MAINTENANCE MANUAL

FERROGRAPH
SERIES SEVEN

FERROGRAPH SERIES SEVEN

The Company reserve the right to modify designs and specifications without prior notice, in pursuance of a policy of continuous technical improvement.

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A - Introduction

101 Apart from changes in head line-up and duplication of printed circuit boards in stereophonic models, Series Seven systems are basically identical and consequently one manual covers the whole range.

102 The recorder consists of three main assemblies, a tape deck, which is common to the whole range (except for the head block), an amplifier, and a power unit. Tape deck component parts are mounted on an aluminium chassis, which is resiliently mounted on the main cross frames forming the body of the recorder. Amplifier and power units are also clamped to the main framework and linked electrically to the tape deck and each other by plug and socket connections.

103 The 722 model stereophonic recorder is the most comprehensive and for this reason other models are related to it as shown in the following table:

Note: Models with a suffix A require a 117 volt 60 Hz a.c. power supply and all others a 200/250 volt 50 Hz a.c. supply.

104 **Table of Differences**

Model No.	*System*	*Track*	*Tape Speed In/Sec*	*Tape Speed Cm/Sec*	
713	Mono	Half	$7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$	19, 9·5, 4·75	Single channel half-track system only, each has two speakers connected to a single power output stage.
713H	Mono	Half	15, $7\frac{1}{2}$, $3\frac{3}{4}$	38, 19, 9·5	
702	Stereo	Half	$7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$	19, 9·5, 4·75	Half-track stereo version of 722, with output stage replaced by low-level output of up to 300mV into 10 kohms or greater.
702H	Stereo	Half	15, $7\frac{1}{2}$, $3\frac{3}{4}$	38, 19, 9·5	
704	Stereo	Quarter	$7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$	19, 9·5, 4·75	Quarter-track version of 722, with output stage replaced by low level outputs of up to 300 mV into 10 kohms or greater.

Model No.	*System*	*Track*	*Tape Speed In/Sec*	*Tape Speed Cm/Sec*	
722	Stereo	Half	7½, 3¾, 1⅞	19, 9·5, 4·75	Half track stereo system with 10 watt output on each channel. A transfer switch is fitted for special effects.
722H	Stereo	Half	15, 7½, 3¾	38, 19, 9·5	
724	Stereo	Quarter	7½, 3¾, 1⅞	19, 9·5, 4·75	Quarter track version of 722.

B - Specification

105 **Recording Medium**

Magnetic tape $\frac{1}{4}$ in. (6·3 mm) wide on reels of up to $8\frac{1}{4}$ in. (210 mm) dia.

Track Width

$\frac{1}{2}$ track 0·090 in. (2·3 mm) :
$\frac{1}{4}$ track 0·043 in. (1·1 mm).

Head Gap Width

Record head — 250 μ in. (6·3μ) : Replay head — 80 μ in. (2μ).

Operating Tape Speed

Three (3) :		$7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ in/sec. (19, 9·5, 4·75 cm/sec)
	Suffix H	15, $7\frac{1}{2}$, $3\frac{3}{4}$ in sec. (38, 19, 9·5 cm/sec)

Tape Speed Accuracy

Better than ± 1% (at specified supply frequency).

Playing Time Per Track

2,400 ft. (720 m) of tape :	1 hr. 4 min. at $7\frac{1}{2}$ in/sec. (19 cm/sec.)
	2 hr. 8 min. at $3\frac{3}{4}$ in/sec. (9·5 cm/sec.)

Fast Wind Time

Continuously variable in either direction : at fast speed less than 1 min. for 1,200 ft. (360 m.) of tape.

"Wow" and "Flutter"

Less than	0·08% at $7\frac{1}{2}$ in/sec. (19 cm/sec).
	0·15% at $3\frac{3}{4}$ in/sec. (9·5 cm/sec).
	0·20% at $1\frac{7}{8}$ in/sec. (4·75 cm/sec).

High Speed Models (Suffix H)

Less than	0·08% at 15 in/sec. (38 cm/sec).
	0·10% at $7\frac{1}{2}$ in/sec. (19 cm/sec).
	0·15% at $3\frac{3}{4}$ in/sec. (9·5 cm/sec).

Frequency Response

Record-Replay, using Long Play Ferrotape type B :

15 in/sec. (38 cm/sec.)	: 30-20,000Hz ± 2dB
$7\frac{1}{2}$ in/sec. (19 cm/sec.)	: 30-17,000Hz ± 2dB
$3\frac{3}{4}$ in/sec. (9·5 cm/sec.)	: 40-14,000Hz ± 3dB
$1\frac{7}{8}$ in/sec. (4·75 cm/sec.)	: 50- 7,000Hz ± 3dB

Replay Characteristic	D.I.N.	N.A.B. (117v models)
15 in/sec. (38 cm/sec.)	: 35μsec.	: 50μsec.
$7\frac{1}{2}$ in/sec. (19 cm/sec.)	: 50/3180μsec.	: 50/3180μsec.
$3\frac{3}{4}$ in/sec. (9·5 cm/sec.)	: 90/3180μsec.	: 90/3180μsec.
$1\frac{7}{8}$ in/sec. (4·75 cm/sec.)	: 120/1590μsec.	: 120/3180μsec.

Maximum Output (per channel)

10 Watts R.M.S. into 8-16 ohm loudspeaker.

Amplifier Distortion

Less than 0·25% R.M.S. at all levels up to 10 Watts.

Signal to Noise Ratio (at 7½in/sec (19 cm/sec))
Unweighted, including hum, better than 55dB — ref 2% distortion.
Weighted (C.C.I.F.), better than 60dB (¼ track — 58 dB)

Bass Control
Continuously variable up to ± 15dB at 50Hz. ± 20dB at 20 Hz.

Treble Control
Continuously variable up to ± 10dB at 10kHz, ± 15dB at 20kHz

Internal Loudspeakers
Two (2) — elliptical 7 in. x 4 in. (180 mm. x 100 mm.)

Input Level (for full depth recording)
Microphone: 150μV-15mV at 10K Ω, Recommended Source: 250-2,000 Ω
Line: 75mV-10V at 2M Ω Recommended Source: any impedance.
Later Models (*see Parts Lists — Record Board*)
Microphone: 300μV-15mV at 10K Ω, Recommended Source: 250-2,000 Ω
Line: 50mV-10V at 2M Ω Recommended Source: any impedance.

Output (from full amplitude recording)
600 ohms: 2V at 600 ohms.
Low Level: 300mV into 10K ohms or greater.
*Loudspeaker: up to 10 Watts R.M.S. into 8-16 ohms.

Power Supply
200-250V, 50Hz; Suffix A: 117V, 60Hz.

Power Consumption
100 Watts approximately.

Channel Separation (Stereo Models Only)
Stereo operation — approx. 50dB:
Mono operation — better than 65dB at 1000Hz.

Overall Dimensions (with lid)
16¾ in. wide x 17½ in. x 10 in. (425 mm. wide x 445 mm. x 255 mm.)

Weight
49½ lbs. (22,5 kgm)

Alternative Models
Suffix P. Portable wood case, leather-cloth covered, with lid.
Suffix W. Wooden case, natural wood finish.
Suffix S. Uncased version.
Suffix R. Rack mounting version.

*On Models 702 and 704, this output is replaced by:—
Low Level Adjustable: up to 300 mV into 10K ohms or greater.

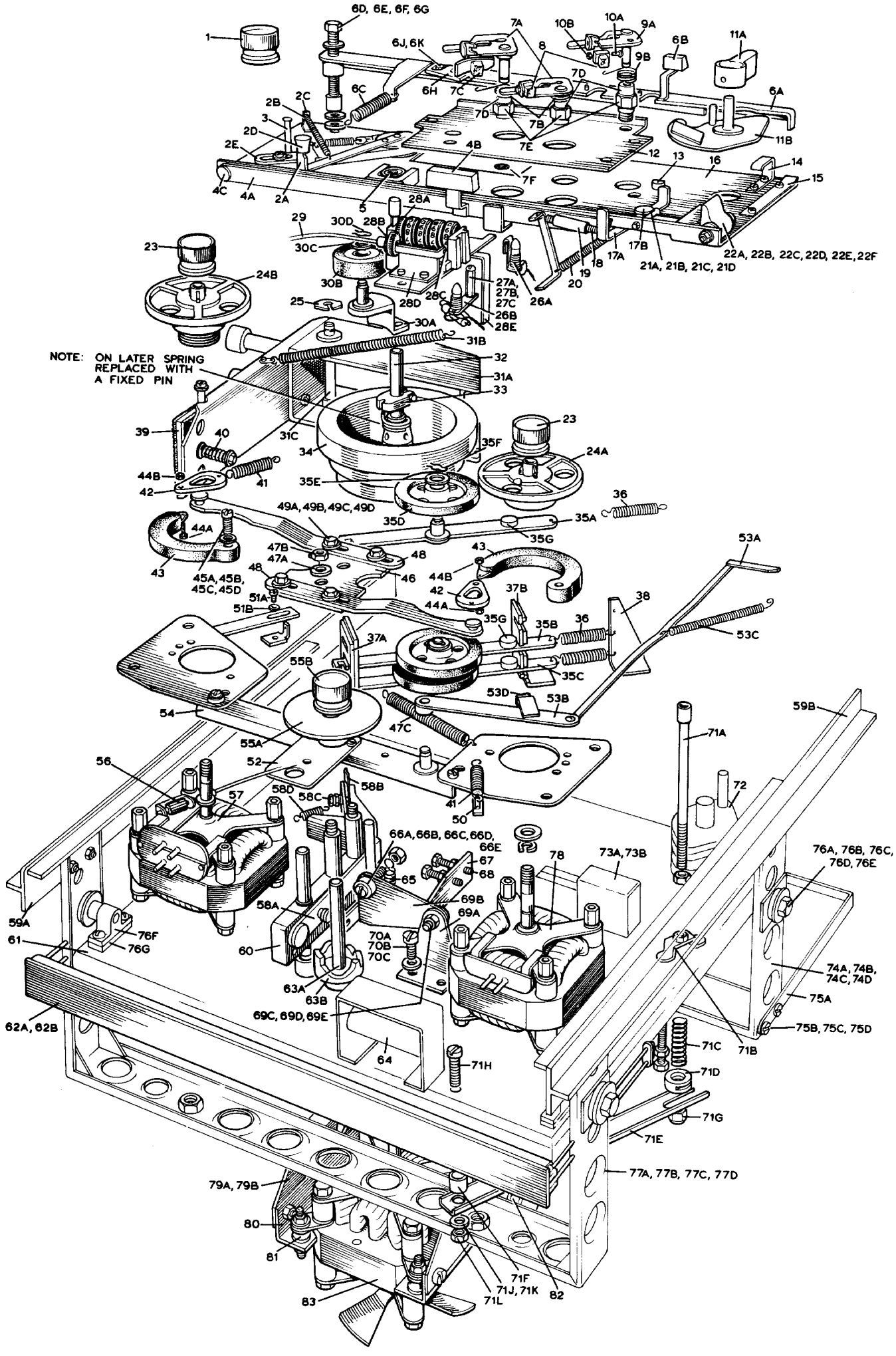
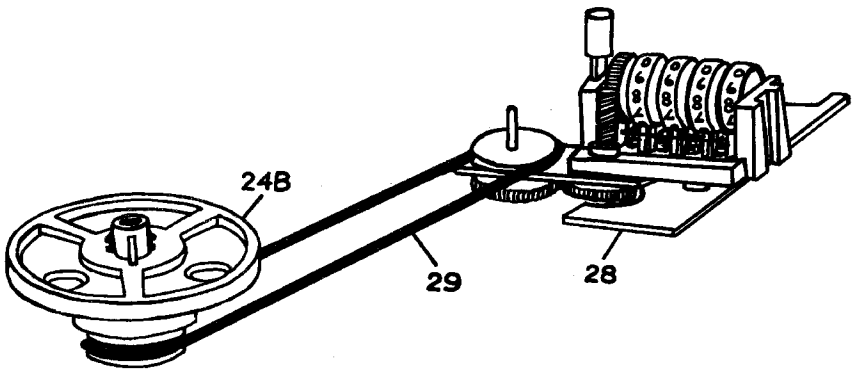


FIG. 1. EXPLODED VIEW OF TAPE-DECK (PARTS LIST IDENTIFICATION)

Paras. 108 & 132 **Serial No. 78,300 onwards**

The turns counter mechanism is belt driven from a pulley on the underside of the take-up reel carrier.



MODIFICATION NOTE No. 1
Serial No. 78,300 onwards

C - Tape deck operation

General (Fig. 8)

106 The main body of the tape deck is constructed on an $\frac{1}{8}$ in. (3·2 mm.) aluminium chassis which supports the solenoids, motors and tape drive mechanism. The fore part of the chassis has a raised platform, normally covered by a deck control panel, which supports a function switch, head assembly, pressure pad assembly, pinch roller and *Fast Wind* and *Record* controls. Between platform and chassis is a pinch roller arm and flywheel. The rear part of the chassis has a raised bracket which carries the supply *On/Off* switch and speed selector, and is supported by the top plates of the reel motors. The centre of the chassis houses a drive mechanism and start and run solenoids with their armature assemblies. This centre chassis and raised rear bracket are normally covered by a deck cover plate.

Tape Transport

107 The tape transport system utilises three motors, a capstan motor (X100) and two reel motors (X101 and X102). The capstan motor, mounted below the main chassis (Fig. 15), is a split phase, capacity type, synchronous induction motor. The motor assembly is resiliently mounted on neoprene shock mounts and the motor has grease packed ball races seated in neoprene mounts. The motor runs anti-clockwise, viewed from the top, and a stepped pulley with a sand-blasted finish is mounted on its spindle.

108 Reel motors, supply and take-up, are both 150 volt nominal (75 volt on 117 volt 60Hz models). The left-hand supply motor, which runs clockwise when energised, is mounted directly on the chassis with a top plate supporting the raised rear bracket. This top plate carries a wrap type brake assembly which acts on the drum of the reel carrier along with a constant friction brake. The right-hand take-up motor, which runs anti-clockwise, is fixed to the main chassis and its top plate, fixed to the rear bracket, carries a wrap type brake assembly which acts on the reel carrier drum. The take-up reel carrier has a worm drive for the turns counter mechanism, the drive gear of which is mounted below the top plate. Electrical connections to both supply and take-up reel motors are via two-pin connectors, and the take-up reel motor has a dummy plug connector used to disconnect this motor when the recorder is used with an Endless Loop Cassette.

Speed Change Switch SW104 (Fig. 8)

109 Speed change switch SW104 is located at the centre of the rear bracket. On the centre section of the switch spindle, between bracket and chassis, is mounted a three position cam which decides the position of a start lever. At the extension of the start lever arm, a leaf spring engages in one of three slider arms. Each of the slider arms carries an idler wheel which transfers drive from the capstan motor pulley to a flywheel. When the start lever is operated by a start solenoid, the leaf spring engages the selected idler wheel arm, moving the idler wheel into contact with the pulley and the flywheel periphery.

110 At the bottom of the speed change switch spindle, below the main chassis, is a three position electrical switch SW104 (Figs. 27 and 28). This switch is used in conjunction with an equalisation switch SW700. If switch SW104 is set to high speed (H) then an auto-stop relay RL100 is connected to contacts L and M via a shorting bar on the switch. A slider contact of SW104 is connected via P100/SK100 pins 2, 3 and 4 to contacts H, M and L of equalisation switch

SW700. If the slider of SW700 is set to either L or M then auto-stop relay RL100 is connected between 24 volts d.c. and earth, energising the relay. Relay contact RL100A disconnects the 24 volt d.c. line from the start relay and routes the 24 volt d.c. line to a red *Reset* lamp LP100 which lights to indicate a fault condition. Similar situations occur when the speed change switch SW104 is set to the M and L positions.

Function Control SW100 (Fig. 8)

111 The function control is a four position, electro-mechanical switch, which controls the operations of the tape deck. Mounted on the left-hand side of the main chassis beneath the front raised platform, switch SW100 has a cam at the top of its spindle which performs mechanical functions, and is a six pole, two bank, ceramic switch which controls solenoid and reel motor switching. The four positions of the switch are *Fast, Stop, Pause* and *Run*, and the operating sequences of the tape deck are described under these headings. It is possible to over-ride the function control when it is set to *Pause*, and this sequence is described under the heading Remote Control.

Function Control at Fast (Figs. 8, 27 and 28)

112 With function control SW100 set to *Fast*, the cam on the switch spindle (Fig. 2) operates a brake arm which moves the constant friction brake well clear of the supply reel drum. A vertical pin on the cam moves a loading arm, which lifts three pressure pads well clear of the head assembly and away from the fast moving tape.

113 The ceramic, two bank, electrical switch SW100 is at position F as shown in Figs. 27 and 28. Contact 2a completes the 24 volt d.c. supply circuit to start solenoid L100, energising the solenoid. With the solenoid energised, an armature on the start lever is engaged, moving the start lever about its pivot (Fig. 8) and performing the following functions:

(i) Self-wrapping brakes on the reel drums are released.

(ii) A leaf spring on the start lever extension moves a selected idler wheel into engagement with the capstan motor pulley and flywheel.

(iii) Two arms on the start lever rear bracket operate micro-switches SW102 and SW103.

114 Micro-switch SW102 completes the power supply circuit from P101 to the capstan and reel motors, and micro-switch SW103 operation varies dependent upon the recorder serial number, as follows:

(i) On models before serial number 70500 (Fig. 26) it acts as an economy switch. Connected in the earth return circuit of L100, it puts resistor R100 in series with L100 coil, and reduces current through the coil.

(ii) On later models the switch is connected in the 24 volt d.c. line to L100 and performs two functions. One is to put resistor R100 in series with the coil and reduce operating current, and the other is to complete the 24 volt d.c. supply line to a run solenoid L101.

115 Switch SW100 poles, 1b and 1c, connect *Fast Wind* control potentiometer RV103 directly across the two reel motors X101 and X102. The slider of RV103 is connected to the common connection of the series-connected reel motors, so that, at the central position of the slider, the power is divided equally between both motors. When a tape is fitted to the recorder, the motors will remain stationary

due to the tape tension and power is dissipated in the form of heat. By moving slider RV103 to either side of the central position, the power is divided unequally between reel motors, so that tape wind is achieved in either direction at slow or fast speeds.

116 Switch SW100 poles, 1a and 2b, are connected via P100/SK100 to the amplifier unit so that in the *Fast* position the level of the audio output, caused by the tape passing the replay head at high speed, is reduced.

Function Control at Stop (Figs. 8, 27 and 28)

117 With function control SW100 at *Stop*, the cam sets the constant friction brake arm so that the constant friction brake is just clear of the supply reel drum, and a pin on the cam sets the loading arm so that the pressure pads are approximately $\frac{3}{8}$ in. (9·5 mm.) from the heads.

118 Electrical switch SW100 is at position S as shown in Figs. 27 and 28. Poles 1b and 1c disconnect the *Fast Wind* potentiometer from across the reel motors, and poles 1a and 2b, via P100/SK100, reduce the audio output level of the replay boards. Pole 2a of the switch disconnects the supply to solenoid L100 which is de-energised and the start lever is in the non-operating position. With the start lever in this position the following conditions apply:

(i) The wrap-round brakes are applied to the reel drums.

(ii) The selected idler wheel is disengaged from the capstan motor pulley and flywheel.

(iii) Micro-switches SW102 and SW103 are not operated. With micro-switch SW102 in its non-operated position, the supply to the capstan and reel motors, from P101, is disconnected. On later models, when SW103 is in its non-operated position, the 24 volt d.c. supply to the run solenoid L100 is also disconnected.

Function Control at Pause (Figs. 8, 27 and 28)

119 With the function control SW100 at its *Pause* position, the constant friction brake arm, actuated by a brake arm spring, pulls the constant friction brake into contact with the supply reel drum. The vertical pin on the cam no longer acts on the loading arm, which, actuated by a return spring, allows the pressure pads to function, and moves the pinch roller arm. The pinch roller arm is moved by a plastic ramp on the loading arm acting on the pinch roller bracket, so that the armature on the pinch roller bracket is in close proximity with the run solenoid pole piece.

120 Electrical switch SW100 is at position P as shown in Figs. 27 and 28. Pole 2a completes the circuit of start solenoid L100 and the solenoid is energised. As the armature is pulled to the pole piece, the start lever moves about its pivot and performs the following functions:

(i) Self-wrapping brakes are released from the reel drums.

(ii) The leaf spring, on the start lever extension, moves the selected idler wheel into engagement with the capstan motor pulley and flywheel.

(iii) Two arms, on the start lever rear bracket, operate micro-switches SW102 and SW103, energising the capstan and reel motors.

The action of the micro-switches SW102 and SW103 is explained in paragraph 114. With the reel motors connected in series across the supply from P101, and with the self-wrapping brakes released, the motors are free to rotate, but are held stationary by the tape tension.

121 Switch SW100 pole 2c connects the run solenoid via P101/SK101 to an auxiliary socket SK701 which is used for remote switching of the recorder, see paragraph 134. Further contacts, on poles 1a and 2b, complete the circuit to the *Record* micro-switches SW107 and SW108 (paragraph 126) and the replay level (paragraph 116) is returned to normal.

Function Control at Run (Figs. 8, 27 and 28)

122 When function control SW100 is switched to *Run*, the cam does not perform any function. The operating condition of the self-wrapping brakes, constant friction brake and pinch roller arm, were set when the function control was at *Pause* (paragraphs 119 and 120) and tape drive is initiated by electrical switch SW100.

123 Electrical switch SW100 is at position R as shown on Figs. 27 and 28. Contacts of pole 2a maintain the same conditions as described in paragraph 120 and contacts of pole 2c complete the circuit to the run solenoid L101.

124 With the circuit of solenoid L101 completed, the armature on the pinch roller arm is energised, and as it moves, the pinch roller arm pivots and performs the following functions:

(i) A post at the top of the armature block operates a micro-switch SW106, which is mounted on top of the run solenoid assembly.

(ii) The pinch roller arm forces the pinch roller against the tape, gripping it to the capstan spindle. As the capstan spindle is already rotating, due to the action of the start lever (paragraph 113), the tape is driven immediately at the correct speed. Pressure applied by the pinch roller to the tape is critical, and the full setting up procedure is given in Section 4.

125 Micro-switch SW106, operated by the pinch roller arm, puts a short circuit across the supply reel motor, and connects R105 in series with the take-up reel motor across the supply. The tape issuing from the capstan is taken up by the take-up reel, and a slight back tension on the tape is maintained by the action of the constant friction brake acting on the supply reel drum.

Record and Record Release (Figs. 8, 27 and 28)

126 When the *Record* button is pressed down, the record lever arm moves the *Record Release* arm, which then returns under spring pressure, to lock the record lever arm down in the *Record* position. This operation is only possible when the function control SW100 is in either *Pause* or *Run* positions, as SW100 cam inhibits the *Record Release* arm when at *Fast* or *Stop*. In these positions, the cam periphery moves the *Record Release* arm, against spring pressure, to the left, inhibiting the "locking" action. The end of the *Record Release* arm protrudes through the deck cover plate, adjacent to the foil stop, and when moved manually to the left, it releases the *Record* lever arm. It is automatically moved by SW100 cam when the function control is switched to *Stop* or *Fast*.

With the *Record* button operated and locked in the *Record* position, a right-angled arm on the record lever operates two micro-switches SW107 and SW108. Contacts of SW108, which normally short circuit the output of the record amplifiers to earth via P100/SK100 pins 1 and 9 (pin 9 only on mono models), are opened. Micro-switch SW107 contacts route the 50 volt d.c. supply, via P100/SK100 pins 7 and 8, to the amplifier where it performs the following functions:

(i) Provides a positive 50 volts d.c. for the 100 kHz oscillator.

(ii) On models prior to Serial No. 75,000, energises relay RL700, whose contact RL700B switches the record signal, via *Output* switch SW702, to the VU meter (also RL700A on stereo models).

Tape Tension (Fig. 8)

127 Tape snatch on stopping and starting is eliminated by two differentially-damped tape tensioning arms. The left-hand arm assembly is mounted on the underside of the deck control panel, and the right-hand arm is mounted on the raised platform to the right of the pinch roller. Both arms are fitted with a differential brake, employing a nylon tape tensioned by a spring. Tension is adjustable, and setting-up instructions are detailed in Section 4, paragraph 408.

Auto-stop and Foil Stop (Figs. 8, 27 and 28)

128 The auto-stop and foil stop are two of the three safety devices which automatically inhibit the tape deck drive when they are operated. In each case, relay RL100 is energised by completing the earth return circuit of its operating coil. Relay contact RL100B open-circuits the 24 volt d.c. supply to start solenoid L100, at the same time completing the 24 volt d.c. supply circuit to the red *Reset* lamp, which lights. One safety device, the setting of the *Speed Control* and *Equalisation* switches, has been explained in paragraph 110 and the other two are as follows:

(i) The right-hand damping arm (paragraph 127) is normally held in its operating position by the tape, but should the tape run out or be incorrectly loaded (*i.e.* not on the arm), then the arm is pulled into contact with an insulated pillar by a spring. The insulated pillar is connected to the negative side of the relay RL100, and if the earthed tension arm touches the insulated pillar the circuit of RL100 is completed and the relay operates.

(ii) The tape guide, between the left-hand tension arm and the supply reel, is an insulated pillar mounted on the deck cover plate. This pillar is connected to the negative side of relay RL100, and if the metallic foil on the end of the tape makes contact with the insulated pillar and the tensioning arm, then the circuit of RL100 is completed and the relay operates.

Note: Contact RL100A is a hold-on contact, and when operated completes the negative circuit of the replay even if the fault condition is removed. To de-energise the auto-stop relay, the fault must be cleared and the function control SW100 switched to *Stop*.

Turns Counter and Lamps (Figs. 8, 27 and 28)

129 A turns counter mechanism and two lampholders are fixed to a panel which is mounted above the idler wheel assembly. The panel is fixed to the main assembly by two lugs at the front, which fit into slots at the rear of the raised platform, and a screw at the rear of the panel which clamps it to a stand-off pillar. Attached to the left-hand side of the panel is an arm which stops the idler wheel arms from moving out of their retaining slots.

130 The rear lamp holder supports the "power on" lamp LP101. This lamp is connected to the 24 volt d.c. line on the "live" side of the d.c. fuse FS100, and when lit illuminates the amber indicator on the deck cover plate.

131 Mounted on a block at the left of the turns counter assembly, is a lampholder supporting the reset lamp LP100. This lamp is connected to the 24 volt d.c, supply by RL100B when a fault condition is present (paragraphs 110 and 128). and when lit illuminates a red indicator on the deck cover plate.

132 The turns counter mechanism is a four digit system with a *zero* button which protrudes through the deck cover plate, and when operated manually resets the counter to its zero position. Drive to the counter, via a flexible cable, is from a gear wheel, mounted on the take-up motor below the top plate, which meshes with a worm drive on the base of the take-up reel drum. The counter indicates the revolutions of the take-up reel, and is not related linearly to time as the length of tape per revolution is dependent upon the amount of tape on the reel. A graph showing relationship tape/turns is given in the Operator's Handbook.

High Speed Models (Figs. 27 and 28)

133 High speed models, suffix H, are fitted with an additional relay RL101, which temporarily increases the power on the take-up reel motor on starting up at 15 in/sec. With the speed control set to 15 in/sec (38 cm/sec) the electrical switch SW104 is at H. Contacts of SW104 connect RL101 in parallel with the run solenoid L101, so that with function control SW100 at *Run* both the relay and solenoid L101 are energised (paragraph 123). Relay contact RL101A short circuits resistor R105, so that the take-up reel motor X102 has the supply from P101 applied directly across it. While capacitor C105 is charging, relay RL101 is energised but after a few seconds the current falls below the relay hold-on value and RL101 is de-energised. Contact RL101A opens, removing the short circuit across R105, and the take-up reel motor supply returns to normal.

Remote Control (Figs. 27 and 28)

134 A seven pin auxiliary socket SK701, mounted on the rear panel, makes provision for remote control or connection to ancillary units such as the Signal-operated Switching Unit. These duplicate the action of turning the function control from *Pause* to *Run* as follows. Pin 1 of the socket is connected via P101/SK101 pin 1 to contact P, pole 2c of function control switch SW100. With the function control switched to *Pause* (paragraph 121), the negative side of run solenoid L101 is connected to contact P, so that when a connection is made between pins 1 and 2 (earth) of the auxiliary socket, either by a remote switch, time clock or Signal–operated Switching Unit, then solenoid L101 is energised and the *Run* sequence initiated (paragraph 124).

135 Auxiliary socket SK701 provides a 50 volt, 200 mA d.c. supply on pin 3 (pin 2 earth), and *Low Level* and *600 Ohm Outputs* on pins 4 and 6 (also pins 5 and 7 on stereo models). These connections can be used for remote volume control units, remote level indicators, or the Signal-operated Switching Unit as required.

Reel Height Adjustment (Fig. 11)

136 To accommodate different thicknesses of spools, the reel carriers are adjustable in height and the method of adjustment is the same on both reel carriers.

137 The spindle of the reel motor runs in two self-aligning bearings and the vertical height of the spindle is set at its base where it runs in a special device which limits the amount of end-float on the spindle. The limiter is fitted to a horizontal bar which is pivoted on a resilient mounting at one end and at the other end keyed into a special nut on the vertical adjuster.

138 The vertical adjuster is spring-loaded, between the special nut and deck plate, to maintain the horizontal bar steady in the set position. Adjustment is by means of a screwdriver slot in the top of the shaft, which, when rotated, raises or lowers the horizontal bar by moving the special nut on its thread. The upper overall adjustment is set by a Simmonds nut at the base of the adjusting shaft, and the lower overall adjustment by a nut at the top of the threaded portion of the shaft.

Head Assembly (Fig. 9)

139 The head assembly, mounted on the raised platform beneath the hinged portion of the deck control panel, consists of three heads each bolted rigidly on its own mounting plate. Four socket-headed, recessed bolts clamp the head assembly to the raised platform, and two socket-headed bolts at the front of the assembly provide azimuth adjustment of the record and replay heads. Electrical connections to the heads are via screened leads, taken from the base of the assembly. Record and erase head connections are via phono sockets on the rear amplifier unit, and the replay head is connected direct to pins of the replay board on the amplifier unit. On stereo models there are two screened leads for each head, viz: erase, record and replay. The removal and replacement of the head assembly is detailed in Section 3 but no adjustment to the heads should be made without consulting Section 4.

Para. 126 **Serial No. 78,300 onwards**

The Record arm has been modified slightly so that with the Function knob at Pause or Run, the Record knob cannot be pressed accidentally; the Record Release catch must be moved to the left before the Record knob can be pressed down. The Record knob is still locked down on allowing the catch to return to the right. In all other respects the operation of the Record arm is as described in the manual.

Para. 128 **Serial No. 78,800/2 onwards**

The action of the Auto Stop now has a built-in delay of approx. 1½ seconds, but also operates if there is a loss of tape tension. Para. 128 (i) should now read:—

. . . and if the earthed tension arm touches the insulated pillar, it triggers the delay circuit (R111, R112, C106). If the pillar is earthed for more than 1½ secs. approx., transistors VT100 & VT101 conduct and operate RL100. If the pillar is disconnected from earth before VT100 conducts, the delay circuit resets and the fault relay is not energised.

The meter is illuminated when in the Record Mode (Record knob pressed on Run or Pause); one lamp on stereo models, two lamps on mono models

D - Electronic Units

General

140 The electronics of the recorder are contained in two main units, an amplifier and a power unit, which are mounted on the main cross frames of the recorder body. Electrical connections between the tape deck, head assembly and other units are made by plug and socket connectors.

141 Mounted at the rear of the recorder, bolted to the lower cross frames, is the power unit, which contains a power transformer, smoothed d.c. supplies, power output amplifiers and the input/output panel. The amplifier, mounted at the front of the recorder and bolted to both the cross and side frames, comprises a main control panel, potentiometers, switches and printed circuit boards. On stereophonic models, switches, controls, meters and printed circuit boards are duplicated in the second channel and a *Record Mode* switch and a *Transfer* switch are also fitted. In the circuit descriptions that follow, only one channel is described, with special references to the additional switches where necessary.

Electronic System (Fig. 25)

142 A block diagram of the electronic system is shown in Fig. 25 and it is basically similar for all models; this is achieved by the duplication of printed circuit boards on stereophonic models. Monophonic models use one channel of the stereophonic system illustrated, and are without *Record Mode* and *Transfer* switches. On earlier stereophonic models, up to serial number 70500, the signal to the transfer switch from the meter and tone control amplifier is not affected by the tone controls.

143 An input to the recorder can be applied either at the *Line* input socket (rear panel) or the MIC socket (main control panel), and in each case the signal passes to a pre-amplifier stage with a gain control. On stereophonic models the output of the transfer switch is applied to the line pre-amplifier gain control.

144 The outputs from the mic and line pre-amplifiers are mixed together and are fed to the record amplifier which has two outputs. One is taken to an *Output* switch, as the "source" signal, and the other to the record output stage. During replay, the record output stage is short-circuited to earth by a micro-switch, and this short-circuit is removed by the action of the *Record* button. The record output signal has negative feedback applied to it from the pre-emphasis board, before being mixed with bias and fed to the record head.

145 Signals from the replay head are fed via a replay amplifier, where they are frequency compensated and amplified before being fed to the *Output* switch as the "tape" signal.

146 The *Output* switch is manually operated to select the signal which is fed to the meter & tone control amplifier, either the *"Tape"* signal from the replay amplifier or the *"Source"* signal from the record amplifier.

Note: On models Serial No. 70,000—74,999, the *Output* switch has a centre position *"Normal"*, at which the signal is selected automatically by RL700. On "fast wind", "stop" and "replay", the *"Tape"* signal is selected, but when the *Record* button is pressed (on "Pause" and "Run"), energising RL700, the "Source" signal is selected.

The first stage of the meter & tone control amplifier has three outputs, one fed to the *600 Ohm Output* and the second to a panel-mounted VU meter. The meter indicates the *output signal* or the *bias level* as selected by the *Meter* switch.

Note: On models Serial No. 75,000— , , the *Meter* switch has a centre position *"Source"*, at which the "source" signal is fed to the meter (via a meter pre-amplifier) independently of the *Output* switch setting.

The third output of the meter & tone control amplifier first stage is fed to the tone control stage, which provides variable boost or cut, at both ends of the audio band, and the signal is then fed to the *Low Level* output and *Output* control. From the *Output* control the signal is fed to a power amplifier, mounted on the power unit, which feeds either an external speaker or internal monitor speaker. Models 702 and 704 have no power output stages, these being replaced by dummy boards taking the outputs from RV705 and RV706 to sockets JK700 and JK701, giving *Low Level Adjustable* outputs of up to 300 mV into 10,000 ohms or greater.

147 A 100 kHz oscillator, switched on by the *Record* button, provides power for the erase head and bias for the record head. On stereophonic models the oscillator output is fed via a *Record Mode* switch which selects the track or tracks to be erased and recorded.

148 The *Transfer* switch enables the signal from one track of a tape to be fed to the line pre-amplifier of the other track, without the need for external connections, and thus re-recorded. The switch can also be used for special effect recordings.

POWER UNIT

General (Figs. 6 and 7)

149 The power unit has two functions, one to provide smoothed d.c. supplies, and the other to route outputs via jack sockets on the rear panel. A 14 pin plug, internally connected to the amplifier, routes amplifier outputs to speakers and an auxiliary socket on the rear panel, and feeds a 50 volt d.c. supply to the amplifier. An 8 pin rectangular plug, connected to the top of the tape deck chassis, carries the 24 volt d.c. supply from power unit to tape deck, the power supply input to the *On/Off* switch on the tape deck, and the remote control switching from the auxiliary socket.

150 Mounted on the rear panel, below the carrying handle, are output jack socket connections, voltage selectors, fuses, power supply and auxiliary socket and a *Line Input* jack socket which is connected, via a screened lead, to the record board on the amplifier. On stereo models, all jack sockets are duplicated. Internal monitor loudspeakers are connected to 2 pin sockets at the front of the power unit.

Circuit Description (Figs. 27 and 28)

151 The a.c. power supply is connected to plug P701 and fed via fuse FS702 and SK101/P101 to the tape deck On the tape deck the a.c. supply is fed via *On/Off* switch SW101 (single pole on early models) to three motors, and back via SK101/P101 to the power unit. From SK101 pins 3 and 4, it is taken, via voltage selectors VS700/VS701, to the primary of transformer TR700. On 117 volt models, a.c. from SK101 pins 3 and 4 is fed direct to the primary of TR700.

152 Transformer TR700 secondary has two outputs which feed bridge rectifiers MR700 and MR701. Bridge rectifier MR700 output, smoothed by C700, is 50 volts d.c.,

three supplies being fed via fuse FS701. One is fed to the power amplifier, another via P700 pin 5 to the amplifier unit, and a third to auxiliary socket SK701 pin 8 for use, if required, on an external unit. On stereophonic models a second 50 volt d.c. supply is fed via fuse FS700 to the lower track power amplifier, and via P700 pin 6 to the amplifier. Bridge rectifier MR701 output, smoothed by C701, is 24 volts d.c. fed via SK101 pin 7 to the tape deck.

Power Amplifier (Figs. 27 and 28)

153 The power amplifier consists of a transformerless push-pull amplifier, with complementary transistors in the driving stage. Two transistors VT505 and VT504, feeding complementary transistors VT501 and VT503, comprise the driving stage. A high power output, up to 10 watts, is provided by output transistors VT500 and VT502. Heavy negative feedback is taken from both sides of the output coupling capacitor C500. Resistor R511 provides feedback down to d.c., ensuring high stability, and resistor R512 provides feedback which effectively reduces the reactance of C500 to zero. Control of quiescent current in the output stage is effected by R506 whose value, adjusted by a trimmer resistor, sets quiescent current at 20 to 35 mA. Correction of quiescent current for ambient temperature changes is obtained from the forward resistances of MR500 and MR501 which are connected to the base of VT503.

154 On stereophonic models there are two power amplifier boards, each feeding an internal monitor speaker or an external speaker via a jack socket. On monophonic models the two internal speakers are fed in phase from the one power amplifier, and there is one output via a jack socket. Models 702 and 704 have a dummy board in place of each power amplifier board and the speaker outputs are replaced by *Low Level Adjustable* outputs, the output levels being varied by the *Output* controls RV705 and RV706 (see paragraph 146).

AMPLIFIER UNIT

General (Figs. 2-5)

155 The amplifier unit is contained in a chassis mounted on the side and cross frames of the recorder, and comprises two main sections. A top section, hinged to facilitate servicing, comprises the main control panel (which carries the main controls and VU meter), and a hinged flap beneath which are the auxiliary controls and switches. A lower section houses the printed circuit boards, equalisation switch and pre-set potentiometers, and the rear panel of this section supports the sockets SK100, SK700, P600-P603. On stereophonic models, the main control panel also carries second channel controls and, beneath the hinged flap, the *Transfer* switch. The body of the *Record Mode* switch is on the oscillator board in the lower section.

Replay Board (Figs. 27 and 28)

156 The output of the replay head is fed, via a screened lead, direct to the replay board to avoid hum loops. Signal input is passed, via isolating capacitor C301 and RF suppression components R300/C302, to the base of low-noise transistor VT300. Transistors VT300 and VT301 amplify the signal, negative feedback being applied to VT300 emitter via equalisation switch SW700. Switch SW700 selects from resistors R315-319 and capacitors C313-317 to provide the correct characteristic at each speed; capacitors C313, 315 or 316 adjust the treble response, while the resistors R315 or 317 adjust the extreme bass. On stereophonic models the emitters of VT300 in each channel are connected by RV700, in parallel with C714, and potentiometer RV700 is adjusted for minimum cross-talk. Transistor VT302 further amplifies the signal, a small treble lift being provided by a phase shift arrangement of capacitor C311 with C305, 306 or 307, as selected

by the equalisation switch SW700. The small treble lift is followed by a sharp fall in response at frequencies above the required range. This removes any RF bias pick-up and ensures that the frequency response extends only slightly beyond the chosen limits for each tape speed, thereby reducing hiss to a minimum. The replay board output is developed across tape level potentiometer RV725, which is mounted under the hinged flap of the control panel and marked "A". Reduction of the replay board output when the function control is at *Fast*, is effected by switching R313 and C312 into circuit. Signal output from the slider of RV725 is fed to the *Output* switch as the "tape" signal.

Meter and Tone Control Board (Figs. 27 and 28)

157 The meter and tone control board receives a signal input from the *Output* switch SW702, and this signal can be either the "tape" signal from the replay board or the "source" signal from VT203 on the record board (see paragraph 146). A low gain transistor-stage VT400 feeds the signal input to emitter follower VT401, which gives an output of 2 volts at approximately 30 ohms. There are three outputs from VT401. One fed via R406 (which increases the impedance to 600 ohms) and SK100 pin 13 to the *600 Ohm Output*, another is fed direct to the *Meter* switch, and the third via R407 to the tone stage.

158 Except when the *Meter* switch is at *Bias*, the front-panel mounted VU meter monitors signal level and, as is usual with VU meters, an offset of 4 dB is used between sine-wave and music signals, an indication of 0 VU on music signals corresponding to maximum recording level (32 mMx/mm).

159 Resistor R407 feeds signals from emitter follower VT401 to the tone control stage, comprising VT402 and its associated circuit. Circuit parameters are such that there is little or no mid-frequency gain, but variable boost or cut at both ends of the audio band is provided by RV703 (*Bass*) and RV719 (*Treble*). Transistor VT402 has two outputs (three on stereo) fed via capacitor C412 as follows:

(i) To the power amplifier via resistor R417, *Output* potentiometer RV705, and SK700 pin 3.

(ii) To the *Low Level Output* jack socket on the power unit via R417 and SK700 pin 2.

(iii) On stereo models to the *Transfer* switch SW704.

Note: On earlier stereo models the output to the *Transfer* switch is taken from the junction C406/R407.

160 **Meter Board** (Serial Nos. 75,000 onwards)

The Meter Board is mounted directly on the back of the meter(s), the *Source* signal being fed to it from RV220 on the Record Board. Transistor VT800 (or VT801) amplifies this signal to a level suitable for feeding to the meter when selected by the Meter switch at *Source*. With the Meter switch at *Bias*, the bias is read directly on the meter. With the Meter switch at *Output*, the meter is connected to the emitter follower VT401 and reads *Tape* or *Source* as selected by the Output switch.

Record Board (Figs. 27 and 28)

161 The record board comprises two pre-amplifiers VT200/VT201 and VT202, an intermediate amplifier VT203, and record signal amplifier VT204. Input signals are fed to the pre-amplifiers via jack sockets; the MIC jack socket is mounted on the main control panel and the *Line Input* jack socket, mounted on the rear panel, is connected via a screened lead direct to the board at A.B. (X.Y. on lower track).

162 Signals applied to A.B. are fed via C205 (and R227 on later models) to the gate of a field effect transistor VT202, which is used in a follower configuration to give unity voltage gain with an impedance transfer from 2 megohms to a few hundred ohms. Protection of the F.E.T. from stray leakage voltages at the input is provided by MR200 (and R227). The output of VT202, fed via R216, is developed across the *Line Gain* control (potentiometer RV709). On stereophonic models the output of the *Transfer* switch SW704 is also developed across RV709.

Signals applied to the MIC jack socket are fed, via an RF filter R200/C202, to the base of transistor VT200. Transistors VT200 and VT201 form a two-stage amplifier and gain is controlled by MIC potentiometer RV727 which controls the negative feedback applied to VT200. The output of the microphone pre-amplifier is fed, via C206 and R214, to C208 where it mixes, at a low impedance to reduce noise level, with the output of the line pre-amplifier (paragraph 161).

163 Signals from pre-amplifiers are fed, via C208, to an amplifier VT203 and bass boost is applied by network C210 and R217. Transistor VT203 has two outputs, one via RV220 (with bass boost removed by C212 and R222) to provide the "source" signal, and the other to the record amplifier VT204. Transistor VT204 operates with heavy negative feedback which is reduced at high frequencies by a selected by-pass capacitor (see paragraph 164). Amplifier VT204 output is mixed, via a bias filter (L601/C608), with the H.F. bias and passed to the record head. With the *Record* button in the raised position (not recording), the output of VT204 is inhibited at C216/R212 by an earth connection which is fed via SK100 pin 9 from micro-switch SW108 (see paragraph 126).

Pre-emphasis Board (Figs. 27 and 28)

164 The pre-amphasis board, mounted at the front of the amplifier, carries feedback components C702-704 (and C708-710 on stereo) selected by the equalisation switch SW700 to provide high frequency boost to the record signal by reducing the heavy negative feedback on VT204 (see paragraph 163). Further boost at the extreme limit of the response is provided by inductor L700 and capacitors C705-707 (and L701 and C711-713 on stereo) and controlled by RV711-713 (and RV715-717 on stereo).

Oscillator Board (Figs. 27 and 28)

165 The oscillator board, mounted at the rear of the amplifier, consists of a push-pull arrangement with VT600 and VT601 operating at approximately 100 kHz. The oscillator coil L600 has a tuned secondary which passes the R.F. signal to the record and erase heads. On stereo models this is done via the Record Mode switch SW600, which also maintains the bias constant in the *Upper, Stereo* and *Lower* modes by the dummy load RV606 and the frequency is kept constant by C607. The erase/bias supply is fed to the erase head X103 via SK602 (SK603) and the bias is fed to the record head X104 via the bias control RV723 (RV724), marked "B" on the front panel (Figs. 2 and 4). The earth return of the record head to the oscillator coil is via RV721 (RV722), which gives a measurement point for the bias current when the meter is set to read *Bias*, and which adjusts the bias calibration of the meter. The d.c. supply for the oscillator is present only when the Record Button is pressed on *Pause* and *Run*, via SW107, and the oscillator voltage is increased slightly at the higher tape speeds by shorting out R701 and R702. This increases the bias proportionally so that at each tape speed the value is optimum, giving the best possible balance between distortion, dynamic range and frequency response.

E - General Overhaul

166 Before proceeding with the general overhaul strip the recorder as follows:

(i) Remove the recorder from its case as detailed in Section 3.

(ii) Remove the deck cover plate as detailed in Section 3.

(iii) Remove the deck control panel as detailed in Section 3.

(iv) Replace the *Speed, Fastwind* and function control knobs, and the auto-stop arm guide.

167 Thoroughly clean, with the brush provided, any dirt, dust or tape oxide from the tape transport system, paying particular attention to the following:

(i) Head assembly (record and replay head faces should have a polished finish).

(ii) Tape guides.

(iii) Capstan spindle.
(iv) Pinch Roller. } use slightly damped, fluff-free cloth.

(v) Guides on tape tensioning arms (one mounted on deck control panel).

(vi) Pressure pads (replace if hard or damaged).

Warning: Do not use abrasives. If accumulation of tape oxide is excessive, use methylated spirits.

168 Clear any dirt, dust, tape oxide or solidified grease from the tape deck chassis and mechanisms, paying particular attention to the following:

(i) Capstan motor pulley.

(ii) Idler wheels.

(iii) Flywheel.

(iv) Self-wrapping brakes.

(v) Constant friction brake pad (replace if hard or damaged).

(vi) Cam mechanism of the function control.

(vii) *Lock Release* assembly.

(viii) Loading arm leaf spring.

(ix) Record micro-switch assembly (SW107 and SW108).

(x) Solenoid pole pieces; these should be free from obstruction.

(xi) Foam pads; these should be firmly attached to the solenoid armatures to minimise mechanical noise.

(xii) Spool height adjuster assembly.

(xiii) Start lever pivot.

(xiv) Run lever pivot.

(xv) Record lever pivot.

(xvi) Record release arm.

(xvii) Turns counter and flexible drive.

169 *Lightly* oil the following points, using a highly refined straight mineral oil such as Shell Tellus 27, Aeroshell No. 3, etc.:

(i) Idler wheel bushes (see Section 3 for access to bushes).

(ii) Pinch roller bush.
(iii) Capstan spindle bearing.
(iv) Start lever pivot
(v) Run lever pivot
(vi) Spool height adjuster assembly (see Fig. 11).
(vii) Friction brake arm pivots.
(viii) Lock release mechanism.

Warning: Do not over-oil as this will cause more trouble than lack of oil. (This applies particularly to the idler wheels and pinch roller).

170 Lightly grease the following points, using a high viscosity grease:
(i) Face of Function switch cam mechanism.
(ii) Record release mechanism (arm and lever pivot).
(iii) Face of record micro-switch operating arms.
(iv) Loading arm locking spring.

171 Check the condition and action of all return springs and replace if damaged.

172 Check the operation of the tape deck as follows:
(i) Set voltage selectors to the local supply voltage.
(ii) Connect the recorder to the local supply and switch *On*.
(iii) Load the recorder with a recommended tape.
(iv) Switch the function control to *Run*, and check that tape runs smoothly and does not twist or curl in the tape transport.
(v) Ensure that the height of the tape across the head faces is correct (see Fig. 12).
(vi) Ensure that the reel height adjusters operate, and that the tape reels do not scrape on the side frames.
(vii) Check that tape runs central on the pinch roller.
(viii) Check that pressure pads hold tape in intimate contact with the headfaces.

173 Check the recorder controls as follows:
(i) Examine all switch and control knobs, and ensure that they are tight on their spindles.
(ii) Operate each switch in turn, and ensure that the action of the switch is positive.
(iii) Rotate each potentiometer in turn, and ensure that the action is smooth.
(iv) Check that all gain control knobs indicate zero when turned fully anti-clockwise and also that the tone controls indicate equally plus or minus when rotated to their extreme settings.
(v) Visually inspect the wiring for signs of over-heating, and ensure that all internal plugs and sockets are properly mated.

Warning: Visual inspection should be carried out with power disconnected.

174 For a more detailed examination of the tape deck operation and setting up procedure see Section 4.

MODIFICATION NOTES

Fault Finding

CONTENTS

MODIFICATION NOTES

Voltages on Motors **240V (117V) models**

A.C. Voltage across	*Stop*	*Pause*	*Run*	*Fast Wind*
Capstan Motor Input	0	240 (117)	240 (117)	240 (117)
Take-up Motor Input	0	120 (58)	145 (72)	0-240 (117)
Supply Motor Input	0	120 (58)	0	240 (117) -0

A - Electro/Mechanical Faults

	Symptom	*Possible Cause and Remedy*
201	Tape transport sluggish — signal sounds low in pitch.	Tape scraping on reels. Check reel height adjustment. Incorrect tape being used. Friction brake incorrectly set. Check setting of brake as detailed in *Section* 4 paragraph 411. Wrap-type brakes operating. Check setting as detailed in *Section* 4 paragraph 403. Pressure on pinch roller incorrect. Check setting as detailed in *Section* 4 paragraph 406. Tape speed incorrect. Check tape speed as detailed in *Section* 4 paragraph 414.
202	Tape slips or "wows".	Oil or grease on friction brake pad. Replace pad if necessary. Excessive oil or grease on idler wheels. Clean and oil as detailed in *Section* 1E. Accumulation of dirt or tape oxide on tape heads and pinch rollers. Clean heads and roller as detailed in *Section* 1E. Pressure on pinch roller incorrect. Check setting as detailed in *Section* 4 paragraph 406.
203	Tape "flutters".	Dirt or tape oxide on pressure pads. Clean pads as detailed in *Section* 1E and check settings detailed in *Section* 4 paragraph 407.
204	Tape winds unevenly.	Faulty tape. Check tape for stretching, indicated by tape being concave or wavy. Reel carrier loose on supply or take-up motor spindle. Check tightness of reel carriers on spindles.
205	Take-up reel carrier appears to run hot.	It is normal for the take-up reel carrier to feel hot compared to the supply reel carrier, as the latter is not energised on *Run*.
206	Turns counter does not register.	"Zero button incorrectly set. Drive belt stretched or snapped. Replace belt.
207	Motors will not start (Capstan does not rotate).	Start solenoid faulty. Check circuit (Figs. 27 and 28) and replace solenoid if required. Function switch faulty. Clean electrical contacts and check connections.

	Symptom	*Possible Cause and Remedy*
208	Start solenoid energised but motors do not run.	Micro-switch SW102 not operated. Check as detailed in *Section* 4 paragraph 403. Faulty micro-switch. Check switch, replace if required.
209	Tape not driven with function control at *"Run"*.	Faulty run solenoid. Check run solenoid and replace if necessary. No supply to solenoid. Check contacts of switch SW100 (function control), clean or replace as required.
210	Supply reel still energised at *"Run"*.	Micro-switch (SW106) not operated or faulty. Check micro-switch as detailed in *Section* 4 paragraph 406.

B - Electronic Faults

	Symptom	*Possible Cause and Remedy*
211	Tape transport operates but no output heard or indicated on meter.	Faulty d.c. fuse. Check fuse and replace if required. **Note:** There are two fuses on stereo models
212	Low output.	Excessive dirt or tape oxide on heads. Clean as detailed in *Section* 1 paragraph 166. Pressure pad pressure incorrect. Check setting of pressure pads as detailed in *Section* 4 paragraph 407. Fault in power amplifier. Check amplifier quiescent current as detailed in *Section* 4 paragraph 439. Incorrect bias setting. Check bias as detailed in *Section* 4 paragraph 427.
213	Distorted output.	Recording level too high. Input level too high. Incorrect bias setting. Check bias as detailed in *Section* 4 paragraph 427. Faulty amplifier. Check replay section with test tape and then check individual boards.
214	Low output and severe distortion.	No bias. Check H.T. supply to 100 kHz oscillator and relay RL700 via micro-switch SW107. If H.T. supply available, check oscillator circuit. Faulty record or replay head. Check head for cleanliness and wear. Clean or replace as required. If head replaced, re-align head assembly as detailed in *Section* 4 paragraphs 420 and 426.
215	Excessive hum.	Check that voltage selectors are set to same position. Check for double earths on recorder and associated equipment. Reverse power supply connections to the motors. Check input screened leads and ensure proper earth connections.
216	Excessive hiss when recorded tape is replayed.	Head magnetised. Demagnetise heads using a defluxer. Incorrect bias (too low). Check bias setting as detailed in *Section* 4 paragraph 427. Record head misaligned. Check head alignment and frequency response as detailed in *Section* 4 paragraphs 426, 427 and 428.

	Symptom	*Possible Cause and Remedy*
217	No erasure.	Faulty erase head. Check head and head alignment as shown in Fig. 12. No feed to erase head. Check 100 kHz oscillator and oscillator supply via micro-switch SW107.
218	Poor top response.	Heads dirty. Clean heads as detailed in *Section* 1 paragraph 166. Pressure pad pressure incorrect. Check pressure pad setting as detailed in *Section* 4 paragraph 407. Incorrect bias. Check bias setting as detailed in *Section* 4 paragraph 427. Incorrect head alignment. Check head height as shown in Fig. 12 and reset azimuth as detailed in *Section* 4 paragraphs 420 and 426.
219	Poor bass response.	Faulty capacitor. Check by-pass capacitors in amplifying stages. Check replay section by playing a test tape, this should indicate if fault is in replay or record section.
220	Excessive crosstalk—stereo models only.	Incorrect head height. Check alignment as detailed in *Section* 4 paragraphs 420 and 426. RV700 faulty or incorrectly set. Check RV700 and C714 and check setting as detailed in *Section* 4 paragraph 436. Transfer switch faulty. Check operation of transfer switch and replace if required. Check position of white and violet leads from replay board to equalisation switch.

MODIFICATION NOTES

Removals and Replacement

CONTENTS

MODIFICATION NOTES

Removal/replacement of the recorder from case

301 To remove the recorder from the case proceed as follows:

(i) Stand recorder vertical, with the handle at the top and amplifier at the bottom.

(ii) Remove all connections and fuses from the recorder rear panel.

(iii) Lift the handle, push down one end, then the other end, into the recess to take it clear of the inside of the case.

(iv) Remove four securing bolts from the floor of the case.

(v) Ease the recorder just clear of the case.

(vi) Unplug the loudspeaker connections, one plug each side.

(vii) On earlier models remove earth (screen) connection by removing the 4 BA screw securing the solder tag (located on right-hand side).

(viii) Replace the 4 BA screw after removing the solder tag.

(ix) The case can now be removed completely and the fuses replaced.

302 Before replacing recorder, remove fuses. Insert a length of tape or string between the handle and its recess, and feed the ends through the slot in the rear of the case, so that the handle can be pulled out of the recess after the recorder has been replaced. To replace the recorder in the case, reverse the removal procedure.

Removal/replacement of deck cover plate

303 To remove the deck cover plate proceed as follows:

(i) Lay recorder on its back.

(ii) Remove tape spools.

(iii) Remove *On/Off* knob (earlier models are fitted with an *On/Off* slide switch which can be left in position).

(iv) Remove speed control knob.

(v) Remove four screws securing the plate to the chassis.

(vi) Ease plate clear of chassis, lifting rear first and taking care not to strain the record release lever.

(vii) Remove foil stop connection on underside of plate, by releasing solder tag fitted to tape guide. On later recorders this step is not necessary.

304 The replacement of the deck cover plate is the reverse of the removal procedure.

Removal/replacement of deck control panel

305 To remove the deck control panel proceed as follows:

(i) Remove fast wind control knob.

(ii) Remove the function knob after setting the function switch to *"Run"* with the loading gate closed.

(iii) Remove the auto-stop contact from the auto-stop arm (not necessary on later models).

(iv) Remove four screws securing panel to chassis.

(v) Lift panel clear, taking care not to damage or strain the loading knob.

(vi) After removal of the panel remove the four brass spacing washers (located under four securing screws).

Note: If tests or alignment are to be carried out, replace function knob and the auto-stop contact on the auto-stop arm.

306 The replacement of the deck control panel is the reverse of the removal procedure.

Removal/replacement of amplifier assembly (Figs. 2 - 5)

307 To remove the amplifier assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove 9 pin and 14 pin plugs from the rear of assembly.

(iii) Remove the head phono plug connectors from rear centre bracket.

Note: There are two connectors on mono models and four on stereo models.

(iv) Remove the screened-lead connections from the bottom right-hand pins of the replay board as follows:

(a) Stereo models (Figs. 2 and 20). On the upper replay board the lead is marked with a red sleeve, and on the lower replay board the lead is marked with a white sleeve.

(b) Mono models (Figs. 4 and 20). The lead to the board is marked with a red sleeve.

(v) Remove the screened-lead connections from the top left-hand pins of the record board as follows:

(a) Stereo models (Figs. 2 and 19). On the upper record board the lead is marked with a red sleeve and on the lower record board the lead is marked with a black sleeve.

(b) Mono models (Figs. 4 and 19). The lead to the board is marked with a red sleeve.

(vi) Remove the six securing screws (three each side).

(vii) Lift amplifier assembly clear of chassis.

308 The replacement of the amplifier assembly is the reverse of the removal procedure.

Removal/replacement of main panel controls (Figs. 2, 3 and 4)

309 To remove one of the main panel controls proceed as follows:

(i) Remove amplifier assembly as detailed in paragraph 307.

(ii) Remove the *Equalisation* switch link, by locating and then removing the bolt connecting the link arm to the switch spindle extension (see Fig. 2) *Equalisation* switch should be in *"Medium"* position.

Note: On stereo models only, remove the *Record Mode* switch spindle as follows:

(a) Ensure that *Record Mode* switch is in the *"Stereo"* position.

(b) Locate the spindle extension upper locking screw (Fig. 3).

(c) Slacken screw and remove spindle extension.

(iii) Slacken the grub screw of each control knob, and remove the control knobs.

(iv) Slide out plastic facia of the main control panel, lifting it over the control spindles. The panel can then be hinged upwards to give access to the potentiometer tags.

(v) Removal/replacement of individual components on the main control panel now becomes self-evident.

310 Before replacing the control knobs on potentiometers, turn all potentiometers to zero. The replacement of the main control panel is the reverse of the removal

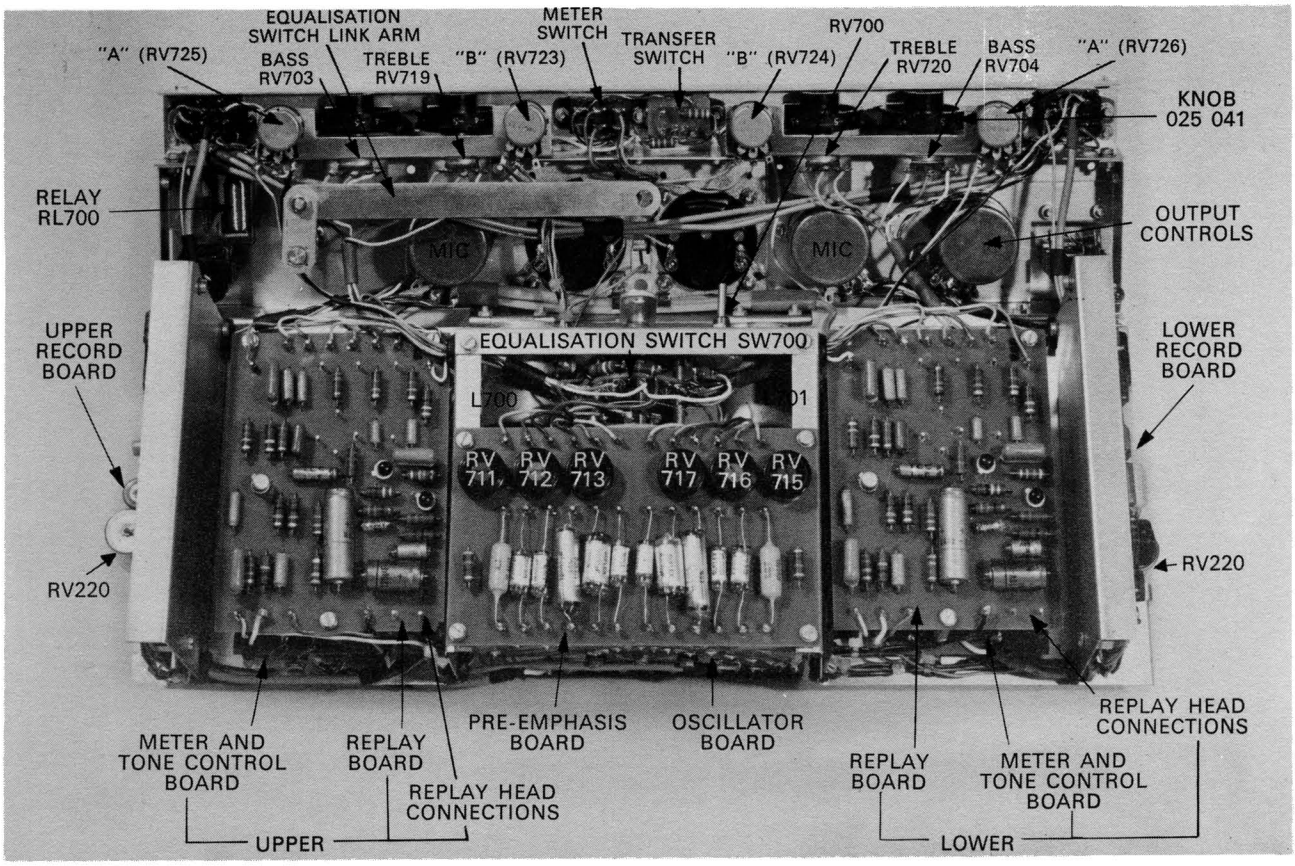


FIG. 2. AMPLIFIER—STEREO, FRONT VIEW

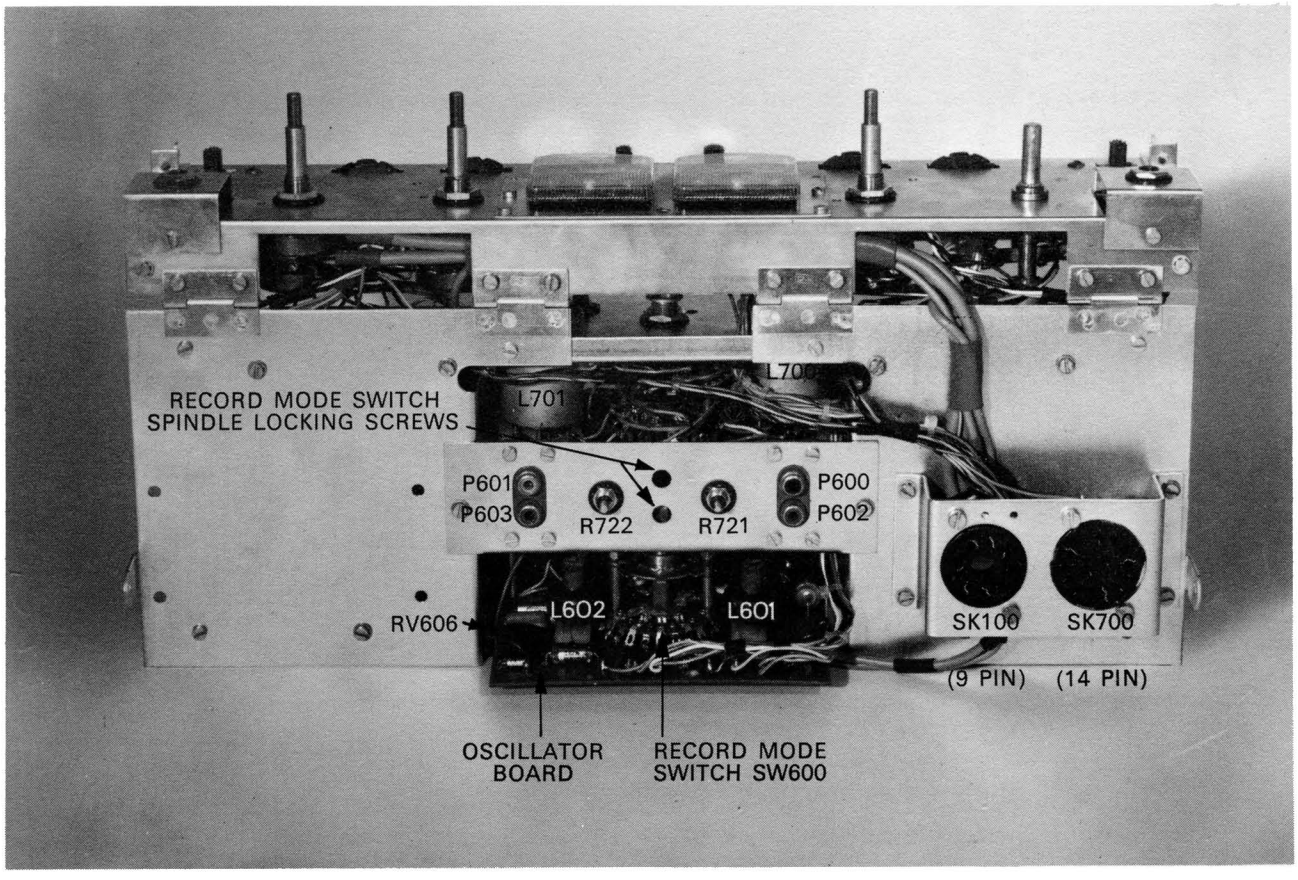


FIG. 3. AMPLIFIER—STEREO, REAR VIEW

procedure. Ensure that marks on knobs and switches correspond to the positions indicated.

Removal/replacement of record and replay boards and components (Figs. 2 and 4)

311 Locate the required board on Fig. 4 for mono models and Fig. 2 for stereo models, and proceed as follows:

(i) Remove the three screws securing the board.

(ii) Lift the board partially clear.

(iii) Removal/replacement of individual components is self-evident (Figs. 19 and 20).

(iv) To remove the complete board, note connections then disconnect wires to pins (Figs. 19 and 20).

312 The replacement of record and replay boards is the reverse of the removal procedure.

Removal/replacement of meter & tone control boards and components on stereo models (Fig. 2)

313 Locate the required board and proceed as follows:

(i) Remove the replay board as detailed in paragraph 311 (i) and (ii).

(ii) Remove the three hexagonal stand-offs.

(iii) Lift the board partially clear.

(iv) Removal/replacement of individual components is self-evident (Fig. 21).

(v) To remove the complete board, note connections then disconnect wires to pins.

314 The replacement of meter & tone control boards is the reverse of the removal procedure.

Removal/replacement of meter & tone control board and components on mono models (Figs. 4 and 21)

315 The removal/replacement of meter & tone control board and components is the same procedure as detailed in paragraph 311.

Removal/replacement of equalisation board (Figs. 2 and 4)

316 To remove the equalisation board proceed as follows:

(i) Remove the four screws securing the board.

(ii) Lift board partially clear.

(iii) Removal/replacement of individual components is sefl-evident (Figs. 15-18).

(iv) To remove complete board, note connections then disconnect wires to pins.

317 The replacement of the equalisation board is the reverse of the removal procedure.

Removal/replacement of oscillator board and components (Fig. 10)

318 To obtain access to the oscillator components and to remove the oscillator board proceed as follows:

(i) Unsolder the leads to the earth tags at the bottom of the equalisation board (Fig. 2 or 4).

(ii) Remove the four screws fastening the board to the chassis.

(iii) Swing the equalisation board upwards to expose the oscillator components.

(iv) Removal/replacement of individual components is now self-evident (Figs. 23 and 24).

(v) (a) On Stereo Models, slacken the lower grub screw in the Record Mode switch shaft (Fig. 3) and remove the two nuts holding the switch to the cross bracket.

(b) On Mono Models, remove the two screws and spacers holding the board to the cross bracket.

(vi) The oscillator board can now be moved downward and clear of the chassis.

(vii) To remove the complete board, note the connections to the pins and disconnect the wires.

319 The replacement of the oscillator board is the reverse of the removal procedure. Do not forget to resolder the earth leads, when refitting the equalisation board.

Removal/replacement of power unit assembly (Figs. 6, 7 and 10)

320 To remove the power unit assembly proceed as follows:

(i) Remove recorder from case as detailed in paragraph 301.

(ii) Lay the main chassis on one side.

(iii) Remove 14 pin plug P700 from socket SK700 at rear of amplifier assembly (Fig. 3 or 5).

(iv) Lay the main chassis horizontal.

(v) Remove rectangular socket SK101 from plug P101 on top of chassis (Fig. 8).

(vi) Disconnect *Line Input* jack socket (two on stereo models) by removing jack assembly from chassis (Fig. 10), taking care to retain the spacing washers.

(vii) Lay the main chassis on one side.

(viii) Remove four countersunk securing screws from the cross frames (Fig. 10).

(ix) Lay main chassis horizontal.

(x) Ease power unit partially clear of main chassis taking care not to damage the electrical switch at the base of the *Speed* control.

(xi) Lift the handle cables clear of slots on each side.

(xii) Hold the handle clear, easing cables sideways, and slide unit clear of chassis.

321 The replacement of the power unit is the reverse of the removal procedure.

Removal/replacement of turns counter assembly

322 To remove the turns counter assembly proceed as follows:

(i) Remove the deck cover plate as detailed in paragraph 303.

(ii) Slacken the flexible drive retaining screw at the counter end and remove from spindle. On later models with the "spring" flexible drive, pull off the drive while rotating it clockwise with the counter pinions held locked.

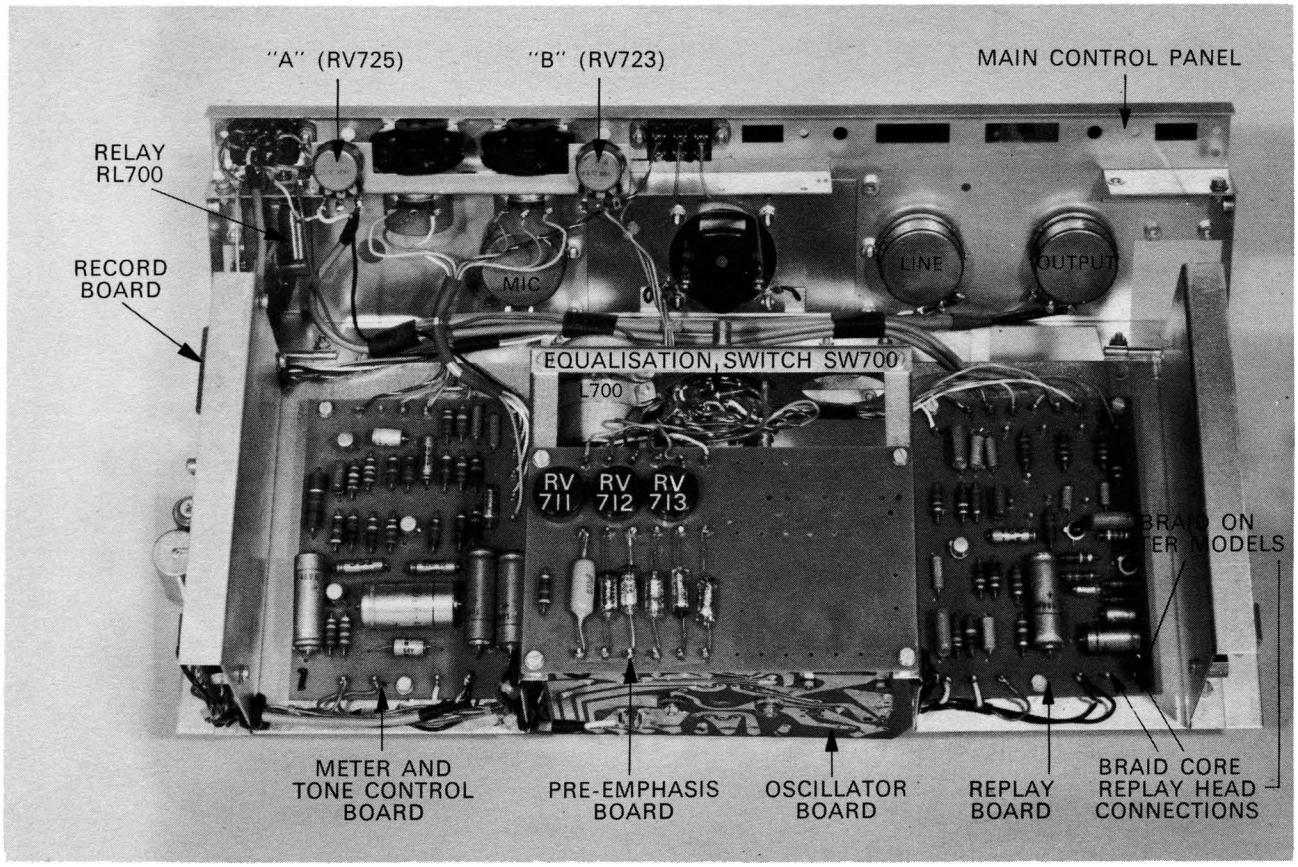


FIG. 4. AMPLIFIER—MONO, FRONT VIEW

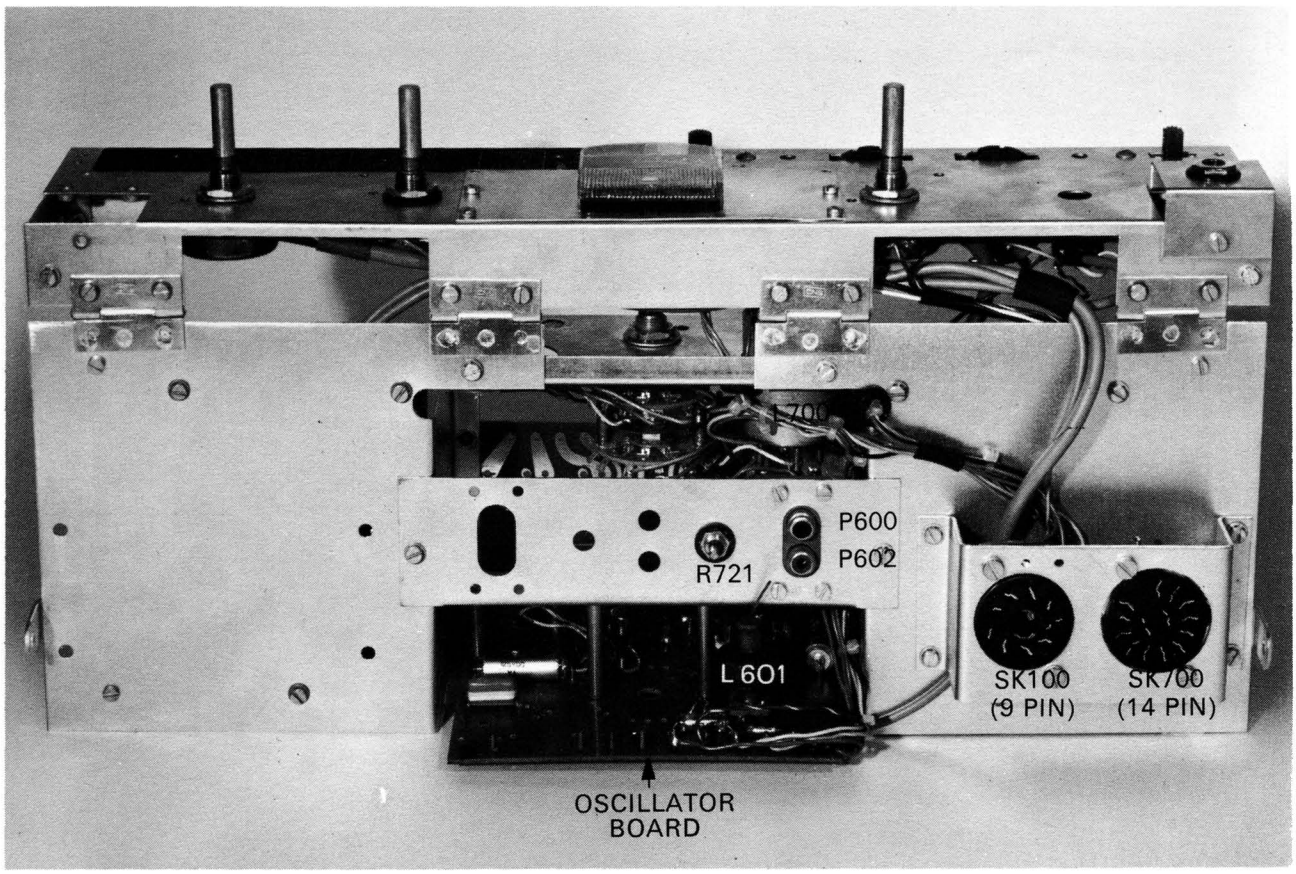


FIG. 5. AMPLIFIER—MONO, REAR VIEW

(iii) Remove the turns counter drive belt from the counter pulley (taking care to keep it clear of oil or grease).

(iv) Lift the *"On"* lamp clear, and unclip and remove the reset lamp.

(v) Pull the turns counter chassis clear of the retaining slots on the chassis and lift turns counter assembly clear.

323 The replacement of the turns counter assembly is the reverse of the removal procedure. When refitting the "spring" flexible drive, lock the counter pinions and push on the drive, at the same time turning it clockwise.

Removal/replacement of idler wheels

324 To remove the idler wheels proceed as follows:

(i) Remove the turns counter assembly as detailed in paragraph 322.

(ii) Turn the speed control knob to the highest speed.

(iii) Slide the top idler arm clear of the assembly, being careful not to damage or stretch the spring.

(iv) Slide the second idler arm clear of the assembly, being careful not to damage or stretch the spring.

(v) Turn the speed control knob to medium or low speed.

(vi) Slide lower (high speed) idler arm clear of assembly and lift clear, being careful not to damage or stretch the spring.

(vii) To remove/replace individual idler wheels:

(a) Remove the spring retaining clip and lift the washer and then the wheel clear of the idler arm spindle.

(b) Replace in the reverse order with the small boss nearer the idler arm.

Note: The lowest wheel (high speed) is fitted with the large boss next to the idler arm and on earlier models it is fitted to the arm which has the spring clip.

325 Before replacing the idler wheels, ensure that they rotate freely and that the special idler wheel arm is the lowest one. To replace the idler wheels, reverse the removal procedure.

Removal/replacement of supply reel motor assembly (Fig. 8)

326 To remove the supply reel motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove the deck cover plate as detailed in paragraph 303.

(iii) Remove the power unit as detailed in paragraph 320.

(iv) Remove the supply reel carrier by slackening grub screw and lifting clear.

(v) Remove the packing washer(s) from the motor spindle.

(vi) Remove the spring clip at the constant friction brake arm pivot, and ease arm clear of motor assembly.

(vii) Lift the plastic brake linkage clear of brake actuating arm.

(viii) Remove two bolts and one screw holding the top plate to the motor assembly and speed arm bracket.

(ix) Remove the brake return spring and lift motor top plate clear of tape deck.

(x) Remove the electrical plug from the motor assembly.

(xi) Remove the nuts securing the motor assembly to the tape deck chassis and lift motor clear of tape deck.

327 The replacement of the supply reel motor is the reverse of the removal procedure.

Note: After replacing the motor assembly check the adjustment as follows. Ensure that the reel carrier is parallel with the deck by using a straight edge across the carrier face. Adjust motor securing nuts as required.

Removal/replacement of take-up motor assembly (Fig. 8)

328 To remove the take-up motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Remove the deck cover plate as detailed in paragraph 303.

(iii) Remove the power unit as detailed in paragraph 320.

(iv) Remove the take-up reel carrier by loosening the grub screw, unlooping the counter drive belt and lifting clear. Unloop the belt from the motor spindle.

(v) Remove the packing washer and 'C' clip from the motor spindle.

(vi) Remove the three bolts and screw holding the top plate to the motor assembly and speed arm bracket.

(vii) Lift the plastic brake linkage clear of the brake actuating arm and lift top bracket clear of motor.

(viii) Remove electrical plug connections from the lower two pins on the motor body.

(ix) Remove the nuts and washers securing the motor assembly to the tape deck chassis and lift motor clear of tape deck.

329 Before replacing the motor assembly ensure that the anti-vibration mountings (if fitted) are in good condition, and, when refitting the reel carrier, that the counter mechanism gears are adequately meshed but without binding. To replace motor assembly reverse the removal procedure.

Note: After replacing motor assembly check the adjustment as follows. Refit cover plate and adjust height adjuster to its lowest position. Adjust the packing washers until the carrier surface is $\frac{3}{32}$ in (2·3 mm) above the cover plate. Tighten the motor securing nuts and, with a straight edge across the face, check that the reel carrier is parallel with deck. Adjust motor securing nuts as required.

Removal/replacement of capstan motor assembly (Fig. 10)

330 To remove the capstan motor assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.

(ii) Lay the recorder on one side.

(iii) Remove cable clip from C101 securing clamp.

(iv) Remove electrical plug connector.

(v) Remove the four bolts holding the capstan motor bracket to the tape deck chassis (see Fig. 10).

(vi) Ease motor and bracket (complete) clear of the tape deck.

(vii) Remove the four nuts securing the capstan motor to the anti-vibration mountings, unsolder the capacitor connections and lift the capstan motor clear.

(viii) Remove the stepped pulley from the capstan motor spindle.

(ix) Remove fan from motor spindle.

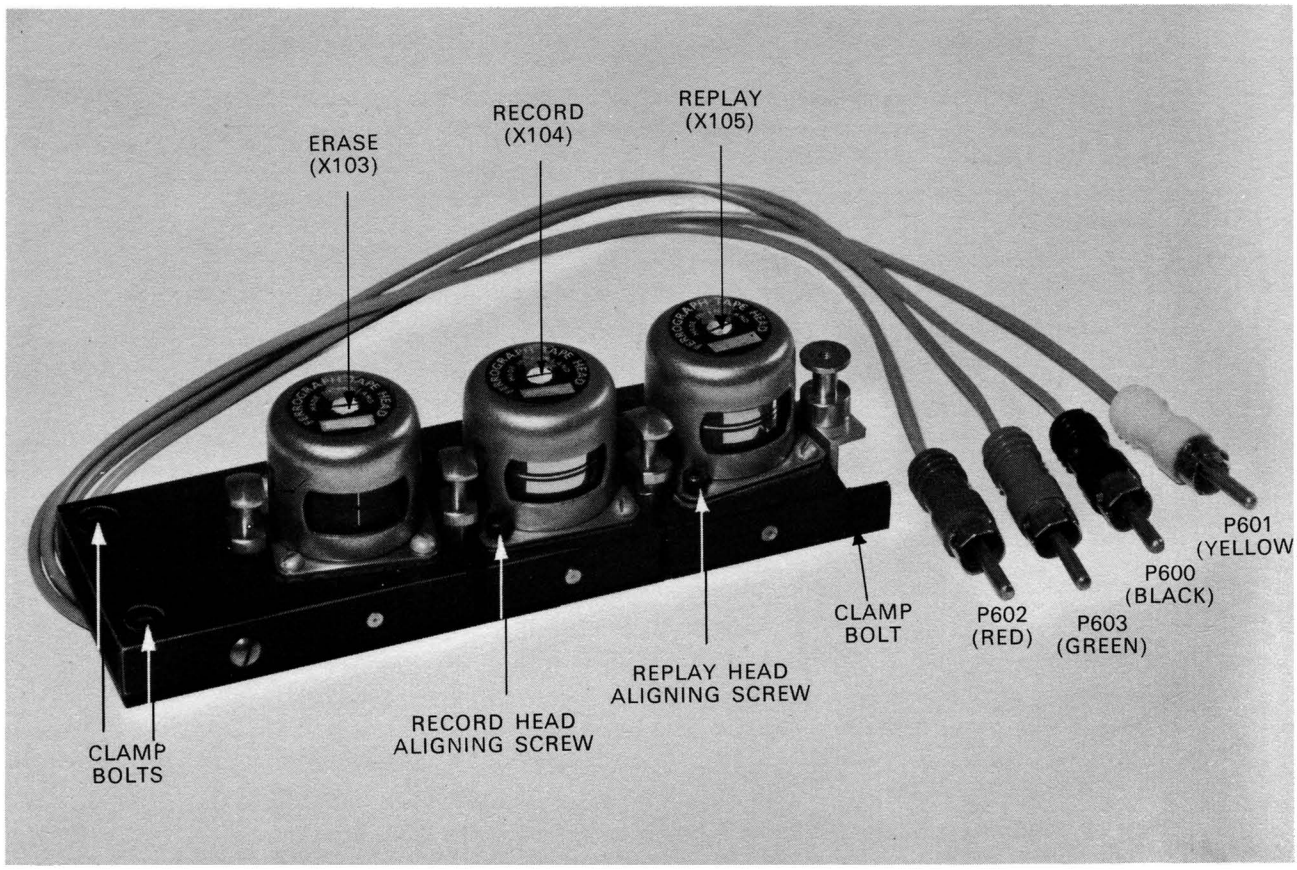


FIG. 9. HEAD ASSEMBLY

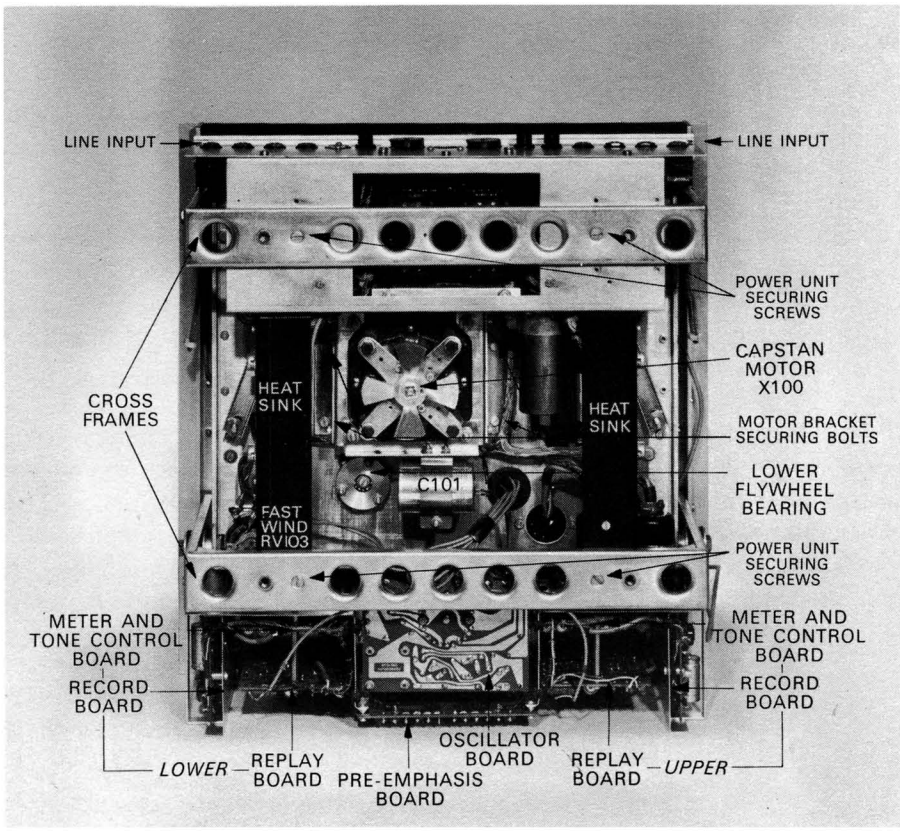


FIG. 10. RECORDER CHASSIS—REAR VIEW

331 Before replacing the capstan motor ensure that the anti-vibration mountings are in good condition. To replace the capstan motor assembly reverse the removal procedure. While doing so, ensure that the motor pulley is centrally situated through the hole in the deck plate, or the idler wheels may not engage properly.

Removal/replacement of pinch roller arm (Fig. 8)

332 To remove the pinch roller arm proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.
(ii) Remove the deck cover plate as detailed in paragraph 303.
(iii) Remove the deck control panel as detailed in paragraph 305.
(iv) Remove amplifier assembly as detailed in paragraph 307.
(v) Remove the two screws and locking plate (no plate on earlier models) securing the pinch roller bracket to the pinch roller arm and remove the pinch roller and bracket.
(vi) Remove the pinch roller arm return spring from the tag on the pinch roller arm.
(vii) Remove the micro-switch SW106 actuating arm.
(viii) Remove the two counter-balance weights by unscrewing the weights and spindles from the pinch roller arm (no weights fitted on modified arm of later models).
(ix) Remove the screw (from the bottom) and 'C' clip (from the top) of the pivot spindle and withdraw pivot spindle from the bottom of the tape deck chassis.
(x) Ease the pinch roller arm clear of the assembly from the front.

333 To replace the pinch roller arm reverse the removal procedure. After the pinch roller arm has been replaced, the gap between armature and the pinch roller arm must be set correctly as detailed in Section 4A paragraph 406.

Removal/replacement of spindle and/or flywheel (Figs. 8 and 10)

334 To remove the spindle and/or flywheel proceed as follows:

(i) Remove the pinch roller arm as detailed in paragraph 332.
(ii) Remove the screw from the lower end of the flywheel spindle (Fig. 10).
(iii) Slacken the pinch clamp which is located just above the surface of the flywheel.
(iv) Withdraw the capstan spindle upwards.
(v) Lift the flywheel clear of the lower flywheel bearing and remove from the recorder.

335 Before replacing the flywheel ensure that the spring is firmly fitted to the top and grease the spring and lower flywheel bearing using a high viscosity grease. On later models the spring has been replaced by a fixed pin in the flywheel. To replace the flywheel reverse the removal procedure, fitting the spindle so that the lower end is almost flush with the bottom bearing plate but slightly recessed into the bearing.

Note: After replacing the flywheel, check the adjustment of the gimbal bearing and flywheel as detailed in Section 4A.

Removal/replacement of head assembly (Figs. 3, 5 and 9)

336 To remove the head assembly proceed as follows:

(i) Remove the recorder from case as detailed in paragraph 301.
(ii) Remove the deck control panel as detailed in paragraph 305.

(iii) Unplug the erase and record head leads from the phono socket at the rear of the amplifier (Fig. 5)—there are four connections on stereo models (Fig. 3).

(iv) Remove the replay board connections as follows:

(a) On mono models (Fig. 4) the lead with a red sleeve connected to the two bottom right-hand pins on the board.

(b) On stereo models (Fig. 2) the lead with a white sleeve from the lower replay board and the lead with a red sleeve from the upper replay board and in each case it is the two bottom right-hand pins on the board.

(v) Remove the cable clip from C101 securing clamp.

(vi) Pull back the loading arm to the *"Load"* position and remove the four clamp bolts from the head assembly (Z in Fig. 8).

(vii) Lift the head assembly clear of the raised platform, threading the cables through the holes in the chassis and raised platform.

337 To replace the head assembly reverse the removal procedure, ensuring that the pressure arms are correctly located with respect to their actuating pins in the loading arm. When reconnecting the leads, check that they do not foul the fan blades on the capstan motor assembly.

Removal/replacement of heads (Fig. 9)

338 To remove one of the heads proceed as follows:

(i) Remove the complete head assembly as detailed in paragraph 336.

(ii) To enable the head plate to be removed it is first necessary to remove one of the tape guides by loosening the screw on the underside of the head assembly.

(a) For the *Erase* head, remove the L.H. tape guide then remove the screws on the front and rear flanges.

(b) For the *Record* head, remove the centre tape guide.

(c) For the *Replay* head, it is not necessary to remove any guide.

(iii) Remove the spindle holding the head mounting plate to the main head assembly by sliding it towards the rear.

(iv) Raise the head plate, easing the leads through the hole. On the *Record* and *Replay* heads take care not to lose the springs under the two right-hand fixing screws.

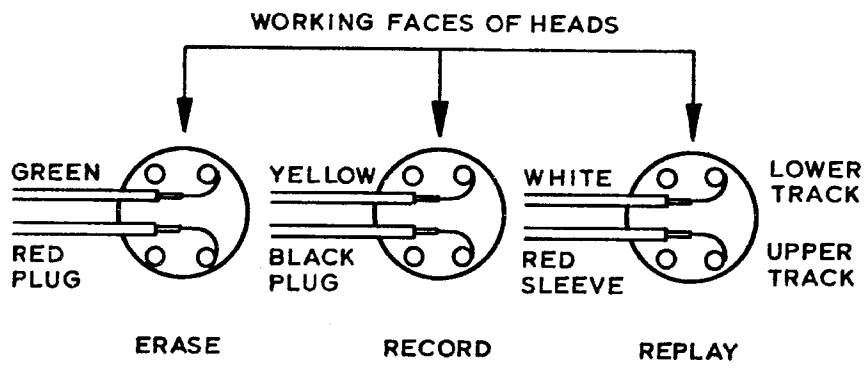


Fig. 301 Head Wiring

(v) Unsolder the leads to the head pins, noting to which pin the braid is soldered (normally the left-hand pin viewed from front face) and on stereo models which lead is soldered to the rear two pins (Upper Track).

(vi) Remove the four screws which fasten the heads to the mounting plate. On the *Record* and *Replay* heads take care not to lose the spring under the socket-headed screw at the front left of each head.

339 To replace a head, reverse the removal procedure, ensuring that the springs are refitted to the *Record* and *Replay* heads. After a *Record* or *Replay* head has been replaced (or refitted) and the head block remounted, it must be re-aligned correctly. The socket-headed aligning screw (Fig. 9) should be set so that the head cap appears vertical, then the height checked as in Fig. 12. The head height is adjusted by inserting or removing thin shims of B.P. (or non-magnetic material) between the head and its mounting plate, and retightening the fixing screws. As the head face must remain vertical, shims of equal height must be inserted front and rear. The gap azimuth alignment should then be set accurately as in paragraph 420 or 426.

MODIFICATION NOTES

Test Procedures and Adjustments

CONTENTS

MODIFICATION NOTES

A - Mechanical

General

401 Before proceeding with mechanical adjustments it is good practice to carry out a general overhaul, as detailed in *Section* 1E.

402 Remove the recorder from case and remove the deck cover plate and deck control panel as detailed in Section 3. Check that the settings of the Voltage Selectors agree with the power supply voltage available, and connect the recorder to the power supply. Set the function control to *Stop* and then switch *On* the recorder. Except where specified otherwise, the deck should be loaded with a full 7 in. reel of Long Play tape.

Solenoids, Micro-switches, Motors and Brakes

403 To check the correct operation of solenoids, micro-switches, motors and brakes proceed as follows:—

(i) Turn the function switch to *Pause* and check that there is no "chatter" when the start solenoid is energised. If it does occur, this is usually due to incorrect setting of the operating stud of the economy switch SW103.

(ii) Should the stud of SW103 require resetting, disconnect the power supply and operate the start lever mechanism by hand until it is fully engaged with the start solenoid. Slacken the locknut and adjust the operating stud until it is ·015—·020 in. (0·4—0·5 mm) from the body of the micro-switch. Reconnect the power supply and repeat (i) above. If satisfactory, retighten the locknut and proceed to (iv). If chatter occurs, proceed to (iii).

(iii) If chatter occurs, slightly increase the distance between the operating stud and the body of the micro-switch until the chatter ceases (the distance must not be so great that the micro-switch is not operated). Retighten the locknut.

(iv) Ensure the microswitch SW102 is operated immediately before SW103. If not, adjust the operating stud of SW102 accordingly. Do not forget to retighten the locknut after adjustment.

(v) Turn the function switch to *Pause* (energising *Start* solenoid) and check that the gap between the brake shoe and the reel carrier drum is equal all round and is approximately $\frac{1}{32}$ in. (0·8 mm). If not, slacken the two nuts holding the brake arm and reset the arm, ensuring that on returning to *Stop* the pin on the end of the arm is not exerting pressure on the plastic linkage and holding off the brake.

(vii) Turn the function control to *Fast*. Check the action of the *Fast Wind* control, ensuring that the tape winds freely in either direction.

(viii) With the tape travelling at maximum speed on *Fast*, return the function switch to *Stop* and check that the tape comes to rest smoothly and without snatching or tape spillage. Repeat with the tape travelling in the opposite direction and adjust the brakes if necessary (see (ix)).

(ix) To adjust the brake tension, release the spring tension adjusting screw (Fig. 8) — on later models use a 3BA Allen key — and re-clamp in the correct position. Moving the adjuster away from the reel carrier increases the brake spring tension, and vice versa.

Counter Mechanism

404 To check the operation of the counter mechanism proceed as follows:

(i) Check that the counter gears do not over-mesh and bind on the blind portion of the teeth.

(ii) Check that the turns counter belt drive is running correctly on both pulleys, and that rotating the take-up reel carrier in each direction drives the turns counter.

(iii) Switch the function control to *Run* and check that the counter mechanism movement operates satisfactorily.

(iv) Switch the function control to *Stop* and check the function of the *zero* button. Switch back to *Run* and check that counter operates satisfactorily.

(v) Examine the two lampholder assemblies and connections and ensure that there is no chance of a short-circuit.

Idlers and Idler Arms

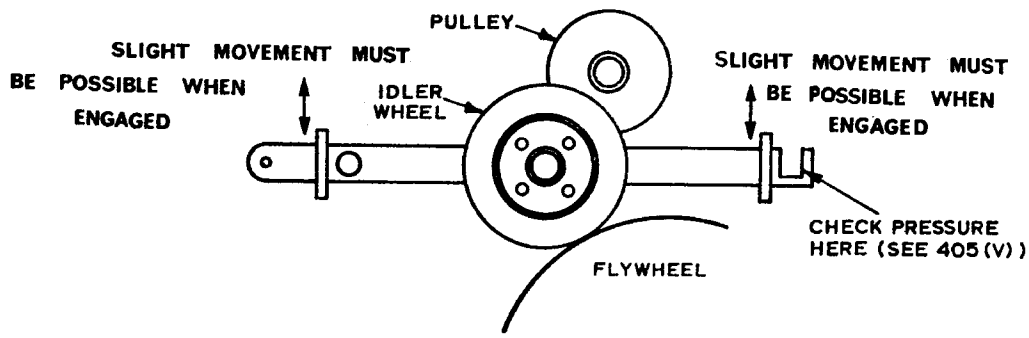


Fig. 401 Idler and Idler Arm Assembly

405 To check the operation of the idlers and idler arms proceed as follows:

(i) With the recorder switched *On* and the function control set to *Stop*, check that there is clearance between the leaf spring (Fig. 8) and the appropriate idler arm, at each setting of speed change switch SW104. This is adjusted by the set screw (Fig. 8) on the start lever arm.

(ii) Check that on turning to *Pause* at each setting of the speed change switch SW104, a slight movement of the idler arm is possible (Fig. 401).

(iii) Check the height of idler wheels in relation to the stepped capstan motor pulley (Fig. 8). The pulley should be such that no idler wheel runs on the edge of a step.

(iv) Ensure that (when fitted) the outrider on the high speed arm (lowest arm) keeps the idler wheel lying square to the flywheel and drive pulley. In this condition the outrider should be touching the deck plate (not fitted on later models).

(v) Check that the pressure applied by the start lever spring to the idler arm is 200 grams (see Fig. 401).

(vi) On Pause, check that the leaf spring is held clear of the start lever adjusting screw.

Run Solenoid and Pinch Roller Arm

406 To check and adjust the run solenoid and pinch roller arm proceed as follows:

(i) Switch the function control to *Run* and ensure that the run solenoid (Fig. 8) is energised and that the armature moves the pinch roller arm assembly. The solenoid should be reasonably quiet in operation. Return function control to *Pause*.

(ii) Place a $\frac{3}{16}$ in. (2·38 mm) thick bar between the armature and its carrying arm and switch the function control to *Run*.

(iii) Check that the pinch roller is just touching the capstan spindle. If not, slacken the two screws holding the pinch roller bracket and adjust. Re-tighten screws when in correct position.

(iv) Switch the function control to *Pause* and remove the bar from between the armature and its carrying arm.

(v) When the function control is set to *Run* there should be a gap between the armature and the arm. This ensures that the spring has full control of the pressure of the pinch roller, independent of the magnetic force.

(vi) With the function control still on *Run*, check that there is approximately $\frac{1}{32}$-$\frac{1}{16}$ in. (0·8-1·6 mm) clearance between pinch roller bracket and plastic ramp. If not, reset the plastic ramp.

(vii) With a Tension Gauge check the pressure of the pinch roller on the drive spindle. This should be between 1200-1400 grams, adjustable by the armature adjusting nut on the pinch roller arm (Fig. 8).

(viii) Switch the function control to *Pause*, and check that the pinch roller moves clear of the capstan by ·015-·02 in. (0·4-0·5 mm).

(ix) Check the action of the pinch roller, it should be very free in movement and a slight end play is preferred.

(x) Switch the function control to *Run*.

(xi) Check that the pinch roller runs parallel to the capstan spindle.

(xii) There should be no heavy run up or down of the tape caused by the pinch roller. This can be determined by observing the behaviour of the tape in the right-hand guide. Check that the tape runs reasonably central on the pinch roller.

(xiii) Check the action of micro-switch SW106 (top of Run solenoid); this should short out the supply motor on *Run* and re-energise it on *Pause*.

(xiv) With the function control at *Run* check the armature does not bind on the sides of the arm by moving the assembly gently back to the "off" position to see if any stiffness is present.

Loading Arm & Pressure Arms

407 To check the operation of the loading arm and pressure arms proceed as follows:

(i) With the function control at *Pause* check that the clearance between the pinch roller and capstan spindle is ·015 - ·02 in (0·4-0·5 mm) and check the clearance for tape loading with the lever in the *Load* position.

(ii) Check the action of the loading arm, which should not be too stiff, and in the *Load* position some slight movement should be possible.

(iii) Set the function control to *Run* and check the pressure setting of the pressure pad arms which should be 25 grams measured on the arm "neck" behind the pad. Each pad should be self-aligning except on the playback head, which has the mumetal wing.

(iv) On the playback head pressure pad ensure that the Mu-Metal Wing is locked in the correct position such that the pad is making proper contact with the head face, and the wing is not fouling the tape.

Cut-Out Switches and Damping Arms

408 To check the operation of the cut-out switches and damping arms proceed as follows:

(i) Replace the deck control panel as detailed in Section 3 paragraph 306.

(ii) Load the recorder with $8\frac{1}{4}$ in. reels and ensure that almost all the tape is on the take-up reel, as this is the most critical condition.

(iii) Switch *On* recorder and observe the operation of the tape transport in all positions of the function control. Check that the spring of the right-hand tape tension/auto-stop arm is not so strong that the arm traps the tape continuously against the insulated auto-stop pillar. However, it is normal for it to trap the tape on starting to run, while the take-up reel is picking up speed.

(iv) Switch the function control to *Pause* and unloop tape from right-hand guide. Ensure that when left free the arm touches the "live" auto-stop pillar, lighting the *Reset* lamp and switching off the motors after approx. 1.5 secs.

(v) Replace tape and check that *Reset* lamp is still lit and that the function control has to be switched to *Stop* before lamp is extinguished.

(vi) Ensure that when the left-hand guide and the tape damping arm are bridged by the metal foil on the tape, the auto-stop relay is tripped and the *Reset* lamp lights.

Tape Transport

409 To check the correct operation of the tape transport system proceed as follows:

(i) Load a tape on the recorder and switch *On*. Turn the function control to *Run* and observe the tape running. There must be no evidence of tape buckling due to guides being incorrectly set.

(ii) Check the setting of the spool height adjusters and see that the tape does not scrape on the spool rim. At the lowest setting of the spool height adjusters the edges of the tape must not scrape on the plastic supports of the cover box.

(iii) Check ease of tape loading.

Capstan and Flywheel

410 To check the correct operation of the capstan and flywheel proceed as follows:

(i) Grasp the flywheel and the capstan spindle (Fig. 8) — there should be slight end play and a very small rotary movement between the two components.

(ii) The freedom of the gimbal bearing can be observed on a W. & F. meter as in paragraph 415 by gently pressing either side of the gimbal, when a change in the tape speed should be observed. There should be a complete return to normal on releasing the pressure on the bearing.

(iii) Set the recorder to *Run* at $7\frac{1}{2}$ in/sec (19 cm/sec), then return to *Stop*. Check that the flywheel runs for approximately 45 seconds after switch off.

Friction Brake

411 To check the correct operation of the friction brake proceed as follows:

(i) Check that the lever is free moving.

(ii) Switch *On* the recorder and set the function control to *Run.*

(iii) Observe that the brake causes just sufficient damping of the supply reel to prevent overrun on starting.

Record Button

412 To check the correct operation of the record button proceed as follows:

(i) Press the *Record* button and check that the action is smooth.

(ii) Check that the arm will not lock in the *Record* position (down) when the function control is at *Fast* and *Stop.*

(iii) Switch the Function control to Pause and try to press the Record button. It should not operate unless the Record Release catch is moved to the left, and is locked down on allowing the Record Release catch to return.

(iv) Check the action of the Record Release arm and its return spring.

(v) With the function control at *Pause,* operate the *Record* button and then switch the function control to *Stop* and check that the record arm is released.

(vi) Check that the switch operating bracket on the record arm is clear of the micro-switch arms when in the *"Off"* position.

(vii) Press the *Record* button and check that micro-switches SW107 and SW108 (Fig. 8) are operated by the bracket well before the arm locks "on".

Main Function Switch and Lock Lever

413 To check the correct operation of the function switch and lock lever proceed as follows:

(i) Switch the function control to *Fast,* then back to *Stop* and then check that the lock lever prevents the control from being turned to *Pause.*

(ii) Release lock by operating the *Lock Release* button and observe that the Function Control advances to the normal Stop position so that it can now be turned to *Pause.*

(iii) Check that the lock lever spindle is rigidly fastened to the frame, but allows the lever to operate freely.

Tape Speed Using Measured Tape or Stroboscopic Tape

414 To measure the speeds of the recorder a stroboscopic tape should be used as in (viii) below, or (in the absence of special equipment) a speed tape can be calibrated and used as follows:

(i) Take a full 7 in. reel of tape and make a visible mark near the beginning. At exactly 31 ft. 3 in. (9·525 m) from this mark make another mark and give this mark a number 0. At $3\frac{3}{4}$ in (95·25 mm) intervals along the tape and either side of the 0 mark, place further marks with the numbers —1, —2, —3, —4, —5, —6, (towards end of tape) and +1, +2, +3, +4, +5, +6 (towards start of tape). At tape speeds of 15, $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ in/sec (38, 19, 9·5 and 4·75 cm/sec), it takes exactly 25, 50, 100 and 200 seconds respectively for a tape of 31 ft 3 in. (9·525 m) to pass through the machine.

(ii) Load the tape onto the recorder and switch *On.* Set speed change switch to a predetermined speed.

(iii) With the function control at *Pause,* align the start mark on the speed tape with a visible and static element (*e.g.* tape guide).

(iv) Switch the function control to *Run* and after exactly 25, 50, 100 or 200 seconds depending on tape speed selected (use stop-watch), switch control back to *Pause.*

(v) Read off speed variation in percentages from the mark on the tape as indicated by the static element selected in (iii). On faster speeds it is advisable to repeat (iii) to check accuracy of measurement.

(vi) If speed is incorrect, do not adjust whilst speed tape is operating. Recheck after each adjustment.

(vii) The tape speed accuracy should be better than ± 1%. If outside these limits check the idler wheel (paragraph 405) and the pinch roller pressure (paragraph 406), and also the action of the wrap-round type brakes (paragraph 403) and friction brake (paragraph 411). Recheck tape speed (ii) to (v) after each adjustment.

(viii) As an alternative to paragraphs (i)-(vii) above, a stroboscopic tape (100 stripes per 7½ in (19 cm)) could be replayed as part of a full 7 in reel of tape, and viewed under 50 Hz mains lighting. If the tape is running at exactly the nominal speed the stripes will appear to stand still. If the tape appears to move, count the number of dark stripes progressing (tape speed too fast) or regressing (tape speed too slow) past a fixed mark in a certain number of seconds. This should be not more than the following:

15 in/sec (38 cm/sec) — 2 stripes per second
7½ in/sec (19 cm/sec) — 1 stripe per second
3¾ in/sec (9·5 cm/sec) — 1 stripe per 2 seconds

Note: This test cannot be used at 1⅞ in/sec (4·75 cm/sec) tape speed.

Wow and Flutter Measurement

415 To measure wow-and-flutter using a meter with DIN weighting, *e.g.* Miniflux type ME101, proceed as follows:

(i) Connect oscillator output of wow-and-flutter meter to tape recorder *Line Input.*

(ii) Connect meter input to *Low Level* output socket of recorder.

(iii) Record the fixed frequency for approximately 5 minutes.

(iv) Play back the recording and

(a) Adjust W & F meter input sensitivity.

(b) Select total wow-and-flutter reading.

(c) Select percentage range.

(v) Note the wow-and-flutter reading.

(vi) Repeat (ii) to (v) for all three tape speeds.

(vii) Check the readings noted in (v) against the following figures:

(a) Normal Speed models
Less than 0·08% at 7½ in/sec (19 cm/sec)
0·15% at 3¾ in/sec (9·5 cm/sec)
0·20% at 1⅞ in/sec (4·75 cm/sec)

(b) High Speed models (suffix H)
Less than 0·08% at 15 in/sec (38 cm/sec)
0·10% at 7½ in/sec (19 cm/sec)
0·15% at 3¾ in/sec (9·5 cm/sec)

(viii) If the wow-and-flutter readings are out of tolerance, thoroughly check that the General Overhaul detailed in Section 1 E has been carried out. All mechanical operations can affect the wow-and-flutter readings and if a general overhaul fails to bring the recorder into tolerance, carry out the checks and adjustments detailed in paragraphs 403 to 413 of this section.

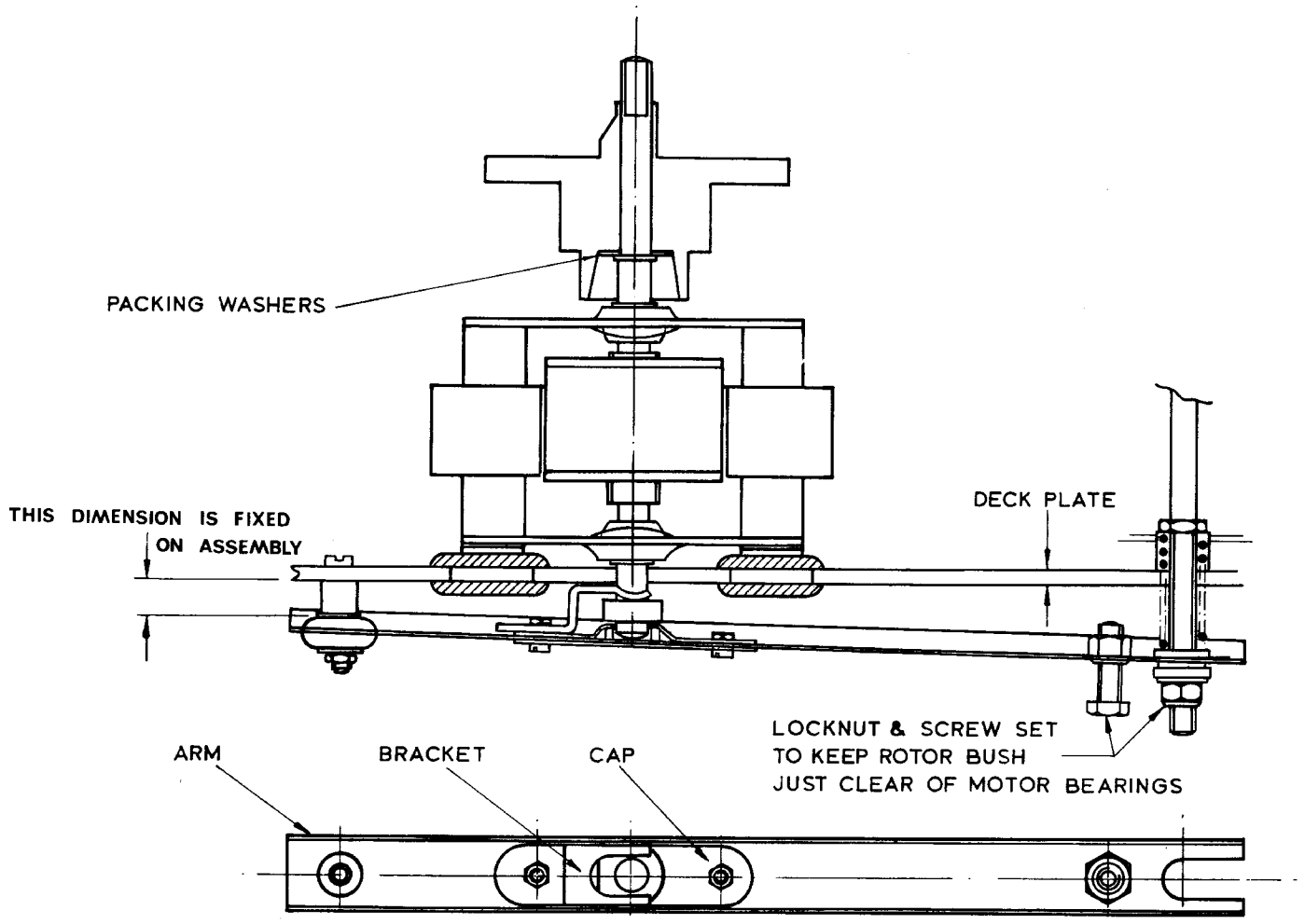


FIG. 11. REEL HEIGHT ADJUSTMENT

	TRACK WIDTH		
		Head	Tape
MONO (Half-track)	Erase	0·130	0·124
	Record	0·100	0·100
	Replay	0·100	0·100
STEREO (Half-track)	Erase	0·120	0·110
	Record	·093	·091
	Replay	·093	·091
STEREO (Quarter-track)	Erase	·055	·049
	Record	·043	·043
	Replay	·043	·043

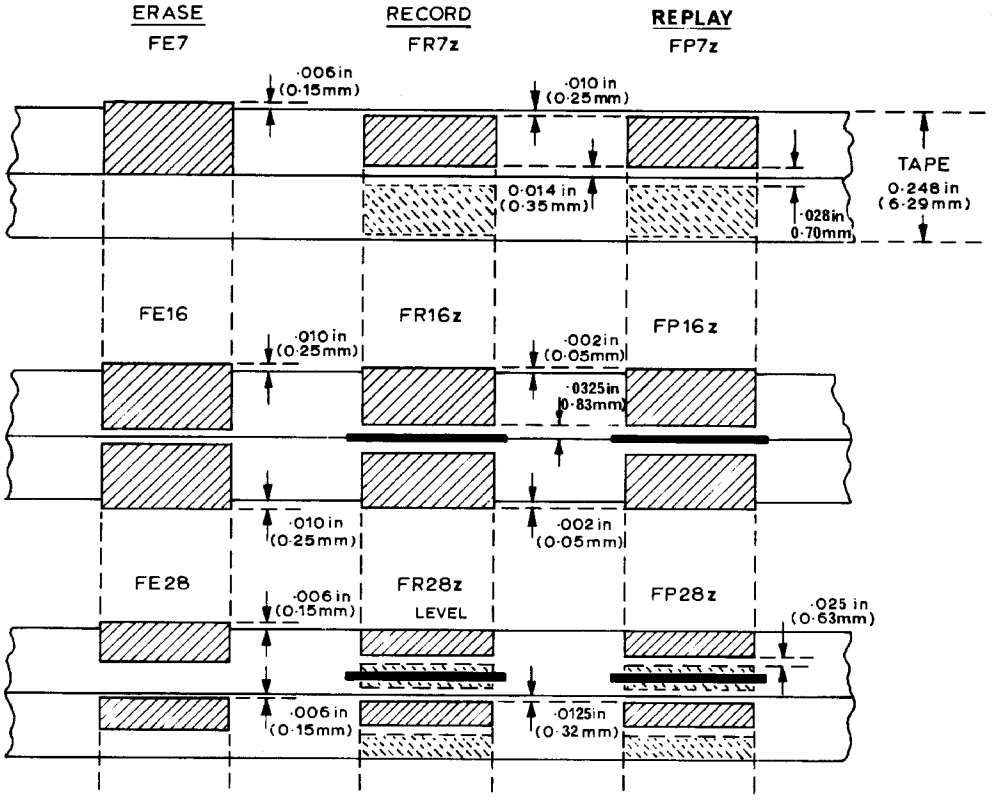


FIG. 12. HEAD ALIGNMENT

Electronic Section

General

416 The following paragraphs detail the overall electrical test procedure. It must be emphasised that existing settings should not be disturbed unless accurate test equipment is available.

417 The tape heads should be thoroughly demagnetised before any alignment procedure is carried out or before standard test tapes are played. Calibration of these tapes will be permanently damaged if they are played on magnetised heads.

418 An earthed soldering iron must not be used to make connections to any part of the electronics while the recorder is switched on, since this may cause current surges resulting in damage to transistors or head magnetisation. For the same reason, the replay head must not be reconnected to the amplifier while the recorder is switched on.

Equipment Required

419 The instruments required to carry out the alignment procedure are as follows:

(i) Test Tape(s) { Head alignment; Frequency Response (for each speed); Peak (or 0 VU) signal level }

(ii) Millivoltmeter (3mV-3V).

(iii) AF Signal Generator (20Hz-20kHz, sine-wave).

(iv) Distortion Meter.

(v) Head Demagnetiser.

(vi) Wave Analyser or 1kHz Filter.

(vii) Milliammeter (0-50mA).

(viii) Throughout the following tests and adjustments, Ferrotape type B or Scotch Dynarange 203 tape *must* be used. If neither of these is available, reasonable results can be obtained using similar *low noise* tape, such as Ampex 444 or BASF LP35LH.

Warning: Before starting the test and alignment procedure, see that the General Overhaul as detailed in *Section* 1 E has been carried out and that the mechanical checks laid down in part A of this *Section* have been carried out. For example, oxide on tape heads or incorrect setting of pressure pads will lead to imperfect contact between heads and tape, causing high frequency losses.

Replay Head Alignment

420 To carry out the head alignment proceed as follows:

(i) Load a standard head alignment tape onto the recorder and switch *On*.

(ii) Connect a millivoltmeter to the *600 Ohm Output* and turn the function switch to *Run*.

(iii) Using the 4BA azimuth aligning screw (Fig. 9), adjust the replay head for the highest output on the millivoltmeter, *Output* switch at *Tape*.

Note: On stereo recorders both tracks should be monitored while this adjustment is being carried out.

(iv) Inspect visually to make sure that the tape runs over the replay head at the correct height, see Fig. 12.

Note: On quarter track mono and quarter track stereo the top edge of the active head face should coincide with the top edge of the tape (use transparent leader). On half track stereo the head is set centrally on the tape allowing ·002 in (0·05 mm) of head face to be visible at each edge of the tape. On half track mono the top edge of the active head face should be ·010 in (0·25 mm) below the top edge of the tape (use transparent leader). If any adjustment is necessary, see paragraph 339.

Replay Frequency Response

421 To check the replay frequency response proceed as follows:

(i) Load an appropriate response test tape onto the recorder and switch *On.*

(ii) Connect a millivoltmeter to the *600 Ohm Output* and set the *Output* switch to *Tape,*

(iii) Turn the function control to *Run* and measure the recorder output on the millivoltmeter for all recorder speeds as follows:

35 μ sec — 15 in/sec (38 cm/sec) 30Hz-20kHz ± 2dB
50/3180μ sec — 7½ in/sec (19 cm/sec) 30Hz-17kHz ± 2dB
90/3180μ sec — 3¾ in/sec (9·5 cm/sec) 40Hz-14kHz ± 3dB
120/1590μ sec — 1⅞ in/sec (4·75 cm/sec) 60 Hz- 7kHz ± 3dB

Replay Response Correction

422 If the frequency response is not within the limits specified, the level of the high frequencies may be adjusted by means of capacitors C313, C315 and C316 and the low frequencies by R315 and R317. These components are soldered to pins on the replay board (see Figs. 2, 4 and 20) and are adjusted at each recorder speed as follows:

(*a*) *Normal speed models, Serial No. 70,500 to 74,999*

Speed	*High 7½ in/sec (19 cm/sec)*	*Medium 3¾ in/sec (9·5 cm/sec)*	*Low 1⅞ in/sec (4·75 cm/sec)*
High Frequencies	C316	C315	C313
Low Frequencies	R315	R317	R317

(*b*) *Normal versions of recorder, Serial No. 70,000 to 70,499 and 75,000 onwards, and all high speed models (suffix H)*

Speed	*High 7½ or 15 in/sec (19 or 38 cm/sec)*	*Medium 3¾ or 7½ in/sec (9·5 or 19 cm/sec)*	*Low 1⅞ or 3¾ in/sec (4·75 or 9·5 cm/sec)*
High Frequencies	C313	C315	C316
Low Frequencies	R317	R317	R315

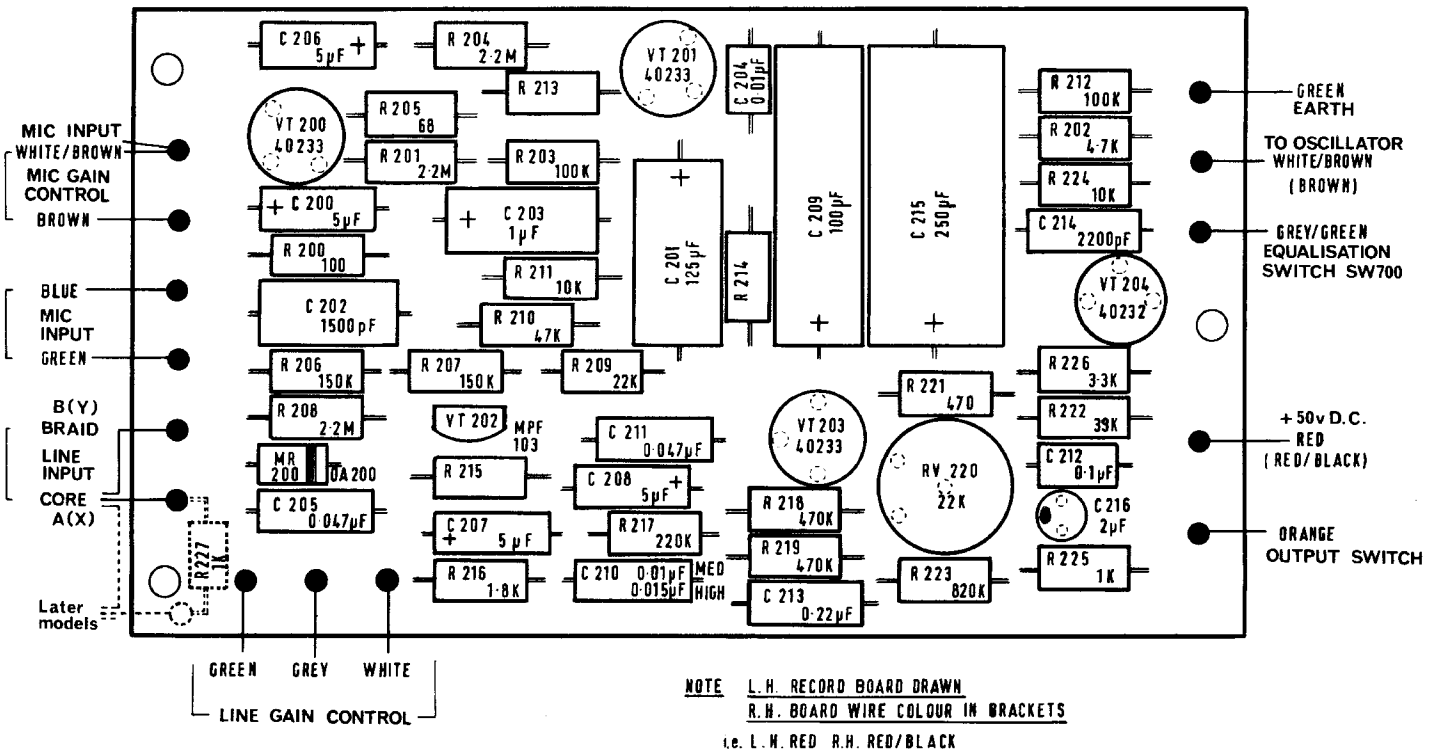


FIG. 19. RECORD BOARD

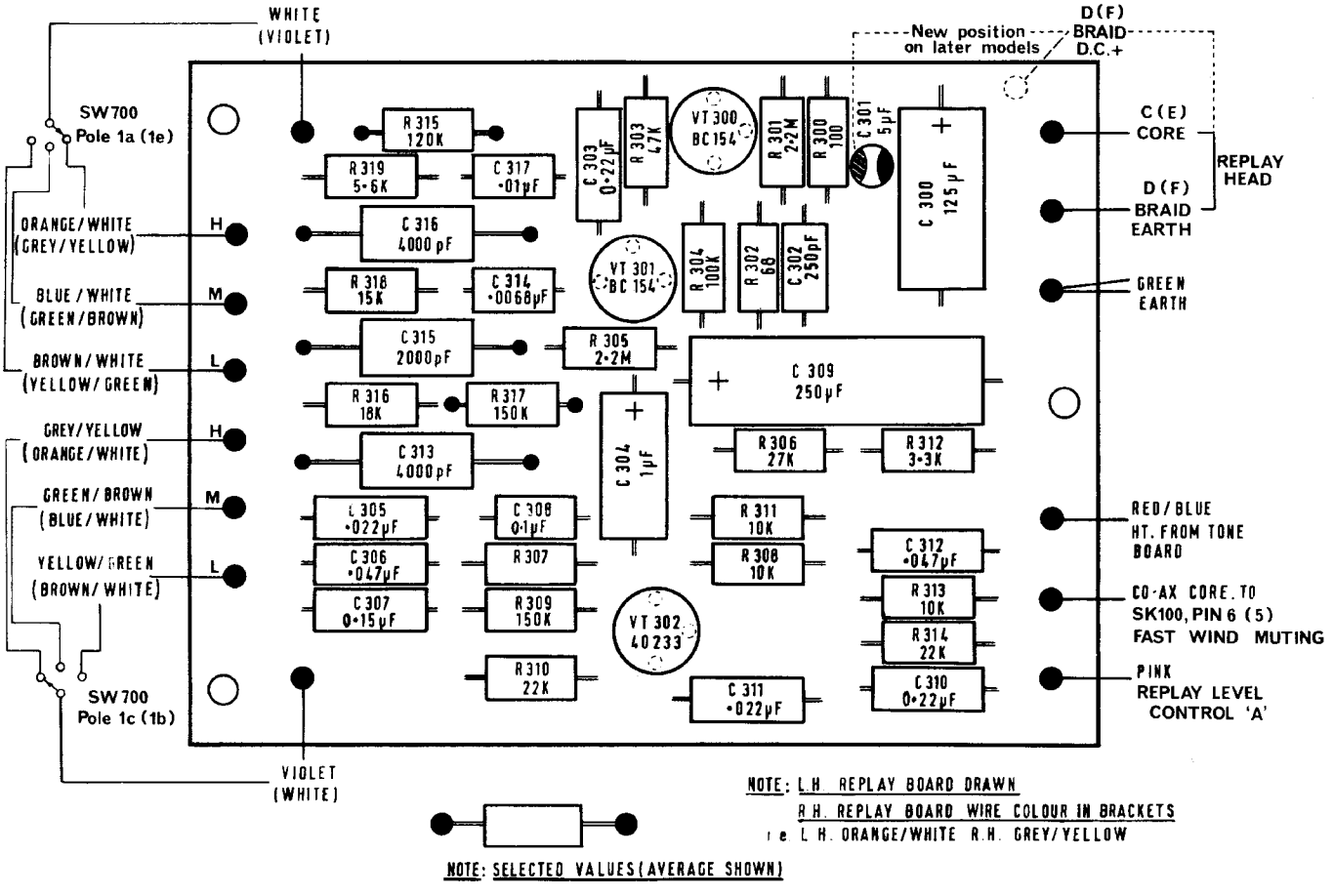


FIG. 20. REPLAY BOARD

It is not usually necessary to replay test tapes at $1\frac{7}{8}$ in/sec. (4·75 cm/sec). The value of the treble control capacitor C313 may be twice that required for $3\frac{3}{4}$ in/sec. (9·5 cm/sec).

Note: Test tapes are usually recorded across the full width of the tape and when they are replayed on quarter track heads, fringing flux from that part of the tape between the tracks will cause a rise in bass response. At 40Hz this is approximately + 2dB on the upper track and + 3 dB on the lower track. This rise should not be compensated for, since it is not present when the correct recording track width is used.

Replay Output Level

423 To adjust the output level using a European test tape proceed as follows:

Note: On European test tapes the maximum recording level is 32 milli-maxwells per mm at 15 in/sec. (38 cm/sec) and $7\frac{1}{2}$ in/sec. (19 cm/sec); and 25 milli-maxwells per mm at $3\frac{3}{4}$ in/sec. (9.5 cm/sec) and $1\frac{7}{8}$ in/sec. (4·75 cm/sec). This level corresponds to a reading of + 4VU on the meter, which is greater than full scale deflection, and in this case a millivoltmeter is used across the *600 Ohm Output.*

(i) Load the peak level test tape onto the recorder, set the speed selector to $7\frac{1}{2}$ in/sec. (19 cm/sec) and switch *On.*

(ii) Connect a millivoltmeter to the *600 Ohm Output,* and turn to *Run.*

(iii) Locate the preset control marked "A" (RV726 under hinged flap) and adjust control to give a reading of 2 volts on the millivoltmeter, with the *Output* switch at *Tape.*

424 To adjust the output level using an American test tape proceed as follows:

(i) Load the test tape onto the recorder, set the speed selector to $7\frac{1}{2}$ in/sec. (19 cm/sec) and switch *On.*

(ii) Locate the section on the tape which has a recorded level 4-6 dB below peak level, corresponding to O VU.

(iii) Locate the preset control marked "A" (RV725 under hinged flap) and adjust control to give a reading of 0 VU on the internal VU meter.

MIC and LINE Inputs

425 To check the inputs proceed as follows:

(i) Connect the AF Signal Generator giving a 1kHz signal (1mV) to the M*ic* input.

(ii) Switch *On* recorder and turn up *Mic* and *Output* controls. Set the *Output* switch to *Source* and check that the signal is heard on the internal loudspeaker (external on models 702 and 704).

(iii) Connect the AF Signal Generator giving a 1 kHz signal ($\frac{1}{2}$V) to the *Line Input* and turn up *Line* gain control. Check that the signal is heard on the internal loudspeaker.

(iv) Switch the *Output* switch to *Tape,* and check that no output is heard.

(v) With the *Output* switch ar *Normal* and the function switch at *Run,* check that no signal is heard. Press the *Record* button and check that an output is then heard on the internal loudspeaker.

Note: On models Serial No. 75,000 onwards, the *Normal* position is not fitted and 425 (v) should be omitted.

Record Head Alignment

426 To align the record head ensure that the Replay Head is correctly aligned as in paragraph 420, then proceed as follows:

(i) Load a tape onto the recorder and set the speed selector to 7½ in/sec. (19 cm/sec.).

(ii) Connect an AF Signal Generator to the *Line Input* and a millivoltmeter to the *600 Ohm Output.*

(iii) Switch *On* the recorder and adjust the Signal Generator ouput to give 200 mV on the meter at a frequency of 16 kHz (output switch at *Source*).

(iv) Turn the function control to *Run* and press the *Record* button.

(v) Adjust the azimuth setting of the record head by adjusting the aligning screw (Fig. 9) for maximum replay output whilst monitoring from the tape, *Output* switch at *Tape.*

(vi) On stereo models, both tracks should be checked before a final position is adopted.

(vii) Check the position of the tape (using transparent leader) in relation to the record head, see Fig. 12.

Note: On quarter track mono and quarter track stereo the top edge of the active head face should coincide with the top edge of the tape (use transparent leader). On half track stereo the head is set centrally on the tape allowing ·002 in (·05 mm) of head face to be visible at each edge of the tape. On half track mono the top edge of the active head face should be ·010 in (0·25 mm) below the top edge of the tape (use transparent leader). If any adjustment is necessary, see paragraph 339.

HF Bias Setting

427 To set the HF bias proceed as follows:

(i) Load either Ferrotape type B or Scotch Dynarange 203 tape onto the recorder and set the speed selector to 7½ in/sec. (19 cm/sec.). On stereo models, set *Record Mode* switch to *Stereo.*

(ii) Connect an AF Signal Generator giving 1 kHz to the *Line Input* and millivoltmeter to the *600 Ohm Output.*

(iii) Switch *On* recorder and set *Output* switch to *Tape.* Turn to *Run,* press the *Record* button and adjust the Signal Generator output to give a reading of approximately 200 mV on the millivoltmeter.

(iv) Locate and adjust the preset control "B" (RV723 or RV724 on Figs. 2 or 4) for a maximum reading on the millivoltmeter. Turn to *Pause.*

(v) Switch the *Meter* switch to *Bias* and ensure that a reading of 0 VU is obtained on the record level meter. If this reading is not obtained adjust RV 721 (see Fig. 5).

Note: On stereo models adjust RV721 for upper track and RV722 for lower track (see Fig. 3).

(vi) Connect the millivoltmeter to the collector of VT 203 (transistor can) on the record board.

(vii) Tune L601 (through access hole in oscillator board, see Fig. 5) until millivoltmeter reading (bias leakage voltage) is less than 300 mV.

Note: On stereo models adjust L601 for upper track and L602 for lower track (see Fig. 3).

(viii) On stereo models repeat (ii)-(vii) for the other channel.

(ix) On stereo models, with the meter switch at *Bias*, release *Record* button, turn *Record Mode* switch to *Upper* and press *Record* button. Check that the bias still reads 0 VU on the Upper meter. If not, adjust RV 606 on oscillator board.

(x) Release the *Record* button and turn *Record Mode* switch to *Lower*. Press *Record* button and check that the bias reads approximately 0 VU on the Lower meter.

Note: Do not turn the *Record Mode* switch while the *Record* button is depressed (*i.e.* on *Record*) as this will polarise the head.

Record/Replay Frequency Response Measurement

428 To measure and adjust the record/replay frequency response proceed as follows:

Note: It is essential that the recording tests using constant tones are carried out at 20 dB below maximum recording level *i.e.* producing 200 mV at the *600 Ohm Output*. Frequency responses carried out at recording levels significantly higher than this are meaningless due to the danger of tape overload at the high frequencies.

(i) Load unused, or bulk erased, Ferrotape type B or Scotch Dynarange 203 tape onto the recorder.

(ii) Connect an AF Signal Generator to the *Line Input* and a millivoltmeter to the *600 Ohm Output*.

(iii) Set the speed selector to $7\frac{1}{2}$ in/sec. (19 cm/sec.) and switch *On*.

(iv) Set the function control to *Run* and press the *Record* button.

(v) Vary the Signal Generator output between 30 Hz and 17 kHz, keeping the signal at a constant voltage level.

(vi) With the *Output* switch at *Tape*, check that the frequency response on the millivoltmeter does not vary more than $\pm$ 2 dB.

(vii) Repeat (iv)-(vi) for all three speed settings of the recorder. The Signal Generator settings and frequency response limits are as follows:

15 in/sec. (38 cm/sec.)	30 Hz — 20 kHz $\pm$ 2 dB
$7\frac{1}{2}$ in/sec. (19 cm/sec.)	30 Hz — 17 kHz $\pm$ 2 dB
$3\frac{3}{4}$ in/sec. (9·5 cm/sec.)	40 Hz — 14 kHz $\pm$ 3 dB
$1\frac{7}{8}$ in/sec. (4·75 cm/sec.)	50 Hz — 7 kHz $\pm$ 3 dB

(viii) If the frequency response is within the limits specified, set the speed selector to $7\frac{1}{2}$ in/sec. (19 cm/sec.) and adjust RV220 (located on record board) until the signal output level is the same on *Source* as on *Tape*. On stereo models repeat (iv)-(viii) on the other channel.

(ix) If the frequency response does not fall within the limits specified adjust as detailed in paragraph 429.

Record/Replay Frequency Response Correction

429 If the record/replay frequency response does not fall within the limits specified in paragraph 428 the equalisation board components (Fig. 15 - 18) may be adjusted as follows:

(i) On normal speed models

Speed	*7½ in/sec. (19 cm/sec')*		*3¾ in/sec. 9·5 cm/sec.)*		*1⅞ in/sec. (4·75 cm/sec.)*	
Frequency	5kHz–15kHz	15kHz–18kHz	3kHz–10kHz	10kHz–15kHz	1kHz–5kHz	5kHz–8kHz
Upper Track	C704	R713	C703	R712	C702	R711
Lower Track	C710	R717	C709	R716	C708	R715

(ii) On High Speed models (suffix H)

Speed	*15 in/sec. (38 cm/sec.)*		*7½ in/sec. (19 cm/sec.)*		*3¾ in/sec. (9·5 cm/sec.)*	
Frequency	8kHz–18kHz	18kHz–22kHz	5kHz–15kHz	15kHz-18kHz	3kHz–10kHz	10kHz–15kHz
Upper Track	C704	R713	C703	R712	C702	R711
Lower Track	C710	R717	C709	R716	C708	R715

(iii) When frequency responses are within the limits specified, carry out adjustments detailed in paragraph 428 (viii).

Record Head Muting

430 To check the record head muting proceed as follows:

(i) Load an unused or bulk erased tape onto the recorder, switch *On* and select the medium speed.

(ii) Connect the AF Signal Generator, giving 1 kHz, to the *Line* input (*Upper* on stereo models) and adjust to give + 3 VU on the internal meter.

(iii) On stereo models switch the *Record Mode* selector to *Stereo*. Turn the function switch to *Run. Do* not *press the Record button.*

(iv) After running a section of the tape, turn the function control to *Stop*. Rewind tape to the 'start' position and then turn function control to *Run*.

(v) Turn recorder *Output* fully up and check that no recording has been made.

(vi) On stereo models, repeat (ii) - (v) for *Lower* channel.

Noise Level Measurement

431 To measure the noise level on the replay amplifier proceed as follows:

Note: Avoid double mains earths on the recorder and associated test equipment during noise measurements.

(i) Load a Ferrotape type B or Scotch Dynarange 203 tape onto the recorder and set the speed selector to 7½ in/sec. (19 cm/sec.)

(ii) Connect a millivoltmeter to the *600 Ohm Output.*

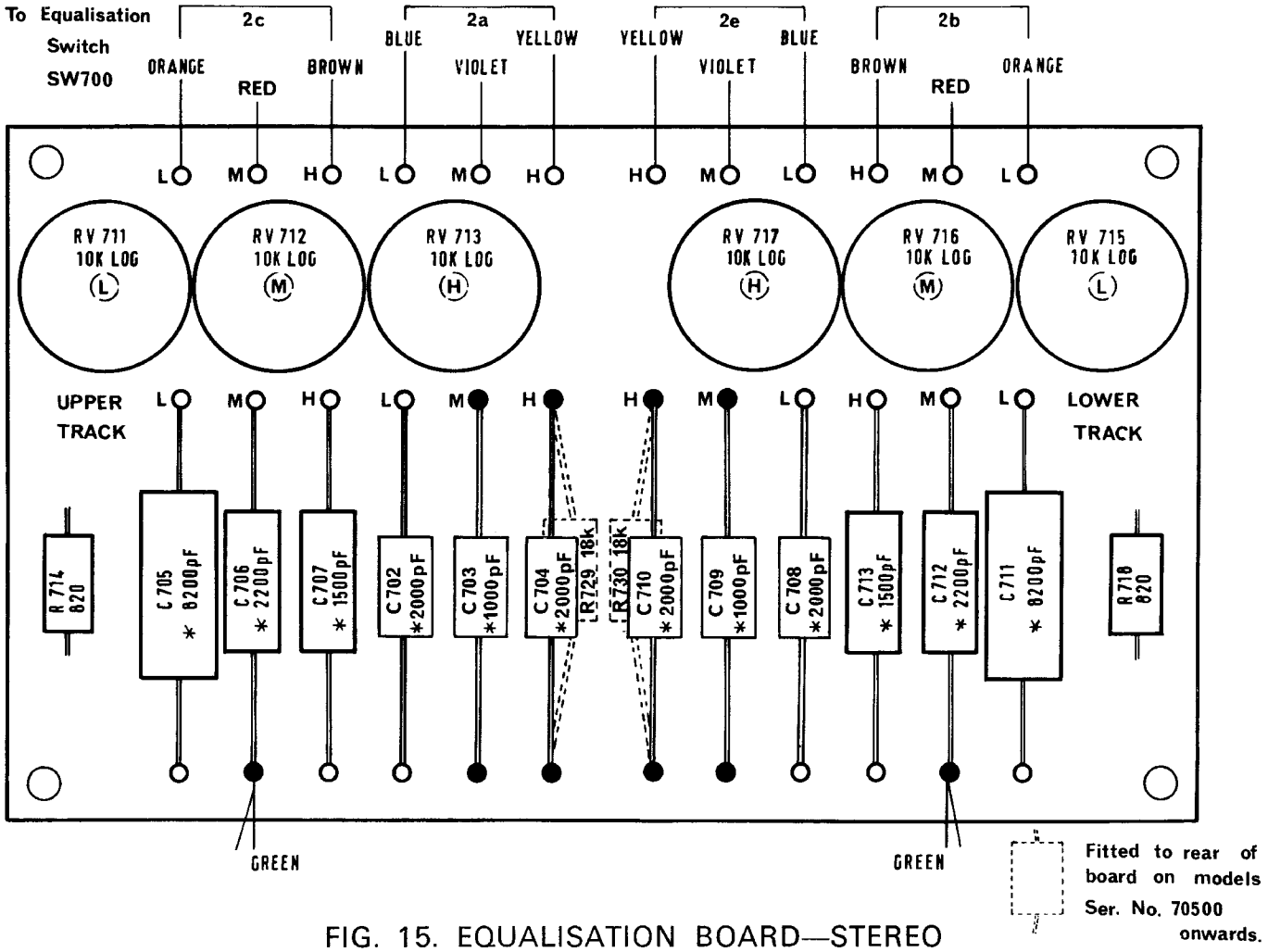


FIG. 15. EQUALISATION BOARD—STEREO

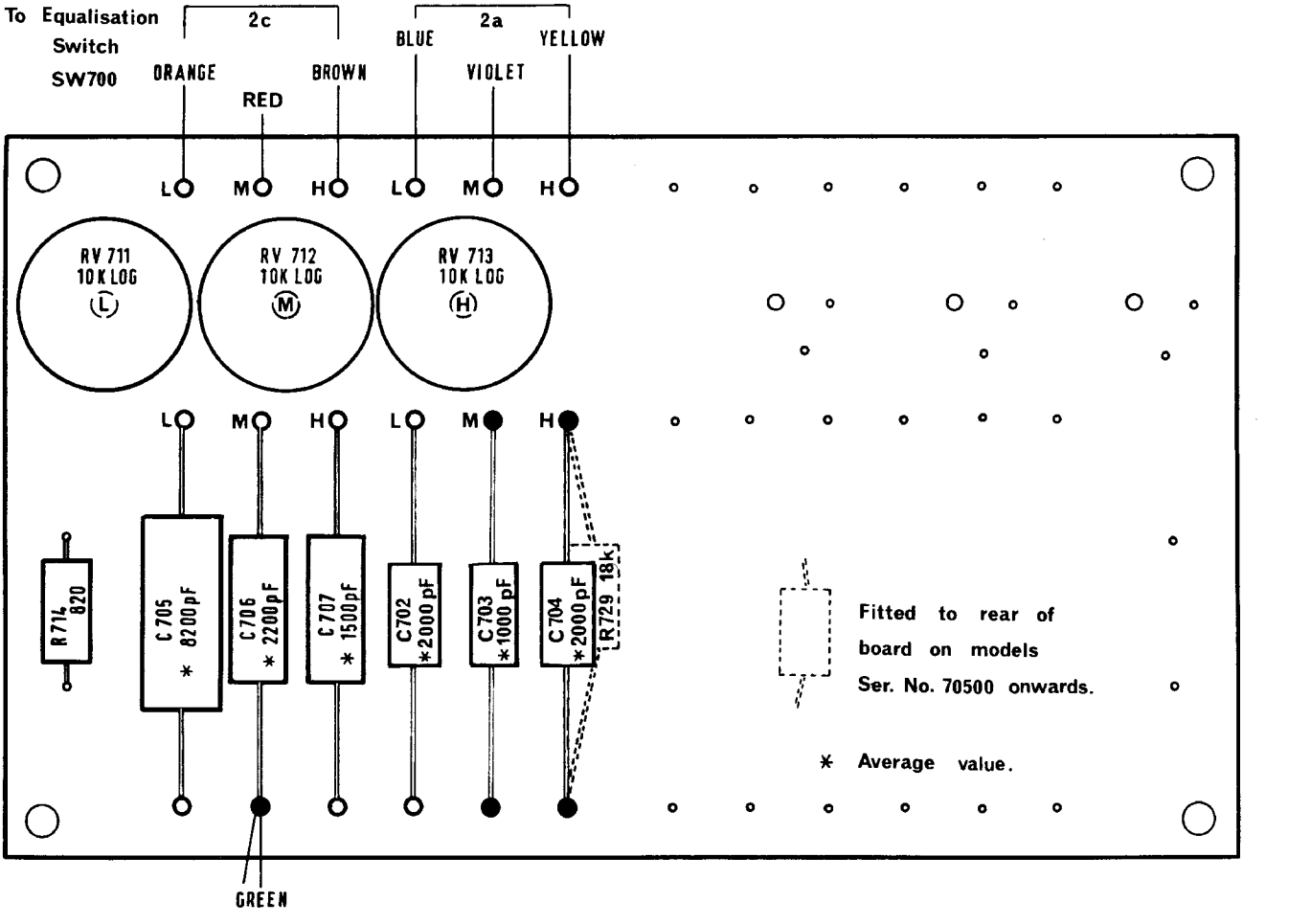


FIG. 16. EQUALISATION BOARD—MONO

(iii) Short-circuit the replay head with a very short wire across the pins on the replay amplifier board, to avoid hum loops. These are the two lower R.H. pins on the board, (see Fig. 20).

(iv) Switch *On* recorder and turn the function control to *Pause.*

(v) Note the reading on the millivoltmeter. It should be less than 1·5 mV.

(vi) Switch *Off* recorder.

(vii) Remove the short circuit from the replay board.

(viii) Switch *On* recorder and note the reading on the millivoltmeter.

(ix) The hum picked up should not increase the reading to more than 3 mV for half track models or 4 mV for quarter track models.

(x) On stereo models repeat (iii) - (ix) for the other channel. See Fig. 20 for replay amplifier board connections.

(xi) Turn to *Run* and press *Record* button.

(xii) Run tape for a short time with *Mic* and *Line* gain controls at zero, then rewind.

(xiii) Replay erased part of tape and measure the output on the millivoltmeter. This should be less than –55 dB below a peak level recording (2V), *viz.* less than 3·56 mV. On stereo models repeat (xi)-(xiii) for other channel.

Noise Level Correction

432 If the noise level readings noted in 431 (v), (ix) and (xiii) are more than those specified proceed as follows:

(i) Reverse the power supply connections to the capstan and take-up motors in turn to check if the hum level is reduced.

(ii) Check transistor VT300 and if necessary replace with a low noise transistor.

(iii) Check capacitor C301 (which is a tantalum low-leakage type) by connecting a milliammeter in series with the head lead (switch *Off* when doing this). The reading, after recorder has been switched on for a few seconds, should not exceed 0·5 μA. If it is greater than this replace C301.

(iv) Recheck noise level after each of (i) to (iii) and on stereo models repeat tests on each channel.

Distortion Measurement

433 To measure overall record/replay distortion proceed as follows:

(i) Load a Ferrotape type B or Scotch Dynarange 203 tape onto the recorder and switch *On*. Set the speed control and equalisation switch to 7½ in/sec. (19 cm/sec.)

(ii) Connect an AF Signal Generator giving 0·5V at 1 kHz to the *Line Input,* and adjust the *Line* gain control to produce 2V at the *600 Ohm Output* measured on the millivoltmeter (*Output* switch at *Source*).

(iii) Turn the function control to *Run,* and press the *Record* button.

(iv) Record for a short time then rewind the tape.

(v) Connect the distortion meter or the Wave Analyser to the *600 Ohm Output* and replay the tape.

(vi) With the *Output* switch at *Tape,* measure the distortion. At 2 volt output it must be < 3% at 7½ in/sec. (19 cm/sec.).

Note: The distortion cannot be measured while recording as, due to the low signal levels involved, any stray bias pick-up in the output leads would give misleading results.

Causes of Excessive Distortion

434 Excessive distortion may be caused by one of the following:

(i) Too high a recording level. Recheck Output Level, paragraph 423 or 424, and *Tape/Source* setting, paragraph 428, (viii).

(ii) Incorrect bias. Recheck H.F. Bias setting, paragraph 427. Note that Ferrotape type B or Scotch Dynarange 203 must be used for distortion and bias measurements, as other brands of tape may give different results.

(iii) Faulty Signal Generator. Measure the distortion of the AF Signal Generator by connecting directly to the Distortion Meter and also check that the input to the recorder does not exceed 10V.

(iv) Electronic Fault. If (i), (ii), and (iii) have not cured the distortion, recheck the calibration of the distortion meter. If the distortion is still high, carry out the following checks:

(a) Connect the AF Signal Generator to the *Line Input*, set the *Output* switch to *Source* and connect the Distortion Meter to the *600 Ohm Output*. At 2V output the distortion should be less than 0·3%.

(b) Replay the Output Level test tape as in paragraph 423 or 424 and measure the distortion at the *600 Ohm Output*. With the European test tape (peak level) this should be less than 3%; with the American test tape (–5 dB below peak level) this should be less than 1%.

(c) If the distortion is excessive in only (a) above, check the record pre-amplifier (VT202, 203). If it is only excessive in (b), check the replay pre-amplifier (VT300-302). If the distortion is excessive in both (a) and (b), check the Meter and Tone Control amplifier (VT400,401). If neither gives excessive distortion, carry out (d) below.

(d) The distortion of the record head signal may be checked by connecting the distortion meter to the *Bias* tag of the *Meter* switch with the switch NOT at *Bias* (on stereo models check that it is the correct track). Connect the AF Signal Generator to the *Line Input* and set the *Output* switch to *Source*. Connect the millivoltmeter to the *600 Ohm Output* and adjust the signal to give 2V output. The *Record* button should be held down manually (to unshort the record head), with the function switch at *Stop* (to avoid any bias masking the signal). The record distortion measured on the *Meter* switch should be less than 0·3%.

Erasure

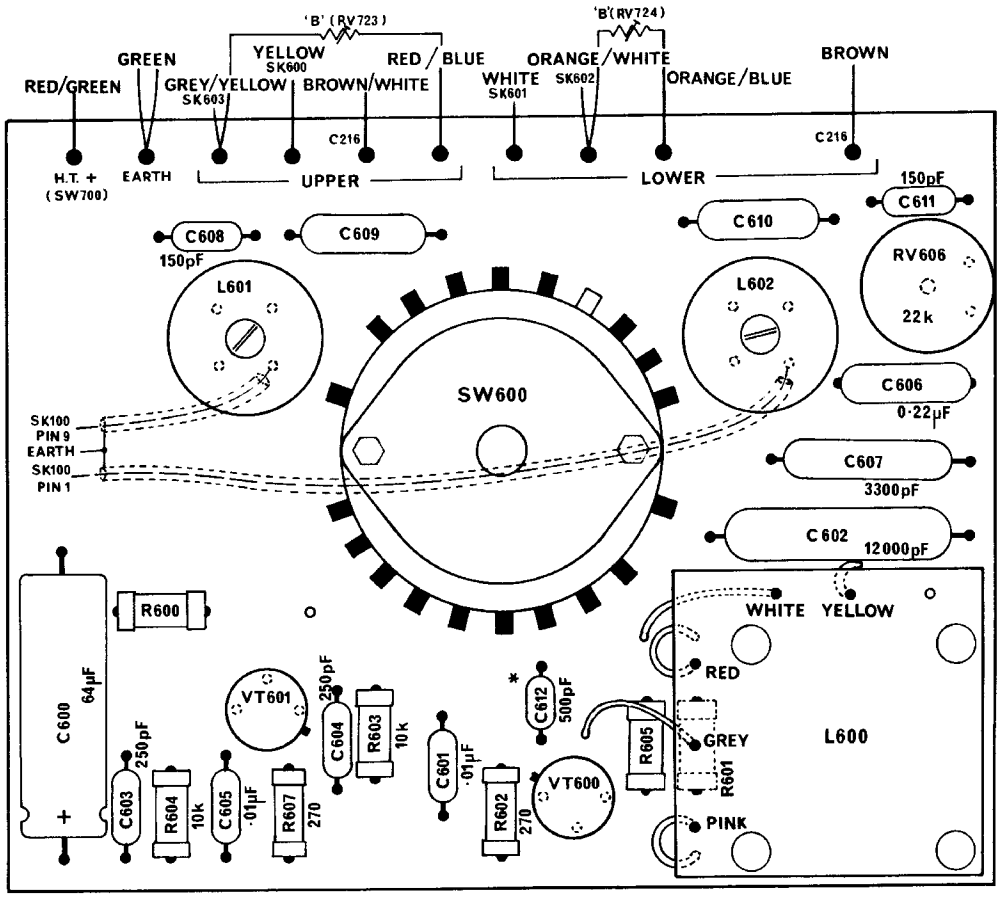
435 To check erasure proceed as follows:

(i) Load an unused or bulk erased tape onto the recorder, switch *On* and select the medium speed.

(ii) Connect an AF Signal Generator giving 1 kHz to the *Line Input* and adjust to give 2V at the *600 Ohm Output* measured on the millivoltmeter (*Output* switch at *Source*).

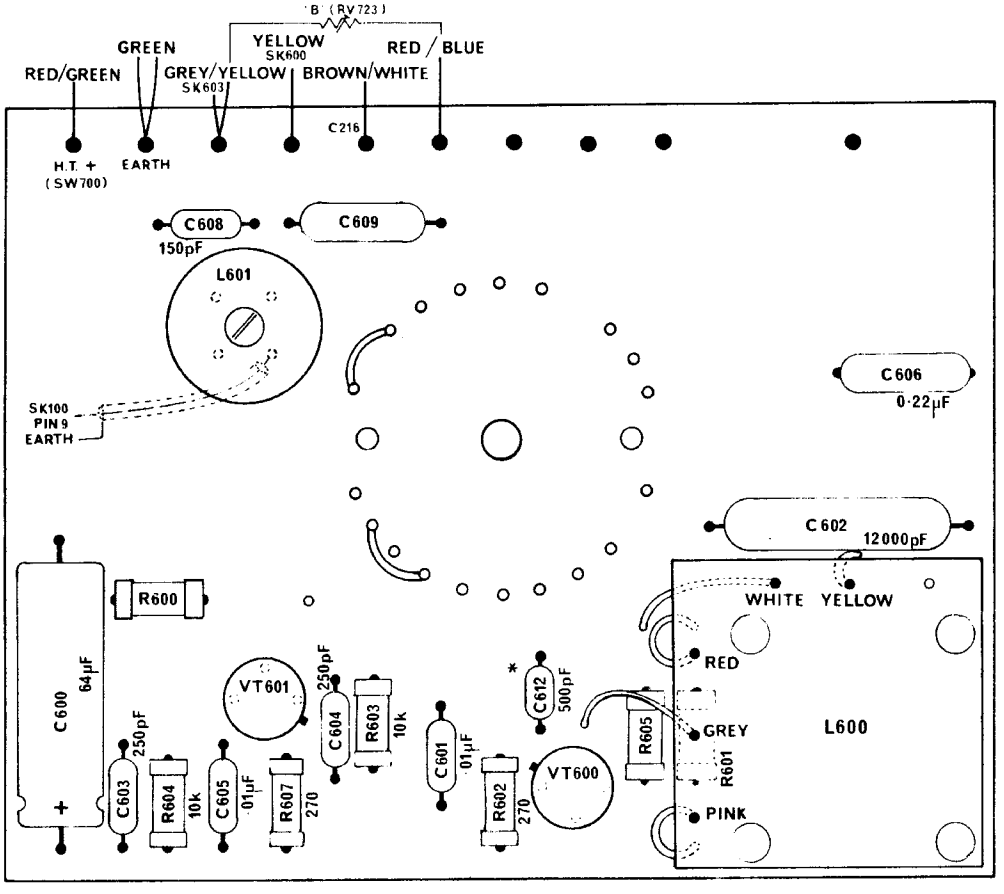
(iii) Turn to *Run*, note counter reading; press record button and record the 1 kHz signal on a predetermined length of tape. On stereo models record in *Stereo* position.

(iv) Wind back the tape to the middle of the recording (determined by counter reading) and disconnect the AF Signal Generator. Turn *Mic* and *Line* gain controls to zero.



* Fitted on later models.

FIG. 23. OSCILLATOR BOARD—STEREO



* Fitted on later models

FIG. 24. OSCILLATOR BOARD—MONO

(v) Re-record (*i.e.* erase) part of the tape. On stereo models record in *Stereo* position.

(vi) Connect the Wave Analyser (or millivoltmeter via the Filter) to the *600 Ohm Output* and tune to give a maximum at 1 kHz.

(vii) Replay the whole recording (*Output* switch at *Tape*) and note the difference in level between the recorded and erased sections of the tape.

(viii) On stereo models, repeat for each track with the *Record Mode* switch in the *Upper* or *Lower* position.

Note: The erased (residual) signal level must be more than 60 dB below peak level, *i.e.* less than 2 mV with reference to 2V.

Crosstalk

436 To measure crosstalk proceed as follows:

(i) Load an unused or bulk-erased tape onto the recorder and switch *On*.

(ii) Turn the speed and equalisation switches to $7\frac{1}{2}$ in/sec. (19 cm/sec.).

(iii) Connect an AF Signal Generator giving 1 kHz output to the *Line Input* and a millivoltmeter to the *600 Ohm Output*. On stereo models set the *Record Mode* switch to *Upper*.

(iv) Turn the function switch to *Pause* and press the *Record* button.

(v) Adjust the *Line* gain control to give 2V signal at the *600 Ohm Output* (*Output* switch at *Source*).

(vi) Turn the function switch to *Run* and record a section of the tape, then re-wind.

(vii) Connect a Wave Analyser (or millivoltmeter via a 1 kHz filter) to the *600 Ohm Output* (*Upper* track on stereo models).

(viii) Replay the tape (*Output* switch at *Tape*) and tune the Wave Analyser (or 1 kHz filter) for maximum reading.

(ix) On *mono* models, wind on the tape to the end of the recording then reverse the tape. Replay the unrecorded half of the tape, when the output should be less than –65 dB below the peak level reading obtained in (viii). If not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(x) On *half track stereo* models, replay the tape on *Upper* as in (viii), then connect the Wave Analyser to the *Lower 600 Ohm Output* and observe the readings, which should be less than –65 dB below the peak level reading. If not, see (xii). Wind on to the end of the recording and reverse the tape. Replay the tape and measure the output (peak level) on *Lower*, than connect the Wave Analyser to the *Upper 600 Ohm Output*, when the reading should again be more than –65 dB down. If not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(xi) On *quarter track* models, record on *Upper* as in (i)-(viii) above.

(a) Replay the tape, measuring first on *Upper* then on *Lower*. The difference should be greater than 65 dB. If not, see (xii).

(b) Wind on the tape to the end of the recording and reverse tape. Replay the tape, measuring on *Lower*, when the reading should be less than –65 dB below previous peak level reading on *Upper* (a). If not, check head heights as in paragraphs 420 (iv) and 426 (vii).

(c) Repeat the recording procedure (i)-(vii) but with the *Record Mode* switch at *Lower*.

(d) Wind back the tape and replay, measuring first on *Lower*, then on *Upper*. The difference should again be greater than 65 dB, and if not, see (xii).

(e) Wind on to the end of the recording and reverse the tape. Replay the tape, measuring first on *Upper*, then on *Lower*. In each case the reading should be less than –65 dB below the peak level reading on *Lower* (d), and if not, check the head heights as in paragraphs 420 (iv) and 426 (vii).

(xii) On stereo models the crosstalk between *Upper* and *Lower* tracks can usually be reduced by adjusting RV700 (see Fig. 3) for minimum.

Note: For a peak level output of 2V, –65 dB is 1·1 mV.

Replay Amplifier

437 To check the replay amplifier proceed as follows:

(i) Load a pre-recorded tape onto the recorder and switch *On*.

(ii) Replay the tape and check that the recording can be heard over the loudspeaker with the *Output* switch at *Tape*. Turn to *Stop*.

(iii) Turn the speed selector switch to the slowest speed and turn the function control to *Pause*.

(iv) Turn the *Output* control fully on and listen to the replay amplifier hiss. It should not contain any "crackles" or intermittent noises.

Loudspeaker Output

438 To measure the loudspeaker output proceed as follows:

(i) Load a peak level test tape onto the recorder and switch *On*.

(ii) With the function control at *Run*, the *Output* switch at *Tape*, and the *Output* control fully clockwise, measure the output from the *8-16 Ohm Speaker* jack across a 15 ohm, 10 watt resistor. Check that the output is at least 12 volts.

(iii) Connect the AF Signal Generator at 1 kHz to the *Line Input* and adjust the *Line* gain control to give peak level (2V) at the *600 Ohm Output* (*Output* switch at *Source*).

(iv) Connect the Wave Analyser or distortion meter to the *8-16 Ohm Speaker* output across the 15 ohm 10 watt resistor. With the *Output* switch still at *Source*, measure the distortion at 12 volts. Check that it is < 0·5%.

Power Amplifier

439 When a fault occurs on the power amplifier printed circuit board, it is recommended that the complete board be replaced. If this is not possible and an individual component is replaced, the quiescent current must be checked as follows:

(i) Connect a milliammeter in series with the d.c. supply to the board.

(ii) Short circuit the audio input to chassis.

(iii) Switch *On* the recorder and allow to stabilise for 5 minutes.

(iv) Measure the total current on the milliammeter. This should be between 20-25 mA. If it is not, adjust the trimmer resistor soldered across R506 until the correct reading is obtained.

MODIFICATION NOTES

Electronic # **Serial No. 78,300 onwards**

Paras. 426 (iv), 427 (iii), 428 (iv), 431 (xi), 433 (iii), 435 (iii), 436 (iv)

Before the Record button can be pressed on Pause or Run, the Record Release catch must be moved sideways.

MODIFICATION NOTES

Parts Lists

CONTENTS

MODIFICATION NOTES

Serial Nos. 70,500-74,499 inclusive

117V 60Hz MODELS (SUFFIX A)

Note: The parts lists are the same as for the corresponding 240V 50Hz model with the exceptions listed below.

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
RV103	625 Ω	30W	Wire-wound	582-019
R105	125 Ω	27W	Wire-wound	626-007
Capacitors				
C101	2·5μF	200V	A.C. Working	132-002
Miscellaneous				
X100	Capstan Motor (110V)			022-039
X101	Supply Reel Motor (75V)			022-037
X102	Take-up Reel Motor (75V)			022-038
TR700	Power Transformer (110V)			022-064
‡FS700	D.C. Fuse (1 Amp) 20 mm. x 5 mm. dia.			380-000
FS701	D.C. Fuse (1 Amp) 20 mm. x 5 mm. dia.			380-000
FS702	Mains Fuse (1·5 A) 20 mm. x 5 mm. dia. — Power Supply			380-004
VS700	Not fitted			
VS701	Not fitted			

FERROGRAPH
SERIES SEVEN

Serial Nos. 75,000- inclusive

100—DECK UNIT # See page 103

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
R100	68 Ω	2W	Wire-Wound	626-002
R101	220 Ω	2W	Wire-Wound	626-003
R102	15 Ω	½W	20%	625-08-15
RV103	2·5K Ω	25W	Wire-Wound	582-000
R104	15 Ω	½W	10%	625-08-15
R105	500 Ω	18W	Wire-Wound	626-000
R106	15 Ω	½W	20%	625-08-15
HR107	3·3K Ω	½W	20%	625-14-3K3
R108	220 Ω	2W	Wire-Wound	626-003
R109	1K Ω	½W	20%	625-08-1K
Capacitors				
C100	0·1 μF	250V	A.C. Working	132-000
C101	0·75μF	450V	A.C. Working	132-001
C102	0·1 μF	250V	A.C. Working	132-000
C103	0·1 μF	250V	A.C. Working	132-000
C104	0·1 μF	250V	A.C. Working	132-000
HC105	100μF	40V	Electrolytic	130-001
Miscellaneous				
SW100	Function Switch			750-000
SW101	Power Supply Switch (Rotary, 2 pole)			750-004
SW102	Start Switch (Motors)			748-000
SW103	Start Switch (Economy)			748-000
SW104	Speed Change Switch			750-002
SW106	Run Switch			748-000
SW107	Record Switch (Oscillator)			748-000
SW108	Record Contacts (Head)			
RL100	Auto-Stop Relay (24V)			622-000
HRL101	Take-Up Relay (24V)			622-000
L100	Start Solenoid			025-084
L101	Run Solenoid			025-083
MR101	Diode OA200 (or BAX16)			290-001
MR102	Diode OA200 (or BAX16)			290-001
HMR103	Diode OA200 (or BAX16)			290-001
P100	Plug 9 way			577-007
P101	Plug 8 way			577-001
LP100	Lamp LES, 14V			455-002
LP101	Lamp, LES, 14V			455-002

Serial Nos. 75,000- inclusive

Circuit Ref.		*Part Number*
FS100	Fuse 1 Amp, 5 mm. dia. x 20 mm.	380-000
X100	Capstan Motor (240V)	022-003
X101	Supply Reel Motor (150V)	022-010
X102	Take-up Reel Motor (150V)	022-011

Head Assemblies

		Models 713	Models 702-722	Models 704-724
X103	Erase Head	FE7	FE16	FE28
X104	Record Head	FR7z	FR16z	FR28z
X105	Replay Head	FP7z	FP16z	FP28z

200—RECORD BOARD (Assembly M025-104 H025-153)

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
R200	100 Ω	½W	20%	625-14-100
R201	2·2M Ω	½W	20%	625-14-2M2
R202	3·9K Ω	½W	5%	625-12-3K9
R203	100K Ω	½W	5% Low noise	624-002
R204	2·2M Ω	½W	20%	625-14-2M2
R205	68 Ω	½W	5%	625-12-68
R206	150K Ω	½W	10%	625-13-150K
R207	150K Ω	½W	10%	625-13-150K
R208	2·2M Ω	½W	20%	625-14-2M2
R209	22K Ω	½W	10%	625-13-22K
R210	47K Ω	½W	20%	625-14-47K
R211	10K Ω	½W	10%	625-13-10K
R212	100K Ω	½W	20%	625-14-100K
R213	1K Ω	½W	10%	625-13-1K
R214	27K Ω	½W	10%	625-13-27K
R215	2·2K Ω	½W	10%	625-13-2K2
R216	1·8K Ω	½W	10%	625-13-1K8
R217	220K Ω	½W	5%	625-12-220K
R218	1M Ω	½W	10%	625-13-1M
R219	470K Ω	½W	10%	625-13-470K
RV220	22K Ω	Linear Pre-Set		582-012
R221	470 Ω	½W	10%	625-13-470
MR222	8·2K Ω	½W	5%	625-13-8K2
HR222	10K Ω	½W	5%	625-13-10K
R223	1·5M Ω	½W	10%	625-13-1M5
R224	10K Ω	½W	10%	625-13-10K
R225	1K Ω	½W	10%	625-13-1K

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
R226	3·3K Ω	½W	10%	625-13-3K3
R227	1K Ω	1/10W	5%	625-03-1K
Capacitors				
C200	5μF	64V	Electrolytic	130-007
C201	125μF	16V	Electrolytic	130-002
C202	1,500pF	125V	10%	131-761
C203	1μF	50V	Electrolytic	130-015
C204	·01μF	250V	10%	131-500
C205	·047μF	250V	10%	131-506
C206	5μF	64V	Electrolytic	130-007
C207	5μF	64V	Electrolytic	130-007
C208	5μF	64V	Electrolytic	130-007
C209	100μF	40V	Electrolytic	130-001
MC210	·01μF	250V	10%	131-500
HC210	·015μF	250V	10%	131-509
C211	·047μF	250V	10%	131-506
C212	0·22μF	100V	10%	131-250
C213	0·22μF	250V	10%	131-508
MC214	2,200pF	125V	10%	131-762
HC214	3,300pf	125V	10%	131-751
C215	250μF	40V	Electrolytic	130-003
C216	2·2μF	35V	Tantalum	130-006
Miscellaneous				
VT200	Transistor 40233 (or BC 184 LC)			825-005
VT201	Transistor BC183LB (or BC108, 40233)			825-015
VT202	F.E. Transistor MPF103 (or 2N5457)			825-006
VT203	Transistor BC183LB (or BC108)			825-015
VT204	Transistor BC183LB (or BC108)			825-015
MR200	Diode OA200 (or BAX16)			290-001

300—REPLAY BOARD (Assembly M025-101 H025-154)

Circuit Ref.				*Part Number*
Resistors				
R300	100 Ω	½W	20%	625-14-100
R301	2·2M Ω	½W	20%	625-14-2M2
R302	68 Ω	½W	5%	625-12-68
R303	47K Ω	½W	5% Low noise	624-001
R304	100K Ω	½W	20%	625-14-100K
R305	2·2M Ω	½W	20%	625-14-2M2
R306	27K Ω	½W	10%	625-13-27K

FERROGRAPH
SERIES SEVEN

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
R307	6·8KΩ	½W	5%	625-12-6K8
R308	10KΩ	½W	5%	625-12-10K
R309	150KΩ	½W	10%	625-13-150K
R310	22KΩ	½W	10%	625-13-22K
R311	6·8KΩ	½W	10%	625-13-6K8
R312	3·3KΩ	½W	10%	625-13-3K3
R313	10KΩ	½W	20%	625-14-10K
R314	22KΩ	½W	10%	625-13-22K
MR315	120KΩ	½W	Average Value	
HR315	150KΩ	½W	Average Value	
MR316	5·6KΩ	½W	5%	625-12-5K6
HR316	3·3KΩ	½W	5%	625-12-3K3
MR317	150KΩ	½W	Average Value	
HR317	120KΩ	½W	Average Value	
MR318	10KΩ	½W	5%	625-12-10K
HR318	5·6KΩ	½W	5%	625-12-5K6
MR319	12KΩ	½W	5%	625-12-12K
HR319	10KΩ	½W	5%	625-12-10K
R320	150KΩ	½W	Average Value	
Capacitors				
C300	125μF	16V	Electrolytic	130-002
C301	4·7μF	20V	Tantalum	130-012
C302	250pF	350V	5%	131-758
C303	0·22μF	250V	10%	131-508
C304	1μF	50V	Electrolytic	130-015
MC305	·022μF	250V	10%	131-505
HC305	·015μF	250V	10%	131-509
MC306	·033μF	150V	10%	131-501
HC306	·022μF	250V	10%	131-505
MC307	0·15μF	250V	10%	131-502
HC307	·033μF	250V	10%	131-501
C308	0·1μF	100V	10%	131-250
C309	250μF	40V	Electrolytic	130-003
C310	0·22μF	250V	10%	131-508
C311	·022μF	250V	10%	131-505
C312	·047μF	250V	10%	131-506
MC313	4,000pF	Average Value		
HC313	1,500pF	Average Value		
C314	·01μF	250V	10%	131-500
MC315	2,000pF	Average Value		
HC315	4,000pF	Average Value		
MC316	4,000pF	Average Value		
HC316	2,000pF	Average Value		
C317	·01μF	250V	10%	131-500
C318	·01μF	250V	10%	131-500

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
Miscellaneous				
VT300	Transistor BC214LB (or BC154)			825-016
VT301	Transistor BC214LB (or BC154)			825-016
VT302	Transistor BC183LB (or BC108, 40233)			825-015

400—METER & TONE CONTROL BOARD (Assembly 025-102)

Circuit Ref.				*Part Number*
Resistors				
R400	1·5M Ω	½W	10%	625-13-1M5
R401	10K Ω	½W	10%	625-13-10K
R402	33K Ω	½W	20%	625-14-33K
R403	68K Ω	½W	10%	625-13-68K
R404	1K Ω	½W	10%	625-13-1K
R405	1K Ω	1W	10%	625-16-1K
R406	560 Ω	½W	20%	625-14-560
R407	620 Ω	½W	5%	625-12-620
R408	27K Ω	½W	5%	625-12-27K
R409	180 Ω	½W	10%	625-13-180
R410	22K Ω	½W	10%	625-13-22K
R411	10K Ω	½W	10%	625-13-10K
R412	27K Ω	½W	5%	625-12-27K
R413	330K Ω	½W	10%	625-13-330K
R414	1M Ω	½W	10%	625-13-1M
R415	10K Ω	½W	10%	625-13-10K
R416	1·5K Ω	½W	10%	625-13-1K5
R417	1K Ω	½W	10%	625-13-1K
R418	1·5K Ω	½W	10%	625-13-1K5
R419	470 Ω	½W	10%	625-13-470
Capacitors				
C400	1μF	50V	Electrolytic	130-015
C401	100μF	50V	Electrolytic	130-020
C402	1μF	50V	Electrolytic	130-015
C403	5μF	64V	Electrolytic	130-007
C404	250μF	40V	Electrolytic	130-003
C405	100μF	40V	Electrolytic	130- 001
C406	32μF	40V	Electrolytic	130-013
C407	·022μF	250V	10%	131-505
C408	·022μF	250V	10%	131-505
C409	0·1μF	250V	20%	131-507

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
C410	5μF	64V	Electrolytic	130-007
C411	800pF	125V	10%	131-759
C412	1μF	50V	Electrolytic	130-015

Miscellaneous

VT400	Transistor BC183LB (or BC108)	825-015
VT401	Transistor 40232	825-004
VT402	Transistor BC183LB (or BC108)	825-015

500—POWER AMPLIFIER BOARD (Assembly 025-100)

Circuit Ref. *Part Number*

Board + Heat Sink L.H.: 022-031 R.H.: 022-030

Resistors

R500	0·35 Ω	1W	Wire-wound	626-005
R501	0.35 Ω	1W	Wire-wound	626-005
R502	220 Ω	½W	5%	625-12-220
R503	220 Ω	½W	5%	625-12-220
R504	2·2 Ω	½W	±½ Ω	625-14-2D2
R505	4·7K Ω	½W	10%	625-13-4K7
R506	160 Ω	½W	Nominal Value	624-003
R507	470 Ω	½W	10%	625-13-470
R508	1K Ω	½W	10%	625-13-1K
R509	39K Ω	½W	5%	625-12-39K
R510	4·7K Ω	½W	10%	625-13-4K7
R511	10K Ω	½W	10%	625-13-10K
R512	10K Ω	½W	10%	625-13-10K
R513	3·9K Ω	½W	10%	625-13-3K9
R514	8·2K Ω	½W	10%	625-13-8K2
R515	82K Ω	½W	10%	625-13-82K
R516	68 Ω	½W	10%	625-13-68
R517	100K Ω	½W	10%	625-13-100K
R518	6·8K Ω	½W	10%	625-13-6K8
R519	3·3K Ω	½W	10%	625-13-3K3
R520	22 Ω	½W	20%	625-07-22

Capacitors

C500	640μF	25V	Electrolytic	130-004
C501	125μF	16V	Electrolytic	130-002
C502	25μF	25V	Electrolytic	130-016
C503	100μF	40V	Electrolytic	130-001
C504	350pF	350V	5%	131-763
C505	125μF	16V	Electrolytic	130-002
C506	1μF	50V	Electrolytic	130-015

Serial Nos. 75,000- inclusive

Circuit Ref.		*Part Number*
Miscellaneous		
VT500	Transistor 40312	825-002
VT501	Transistor NKT0039 (or 40360-RCA)	825-014
VT502	Transistor 40312	825-002
VT503	Transistor NKT0029 (or 40362-RCA)	825-013
VT504	Transistor NKT0028 (or NKT0039, 40317-RCA)	825-012
VT505	Transistor BC183LB (or BC108, 40232-RCA)	825-015
MR500	Diode IN3754	290-000
MR501	Diode IN3754	290-000

600—OSCILLATOR BOARD (Stereo 025-103, Mono 025-108)

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
R600	100 Ω	½W	10%	625-13-100
R601	100K Ω	½W	10%	625-13-100K
R602	270 Ω	½W	5%	625-12-270
R603	10K Ω	½W	5%	625-12-10K
R604	10K Ω	½W	5%	625-12-10K
R605	100K Ω	½W	10%	625-13-100K
‡RV606	22K Ω	Linear Pre-set		582-012
R607	270 Ω	½W	5%	625-12-270
Capacitors				
C600	64μF	64V	Electrolytic	130-008
C601	·01μF	250V	10%	131-500
C602	12,000pF	125V	10%	131-750
C603	250pF	350V	5%	131-758
C604	250pF	350V	5%	131-758
C605	·01μF	250V	10%	131-500
C606	0·22μF	250V	10%	131-508
‡C607	3,300pF	125V	10%	131-751
C608	150pF	350V	20%	131-757
C609	250pF	350V	10%	131-758
‡C610	250pF	350V	10%	131-758
‡C611	150pF	350V	20%	131-757
C612	500pF	160V	10%	131-765
Miscellaneous				
VT600	Transistor NKT0039 (or 40317-RCA)			825-014
VT601	Transistor NKT0039 (or 40317-RCA)			825-014

Serial Nos. 75,000- inclusive

Circuit Ref.		*Part Number*
‡SW600	Record Mode Switch	750-003
L600	Oscillator Coil (Type 799)	025-085
L601	Filter Coil (Type 800)	
‡L602	Filter Coil (Type 800)	
P600	Coaxial Plug (Black) + lead	578-000D
‡P601	Coaxial Plug (Yellow) + lead	578-000A
P602	Coaxial Plug (Red) + lead	578-000C
‡P603	Coaxial Plug (Green) + lead	578-000B
SK600	Coaxial Socket (Black) with SK602	692-001
‡SK601	Coaxial Socket (Yellow) with SK603	692-002
SK602	Coaxial Socket (Red) with SK600	692-001
‡SK603	Coaxial Socket (Green) with SK601	692-002

700—POWER UNIT AND GENERAL

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
‡RV700	100K Ω	Linear Pre-set		582-008
MR701	220 Ω	½W	10%	625-07-220
HR701	0	(short-circuit)		
MR702	270 Ω	½W	10%	625-07-270
HR702	220 Ω	½W	10%	625-07-220
RV703	500K Ω	Linear *"Bass"*		582-001
‡RV704	500K Ω	Linear *"Bass"*		582-001
†RV705	100K Ω	Linear *"Output"*		582-004
‡RV705	100K Ω	Linear (with RV706) *"Output"*		582-007
‡RV706	100K Ω	Linear (with RV705) *"Output"*		582-007
‡R707	6·8K Ω	½W	20%	625-08-6K8
‡R708	6·8K Ω	½W	20%	625-08-6K8
†RV709	50K Ω	Logarithmic *"Line"*		582-024
‡RV709	50K Ω	Logarithmic (with RV727) *"Line"*		582-010
‡RV710	50K Ω	Logarithmic (with RV728) *"Line"*		582-010
RV711	10K Ω	Logarithmic Pre-set		582-011
RV712	10K Ω	Logarithmic Pre-set		582-011
RV713	10K Ω	Logarithmic Pre-set		582-011
R714	820 Ω	½W	10%	625-13-820
MR714	820 Ω	½W	10%	625-13-820
‡RV715	10K Ω	Logarithmic Pre-set		582-011
‡RV716	10K Ω	Logarithmic Pre-set		582-011
‡RV717	10K Ω	Logarithmic Pre-set		582-011
‡R718	820 Ω	½W	10 Ω	625-13-820
RV719	500K Ω	Linear *"Treble"*		582-001
H‡R718	820 Ω	½W	10%	625-13-820

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
‡RV720	500K Ω	Linear *"Treble"*		582-001
RV721	1K Ω	Linear		582-015
‡RV722	1K Ω	Linear		582-015
RV723	25K Ω	Linear *"B"*		582-002
‡RV724	25K Ω	Linear *"B"*		582-002
RV725	100K Ω	Linear *"A"*		582-008
‡RV726	100K Ω	Linear *"A"*		582-008
†RV727	250K Ω	Logarithmic *"Mic"*		582-009
‡RV727	250K Ω	Logarithmic (with RV709) *"Mic"*		582-010
‡RV728	250K Ω	Logarithmic (with RV710) *"Mic"*		582-010
†R731	400R	2W		626-014
‡R731	560R	3W		626-013
Capacitors				
C700	1,000μF	70V	Electrolytic	130-014
C701	2,000μF	30V	Electrolytic	130-017
C702	2,000pF	Average Value		
C703	1,000pF	Average Value		
C704	2,000pF	Average Value		
C705	8,200pF	Average Value		
C706	2,200pF	Average Value		
C707	800pf	Average Value		
‡C708	2,000pF	Average Value		
‡C709	1,000pF	Average Value		
‡C710	2,000pF	Average Value		
‡C711	8,200pF	Average Value		
‡C712	2,200pF	Average Value		
C713	800pf	Average Value		
‡C714	600pF	125V	10%	131-756
‡C715	500pF	160V	10%	131-765
C716	·022μF	250V	10%	131-505
C717	·022μF	250V	10%	131-505
Miscellaneous				
SW700	Equalisation Switch			750-001
SW701	Meter Switch			746-002
SW702	Output Switch			746-003
‡SW703	Output Switch			746-003
‡SW704	Transfer Switch			746-000
L700	Treble Boost Inductor (Type 727)			
‡L701	Treble Boost Inductor (Type 727)			
TR700	Power Transformer (240V)			022-056

LP700	Lamp. LES, 14V	455-002
†LP701	Lamp, LES, 14V	455-002

Serial Nos. 75,000- inclusive

Circuit Ref.		*Part Number*
MR700	Bridge Rectifier WO2 (or WO4, OSH01-100)	600-002
MR701	Bridge Rectifier WO2 (or WO4, OSH01-100)	600-002
JK700	Jack Socket, 2 way	692-011
‡JK701	Jack Socket, 2 way	692-011
JK702	Jack Socket, 2 way	692-011
‡JK703	Jack Socket, 2 way	692-011
JK704	Jack Socket, 2 way	692-011
‡JK705	Jack Socket, 2 way	692-011
JK706	Jack Socket, 2 way	692-011
‡JK707	Jack Socket, 2 way	692-011
JK708	Jack Socket, 2 way	692-011
‡JK709	Jack Socket, 2 way	692-011
P700	Plug, 14 way	577-008
P701	Plug, 3 way (Mains)	577-000
P702	Plug, 2 way (Loudspeaker)	577-006
‡P703	Plug, 2 way (Loudspeaker)	577-006
SK100	Socket, 9 way	692-012
SK101	Socket, 8 way	692-003
SK700	Socket, 14 way	692-013
SK701	Socket, 7 way (Aux. Skt.)	692-004
SK702	Socket, 2 way (Loudspeaker)	692-014
‡SK703	Socket, 2 way (Loudspeaker)	692-014
VS700	Voltage Selector Tagboard	025- 164
VS701	Voltage Selector	920-000
‡FS700	D.C. Fuse (1 Amp — 20 mm. x 5 mm. dia.)	380-000
FS701	D.C. Fuse (1 Amp — 20 mm. x 5 mm. dia.)	380-000
FS702	Mains Fuse (1 A — 20 mm. x 5 mm. dia.) — Power Supply	380-000
	Fuse Holder D.C. Fuse (Black)	380-001
	Mains Fuse (Red)	380-005
M700	Meter (V.U.)	512-000
‡M701	Meter (V.U.)	512-000
LS700	Loudspeaker (30 Ω)	700-000
‡LS701	Loudspeaker (30 Ω)	700-000

800—METER BOARD (Assembly †025-163 ‡025-162)

Circuit Ref.				*Part Number*
Resistors				
R800	18K Ω	½W	10%	625-13-18K
R801	330K Ω	½W	10%	625-13-330K

Serial Nos. 75,000- inclusive

Circuit Ref.				*Part Number*
R802	330K Ω	½W	10%	625-13-330K
R803	220 Ω	½W	5%	625-12-220
R804	3·3K Ω	½W	5%	625-12-3K3
†R805	5·6K Ω	½W	10%	625-13-5K6
‡R805	2·7 Ω	½W	10%	625-13-2K7
‡R806	3·3K Ω	½W	5%	625-12-3K3
‡R807	220 Ω	½W	5%	625-12-220
‡R808	330K Ω	½W	10%	625-13-330K
‡R809	330K Ω	½W	10%	625-13-330K
‡R810	18K Ω	½W	10%	625-13-18K

Capacitors

C800	5μF	64V	Electrolytic	130-007
C801	0·1μF	250V	20%	131-507
C802	5μF	64V	Electrolytic	130-007
C802	32μF	40V	Electrolytic	130-013
‡C804	5μF	64V	Electrolytic	130-007
‡C805	0·1μF	250V	20%	131-507
‡C806	5μF	64V	Electrolytic	130-007

Miscellaneous

VT800	Transistor BC183LB	825-015
‡VT801	Transistor BC183LB	825-015

117V 60Hz MODELS (Suffix A)

Note: The parts lists are the same as for the corresponding 240V 50Hz model with the exceptions listed below.

Circuit Ref.				*Part Number*
Resistors (R) and Potentiometers (RV)				
RV103	625 Ω	30W	Wire-wound	582-019
R105	Not fitted — replaced by L102			

Capacitors

C101	2·5μF	200V	A.C. Working	132-002

Miscellaneous

SW100	Function Switch	750-007
L102	Choke	180-000
X100	Capstan Motor (110V)	022-039
X101	Supply Reel Motor (75V)	022-037
X102	Take-up Reel Motor (75V)	022-038

Serial Nos. 75,000- inclusive

Circuit Ref.		*Part Number*
TR700	Power Transformer (110V)	022-064
VS700	Not fitted	
VS701	Not fitted	

Serial Nos. 78,800/2 onwards

#	**100 DECK UNIT**				
	R110	15 Ω	½W	20%	625-08-15
	R111	4·7M Ω	½W	10%	625-07-4M7
	R112	4·7M Ω	½W	10%	625-07-4M7
	R113	68K Ω	½W	10%	625-07-68K
	R114	3·3K Ω	½W	10%	625-07-3K3
	R115	4·7K Ω	½W	10%	625-07-4K7
	C106	0·47 μF	250V	10%	131-512
	VT100	Transistor BC263 (or BC 214 LB)			825-023
	VT101	Transistor BC182LB			825-012

B - Mechanical

Deck Unit (Fig. 1)

Reference Number	*Item*	*Quantity*	*Part Number*
1	Fast Wind Knob	1	025-059
2A	Auto-stop Arm	1	025 -159
2B	Auto-stop Arm Return Spring	1	712-006
2C	Auto-stop Arm Spring Tension Bracket	1	022-035
2D	Auto-stop Arm Guide	1	409-004
2E	Auto-stop Arm Tape Damping Bracket	1	022-065
3	Contact Pin	1	570-031
4A	Record Arm	1	025-021 (Issue 5)
4B	Record Arm Knob	1	448-002
4C	Record Arm Pivot Screw	1	MP/1806
5	Gimbal Bearing	1	022-016
6A	Loading Arm	1	025-011
6B	Loading Arm Knob	1	448-010
6C	Loading Arm Spring	1	712-012
6D	Loading Arm Sleeve	1	687-011
6E	Screw 2BA x 1 in. (25·4 mm.) Hex. Hd. BMS	1	BP/3511/S
6F	Washer 2 BA x $\frac{1}{2}$ in. (12·7 mm.)	2	MP/2952A
6G	Washer 2 BA x $\frac{5}{8}$ in. (15·8 mm.) x 18g. BMS	1	BP/7307/W
6H	Pinch Roller Stop-plate	1	573-056
6J	Screw 6 BA x $\frac{5}{16}$ in. (7·9 mm.) Hex. Hd. Brass	2	668-000
6K	Washer 6 BA x $\frac{5}{16}$ in. (7·9 mm.) x 22g. Brass	2	BP/7341/W
7A	Pressure Arm	2	025-049
7B	Spring	2	712-003
7C	Pressure Pad and Wing	1	025-047
7D	Pillar	3	568-003
7E	Nut $\frac{1}{4}$ in. BSF x ·324 in. AF.	3	556-004
7F	Retainer	3	630-000
8	Pressure Pad	2	025-045
9A	Pressure Arm	1	025-048
9B	Spring	1	712-001
10A	Screw 8 BA x $\frac{7}{16}$ in. (11 mm.) Rd. Hd. Brass	1	BP/3827/S
10B	Locknut 8BA	1	544-001
11A	Function Knob	1	025-065
11B	Function Select Cam	1	025-015
12	Head Screen Plate	1	022-036
13	Loading Arm Stop	1	025-075
14	Loading Arm Retaining Bracket	1	095-036
15	Loading Arm Leaf Spring	1	714-003
16	Upper Support Plate	1	573-002
17A	Record Release Arm	1	012-003
17B	Record Release Arm Pivot Screw	1	MP/1806
18	Record Release Arm Spring	1	BP/4026/S

FERROGRAPH
SERIES SEVEN

Reference Number	*Item*		*Quantity*	*Part Number*
19	Sleeving 5 mm. x 1 in. (25 mm.)		1	RM/4630/S
20	Record Arm Return Spring		1	BP/4040/S
21A	Screw 6 BA x $\frac{7}{8}$ in. (22·2 mm.) Rd. Hd. BMS	Spring Stop	1	BP/3747/S
21B	Nut 6 BA		1	BP/2030/N
21C	Washer S.P. 6 BA		1	BP/7303/W
21D	Spacer		1	698-017
22A	Function Lock Lever		1	025-062
22B	Spacer 4 BA x $\frac{1}{2}$ in. (12·7 mm.) Brass		1	MP/3571B
22C	Screw 4 BA x $\frac{7}{8}$ in. (22·2 mm.) Ch. Hd. BMS		1	BP/3678/S
22D	Washer 4 BA x $\frac{3}{8}$ in. (9·5 mm.) x ·028 in. (0·7 mm.)		2	BP/7329/W
22E	Washer 4 BA S.P.		1	BP/7301/W
22F	Locknut 4 BA		1	BP/2011/N
23	Reel Retaining Knob		2	025-060
24A	Reel Carrier, Supply		1	002-001
24B	Reel Carrier, Take-up		1	025 -008
25	"C" Clip Retainer		1	630-002
26A	Lamp Holder LES		1	455-000
26B	Lamp Holder LES		1	455-003
27A	Deck Cover Support Pillar		1	568-004
27B	Washer 4BA S.P.		1	BP/7301/W
27C	Rubber Insert		1	440-012
28	Counter		1	210 -002
	Spindle		1	705 -020
	Gear (25T)		1	390 -000
	Gear (35T)		1	390 -001
	Pulley		1	596 -001
	Plate		1	025 -200
	Spacer		1	698 -048
	Strap		1	722 -017
	Bush		1	100 -033
29	Drive Belt		1	BP/142/B
30A	Pinch Roller Bracket		1	095 -057
30B	Pinch Roller		1	025 -112
30C	Washer		1	MP/1952/A
30D	Circlip		1	BP/4010/S
31A	Pinch Roller Arm Assembly		1	022-054
31B	Pinch Roller Ext. Spring		1	712-007
31C	Pinch Roller Spindle		1	705-005
32A	Capstan Spindle M 50Hz			705-000
32B	Capstan Spindle H 50Hz			705-013
32C	Capstan Spindle L 50Hz		1	705-014
32D	Capstan Spindle M 60Hz			705-015
32E	Capstan Spindle H 60Hz			705-016
33	Clamp		1	190-003
34	Flywheel		1	940-001

Reference Number	*Item*	*Quantity*	*Part Number*
35A	Idler Arm, Low Speed	1	022-000A
35B	Idler Arm, Med. Speed	1	022-000B
35C	Idler Arm, High Speed	1	022-000C
35D	Idler Wheel	3	025-113
35E	Washer	3	MP/2952/A
35F	Circlip	3	BP/4010/S
35G	Grommet	3	398-004
36	Idler Arm Ext. Spring	3	712-004
37A	Idler Arm Support	1	025-006
37B	Idler Arm Support	1	025-007
38	Spring Retaining Bracket	1	095-003
39	Run Solenoid Armature	1	013-001
40	Run Solenoid Comp. Spring	1	712-010
41	Brake Extension Spring	2	712-005
42	Brake Connecting Link	2	470-000
43	Brake Block	2	097-000
44A	Screw 8 BA x $\frac{1}{4}$ in. (6·3 mm.) Ch. Hd. Brass	2	BP/3838/S
44B	Nut 8 BA *Aerotight*	2	554-001
45A	Screw 6 BA x $\frac{1}{2}$ in. (12·7 mm.) Hex. Hd. BMS C.P.	2	666-022
45B	Washer 6 BA x $\frac{3}{8}$ in. (9·5 mm.) x ·030 in. (0·76 mm.)	2	BP/7347/W
45C	Sleeve	2	MP/1784
45D	Sleeve	2	MP/1783
46	Brake Arm Mounting Plate	1	573-005
47A	Washer 2 BA S.P.	2	BP/7300/W
47B	Locknut 2BA	2	BP/2000/N
47C	Brake Return Spring	1	BP/4026/S
48	Brake Release Arm	2	025-000
49A	Screw 4 BA x $\frac{3}{8}$ in. (9·5 mm) Hex. Hd. BMS	4	BP/3667/S
49B	Washer 4 BA x $\frac{3}{8}$ in. (9·5 mm.) Brass	8	BP/7329/W
49C	Washer 4 BA S.P.	4	BP/7301/W
49D	Locknut 4 BA	4	BP/2011/N
50	Brake Spring Tension Bracket	2	095-019
51A	Screw 6 BA x $\frac{3}{16}$ in. (4·7 mm.) Ch. Hd. BMS	2	BP/3767/S
51B	Washer 6 BA S.P.	2	BP/7303/W
52	Power Supply Switch Bracket	1	095-044
53A	Friction Brake Arm	1	025-016
53B	Friction Brake Arm	1	025-043
53C	Friction Brake Return Spring	1	BP/4005/S
53D	Friction Brake Pad	1	560-009
54	Motor Strap	1	022-052
55A	Tape Speed Indicator	1	025-053

FERROGRAPH
SERIES SEVEN

Reference Number	*Item*	*Quantity*	*Part Number*
55B	Tape Speed Indicator Knob	1	025-165
56	Drive Gear and bracket	1	025-010
57A	Take-up Reel Motor 150V (240V Models)	1	022-011
57B	Take-up Reel Motor 75V (117V Models)		022-038
58A	Speed Change Arm Assy.	1	022-041
58B	Spring Assy.	1	025-003
58C	Screw 6 BA x $\frac{3}{8}$ in. (9·5 mm.) Hex. Hd. BMS CP	1	666-020
58D	Spring	1	712-004
59A	Side Frame R.H.	1	025-069
59B	Side Frame L.H.	1	025-070
60	Start Solenoid Armature	1	015-000
61	Tape Deck Plate	1	025-061
62A	Handle Main Rib	1	412-000
62B	Handle Cover	1	215-007
63A	Speed Change Spindle	1	705-003
63B	Speed Change Cam	1	126-000
64	Resistor R105 Assy.	1	022-040
65	Cam Follower Bracket Spring	1	712-011
66A	Screw 4 BA x $\frac{5}{8}$ in. (15·8 mm.) Ch. Hd. BMS	1	BP/3648/S
66B	Cam Follower Roller	1	642-002
66C	Washer 4 BA x $\frac{3}{8}$ in. (9·5 mm.)	1	BP/7330/W
66D	Washer 4 BA x $\frac{5}{16}$ in. (7·9 mm.) x ·028 in. (0·7 mm.) Brass	1	BP/7332/W
66E	Locknut 4BA	1	BP/2011/N
67	Switch Operating Bracket Assy.	1	025-009
68	Screw 6 BA x $\frac{3}{8}$ in. (9·5 mm.) Hex. Hd. BMS	2	666-023
69A	Cam Follower Support Bracket Assy.	1	022-001
69B	Cam Bracket	1	025-001
69C	Screw	1	MP/1806
69D	Washer 4 BA S.P.	1	BP/7301/W
69E	Locknut 4 BA	1	BP/2011/N
70A	Screw 4 BA x $\frac{3}{8}$ in. (9·5 mm.) Ch. Hd. BMS	2	BP/3644/S
70B	Washer 4 BA S.P.	2	BP/7301/W
70C	Locknut 4 BA	2	BP/2011/N
71A	Reel Height Adjusting Screw	2	025-118
71B	Reel Height Adjusting Bracket	2	095-006
71C	Reel Height Adjusting Spring	2	712-008
71D	Reel Height Adjusting Nut	2	356-001
71E	Reel Height Adjusting Arm	2	022-002
71F	Reel Height Adjusting Spacer	2	698-014
71G	Nut Nyloc 2 BA	2	BP/2006/N
71H	Screw 4 BA x $\frac{7}{8}$ in. (22.2 mm.) Ch. Hd. BMS	2	BP/3678/S

Reference Number	*Item*	*Quantity*	*Part Number*
71J	Washer 4 BA x $\frac{3}{8}$ in. (9·5 mm.) x ·028 in. (0·7 mm.)	2	BP/7329/W
71K	Washer 4 BA S.P.	2	BP/7301/W
71L	Locknut 4 BA	2	BP/2011/N
72	Function Switch (SW100)	1	750-000
73A	Record Switch Bracket	1	095-017
73B	Record Switch SW107	1	748-000
74A	Deck Support Frame (Front)	1	025-051
74B	Screw 4 BA x $\frac{3}{8}$ in. (9·5 mm.) Hex. Hd. BMS	4	BP/3667/S
74C	Washer 4 BA Fan Disc Lock	4	922-008
74D	Locknut 4BA	4	BP/2011/N
75A	Amplifier Support Strap	1	025-124
75B	Screw 4 BA x $\frac{3}{8}$ in. (9·5 mm.) Hex. Hd. BMS	4	BP/3667/S
75C	Washer 4 BA S.P.	4	BP/7301/W
75D	Locknut 4BA	4	BP/2011/N
76A	Grommet	4	398-005
76B	Screw 1$\frac{1}{4}$ in. x $\frac{1}{4}$ in. B.S.W. Hex. Hd. BMS	4	666-100
76C	Washer $\frac{1}{4}$ in. (6·3 mm.)	8	922-002
76D	Sleeve	4	687-009
76E	Spacer	4	698-016
76F	Tape Deck Support Bracket	2	095-037
76G	Tape Deck Support Plate	2	573-031
77A	Deck Support Frame (Rear)	1	025-052
77B	Screw 4 BA x $\frac{3}{8}$ in. (9·5 mm.) Hex. Hd. BMS	4	BP/3667/S
77C	Washer 4BA Fan Disc Lock	4	922-008
77D	Locknut 4BA	4	BP/2011/N
78A	Supply Reel Motor 150V (240V Model)	1	022-010
78B	Supply Reel Motor 75V (117V Model)		022-037
79A	Capstan Motor Bracket L.H.	1	095-000A
79B	Capstan Motor Bracket R.H.	1	095-000B
80	Motor Mounting Bracket	2	095-045
81	Neoprene Resilient Mounts	4	BP/1987/M
82	Capacitor Support Bracket	1	095-059
83A	Capstan Motor 240V	1	022-003
83B	Capstan Motor 110V		022-039

Miscellaneous

Item		*Part Number*
Knobs		
Amplifier Control Knobs — (Mic, Line, Output)	Mono	025-059
	Upper	025-058
	Lower	448-006
	Felt Washer	922-013
Equalisation Knob —	Mono	025-059
	Upper	025-059
	Lower	448-011

Record Mode Knob (Stereo)	025-063
Bass/Treble Control Knob	025-041
Mains Switch Knob	448-013
Turns Counter Zero Knob	448-009
Rear Catch Knob (lid locking)	448-010

Labels

Front Panel	(Serial Nos. 70,000-74,999)		
	L.H. Stereo and Mono		450-004A
	R.H. Stereo		450-004B
	R.H. Mono		450-004C
	(Serial Nos. 75,000-)		
	L.H. Stereo and Mono		450-020A
	R.H. Stereo		450-020B
	R.H. Mono		450-004C
Rear Panel	Model 713		450-005B
	Models 702, 704 —	Upper	450-021B
		Lower	450-021A
	Models 722, 724 —	Upper	450-005B
		Lower	450-005A
Rear Cover (Flap)	Model 713		450-005C
	Models 702, 704 —	Upper	450-021C
		Lower	450-021D
	Models 722, 724 —	Upper	450-005C
		Lower	450-005D

Cabinet Feet — Small, Brown	332-001
Small, Grey	332-000
Large, Grey	BP/1115/F
Lid Catches L.H.	140-000
R.H.	140-001
Head Cleaning Brush	BP/288/P
Amplifier Control Panel — Stereo	573-034
Mono	573-037
Deck Control Panel Assembly	022-102
Deck Control Panel	573-040
Head Cover Flap	215-005
Head Cover Rear	095-068
Head Cover, Side Bracket L.H.	095-064
R.H.	095-065
Amplifier Control Cover (Flap)	215-006
Retaining Pillar	568-006
Screw 8 BA x $\frac{7}{16}$ in.	BP/3827/S
Rear Panel Cover (rear flap)	215-003
Rear Panel Blanking Grommet (Mono Models)	398-008
Mains Socket and Lead	578-001

Rack Mounting Kit

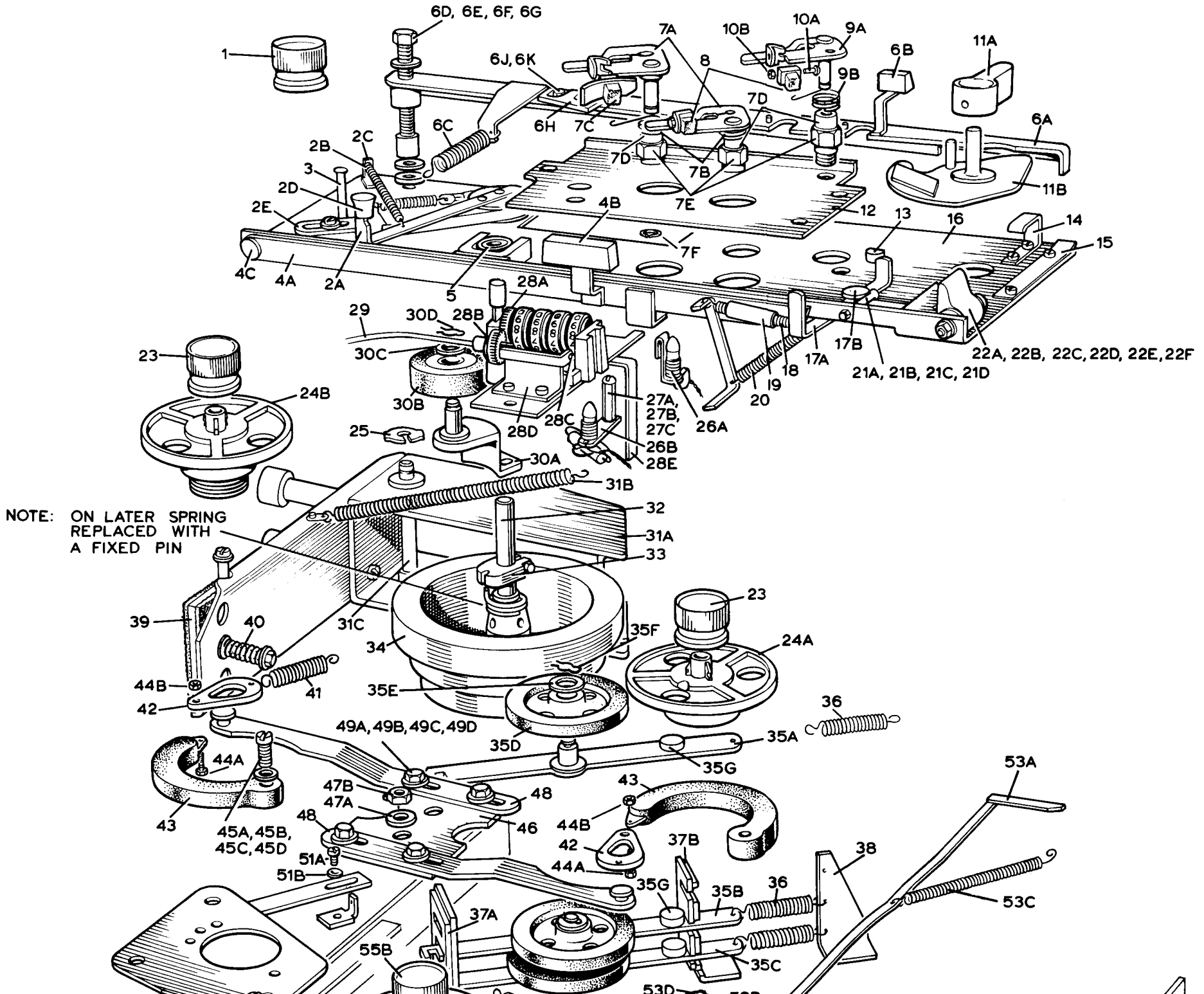
The rack mounting kit comprises a set of parts which enable the Recorder to be mounted into a standard 19 in. (483 mm.) rack, when the total height is 17½ in. (445 mm.).

Bracket L.H. Side Support	1	095-075
Bracket R.H. Side Support	1	095-076
Bolt ¼ BSF x 1¼ in. (31·7 mm.) Hex. Hd.	4	666-103
Spacer	4	698-031
Plate, Filler Strip	1	573-063

Note: When fitting the Signal-operated Switching Unit, the filler strip (573-063) is replaced by a panel assembly (022-066). In this case the overall height of the recorder is 19¼ in. (489 mm.).

Motor Socket (2 way)	3	BP/3902/S
Capstan Motor Pulley	1	596-000

	Mono	*Stereo*	
Lamp Holder	2	1	455-001
Lens, Red	2	1	440-010
Diffuser	2	1	860-004
Grommet (G13)	2	1	BP/1303/G
Tagstrip	1	1	BP/6031/T


NOTE: ON LATER SPRING REPLACED WITH A FIXED PIN
1
6D, 6E, 6F, 6G
6J, 6K
6H
7C
7A
10B
10A
9A
8
9B
6B
11A
6A
11B
6C
2B
2C
3
2D
2E
4C
4A
2A
7D
7B
7E
4B
7F
5
12
13
16
14
15
17A
17B
18
19
20
21A, 21B, 21C, 21D
22A, 22B, 22C, 22D, 22E, 22F
23
24B
29
30D
28B
28A
30C
30B
28D
28C
25
27A, 27B, 27C
26A
26B
28E
30A
31B
32
31A
33
31C
39
40
41
44B
42
34
35F
35E
35D
23
24A
36
35A
35G
49A, 49B, 49C, 49D
44A
43
47B
47A
48
45A, 45B, 45C, 45D
46
51A
51B
37B
38
35B
53A
53C
37A
55B
35C
53D

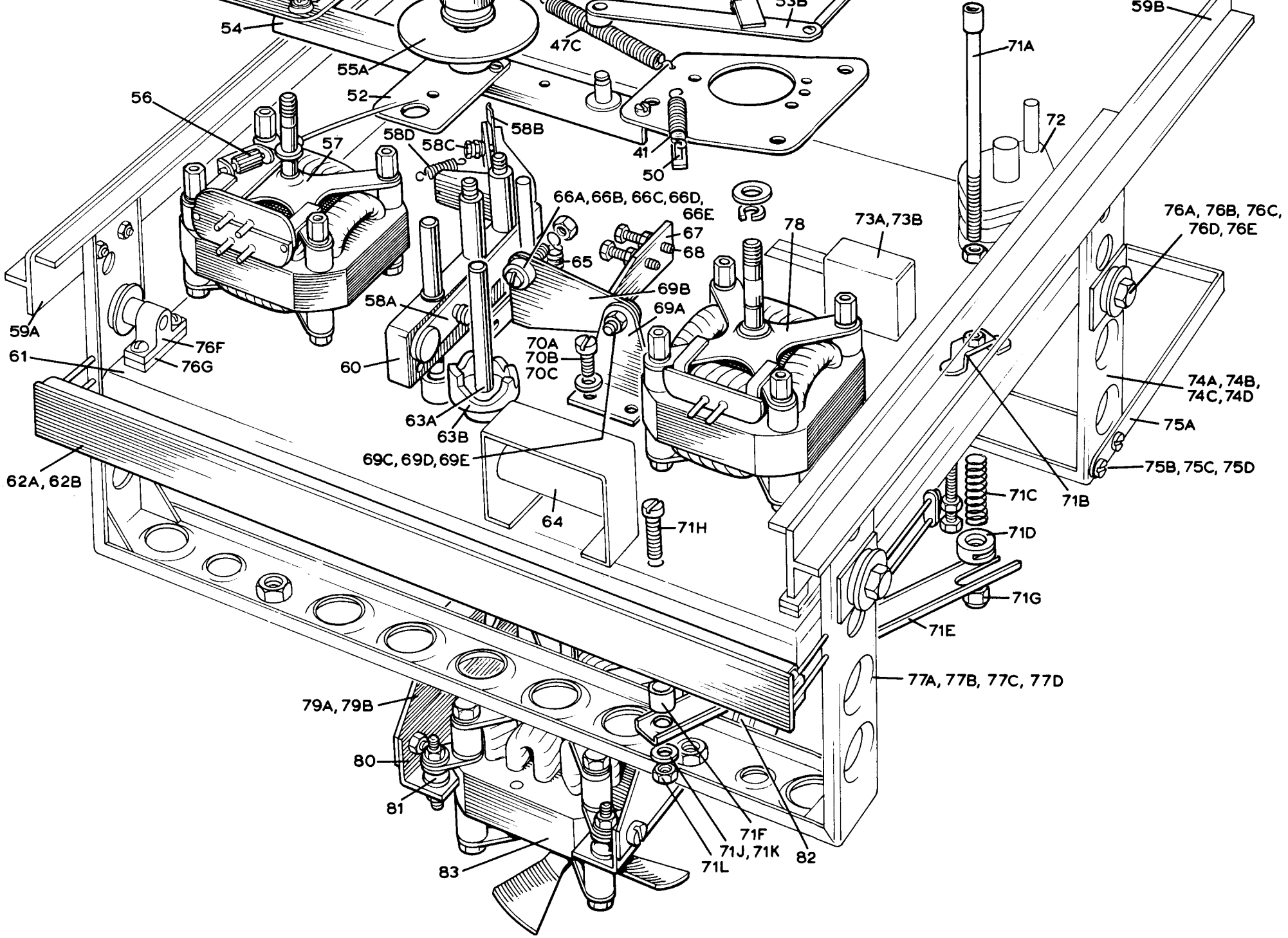


FIG. 1. EXPLODED VIEW OF TAPE-DECK (PARTS LIST IDENTIFICATION)

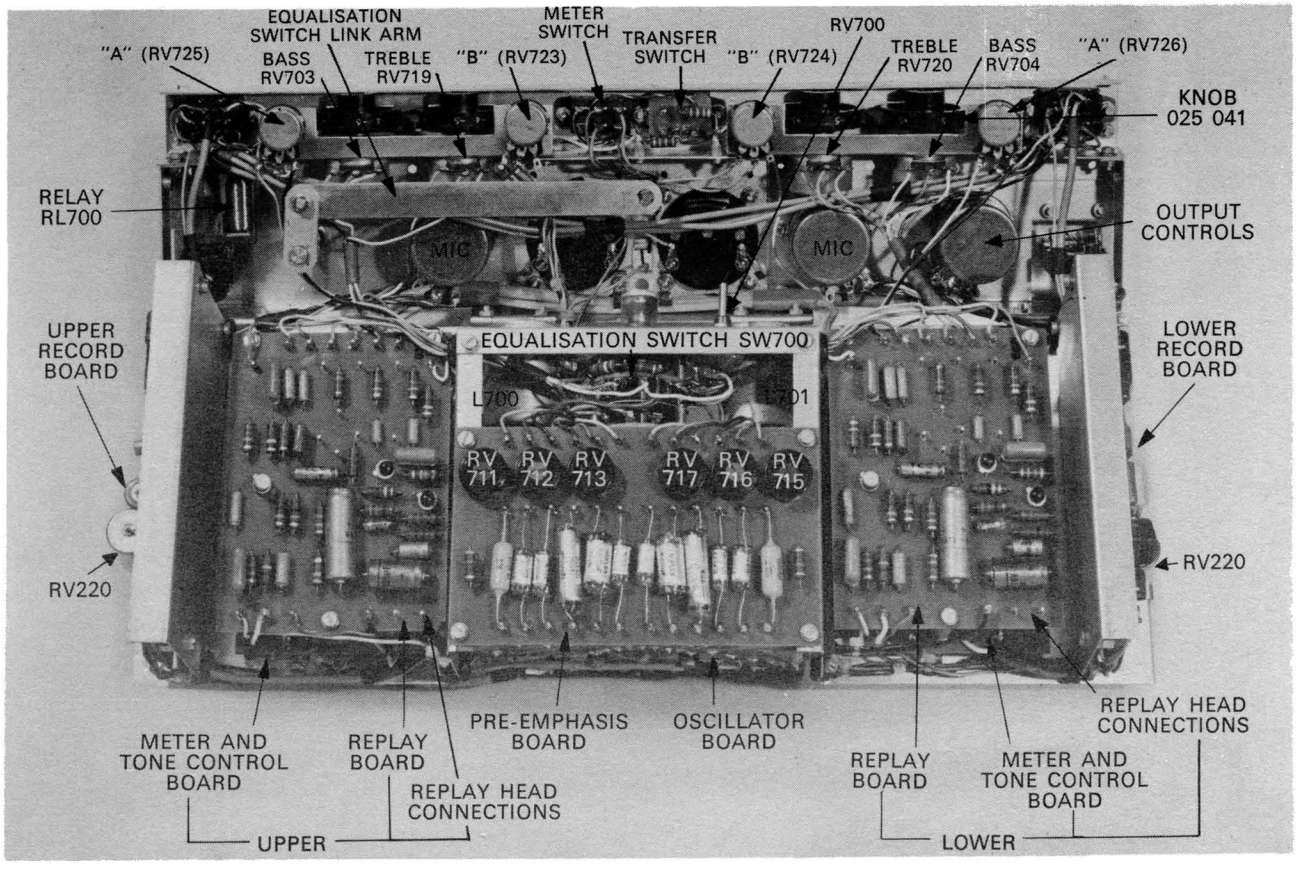


FIG. 2. AMPLIFIER—STEREO, FRONT VIEW

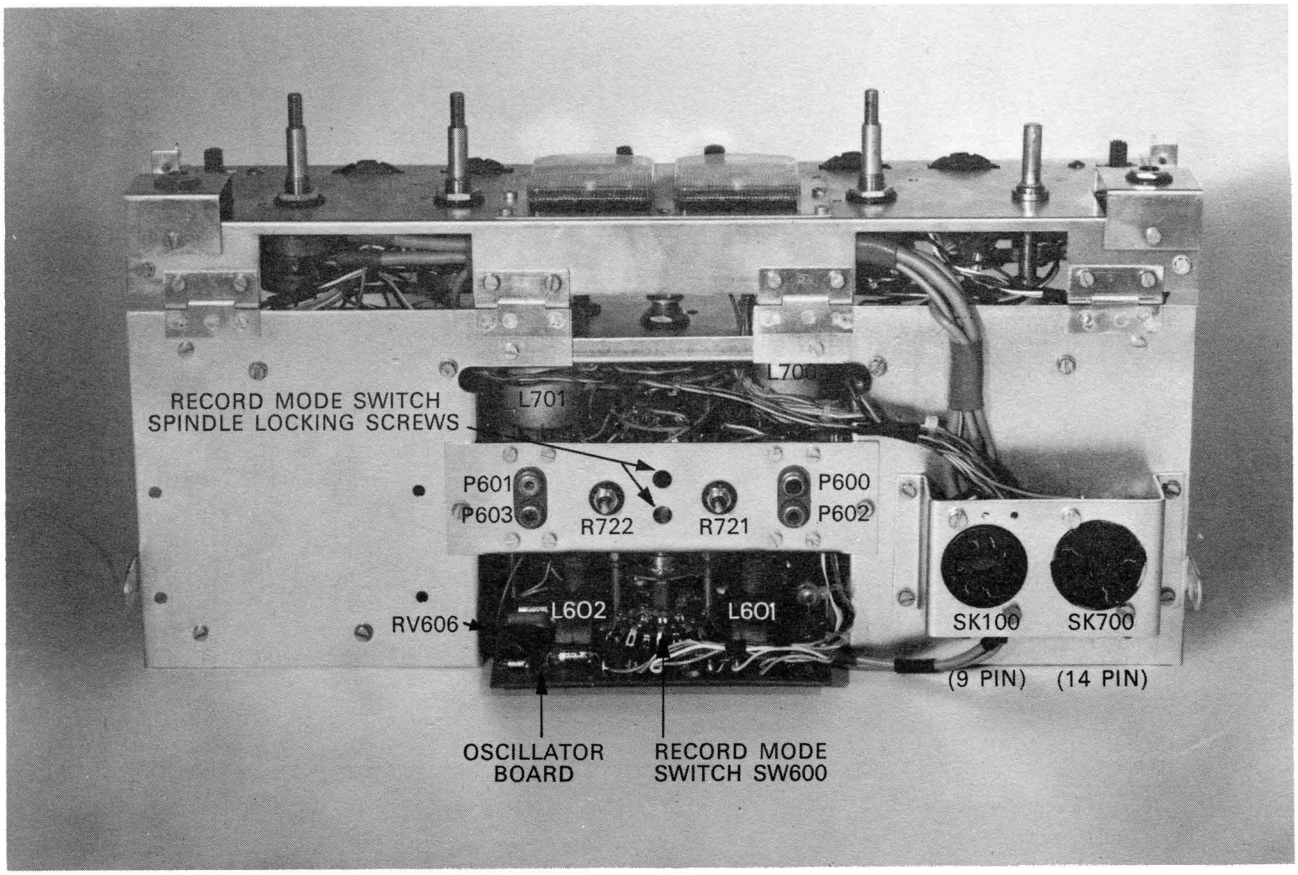


FIG. 3. AMPLIFIER—STEREO, REAR VIEW

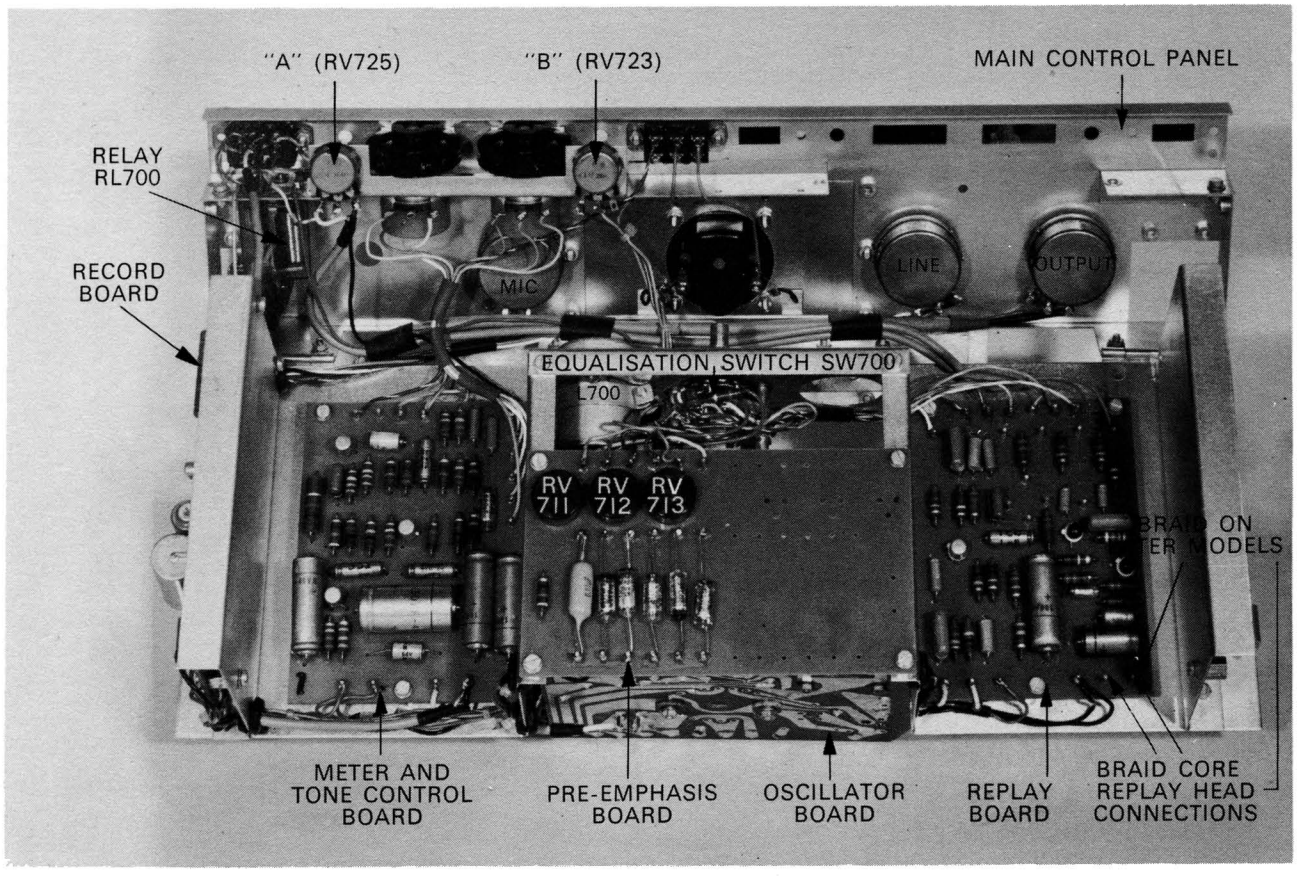


FIG. 4. AMPLIFIER—MONO, FRONT VIEW

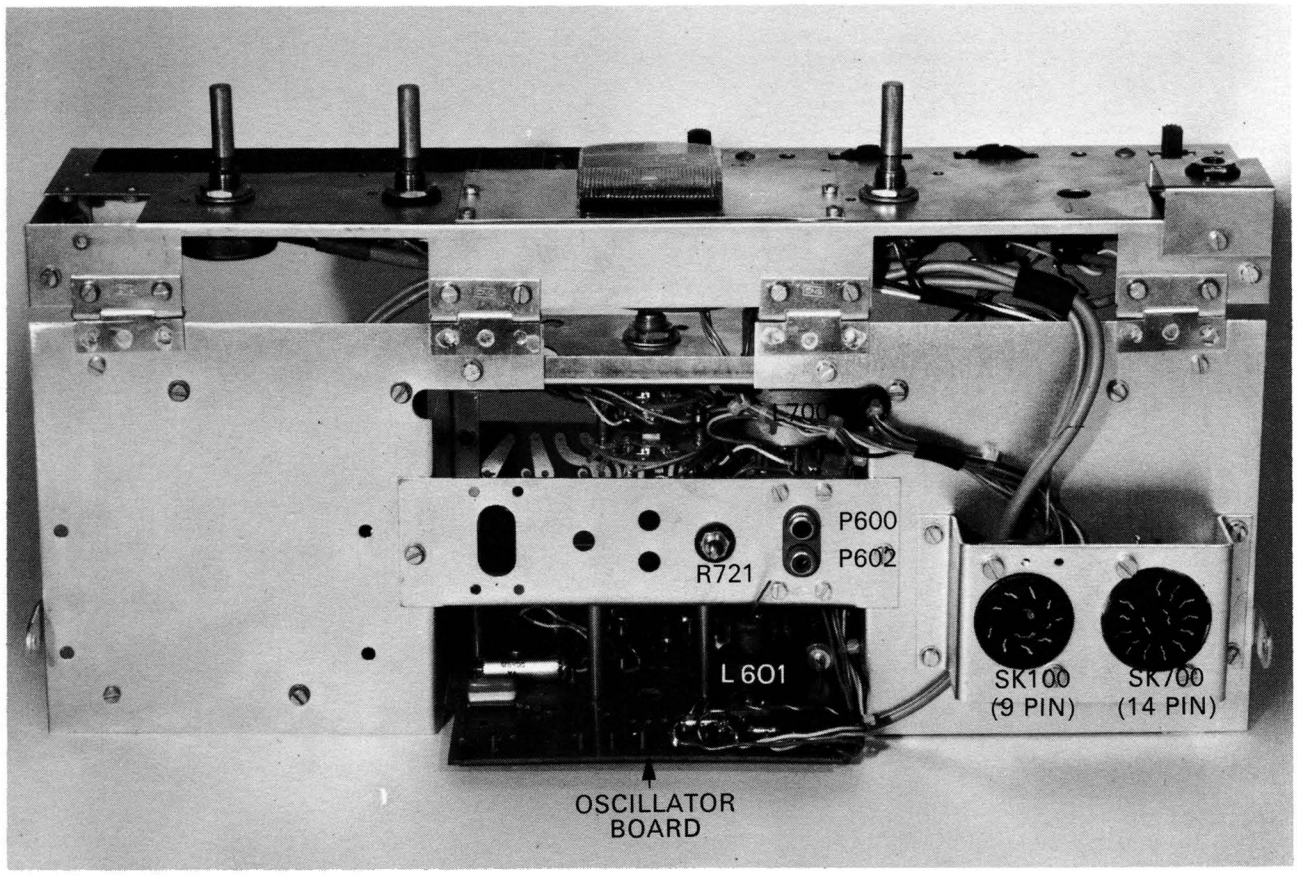


FIG. 5. AMPLIFIER—MONO, REAR VIEW

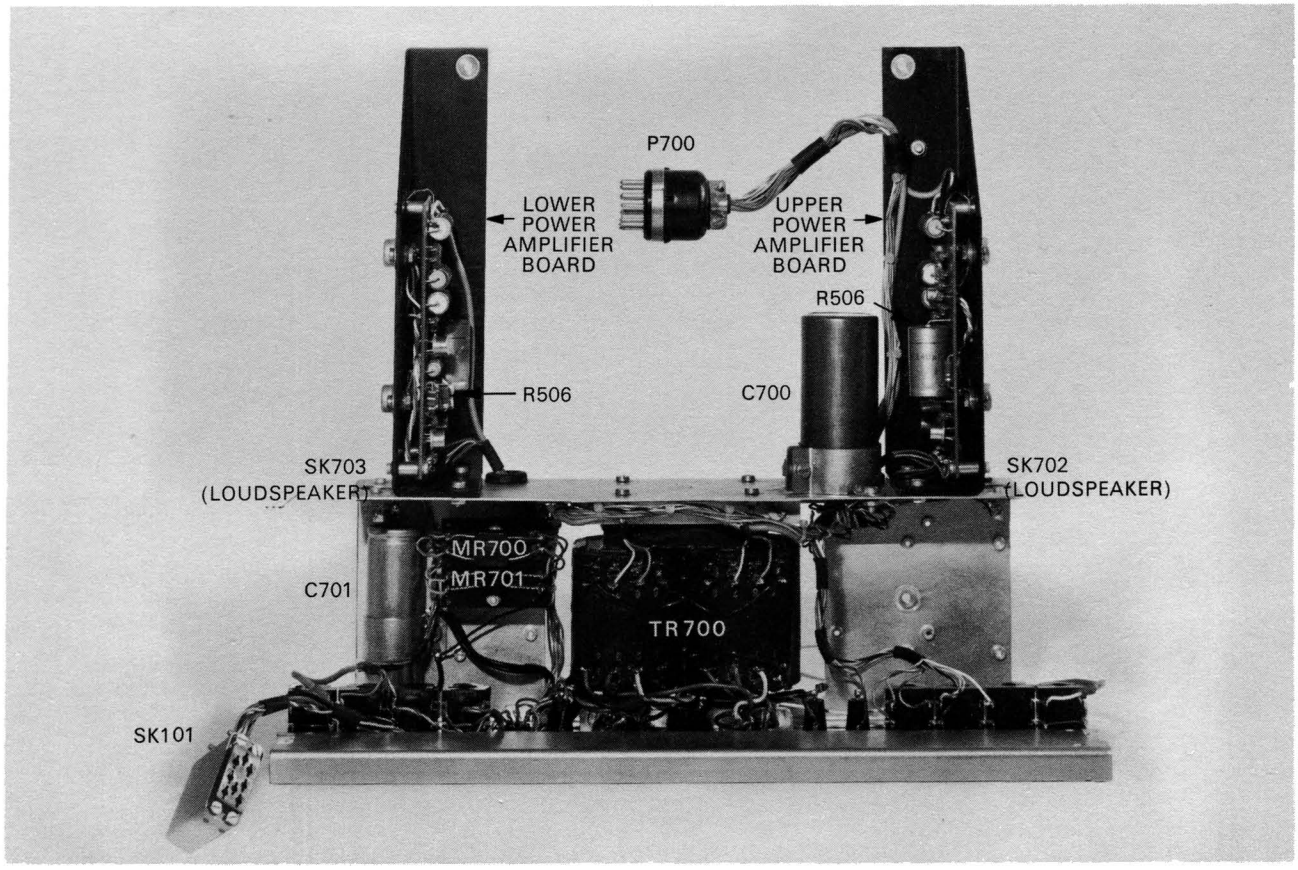


FIG. 6. POWER UNIT—STEREO

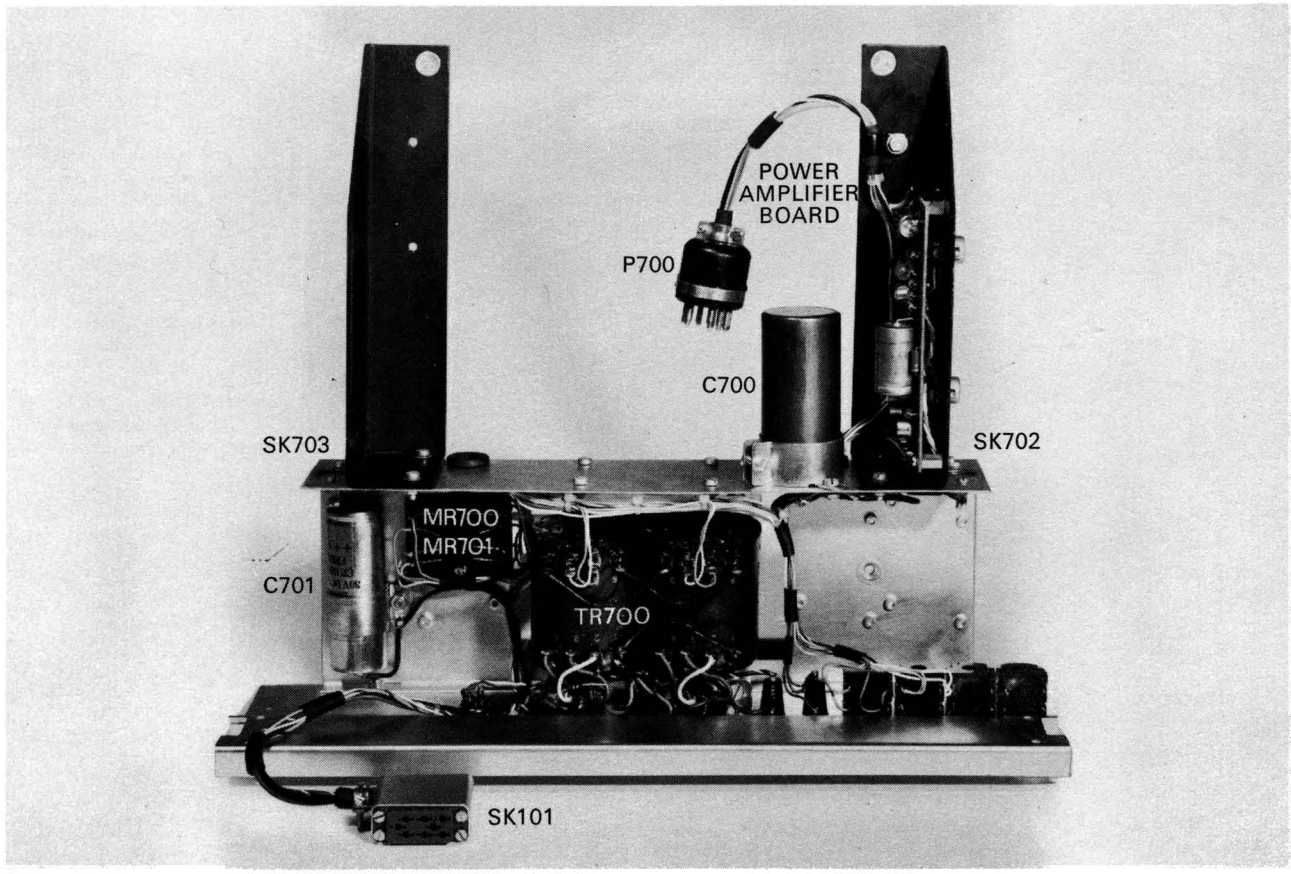


FIG. 7. POWER UNIT—MONO

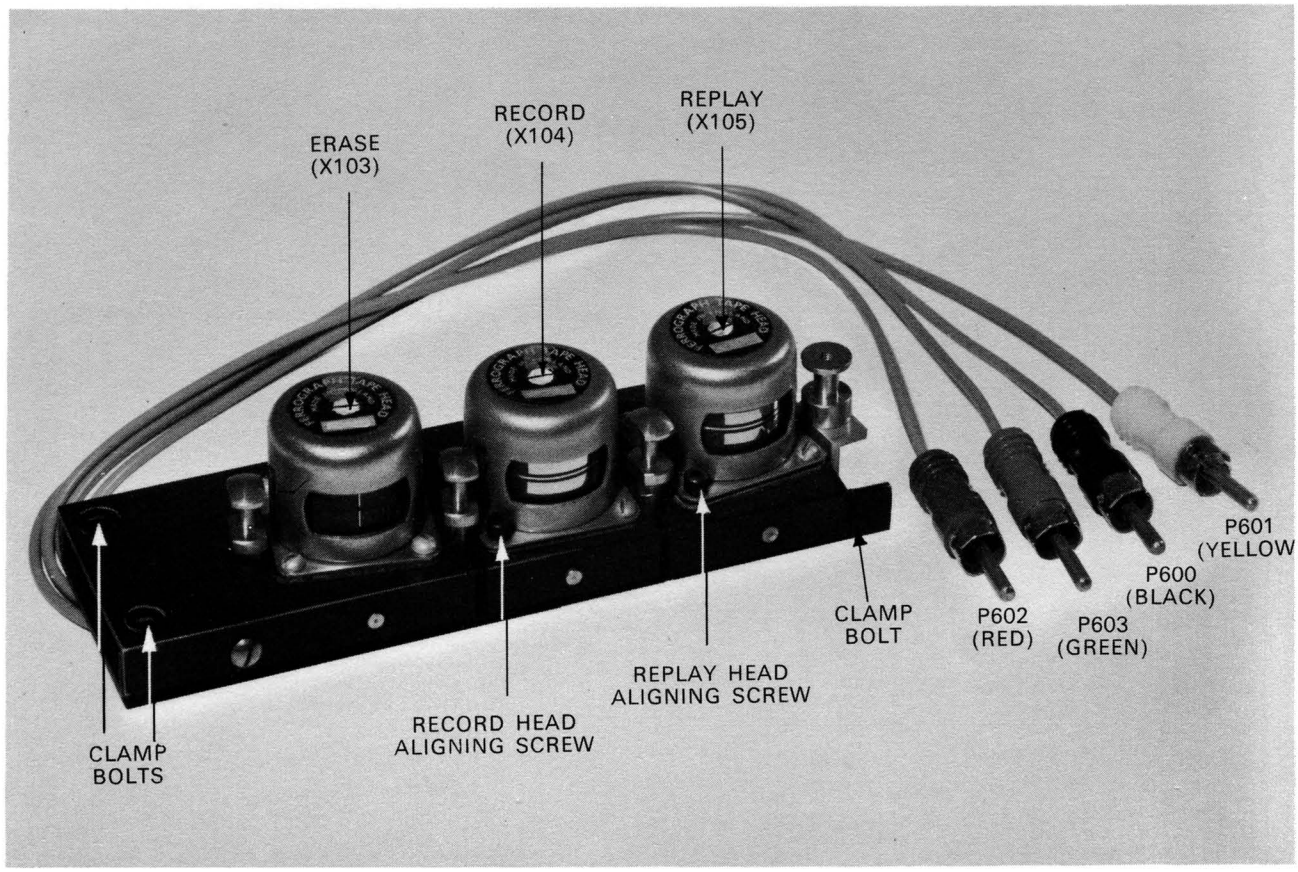


FIG. 9. HEAD ASSEMBLY

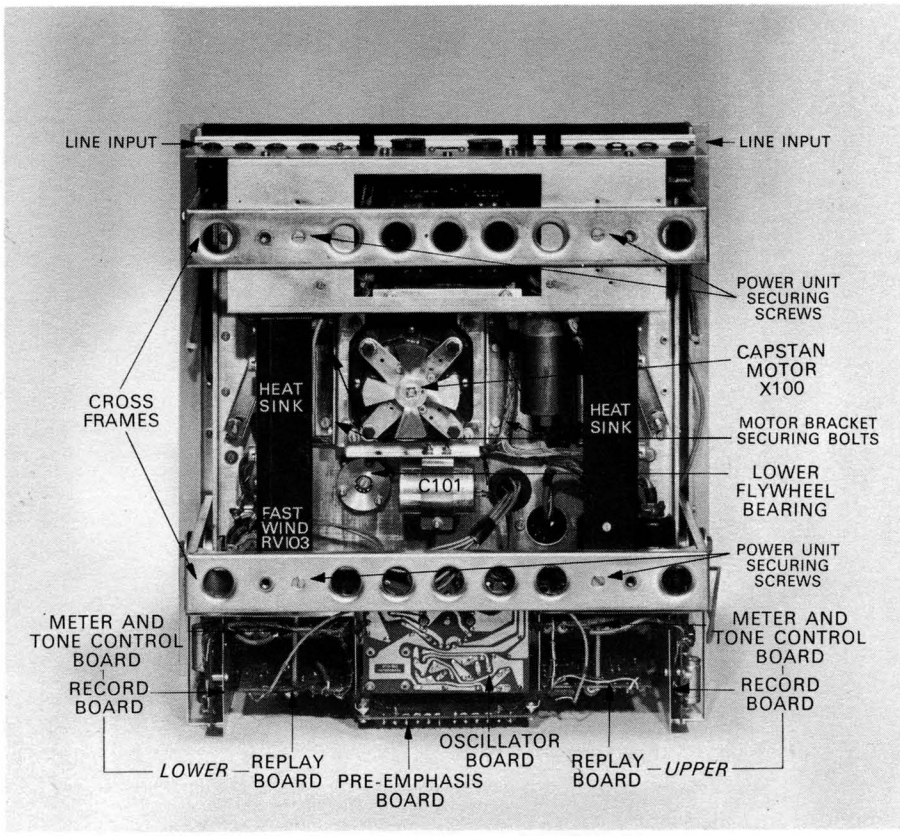


FIG. 10. RECORDER CHASSIS—REAR VIEW

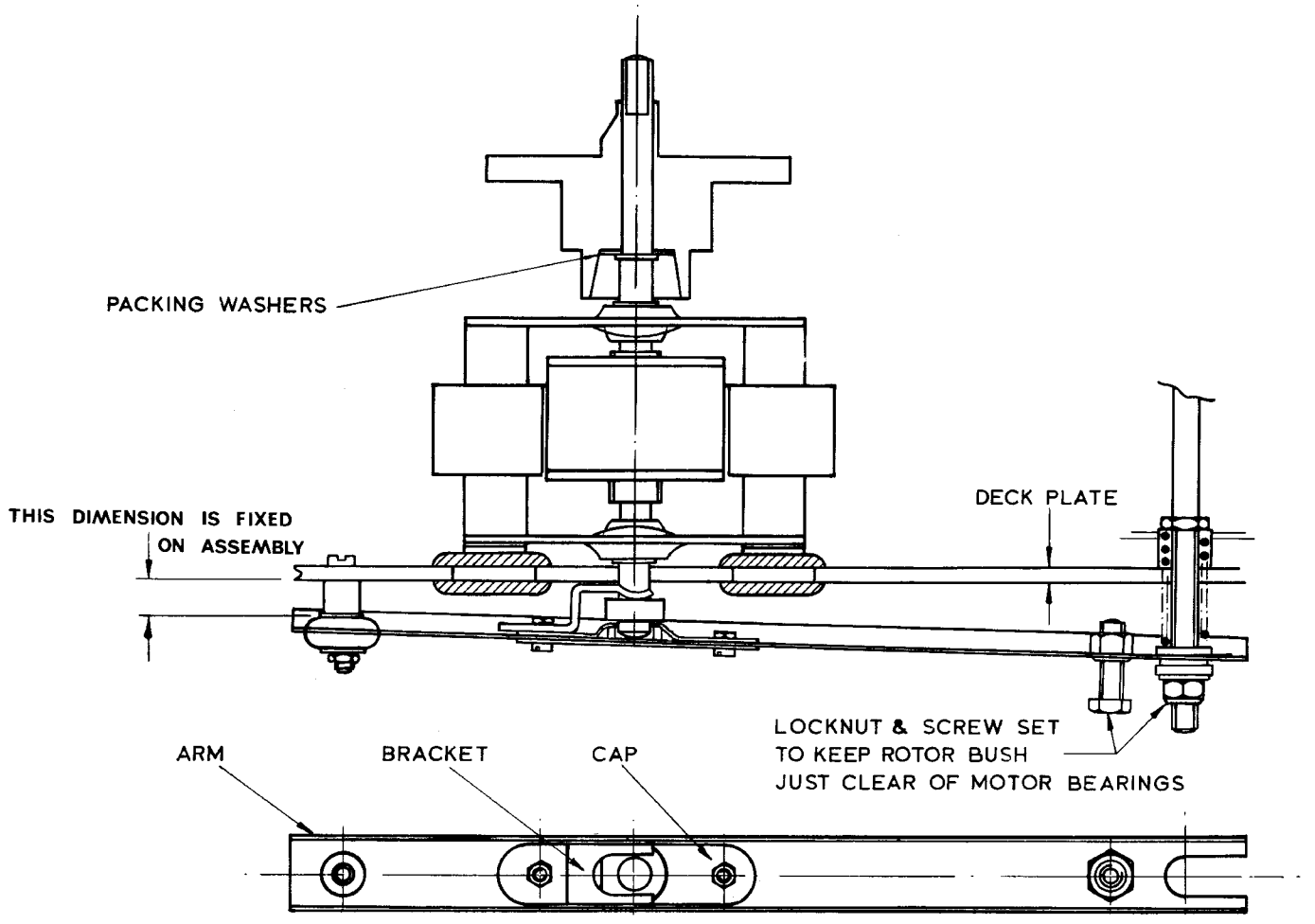


FIG. 11. REEL HEIGHT ADJUSTMENT

		TRACK WIDTH	
		Head	Tape
MONO (Half-track)	Erase	0·130	0·124
	Record	0·100	0·100
	Replay	0·100	0·100
STEREO (Half-track)	Erase	0·120	0·110
	Record	·093	·091
	Replay	·093	·091
STEREO (Quarter-track)	Erase	·055	·049
	Record	·043	·043
	Replay	·043	·043

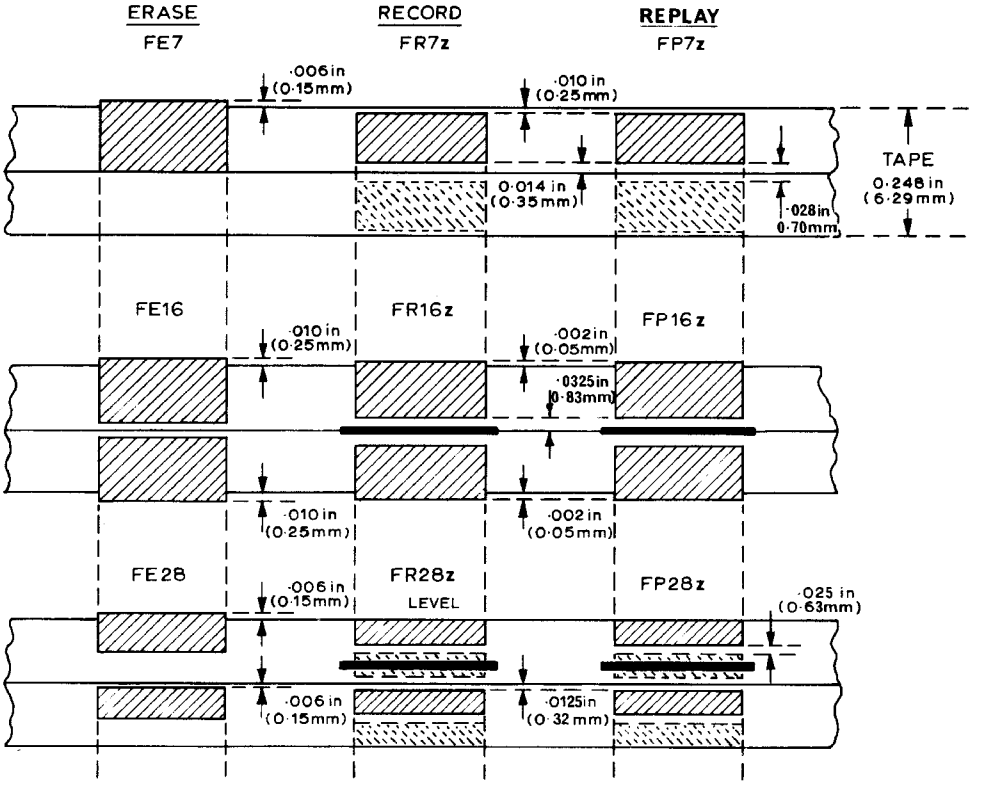


FIG. 12. HEAD ALIGNMENT

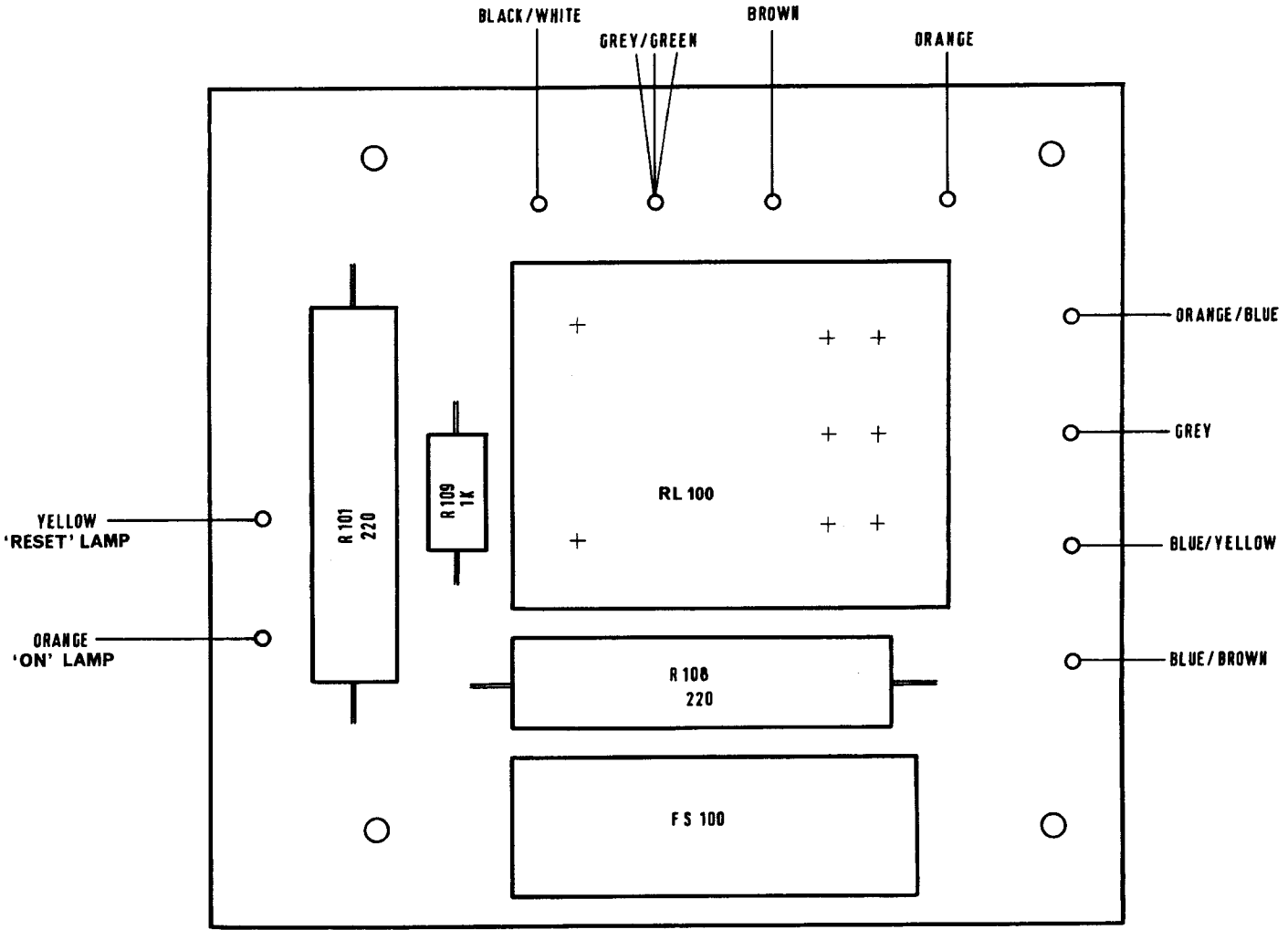
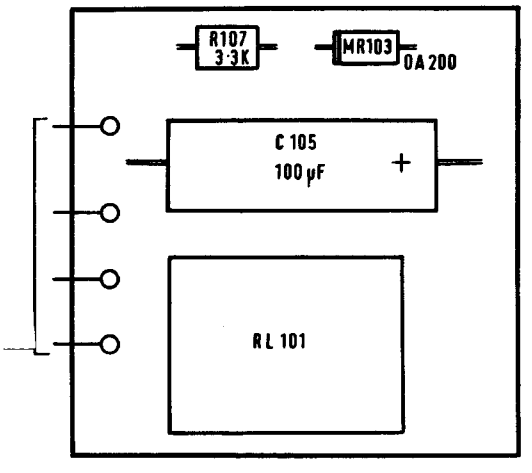


FIG. 13. AUTO STOP RELAY BOARD



½" bare wire link to Auto Stop Relay Board Figure 13.

FIG. 14. DELAY BOARD (HIGH SPEED ONLY)

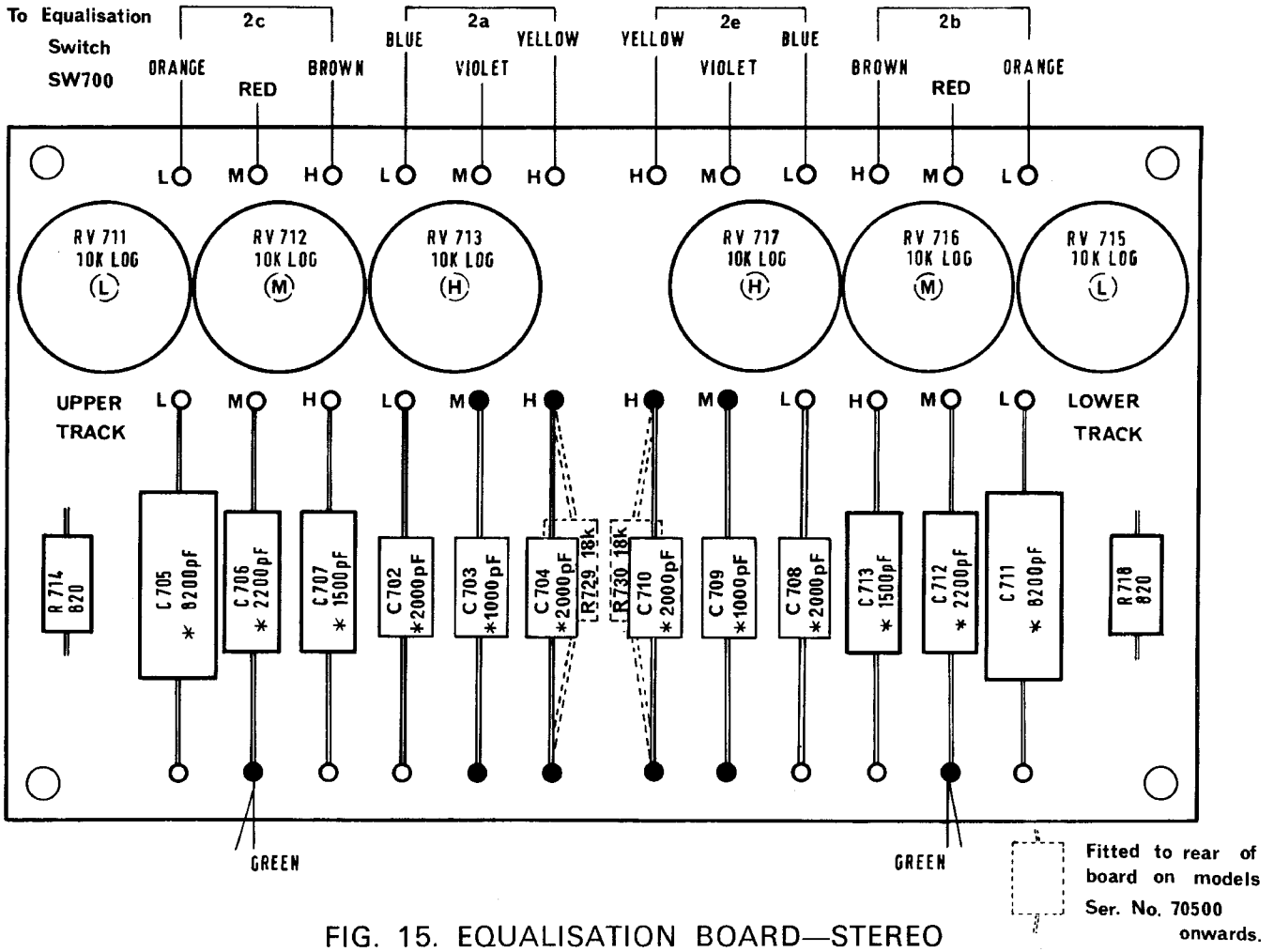


FIG. 15. EQUALISATION BOARD—STEREO

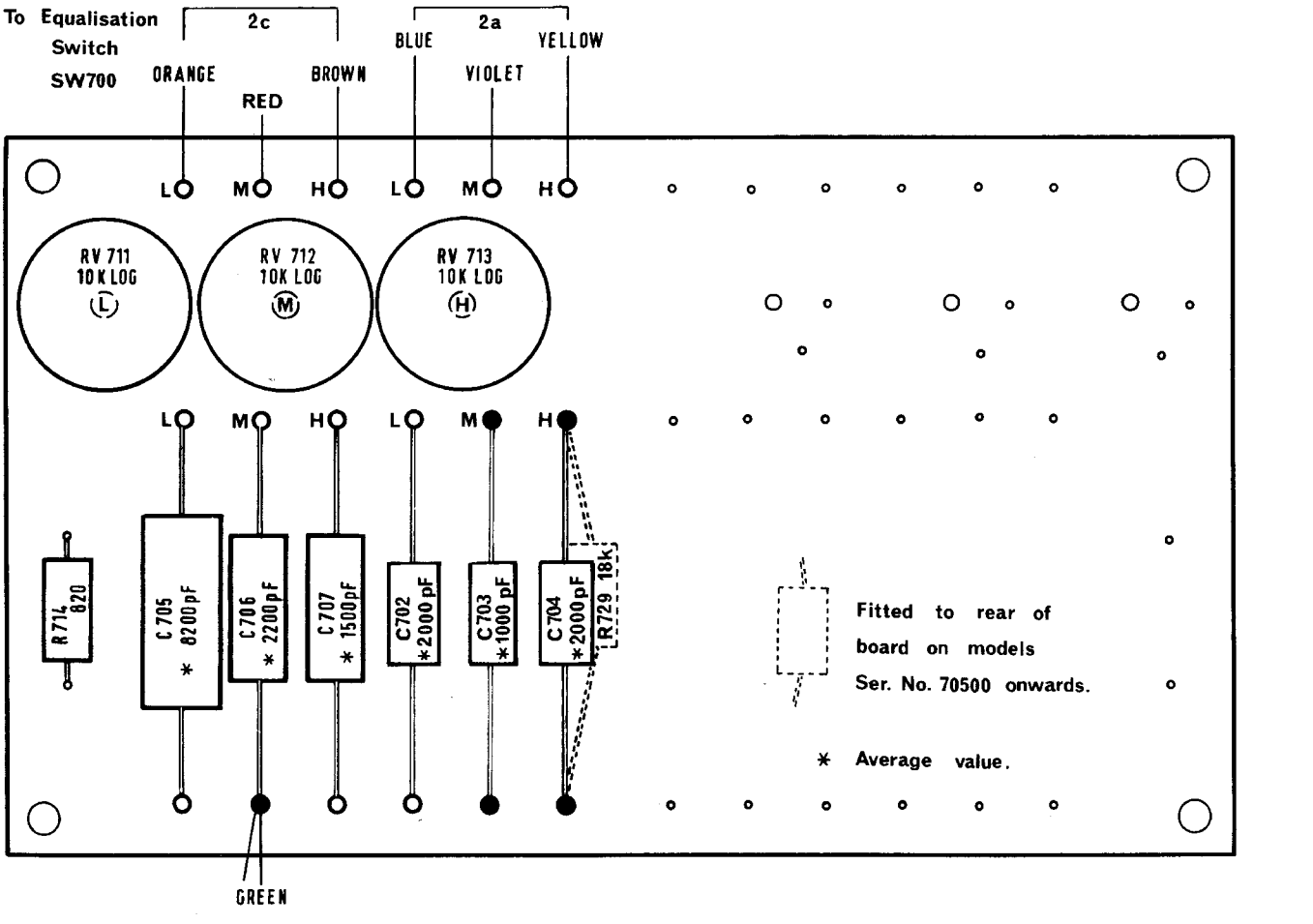


FIG. 16. EQUALISATION BOARD—MONO

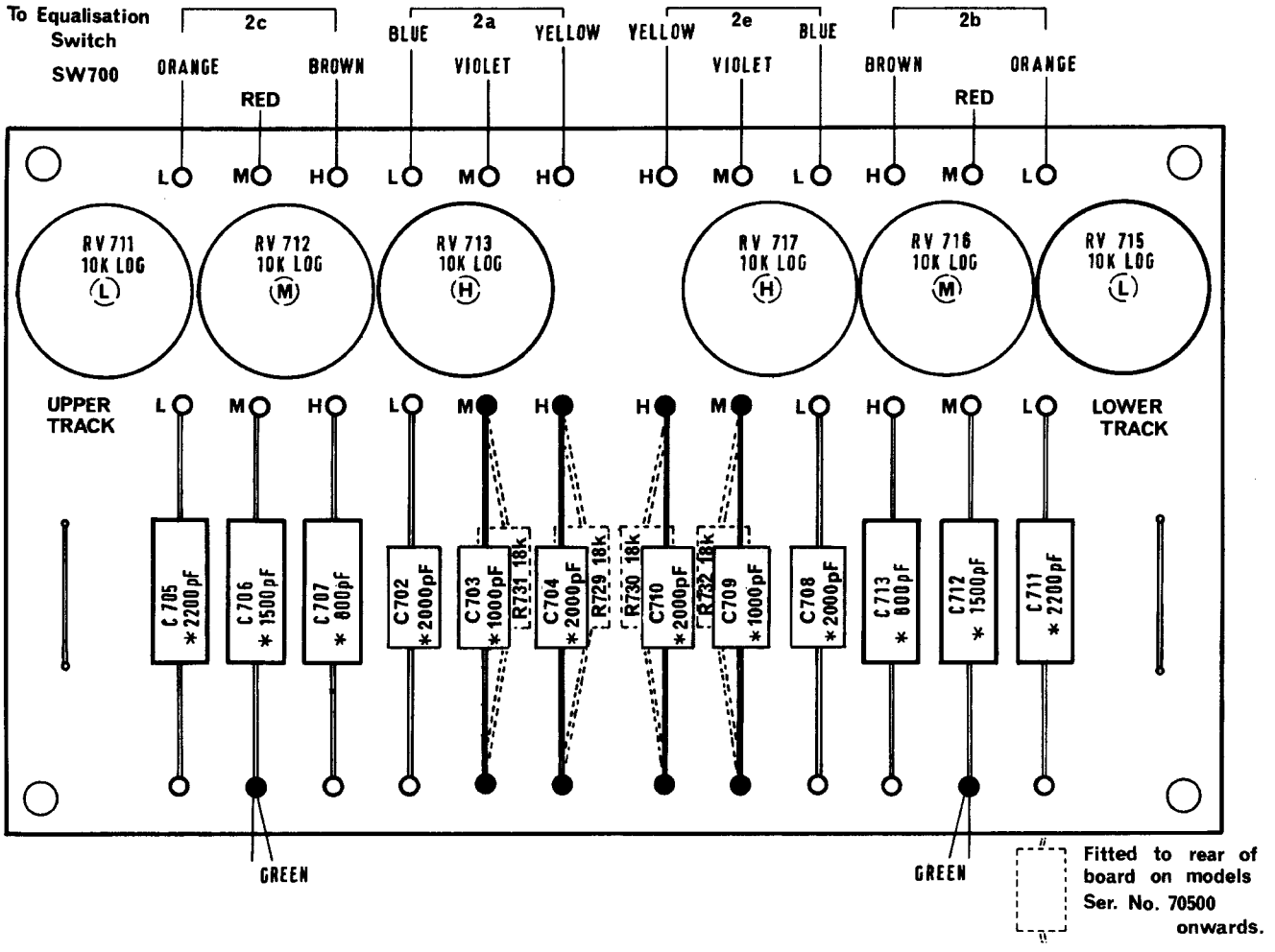


FIG. 17. EQUALISATION BOARD—STEREO, HIGH SPEED * Average value.

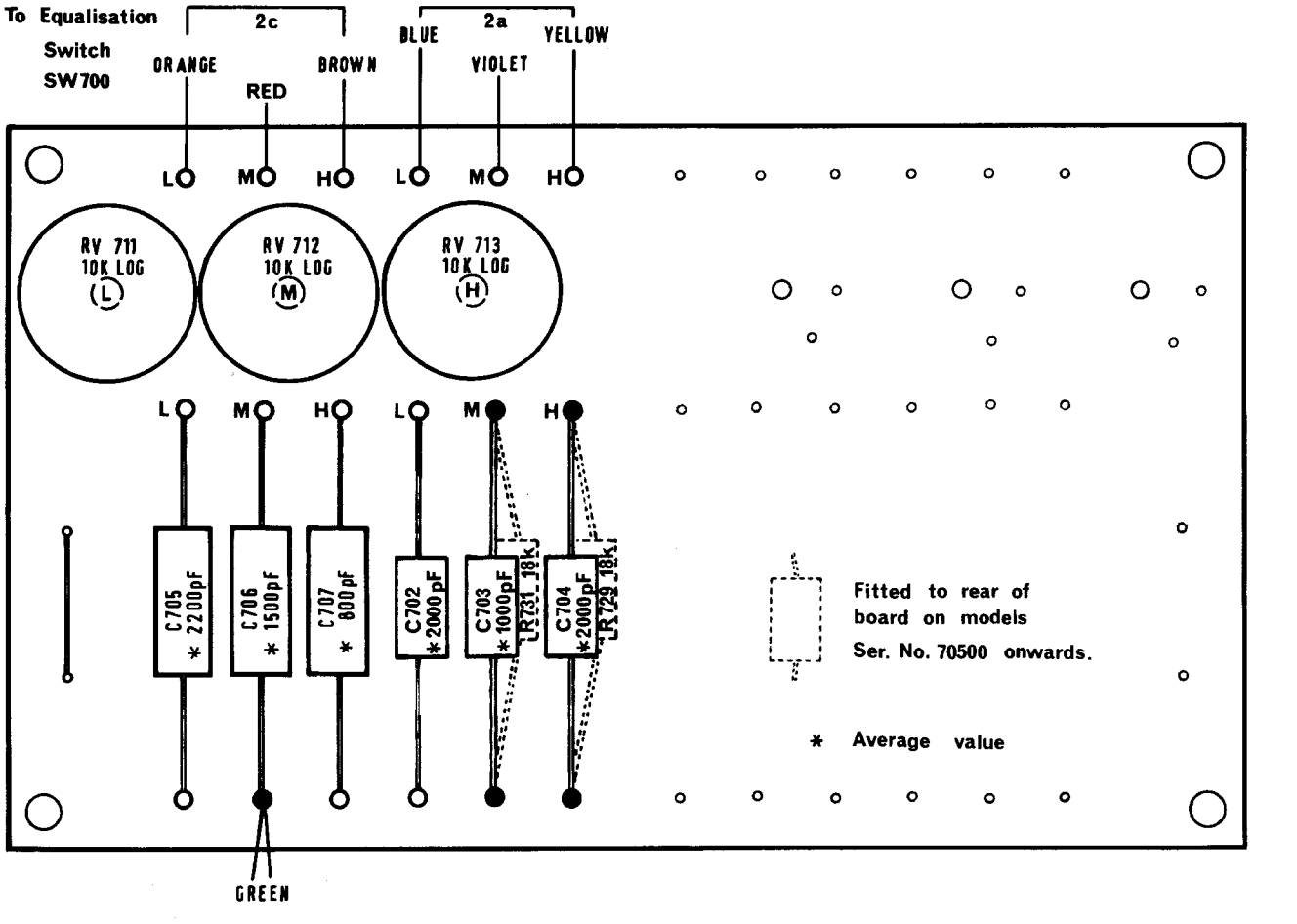


FIG. 18. EQUALISATION BOARD—MONO, HIGH SPEED

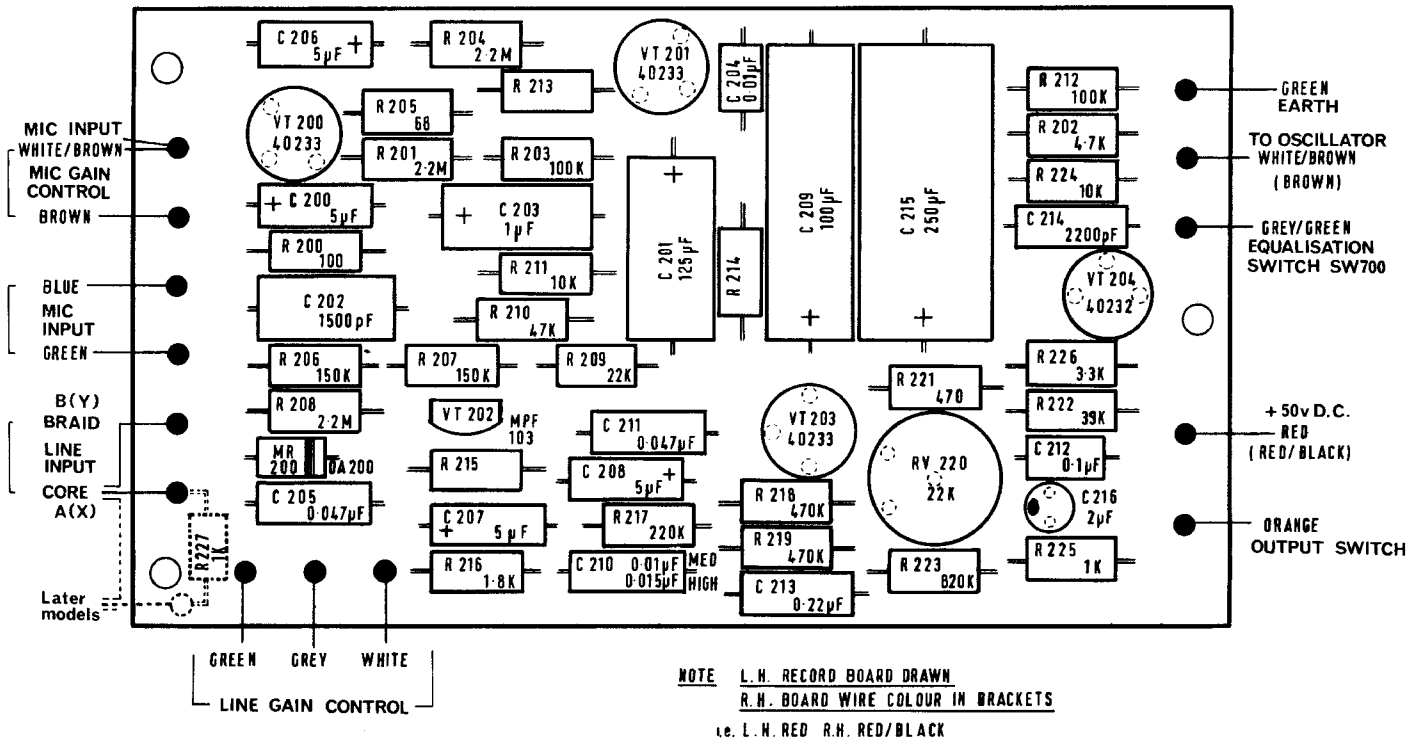


FIG. 19. RECORD BOARD

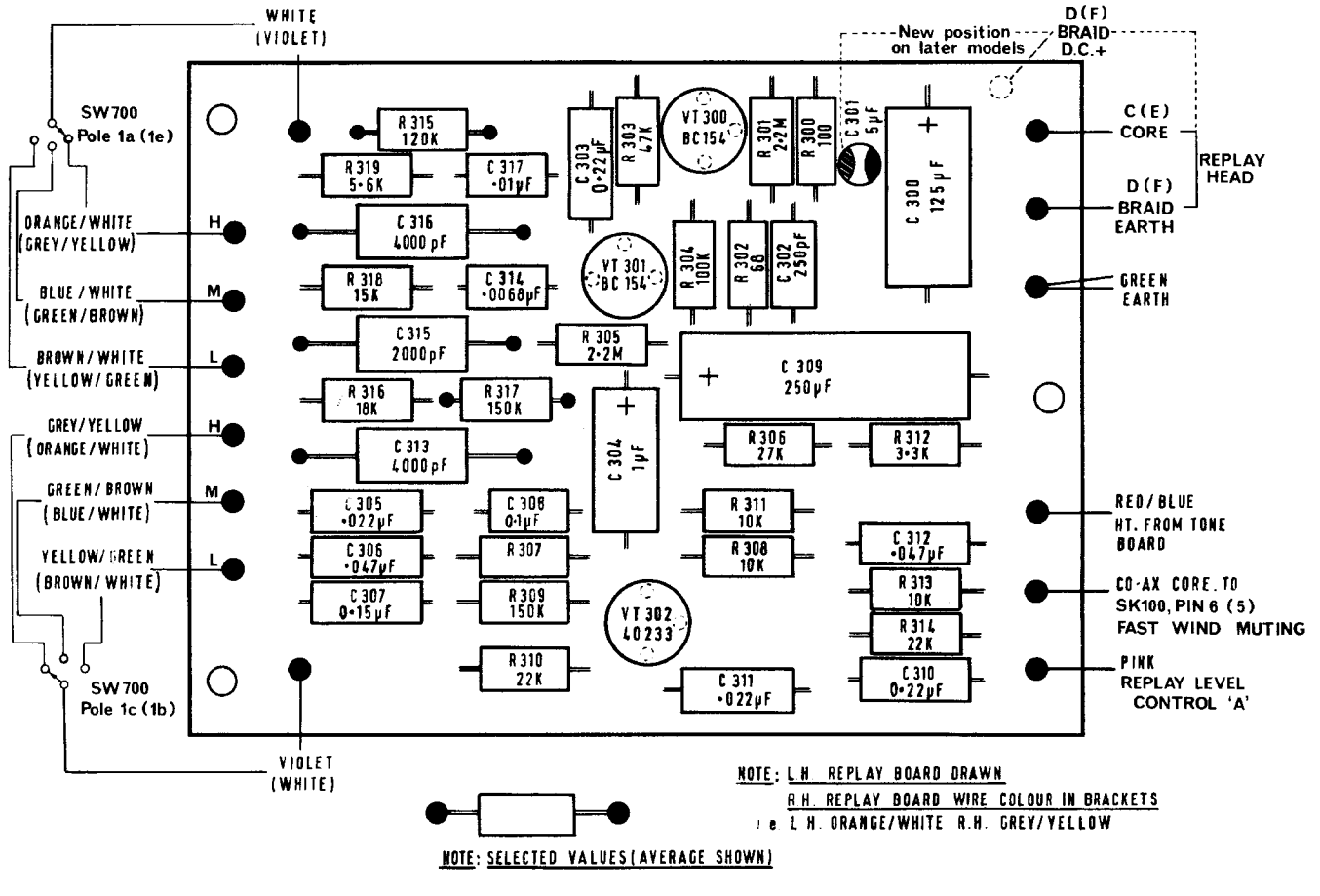


FIG. 20. REPLAY BOARD

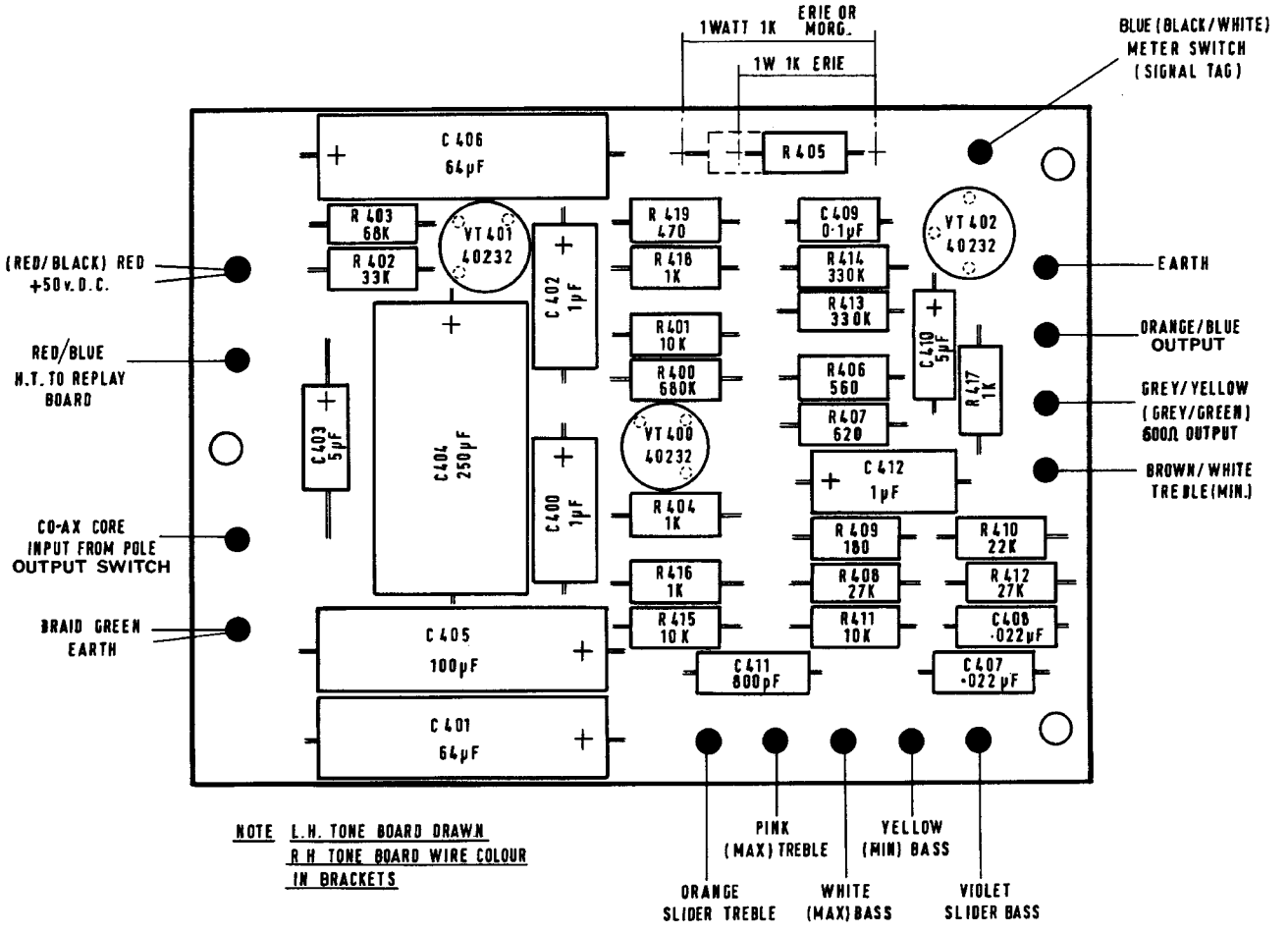


FIG. 21. METER & TONE CONTROL BOARD

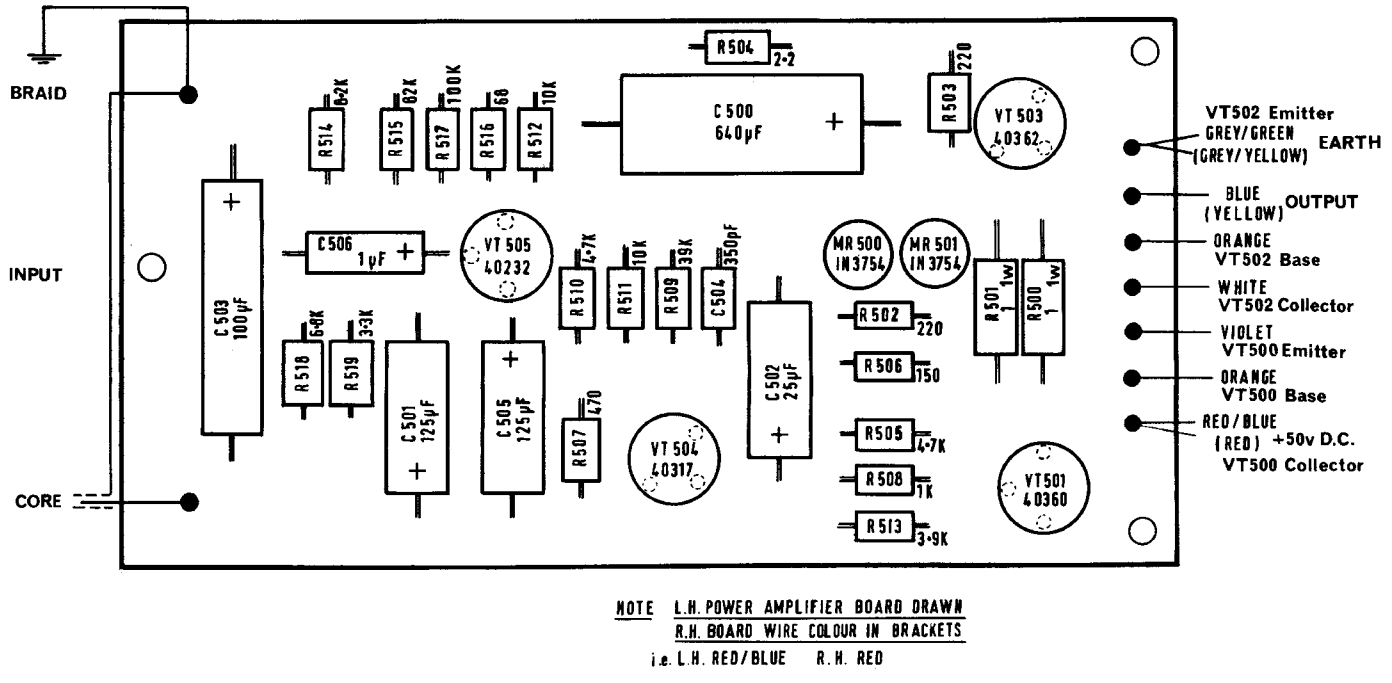
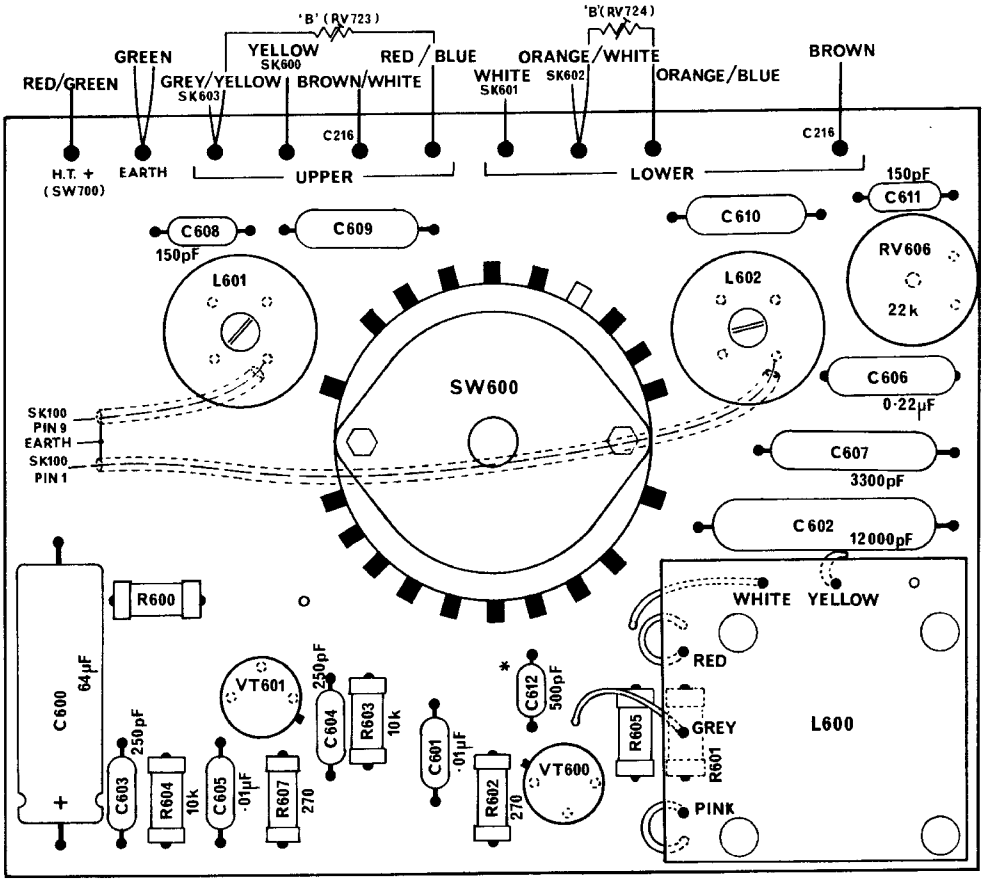
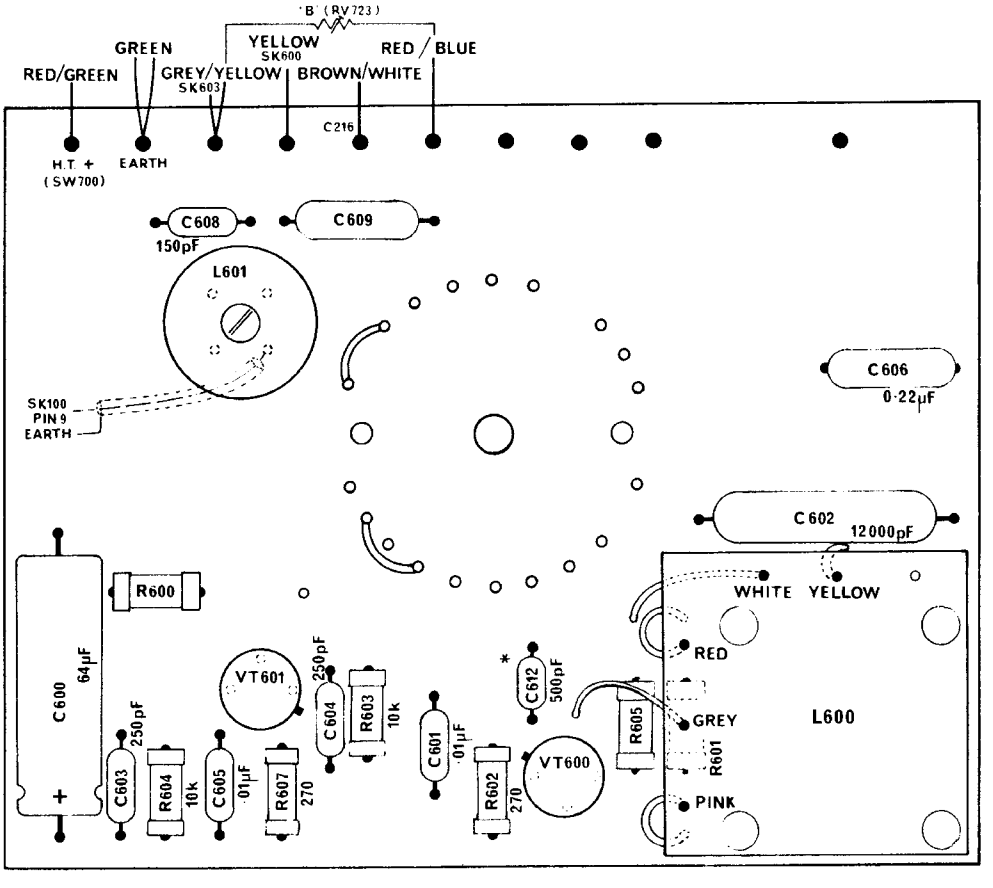


FIG. 22. POWER AMPLIFIER BOARD



* Fitted on later models.

FIG. 23. OSCILLATOR BOARD—STEREO



* Fitted on later models

FIG. 24. OSCILLATOR BOARD—MONO

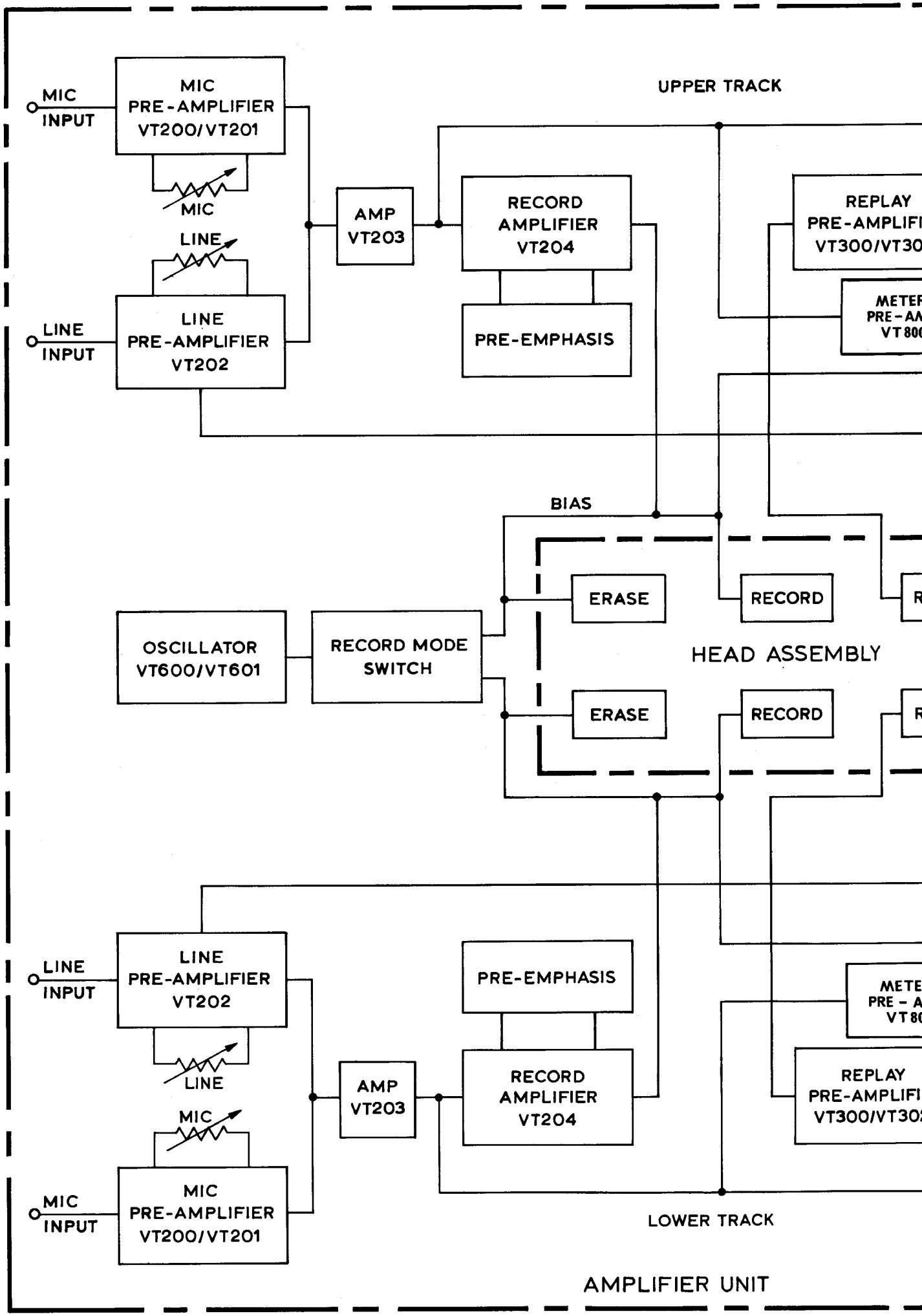
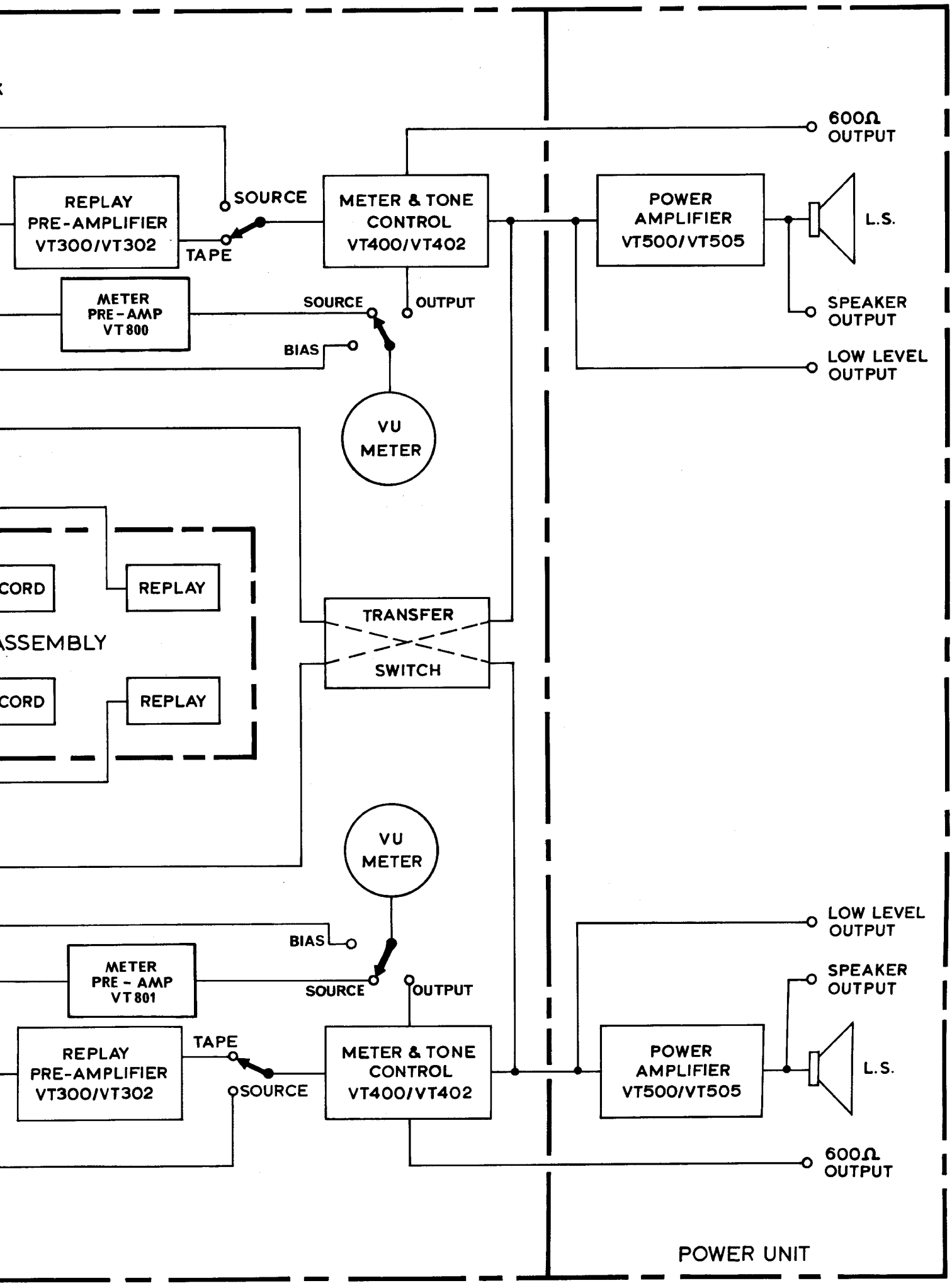


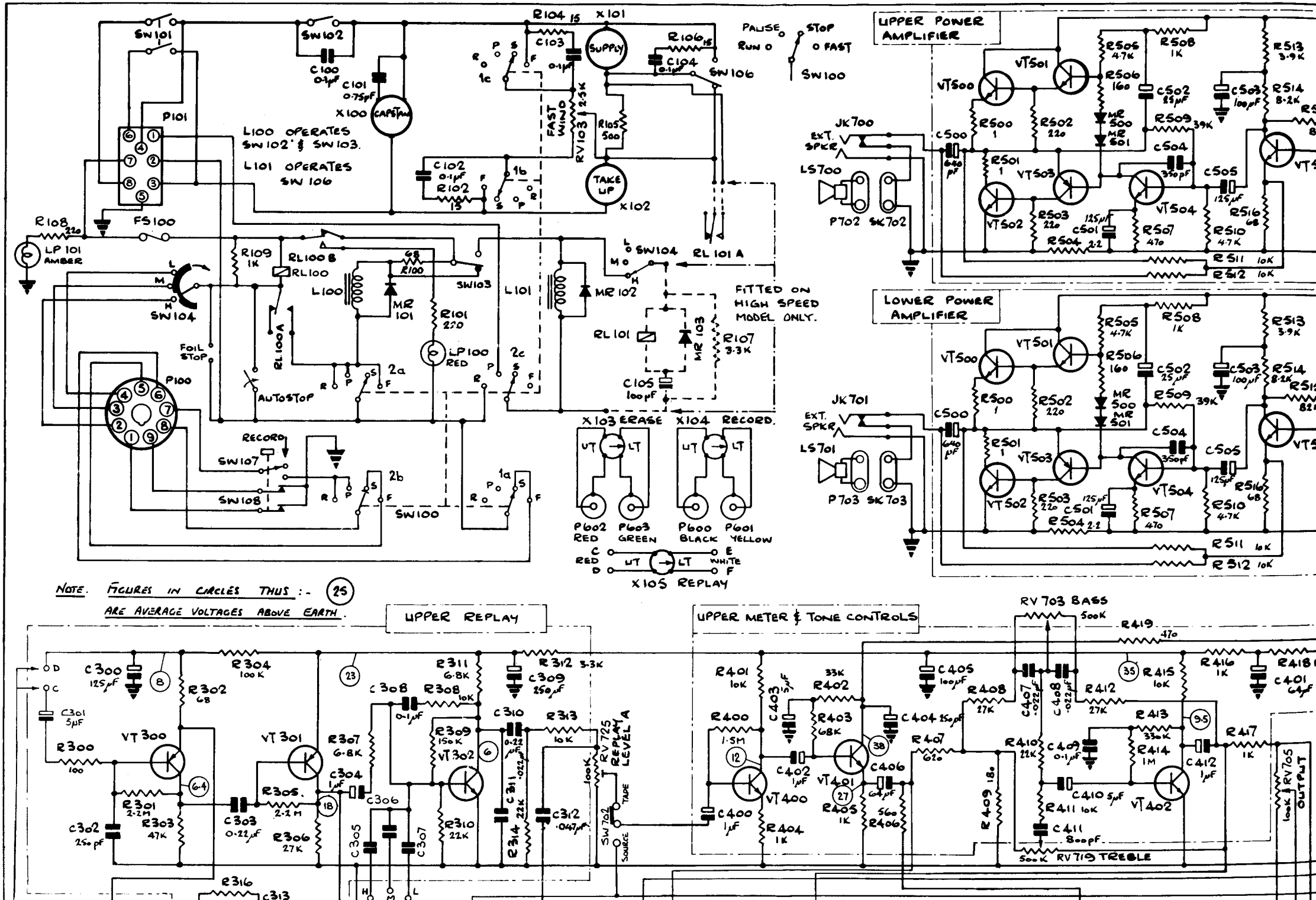
FIG. 25b. ELECTRONICS BLOCK DIAGRAM—(STEREO), SERIAL Nos. 75,000-

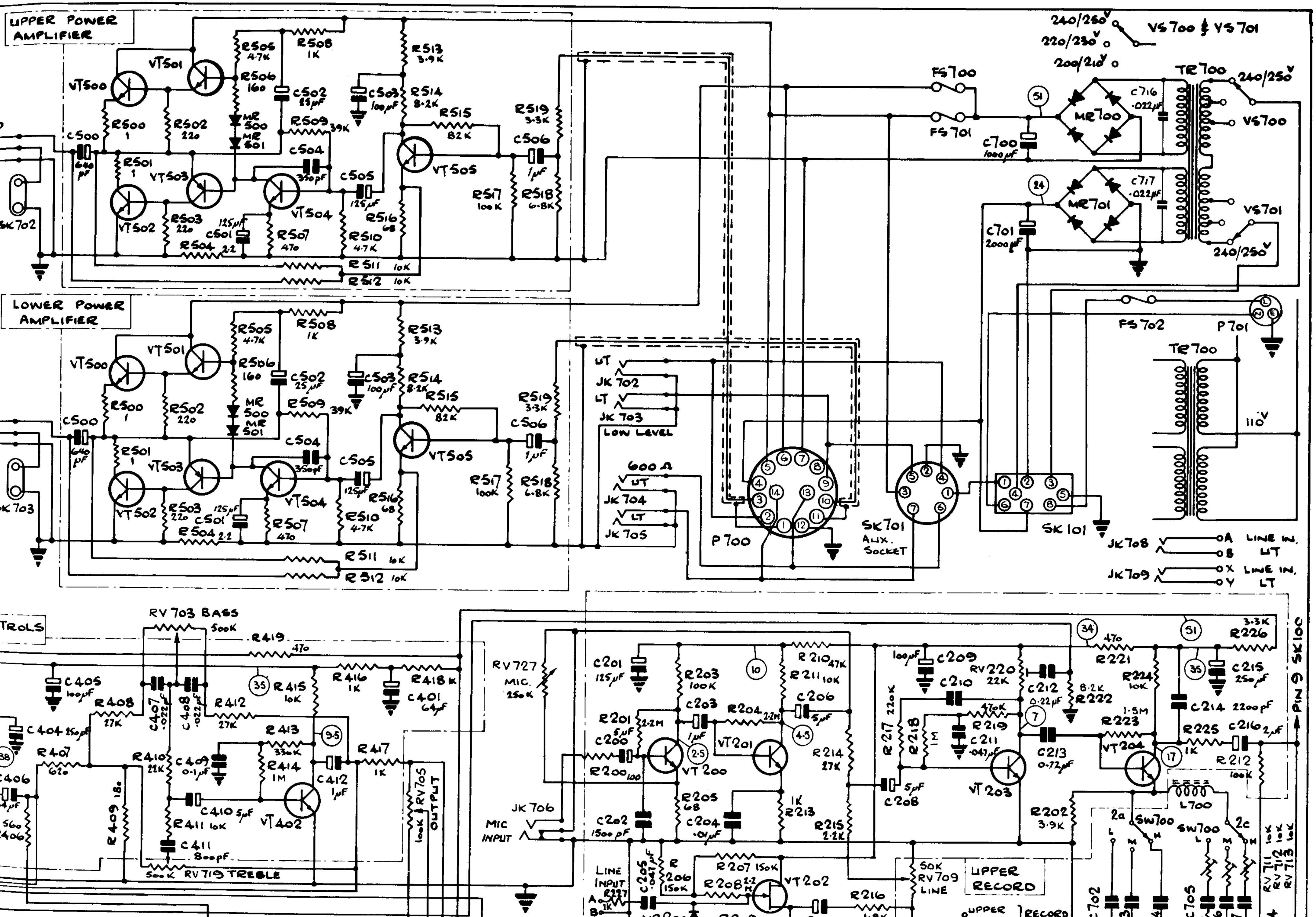

600Ω OUTPUT
REPLAY PRE-AMPLIFIER VT300/VT302
SOURCE
TAPE
METER & TONE CONTROL VT400/VT402
POWER AMPLIFIER VT500/VT505
L.S.
METER PRE-AMP VT800
SOURCE
OUTPUT
SPEAKER OUTPUT
BIAS
LOW LEVEL OUTPUT
VU METER
CORD
REPLAY
TRANSFER SWITCH
ASSEMBLY
CORD
REPLAY
VU METER
LOW LEVEL OUTPUT
BIAS
METER PRE-AMP VT801
SOURCE
OUTPUT
SPEAKER OUTPUT
REPLAY PRE-AMPLIFIER VT300/VT302
TAPE
SOURCE
METER & TONE CONTROL VT400/VT402
POWER AMPLIFIER VT500/VT505
L.S.
600Ω OUTPUT
POWER UNIT

Series Seven Circuit Diagrams

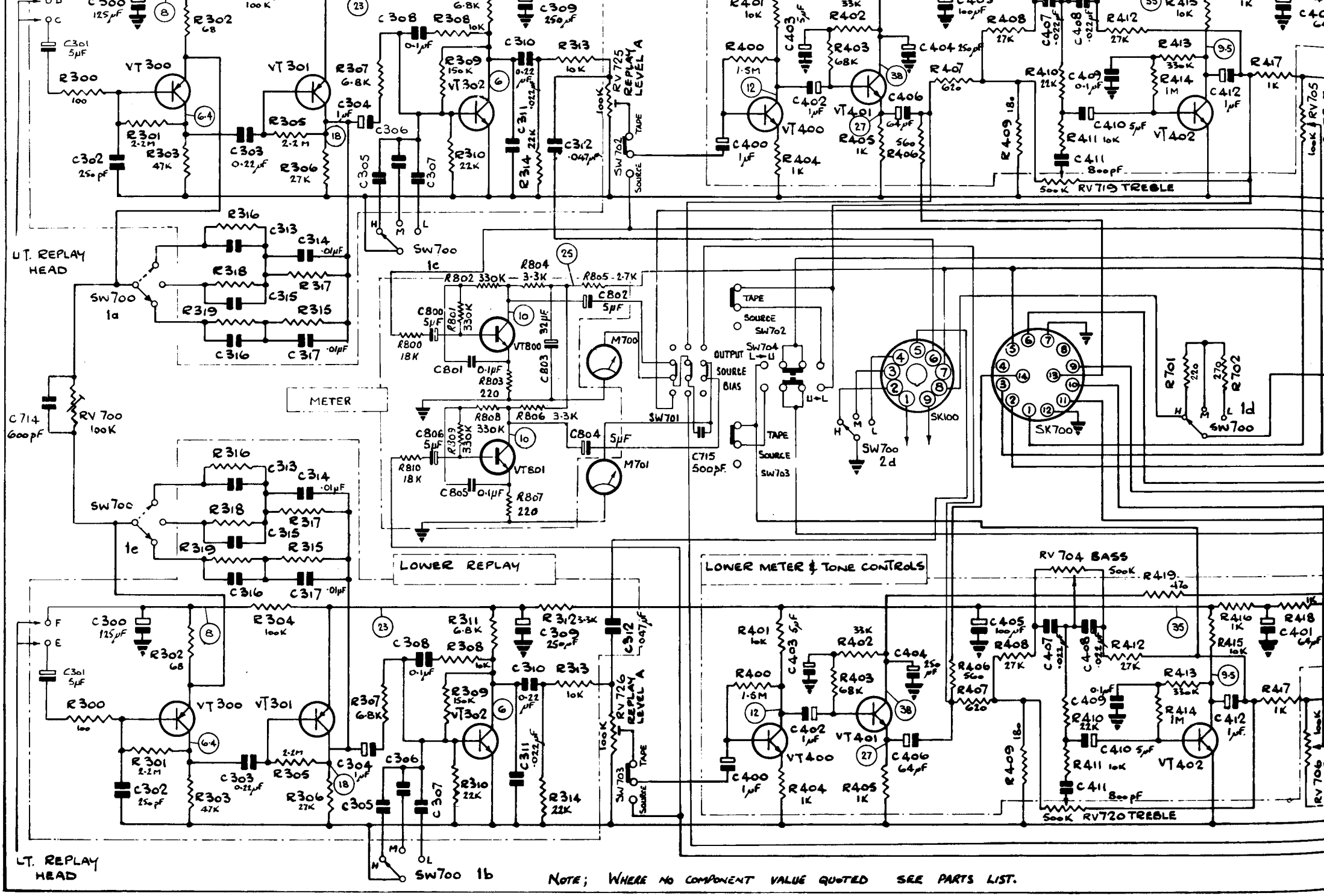
Each circuit diagram has been scanned on to four A4 size sheets.
It is suggested that the required circuit diagram be printed on A4 paper, then trimmed and glued to reproduce the original full sized print.
The original manual contained circuit diagrams for Mark 1+2, Mono + Stereo.

Mark 1 Stereo


SW101
SW102
C100 0.1μF
C101 0.75μF
X100 CAPSTAN
P101
L100 OPERATES SW102 & SW103.
L101 OPERATES SW106
R104 15
X101
C103 0.1μF
SUPPLY
R106 15
C104 0.1μF
SW106
PAUSE
STOP
RUN
FAST
SW100
FAST WIND
RV103 2.5K
R105 500
C102 0.1μF
R102 15
TAKE UP
X102
R108 220
FS100
LP101 AMBER
R109 1K
RL100B
RL100
RL100A
R100 68
SW103
L100
MR101
R101 220
LP100 RED
L101
MR102
SW104
RL101A
FITTED ON HIGH SPEED MODEL ONLY.
RL101
MR103
R107 3.3K
C105 100pF
FOIL STOP
AUTOSTOP
P100
RECORD
SW107
SW108
SW100
X103 ERASE
X104 RECORD.
P602 RED
P603 GREEN
P600 BLACK
P601 YELLOW
X105 REPLAY
UPPER POWER AMPLIFIER
JK700
EXT. SPKR
LS700
P702 SK702
C500 640pF
VT500
VT501
VT502
VT503
VT504
R500 1
R501 1
R502 220
R503 220
R504 2.2
R505 4.7K
R506 160
R507 470
R508 1K
R509 39K
C501 125μF
C502 25μF
C503 100pF
C504 350pF
C505 125μF
R510 4.7K
R511 10K
R512 10K
R513 3.9K
R514 8.2K
R516 68
MR500 MR501
LOWER POWER AMPLIFIER
JK701
P703 SK703
R515 820
NOTE. FIGURES IN CIRCLES THUS :- (25) ARE AVERAGE VOLTAGES ABOVE EARTH.
UPPER REPLAY
C300 125μF
R304 100K
R302 68
C301 5μF
R300 100
VT300
VT301
R301 2.2M
R303 47K
C302 250pF
C303 0.22μF
R305
R306 27K
C304 1μF
C305
C306
C307
R307 6.8K
C308 0.1μF
R308 10K
R309 150K
VT302
R310 22K
R311 6.8K
C309 250pF
R312 3.3K
C310 0.22μF
C311 .022μF
R313 10K
R314 22K
C312 .047μF
RV725 REPLAY LEVEL A
SW702 TAPE SOURCE
UPPER METER & TONE CONTROLS
RV703 BASS 500K
R419 470
R401 10K
C403 .1μF
R402 33K
R400 1.5M
R403 68K
C402 1μF
VT400
VT401
C404 150pF
C405 100pF
R407 620
R408 27K
R409 1.8K
C406 64pF
R405 1K
R406 560
C400 1μF
R404 1K
C407 .022μF
C408 .022μF
R412 27K
R410 22K
C409 0.1μF
R411 10K
C410 5μF
C411 800pF
R413 33K
R414 1M
VT402
R415 10K
R416 1K
R417 1K
C412 1μF
C401 64μF
RV705 TREBLE
RV719 OUTPUT

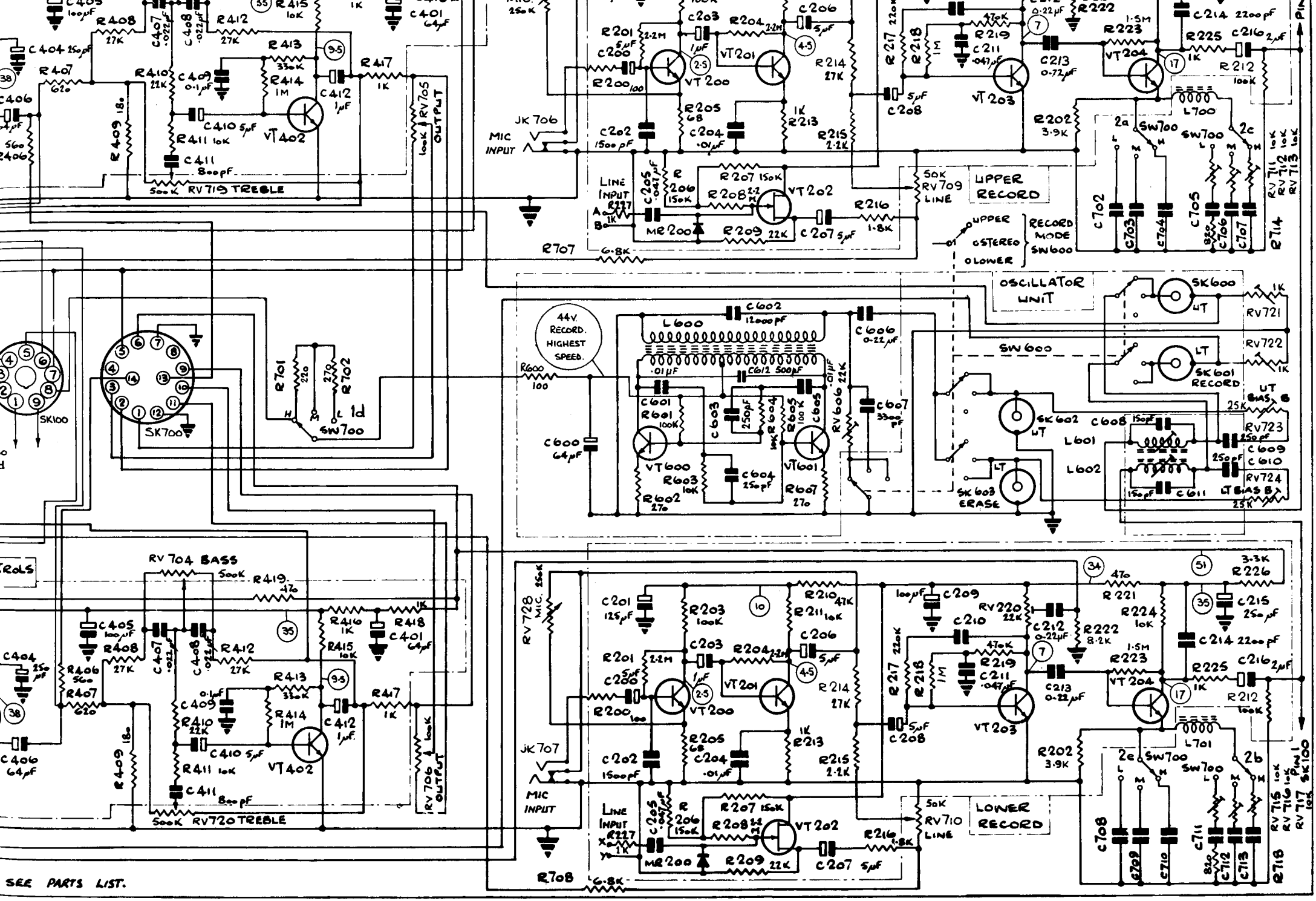


UPPER POWER AMPLIFIER
LOWER POWER AMPLIFIER
VT500
VT501
VT502
VT503
VT504
VT505
R500 1
R501 1
R502 220
R503 220
R504 2.2
R505 4.7K
R506 160
R507 470
R508 1K
R509 39K
R510 4.7K
R511 10K
R512 10K
R513 3.9K
R514 8.2K
R515 82K
R516 68
R517 100K
R518 6.8K
R519 3.3K
C500 640μF
C501 125μF
C502 25μF
C503 100μF
C504 350pF
C505 125μF
C506 1μF
MR 500
MR 501
VS700 & VS701
240/250V
220/230V
200/210V
TR700
FS700
FS701
FS702
C700 1000μF
C701 2000μF
C716 .022μF
C717 .022μF
MR700
MR701
P700
P701
SK701 AUX. SOCKET
SK101
JK702
JK703
LOW LEVEL
600 Ω
JK704
JK705
JK708
JK709
LINE IN. UT
LINE IN. LT
110V
RV703 BASS 500K
RV719 TREBLE
RV705 OUTPUT 100K
RV727 MIC. 250K
JK706
MIC INPUT
LINE INPUT
VT402
VT200
VT201
VT202
VT203
VT204
L700
SW700
RV709 LINE 50K
UPPER RECORD
RV711 10K
RV712 10K
RV713 10K
PIN 9 SK100



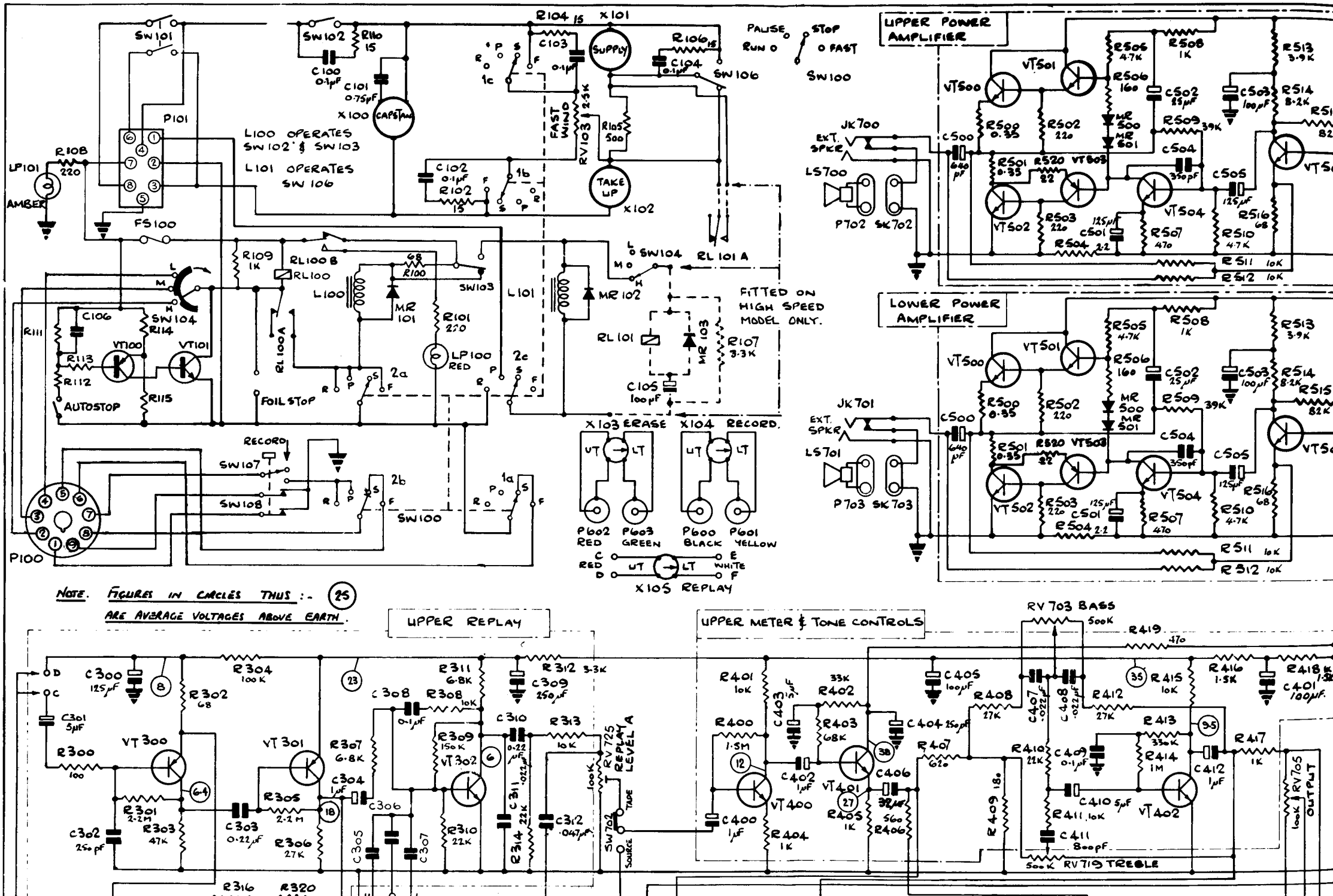
NOTE; WHERE NO COMPONENT VALUE QUOTED SEE PARTS LIST.

FIG. 27b. CIRCUIT DIAGRAM—(STEREO), SERIAL Nos. 75,000-

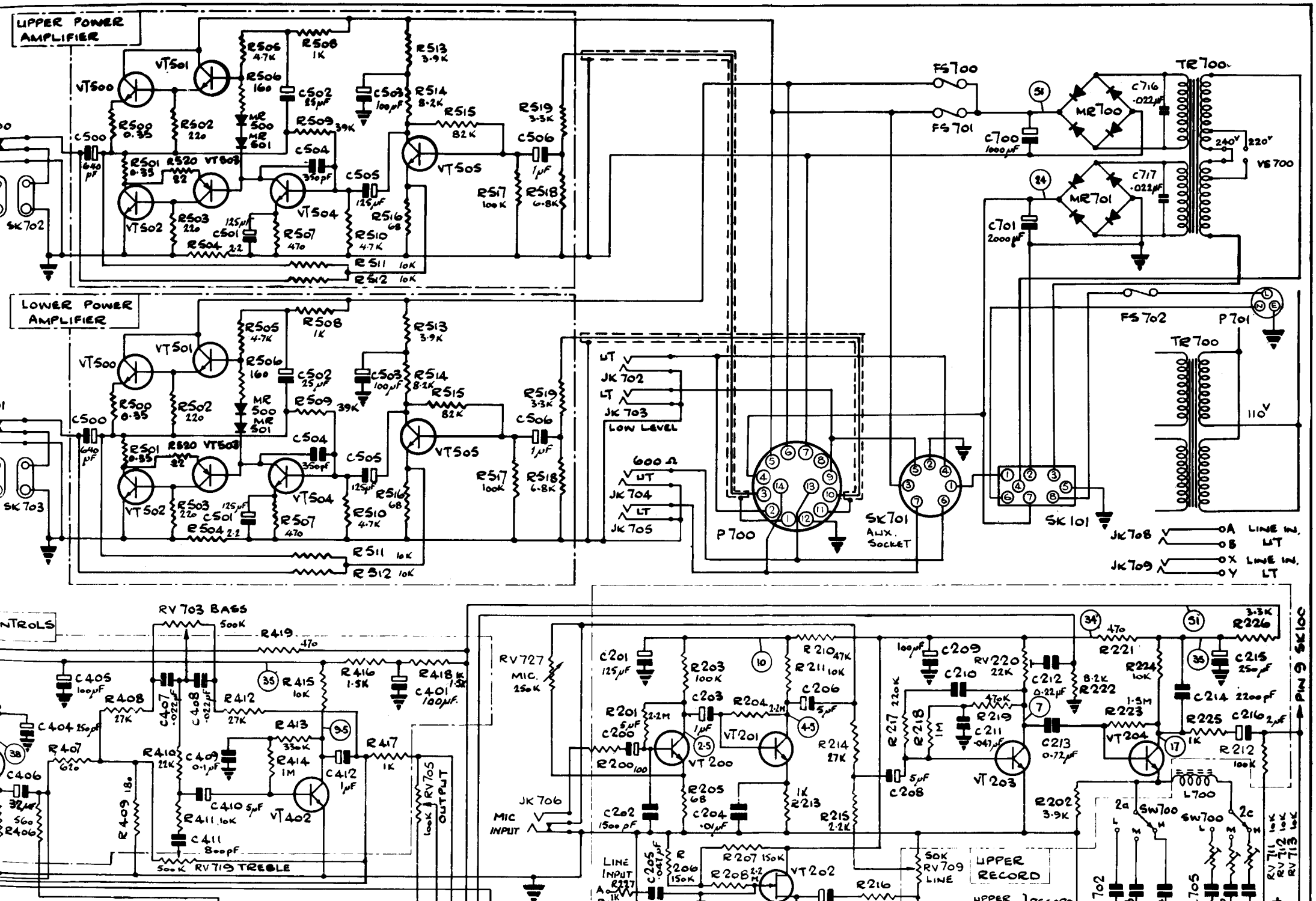

SEE PARTS LIST.
OSCILLATOR UNIT
44V. RECORD. HIGHEST SPEED.
UPPER RECORD
LOWER RECORD
RECORD MODE SW600
MIC INPUT
LINE INPUT
SK100
SK700
SK600
SK601 RECORD
SK602
SK603 ERASE
SW700
SW600
RV704 BASS
RV719 TREBLE
RV720 TREBLE
RV705 OUTPUT
RV706 OUTPUT
RV709 LINE
RV710 LINE
RV721
RV722
RV723
RV724
L600
L601
L602
L700
L701
VT200
VT201
VT202
VT203
VT204
VT402
VT600
VT601
R600
R601
R602
R603
R604
R605
R606
R607
R701
R702
R707
R708
C600
C601
C602
C603
C604
C605
C606
C607
C608
C609
C610
C611
C612
C700
C701
C702
C703
C704
C705
C706
C707
C708
C709
C710
C711
C712
C713
C714
C718
R714
R718
PANEL

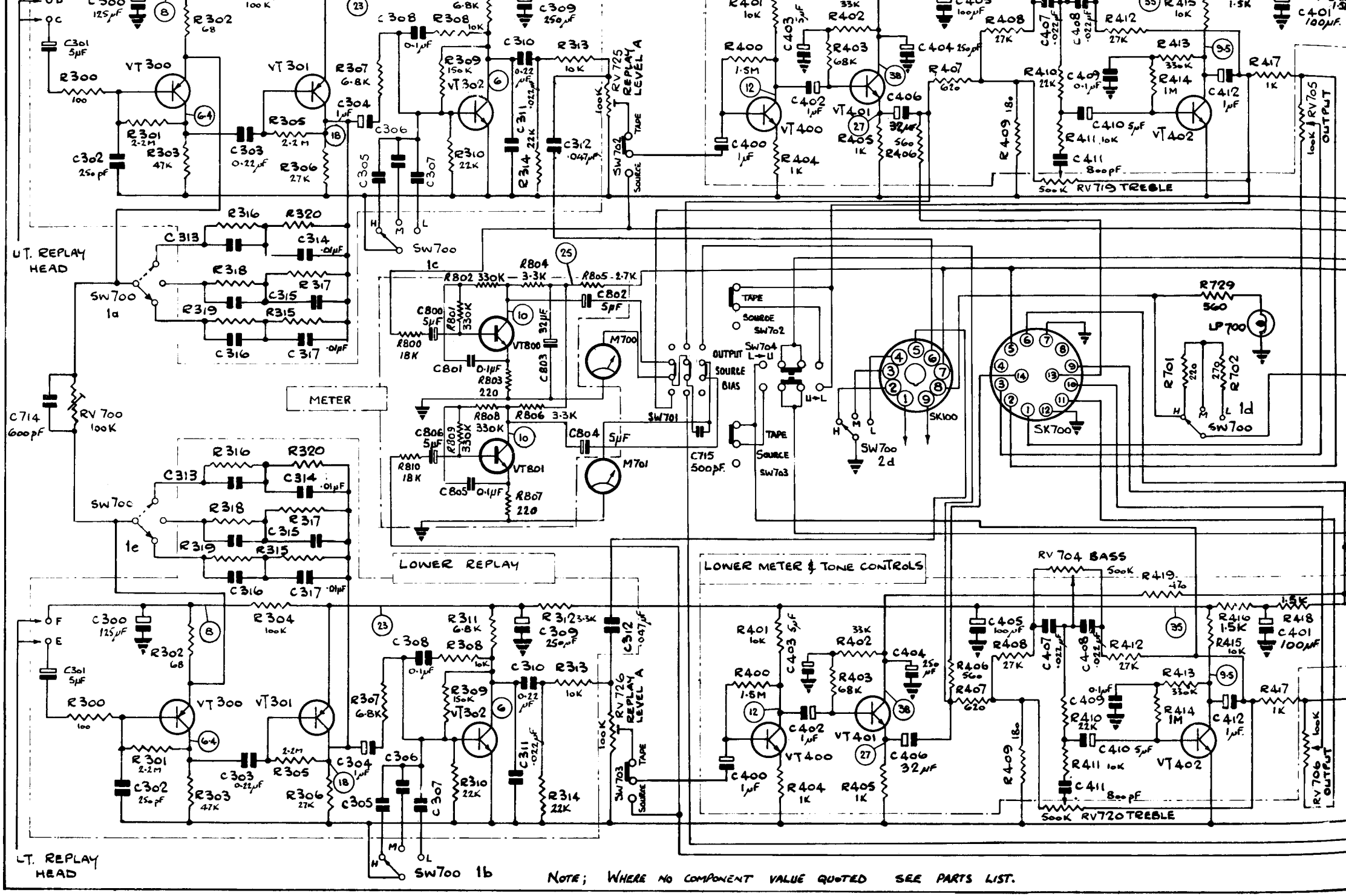
Mark 2 Stereo

FERROGRAPH SERIES SEVEN



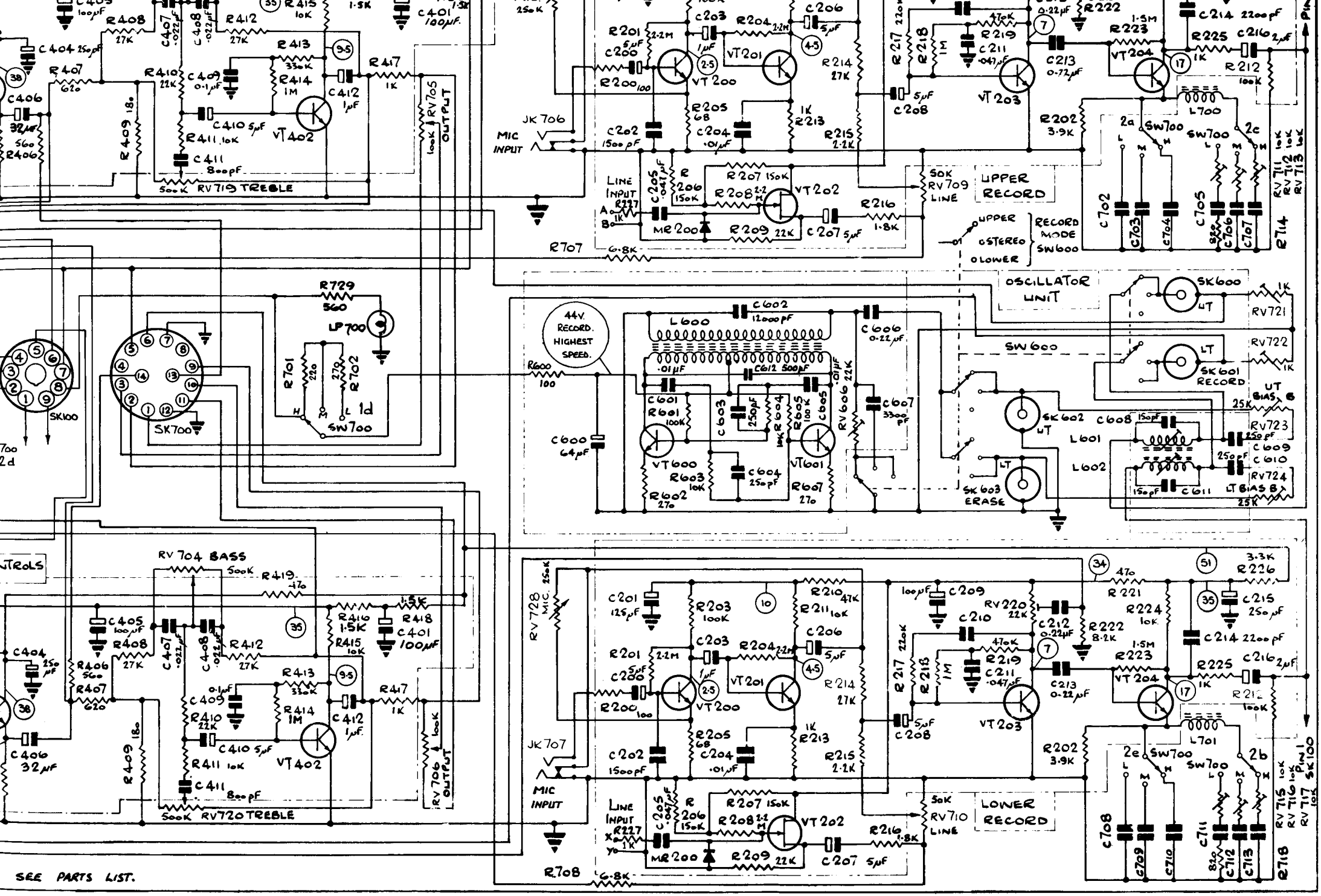
GRAPH SERIES SEVEN MK.2



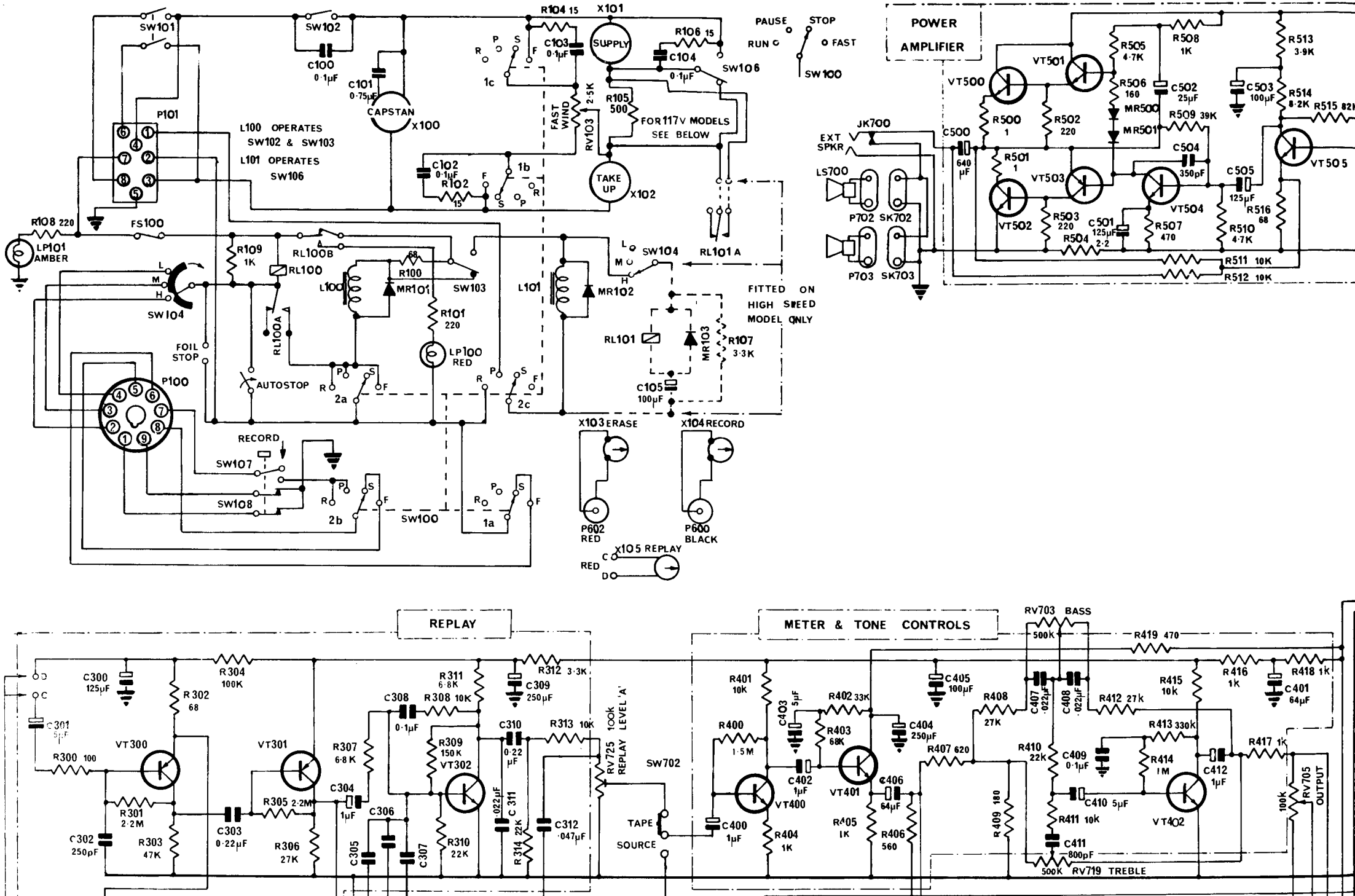


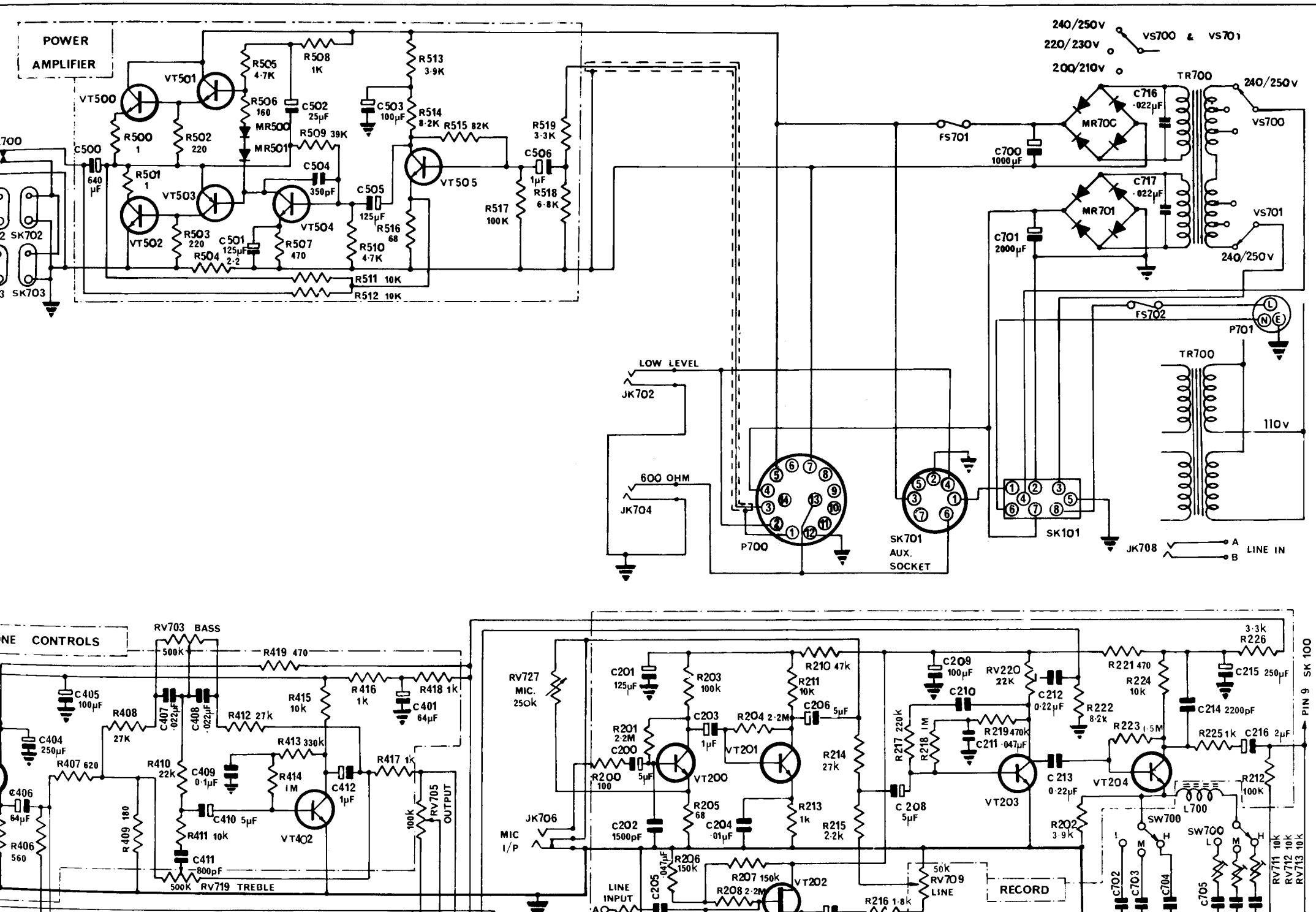
NOTE; WHERE NO COMPONENT VALUE QUOTED SEE PARTS LIST.

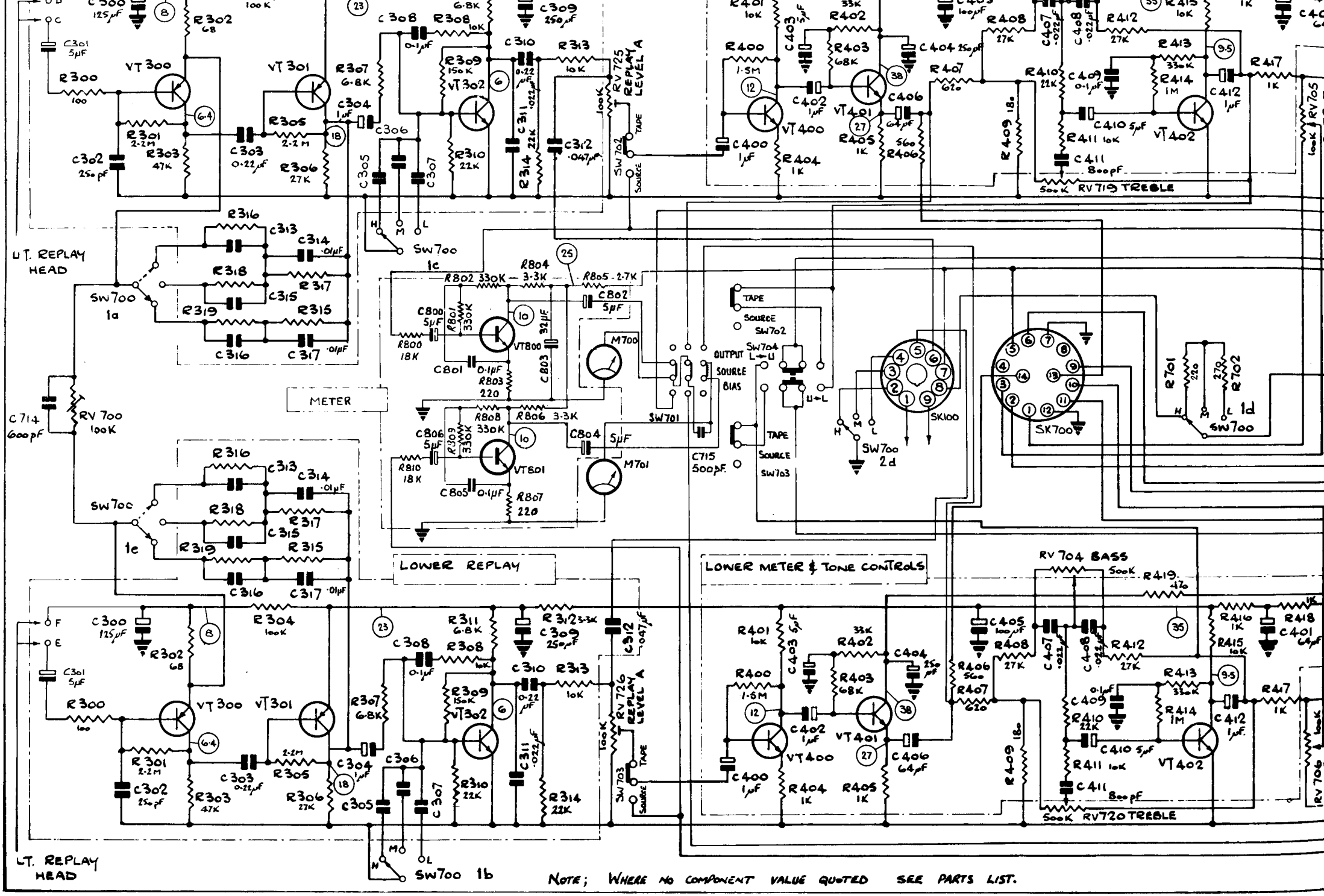
FIG. 27c. CIRCUIT DIAGRAM—(STEREO MK.2), SERIAL No. 78,800/2


R729 560
LP700
SK100
SK700
R701 220
R702 270
SW700
1d
2d
RV704 BASS 500K
RV720 TREBLE 500K
RV719 TREBLE 500K
JK706 MIC INPUT
JK707 MIC INPUT
RV728 MIC. 25K
LINE INPUT R227 1K
R708 6.8K
R707 6.8K
RV706 100K OUTPUT
RV705 100K OUTPUT
R419 470
R417 1K
R418 1.5K
R416 1.5K
R415 10K
R414 1M
R413 330K
R412 27K
R410 22K
R409 18Ω
R408 27K
R407 620
R406 560
C404 250pF
C405 100μF
C406 32μF
C407 .022μF
C408 .022μF
C409 0.1μF
C410 5μF
C411 800pF
C412 1μF
C401 100μF
VT402
VT200
VT201
VT202
VT203
VT204
R200 100
R201 2.2M
R202 3.9K
R203 100K
R204 2.2M
R205 68
R206 150K
R207 150K
R208 2.2M
R209 22K
R210 47K
R211 10K
R213 1K
R214 27K
R215 2.1K
R216 1.8K
R217 22K
R218 1M
R219 4.7K
R221 470
R222 8.2K
R223 1.5M
R225 1K
R226 3.3K
R227 1K
C200 5μF
C201 125μF
C202 1500pF
C203 1μF
C204 .01μF
C205 .047μF
C206 5μF
C207 5μF
C208 5μF
C209 100μF
C210 4.7K
C211 .047μF
C212 0.22μF
C213 0.22μF
C214 2200pF
C215 250pF
C216 2μF
MR200
50K RV709 LINE
50K RV710 LINE
UPPER RECORD
LOWER RECORD
RECORD MODE SW600
UPPER
STEREO
LOWER
L700
L701
C702
C703
C704
C705
C706
C707
C708
C709
C710
C711
C712
C713
C714
C718
RV711 10K
RV712 10K
RV713 10K
RV715 10K
RV716 10K
RV717 10K
OSCILLATOR UNIT
SW600
SK600
SK601 RECORD
SK602 ERASE
SK603 ERASE
UT
LT
RV721 1K
RV722 1K
RV723 250pF
RV724 25K
UT BIAS
LT BIAS
L600
L601
L602
C600 64μF
C601 .01μF
C602 12000pF
C603 250pF
C604 250pF
C605 .01μF
C606 0.22μF
C607 3300pF
C608 150pF
C609 250pF
C610 250pF
C611 150pF
C612 500pF
R600 100
R601 100K
R602 270
R603 10K
R604 10K
R605 100K
R606 22K
R607 270
VT600
VT601
44V. RECORD. HIGHEST SPEED.
SEE PARTS LIST.

Mark 1 Mono

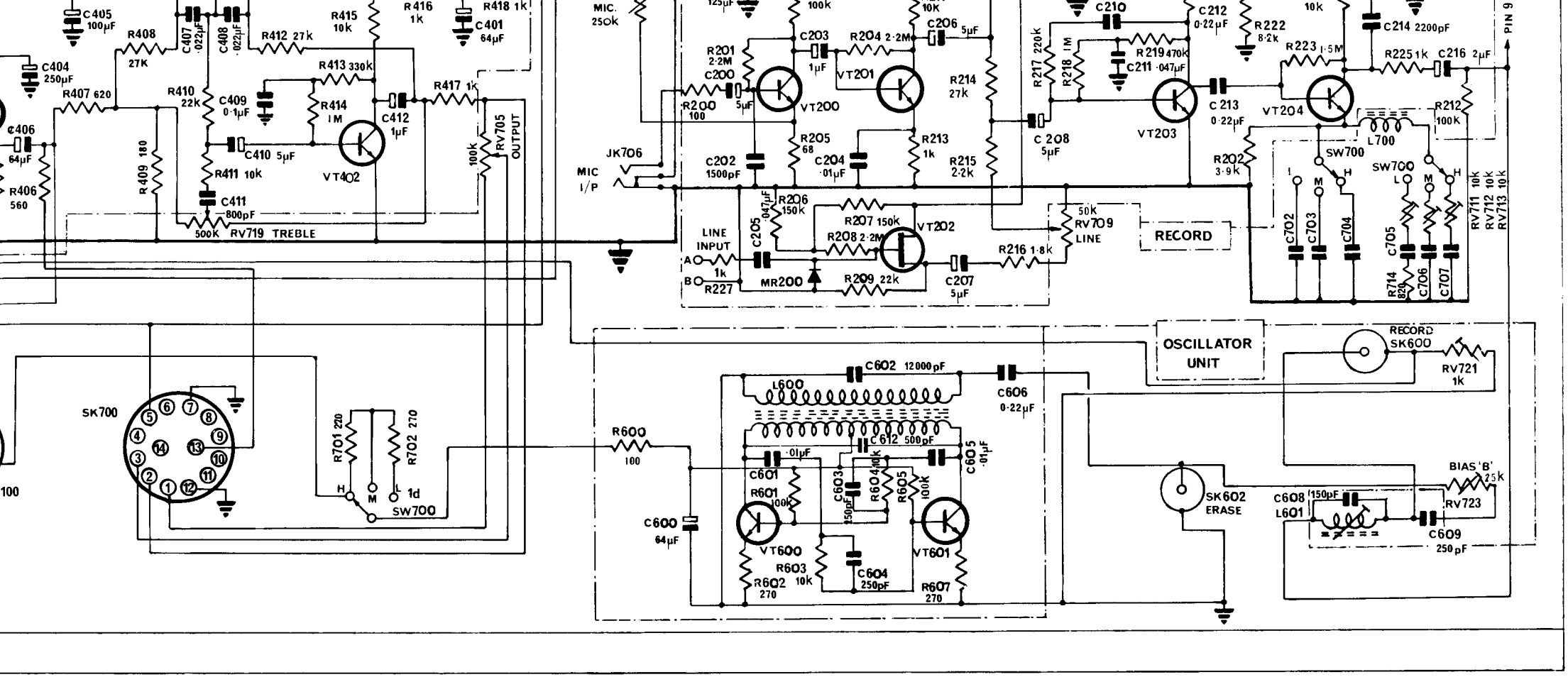

SW101
SW102
C100 0·1μF
C101 0·75μF
CAPSTAN X100
P101
L100 OPERATES SW102 & SW103
L101 OPERATES SW106
R104 15
X101 SUPPLY
C103 0·1μF
R106 15
C104 0·1μF
SW106
PAUSE STOP
RUN FAST
SW100
1c
FAST WIND
RV103 2·5K
R105 500
FOR 117V MODELS SEE BELOW
C102 0·1μF
R102 15
1b
TAKE UP X102
R108 220
FS100
LP101 AMBER
R109 1K
RL100B
RL100
SW104
SW103
R100 68
L100
MR101
L101
MR102
SW104
RL101A
FITTED ON HIGH SPEED MODEL ONLY
R101 220
LP100 RED
RL101
MR103
R107 3·3K
C105 100μF
FOIL STOP
RL100A
AUTOSTOP
P100
2a
2c
RECORD
SW107
SW108
2b
SW100
1a
X103 ERASE
X104 RECORD
P602 RED
P600 BLACK
X105 REPLAY
RED
POWER AMPLIFIER
JK700
EXT SPKR
LS700
P702 SK702
P703 SK703
C500 640 μF
VT500
VT501
VT502
VT503
VT504
VT505
R500 1
R502 220
R503 220
R504 2·2
C501 125μF
R505 4·7K
R506 160
MR500
MR501
R507 470
R508 1K
C502 25μF
R509 39K
C504 350pF
R501 1
C503 100μF
R513 3·9K
R514 8·2K
R515 82K
C505 125μF
R516 68
R510 4·7K
R511 10K
R512 10K
REPLAY
C300 125μF
R304 100K
R302 68
C301 5μF
VT300
VT301
R300 100
R301 2·2M
R303 47K
C302 250pF
C303 0·22μF
R305 2·2M
R306 27K
R307 6·8K
C304 1μF
C305
C306
C307
R308 10K
C308 0·1μF
R309 150K
VT302
R310 22K
R311 6·8K
C309 250μF
R312 3·3K
C310 0·22μF
C311 ·022μF
R314 22K
R313 10K
C312 ·047μF
RV725 100K REPLAY LEVEL 'A'
SW702
TAPE SOURCE
METER & TONE CONTROLS
R401 10K
R400 1·5M
C400 1μF
C403 5μF
R402 33K
R403 68K
C402 1μF
VT400
VT401
R404 1K
R405 1K
C404 250μF
C406 64μF
R406 560
C405 100μF
R407 620
R408 27K
R409 180
R410 22K
C409 0·1μF
R411 10K
C410 5μF
C411 800pF
C407 ·022μF
C408 ·022μF
R412 27K
R413 330K
R414 1M
VT402
R415 10K
R416 1K
C412 1μF
R417 1K
R418 1K
C401 64μF
RV703 BASS 500K
R419 470
RV719 TREBLE 500K
RV705 OUTPUT 100K

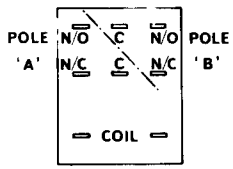

POWER AMPLIFIER
VT500
VT501
VT502
VT503
VT504
VT505
R500 1
R501 1
R502 220
R503 220
R504 2·2
R505 4·7K
R506 160
R507 470
R508 1K
R509 39K
R510 4·7K
R511 10K
R512 10K
R513 3·9K
R514 8·2K
R515 82K
R516 68
R517 100K
R518 6·8K
R519 3·3K
C500 640 µF
C501 125µF
C502 25µF
C503 100µF
C504 350pF
C505 125µF
C506 1µF
MR500
MR501
SK702
SK703
240/250v
220/230v
200/210v
VS700 & VS701
TR700
C716 ·022µF
MR70C
VS700
FS701
C700 1000µF
C717 ·022µF
MR701
VS701
C701 2000µF
240/250v
FS702
P701
LOW LEVEL
JK702
600 OHM
JK704
P700
SK701 AUX. SOCKET
SK101
110v
JK708
A
B
LINE IN
TONE CONTROLS
RV703 BASS 500K
R419 470
C405 100µF
R408 27K
C407 ·022µF
C408 ·022µF
R412 27k
R415 10k
R416 1k
R418 1k
C401 64µF
C404 250µF
R407 620
R410 22k
C409 0·1µF
R413 330k
R414 1M
C412 1µF
R417 1k
C406 64µF
R406 560
R409 180
C410 5µF
R411 10k
VT402
C411 800pF
500K RV719 TREBLE
100k
RV705 OUTPUT
RV727 MIC. 250k
JK706
MIC I/P
C201 125µF
R203 100k
R210 47k
R211 10K
C203 1µF
R204 2·2M
C206 5µF
R201 2·2M
C200
R200 100
5µF
VT200
VT201
R214 27k
C202 1500pF
R205 68
C204 ·01µF
R213 1k
R215 2·2k
C208 5µF
C205 ·047µF
R206 150k
R207 150k
R208 2·2M
VT202
LINE INPUT
50k RV709 LINE
R216 1·8k
RECORD
C209 100µF
C210
RV220 22K
C212 0·22µF
R217 220k
R218 1M
R219 470k
C211 ·047µF
VT203
C213 0·22µF
R202 3·9k
R222 8·2k
R221 470
R224 10k
3·3k R226
C215 250µF
C214 2200pF
R223 1·5M
R225 1k
C216 2µF
VT204
R212 100K
L700
SW700
SW700
C702
C703
C704
C705
RV711 10K
RV712 10K
RV713 10K
PIN 9 SK 100



NOTE; WHERE NO COMPONENT VALUE QUOTED SEE PARTS LIST.

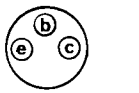
FIG. 27b. CIRCUIT DIAGRAM—(STEREO), SERIAL Nos. 75,000-



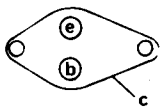


RL100

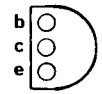
RL101



40232 40317 NKT0028 BC108
40233 40360 NKT0029 BC154
40362 NKT0039



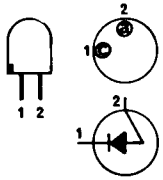
40312



BC183LB
BC214LB

MPF103
2N5457

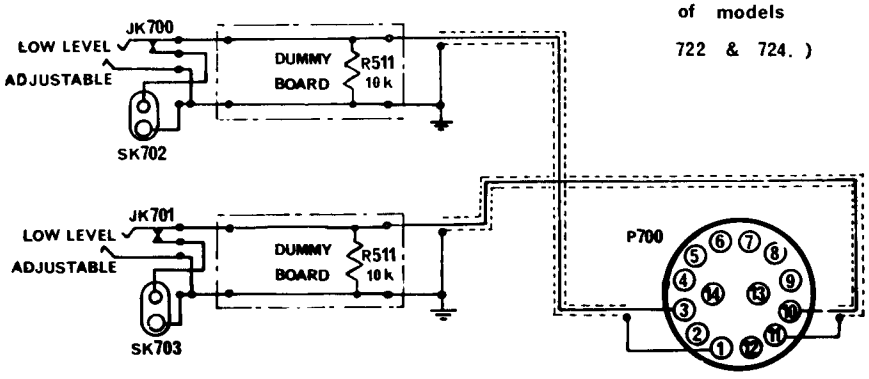
OA200
MR101
102
103
200



IN3754
MR500
501

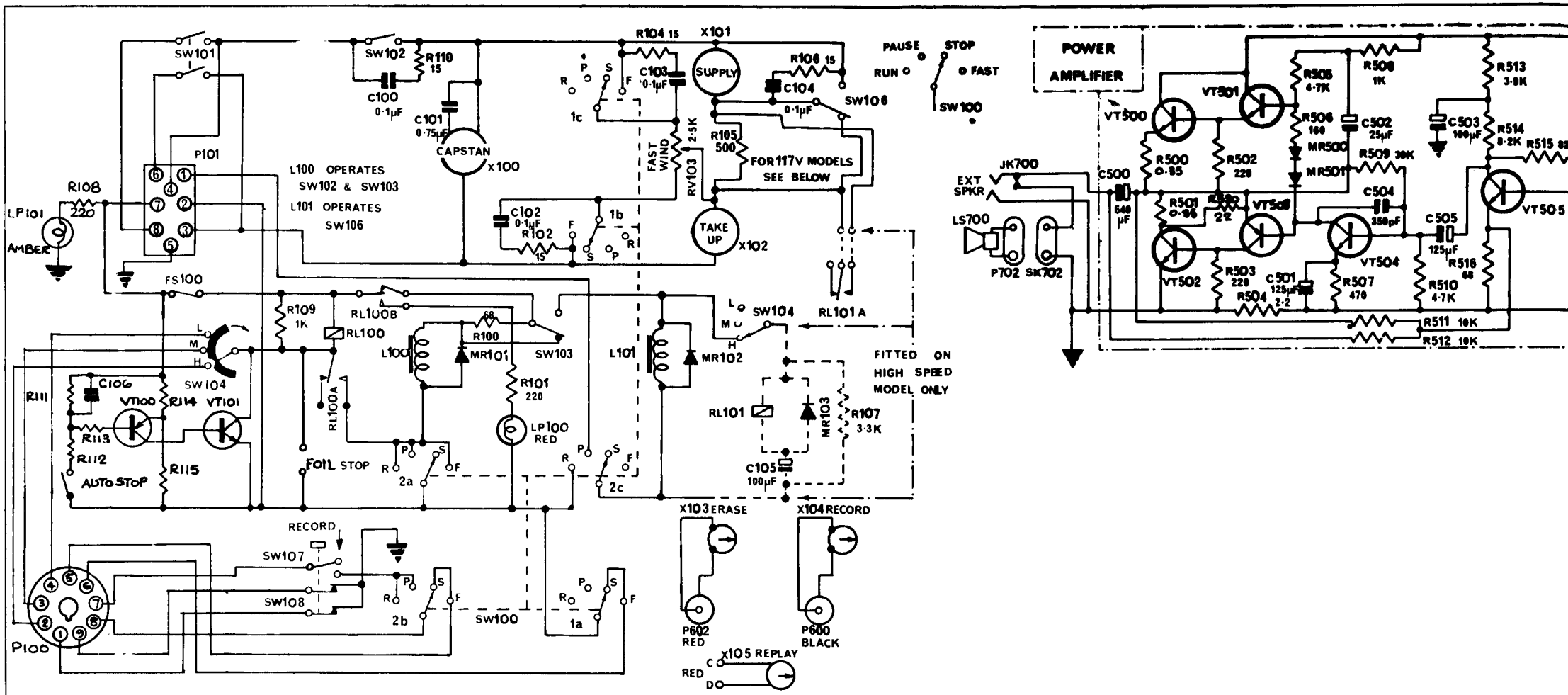
DETAIL OF MODELS 702 & 704.

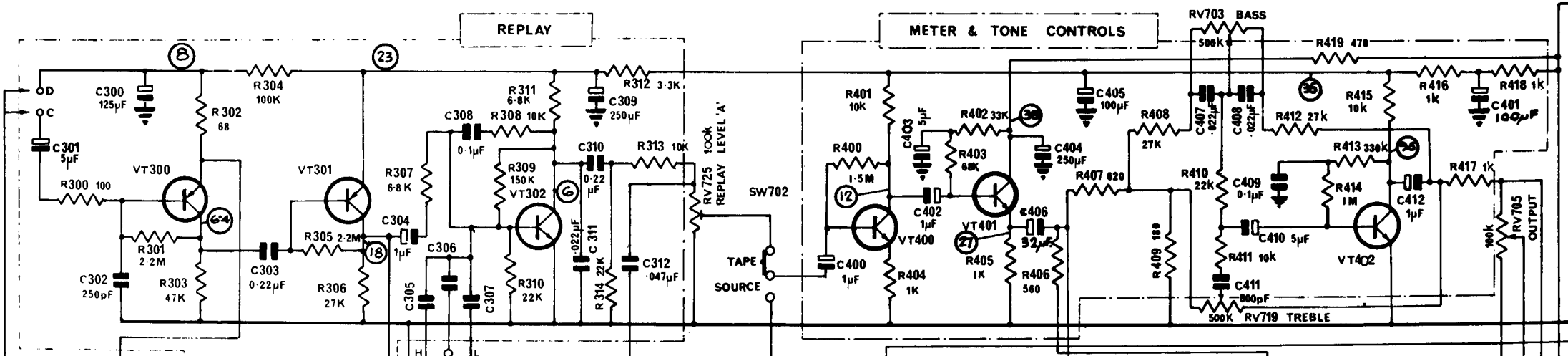
(Reference circuit of models 722 & 724.)



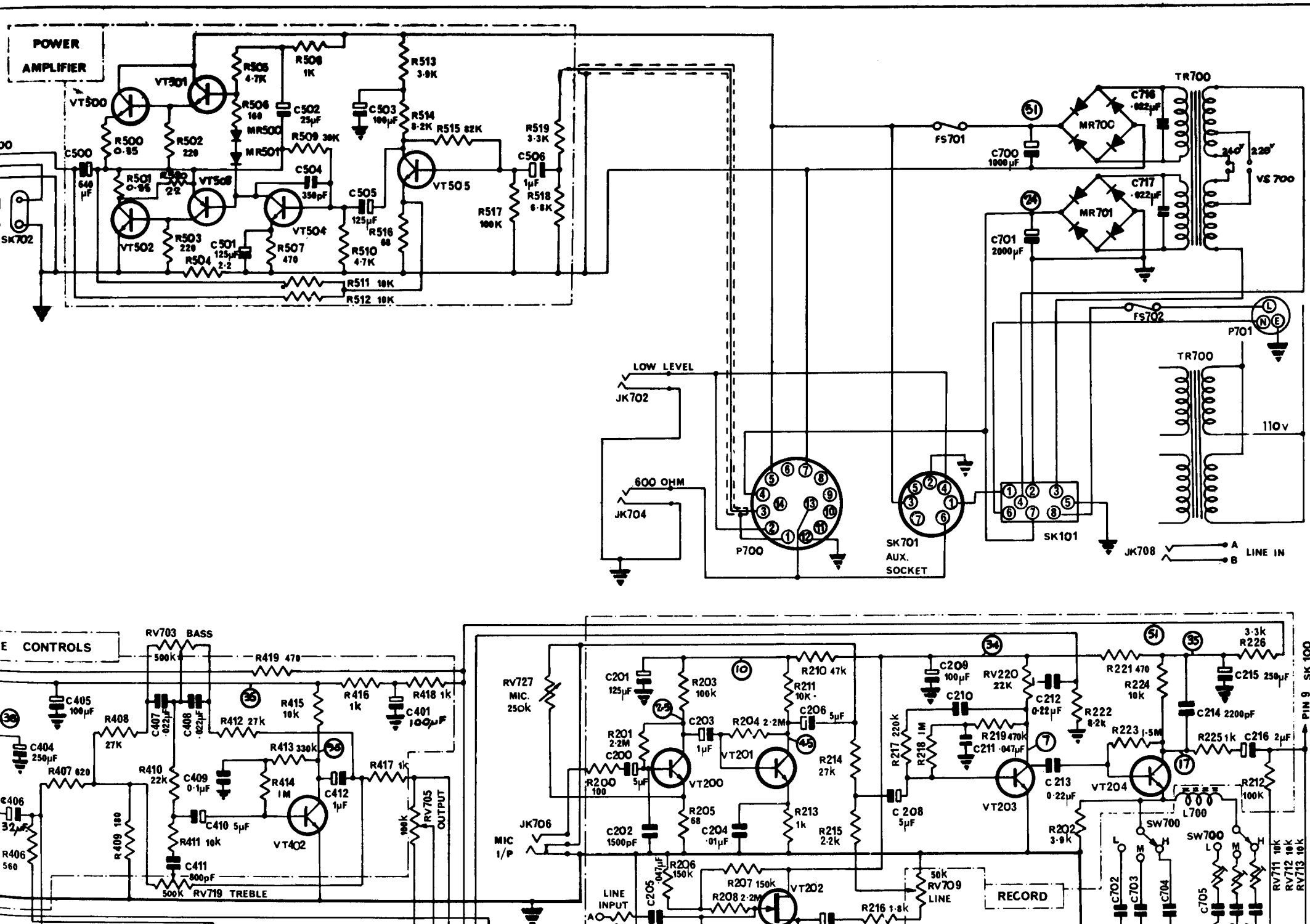
Mark 2 Mono

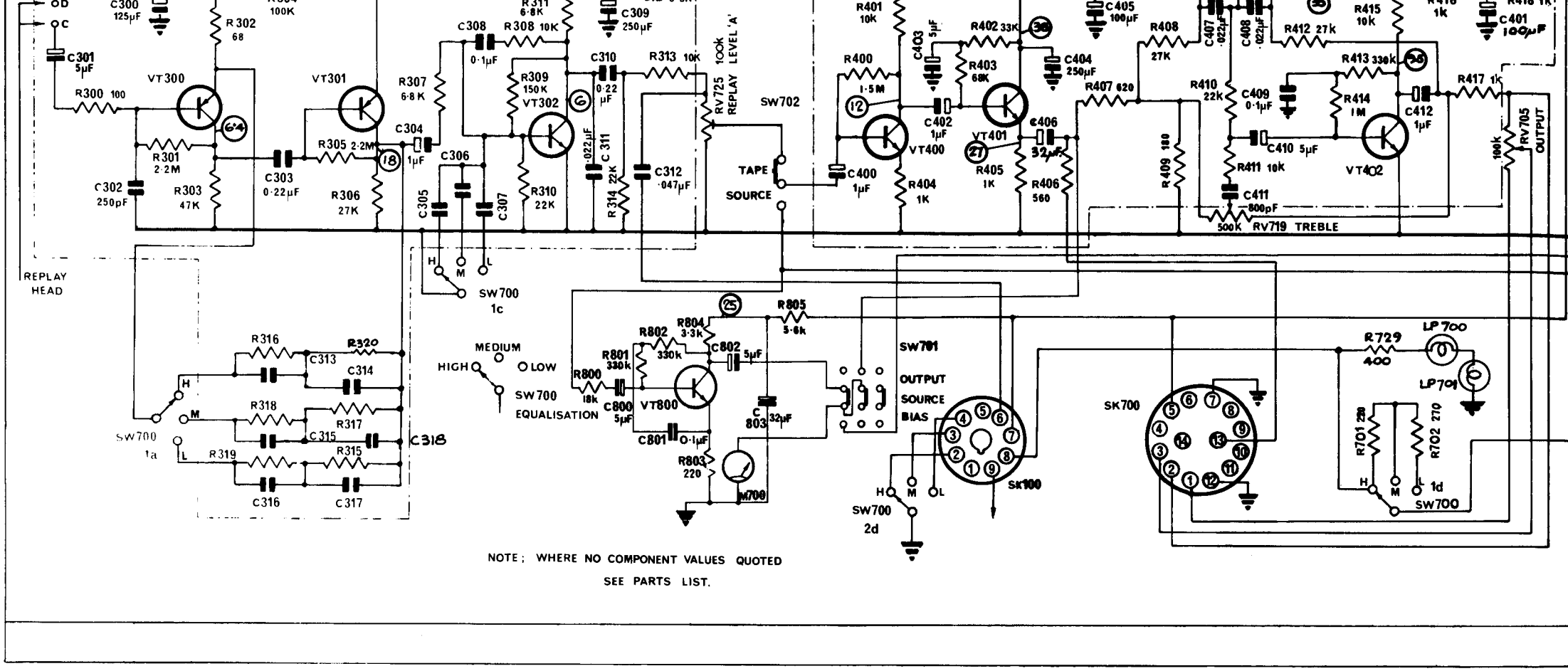
FERROGRAPH SERIES SEVEN





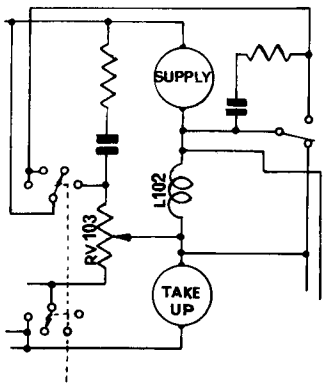
GRAPH SERIES SEVEN MK.2

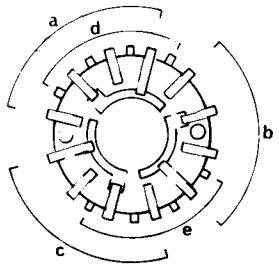




NOTE; WHERE NO COMPONENT VALUES QUOTED SEE PARTS LIST.

REEL MOTOR WIRING
117V MODELS

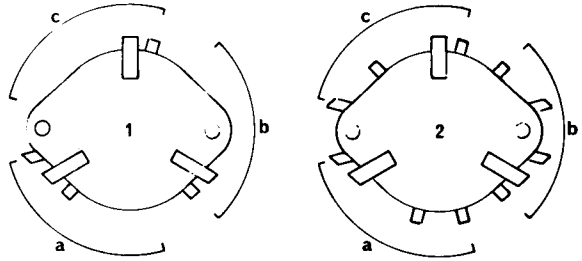




SW700

REAR VIEW (FROM BENEATH)

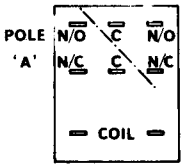
WAFERS NUMBERED FROM INDEX END



SW100

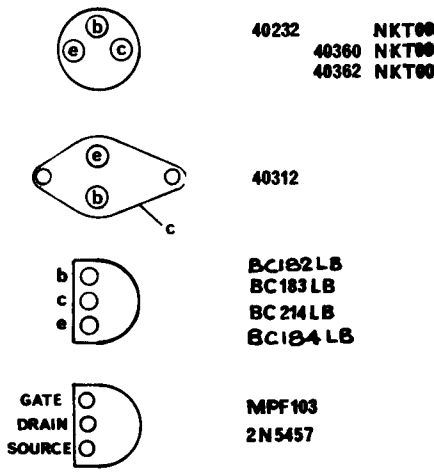
VIEWED FROM INDEX END

WAFERS NUMBERED FROM INDEX END



RL100

RL101



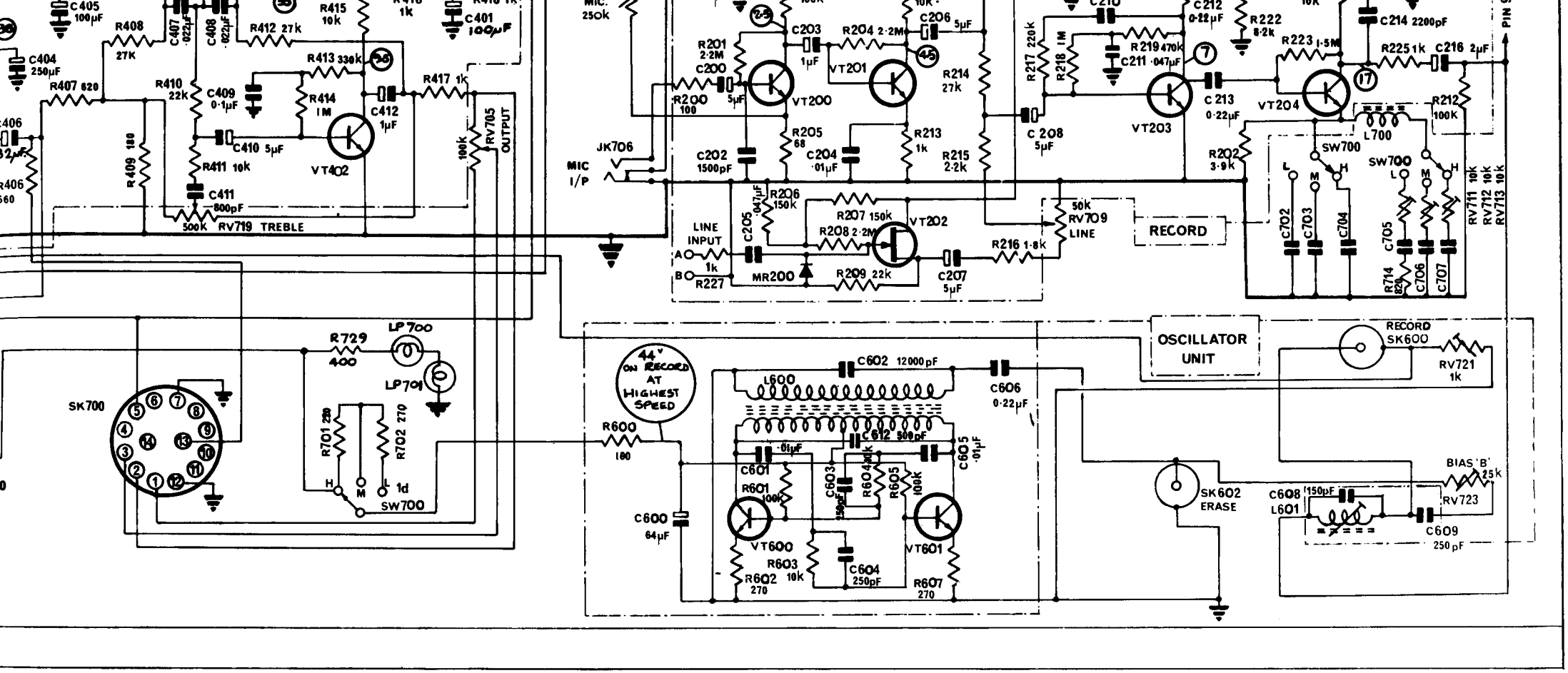
40232 NKT90
40360 NKT90
40362 NKT90

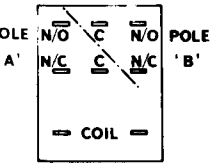
40312

BC182LB
BC183LB
BC214LB
BC184LB

MPF103
2N5457

FIG. 28c. CIRCUIT DIAGRAM—(MONO MK.2), SERIAL No. 78,800/2

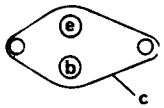




RL100

RL101

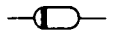
40232 NKT0028
40360 NKT0029
40362 NKT0039



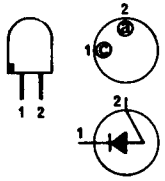
40312

BC182LB
BC183LB
BC214LB
BC184LB

MPF103
2N5457



BAX16
MR101
102
103
200



IN3754
MR500
501

FERROGRAPH SERIES 7D

DOLBY NOISE REDUCTION (SYSTEM B) RECORDERS

THE FERROGRAPH COMPANY LTD.
London and South Shields.

DOLBY NOISE REDUCTION (SYSTEM B) RECORDER

Dolby Noise Reduction System (B)

The Dolby Noise Reduction System fitted to the Ferrograph Series 7D recorders enables tapes to be recorded and replayed with very much reduced levels of tape hiss and noise. With the Dolby Noise Reduction (N.R.) System in operation, the tape noise is reduced by up to 10dB without any loss of sound quality, and in consequence lower tape speeds and/or narrower track widths become acceptable for a wider range of programme material. For instance, a recording made at $1\frac{7}{8}$ in/s with the N.R. System may have less background noise than one made at $7\frac{1}{2}$ in/s on a conventional recorder.

Application of the Dolby N.R. System is a two stage process, the first part taking place on record, the second on replay. The complete system is a complex circuit whose application depends upon the dynamics of the signal concerned, but basically those parts of the signal which are high frequency and at low levels are recorded at a higher level than normal. The amount of this extra boost can be as much as 10dB, the actual boost being both frequency and amplitude conscious and controlled by the Dolby N.R. circuitry to a specified set of response curves (Dolby B System). During replay an exactly complementary action takes place and the various sections of the signal are restored to their correct amplitude and phase relationships. However, during the process of reducing the level of the replay signals to normal, the tape noise is also reduced giving the improved noise performance associated with the Dolby System.

For correct operation, the record and replay processes must be exactly complementary, and for Dolby N.R. tapes to be compatible between Dolby recorders, these processors must also match the B System standard. For this reason the alignment of the Dolby boards in the

Ferrograph Series 7D recorders has been undertaken with great care, and any adjustments on these boards should only be carried out by an engineer who is fully conversant with the system and who has recourse to adequate testing facilities.

Dolby N.R. System B Recordings

It will be appreciated from the preceding section that noise reduction is only possible if the tape has been recorded using the Dolby N.R. process; the system does not improve the signal to noise ratio of an existing, conventionally recorded tape. It is also important to note that the Dolby N.R. System only reduces noise introduced between the record and replay processors *i.e.* tape noise and some record-replay amplifier noise. Any noise fed to the recorder input as part of the incoming signal will be recorded and reproduced as normal, the Dolby N.R. System only reducing the noise *added* by the standard record/replay process.

A tape recording made with the Dolby N.R. System B in operation is suitable for replay on any Dolby B System instrument. If it is replayed on an instrument without Dolby B System circuitry, it will show pronounced and variable accentuation of the higher frequencies. This effect may be reduced by use of the treble control and, depending upon the programme content and the quality required, an acceptable result may be obtained. However, such an arrangement is not recommended for high fidelity results and should be avoided if possible. A Dolby B recording should always be replayed using the Dolby B System processor, and for this reason System B recordings should always be labelled very clearly.

Replay

With the 'N.R.' switch (Noise Reduction) set to "out", the recorder performs in all respects as a standard replay instrument.

To replay a Dolby System B recording, the 'N.R., switch must be set to "in" (or possibly to the centre position—marked by a 'bar'—if replay only is required), which introduces the noise reduction circuitry. No other operation or adjustment is required, and the controls and remaining switches function as described in the 'Operator's Handbook' (pages 22, 23).

Record

With the 'N.R.' switch set to "out", the instrument performs in all respects as a standard recorder.

To record a tape to the Dolby System B characteristic, the 'N.R.' switch must be set to "in", which introduces the noise reduction circuitry. No other special settings or operations are required (pages 24-27) and the recorder facilities such as 'multiplay', mixing, echo, etc. (page 39) still function as described in the 'Operator's Handbook'.

Note When a Dolby System B recording is to be made from an F.M. tuner, it is advisable to switch "in" the multiplex filter (M.P.X. switch) to avoid the possibility of the stereo multiplex carrier frequency's interfering with the correct operation of the Dolby B circuit.

Monitoring

Monitoring of a recording can be carried out as described on page 27 of the 'Operator's Handbook' while making a normal recording ('N.R' switch at "out") or a Dolby System B recording ('N.R.' switch at "in").

In certain circumstances it may be required to record a signal which has already been processed to the Dolby N.R. System B characteristic. This should be done in the conventional manner with the recorder's N.R. record processor out of circuit, when the resultant tape will be a Dolby B recording which must be replayed through the Dolby N.R. System B replay processor.

To enable this recording to be monitored aurally, the 'N.R.' switch should be set to the centre position mid-way between the 'on' and 'off' positions (marked by a 'bar'). The Dolby B System N.R. record processor is then out of circuit but the N.R. replay processor is in circuit. Thus the 'tape' signal can be monitored in 'decoded' form on a loudspeaker or headphones.

Note The normal A-B ('source'—'tape') comparison cannot be made in this case as the 'source' signal is Dolby B System N.R. processed, whereas the 'tape' signal is the decoded signal.

The above arrangement is useful for copying a Dolby N.R. System B tape which is being replayed on a tape recorder using the standard equalisation without the N.R. processor, or for recording the output from a standard F.M. tuner when a Dolby B System processed signal is being broadcast. In this latter case it may be necessary to switch 'in' the M.P.X. filters.

M.P.X. Switch

The M.P.X. (multiplex) switch connects into the record amplifier filters which attenuate the high frequency response at 19kHz, and thus suppress the stereo multiplex carrier frequency which otherwise would falsely trigger the Dolby circuitry. It is recommended that the M.P.X. switch be set to 'in' when making a recording from an F.M. tuner.

A steep roll-off notch filter is used in obtaining maximum attenuation at 19kHz, but nevertheless there is a slight attenuation below 19kHz and the response is restricted to –3dB at approximately 16.5kHz. This will not affect the recording quality at $3\frac{3}{4}$ in/s or at slower speeds, but when using $7\frac{1}{2}$ or 15 in/s the M.P.X. switch should be set to 'out' unless the filters are specifically required in circuit.

Distortion

While the primary purpose of the Dolby B System is the reduction of noise arising in the record/replay process, if required some of this improvement can be exchanged for a reduction in distortion. Either with or without the Dolby N.R. System, the best possible signal-to-noise ratio is obtained when the recording level rises to O VU as described on page 24 of the 'Operator's Handbook', as above this level distortion is increased on peaks in the signal.

With the increased signal-to-noise ratio conferred by the Dolby N.R. System (which can be as much as 10dB), should the peaks of the signal be adjusted to a reading of, say, –4dB, the signal-to-noise ratio improvement will be reduced by 4dB but the distortion on the peaks of the signal will also be reduced. The amount by which the available noise reduction is

sacrificed to obtain reduced distortion is a matter of compromise depending upon circumstances and the particular type of recording being made.

Even without the sacrifice of any of the available noise reduction, the use of the Dolby B System N.R. processors on record and replay tends to reduce harmonic distortion on signals of medium to low levels in the mid-frequency band. Because of this, it is sometimes possible to observe an improvement in sound quality (as well as the usual improvement in signal-to-noise ratio) when using the Dolby N.R. System.

Compatibility

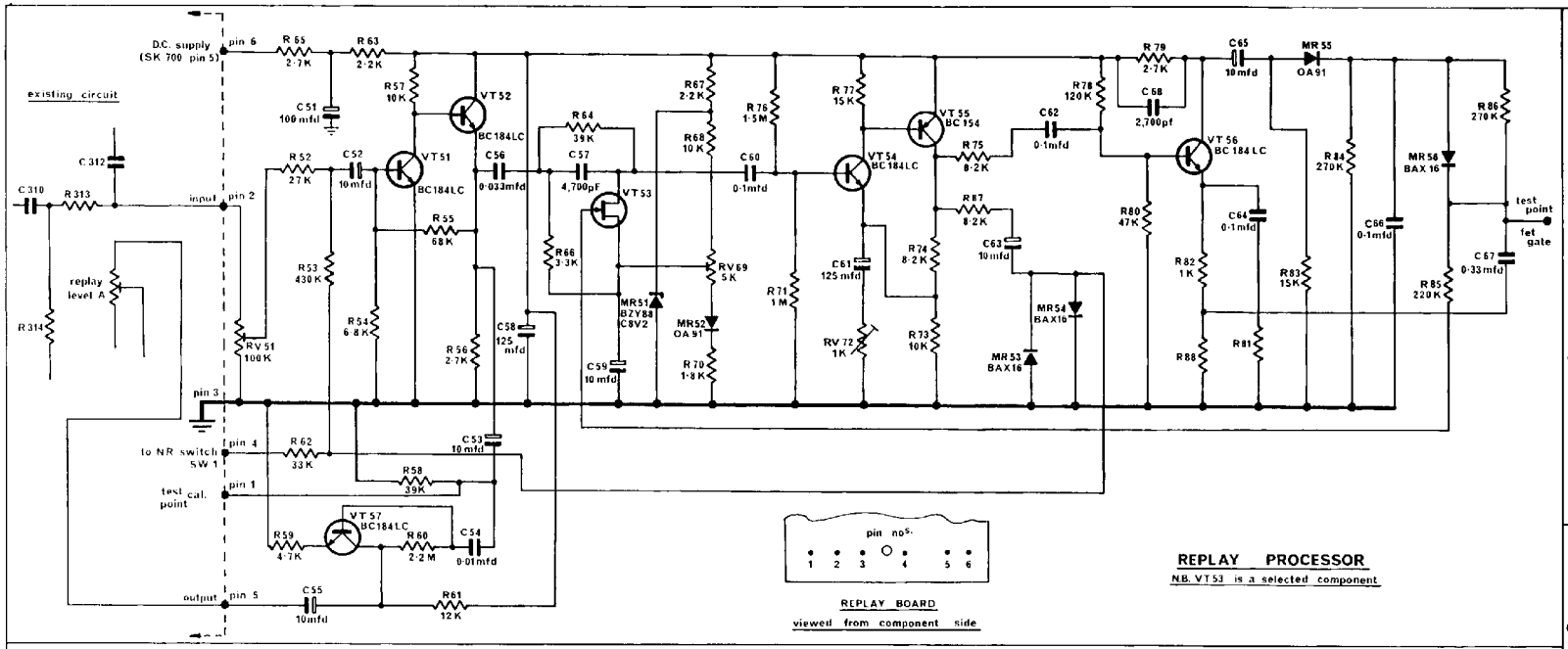
It should be stressed that the complete Dolby B N.R. System will improve the signal-to-noise ratio of a recording by as much as 10dB, without any loss of sound quality, and a Dolby B System recording should always be replayed through the Dolby B replay processor, if available. However, it is a valuable feature of the system that if a 'Dolby B tape' is reproduced without the Dolby B replay processor, the result will still be acceptable for many purposes. As only the record process has been applied, the dynamic range of the signal is reduced and at the lower levels of signal there is accentuation of the high frequencies which, to some extent, can be compensated for by use of the Treble control. These effects are usually noticeable when listening critically to high quality sound reproduction or when a direct comparison is made with the original signal, but with more modest orders of sound quality and with less critical listening, the results are often found to be quite acceptable.

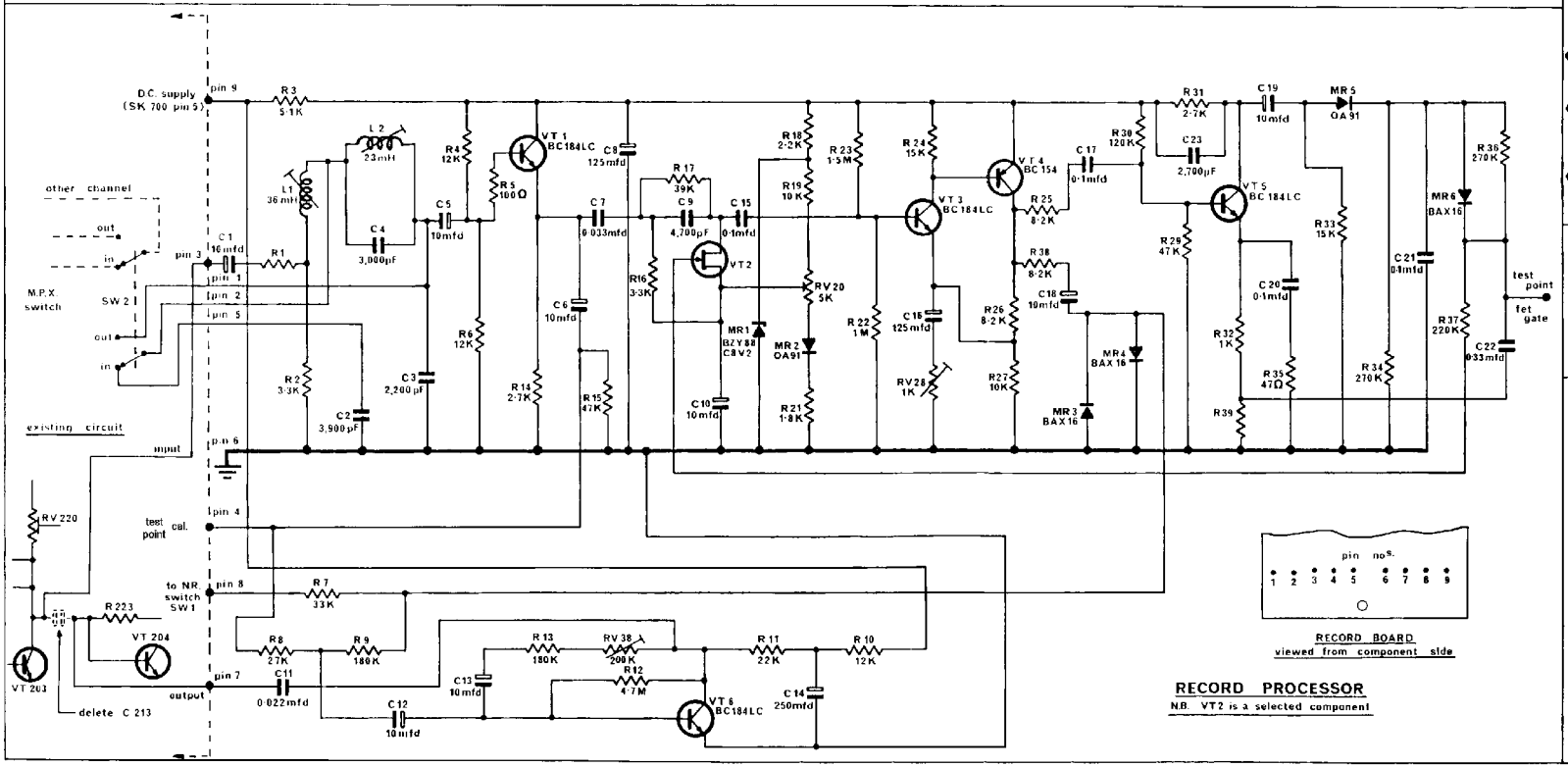
There is a similar compatibility when a recording made on an ordinary, non-Dolby-equipped recorder is reproduced through a Dolby N.R. replay processor, but this situation is much less likely to occur since all instruments incorporating Dolby B System processors possess an N.R. in/out switch.

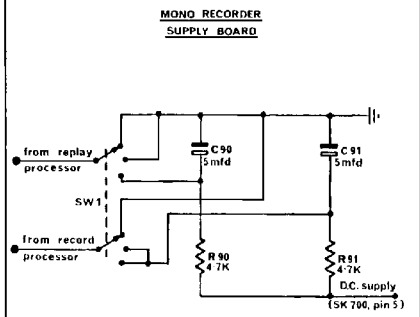
Care and Maintenance

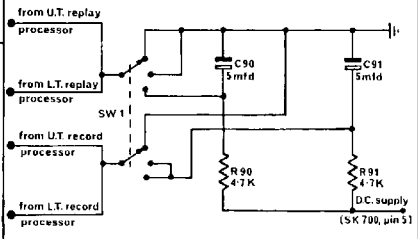
The 'Care and Maintenance' section on page 44 of the 'Operator's Handbook' will apply equally to the Series 7D recorders.

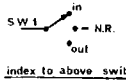
No regular attention is required for the Dolby B System processors. However, should it be necessary to replace a component on one of the Dolby B processor boards, it is essential to check that the processor still matches the Dolby B System standard. The alignment of the boards has been undertaken with great care and any adjustments to these should only be carried out by an engineer who is fully conversant with the System and who has recourse to adequate testing facilities.











index to above switches

FERROGRAPH SERIES 7D

Dolby Noise Reduction (System B) Recorders

Circuit Diagram 250-034 issue 1

To be used in conjunction with the normal circuit diagram and parts list.

CIRCUIT DIAGRAM OF DOLBY N. R. PROCESSORS

Circuit Reference	**RECORD PROCESSOR**	Assembly 025-286	*Part Number*

Resistors (R) and Potentiometers (RV)

R1	22k Ω	½W	10%	625-13-22K
R2	3·3k Ω	½W	5%	625-12-3K3
R3	5·1k Ω	½W	5%	625-12-5K1
R4	12k Ω	½W	10%	625-13-12K
R5	100 Ω	½W	10%	625-13-100
R6	12k Ω	½W	10%	625-13-12K
R7	33k Ω	½W	10%	625-13-33K
R8	27k Ω	½W	10%	625-13-27K
R9	180k Ω	¼W	2%	625-25-180K
R10	15k Ω	½W	10%	625-13-15K
R11	22k Ω	½W	10%	625-13-22K
R12	4·7M Ω	½W	10%	625-13-4M7
R13	180k Ω	½W	10%	625-13-180K
R14	2·7k Ω	½W	10%	625-13-2K7
R15	47k Ω	½W	10%	625-13-47K
R16	3·3k Ω	¼W	1%	625-24-3K3
R17	39k Ω	½W	5%	625-12-39K
R18	2·2k Ω	½W	10%	625-13-2K2
R19	10k Ω	½W	10%	625-13-10K
RV20	5k Ω	Linear	Pre-set	582-049
R21	1·8k Ω	½W	10%	625-13-1K8
R22	1M Ω	½W	10%	625-13-1M
R23	1·5M Ω	½W	10%	625-13-1M5
R24	15k Ω	½W	10%	625-13-15K
R25	8·2k Ω	½W	10%	625-13-8K2
R26	8·2k Ω	½W	5%	625-12-8K2
R27	10k Ω	½W	10%	625-13-10K
RV28	1k Ω	Linear	Pre-set	582-047
R29	47k Ω	½W	5%	625-12-47K
R30	120k Ω	½W	5%	625-12-120K
R31	2·7k Ω	½W	5%	625-12-2K7
R32	1k Ω	½W	5%	625-12-1K
R33	15k Ω	½W	10%	625-13-15K
R34	270k Ω	½W	10%	625-13-270K
R35	47 Ω	½W	10%	625-13-47
R36	270k Ω	½W	10%	625-13-270K
R37	220k Ω	½W	10%	625-13-220K
RV38	200k Ω	Linear	Pre-set	582-048
R38	8·2k Ω	½W	10%	625-13-8K2
R39	47 Ω	½W	5%	625-12-47

Circuit Reference	**RECORD PROCESSOR**		Assembly 025-286	*Part Number*
	Capacitors			
C1	10μF	16V	Electrolytic	130-027
C2	3,900pF	63V	5%	131-780
C3	2,200pF	63V	5%	131-781
C4	3,000pF	63V	5%	131-782
C5	10μF	16V	Electrolytic	130-027
C6	10μF	16V	Electrolytic	130-027
C7	0·033μF	250V	1%	131-260
C8	125μF	16V	Electrolytic	130-002
C9	4,700pF	63V	1%	131-783
C10	10μF	16V	Electrolytic	130-027
C11	0·022μF	250V	10%	131-517
C12	10μF	16V	Electrolytic	130-027
C13	10μF	16V	Electrolytic	130-027
C14	250μF	40V	Electrolytic	130-003
C15	0·1μF	250V	10%	131-507
C16	125μF	16V	Electrolytic	130-002
C17	0·1μF	250V	10%	131-507
C18	10μF	16V	Electrolytic	130-027
C19	10μF	16V	Electrolytic	130-027
C20	0·1μF	250V	5%	131-261
C21	0·1μF	250V	10%	131-507
C22	0·33μF	100V	10%	131-257
C23	2,700pF	30V	5%	131-785
	Miscellaneous			
VT1	Transistor BC184LC			825-005
VT2	F.E. Transistor 2SK30GR—selected			825-027
VT3	Transistor BC184LC			825-005
VT4	Transistor BC154			825-007
VT5	Transistor BC184LC			825-005
VT6	Transistor BC184LC			825-005
MR1	Zener Diode BZY 88-C8V2			290-018
MR2	Diode	OA91		290-003
MR2	Diode	BAX16		290-001
MR4	Diode	BAX16		290-001
MR5	Diode	OA91		290-003
MR6	Diode	BAX16		290-001
L1	Filter Coil 36mH (type 15F)			200-002
L2	Filter Coil 23mH (type 10ME)			200-003

Circuit Reference	**REPLAY PROCESSOR**	Assembly 025-285	*Part Number*

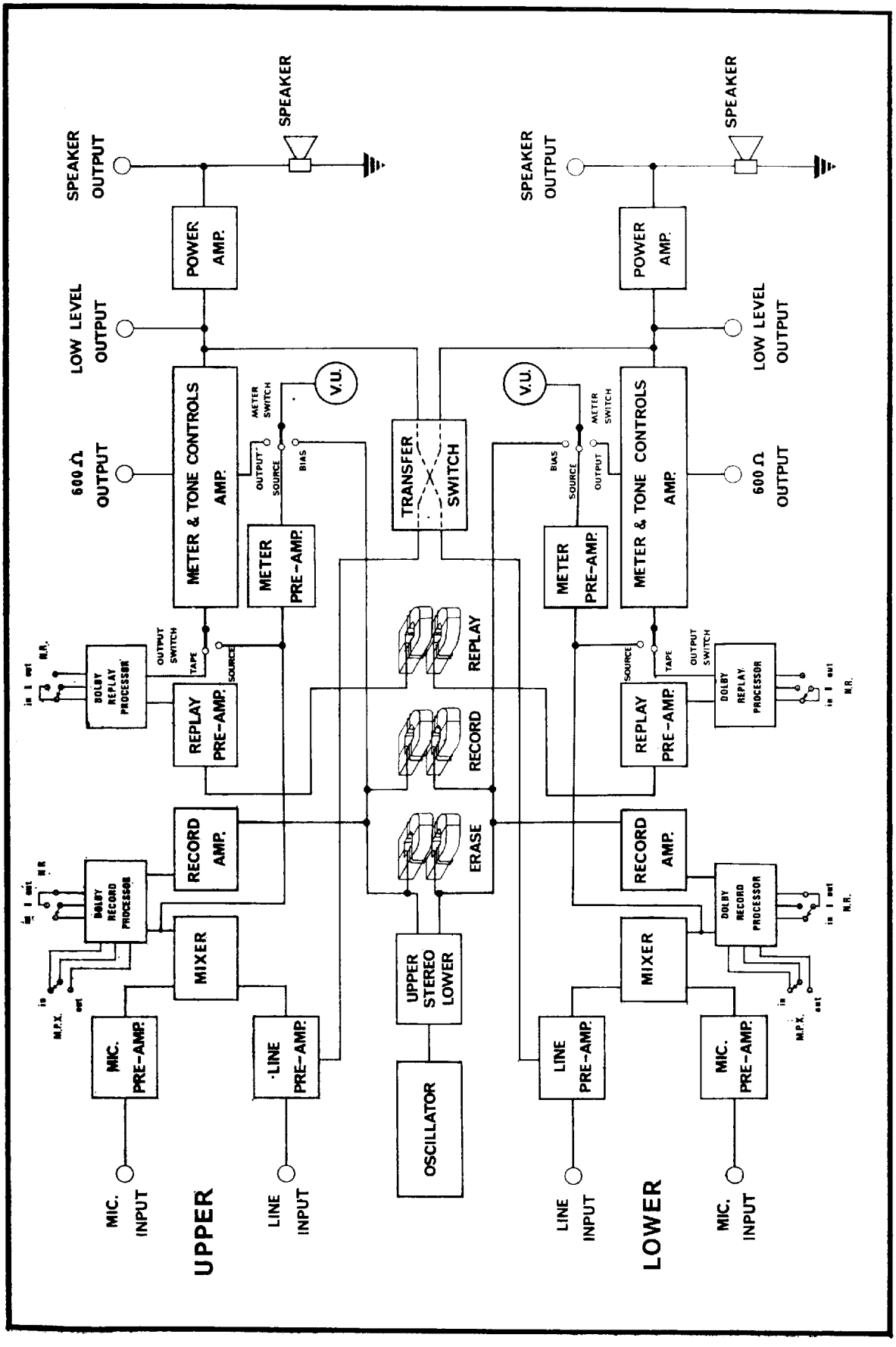
Resistors (R) and Potentiometers (RV)

RV51	100k Ω	Linear	Pre-set	582-045
R52	27k Ω	½W	10%	625-13-27K
R53	430k Ω	½W	2%	625-25-430K
R54	6·8k Ω	½W	10%	625-13-6K8
R55	68k Ω	¼W	2%	625-25-68K
R56	2·7k Ω	½W	10%	625-13-2K7
R57	10k Ω	½W	10%	625-13-10K
R58	39k Ω	½W	10%	625-13-39K
R59	4·7k Ω	½W	10%	625-13-4K7
R60	2·2M Ω	½W	10%	625-13-2M2
R61	12k Ω	½W	10%	625-13-12K
R62	33k Ω	½W	10%	625-13-33K
R63	2·2k Ω	½W	10%	625-13-2K2
R64	39K Ω	½W	5%	625-12-39K
R65	2·7k Ω	½W	10%	625-13-2K7
R66	3·3k Ω	¼W	1%	625-24-3K3
R67	2·2k Ω	½W	10%	625-13-2K2
R68	10k Ω	½W	10%	625-13-10K
RV69	5k Ω	Linear	Pre-set	582-049
R70	1·8k Ω	½W	10%	625-13-1K8
R71	1M Ω	½W	10%	625-13-1M
RV72	1k Ω	Linear	Pre-set	582-047
R73	10k Ω	½W	10%	625-13-10K
R74	8·2k Ω	½W	5%	625-12-8K2
R75	8·2k Ω	½W	10%	625-13-8K2
R76	1·5M Ω	½W	10%	625-13-1M5
R77	15k Ω	½W	10%	625-13-15K
R78	120k Ω	½W	10%	625-13-120K
R79	2·7k Ω	½W	5%	625-12-2K7
R80	47k Ω	½W	5%	625-12-47K
R81	47 Ω	½W	10%	625-13-47
R82	1k Ω	½W	5%	625-12-1K
R83	15k Ω	½W	10%	625-13-15K
R84	270k Ω	½W	10%	625-13-270K
R85	220k Ω	½W	10%	625-13-220K
R86	270k Ω	½W	10%	625-13-270K
R87	8·2k Ω	½W	10%	625-13-8K2
R88	47 Ω	½W	5%	625-12-47

Circuit Reference	**REPLAY PROCESSOR**			Assembly 025-285	*Part Number*
	Capacitors				
C51	100μF	40V	Electrolytic	130-001
C52	10μF	16V	Electrolytic	130-027
C53	10μF	16V	Electrolytic	130-027
C54	0·1μF	250V	10%	131-507
C55	10μF	16V	Electrolytic	130-027
C56	·033μF	250V	1%	131-260
C57	4,700pF	63V	1%	131-783
C58	125μF	16V	Electrolytic	130-002
C59	10μF	16V	Electrolytic	130-027
C60	0·1μF	250V	10%	131-507
C61	125μF	16V	Electrolytic	130-002
C62	0·1μF	250V	10%	131-507
C63	10μF	16V	Electrolytic	130-027
C64	0·1μF	250V	5%	131-261
C65	10μF	16V	Electrolytic	130-027
C66	0·1μF	250V	10%	130-507
C67	0·33μF	100V	10%	131-257
C68	2,700pF	30V	5%	131-785
	Miscellaneous			
VT51	Transistor BC184LC			825-005
VT52	Transistor BC184LC			825-005
VT53	F.E. Transistor 2SK30GR-selected			825-027
VT54	Transistor BC184LC			825-005
VT55	Transistor BC154			825-007
VT56	Transistor BC184LC			825-005
VT57	Transistor BC183LC			825-005
MR51	Zener Diode BZY88-C8V2			290-018
MR52	Diode OA91			290-003
MR53	Diode BAX16			290-001
MR54	Diode BAX16			290-001
MR55	Diode OA91			290-003
MR56	Diode BAX16			290-001

Circuit Reference	**SUPPLY BOARD**			Assembly 025-287	*Part Number*
	Resistors				
R90	4·7k Ω	½W	10%		625-13-4K7
R91	4·7k Ω	½W	10%		625-13-4K7
	Capacitors				
C90	5μF	64V	Electrolytic		130-007
C91	5μF	64V	Electrolytic		130-007

Circuit Reference	**GENERAL**	*Part Number*
SW1	N.R. Switch (3 position)	747-001
SW2	M.P.X. Switch (2 position)	747-002


SPEAKER OUTPUT
SPEAKER
POWER AMP.
LOW LEVEL OUTPUT
600 Ω OUTPUT
METER & TONE CONTROLS AMP.
METER SWITCH
V.U.
OUTPUT
SOURCE
BIAS
METER PRE-AMP.
TRANSFER SWITCH
REPLAY
RECORD
ERASE
OUTPUT SWITCH
TAPE
REPLAY PRE-AMP.
DOLBY REPLAY PROCESSOR
in I out
N.R.
RECORD AMP.
DOLBY RECORD PROCESSOR
MIXER
in
out
M.P.X.
MIC. PRE-AMP.
LINE PRE-AMP.
UPPER STEREO LOWER
OSCILLATOR
MIC. INPUT
LINE INPUT
UPPER
LOWER

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Due to constant efforts to improve performance and consequent modifications, it may be found that minor differences exist between the actual instrument and that described in this manual. It is therefore essential to quote the serial number of the recorder when ordering any replacement parts.

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