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CUEMASTER

77 MK IV

PROFESSIONAL TRANSPORTABLE

RECORDER

1. INTRODUCTION

In designing the 77 MK IV recorder the importance of reliability and dependability in equipment for the audio industry was fully appreciated. Consequently the 77 MK IV is designed to meet the most arduous service conditions of continuous operation. Its robust mechanical construction will stand up to the tough demands of a busy recording studio.

The three motor deck system of direct tape drive in play and recording modes allows maximum tape control for split second timing.

Simultaneous erase, record and replay is achieved by the use of three separate full track heads covering the entire width of a ¼ in tape. This head arrangement ensures the best noise performance and reduces tape drop-out effects to an absolute minimum.

To meet current professional requirements, the 77 MK IV has a two speed capstan motor for 7½ i.p.s. and 15 i.p.s. operation. To ensure smooth torque with minimum flutter, the motor is fitted with a heavy flywheel.

Control of the electro-mechanical tape transport system and selection of operating functions is achieved by selecting the marked and colour-coded pushbuttons. All the functions can be transferred to a remote control unit via a connector at the rear of the unit.

Input levels to the recorder are in accordance with broadcasting authorities' requirements for line input either as a terminated 600Ω line, or a bridging 10 KΩ line. Both inputs are connected through standard tip ring sleeve telephone jacks.

A low impedance microphone can be connected to the recorder through a connector at the rear of the unit.

Line and microphone signal levels are independently controlled, before they are mixed and fed into the record amplifier or into the monitor amplifier or both.

The low impedence output from the recorder is intended for connection to standard 600Ω lines and is fully protected against accidental short circuits. It is connected through a standard tip ring sleeve jack.

Monitoring facilities enable either the incoming or the outgoing recorded signals to be replayed either through an internal speaker, or to be fed via another tip ring sleeve jack into an external 15Ω speaker.

1 **(continued)**

For rack-mounting, input and output sockets are duplicated on the rear panel using "XL" type connectors.

2. SPECIFICATION SUMMARY

SIZE (including case)	21 in wide, $20\frac{7}{8}$ in high, 10 in deep. (53.3 cm wide, 53.0 cm high, 25.4 cm deep)
(rack mounted)	19 in wide, $19\frac{1}{4}$ in high, $7\frac{1}{2}$ in deep. (48.3 cm wide, 35.2 cm high, 19.1 cm deep)
WEIGHT (including case)	66 lb (30 kg)
(rack mounted)	44 lb (20 kg)
TAPE SIZE	Nominal $\frac{1}{4}$ in
HEADS	Separate heads for erase, record and play.
(standard)	Full width track.
(option)	Half track heads for recording on tape in each direction.
SPOOL SIZES	Cine type 7 in (BS1568/1960), 5 in or 3 in.
TAPE TIMING INDICATOR	Driven directly from tape and indicates real time in minutes.
TAPE SPEED (standard)	15/7.5 i.p.s. (38/19 cm.p.s.)
(option)	7.5/3.75 i.p.s. (19/9.5 cm.p.s.)
WOW AND FLUTTER	Better than 0.12% r.m.s. at 15 i.p.s.
	Better than 0.15% r.m.s. at 7.5 i.p.s.
	Better than 0.20% r.m.s. at 3.75 i.p.s.
STARTING TIME	Will meet wow and flutter specification within 2.5 sec.
SPOOLING CONTROL	Continuously variable control from full forward to full reverse.
SPOOLING TIME	Less than 1 minute for 1200 ft (360 m)
POWER REQUIREMENTS (AC supply)	210 V to 260 V, 50 Hz 0.7 A maximum

SPECIFICATION SUMMARY (continued)

FUSES (20 mm x 5 mm diameter)	1 A (2 off), for AC supply 2 A for 60 V unregulated DC supply, 0.5 A for 37 V regulated DC supply.
INPUT SIGNAL	
Line 600Ω and BRIDGE (via tip, ring and sleeve jack)	Balanced – 14 dBm to +20 dBm
Microphone (via XL-3-31 socket)	Balanced 100μV minimum, 16 mV maximum. Common mode rejection better than 35 dB at 15 kHz.
(option)	Two independant line inputs instead of one line and one microphone input.
INPUT IMPEDANCE	
Line	600Ω } Return loss better than 40 dB (30 Hz to 15 kHz).
Bridge	10 KΩ }
Microphone	150 Ω minimum
LINE OUTPUT	
(via tip, ring and sleeve jack)	+21 dBm maximum level before clipping
OUTPUT MATCHING IMPEDANCE	
Line	600Ω
Monitor	15Ω unbalanced
OUTPUT SOURCE IMPEDANCE	
Line	60Ω (30 Hz to 15 kHz)
REPLAY CHARACTERISTICS	
Equalization	Switched, I.E.C. (fully adjustable) or N.A.B.
Frequency response using test tape E.M.I. SRT17 at 15 i.p.s.	30 Hz to 20 kHz ± 1 dB
Using test tape E.M.I. SRT18 at 7.5 i.p.s.	30 Hz to 12 kHz ± 1 dB 30 Hz to 15 kHz +1 dB - 2 dB

SPECIFICATION SUMMARY (continued)

Signal to noise ratio	
Replay amplifier set to +8 dBm at N.R.L.	Better than 62 dB below +16 dBm
Distortion	
Replay head input to line output	
Replay amplifier set to +8 dBm at N.R.L.	Better than -50 dB at 16 dBm (30 Hz to 15 kHz)

PRESAGE CHARACTERISTICS
(Replay from record head)

Frequency response	30 Hz to 7 kHz ± 5 dB
Signal to noise ratio	Better than 35 dBm below +16 dBm

RECORD CHARACTERISTICS

Equalization	I.E.C.: 35μsec at 15 i.p.s., 70μsec at 7.5 i.p.s.
Frequency response	
Line input to line output	
15 i.p.s.	30 Hz to 20 kHz ± 2 dB
7.5 i.p.s.	30 Hz to 15 kHz ± 2 dB
3.75 i.p.s.	30 Hz to 8 kHz ± 2 dB
Signal to noise ratio	Typically less than -64 db below peak recording level for distortion of 3% or less (approx 800 nW/m tape flux) using PER 525 tape.
	Guaranteed less than -56 db below peak recording level of 320 nW/m on standard tape.
Distortion	Less than 2% at 320 nW/m and 1kHz typically 1.2% using Agfa PER 525 tape

SPECIFICATION SUMMARY (continued)

Bias and Erase Frequency	100 kHz ±500 Hz
AMPLIFIER CHARACTERISTICS	
Frequency response	
Line input to line output	30 Hz to 15 kHz ±0.5 dB at +16 dBm
Mic. input to line output	30 Hz to 15 kHz ± 1 dB at +16 dBm
Signal to noise ratio	
Line input to line output (unity gain)	Better than 66 dB below +16 dBm
Mic. input to line output (normal gain)	Better than 56 dB below + 16 dBm
Distortion	
Line input to line output (unity gain)	Better than -56 dB at +16 dBm (30 Hz to 15 kHz)
Mic. input to line output (16 mV input)	Better than -56 dB at 16 dBm (30 Hz to 15 kHz)
MONITOR CHARACTERISTICS	The monitor may be switched to either record or play signals. The monitor output is from either an internal loudspeaker or a 15Ω jack to an external load.
Power	2 W output when monitoring a +8 dBm line
Frequency response	
Line input	30 Hz to 15 kHz ± 1 dB at 2W
Signal to noise ratio	
Monitor record, maximum monitor gain	Better than 60 dB below 2W
Distortion	Better than -46 dB at 400 Hz, -40 dB (30 Hz to 15 kHz).

3. GLOSSARY OF TERMS

3.1 NORMAL RECORDING LEVEL (N.R.L.)

Normal Recording Level is that level which corresponds to a tape flux 8 dB below 320 nWb/m of track width.

Normal Recording Level corresponds to equipment line input and line output level of +8 dBm.

3.2 PEAK RECORDING LEVEL (P.R.L.)

Peak Recording Level is that level which corresponds to a tape flux 4 dB above 320 nWb/m of track width.

Peak Recording Level corresponds to equipment line input and line output levels of +20 dBm.

3.3 REFERENCE RECORDING LEVEL (R.R.L.)

Reference Recording Level is that level which corresponds to a tape flux of 320 nWb/m of track width.

Reference Recording Level corresponds to equipment line input and line output levels of +16 dBm.

A tape accurately recorded to a level of 160 nWb/m of track width at 400 Hz will be used for calibration purposes, i.e. 6 dB below R.R.L. (+10 dBm).

3.4 STANDARD SOUND SIGNAL (S.S.S.)

The Standard Sound Signal is defined as a sine wave signal with a frequency of 400 Hz and a level of +8 dB in a balanced 600Ω circuit.

The Standard Sound Signal corresponds to an indication of 0 VU on the Standard Volume Unit indicator when equipped with a suitable 4 dB pad.

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4. OPERATION

4.1 PRELIMINARY

To set the recorder to its recommended operating position when mounted in a carry case:

(a) Stand the recorder upright.
(b) Pull out the legs towards the back.
(c) Unwind the power lead from the recess at the rear of the recorder.
(d) Tilt the recorder backwards to rest on the legs.

Remove the case lid, which is fastened by rotatable catches at the top and hinged at the bottom.

Plug the mains connector into a correct supply (within the range 210 V to 260 V, 50 Hz).

The recorder controls are shown in Figure A, (see page 10).

Set the OFF/7.5 I.P.S./15 I.P.S. switch to either 15 I.P.S. or 7.5 I.P.S. as required. The VU meter lamps will light. Load a spool of tape onto the supply (left) spindle and lock with the spool retaining knob. Thread the tape along the route indicated by the THREADING LINE on to the empty take-up spool. Ensure that the tape passes over the tape break switch arm and under the OFF/7.5 I.P.S./15 I.P.S. switch and that the oxide coating is towards the inside of each spool.

4.2 CONNECTIONS

The INPUT and OUTPUT jacks are tip/ring/sleeve type.

NOTE: The 15Ω output is *not* balanced: the jack ring is earthed and the tip active.

The microphone socket at the rear of the recorder requires a plug type XL-3-13.

4.3 INTERLOCKS

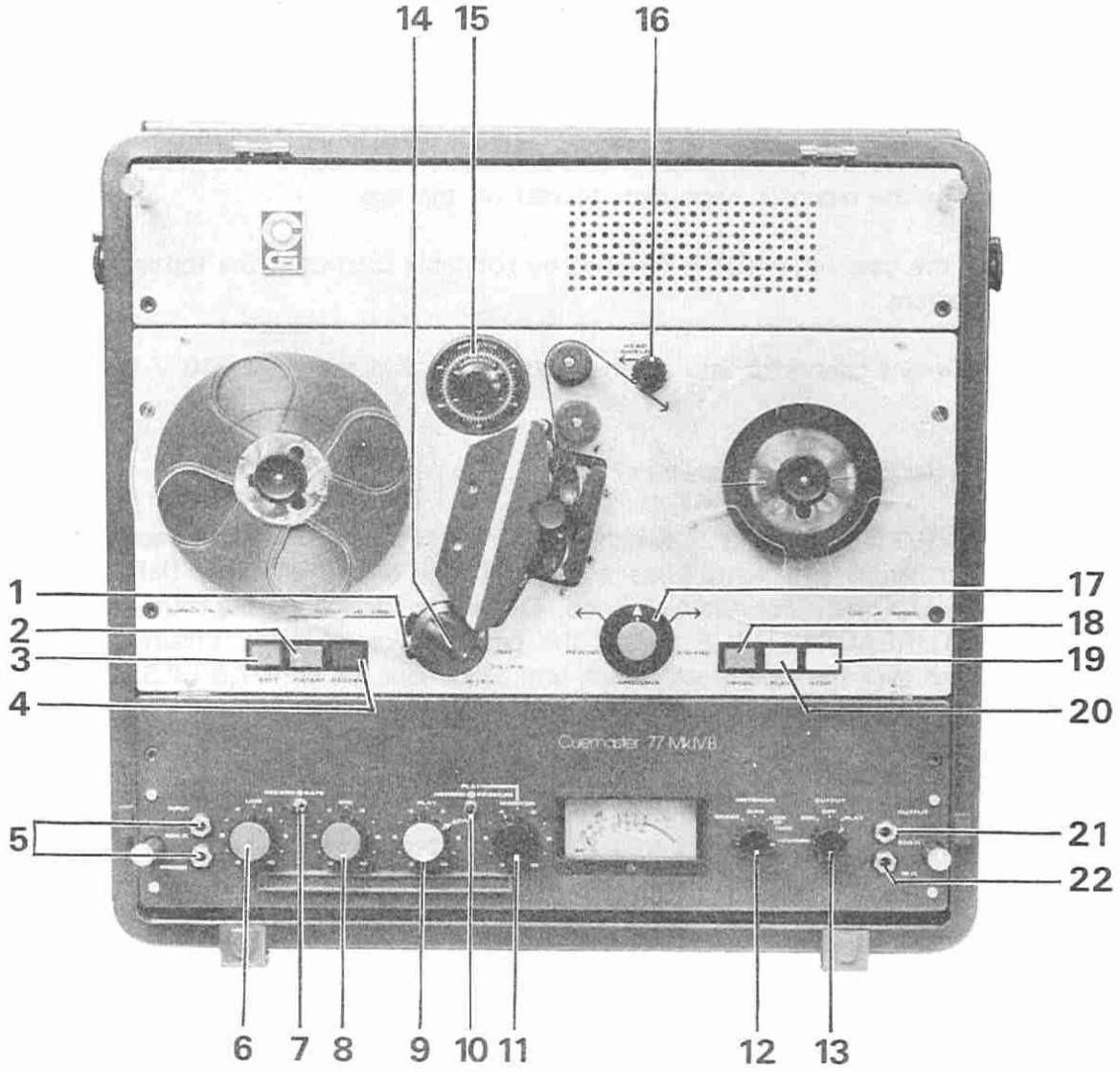
To prevent tape spillage and accidental erasure of tapes, certain interlocks have been incorporated within the control logic of the recorder. Therefore, after engaging either SPOOL or EDIT the STOP button must be pressed. Before engaging RECORD, the RECORD/SAFE switch must be set to RECORD.

IMPORTANT: After spooling at maximum speed, allow the spools to stop before engaging RECORD or PLAY otherwise tape spillage may occur.

4.3 (continued)

When the tape ends, breaks, or loses tension, the tape break switch operates and the tape deck automatically stops.

The effect of the tape break switch is inhibited when the PLAY, RECORD or SPOOL button is pressed, to enable slack tape to be taken up at the start of a function.



1. Tape break arm
2. F/START switch
3. EDIT switch
4. RECORD switch
5. INPUT sockets
6. LINE gain control
7. RECORD/SAFE switch
8. MIC gain control
9. PLAY gain control
10. RECORD/PLAY/PRESAGE switch
11. MONITOR gain control
12. METERING switch
13. OUTPUT switch
14. OFF/7.5 I.P.S./15 I.P.S. switch
15. Tape timing indicator
16. HEADSHIELD lever
17. SPOOLING control
18. SPOOL switch
19. PLAY switch
20. STOP switch
21. 600Ω OUTPUT jack
22. 15Ω OUTPUT jack

FIGURE A RECORDER CONTROLS

4.4 PLAY

For normal play operation press the yellow PLAY button. To achieve instantaneous, click-free start, the green F/START switch should be pressed, which allows the capstan motor to attain operating speed before the pinch roller is engaged and the HEAD SHIELD lever should be operated which closes the magnetic screen around the heads before the tape is started. The PLAY button can now be pressed. Pressing the PLAY button, momentarily applies additional torque to the spool motors which assists in achieving smooth, instantaneous starting.

NOTE: Engaging the STOP button normally cancels the fast start mode. If required again the F/START button must be pressed. For continuous editing purposes this automatic cancelling is undesirable, therefore an operator controlled disengagement of the fast start mode can be provided as detailed in Section 5.1(5).

For normal operation, set the yellow PLAY gain control to the CAL position. When a tape with a signal strength different from the normal recording level (N.R.L.) is to be played, the PLAY gain control should be adjusted in conjunction with the VU meter. To adjust the gain control set the METERING switch to VU. This connects the VU meter across the 600Ω OUTPUT line.

Set the OUTPUT switch to PLAY to connect the line amplifier to the play pre-amplifier output. Set the RECORD/PLAY/PRESAGE switch to PLAY, to monitor the replay signal. Press the PLAY button: this releases the brakes, engages the pinch roller and starts the tape.

The signal level to line is indicated on the VU meter and can be adjusted by means of the PLAY gain control. The monitor signal level can be adjusted by means of the black MONITOR gain control. This will not affect the line signal level.

4.5 RECORD/SAFE SWITCH

A RECORD/SAFE switch is provided to prevent erasure of a pre-recorded programme should the RECORD button be accidentally pressed while replaying a tape. As a further safeguard the RECORD/SAFE switch is a self locking toggle type which must be lifted to change modes.

4.6 RECORD

Set the RECORD/SAFE switch to RECORD. Connect the line carrying the programme to be recorded to the appropriate INPUT jack. If the recording is to be made via a microphone, connect it to the MICROPHONE socket at the rear of the recorder.

Set the RECORD/PLAY/PRESAGE switch to RECORD This connects the monitor amplifier to the output of the record amplifier. The MONITOR gain control can be adjusted without affecting the level of the recorded signal. Set the METERING switch to LINE IN or MIC, as appropriate. This enables measurement of the input signal at the line input jack or the microphone amplifier output. Adjust the meter reading to be approximately 0 VU on peaks. (Occasional excursions

4.6 (continued)

into the red region are acceptable but excessive distortion will occur if the average level is in the red region). When the programme being recorded is required simultaneously at the 600Ω OUTPUT jack of the recorder set the OUTPUT switch to REC. When the programme is not required at the 600Ω OUTPUT jack, set the OUTPUT switch to OFF. Set the METERING switch to VU. Record level adjustment is made by means of the appropriate red LINE or MIC gain control.

IMPORTANT: When only one input is to be used, either line or microphone, set the other gain control to zero.

To start recording, press the red RECORD button. The RECORD and PLAY buttons will be illuminated. The bias and erase oscillator will be energized. Check the levels of bias and erase current on the meter by switching the METERING switch to the appropriate positions. Under normal operating conditions, the meter readings in both the BIAS and ERASE switch positions will be approximately zero. Pressing the SPOOL, PLAY or STOP buttons will cancel the record mode.

4.7 SPOOL

To select the spooling mode, press the blue SPOOL button. The direction and speed of spooling are determined by the blue SPOOLING control on the tape deck. 'Inching' of the tape through the machine for cueing or editing can be effected by operation of the SPOOLING control.

4.8 EDIT

The EDIT function is engaged by pressing the alternate-action, amber EDIT button, This function has two modes of operation:

(a) In conjunction with STOP.
(b) In conjunction with PLAY.

With EDIT and STOP buttons selected, the power is removed from the spool motors, and the brakes are released, which facilitates the movement of the tape for loading or cueing purposes.

When EDIT and PLAY buttons are selected, the tape is transported past the heads in the normal manner, but the take-up motor is not energized, so that bin editing is possible.

4.9 MONITORING

An internal monitoring system is incorporated which, in conjunction with the RECORD/PLAY/PRESAGE switch, the MONITOR gain control and the internal loudspeakers, provides the following features:

(a) RECORD position – monitors the incoming programme being recorded, or to be recorded.

4.9 (continued)

(b) PLAY position – monitors the replayed programme from the play head.

(c) PRESAGE position – monitors the replayed programme using the record head as a playback head.

Operating the switch between RECORD and PLAY positions provides A-B monitoring.

NOTE: When the switch is in the PRESAGE position and the record mode is selected the monitor amplifier is automatically switched from the record head to the play head. When the record mode is cancelled the monitor amplifier is again returned to the record head.

4.10 DUB EDITING

A special feature of the 77 MK IV is its outstanding dub editing operation, i.e. inserting new information or programme at a precisely defined position on the tape. The instantaneous, fast-start, click-free operation of the record mode together with the presage mode monitoring provides this facility. The tape being edited is monitored at the record head and when the exact point in the programme is reached the RECORD button is pressed and the new material is recorded immediately.

Alternatively, a programme being replayed in the presage mode is stopped at the appropriate point on the tape. At the instant the required new programme is available the RECORD button is pressed and the material is recorded immediately.

In both of the above cases when the RECORD button is pressed the monitor amplifier is instantaneously switched from the record head to the play head thereby allowing the dub to be verified.

As the record head is used for monitoring in the presage mode, the need to anticipate and allow for the time difference between the record and play heads, which is necessary when using the play head, is obviated.

Practice at this type of editing will produce results superior to scissor editing as it is faster and does not mutilate the tape.

4.11 TIMING INDICATOR

The timing indicator, located at the top of the tape deck, between the spools is directly driven by the tape. It is calibrated in minutes for tape speeds of 15 i.p.s. and 7.5 i.p.s. and retains accuracy during high speed tape spooling as well as at normal operating speeds.

The pointer movement has a friction drive so that manual resetting of the pointer can be made by turning the knob in the centre of the dial.

4.12 REMOTE OPERATION

An 11 pin REMOTE socket is located in the recess at the rear of the recorder.

The socket type is Painton 74/10/1155/10. The pin connections are:

Pin No.	Function
1	Spool button
2	Spool lamp
3	Play button
4	Play lamp
5	Record button
6	Record lamp
7	Stop button
8	Stop lamp
9	Earth
10	-60V DC unregulated
11	Fast start button and lamp.

5. CIRCUIT DESCRIPTION

5.1 TAPE DECK

The tape deck has three motors and two solenoids (see Figure 1). Eight two-pole relays convert the operation of the six illuminated pushbuttons to control the functions of the recorder. Mains voltage is applied to the tape deck via two 1A fuses, F1 and F2.

The tape deck is switched on by the OFF/7.5 I.P.S./15 I.P.S. switch, SW7, which selects the speed of the capstan motor and also selects the equalization circuit in the amplifier unit. When the tape deck is switched on, mains voltage is applied to the power transformer, T604 situated in the amplifier unit, (see Figure 2). The power transformer has two 41 V secondary windings, one of which is connected via fuse F3 to the bridge rectifier, D1, to give a -60V DC unregulated supply line for the tape deck controls.

(1) STOP

When the STOP button SW6 is pressed, relay S is energized. Contacts S1 form a holding path and complete the STOP lamp circuit. Pressing the STOP button also applies earth potential via diodes D19, D25 and D29 to short out and release relays SP, FS and E, and via diode D5 to the base of transistor TS2 which is biased off to release relays P and PA. When transistor TS2 is cut off, TS3 stops conducting, to release relay R. Contacts S2 open and de-energize the brake solenoid, which applies the brakes. Contacts P1 open, cutting off transistor TS1 to release the pinch roller solenoid. The tape deck is now inoperative and only the STOP lamp is lit.

(2) TAPE BREAKAGE

Releasing the tape break switch arm allows the tape break switch SW8 to energize relay S. The sequence of operation then is the same as for pressing the STOP button.

(3) PLAY

With tape correctly loaded on the tape deck, pressing the PLAY switch SW4 energizes relays P and PA and shorts out relay S via diode D14. Transistor TS3 is cut off while the switch is pressed which inhibits relay R.

Contacts P1 enable the PLAY lamp to be lit, hold relays P and PA energized via diode D10 and switch on transistor TS1 via resistor R4. Capacitor C6 starts to charge. The charging current momentarily energizes relay PT. Contacts PT2 allow an increased current to flow through resistor R23 and the take-up motor.

5.1 (continued)

Contacts PT1 allow a high operating current, caused by shorting out resistor R1, to flow through the pinch roller solenoid. Relay S released completes the current return path for the pinch roller solenoid via contacts S2.

Contacts P2 apply mains voltage to the capstan motor via resistor R25. Contacts PA1 and PA2 energize the supply motor and take-up motor respectively. Relay PT releases when capacitor C6 is charged.

(4) RECORD

With tape correctly loaded on the tape deck, pressing the RECORD button SW5 energizes relays R via diode D17 and releases relay S via diode D18. Contacts R1 hold relay R energized via diode D16, and energize relays P and PA via diode D13. The action of the relay contacts is similar to that described for PLAY. Contacts R1 enable the RECORD lamp to be lit. Contacts R2 switch on the bias and erase oscillator in the amplifier unit.

(5) FAST START

With tape correctly loaded on the tape deck, pressing the F/START button SW1 energizes relay FS. Contacts FS1 enable the F/START lamp to be lit and hold relay FS energized. Contacts FS2 apply mains voltage to the capstan motor via resistor R25, so that the motor can attain normal operating speed before the play or record mode is selected.

To change the self-cancelling feature of the fast start facility to operator controlled cancelling, two links on the control printed circuit board have to be transferred.

SELF-CANCELLING:	Link A to C and D to F
OPERATOR CONTROLLED:	Link A to B and D to E

When the link A to B is made, the tape break switch is inoperative. When the link D to E is made, capacitor C25 is connected across relay FS. Then when the STOP button is pressed, the negative plate of the capacitor is switched via D25 to earth potential. Relay FS remains operated until C25 has discharged to below the holding voltage of the relay. This discharge time is approximately 1.5 sec, thus for the operator to cancel the fast start mode in this configuration, the STOP button has to be held operated for a period of at least 1.5 sec.

(6) EDIT

Pressing the EDIT button SW3 energizes relay E and shorts out relay S via diode D33. Contacts E1 enable the EDIT lamp to be lit, hold relay E energized via diode D31 and short out spool relay SP via diode D20. Contacts E2 open circuit the take-up motor supply. Pressing the STOP button SW6 shorts out relay E via diode D29 and cancels the edit mode.

5.1 (continued)

(7) SPOOL

With tape correctly loaded on the tape deck, pressing the SPOOL button SW2 energizes relay SP and shorts out relay S via diode D24.

Contacts SP1 enable the SPOOL lamp to be lit, hold relay SP energized, short out relay E via diode D28 and bias off transistor TS2 via diode D3. Contacts SP2 connect one side of the mains supply to the wiping contact of the SPOOLING potentiometer R22. One end of the potentiometer is connected to the supply motor, the other end is connected to the take-up motor. By adjusting the potentiometer, the supply voltage to each motor is varied so changing the motor torques and causing the tape to be spooled in the appropriate direction. By careful adjustment of the control (i.e. torque balancing) the tape can be made to remain stationary.

5.2 AMPLIFIER UNIT

The amplifier unit contains the signal and audio controls for the recorder.

Three printed circuit cards are mounted within the unit:

- The amplifiers and power supply card mounted on top of the chassis.
- The record—play card mounted above the hinged bottom cover.
- The microphone pre-amplifier mounted inside a screening can.

The simplified block diagram, Figure 3, shows the functions of the amplifier unit.

(1) POWER REGULATOR

When the recorder is switched on, supply mains voltage is applied to the power transformer T604 (see Figure 2). One of the 41 V secondary windings of the transformer is connected to the bridge rectifier D204 (see Figure 4). The DC output of the rectifier is series regulated by transistor TS601, which in turn is controlled by the voltage sensor amplifier, integrated circuit IC201.

Increasing load current will increase the voltage drop across resistor R233. When this voltage exceeds the turn-on emitter-base junction voltage of transistor TS214 (approx. 0.7 V), the transistor begins to conduct which tends to reduce the base voltage of transistor TS601, thereby reducing the regulated output voltage and achieving current limiting.

The power regulator operating current is normally 100 to 200 mA, but up to 700 mA can be drawn for a short period, after which fuse F4 will rupture.

(2) LINE AMPLIFIER

The input of the line amplifier is derived from either the record amplifier or the play pre-amplifier, depending upon the position of the REC/OFF/PLAY OUTPUT switch SW601. When PLAY is selected the input signal is

5.2 (continued)

taken from the play pre-amplifier via the PLAY gain control R601 into the line amplifier. When REC is selected the line amplifier input signal is the output of the record amplifier integrated circuit. In REC or PLAY the amplifier input is applied to long-tailed-pair TS200, TS201, which provides a high input impedance. Amplifier TS202 supplies the input to complementary drivers TS203, TS204 to drive the output transistors TS205, TS206. The output is transformer coupled through T603 to give complete isolation and balancing.

Overall AC feedback is established by resistors R205 and R206. Diodes D200 and D201 provide biasing for transistors TS203 and TS204. They also provide temperature compensation for changes in V_{BE} of the output transistors to give DC stability.

The large emitter resistors of the output transistors protect the amplifier from short circuits and overloads.

(3) MONITOR AMPLIFIER

The input to the monitor amplifier is derived from either the record amplifier or the buffer amplifier, depending upon the position of the RECORD/PLAY/PRESAGE switch SW602. The amplifier input signal is taken via the MONITOR volume control R602, into amplifier stage TS216. In a circuit similar to that of the line amplifier, long-tailed-pair TS207 and TS208 drive the amplifier transistor TS209 to supply the input to complimentary pair TS210 and TS211. This pair drives the transformerless output stage TS212 and TS213 loaded by either the two 8Ω loudspeakers in series, or an external load connected via the 15Ω OUTPUT jack.

The output is unbalanced.

NOTE: Care should be taken when using an external 15Ω unbalanced load that the polarity of the connector is not reversed, i.e. the tip of the tip/ ring/sleeve jack plug must not be earthed, which would short circuit the output.

The output emitter resistors R229 and R230 protect the amplifier against damage during a short circuit, but the power supply protection fuse F4 may rupture if the drive level is high.

(4) MICROPHONE PRE-AMPLIFIER

The microphone pre-amplifier is a three-stage, DC coupled amplifier with a linear frequency response (see Figure 5). Transistor TS401 operates at a collector current of about 10μA. The bias voltage of transistor TS401, is derived from the emitter of TS403 and is maintained by the DC feedback path. Two negative feedback paths to transistor TS401, one via resistor R405 and the other via R411 and capacitor C406 in parallel increase the input impedance of the amplifier.

5.2 (continued)

Resistor R606 adjusts the DC voltage applied to the gate of unijunction transistor TS402. By changing the gate voltage of TS402, the emitter resistor R403 is shunted by a varying impedance which changes the feedback level and thus the amplifier gain is varied. Resistor R607 acts as a variable potentiometer, used to set the required microphone signal level for the record amplifier input.

Transistor TS404 is an emitter follower acting as a low source impedance.

(5) PLAY PRE-AMPLIFIER

The play pre-amplifier is a three-stage, low noise, DC coupled amplifier (see Figure 6). The source impedance is maintained at low frequencies by resistor R164. RF interference is reduced at the input by capacitor C140. TS113 is an emitter follower output stage.

Relay A is energized when the OFF/7.5 I.P.S./15 I.P.S. switch SW7 is set to 15 I.P.S.

The amplifier output level is preset by the play level potentiometer either R174 at 7.5 i.p.s. or R176 at 15 i.p.s. The output is fed via contacts A2 and capacitor C144 to the PLAY gain control R601.

Three separate equalization feedback paths are provided:

- 7.5 i.p.s. I.E.C. (time constant = 70 μsec) selected by relay contacts A1 released.
- 15 i.p.s. I.E.C. (time constant = 35 μsec) selected by relay contacts A1 energized.
- NAB, (time constant 50/3180 μsec) selected by switch SW101.

The I.E.C. equalization is adjustable at low frequencies by either R186 (7.5 i.p.s.) or R185 (15 i.p.s.) and at high frequencies by R184 (7.5 i.p.s.) or R183 (15 i.p.s.).

(6) PRESAGE AMPLIFIER

The presage amplifier is a three-stage, DC-coupled amplifier. Its input and output are shorted to earth potential when relay B is energized.

Relay B is energized when the RECORD/PLAY/PRESAGE switch SW602 is selected for RECORD or PLAY. When PRESAGE is selected, relay B is released and the presage amplifier input is connected to the record head via capacitor C113 and contacts B2 and the amplifier output is connected via resistor R137 and capacitor C122 to the buffer amplifier TS107.

5.2 (continued)

Overall AC feedback and equalization is applied from the emitter of transistor TS106 to the emitter of TS104. Amplifier output level is pre-set by the presage level potentiometer R129.

(7) BUFFER AMPLIFIER

Transistor TS107 is used as a buffer amplifier. Its output is connected via capacitor C119 to the RECORD/PLAY/PRESAGE switch SW602. In the PLAY and PRESAGE positions, its output is taken from switch SW602 via the MONITOR volume control potentiometer R602 to the monitor amplifier. In the PLAY position relay B is energized and the input to the buffer amplifier is derived from the output of the play pre-amplifier via the monitor play level potentiometer R187 and resistors R138 and R139. In the PRESAGE position relay B is released and the input to the buffer amplifier is the output signal of the presage amplifier via the presage level potentiometer R129.

(8) BIAS AND ERASE OSCILLATOR

The bias and erase currents are drawn from separate output windings of the bias and erase oscillator transformer L103. The bias level is set by potentiometer R105 and is fed to the record head via capacitor C101. The erase head is driven in a series tuned mode via capacitor C103. The tuning is on the high side of resonance to prevent overloading the oscillator. Erase current may be adjusted by trimming the capacitor C103.

Transistors TS101 and TS102 form a tuned-collector, cross-coupled oscillator. The frequency of oscillation is established by the tuned circuit L103 C105.

The oscillator is energized when earth potential is applied to the base bias network of transistor TS103 via the RECORD/SAFE switch SW603 and relay contacts R2. The base potential builds up slowly due to the long time constant of capacitor C110 and resistor R112 and decays slowly due to capacitor C110 and resistor R114. This allows a gradual build up and decay of oscillations which results in silent switching of the record mode.

When the oscillator is energized, a voltage is developed across resistor R110. This voltage is applied across the two series connected light-emitting diodes D103, D106. The light from the diodes causes the light dependant resistors LDR101 and LDR102 to conduct.

With resistor LDR102 conducting, signals are fed into the record drive amplifier, and with resistor LDR101 conducting, the output of the record drive amplifier is applied through the bias-trap filter of L101 and C137 to produce the required record signal. The signals are switched silently because of the relatively slow switching action of the LDR circuits.

(9) RECORD AMPLIFIER

The record signal is applied to the INPUT and/or MICROPHONE sockets and is fed via resistors R144 and/or R143 to the mixer amplifier IC101. The

5.2 (continued)

low input impedance of IC101 provides effective isolation between the two inputs.

With the OUTPUT switch SW601 in the REC position, the output of the mixer amplifier is taken to the line amplifier. In the record mode the output of the mixer is applied to the record level potentiometer R151, via the light dependant resistor LDR102. With the RECORD button SW5 selected on the tape deck, and the RECORD/SAFE switch SW603 set to RECORD,LDR102 is conducting (as described in 5.2(8)) and the record signal is fed to, and amplified by, TS110 via emitter follower TS108. Transistor TS109 acts as a dynamic load which provides a constant current into the collector of TS110. The output from TS110 is fed via the bias trap filter of L101, C137 through LDR101 and into the record head.

HF compensation appropriate to the recording speed is achieved by shunting the emitter resistor of TS110 with a series tuned circuit comprising capacitors C135, C136 and inductor L102. This circuit is tuned to the maximum recorded frequency at a particular speed.

The amount of compensation is set by potentiometer R159 at 7.5 i.p.s. and by R160 at 15 i.p.s. Record balance control R161 allows the record level at 7.5 i.p.s. to be set to the same value as that at 15 i.p.s. for a given input level.

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6. MAINTENANCE

6.1 ELECTRONIC MAINTENANCE

(1) SET DC POWER SUPPLY VOTAGE

(a) Measure the DC voltage between pin 5 (+) and pin 3 of the amplifier and power supply circuit board (on top of amplifier chassis) to be 60 V ±5 V when mains voltage is 240 V ±10 V.

(b) Measure the voltage between pin 5(+) and pin 7.

(c) Set variable resistor R241 to give -37 V on pin 7 with normal mains voltage. This adjustment is required only when exchanging circuit boards.

(2) ADJUST BIAS FREQUENCY

The bias frequency has been set to 100 kHz. The inductor L103 on the record–play circuit board has a tuning slug which will vary the frequency by a small amount should adjustment be required. For a major change in frequency, change the value of C104 (see Figure 6).

IMPORTANT: Use a non-metalic tool to adjust the inductor slug.

(3) ADJUST BIAS TRAP

The bias trap is a tuned rejection filter used to prevent the bias signal from feeding back into the record amplifier, which could cause excessive noise and signal distortion. To ensure maximum bias rejection the filter must be tuned accurately as follows:

(a) Adjust the bias trap inductor tuning slug (L101 on the record–play circuit board).

(b) Set the RECORD/SAFE switch SW603 to RECORD and press the RECORD button. Using an oscilloscope, measure the bias signal on the collector of transistor TS110.

(c) Adjust the bias trap to give the minimum bias level (approx. 1 V P-P) at this point.

(4) SET VU METER CALIBRATION

(a) Set the METERING switch to VU and the OUTPUT switch to REC.

(b) Apply 400 Hz signal to the 600Ω INPUT jack.

6.1 (continued)

(c) Adjust the LINE level control to give an output of +8 dBm at the 600Ω OUTPUT jack when measured with an accurately calibrated AC voltmeter.

(d) Adjust the potentiometer on the meter pad circuit board to give a reading of 0 VU on the VU meter.

(5) SET PLAY FREQUENCY RESPONSE AND GAIN

IMPORTANT: Before commencing, switch off the tape deck,demagnetize all metallic parts in the tape path and set the RECORD/SAFE switch to SAFE. These precautions are essential to prevent accidental damage to the standard test tapes.

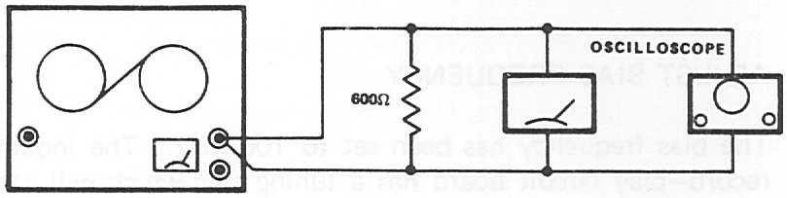

FIGURE B PLAY OUTPUT TEST EQUIPMENT SET-UP

(a) Set up test equipment as in Figure B.

(b) Load the test tape SRT 17 or SRT 20 and select 15 I.P.S. on the OFF/7.5 I.P.S./ 15 I.P.S. switch, SW7.

(c) Select PLAY and set the PLAY gain control to CAL.

(d) Using the first test tone (S.R.L. 160 n Wb/m) adjust the play level potentiometer R176 (accessible behind the removable plastic panel) until an output of +10 dBm (+2 VU) is measured on the meter.

IMPORTANT: Do *not* adjust the play level potentiometer again.

(e) Play the next test tone for azimuth adjustment. Align the play head as detailed in 6.3(3).

IMPORTANT: Do *not* adjust record head azimuth again.

(f) Play the frequency response section of the test tape.

NOTE: All tones should be set to be within ±1 dB of the reference tone level.

If the frequency response falls outside these limits, low frequency equalization (30 Hz to 200 Hz) can be controlled by adjusting the play LF adjust potentiometer R185 (on the record–play circuit board). High frequency equalization (5 kHz to 20 kHz) can be controlled by adjusting the play HF adjust potentiometer R183 (accessible behind the removable plastic panel).

The above procedure completes 15 i.p.s. equalization.

IMPORTANT: Do ***not*** adjust the play LF and HF potentiometers again.

For 7.5 i.p.s. equalization, proceed as follows:

(g) Load the test tape SRT 18 or SRT 21 and select 7.5 I.P.S. on the OFF/7.5 I.P.S./ 15 I.P.S. switch SW7.

(h) Repeat steps (c), (d) and (f) except that different potentiometers are used, as follows:

- R174 for play level adjustment
- R186 for play LF adjustment
- R184 for play HF adjustment

IMPORTANT: Do ***not*** adjust the play LF and HF potentiometers again.

(6) SET BIAS

(a) Set up test equipment as shown in Figure B.

(b) Align the record head azimuth as detailed in 6.3(4).

(c) Set tape speed to be 7.5 i.p.s.

(d) Feed a 400 Hz signal at +8 dBm into the 600Ω INPUT jack.

(e) Select the record mode and set the OUTPUT switch to PLAY.

(f) Set the bias potentiometer R105 (accessible behind the removable plastic cover) to give maximum ***audio*** replay output level.

(g) Measure the play output on the VU meter. Decrease the audio output level by 0.25 dB by ***increasing*** the bias level (adjust R105 clockwise).

(h) The bias level has now been correctly set for the particular type of tape in use.

6.1 (continued)

(7) SET OVERALL RECORDER GAIN

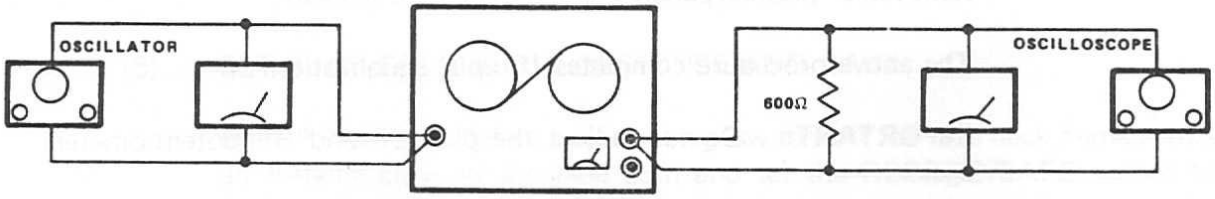

FIGURE C OVERALL RECORDER OUTPUT TEST EQUIPMENT SET-UP

(a) Ensure that procedures 6.1(5) and 6.1(6) have been completed.

(b) Set up the equipment as shown in Figure C.

(c) Load a new tape on the tape deck and set the speed to be 7.5 i.p.s.

(d) Set the record level as follows:

(i) Feed a 400 Hz signal at +8 dBm into 600Ω INPUT jack.

(ii) Set the OUTPUT switch to REC.

(iii) Adjust the record LINE gain control to obtain +8 dBm at the output.

(iv) Set the OUTPUT switch to PLAY.

(v) Select record mode.

(vi) Adjust the record level potentiometer R151 (accessible behind the removable plastic cover) to obtain +8 dBm at the output.

IMPORTANT: Do *not* adjust the record level potentiometer again. The above procedure sets the record level at 7.5 i.p.s.

(vii) Select the tape speed to be 15 i.p.s. and check that the record level is identical to the level at 7.5 i.p.s. Adjustment can be made by the record balance potentiometer R161 (on the record–play circuit board) to equalize the levels.

(8) SET RECORD FREQUENCY RESPONSE

(a) Set up the equipment as shown in Figure C.

6.1 (continued)

(b) Select the record mode and set the tape speed to be 15 i.p.s.

(c) Set the OUTPUT switch to REC.

(d) Feed a 400 Hz signal at 0 dBm into the 600Ω INPUT jack.

(e) Note the output reading, which should be 0 dBm.

(f) Slowly sweep the oscillator over the audio band (30 Hz to 20 kHz) and check that the output level does not vary by more than ±2 dBm from the reference level at 400 Hz.

(g) If the frequency response is outside the limit adjust the record HF adjustment potentiometer R160 (accessible behind the removable plastic panel).

(h) Repeat steps (c) to (g) with tape speed set to 7.5 i.p.s., adjusting potentiometer R159, if necessary.

IMPORTANT: Do *not* adjust the record HF potentiometers again.

(9) SET MONITOR GAIN

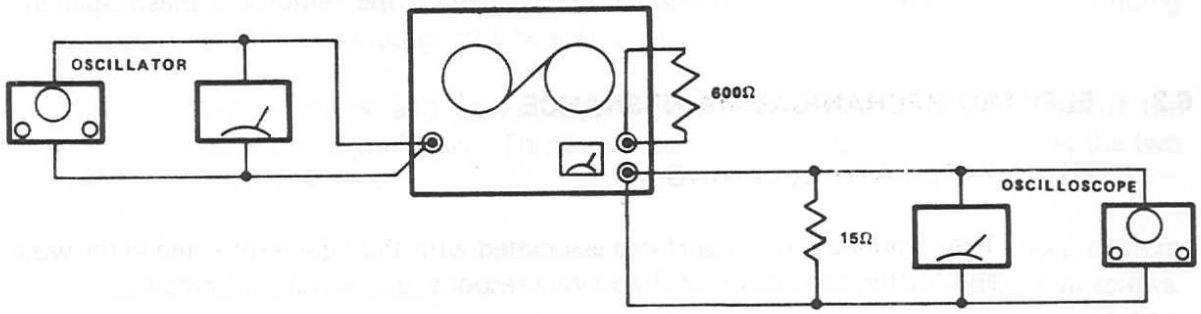

FIGURE D MONITOR AND PRESAGE GAIN TEST EQUIPMENT SET-UP

(a) Set up the equipment as shown in Figure D.

(b) Feed 400 Hz signal at +8 dBm into the 600Ω INPUT jack.

(c) Check that the output on the recorder VU meter is 0 VU.

(d) Set the RECORD/PLAY/PRESAGE switch SW602 to PLAY and set the MONITOR gain control to maximum gain.

(e) Adjust the monitor play level potentiometer R187 (on the record–play circuit board) to produce a 2 W output (5.5 V) across an external 15Ω load.

6.1 (continued)

(10) SET PRESAGE GAIN

(a) Set up the equipment as shown in Figure D.

(b) Record several minutes of tape with a 400 Hz signal at 0 VU, measured on the VU meter.

(c) Check that the replay output level is also 0 VU.

(d) Rewind tape to the beginning of the recorded track and select play mode.

(e) Switch RECORD/PLAY/PRESAGE switch to PLAY and set the MONITOR gain control to maximum gain.

(f) Check that the monitor output level across an external 15Ω load is 2 W (5.5 V).

(g) Switch the RECORD/PLAY/PRESAGE switch to PRESAGE and check that the monitor output level remains at 2 W (5.5 V) across the 15Ω load.

Adjustment can be made, if necessary, by varying the presage level potentiometer R129 (accessible behind the removable plastic panel).

6.2 ELECTRO-MECHANICAL MAINTENANCE

(1) TAPE PATH CLEANING

The cleanliness of all surfaces associated with the tape is reflected in the wow and flutter, tape dropout, frequency response and noise performance.

The pinch roller, capstan shaft and the heads are the most critical surfaces, but all rollers, guides, etc. should be cleaned regularly. Use a solvent-inpregnated soft, lint-free swab for all cleaning.

Recommended solvents are:

- Petroleum ether (Shell X272)
- Toluene
- Ethyl-alcohol

(2) LAMP REPLACEMENT

The lamps in the illuminated pushswitch buttons on the deck can be replaced from the front. The plastic bezel can be pulled off (there are finger nail slots top and bottom). The lamp can them be removed either with an extractor or by the careful use of a pair of long-nose pliers.

6.2 (continued)

The lamps in the VU meter are replaced by removing the amplifier unit from the carry case, opening the bottom hinged cover and removing the two nuts which hold the lamp bracket. This allows the lamp bracket enough movement for the lamps to be replaced.

(3) REMOVING THE AMPLIFIER UNIT

The amplifier unit has to be removed from the carry case to replace the VU meter lamps, to gain access to the printed circuit boards and wiring, and to gain access to all factory-set controls.

Remove the four Allen screws holding the amplifier unit in the carry case and carefully lift out the unit. The three interconnecting cables from the deck must be unplugged before the unit can be completely removed, but the cables are long enough to allow adjustments to be made whilst still connected.

IMPORTANT: When replacing the amplifier unit in the carry case care must be taken to position the three interconnecting cables so that they do not foul the mounting.

(4) REMOVING THE AMPLIFIER UNIT PRINTED CIRCUIT BOARDS

To gain access to the circuit boards, it is first necessary to remove the amplifier unit from the carry case. It is then possible to do most fault finding with the printed circuit boards in position.

The amplifier and power supply circuit board is mounted on top of the amplifier unit chassis. This board can be unplugged after removing the two holding screws.

The record–play circuit board is mounted on the inside of the hinged bottom cover of the amplifier unit. The bottom cover is held closed by two screws. The circuit board can be removed after loosening the three holding screws.

(5) SOLENOID ARMATURE PLATE ADJUSTMENT

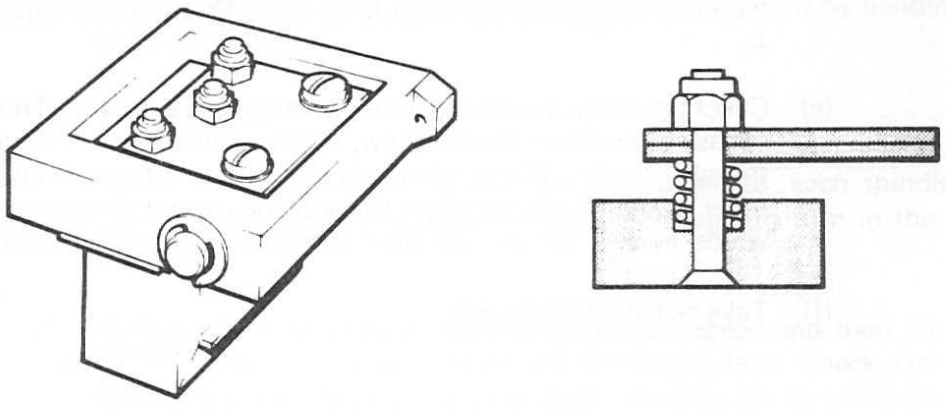

FIGURE E SOLENOID ARMATURE PLATE ADJUSTMENT

6.2 (continued)

Adjust the armature plates of the pinch-roller solenoid and the brake solenoid to lie flat on the pole face, when the solenoids are energized (See Figure E). The pinch roller solenoid has three adjusting screws and the brake solenoid has two.

(6) TRACKING ALIGNMENT

The pressure of the pinch roller against the capstan shaft is critical, as incorrect adjustment can cause excessive wow and flutter, or tape slippage.

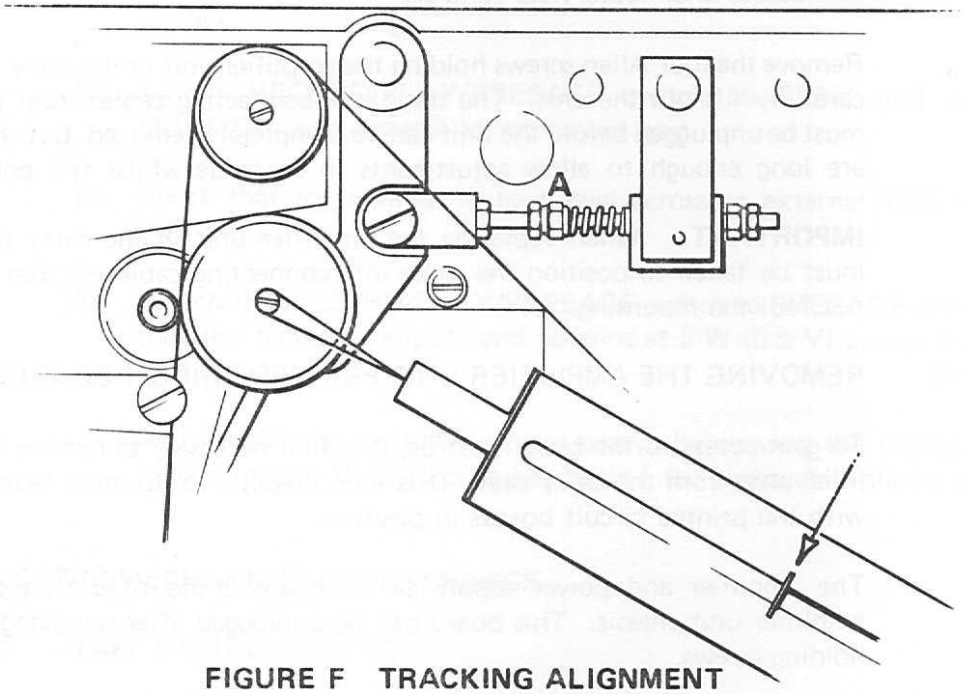

FIGURE F TRACKING ALIGNMENT

(a) Set up the equipment as shown in Figure F.

(b) Play a tape at 7.5 i.p.s.

(c) Hold off the tape break switch.

(d) Exert a pull on the spring balance till the tape stops. The tension required to stop the tape should be 4 lb. This is set by adjusting the nut A.

(e) Check that the roller is parallel to the capstan shaft. This is done by releasing the roller fixing screw, slightly raising the roller and selecting the play mode. If the roller rides up or down too quickly, re-align the roller shaft. Bend the shaft towards the capstan if the roller moves upwards, away from the capstan if the roller moves downwards.

(f) Take out the tape guides.

6.2 (continued)

(g) Check that the head laminations of all three heads can be seen on each side of the tape. Set by adjusting the height of the spools. Each spool rests on a brakedrum, which is locked to the spooling motor shaft by an Allen screw.

(h) Screw in the tape guide pin to the correct height and lock in position. Select SPOOL and check the tape alignment without having the tape passed around the timing roller. The tape will ride up or down if the adjustment is wrong. Bend the tape lift arm so that the tape will not ride up or down.

(j) Insert the two tape guides.

(k) Select the play mode and check that the tape rides centrally without touching the edges of the guides.

(l) Thread the tape round the timing roller.

(m) Check that the tape does not wander up or down. If it does, remove the timer glass, its dial and the three fixing screws. Adjust the height of the tapped pillars and reassemble.

(n) Repeat (m) until the tape does not wander.

(7) BRAKE ADJUSTMENT

Inefficient braking can be caused by dirt or oil on the brake shoes or brake drums. Cleaning with methylated spirits is recommended. For efficient braking it is essential that the toe (the end with the spring) of the brake shoe touches slightly before the heel (the pivoted end).

(a) Operate the brake solenoid by hand.

(b) Set the eccentric bush so that the heel just touches the drum.

(c) Release the brake solenoid.

(d) Set the clearance to be approximately 0.02 in (0.5 mm) by bending the brake crank arm.

(e) Set the spring at right angles to the brake shoe.

(f) Check that with the brake solenoid held operated, each spindle will turn in one direction quite easily, but is difficult to turn in the other direction.

(g) With a full supply spool, spool at maximum speed and then press the STOP button. The spool should not throw any tape. Check again with half-full and nearly empty supply spool. Reverse the spooling direction and repeat the tests. If the spools throw any tape, re-adjust the brakes.

6.2 (continued)

(8) REMOVING THE TAPE DECK FRONT PANEL

It is necessary to remove the tape deck front panel

- For access to the head wiring.
- To adjust the brake shoes and brake drums.
- For access to the tape break switch.

The sequence of actions to remove the panel is:

(a) Remove the HEADSHIELD lever and the SPOOLING knob.

(b) Remove the pinch roller and cover disc, ensuring that all the shim washers are retained.

(c) Remove the two 4BA countersunk screws from near the spool platforms.

(d) Remove the four 6BA cheesehead screws from the edges of the front panel.

(e) Carefully remove the front panel.

(9) TAPE BREAK SWITCH

The tension spring should be set with sufficient tension to just operate the microswitch when the tape runs out at 7.5 i.p.s. If the actuating arm is sluggish, remove it and clean the bearing.

(10) TAPE BREAK SWITCH ARM ADJUSTMENT

(a) Set the return stop so that the tape arm just clears the deck cover at the top end of its travel.

(b) Set the tape break switch so that the switch operates just before the top end of its travel. A distance of approximately $^{1}/_{16}$ in (1.5 mm) is satisfactory for reliable operation.

(c) Set the tension of the spring by rotating the circlip which acts as the spring anchor so that the following conditions are met.

(i) The tape break switch must not operate during normal spool operations.

(ii) When loaded with the tape fully tensioned, the tape break switch must operate when the brakes are released. This condition will be met either in the edit mode or when switching on the mains.

6.2 (continued)

(11) REMOVING THE TAPE DECK

The tape deck has to be removed from the carry case to replace some of the major items and to carry out tape deck control circuit repairs.

Should the amplifier unit also need to be removed from the case, this should be done first, as it makes the removal of the tape deck a little easier.

WARNING: CHECK THAT POWER HAS BEEN DISCONNECTED FROM THE RECORDER.

Remove the four Allen screws holding the deck to the carry case.

Carefully remove the deck from the carry case by tilting it slowly forward. Do *not* lift by spool hubs, capstan, etc.

NOTE: If the amplifier unit is to be left in the case, to make removal of the tape deck easier, stand the recorder upright before starting to remove the Allen screws.

When the tape deck is clear of the carry case, disconnect the three cables from the amplifier unit.

IMPORTANT: When replacing the deck, ensure that the three interconnecting cables do not foul the mounting of the tape deck or amplifier.

(12) REMOVING THE TAPE DECK CONTROL CIRCUIT BOARD

To gain access to the tape deck control circuit board the deck must be removed from the carry case.

The circuit board is screwed to the fuse panel underneath the deck. By removing two of the four screws which hold the fuse panel in place, it can be rotated about the other two screws to reveal the control circuit board.

The control circuit board is wired to the deck, but when the six screws fixing the board to the panel are removed, the loom allows enough movement of the board, for normal maintenance.

(13) CAPSTAN MOTOR REPLACEMENT

To replace the capstan motor the tape deck must be removed from the carry case.

The capstan motor is removed as follows:

(a) Unsolder the motor cable from the tag strip at the rear of the OFF/7.5 I.P.S./ 15 I.P.S. switch.

(b) Remove the tape timing indicator.

6.2 (continued)

(c) Remove the pinch roller solenoid arms.

This allows access to the motor retaining screws.

IMPORTANT: Do *not* upset the adjustments of the tape timing indicator mounting spacers or the pinch roller linkages.

(d) Remove the four motor retaining screws.

(e) LIft out the motor.

To replace the motor, reverse the order of removal.

Extreme care must be taken in handling the capstan motor shaft as damage will result in excessive wow and flutter.

The motor cable must be re-soldered with its leads matching the colour of the leads on the tag strip.

After replacing the capstan motor, the tracking and pinch roller pressure must be checked. If adjustments are required see Section 6.2(6).

(14) SPOOLING MOTOR REPLACEMENT

To remove one of the spooling motors.

(a) Unclip and pull out the set of four motor and solenoid connectors.

(b) Separate the connectors by sliding them apart.

(c) Remove the brake drum.

(d) Unscrew the four mounting screws from the rear of the motor

To replace motor, reverse the order of removal.

The connectors should be joined so that each motor and solenoid is plugged into the nearest socket of matching colour. (No damage to the equipment would occur if the connectors were joined in the wrong order, but incorrect operation would result.)

After reassembling, the tape tracking alignment should be checked as detailed in Section 6.2(6).

(15) OILING THE SPOOLING MOTOR BEARINGS

Remove the motor to be oiled.

To gain access to the bearings (front and rear):

(a) Remove the four screws from the front of the motor.

(b) Pull off the front end bell housing.

6.2 (continued)

(c) Remove the four screws in the end bell housing and lift off the plate to expose the felt oil reservoir pad and bearing.

(d) Lift out the rotor and shaft assembly and winding from the rear end bell housing.

NOTE: The motor shaft is mounted on a single ball bearing.

(e) Remove the four screws in the rear end bell housing and lift off the plate to expose the felt oil reservoir pad and bearing.

Saturate both felt oil reservoirs with Shell G960 oil or an equivalent high grade light spindle oil.

Reassemble the motor in the reverse order to that of dissassembly. After reassembling the motor tap the housings radially to realign the bearings.

6.3 MAGNETIC MAINTENANCE

CAUTION: Do *not* use any magnetized tool in the vicinity of the head.

(1) HEAD MAINTENANCE

CAUTION: Do *not* make DC measurements of head resistance as permanent magnetization may result.

Any accumulation of dirt on a head face causes an increase in noise and a fall-off in signal and high frequency response. The heads should be checked regularly to ensure that they are free from dirt.

A solvent-impregnated soft, lint-free swab is used to clean the head. The type of solvent may depend on the type of dirt, e.g. tape oxide, oil, dust, etc. Carbon tetrachloride should not be used.

Recommended solvents are:

- Petroleum ether (Shell X272)
- Toluene
- Ethyl-alcohol

CAUTION: Do *not* use any abrasive on the head.

After protracted use, the heads will develop a groove in the tape path which may upset tape tracking and result in unreliable high frequency response. It is recommended that heads exhibiting a noticeable groove be returned to Plessey Electronics Pty. Ltd., for relapping and regeneration of the original head face contour.

6.2 (continued)

(c) Remove the four screws in the end bell housing and lift off the plate to expose the felt oil reservoir pad and bearing.

(d) Lift out the rotor and shaft assembly and winding from the rear end bell housing.

NOTE: The motor shaft is mounted on a single ball bearing.

(e) Remove the four screws in the rear end bell housing and lift off the plate to expose the felt oil reservoir pad and bearing.

Saturate both felt oil reservoirs with Shell G960 oil or an equivalent high grade light spindle oil.

Reassemble the motor in the reverse order to that of dissassembly. After reassembling the motor tap the housings radially to realign the bearings.

6.3 MAGNETIC MAINTENANCE

CAUTION: Do *not* use any magnetized tool in the vicinity of the head.

(1) HEAD MAINTENANCE

CAUTION: Do *not* make DC measurements of head resistance as permanent magnetization may result.

Any accumulation of dirt on a head face causes an increase in noise and a fall-off in signal and high frequency response. The heads should be checked regularly to ensure that they are free from dirt.

A solvent-impregnated soft, lint-free swab is used to clean the head. The type of solvent may depend on the type of dirt, e.g. tape oxide, oil, dust, etc. Carbon tetrachloride should not be used.

Recommended solvents are:

- Petroleum ether (Shell X272)
- Toluene
- Ethyl-alcohol

CAUTION: Do *not* use any abrasive on the head.

After protracted use, the heads will develop a groove in the tape path which may upset tape tracking and result in unreliable high frequency response. It is recommended that heads exhibiting a noticeable groove be returned to Plessey Electronics Pty. Ltd., for relapping and regeneration of the original head face contour.

6.3 (continued)

Compensation for the effects of head wear on the frequency response can be made (see 6.1(5) to 6.1(8)), until the equipment fails to meet specification. The head must then be replaced as described in Section 6.3(6) or 6.3(7).

(2) HEAD DEMAGNETIZATION

Magnetization of the heads increases the noise level, partially erases the programme and reduces the quality of recording on a tape. To minimize these effects, the heads should be demagnetized frequently using a suitable head demagnetizer.

(a) Switch off the recorder.

(b) Switch on the demagnetizer while it is away from the deck.

(c) Slowly pass the poles of the demagnetizer over and around the head gaps, shields and capstan shaft with a circular motion.

(d) Slowly remove the demagnetizer from the deck before switching it off.

(3) PLAY HEAD AZIMUTH ALIGNMENT

When the play head is not correctly aligned across the tape the recorder output is reduced and the frequency response is limited.

To align the head.

(a) Remove the head cover, held by two screws.

(b) Demagnetize the heads as described in 6.3(2).

(c) Switch the RECORD/SAFE switch to SAFE.

(d) Load a suitable test tape.

(e) Set the METERING switch to VU and the OUTPUT switch to PLAY.

(f) Play the tape and align the play head by means of the azimuth adjustment screw to give maximum output at 10 kHz at 7.5 i.p.s. or 15 kHz at 15 i.p.s.

(g) Operate the PLAY and SAFE buttons in rapid succession and ensure that the azimuth is maintained. If it is not maintained repeat steps (f) and (g).

(4) RECORD HEAD AZIMUTH ALIGNMENT

The record head should be aligned only after the play head azimuth alignment has been set, as play azimuth is the reference.

6.3 (continued)

To align the head:

(a) Carry out play head azimuth alignment as given in 6.3(3).

(b) Switch the RECORD/SAFE switch to RECORD.

(c) Fit a clean reel of tape.

(d) Set the METERING switch to VU and the OUTPUT switch to REC.

(e) Connect an audio oscillator to the 600Ω INPUT jack and adjust the line gain control to read -10 VU on the meter.

(f) Set the OUTPUT switch to PLAY.

(g) Record a 10 kHz signal at 7.5 i.p.s. or a 15 kHz signal at 15 i.p.s.

(h) Adjust the record head alignment by means of the azimuth adjustment screw to give maximum play output.

(j) Operate the PLAY and SAFE buttons in rapid succession and ensure that the azimuth is maintained. If it is not maintained repeat steps (h) and (j).

(5) ERASE HEAD AZIMUTH ALIGNMENT

There is no azimuth adjustment screw for the erase head as the setting is not critical. If however the head has been disturbed, it might need to be realigned. Normally, ensuring that the mechanical alignment of the erase head gap is perpendicular to the tape path is adequate. However if a more critical adjustment is required the following procedure should be adopted:

(a) Remove the head cover, held by two screws.

(b) Slacken the erase head mounting-nut.

(c) Record a tape to peak recording level (P.R.L.) at 400 Hz.

(d) Set the METERING switch to VU and OUTPUT to PLAY.

(e) Re-record the tape with no input and adjust the erase head alignment to give maximum erasure.

(f) Tighten the head mounting-nut and check the erasure.

(6) HEAD REPLACEMENT

To remove an individual head procede as follows:

(a) Unsolder the connecting leads.

6.3 (continued)

(b) Remove the mounting-nut and unscrew the azimuth adjustment screw.

(c) Withdraw the head.

(d) Take off the keyed shield assembly, including the azimuth adjustment plate and any associated washers.

(e) To replace the head, reverse the order of removal.

(f) Tighten the mounting nut to a maximum pressure which will still allow azimuth adjustment by means of the azimuth adjustment screw. Over-tightening of this nut will lock the head against the mounting bracket which in turn will make the azimuth adjustment screw ineffective and may cause damage to the azimuth adjusting plate.

(g) Check the azimuth alignment as given in 6.3(3) to 6.3(5).

(h) Adjust the frequency response of the equipment as described in 6.1(5) to 6.1(8).

(7) HEAD ASSEMBLY REPLACEMENT

To remove the head assembly:

(a) Remove the tape deck front panel as described in 6.2(8).

(b) Unsolder the head leads.

(c) Remove the OFF/7.5 I.P.S./ 15 I.P.S. switch knob.

(d) Remove the stabilizing roller (using circlip pliers,) ensuring that all shim washers are retained.

(e) Remove the four screws holding the head mounting bracket.

To replace the head assembly, reverse the order of removal. Check the azimuth alignment. Adjust the frequency response of the equipment.

(8) HEAD SHIELD ADJUSTMENT

To adjust the head shields:

(a) Remove the tape deck front panel as described in 6.2(8).

(b) Slacken the head shield retaining screws, adjacent to the head shield hinges.

(c) The position of each head shield is to be concentric with the associated head can and is to make good contact with it.

(d) Tighten the head shield retaining screws.

7. PERFORMANCE TESTS

7.1 CHECK SHORT CIRCUIT PROTECTION

Switch off the equipment. Remove fuse F4 and connect a 1A DC meter across the fuse socket. Connect pin 7 to pin 5.

Use a variac to increase the input voltage to the recorder until the DC current limits.

Meter should indicate 0.7A ±0.1A. If it does not, replace the amplifiers and power supply circuit card.

NOTE: This test must not be continued for more than 15 seconds, the time in which F4 would normally rupture.

7.2 CHECK RECORD/SAFE SWITCH

(a) Set the switch to SAFE, and press the RECORD button on the tape deck.

(b) Check that the record mode cannot be engaged and the RECORD lamp does not light.

(c) Set the switch to RECORD and press the RECORD button on the tape deck.

(d) Check that the record mode is engaged and the RECORD lamp lights.

(e) Set the switch to SAFE.

(f) Check that the record mode is cancelled and that the RECORD lamp is extinguished.

7.3 CHECK METERING SWITCH

(a) With the equipment in the record mode and the METERING switch set to ERASE the VU meter should indicate 0±2 dB.

(b) Set the METERING switch to BIAS. Meter indicates the preset value of bias.

(c) Set the METERING switch to LINE IN. With an input of +8 dBm the VU meter should indicate 0 VU,

(d) Set the METERING switch to MIC. With an input of 20 mV at the MICROPHONE socket and the MIC gain control set to minimum, the meter should indicate 0 VU.

7.3 (continued)

(e) Set the METERING switch to VU and the OUTPUT switch to REC. Apply an input signal of +8 dBm to the 600Ω INPUT jack, and adjust the LINE gain control to approximately mid position.

(f) Check that the VU meter registers.

7.4 CHECK GAIN; INPUT TO OUTPUT

(a) Set the OUTPUT switch to REC, and the LINE gain control to maximum.

(b) Set the PLAY gain control to CAL.

(c) Feed a signal of 400 Hz at -10 dBm into the 600Ω INPUT jack.

(d) Check that output level is +20 dBm ±2 dB, which gives a total gain of 30 dB ±2 dB.

(e) Check that with the output signal level at +21 dBm the output is not clipped.

(It may be necessary to increase the input signal to obtain a +21 dBm output).

7.5 CHECK FREQUENCY RESPONSE; INPUT TO OUTPUT

(a) Apply a 400 Hz signal at the level of +8 dBm to the 600Ω INPUT jack.

(b) Set the PLAY gain control to CAL.

(c) Set the output signal level to +8 dbm by means of the LINE gain control.

(d) Vary the frequency over the range 30 Hz to 15 kHz.

Output signal level variations should not exceed ±0.5 dB relative to the 400 Hz reference level.

7.6 CHECK NOISE; INPUT TO OUTPUT

(a) Set the controls on the recorder to unity gain, as in Section 7.5.

(b) Set MIC. gain control to zero.

With no input, the noise output should be below -50 dBm.

7.7 CHECK DISTORTION; INPUT TO OUTPUT

(a) Set the controls on the recorder to unity gain, as in Section 7.5.

(b) Apply an input signal at a level of +16 dBm.

The distortion introduced by the amplifier should be better than -54 dB from 30 Hz to 15 kHz.

7.8 CHECK GAIN; MICROPHONE TO OUTPUT

(a) Set the OUTPUT switch to REC, and the MIC gain control to maximum.

(b) Apply a 400 Hz signal at 100μ V from the 50Ω source.

Maximum output signal from the 600Ω OUTPUT jack should be greater than +16 dBm.

IMPORTANT: Ensure that no mains hum is introduced at the input.

7.9 CHECK FREQUENCY RESPONSE; MICROPHONE TO OUTPUT

With the conditions as in Section 7.8 vary the input signal frequency over the range 30 Hz to 15 kHz. Output signal level variations should not exceed ±1 dB from the 400 Hz reference level.

7.10 CHECK NOISE; MICROPHONE TO OUTPUT

(a) Set the MIC gain control to give +16 dBm output for an input signal level of 250μ V.

(b) Set the LINE gain control to zero.

The noise introduced from MICROPHONE input to the 600Ω OUTPUT jack should be below -40 dBm.

7.11 CHECK DISTORTION; MICROPHONE TO OUTPUT

Set the MIC gain control to give +16 dBm output for an input signal level of 15 mV.

The distortion introduced from MICROPHONE input to the 600Ω OUTPUT jack should be below -54 dB from 30 Hz to 15 kHz.

7.12 CHECK GAIN; MONITOR

(a) Set the METERING switch to VU

(b) Set the RECORD/PLAY/PRESAGE switch to RECORD

(c) Apply a 400 Hz signal of +8 dBm to the 600Ω INPUT jack and adjust the LINE gain control to give a reading of 0 VU on VU meter.

Check that the output signal at the 15Ω OUTPUT jack when terminated by an external 15Ω load is not less than 2 W (5.5 V) with the MONITOR gain set to maximum.

7.13 CHECK FREQUENCY RESPONSE; MONITOR

(a) Set the equipment as in Section 7.12.

(b) Vary the input signal frequency over the range 30 Hz to 15 kHz.

The output signal level variations should not exceed ±1 dB from the 400 Hz reference level.

7.14 CHECK NOISE; MONITOR

Set the MONITOR gain to maximum and the LINE and MIC gain controls to zero.

With no signal input, the noise introduced by the monitor amplifier should by less than -60 dB below 2 W (5.5 mV) in 15Ω.

7.15 CHECK DISTORTION; MONITOR

Set the equipment as in Section 7.12. The distortion introduced by the amplifier from the 600Ω INPUT jack to the 15Ω OUTPUT jack should be better than -46 dB at 400 Hz and -40 dB at 30 Hz to 15 kHz.

7.16 CHECK WOW AND FLUTTER

(a) Before checking wow and flutter, clean the pinch roller, the capstan shaft and the stabilizing roller with a recommended solvent.

(b) Use spools that are not distorted and a new reel of tape.

(c) Feed a 3 kHz signal at +8 dBm into the 600Ω INPUT jack.

(d) Set the OUTPUT switch to PLAY

(e) Select record mode and check that the output level is 8 dBm.

7.16 (continued)

(f) Feed the output signal into the wow and flutter meter and measure the wow and flutter.

Wow and flutter should be less than 0.15% r.m.s. at 7.5 i.p.s. and less than 0.12% r.m.s. at 15 i.p.s.

7.17 CHECK SPOOLING MOTOR BEARINGS

(a) Remove retaining knob and spool.

(b) To check the supply motor bearings procede as follows:

(i) Press the SPOOL switch

(ii) Turn the SPOOLING knob fully anti-clockwise to run the supply motor at full speed.

(iii) Manually hold off the brakes and press the STOP switch.

(iv) Measure the time for the motor to come to rest to be at least 10 seconds.

(c) To check the take-up motor bearings procede as follows:

(i) Press the SPOOL switch

(ii) Turn the SPOOLING knob fully clockwise to run the take-up motor at full speed.

(iii) Manually hold off the brakes and press the STOP switch.

(iv) Measure the time for the motor to come to rest to be at least 7 seconds.

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8. PARTS LISTS

8.1

MICROPHONE PRE-AMPLIFIER P.C.B. PARTS LIST
Part No. 33-4452

CAPACITORS

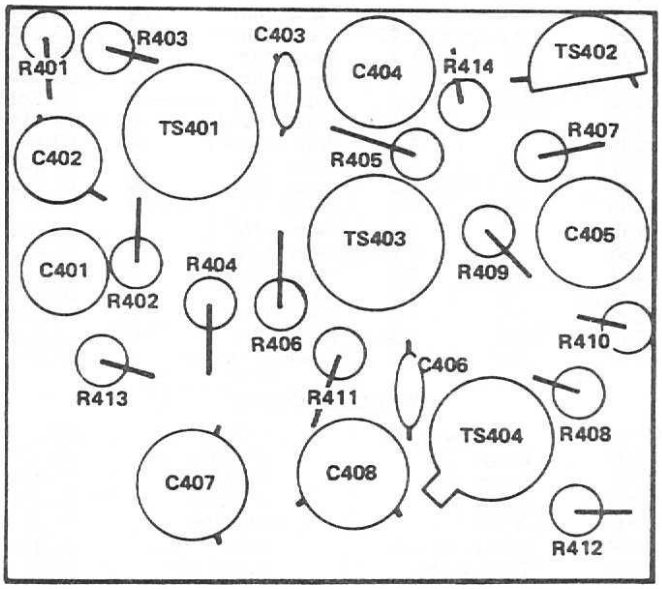
Comp.Ref.	Value	Type	V. Wkg.	Part No.
C401	1μ	Tag Tantalum	35	03-3908
C402	2μ2	Tag Tantalum	35	03-3711
C403	22p	Ceramic	50	25081
C404	100μ	Tag Tantalum	3	03-4531
C405	10μ	Tag Tantalum	25	03-3906
C406	680p	Disk Ceramic	630	03-3836
C407	10μ	Tag Tantalum	25	03-3906
C408	4μ7	Tag Tantalum	25	03-3708

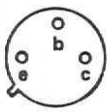
RESISTORS

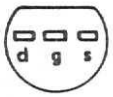
Comp.Ref	Value	Type	Rating(W)	Part No.
R401	2K2	Metal film MR	¼	03-3843
R402	33K	Metal film	¼	03-3992
R403	2K2	Metal film	¼	03-3843
R404	330K	Film	⅛	20125
R405	330K	Film	⅛	20125
R406	220	Metal film	¼	03-4430
R407	1M	Film	⅛	20006
R408	33K	Metal film	¼	03-3992
R409	100	Metal film	¼	03-3990
R410	8K2	Metal film	¼	03-4417
R411	10K	Metal film	¼	03-4418
R412	10K	Metal film	¼	03-4418
R413	4K7	Metal film	¼	03-3849
R414	1K2	Metal film	¼	03-3848

TRANSISTORS

Comp.Ref.	Type	Part No.
TS401	2N4250	03-2934
TS402	2N5486	03-4282
TS403	2N4250	03-2934
TS404	TT645	03-4513







C406 may be removed.

8.2

AMP & POWER SUPPLY PCB ASSY.
Part No. 33-4450

CAPACITORS

Comp.Ref.	Value	Type	V. Wkg.	Part No.
C200	1µ	Tag Tantalum	35	03-2747
C201	1µ	Tag Tantalum	35	03-2747
C202	15p	Disk Ceramic	50	03-4024
C203	10µ	Tag Tantalum	25	03-3906
C204	10p	Disk Ceramic		03-2435
C205	500µ	Electrolyte	35	03-3704
C207	1µ	Tag Tantalum	35	03-2747
C208	1µ	Tag Tantalum	35	03-2747
C210	33p	Disk Ceramic	50	03-3832
C211	10µ	Tag Tantalum	25	03-3906
C212	2500µ	Electrolytic	35	03-4405
C213	100n	Green Cap	100	26005
C214	100µ	Electrolytic	40	03-3407
C215	470p	Disk Ceramic	50	03-3171
C216	47p	Disk Ceramic	50	25161

POTENTIOMETER

Comp.Ref.	Value	Type	Part No.
R241	2k2	Trimpot Lin.	03-4378

RESISTORS

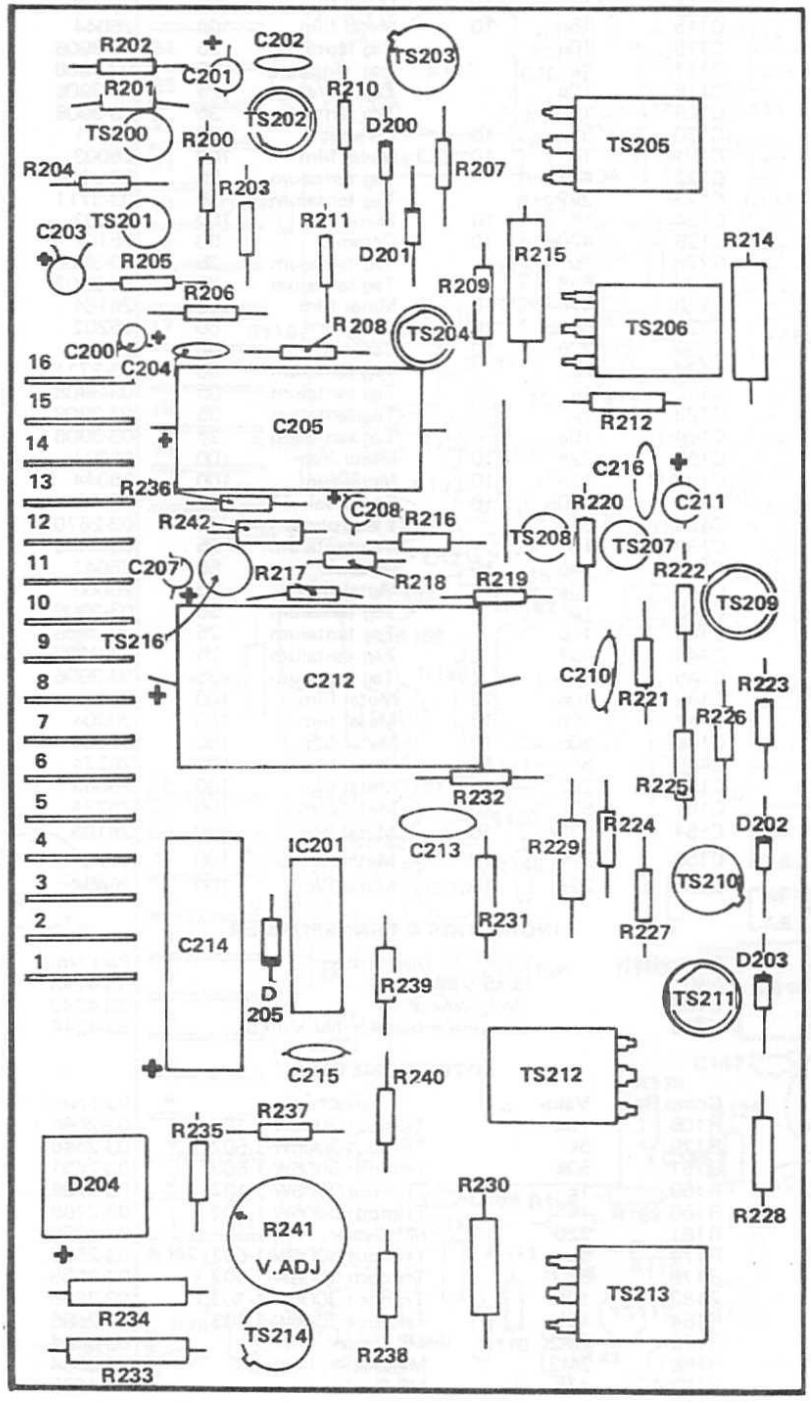
Comp.Ref.	Value	Tol. %	Type	Rating(w)	Part No.
R200	150k	± 2	Metal film	¼	03-4422
R201	180k	± 2	Metal film	¼	03-4423
R202	330k	± 2	Metal film	⅛	20125
R203	6k8	± 2	Metal film	¼	03-4416
R204	100k	± 2	Metal film	¼	03-4421
R205	2k2	± 2	Metal film	¼	03-3843
R206	68k	± 2	Metal film	¼	03-4419
R207	820	± 2	Metal film	¼	03-3851
R208	47k	± 2	Metal film	¼	03-3993
R209	1k2	± 2	Metal film	½	03-2363
R210	82	± 2	Metal film	¼	03-3840
R211	82	± 2	Metal film	¼	03-3840
R212	1k2	± 2	Metal film	½	03-2363
R214	100	± 2	Metal film	1	03-2477
R215	100	± 2	Metal film	1	03-2477
R216	82k	± 2	Metal film	¼	03-4420
R217	82k	± 2	Metal film	¼	03-4420
R218	10k	± 2	Metal film	¼	03-4418
R219	8k2	± 2	Metal film	¼	03-4417
R220	100k	± 2	Metal film	¼	03-4421
R221	47k	± 2	Metal film	¼	03-3993
R222	2k2	± 2	Metal film	¼	03-3843
R223	820	± 2	Metal film	¼	03-3851
R224	47k	± 2	Metal film	¼	03-3993
R225	1k2	± 2	Metal film	½	03-2363
R226	82	± 2	Metal film	¼	03-3840
R227	82	± 2	Metal film	¼	03-3840
R228	1k2	± 2	Metal film	¼	03-2363
R229	10	± 10	Wire wound	4	03-4485
R230	10	± 10	Wire wound	4	03-4485
R231	1k2	± 2	Metal film	¼	03-2363
R232	15	± 2	Metal film	¼	03-3996
R233	1Ω2	± 5	Bifilar	½	03-4478
R235	100	± 2	Metal film	¼	03-3990
R236	220k	± 2	Metal film	¼	03-4415
R237	10k	± 2	Metal film	¼	03-4418
R238	1k2	± 2	Metal film	½	03-2363
R239	3k3	± 2	Metal film	¼	03-3991
R240	3k3	± 2	Metal film	¼	03-3991
R242	2M2	± 5	Cracked carbon	½	03-0644

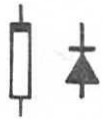
SEMI-CONDUCTORS

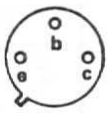
Comp.Ref.	Description	Type	Part No.
D200	Diode	AN2005	03-4002
D201	Diode	AN2005	03-4002
D202	Diode	AN2005	03-4002
D203	Diode	AN2005	03-4002
D204	Bridge rectifier	MB2	03-3975
D205	Zener diode	BZX70C20	03-4539
IC201	Voltage regulator	µA723C	03-3976
TS200	Transistor	2N4250	03-2934

SEMI-CONDUCTORS (cont'd.)

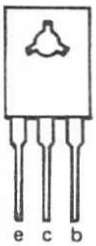
TS201	Transistor	2N4250	03-2934
TS202	Transistor	2N3568	03-2585
TS203	Transistor	2N3645	03-2906
TS204	Transistor	2N3568	03-2585
TS205	Transistor	MJE3055	03-3997
TS206	Transistor	MJE2955	03-3998
TS207	Transistor	2N4250	03-2934
TS208	Transistor	2N4250	03-2934
TS209	Transistor	2N3568	03-2585
TS210	Transistor	2N3645	03-2906
TS211	Transistor	2N3568	03-2585
TS212	Transistor	MJE3055	03-3997
TS213	Transistor	MJE2955	03-3998
TS214	Transistor	2N3645	03-2906
TS216	Transistor	2N4250	03-2934

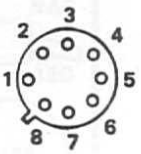






C210 may be removed.





8.3

RECORD–PLAY P.C.B. PARTS LIST
Part No. 33-4511

CAPACITORS

Comp.Ref.	Value	Tol. %	Type	V. Wkg.	Part No.
C101	1n2		Ceramic	50	25023
C102	1n	10	Styroseal	630	03-3874
C103	8n2	10	Styroseal	200	03-4027
C104	2n2	10	Styroseal	200	03-3439
C105	10n	10	Styroseal	200	03-3909
C106	2n2	10	Metal film	100	26083
C107	2n2	10	Metal film	100	26083
C108	100n	10	Metal film	100	26005
C109	100n	10	Metal film	100	26005
C110	22µ		Tag tantalum	25	03-3709
C111	25µ		Electrolytic	35	03-4504
C112	10µ		Tag tantalum	25	03-3906
C113	1µ		Tag tantalum	35	03-3908
C114	1n	10	Metal film	100	26003
C115	15n	10	Metal film	100	26044
C116	10µ		Tag tantalum	25	03-3906
C117	1µ		Tag tantalum	35	03-3908
C118	10µ		Tag tantalum	25	03-3906
C119	1µ		Tag tantalum	35	03-3908
C120	33p	10	Ceramic	50	25121
C121	1n	10	Metal film	100	26003
C122	4µ7		Tag tantalum	25	03-3708
C123	2µ2		Tag tantalum	35	03-3711
C124	1n	10	Metal film	100	26003
C125	470p	10	Ceramic	50	25162
C126	1µ		Tag tantalum	35	03-3908
C127	6µ8		Tag tantalum	35	03-3907
C128	47n	10	Metal film	100	26164
C129	680p	10	Ceramic	50	25202
C130	22p	10	Ceramic	50	25081
C131	2µ2		Tag tantalum	35	03-3711
C132	1µ		Tag tantalum	35	03-3908
C133	1µ		Tag tantalum	35	03-3908
C134	10µ		Tag tantalum	25	03-3906
C135	22n	10	Metal film	100	26084
C136	15n	10	Metal film	100	26044
C137	680p	10	Styroseal	100	03-4044
C138	32µ		Electrolytic	40	03-2670
C139	1µ		Tag tantalum	35	03-3908
C140	15p	10	Ceramic	50	25041
C141	10µ	10	Metal film	25	26003
C142	1µ		Tag tantalum	35	03-3908
C143	10µ		Tag tantalum	25	03-3906
C144	4µ7		Tag tantalum	25	03-3708
C145	10µ		Tag tantalum	25	03-3906
C146	10n	10	Metal film	100	26004
C147	10n	10	Metal film	100	26004
C148	10n	10	Metal film	100	26004
C149	82n	10	Metal film	100	26224
C150	2n2	10	Metal film	100	26083
C151	82n	10	Metal film	100	26224
C154	270n	10	Metal film	200	26105
C155	10n	10	Metal film	100	26004
C156	22n	10	Metal film	100	26084

INDUCTORS & TRANSFORMER

Comp.Ref.	Description	Part No.
L101	3m5 Vinkor	33-4243
L102	3m5 Vinkor	33-4243
L103	Bias/erase transformer Vinkor	33-4244

POTENTIOMETERS

Comp.Ref.	Value	Description	Part No.
R105	10k	Trimpot 3006W-1-103	03-2686
R129	5k	Trimpot 3006W-1-502	03-2588
R151	50k	Trimpot 3006W-1-503	03-2431
R159	1k	Trimpot 3006W-1-102	03-2788
R160	1k	Trimpot 3006W-1-102	03-2788
R161	220	MP Dealer, lin.	03-4376
R174	5k	Trimpot 3006W-1-502	03-2588
R176	5k	Trimpot 3006W-1-502	03-2588
R183	10k	Trimpot 3006W-1-103	03-2686
R184	10k	Trimpot 3006W-1-103	03-2686
R185	2M2	MP Dealer, lin.	03-3984
R186	2M2	MP Dealer, lin.	03-3984
R187	47k	MP Dealer, lin.	03-4295

RELAY

Comp.Ref.	Description	Part No.
A	V23012 A0114-A004	03-4496
B	V23012 A0114-A004	03-4496

RESISTORS

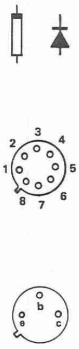
Comp.Ref.	Value	Tol. %	Type	Rating (watts)	Part No.
R101	1k	2	Metal film	¼	03-3846
R102	2k2	2	Metal film	¼	03-3843
R103	10k	2	Metal film	¼	03-4418
R104	22k	2	Metal film	¼	03-4425
R106	100k	2	Metal film	¼	03-4421
R107	100k	2	Metal film	¼	03-4421
R108	680	2	Metal film	¼	03-4410
R109	220	2	Metal film	½	03-2370
R110	82	5	Wire wound	5	02-3948
R111	22k	2	Metal film	¼	03-4425
R112	2k2	2	Metal film	½	03-2302
R113	1k	2	Metal film	¼	03-3846
R114	5k6	2	Metal film	¼	03-4412
R115	47k	2	Metal film	¼	03-3993
R116	220	2	Metal film	¼	03-4430
R117	1k	2	Metal film	¼	03-3846
R118	1k5	2	Metal film	¼	03-3847
R119	22k	2	Metal film	¼	03-4425
R120	180	2	Metal film	¼	03-4501
R121	47k	2	Metal film	¼	03-3993
R122	6k8	2	Metal film	¼	03-4416
R123	300k	2	Metal film	¼	03-4503
R124	2k7	2	Metal film	¼	03-4411
R125	270k	2	Metal film	¼	03-4502
R126	4k7	2	Metal film	¼	03-3849
R127	18k	2	Metal film	¼	03-4413
R128	82	2	Metal film	¼	03-3840
R130	4k7	2	Metal film	¼	03-3849
R131	10k	2	Metal film	¼	03-4418
R132	100k	2	Metal film	¼	03-4421
R133	82k	2	Metal film	¼	03-4420
R134	15k	2	Metal film	¼	03-4426
R135	10k	2	Metal film	¼	03-4418
R136	10k	2	Metal film	¼	03-4418
R137	10k	2	Metal film	¼	03-4418
R138	47k	2	Metal film	¼	03-3993
R139	47k	2	Metal film	¼	03-3993
R140	1k	2	Metal film	¼	03-3846
R141	3k3	2	Metal film	¼	03-3991
R142	6k8	2	Metal film	¼	03-4416
R143	15k	2	Metal film	¼	03-4426
R144	15k	2	Metal film	¼	03-4426
R145	100k	2	Metal film	¼	03-4421
R146	100k	2	Metal film	¼	03-4421
R147	1M5	5	Carbon	½	03-0624
R148	1k5	2	Metal film	¼	03-3847
R149	220	2	Metal film	½	03-2370
R150	390k	5	Film	⅛	20145
R152	100k	2	Metal film	¼	03-4421
R153	10k	2	Metal film	¼	03-4418
R154	100k	2	Metal film	¼	03-4421
R155	68k	2	Metal film	¼	03-4419
R156	470k	5	Film	⅛	20165
R157	100	2	Metal film	¼	03-3990
R158	1k	2	Metal film	½	03-2296
R162	100	2	Metal film	½	03-2294
R163	100k	2	Metal film	¼	03-4421
R164	1k	2	Metal film	¼	03-3846
R165	100k	2	Metal film	¼	03-4421
R166	300k	2	Metal film	¼	03-4503
R167	330	2	Metal film	¼	03-4409
R168	100k	2	Metal film	¼	03-4421
R169	1M	5	Film	⅛	20006
R170	2k7	2	Metal film	¼	03-4411
R171	4k7	2	Metal film	¼	03-3849
R172	18k	2	Metal film	¼	03-4413
R173	82	2	Metal film	¼	03-3840
R175	4k7	2	Metal film	¼	03-3849
R177	4k7	2	Metal film	¼	03-3849
R178	4k7	2	Metal film	¼	03-3849
R179	390k	5	Film	⅛	20145
R180	680	2	Metal film	¼	03-4410
R181	5k6	2	Metal film	¼	03-4412

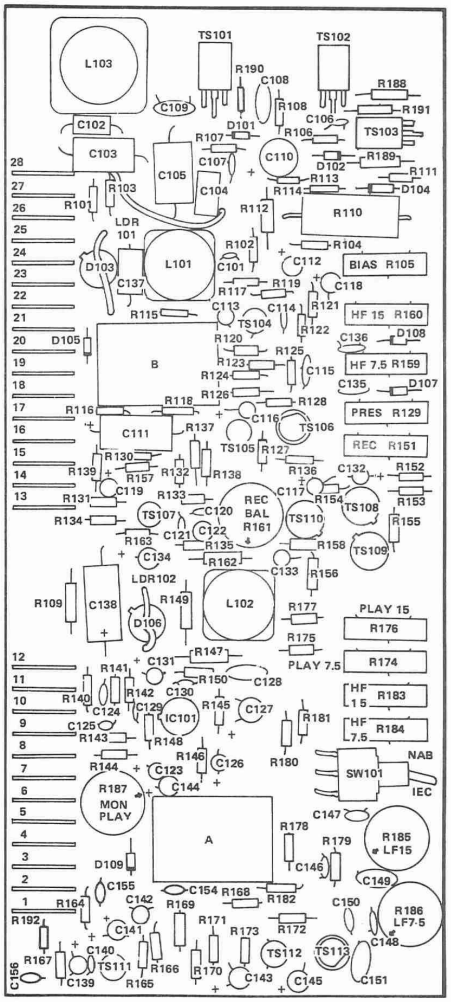
RESISTORS (con't)

R182	4k7	2	Metal film	¼	03-3849
R188	15	2	Metal film	½	03-3996
R189	15	2	Metal film	½	03-3996
R190	180	2	Metal film	¼	03-4501
R191	180	2	Metal film	¼	03-4501
R192	68	2	Metal film	¼	03-4520

SEMI CONDUCTORS

Comp.Ref.	Description	Type	Part No.
D101	Diode	AN2001	03-3902
D102	Diode	AN2001	03-3902
D103	Light-emitting diode	MV10C	03-4499
D104	Zener diode	BZY88C6V8	03-3761
D105	Diode	AN2001	03-3902
D106	Light-emitting diode	MV10C	03-4499
D107	Diode	AN2001	03-3902
D108	Diode	AN2001	03-3902
D109	Diode	AN2001	03-3902
IC101	Integrated circuit	μA709C	03-4498
LDR101	Light-dependant resistor	MKB5H38	03-4475
LDR102	Light-dependant resistor	MKB5H69	03-4525
TS101	Transistor	BD139	03-4497
TS102	Transistor	BD139	03-4497
TS103	Transistor	BD135	03-4527
TS104	Transistor	2N4250	03-3581
TS105	Transistor	2N4250	03-3581
TS106	Transistor	2N3638	03-2419
TS107	Transistor	2N4250	03-3581
TS108	Transistor	2N3645	03-2906
TS109	Transistor	2N3645	03-2906
TS110	Transistor	2N3645	03-2906
TS111	Transistor	2N4250	03-3581
TS112	Transistor	2N4250	03-3581
TS113	Transistor	2N3638	03-2419





R167 may be slected in the range 220Ω to 390Ω.

8.4

AMPLIFIER ASSY. COMPLETE
Part No. 01-0222

CAPACITORS

Comp.Ref.	Value	Tol.%	Type	V.Wkg.	Part No.
C601	2200μ		Elna Type RG	63	03-4038
C602	2200μ		Elna Type RG	63	03-4038
C603	680p		Styroseal	100	03-4044
C604	10n	±20	Disk Ceramic		26004

POTENTIOMETERS

Comp.Ref.	Value	Type	Part No.
R601	10k	LOG TYPE E ¾" shaft	03-4217
R602	100k	LOG TYPE E ¾" shaft	03-3485
R605	10k	LOG TYPE E ¾" shaft	03-4217
R606 } R607	2x10k	DOUBLE GANGED LOG ¾" shaft	03-4419

RESISTORS

Comp.Ref.	Value	Tol. %	Type	Rating(w)	Part No.
R603	1k	± 2	Metal film	1	03-2492
R604	1k2	± 2	Metal film	½	03-2663
R608	56k	± 2	Metal film	¼	03-4454
R609	1k	± 2	Metal film	¼	03-3846

SEMI-CONDUCTOR

Comp.Ref.	Type	Part No.
TS601	Transistor MJE 2955	03-3998

SWITCHES

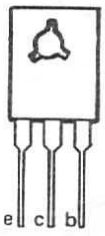
Comp.Ref.	Type	Part No.
SW601	Oak Switch F3 Pos 2 pole 1 sect	03-4004
SW602	Switch C & K Toggle SPTT	03-4488
SW603	Switch C & K Toggle SPDT	03-4490
SW604	Oak Switch F5 Pos 2 pole 1 sect	03-4003

TRANSFORMERS

Comp.Ref.	Type	Part No.
T601	Input Transformer TA17A Case 1239	03-4489
T602	Mic Transformer RDR94	03-4007
T603	Output Transformer EC235	03-3940
T604	Mains Transformer EC252	03-4006

SUNDRY

Comp.Ref.	Type	Part No.
	VU Meter Mod FB30A	03-4005
LS1	Loudspeaker 62900 8 ohm	03-4010
LS2	Loudspeaker 62900 8 ohm	03-4010



8.5 CONTROLS PCB ASSY.
Part No. 33-4448

CAPACITORS

Comp.Ref.	Value	Type	Tol.%	V.Wkg.	Part No.
C4/8/9/12 /13/16/17	250n	C &R unit (200 ohm)		250	03-4223
C5	470n	Capacitor	20	200	26165
C6	32μ	Capacitor - Electrolytic		64	03-2668
C19/20/21 /22/23/24	100n	Capacitor	20	250	03-4214
C25	220μ	Electrolytic		50	03-4540

RELAY

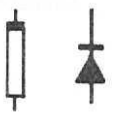
Comp.Ref.	Type	Part No.
E, FS, P, PA, PT, R, S, SP	Relay V23154-D0726-F104	03-2993

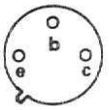
RESISTORS

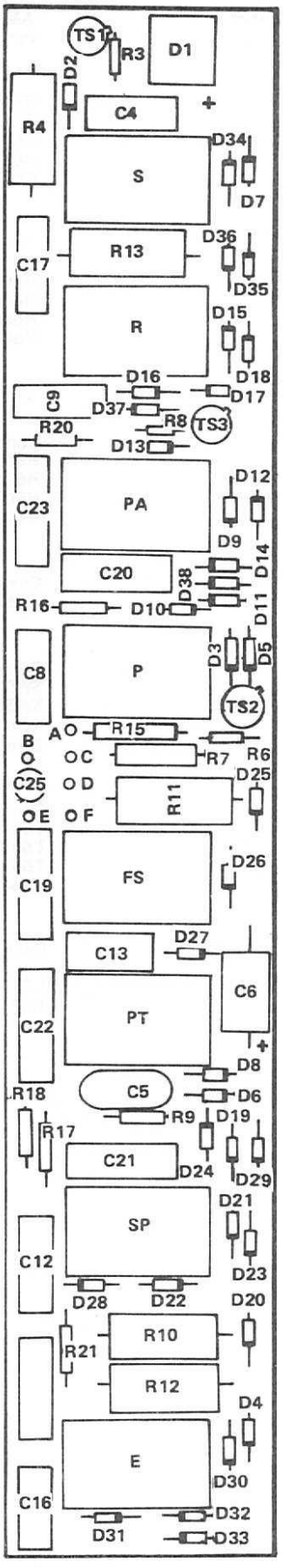
Comp.Ref.	Value (ohm)	Type	Tol.%	Rating (W)	Part No.
R3	1k	Metal film	±2	¼	03-3846
R4/10/11 /12/13	1k5	PW5	±5	5	03-1291
R6, 8	22k	Metal film	±2	¼	03-4425
R7	220	Metal film	±2	1	03-3756
R9	100	Metal film	±2	½	03-3219
R15	560	Metal film	±2	1	03-2931
R16/17/18 /20/21	220	Metal film	±2	½	03-2370
R35	1k	Metal film	±2	¼	03-3846

SEMI-CONDUCTORS

Comp.Ref.	Type	Part No.
D1	Rectifier MB2	03-3975
D2 to D38	Diode EM402	03-3544
TS1	Transistor AY8140	03-4372
TS2/3	Transistor TT3645	03-4192







CONTROL BOX ASSY. PARTS LIST
Part No. 22-5194

CAPACITORS

Comp. Ref.	Value	Tol. %	Type	V. Wkg.	Part No.
C1	250η		C & R Unit (200 ohm)	250	03-4223
C2	250η		C & R Unit (200 ohm)	250	03-4223
C3	250η		C & R Unit (200 ohm)	250	03-4223
C7	2200μ		Electrolytic	63	03-4038
C10	2μ	±5	Block Type 3520	400	03-0969
C11	500η	±10	Block Type 2505	400	03-4023
C14	1μ25	±5	Block Type 3512B	600	03-0962
C15	1μ25	±5	Block Type 3512B	600	03-0962

FUSES

Comp. Ref.	Value	Type	Part No.
F1	1 A	FN1 Slow Blow	03-4020
F2	1 A	FN1 Slow Blow	03-4020
F3	2 A	FN1 Slow Blow	03-4022
F4	315 mA	FN1 Slow Blow	03-4021

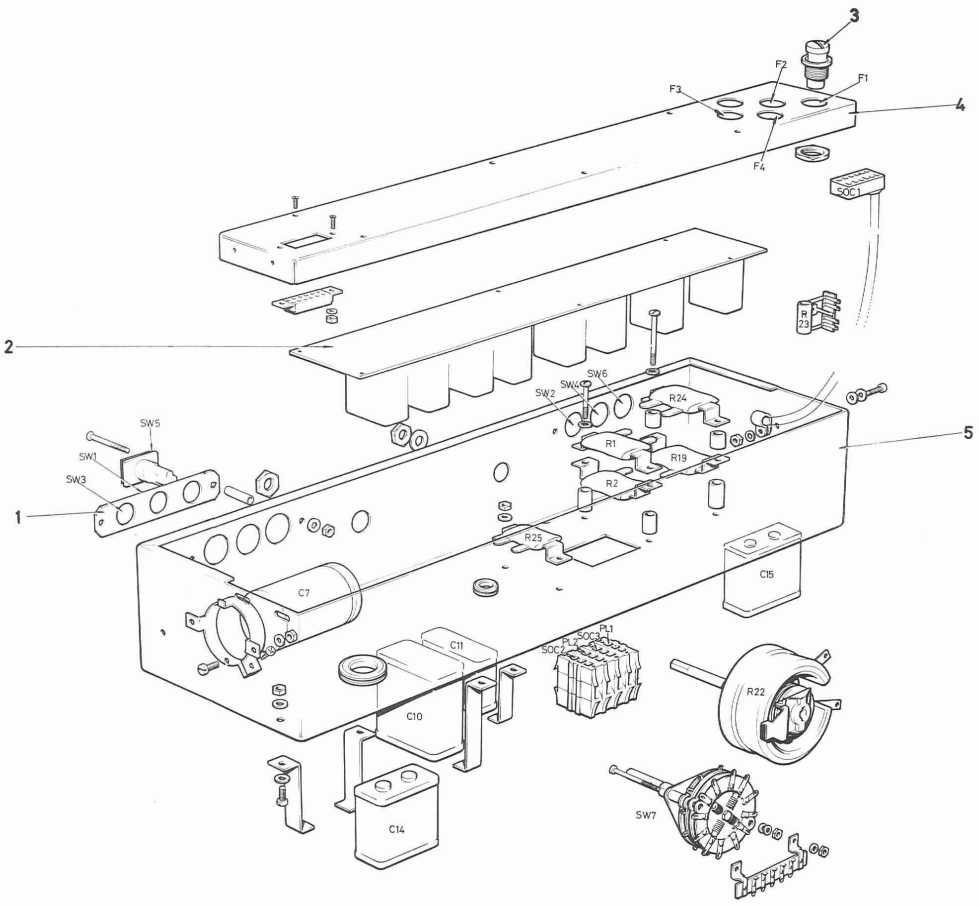
RESISTORS

Comp. Ref.	Value	Tol. %	Type	Rating(W)	Part No.
R1	100	±5	RS1 RECO	20	03-3777
R2	100	±5	RS1 RECO	20	03-3777
R19	1k8	±5	RS1 RECO	20	03-3773
R22	3k5		MALLORY	50	03-0833
R23	100	±5	PW5	5	03-0789
R24	680	±5	RS1 RECO	20	03-3774
R25	250	±5	RS1 RECO	20	03-3776

SUNDRY

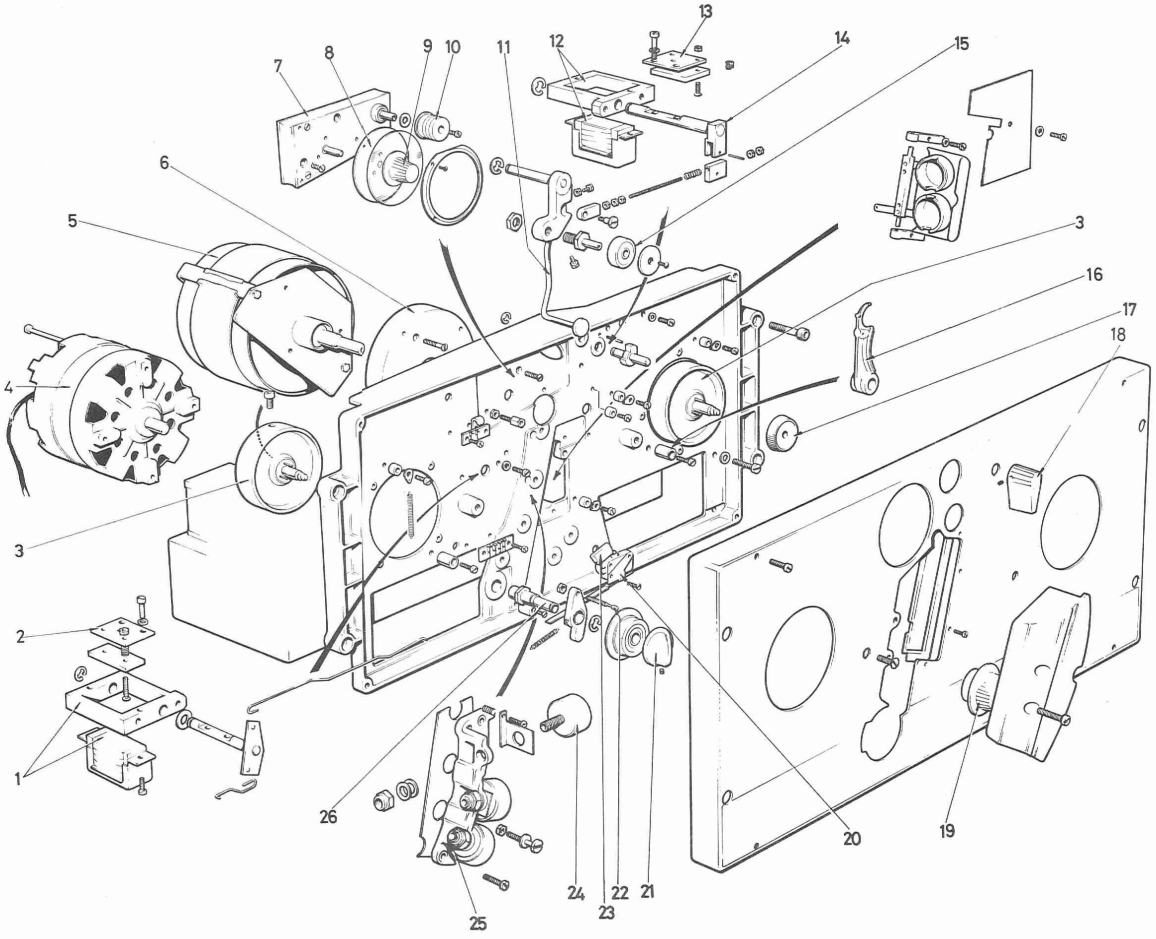
Comp. Ref.		Part No.
PL1	ELCO CONNECTOR RED PLUG 60/6501/34/18/00174	03-4016
PL2	ELCO CONNECTOR RED PLUG 60/6501/34/18/00174	03-4016
PL4	PLUG, 11-PIN 74/10/1101/10	03-4008
SW1	SWITCH ASTROL TYPE 01-121 (GREEN SCREEN)	03-3275
SW2	SWITCH ASTROL TYPE 01-121 (BLUE SCREEN)	03-3967
SW3	SWITCH ASTROL TYPE 01-121 (AMBER SCREEN)	03-4528
SW4	SWITCH ASTROL TYPE 01-121 (YELLOW SCREEN)	03-4524
SW5	SWITCH ASTROL TYPE 01-121 (RED SCREEN)	03-3966
SW6	SWITCH ASTROL TYPE 01-121 (WHITE SCREEN)	03-3698
SW7	SPEED SWITCH ASSY	33-4259
SOC1	SOCKET,	03-4492
SOC2	ELCO CONNECTOR WHITE SOCKET 60/6501/33/18/00/169	03-4013
SOC 3	ELCO CONNECTOR WHITE SOCKET 60/6501/33/18/00/169	03-4013
SOC 4	SOCKET, 11-PIN 74/10/1155/10	03-4009

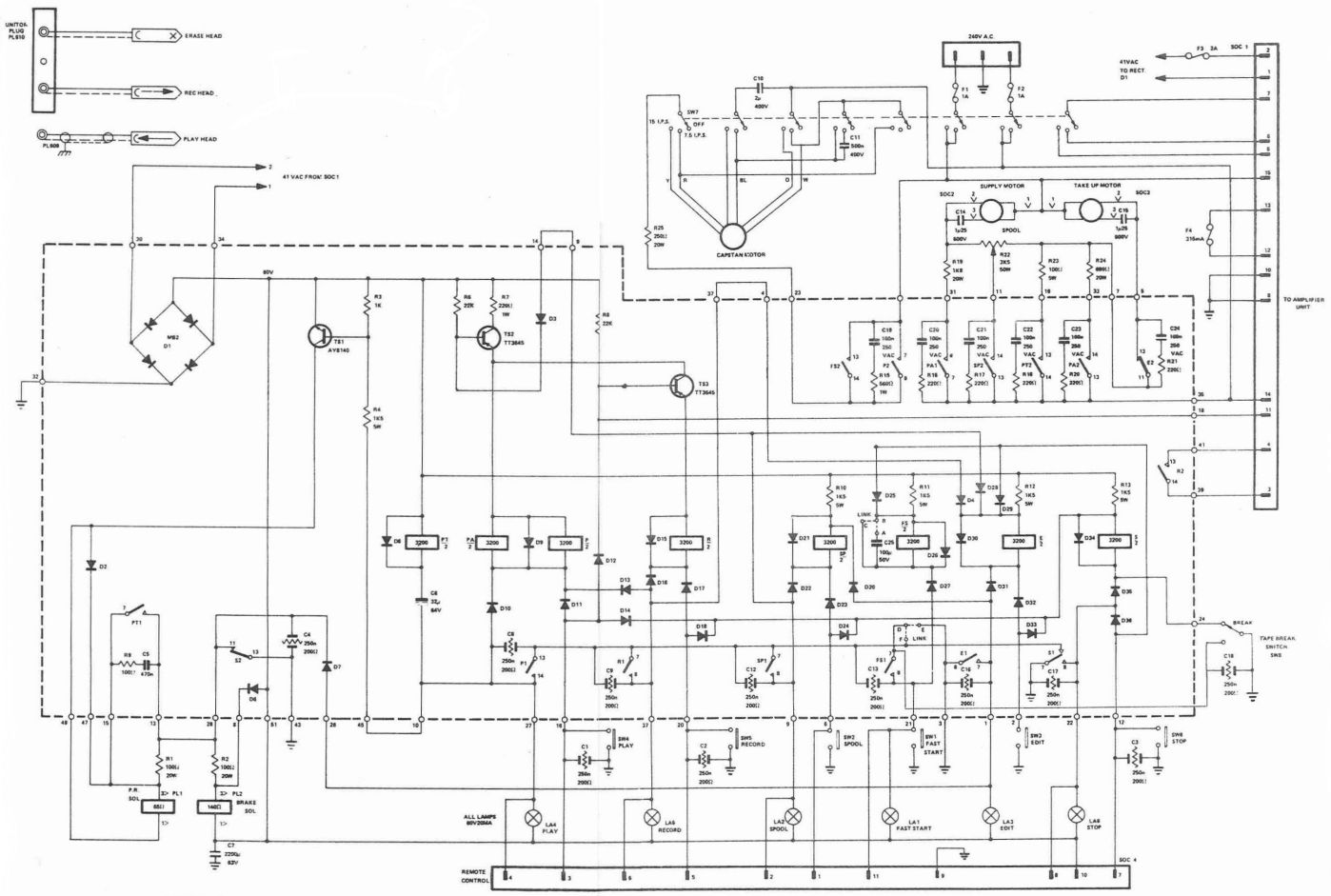
Item	Description	Part No.
1	Pushbutton mounting plate	02-5013
2	Control P.C.B. Assy	33-4448
3	Fuse holder	03-4012
4	Rear panel	02-5196
5	Chassis	025197



TAPE DECK ASSY.
Part No. 01-0221

Item	Description	Part No.
1	Brake solenoid coil and frame assy.	33-4245
2	Brake solenoid armature	22-2580
3	Brake drum	22-0847
4	Spooling motor	22-5187
5	Capstan motor	22-4682
6	Adaptor ring	02-4674
7	Timer mechanism	02-1426
8	Scale	02-5076
9	Knob and cursor assy.	22-5186
10	Timing roller	22-1364
11	Tape lift arm	02-1417
12	P.R. solenoid coil and frame assy.	33-4246
13	P.R. solenoid armature	22-2576
14	P.R. solenoid shaft	22-1405
15	Pinch roller	22-4719
16	Brake shoe	22-0861
17	Spool retaining knob	22-0886
18	Headshield knob	22-5191
19	Spooling knob	22-5170
20	Tape break switch (SW8)	03-1497
21	Speed change knob	02-0648
22	Tape tension pin	02-1398
23	CR unit 250n 200Ω (C18)	03-4223
24	Head can assy.	22-1491
25	Triple head assy.	33-4247
26	Tape tension arm	22-1513





NOTE. ALL RESISTORS ½W UNLESS OTHERWISE INDICATED

ALL DIODES TYPE EM402

FIGURE 1 TAPE DECK CIRCUIT DIAGRAM

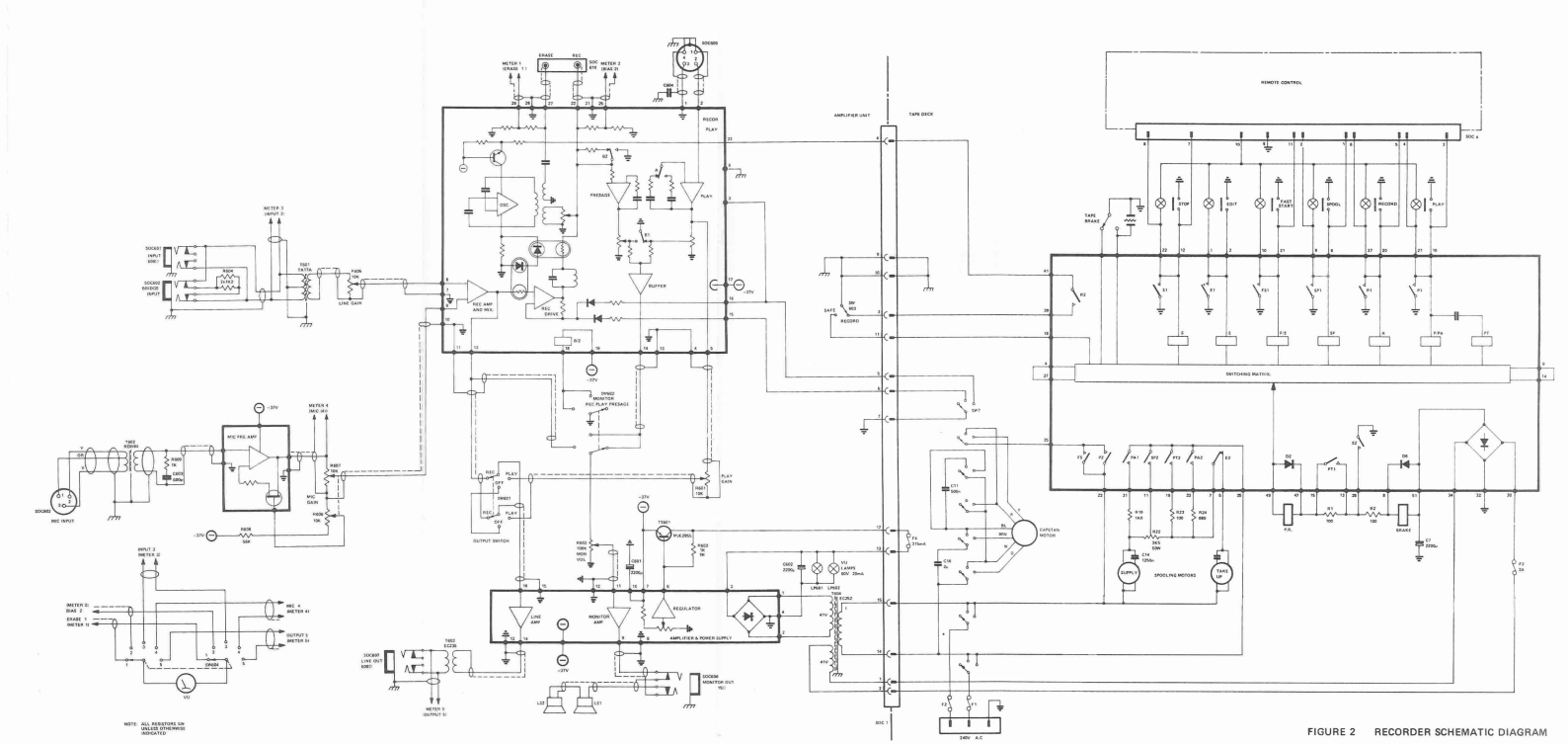


FIGURE 2 RECORDER SCHEMATIC DIAGRAM

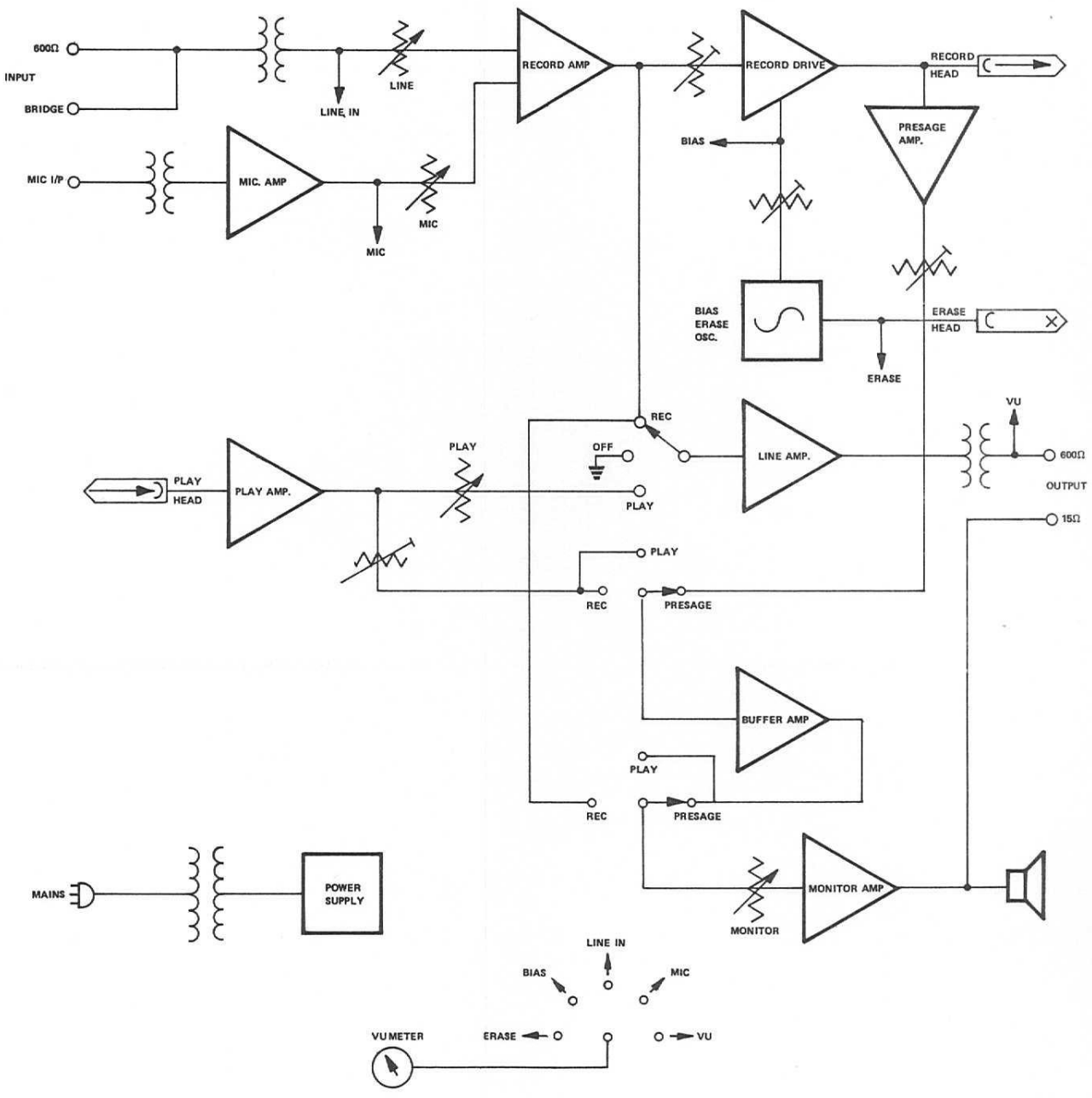


FIGURE 3 AMPLIFIER UNIT SIMPLIFIED BLOCK DIAGRAM

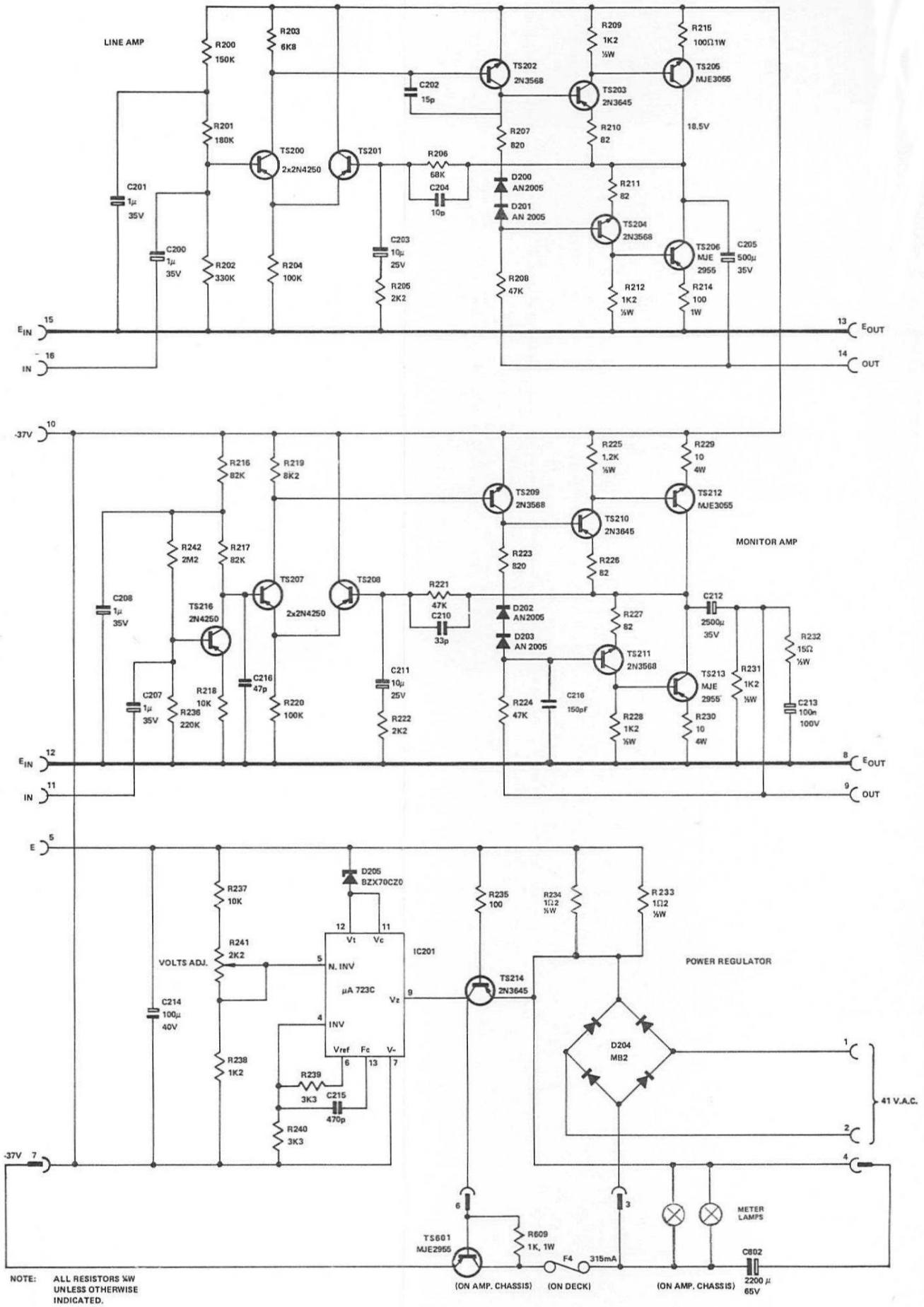
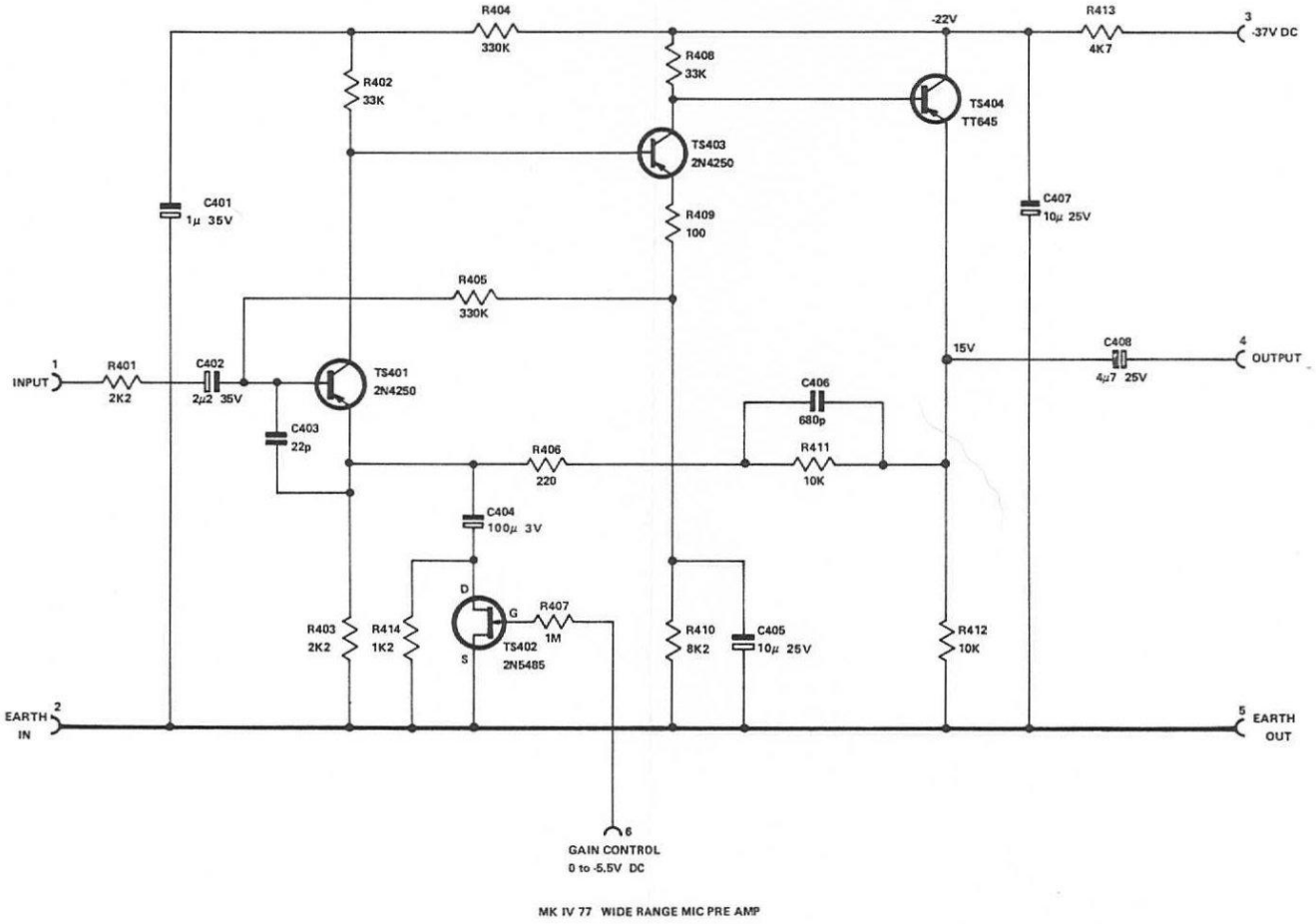


FIGURE 4 AMPLIFIERS AND POWER SUPPLY CIRCUIT DIAGRAM



MK IV 77 WIDE RANGE MIC PRE AMP

FIGURE 5 MICROPHONE PRE-AMPLIFIER CIRCUIT DIAGRAM

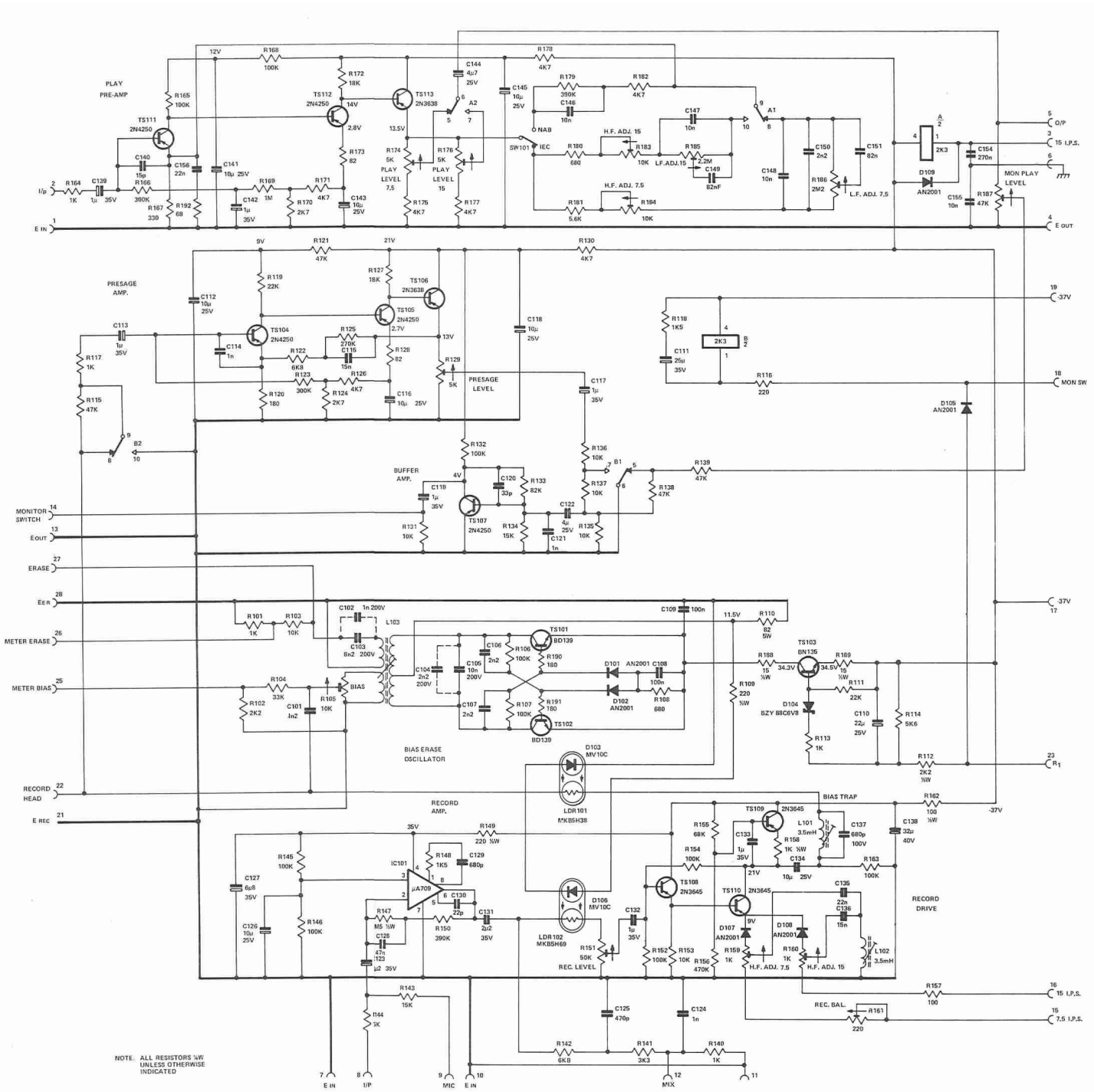


FIGURE 6 RECORD–PLAY CIRCUIT DIAGRAM