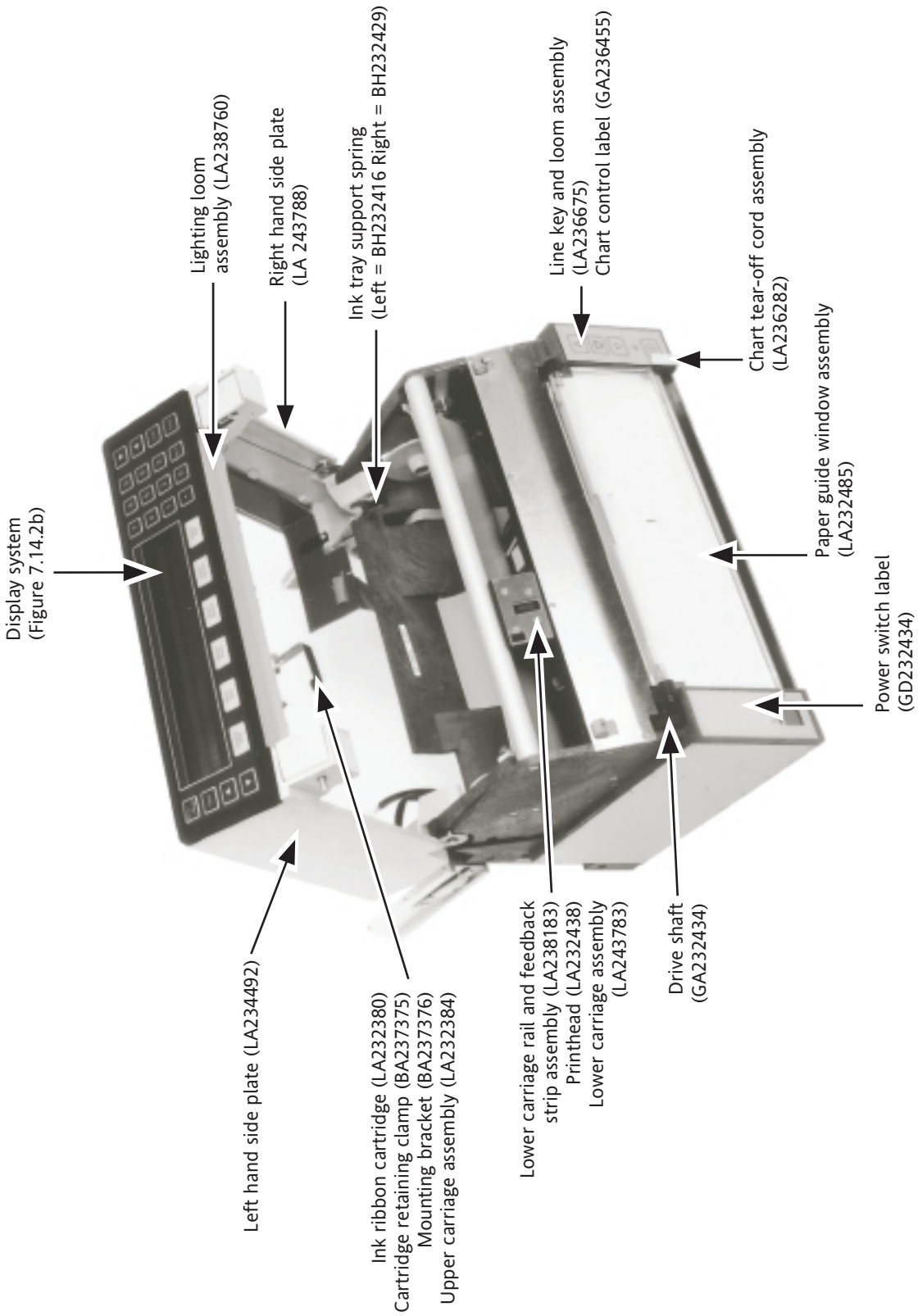


Figure 7.14.2a Writing system spares (general)

7.14.2 WRITING SYSTEM SPARES (Cont.)

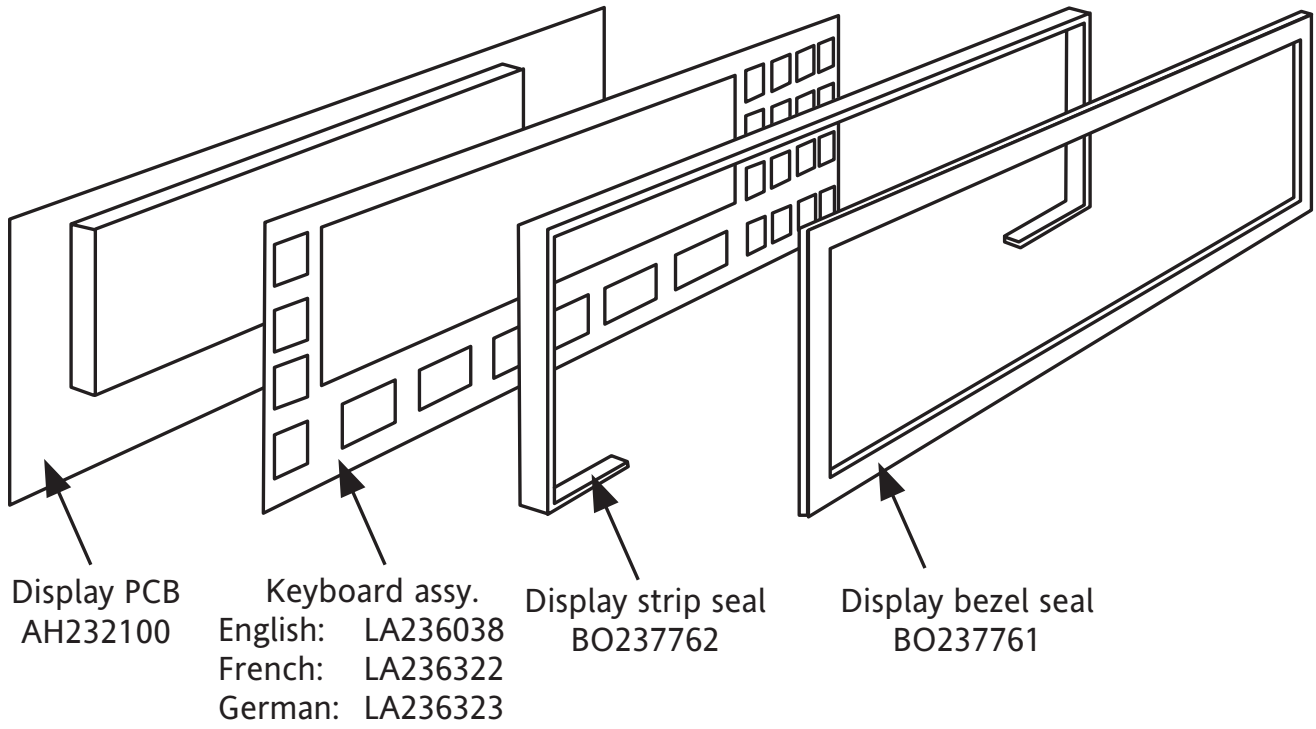


Figure 7.14.2b Writing system spares (display unit)

8 PARTS LISTS

8.1 INTRODUCTION

This section consists of a number of exploded views of the 4001 recorder, together with a list of parts for each diagram.

8.1.1 Column headings

The column headings used in the parts lists are as follows:

ITEM

This refers to the circled item numbers in the associated exploded diagram. Generally items are associated with assemblies rather than with individual items,

PART NUMBER

This gives the Chessell part numbers of the ‘Item’ and of all the parts making up that item, including fixings etc.

Note: Generally speaking, the parts listed are not separately available from the manufacturer as spare parts. Refer to section 7 for Spares details.

NO USED

This indicates how many of each item are used.

DESCRIPTION

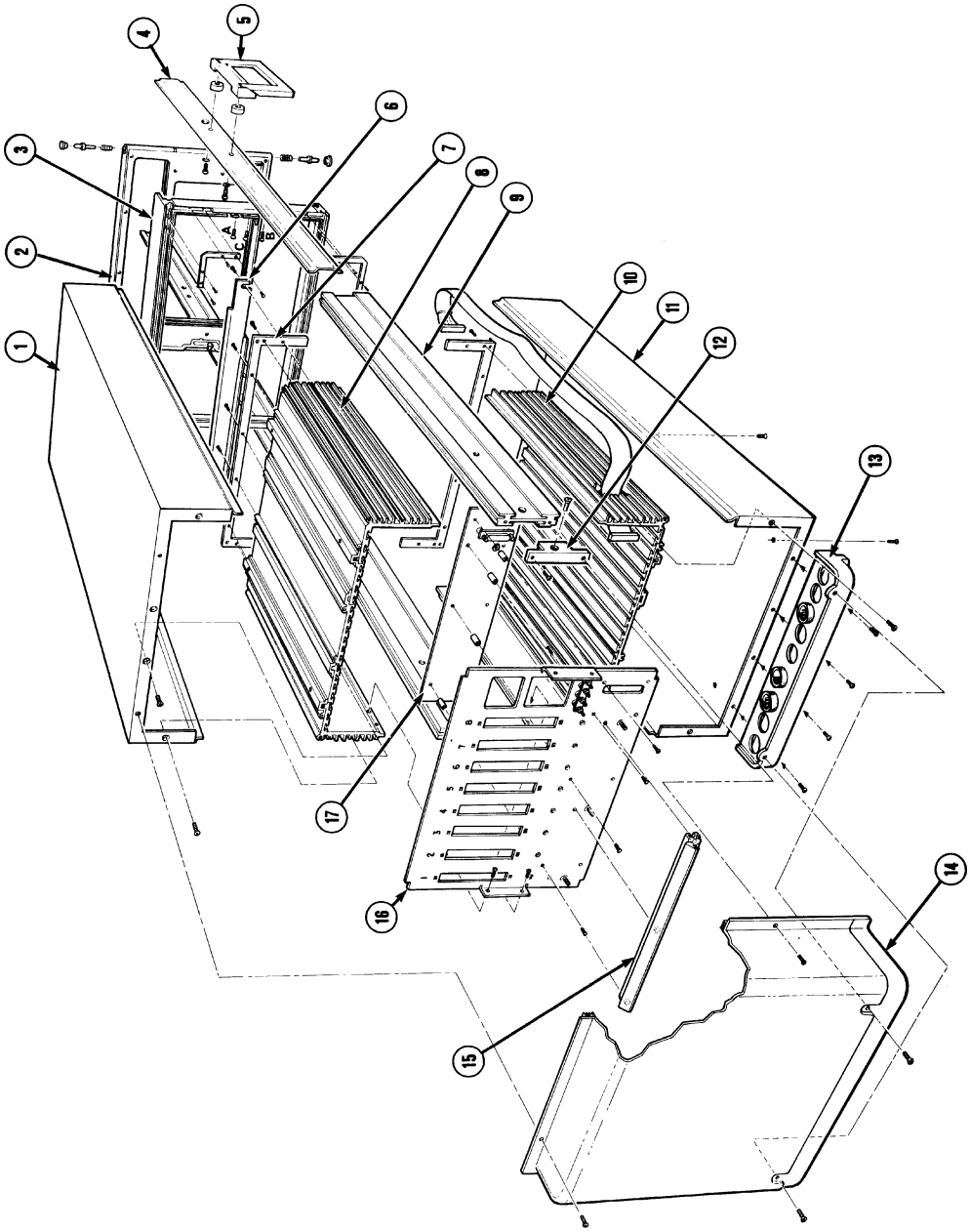
A short description of each part

COMMENTS

Gives a description of the use of the part, or other information which might be of interest.

Note: The design of the model 4001 eveolved over a number of years. The parts lists given here are based on the original design, with indication as to where some parts have been superceded. It is not guaranteed that the parts listed are relevant to the instrument being serviced.

8.2 CASE



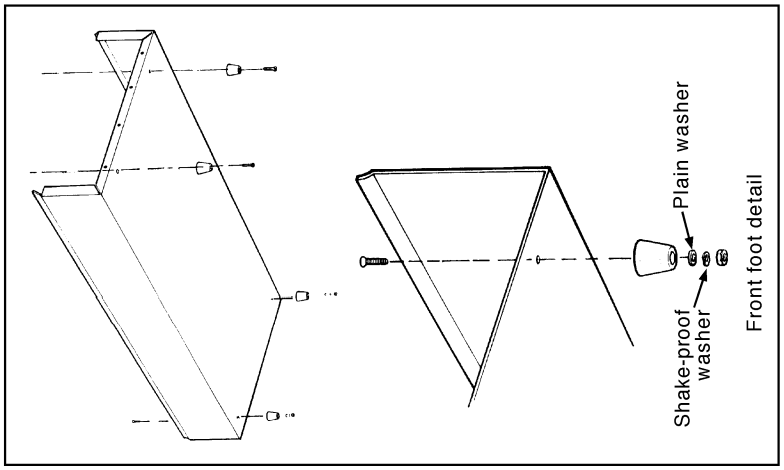


Figure 8.2 Exploded diagram: case (original design)

8.2 CASE ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
1	BA236097	1	Case top cover	
	FB049J08	4	Screw: M3 x 8 Csk pozi taptite	Secure the top cover to the case.
2	LA239116	1	Door assembly	Complete with glass windows.
or	LA232450	1	Door assembly	Previous glass window version.
or	LA239117	1	Door assembly	Complete with Perspex window.
or	LA236302	1	Door assembly	Previous perspex window version.
or	LA239118	1	Door assembly	Complete with non-reflective (NR) glass windows.
or	LA236303	1	Door assembly	Previous non-reflective glass window version.
	BD232204	1	Door	
	BA232187	1	Door back plate	
	BE239016	12	Spacer	
	FB003H06	12	Screw: M2.5 x 6 csk pozi	Secure the back plate to the door.
or	FB004H06	12	Screw: M2.5 csk slotted	Used on previous version.
or	FB013H08	12	Screw: M2.5 x 8 csk slotted	Used on previous version.
or	FB209H08	12	Screw: M2.5 x 8 csk pozi	Used on previous version.
	BT232205	1	Lower door window (glass)	
	BT232206	1	Upper door window (glass)	
	BT232208	1	Lower door window (perspex)	Alternative to BT232205
	BT232207	1	Upper door window (perspex)	Alternative to BT232206
	BT232579	1	Lower door window (NR glass)	Alternative to BT232205
	BT232580	1	Upper door window (NR glass)	Alternative to BT232206
	BD232188	1	Door window seal	
	LA237208	1	Door lock assembly	Includes two keys (FI129237).
	FB001J05	2	Screw: M3 x 5 pan pozi	Secure the door lock to the door.
	BH236111	1	Latch Spring	Latches door shut (in association with the catch post BE236109 (item 9).
	FB001H05	1	Screw: M2.5 x 5 pan pozi	Secures latch spring to door.
	BE239017	1	Pivot pin, upper	Upper hinge for door (was BE236108).
	BE239018	1	Pivot pin, lower	Lower hinge for door (was BE236108).
or	BE236108	2	Pivot pin	Previous door hinge (upper and lower).
	BE239019	1	Pivot bush	Used with lower pivot pin BE239018.
or	BE236110	2	Pivot bush	Used with previous pivot pins BE236108.
	BE236100	1	Pivot spring	Pushes lower pivot pin into bezel locating aperture.
or	BE236125	2	Pivot spring	As BE236100, but for BE236108.
	GA232554	1	Label, single sided	Channel identifications strip.
3	LA232454	1	Bezel assembly	Parts not available separately.
3A	FB073J12	2	M3 x 12 Pan Pozi	Secure the bezel to the side plates.
or	FB073J10	2	M3 x 10 Pan Pozi	Used on previous versions.
3B	FB073J12	2	Screw: M3 x 12 pan pozi	Secure the bezel to the side plates.
3C	FB003J08	2	Screw: M3 x 8 csk pozi	Secure the bezel to the side plates.
	BE238109	2	Bezel foot	Allows the access system to slide.
	BL236765	2	Needle Roller: M4 x 16	Access system catch pin.
4	BA232309	2	Side cover	One each side.
5	LA236903	2	Handle	Portable version only.
	FB001L12	4	Screw: M4 x 12 pan pozi	Portable version only.
		4	Crinkle washer	Supplied by the handle manufacturer
		4	Spacer	Supplied by the handle manufacturer
6	BA237113	1	Board retaining bar	Holds the boards in the card cage
	FB341J10	2	Screw: M3 x 10 pan pozi taptite	Secure the retaining bar to the card cage

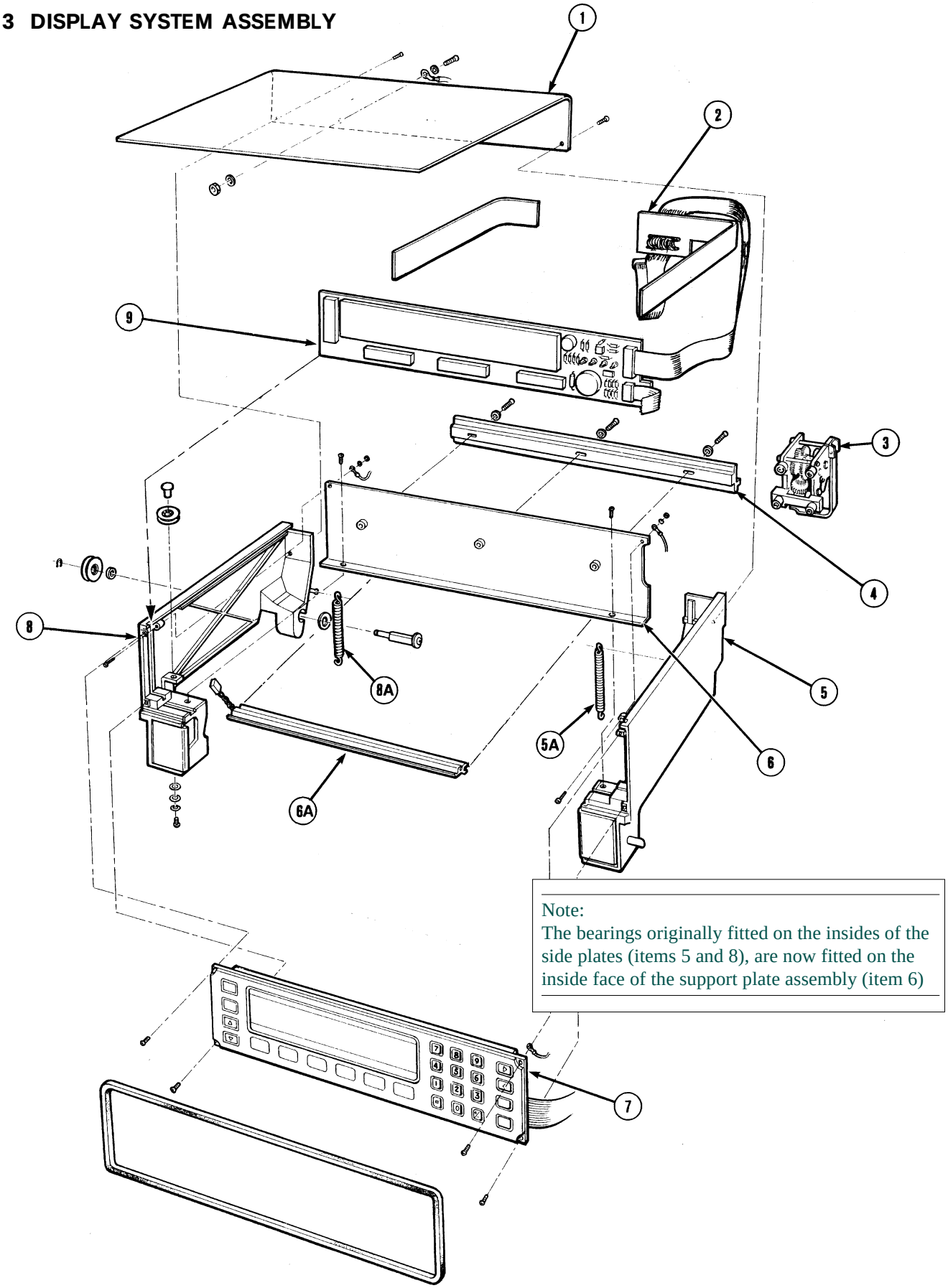
8.2 CASE ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
7	BA232189	2	Card cage brackets	
	FB341J10	15	Screw: M3 x 10 pan pozi taptite	Secure the brackets to the card cage.
8	LA236306	1	Card Cage upper assembly	Individual parts are not available as spares.
	BS234451	1	Corner piece left-hand	
	BS236474	1	Joining piece, left hand	
	BS232185	1	Centre piece	
	BS236304	1	Joining piece, right hand	
	BS236124	1	Corner piece, right hand	
	FB001H06	4	Screw: M2.5 x 6 pan pozi	Secure the joining pieces to the centre piece.
	FB001H10	4	Screw: M2.5 x 10 pan pozi	Secure the joining pieces to the corner pieces.
	BS232194	8	PCB Guides	
	FB341J10	4	Screw: M3 pan pozi taptite	Secure the upper card cage assembly to the side plates (item 9).
9	BS236126	1	Side plate, left hand	Shown in the figure.
	BS232196	1	Side plate, right hand	Not shown in the figure.
	BE236109	1	Catch post	Holds the door closed in association with the latch spring BH236111 (see item 2).
10	LA236307	1	Card cage lower assembly	Individual parts are not available as spares.
	BS232186	1	Corner piece, left hand	
	BS232246	1	Joining piece, left hand	
	BS232185	1	Centre piece	
	BS236475	1	Joining piece, right hand	
	BS234451	1	Corner piece, right hand	
	FB001H06	4	Screw: M2.5 x 6 pan pozi	Secure the joining pieces to the centre piece.
	BS232194	8	PCB guides	
	FB341J10	4	Screw: M3 x 10 pan pozi taptite	Secure the upper card cage assembly to the side plates (item 9).
	FZ239316	2	Nut: Special	Secures the lower cover rear screws on later models.
	LA239115	1	Door closing assembly	Closes the chart take-up drawer.
	FB001J20	2	Screw: M3 pan pozi	Secure the assembly to the card cage.
	FC12306J	2	Washer: M3, internal tooth	Secure the assembly to the card cage.
EITHER				
11	BA232203	1	Case bottom cover	Panel mounting version.
	FB232203	2	Screw: M2.5 x 12 csk pozi	Bottom cover rear screws.
or	FB001J30	2	Screw: M3 x 30 pan pozi	Bottom cover rear screws.
	BE238109	2	Cover plugs	Cover the front foot holes.
or	BC236960	2	Cover plugs	Cover the front foot holes - previous version.
OR				
11	BA232203	1	Case bottom cover	Current portable case version.
	BD101359	4	Rubber foot	
	FB001J30	2	Screw: M3 x 30 pan pozi	Secure the rear feet to the card cage.
	FC12306J	2	Washer: M3 internal tooth	Secure the rear feet to the card cage.
	FB001L16	2	Screw: M4 x 16 pan pozi	Secure the front feet to the case.
	FC12306L	2	Washer: M4 internal tooth	Secure the front feet to the case.
	FA12302L	2	Nut: M4	Secure the front feet to the case.
OR				
11	BA236960	1	Case bottom cover	Previous portable case version.
	BD101359	4	Rubber foot	
	FB001H25	2	Screw: M2.5 x 25 pan pozi	Secure the rear feet to the case.
	FC12306H	2	Washer: M2.5 internal tooth	Secure the rear feet to the case.
	FC12335H	2	Washer M2.5 plain	Secure the rear feet to the case.
	FB003J16	2	Screw: M3 x 16 csk pozi	Secure the front feet to the case.
	FC12306J	2	Washer: M3 internal tooth	Secure the front feet to the case.
	FC12303J	2	Half-nut: M3	Secure the front feet to the case.

8.2 CASE ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
12	BE232191	2	Cover stops	Left-hand stop shown in fig 8.2. Right-hand similar.
	FB003J08	2	Screw: M3 x 8 csk pozi	Secure cover stops to side plates
	FB003M12	2	Screw: M5 x 12 csk pozi	Secure cover stops to side plates
13	LA232459	1	Gland plate	
	BD232525	9	End plug	Removable for cable entry
	FB341J10	4	Screw: M3 x 10 Pan pozi taptite	Secure gland plate to case.
14	LA232461	1	Rear (terminal) cover assembly	Complete with seal.
	BD232193	1	Rear cover	
	BD232456	1	Seal	
	FB073J10	6	Screw: M3 x 10 pan pozi	Secure rear cover to case.
15	BS232234	1	Latch bar	Secures Signal Interface Modules (SIMs) to rear panel
	FA12302J	3	Full nut: M3	Secure rear cover to case
	FC12335J	6	Washer: M3 plain	Fitted in pairs between the latch bar and the rear panel
16	LA232453	1	Rear panel assembly	Complete with items 15 and 17.
	LA236581	1	Rear panel	
	CI129272	4	Earthing connector	For earth link
	BQ236579	4	Insulating sleeve	
	BQ236580	4	Insulating washer	
	BA236316	1	Earth link	Removable link to connect recorder 0V to safety earth.
	FB073J08	3	Screw: M3 x 8 pan pozi	Secure latch bar (item 15)
	BE232589	8	Spacer	Separate mother board from panel (4 shown)
	FB003J06	8	Screw: M3 x 6 csk pozi	Secure spacers to rear panel
	FB049J08	4	Screw: M3 x 8 csk pozi taptite	Secure rear panel to case
17	AH232122	1	Mother board	Complete with integral harness
	FC12308L	2	Insulating washer	
	FB001J05	2	Screw: M3 x 5 pan pozi	Secure mother board to chassis, through insulating washers.
	FB001J04	6	Screw: M3 x 4 pan pozi	Secure mother board to spacers.

8.3 DISPLAY SYSTEM ASSEMBLY



Note:
The bearings originally fitted on the insides of the side plates (items 5 and 8), are now fitted on the inside face of the support plate assembly (item 6)

Figure 8.3 Exploded diagram: Display system (original design)

8.3 DISPLAY SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
1	BA236033	1	Writing system top cover	
	DN238284	1	Grounding harness	Top cover to ground.
	FB073J08	1	Screw: M3 x 8 pan pozi	Secures the grounding harness to the top cover.
	FC12306J	2	Washer: M3 internal tooth	Secures the grounding harness to the top cover.
	FA12302J	1	Nut: M3	Secures the grounding harness to the top cover.
	FB042J06	2	Screw: No 4 x 1/4 pan pozi	Secure the top cover.
2	BT236699	1	Retaining bracket	Protects the display ribbon cable.
	BD236104	1	Clip	Secures the retaining bracket.
	FB042J06	1	Screw: No4 x 1/4 pan pozi self-tap type B	Secures the retaining clip.
3	LA232384	1	Ribbon cartridge carriage	
	BA237375	1	Cartridge retaining strip	Secures the cartridge to the carriage.
	BA237376	1	Retaining clip mounting	
4	BS232383	1	Guide rail	For the ribbon cartridge
	FB001J16	3	Screw: M3 x 16 pan pozi	Secure the guide rail to the support plate (item 6).
	FC12306J	3	Washer: M3 internal tooth	Secure the guide rail to the support plate (item 6).
5	LA234493	1	Side plate assembly (right hand)	
	LA236299	1	Catch assembly	Writing system catch.
	BD234491	1	Catch end plate (right hand)	
	BE234478	1	Rear plunger	Latches the display system.
	BE232296	1	Rear plunger arm	Operates the rear plunger.
	BE234483	1	Rear plunger spring	Operates the rear plunger.
	FB321H06	3	Screw: No 2 x 1/4 pozi self-tap type B	Secure the catch end plate.
	BL234485	1	Rear plunger bush	
	BL236101	1	Side plunger bush	
	LA232568	1	Pulley assembly	Front pulley (includes bearing).
	BE232286	1	Pulley pivot	
	BE23643R	1	Spacer	Spaces the pulley from the lug.
	FB001J06	1	Screw: M3 x 6 pan pozi	Secures the pulley to the side plate.
	FC12306J	1	Washer: M3 internal tooth	Between the screw head and the plain washer.
	FC12335J	1	Washer: M3 plain	Between the shakeproof washer and the lug.
	LA232568	1	Pulley assembly	Rear pulley (includes bearing).
	BE237409	1	Shaft	Stub shaft for the pulley.
	FB095J06	1	Screw	Secures pulley to the stub shaft.
	FG237421	1	Headed roll pin	Anchorage for the spring (item 5A).
5A	BH232429	1	Tension spring (right hand)	Holds the display system open.
6	LA236032	1	Support plate assembly	For the ribbon cartridge guide rail.
	FB016F14	2	Screw: M2 x 14 cheese head slotted	Top fixing for the support plate.
	FC12306F	2	Washer: M2 internal tooth	Top fixing for the support plate.
	FB321H06	2	Screw: No 2 x 1/4 pozi self-tap type B	Bottom fixing for the plate.
	DN238283	1	Grounding harness	Support plate to ground.
6A	DN239428	1	Chart illumination assembly	Socketted 5Volt lamps.
	CJ239427	5	Bulb holder	
	CJ238762	5	5 Volt bulb	
OR				
6A	DN238760	1	Chart illumination assembly	5 volt hard-wired bulbs.

8.3 DISPLAY SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
7	LA236038	1	Keyboard assembly	English language.
OR	LA236322	1	Keyboard assembly	French language.
OR	LA236323	1	Keyboard assembly	German Language.
	BO237762	1	Display strip seal	Keyboard edge seal.
	BO237761	1	Display strip bezel	Keyboard front seal.
	FB321H06	4	Screw: No 2 x 1/4 pozi self-tap type B	Secure the keyboard to the side plates.
	DN238280	1	Grounding harness	Keyboard to the support plate (item 6).
8	LA234492	1	Side plate assembly (left-hand)	
	LA236298	1	Catch assembly	Writing system catch.
	BD234484	1	Catch end plate (left-hand)	
	BE234478	1	Rear plunger	Latches the display system.
	BE232296	1	Rear plunger arm	Operates the rear plunger.
	BE234483	1	Rear plunger spring	Operates the rear plunger.
	FB321H06	3	Screw: No 2 x 1/4 pozi self-tap type B	Secure the catch end plate.
	BL234485	1	Rear plunger bush	
	BL236101	1	Side plunger bush	
	LA232568	1	Pulley assembly	Front pulley (includes bearing).
	BE232286	1	Pulley pivot	
	BE23643R	1	Spacer	Spaces the pulley from the lug.
	FB001J06	1	Screw: M3 x 6 pan pozi	Secures the pulley to the side plate.
	FC12306J	1	Washer: M3 internal tooth	Between the screw head and the plain washer.
	FC12335J	1	Washer: M3 plain	Between the shakeproof washer and the lug.
	LA232568	1	Pulley assembly	Rear pulley (includes bearing).
	BE237409	1	Shaft	Stub shaft for the pulley.
	FB095J06	1	Screw	Secures the pulley to the stub shaft.
	FG237421	1	Headed roll pin	Anchorage for the spring (item 5A).
8A	BH232429	1	Tension spring (right hand)	Holds the display system open.
9	AH232100	1	Display printed circuit board	See section 6.

8.4 WRITING SYSTEM ASSEMBLY

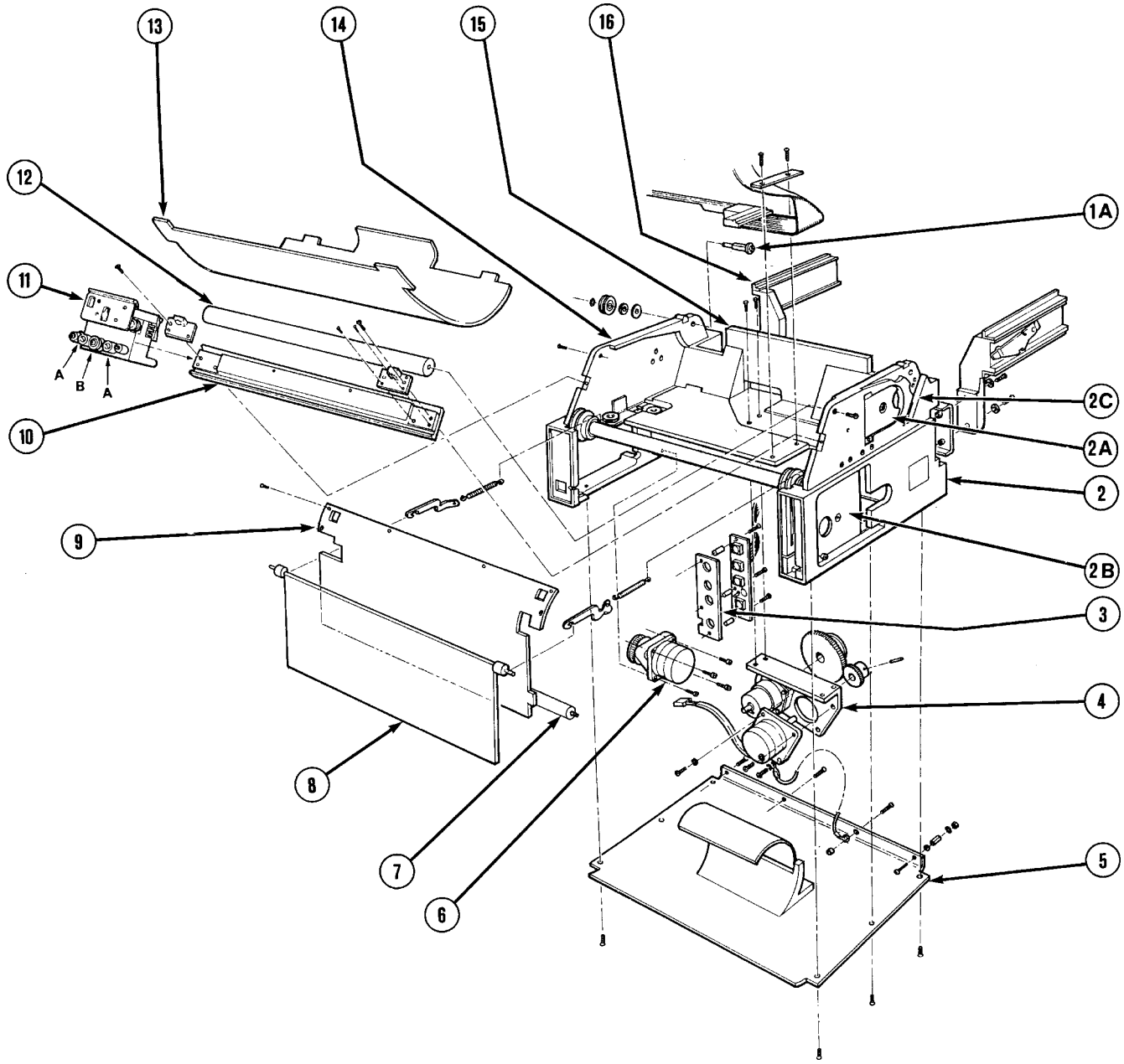
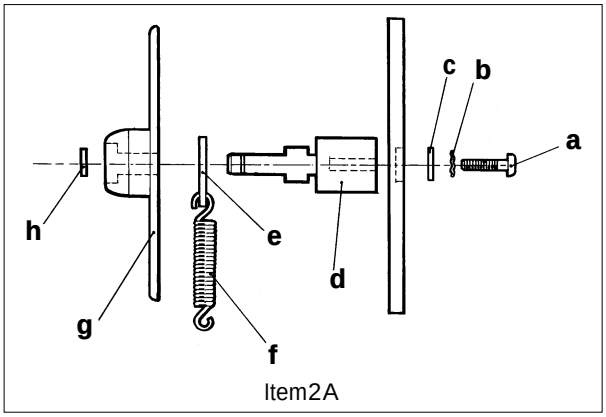
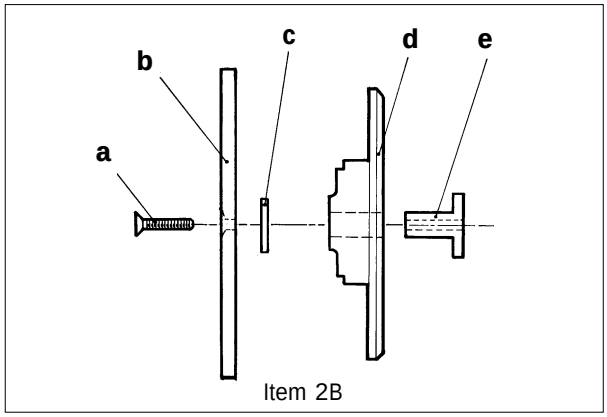


Figure 8.4 Exploded diagram: Writing system (original design) sheet 1 of 2

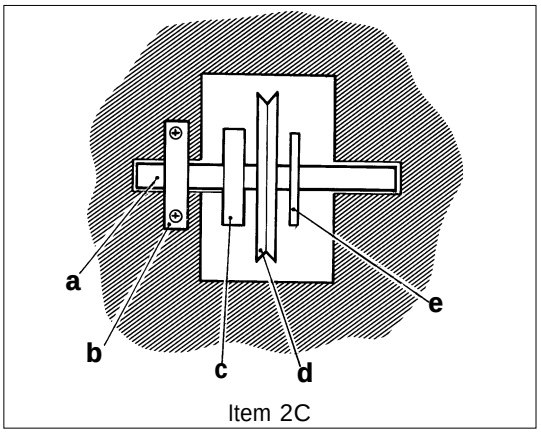
8.4 WRITING SYSTEM ASSEMBLY (Cont.)



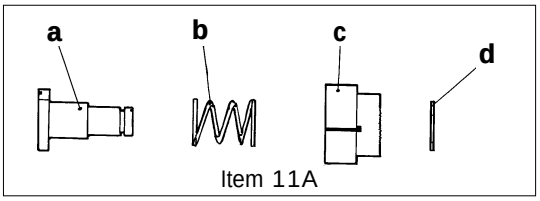
Item2A



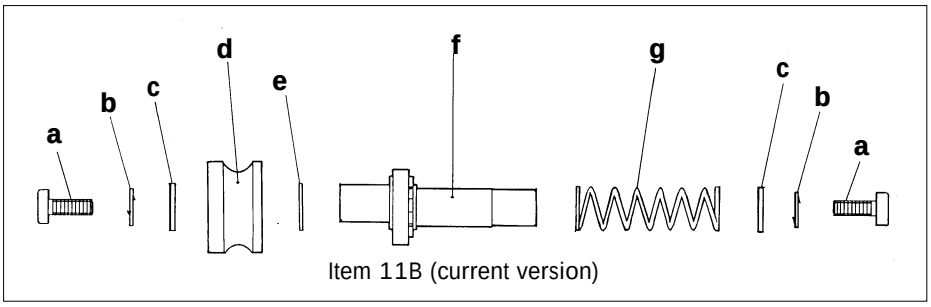
Item 2B



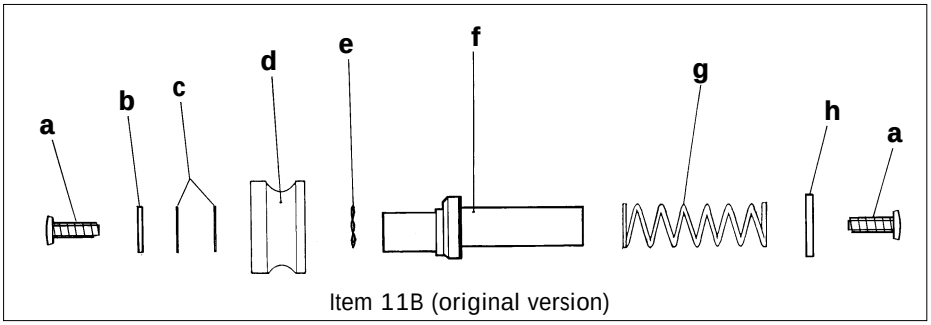
Item 2C



Item 11A



Item 11B (current version)



Item 11B (original version)

Figure 8.4 Exploded diagram: Writing system (original design) sheet 2 of 2

8.5 WRITING SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
1	LA236042	1	Display system assembly	See section 8.3 for details.
1A	BE236031	2	Pivot shaft assembly	Act as display system pivots (one each side).
	BE236432	2	Spacer	One each side.
	LA232488	2	Pulley assembly	Complete with bearings. One each side.
	FJ236772	1	Circlip	Secure the pulleys to the pivots.
2	LA232400	1	Right hand side plate assembly	
2A	LA237640	1	Pay-off door assembly	Complete with hinge pins.
a	FB073L08	1	Screw: M4 x 8 pan pozi	Secures the stub shaft (item d) to the pay-off door.
b	FC12306L	1	Washer: M4, internal tooth	Secures the stub shaft (item d) to the pay-off door.
c	FC12335L	1	Washer: M4, plain	Secures the stub shaft (item d) to the pay-off door.
d	BE232224	1	Stub shaft	For the spool flange.
e	BA232591	1	Spring tab	Secures the spring to the stub shaft.
f	BH232416	1	Spring	Holds the pay-off door closed.
g	LA232401	1	Spool flange assembly	Supports the right hand end of the chart.
h	FJ237704	1	Circlip	Secures the spool flange to the stub shaft.
	BL122529	2	Needle roller 2 x 16.8	Pay-off door hinges.
	BA232215	2	Tab	Door hinge retainers.
	FB321H06	4	Screw: No.2 x 1/4 pozi self-tap type B	Secure hinge retainers.
	BE238608	1	Door stop	Prevents the door closing too far.
	FB003H10	1	Screw: M2.5 x 10 csk pozi	Secures the door stop to the side plate.
	FG23676	1	Headed pin	Anchoring point for the door spring.
2B		1	Take-up door assembly	Provides access to the used portion of the chart.
a	FB003L16	1	Screw: M4 x 16 csk pozi	Secures the stub shaft (item e).
b	BD232222	1	Take-up door	
c	BE232227	1	Spacer	Separates the spool from the door.
d	LA232401	1	Spool flange assembly	
e	BE238638	1	Stub shaft	Spool flange journal.
	FG237352	1	Headed pin: 1/16 x 3/16	Take-up-door stop
	LA232568	1	Pulley assembly	Lower ‘hinge’ pulley.
	BE236754	1	Pulley shaft	
	FJ236772	1	Circlip	Secures the pulley to the shaft.
2C		1	Pulley assembly	
a	BE232491	1	Pulley shaft	
b	BE232492	1	Retaining plate	
	FB344H06	2	Screw: No2 x 1/4 pan pozi plastite	Secure the retaining plate.
c	BE236757	1	Spacer, thick	
d	LA232488	1	Pulley assembly	
e	BE236105	1	Spacer, thin	
	LA232488	2	Pulley assembly	Print head carriage cord pulleys.
	BE232269	1	Pulley bracket (rear)	
	BE232266	1	Pulley bracket (front)	
	FB003H10	4	Screw: M2.5 x 10 csk pozi	Secure the pulley brackets.
	FJ236772	2	Circlip	Secure the pulleys to the brackets.
	FG236768	1	Headed spring pin	Anchorage for transparent-chart-guide tension-spring.
	BH232436	1	Spring	Chart-guide tension-spring.
	BA232244	1	Link	Connects the spring to the transparent chart guide.

8.4 WRITING SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
2 Cont.	LA237628	1	Plunger assembly	Holds the writing system closed.
	FB344H06	1	Screw: No2 x 1/4 pan pozi plastite	Retains the plunger.
	FB003J16	1	Screw: M3 x 16 csk pozi	Secures the upper chart guide.
	BL232418	1	Bush: Oilite	Bearing for the drive shaft.
	FB042J16	1	Screw: No4 x 16 pan pozi Self-tap type B	Secures the side plate to the chassis.
	FB042J10	2	Screw: No4 x 10 pan pozi self-tap type B	Secure the side plate to the chassis.
3	LA236675	1	Chart control panel assembly	Complete with harness.
	AH236070	1	Printed circuit board assembly	
	BA236467	1	Panel	
	BE236467	3	Spacer	Separate the PCB from the panel.
	FB073F04	3	Screw M2 x 4 pan pozi	Secure the PCB to panel.
	CA001K33	1	Resistor 330R, ± 5%	On the PCB.
	CW237448	1	Green LED	On-/Off-line indicator.
	DC127249	4	Keyboard switch	
	DN237394	1	Ribbon cable	
	DN238281	1	Grounding wire	Integral with ribbon cable for later models.
4	LA237563	1	Servo / colour select motor assy	
	LA237610	1	Motor - pinion assembly	
	LA237697	1	Bracket	Holds the motor etc. to chassis.
	FB001L10	4	Screw: M4 x 10 pan pozi	Secure the motor to the bracket.
	FC12306L	4	Washer: M4 internal tooth	Secure the motor to the bracket.
	DN237262	1	Grounding wire	Grounds motor case.
	FE127650	1	'P' clip	Secures the motor harness.
	FB001J06	1	Screw: M3 x 6 pan pozi	Secures 'P' clip.
	BE232253	1	Ribbon cartridge drive capstan	
	FB080J05	2	Screw: M3 x 5 grub (set) screw Socket head	Secure capstan to head. Both screws in the same hole.
	FB209J12	1	Screw: M3 x 12 csk pozi	Secures the bracket to the chassis.
5	BA232214	1	Chassis base plate assembly	
	FB321H06	6	Screw: No2 x 1/4 pozi self-tap type B	Secure the base plate to the chassis.
5A	BE232586	2	Hex studs	Used to secure the control board.
5B	FB073J05	1	Screw: M3 x 8 pan pozi	Grounds the servo motor case.
5C	FB003J08	1	Screw: M3 x 8 csk pozi	Grounds the chart drive motor case, and secures the bracket (item 15).
6	LA237125	1	Chart drive motor assembly	
	LA237231	1	Motor	With pinion and harness.
	BN237123	1	Gearhead	
	BD237105	1	Adapter plate	Between the motor and the gearbox.
	FB043K12	4	Screw: No6 x 1/2 pan slotted	Secure the motor to the adapter plate.
	FB073J08	3	Screw: M3 x 8 pan pozi	Secure the adapter plate to the gearbox.
	FC12335J	3	Washer: M3, plain	Secure the adapter plate to the gearbox.
	FC12306J	3	Washer: M3, internal tooth	Secure the adapter plate to the gearbox.

8.4 WRITING SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
6 Cont.	FB073J08	2	Screw: M3 x 8 pan pozi	Secure the gearbox to the side plate.
	FC12335J	2	Washer: M3, plain	Secure the gearbox to the side plate.
	FC12306J	2	Washer: M3, internal tooth	Secure the gearbox to the side plate.
	LA238640	1	Tooted pulley	Drives the toothed belt.
	FB080J05	2	Screw: M3 x 5 Grub (set) screw Cup point, socket head.	Secure the toothed pulley.
7	LA232402	1	Lower chart guide assembly	Includes pivot pins.
8	LA232425	1	Transparent chart guide	
	BE232357	2	Pinch roller	Provide friction for chart drive.
	BL236798	2	Needle roller: 2 x 21.8	Shafts for the pinch rollers.
	FJ126382	2	Grip ring: 2 mm.	Secure the pinch rollers on their shafts.
	BA232244	1	Link (right-hand)	Secures the transparent chart guide to the spring.
		1	Link (left hand)	Secures the transparent chart guide to the spring.
	BH232436	2	Spring	Load the transparent chart guide, via links.
9	BA232213	1	Front plate	
	FB321H06	2	Screw: No2 x 1/4 pozi self-tap type B.	Secure the front plate.
	FB013F06	2	Screw: M2 x 6 csk slotted head	Secure the front plate.
	FB003F05	2	Screw: M2 x 5 csk pozi	Secure the front plate.
	BH232441	1	Spring (chart tear off cord)	Not supplied with the front plate.
10	LA236283	1	Guide rail assembly	For print head carriage. Complete with integral feedback strip and catch plates.
	BE232216	1	Catch plate (left hand)	
	BE238958	1	Catch plate (right hand)	Latest design.
or	BE232216	1	Catch plate (right hand)	Previous design (as left hand).
	FB003J16	4	Screw: M3 x 16 csk pozi	Secure the catch plates to the guide rail.
	FB344H06	2	Screw: No2 x 1/4 pan pozi plastite.	Secure the rail assembly to the side plates.
11	LA232422	1	Print head carriage assembly	
	BA234464	1	Shield	
	BA236946	4	Shim	
	LA238224	1	Grounding shim	
	FB321H06	4	Screw: No2 x 1/4 pozi self-tap, type B	Secure the shield and the shims.
	BA236949	1	Friction pad	
11A				
a	BE122518	2	Tensioning screw.	One for each capstan.
b	BH232497	2	Compression spring	Hold rachets engaged.
c	BD236784	2	Capstan	For drive cord tensioning.
d	FJ126388	2	Circlip	Secures the capstan carriage.
	BE234449	2	Cord clamp	Drive cord clamp
	FB365H10	2	Screw: No2 x 10 pan pozi self-tap, type B	Secure the cord clamps
	BL232390	2	Carriage upper bearing	Act on the guide rail (item 10),
	FB344H06	2	Screw: No2 x 1/4 pan pozi plastite.	Secure the upper bearings.
	FC12335H	2	Washer: M2.5, plain	Secure the upper bearings

8.4 WRITING SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
11B			Lower bearing assembly	Printhead carriage (current design)
a	FB001H06	2	Screw: M2.5 x 6 pan pozi	Secure the lower bearing (d).
b	FC12306H	2	Washer: M2.5, internal tooth	Secure the lower bearing (d).
c	FC12335H	2	Washer: M2.5, plain	Secure the lower bearing (d).
d	BL232390	1	Lower bearing	
e	FX237112	1	Bearing washer	
f	BD239039	1	Bearing journal	
g	BH232496	1	Compression spring	
OR				
11B			Lower bearing assembly	Printhead carriage (original design).
a	FB344H06	2	Screw: No2 x 1/4 pan pozi plastite.	Secure the lower bearing (d).
b	FC12306H	2	Washer: M2.5, internal tooth	Secure the lower bearing (d).
c	FX237112	2	Bearing washer	
d	BL232390	1	Lower bearing	
e	FX234447	1	Crinkle washer	
f	BD232254	2	Bearing journal	
g	BH232496	1	Compression spring	
h	BA232264	1	Washer: special	
	DN239030	1	Opto flexi cable	Complete with connector.
	FB042J06	1	Screw: No4 x 1/4 pan pozi self-tap, type B	Secures the opto flexi cable.
	LA232445	1	Print head assembly	Complete with heatsink and flexi.
	FB344K10	1	Screw: No6 x 9.5 Csk pozi plastite.	Secures the printhead.
	FC12335H	2	Washer: M2.5, plain	Separate the printhead from the carriage.
	BE237729	2	Boss	
	LA236308	3	Opto assembly	
12	BE232324	1	Upper chart guide	
	FB003J16	2	Screw: M3 x 16 csk pozi	Secure the chart guide to the side plates
13	BD236102	1	Inner chassis liner	
14	LA232405	1	Left hand side plate assembly	See also figure 8.5.
	LA232414	1	Left hand side plate	
	LA232488	1	Front pulley assembly	For the print head carriage cord. Includes bearing.
	LA236287	1	Bracket	Secures the pulley to the side plate.
	FJ236772	1	Circlip	Retains the pulley assembly.
	FB003H10	2	Screw: M2.5 x 10 csk pozi	Secure the bracket to the side plate.
	LA232568	1	Rear pulley assembly	For the print head carriage cord. Includes bearing.
	BE232268	1	Bracket	Secures the pulley to the side plate.
	FJ236772	1	Circlip	Retains the pulley assembly.
	FB003H10	2	Screw: M2.5 x 10 csk pozi	Secure the bracket to the side plate.
	FB003J16	1	Screw: M3 x 16 csk pozi	Secures the upper chart guide (item 12).

8.4 WRITING SYSTEM ASSEMBLY (Cont.)

Item	Part Number	No Used	Description	Comments
15	FB232210	1	Chassis tray	
	FB042J10	4	Screw: No4 x 10 pan pozi Self-tap, type B.	Secure the chassis tray to the side plates.
	AH237399	1	Control board (mark I)	See section 6.3.
or	AH239670	1	Control board (mark II)	See section 6.9.
	BE232586	5	Hexagonal studs	Secure the control board.
	FA238906	5	Nut: M3 nylon self-locking	Secure the control board (later versions).
or	FX122935	10	Washer: M3 acetate	Secure the control board (original version)
and	FA12302J	5	Full nut: M3	Secure the control board (original version)
	BT238985	1	Plastic cover (rectangular)	Protects the ribbon cable.
	FB321H06	4	Screw: No2 x 1/4 csk pozi self-tap, type B	Secure the cover to the chassis tray.
	BA236103	1	Mounting bracket	
	BE238998	1	Support block	Attached to the mounting bracket.
	BT238999	1	Plastic cover (triangular)	Attached to the support block.
	FB321H06	10	Screw: No2 x 1/4 csk pozi self-tap, type B	Secure the mounting bracket to the chassis tray, the support block and the plastic cover.
	FB045H06	2	Screw: No2 x 1/4 pan pozi	Secure the mounting bracket to the left-hand side plate.
	FC12303J	2	Washer: M3, plain	Secure the mounting bracket to the left-hand side plate.
	BT238096	1	Cable clip	
	FB344J12	1	Screw: No4 x 1/2 pan pozi plastite.	Secures the cable clip.
	FC12306J	1	Washer: M3, internal tooth	Secures the cable clip.
	FB344J12	1	Screw: No4 x 1/2 pan pozi plastite.	Secures the display system spring.
	FC12303J	1	Washer: M3, plain	Secures the display system spring.
16	LA236048	1	Access slide assembly	
	BA236045	1	Support channel	
	LA236043	1	Slide support (left-hand)	Handed from the front of the instrument.
	LA236044	1	Slide assembly (right-hand)	Handed from the front of the instrument.
	FB001L12	4	Screw: M4 x 12 pan pozi	Secure the slide assemblies to the support channel.
	FC12306L	4	Washer: M4, internal tooth	Between the screws and the slide assemblies.
	BE236046	1	Pivot pin	Hinge for the access system.
	FJ236744	1	Circlip	
	FB045H06	2	Screw: No2 x 1/4 pan pozi taptite.	Secure the pivot pin to the left-hand side plate.

8.5 CHART DRIVE SYSTEM

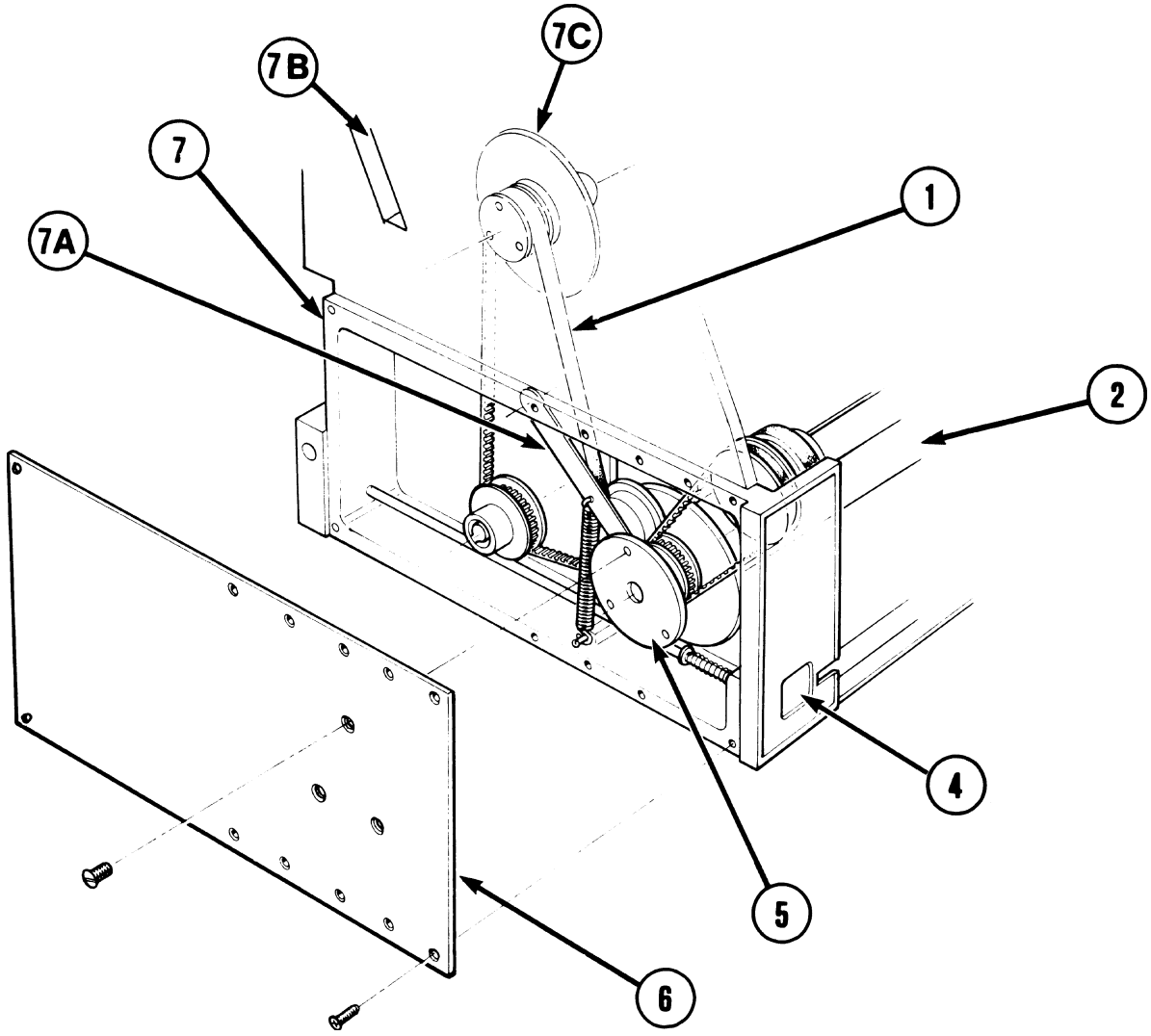
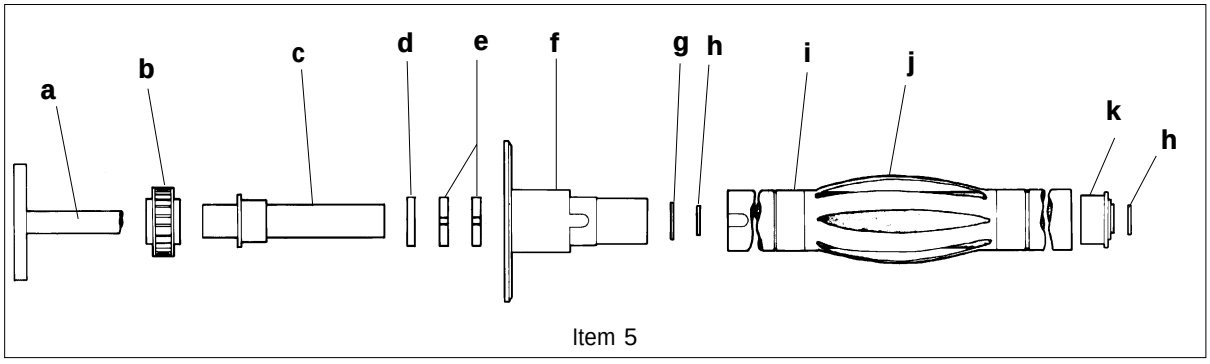
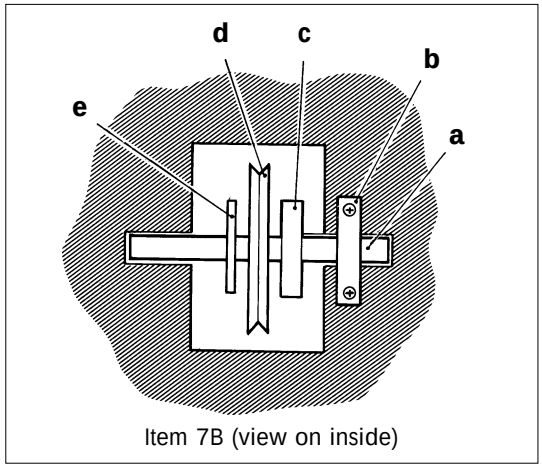


Figure 8.5 Exploded diagram: Chart drive system sheet 1 of 2

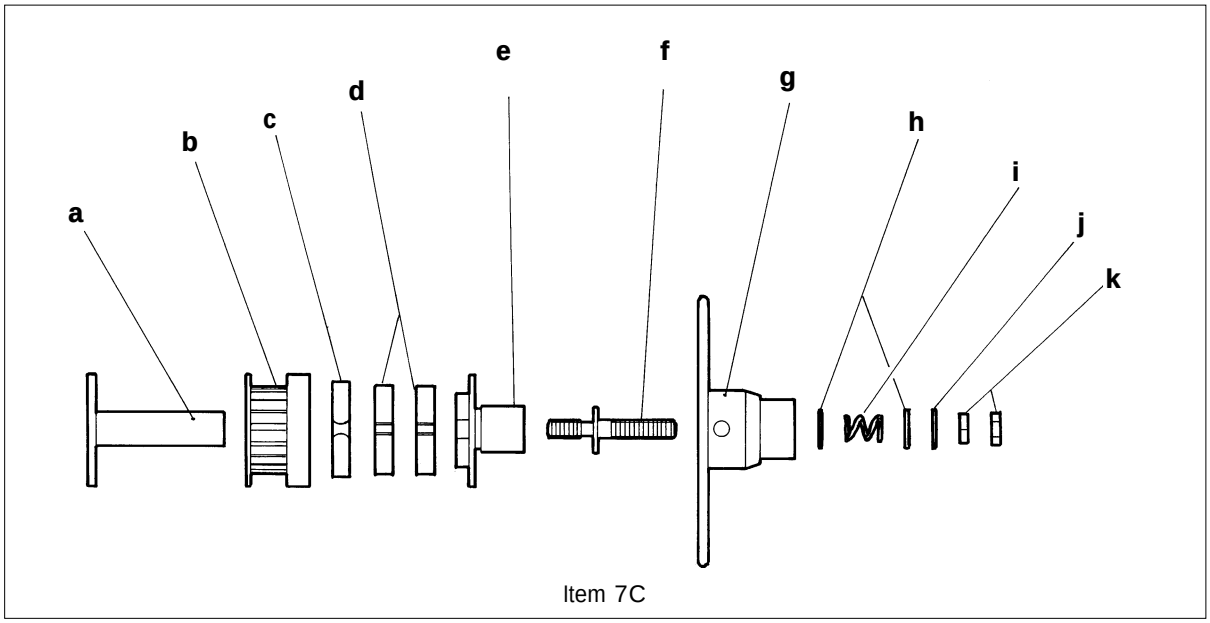
8.5 CHART DRIVE SYSTEM (Cont.)



Item 5



Item 7B (view on inside)



Item 7C

Figure 8.5 Exploded diagram: Chart drive system sheet 2 of 2

8.5 CHART DRIVE SYSTEM (Cont.)

Item	Part Number	No Used	Description	Comments
1		1	Chart drive motor assembly	See figure 8.4
	BQ232428	1	Toothed drive belt	Transmits drive from the motor.
2	LA232424	1	Drive shaft assembly	
	BE232355	1	Drive shaft	
	BD232432	1	Toothed pulley	
	BE232358	2	Drive roller	Provides chart drive friction.
	FB080J05	3	Screw: M3 x 5 Grub (set) screw cup point, socket head.	Secure the pulley and drive rollers.
	BL128378	2	Needle roller 3 x 17.8	One each end of the drive shaft.
3	LA236282	1	Chart tear-off cord assembly	
	BC232240	1	Cord	
	BD232439	1	Handle	
	BH237807	1	Stop pin	Locates behind the power on/off push button.
	BH232441	1	Tension spring	Attached to the front plate (8.3 item 9).
4	LA232412	1	Power switch assembly	
	BD232327	1	Button	
	BE236064	1	Push rod	
	BH236293	1	Compression spring	
	FB001J06	1	Screw: M3 x 6 pan pozi	Sets the operating point f the power switch.
	FA12302J	1	Full nut: M3	Locks screw in the end of the push rod.
5	LA232407	1	Auto take-up spool assembly	
a	LA239147	1	Take-up spool shaft assembly	Current design.
or	LA236290	1	take-up spool shaft assembly	Previous designs.
b	LA236291	1	Clutch pulley	
c	BE232223	1	Sleeve	
d	BG238825	1	Plastic spacer	Fits over the sleeve.
e	BA122746	2	‘C’ spring	Fits inside the spool flange (item f).
f	BE232231	1	Spool flange	
g	BA232226	1	Washer	
h	FJ236719	2	Circlip: 7 mm.	
i	BE232230	1	Spool	
j	BT234453	1	Rubber sleeve	Fixed with adhesive tape.
k	BL232417	1	Plastic bearing	
	FB004H06	3	Screw: M2.5 x 6 csk slotted head	Secure the auto take-up assembly to the access cover.
6	BA238638	1	Chart drive access cover	
	FB321H06	11	Screw: No2 x 1/4 pozi self-tap, type B.	Secure the access cover to the side plate.
	FB004H06	3	Screw: M2.5 x 6 csk slotted head	Secure the auto take-up assembly to the access cover.
7	LA232406	1	Left hand side plate assembly	See also section 8.4, item 14.
7A	LA232464	1	Jockey arm assembly	Maintains tension in the chart drive belt.
	BL237647	1	Jockey arm pivot	
	BH232429	1	Jockey arm spring	
7B			Pulley assembly	
a	BE232491	1	Pulley shaft	
b	BE232492	1	Retaining plate	
	FB344H06	2	Screw: No2 x 1/4 pan pozi taptite	Secure the retaining plate.
c	BE236757	1	Spacer, thick	
d	LA232488	1	Pulley assembly	Ribbon cartridge cord pulley.
e	BE236105	1	Spacer, thin	

8.5 CHART DRIVE SYSTEM (Cont.)

Item	Part Number	No Used	Description	Comments
7C	LA238640	1	Pay-off spool assembly	
a	BE238629	1	Stub shaft	
b	LA238641	1	Toothed pulley assembly	Includes bush.
c	BA122746	1	'C' spring (outer)	
d	BA238643	1	'C' spring (inner)	
e	BE238630	1	Sleeve	
f	BE238628	1	Clutch shaft	
g	LA238650	1	Spool flange assembly	Includes roller clutch.
h	FC12335L	2	Washer: M4 (steel)	
i	BE238634	1	Washer: M4 (plastic)	
j	BH238635	1	Compression spring	Maintains the clutch torque.
k	FA12303L	2	Half nut: M4	
	FB004H06	3	Screw: M2.5 x 6 countersunk, slotted head.	Secures the spool assembly to the side plate.
	BL232418	1	Bush (oilite)	Drive shaft bearing.
	FG236768	1	Headed pin	Anchorage for transparent chart guide link.
		1	Link (Left hand)	Links the transparent chart guide to the spring.
	BH232436	1	Spring	Loads the transparent chart guide.
	FB344J12	1	Screw: No4 x 1/2 pan pozi plastite.	Anchor for display system tension spring.
	FC12303J	1	Washer: M3, plain.	

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Symbols

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