# 1333 'ERT' SERVICE CHART PHILIPS EL 3536

EIGHT valve fully stereophonic portable tape recorder, released 1959 at 92gns.

**Mains.** 110, 127, 220, 245V AC 50c/s, adjustable beneath case.

**Consumption.** 90W.

**Valves.** ECC83 (3), EF86 (2), EL84 (2), EM84.

**Rectifier and diodes.** HT rectifier, full wave metal type (Philips Part No. SR.250B.125). Level indicator rectifier diodes, OA85 (2).

**Outputs.** 4W per channel (at 3-7ohms).

**Speakers.** 6 x 4in. elliptical in recorder and 6½in. round in lid; both 5ohms.

**Deck and tape speeds.** Philips deck. 7½, 3¾ and 1⅞ips.

**Tracks.** Four. Monaural, 1, 4, 3, 2; stereo 1/3, 4/2; each recorded left-to-right in conventional manner.

**Maximum spool size.** 7in.

**Microphone.** Moving coil stereo model included.

**Fuse.** Thermal fuse in series with mains input.

**Manufacturer.** Philips Electrical, Ltd.

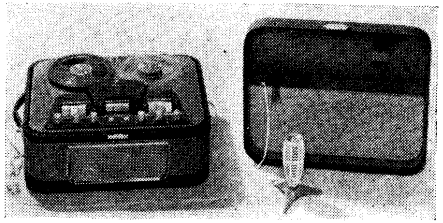
**Service department.** Amalgamated Electric Services, Ltd., Waddon Factory Estate, Croydon, Surrey.

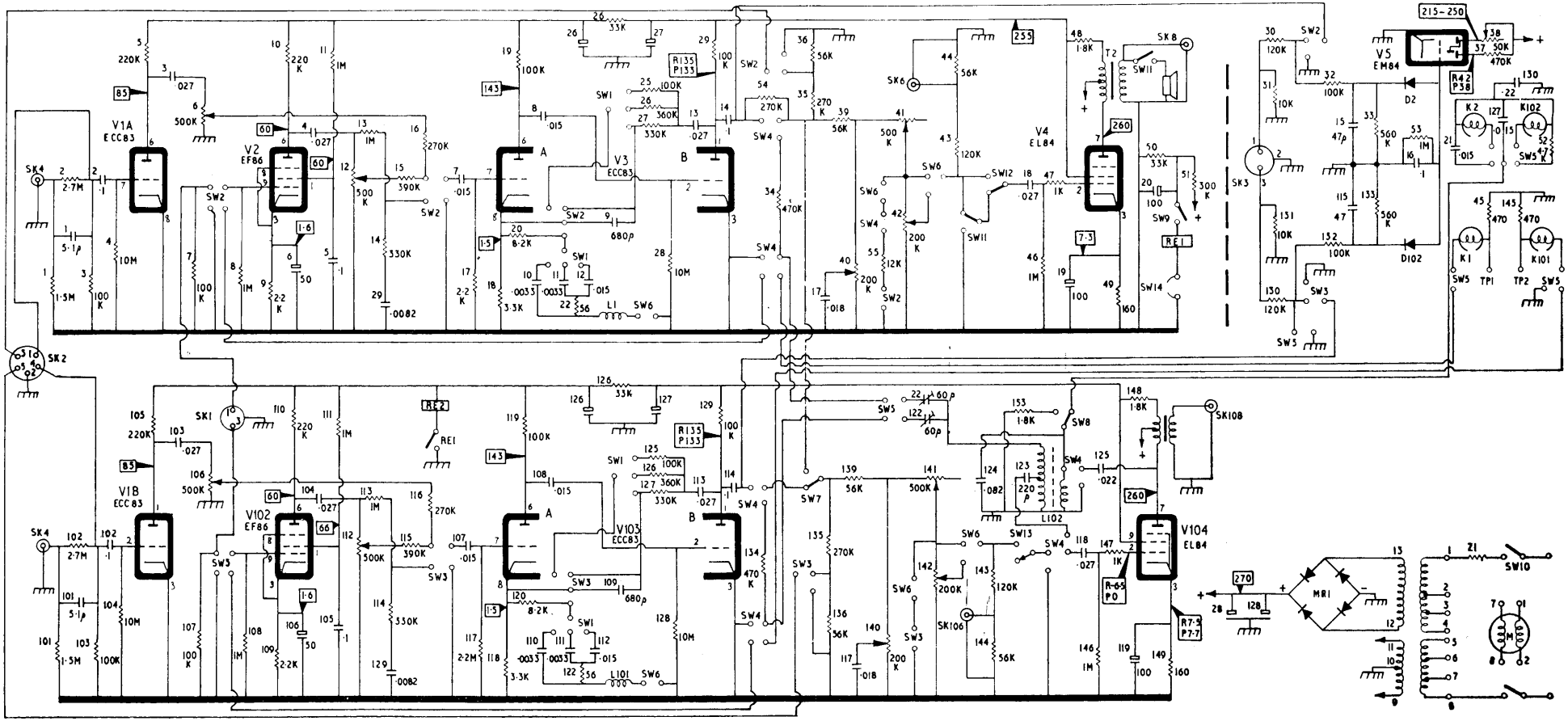
## DISMANTLING

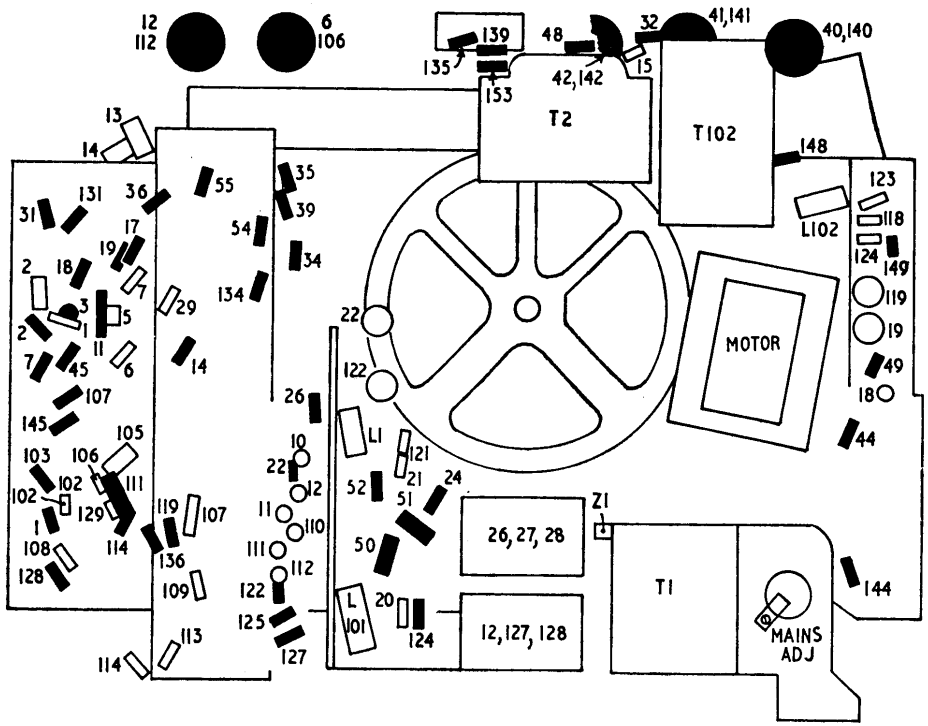
**Top cover removal.** Pull off the six control knobs and remove their fibre washers. Take off plastic head cover by pulling upwards. Extract five brass screws securing plastic facia moulding to deck top cover, then remove moulding; note that three front screws are shorter than two from rear. Carefully lift off the two plastic slide switch buttons and their springs.

Remove five short brass screws recessed into metal deck cover and remove cover. This exposes a large amount of the mechanism on upper side of the assembly and enables valves to be removed.

**Further access.** Parts of the under side of the assembly may be approached by removing the plastic grille from bottom of case. To remove from case completely, first take off small plastic anchoring washer fitted to mains cable so that cable is free to pass into the case if pulled from above; then remove two screws from each of four brackets at corners of main casting and lift complete assembly out of case. Take great care when doing this, noting the considerable weight.








## SERVICE NOTES

**Voltages.** Readings given on circuit are taken with a 20K-per-volt meter with machine switched to stereo position. Where record and playback readings differ, these are both given.

**Circuit differences.** On models earlier than Serial No. 22,606, capacitor C130 was omitted; its function is to cancel modulation hum superimposed on the erasing current. On machines earlier than No. 28,501 capacitors C11/111 and C12/112 were 6800pF and .018mF respectively. On some models the following components are omitted: C29/129 and R33/133.

**Controls.** These comprise nine push buttons, six knobs and two slide switches. From left to right, push buttons have the following functions: *Play*, *Record* (with adjacent interlock button), *Pause* (with adjacent release button), *Rewind*, *Stop*, *Fast forward*, then *Three speeds*, 1⅞, 3¾ and 7½ips. Each speed button also operates main *on-off* switch, the latter being released by a small adjacent button on the left.

Electrical controls from left to right have following functions: *Microphone gain* (R12/R112), *Radio/PU gain* (R6/R106), *Selector* (Sw5/6), giving upper and lower track selection for mono recording and replay, stereo and PA (straight through amplifier); *Dubbing* (Sw8) provides superimposing when used with record button; *Mono* slide switch (Sw7) for feeding a mono signal to both output stages; *Volume* (R42/R142), *Balance* (R41/R141), and *Tone* (R40/R140), in two parts for independent control of each channel.

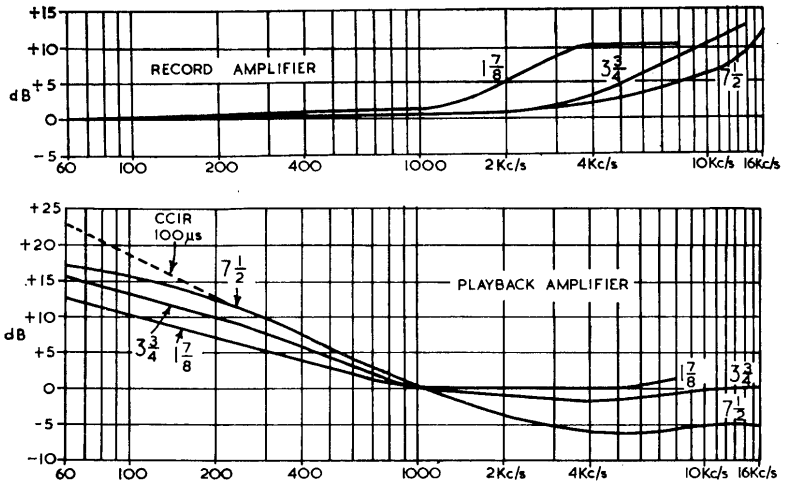
**Inputs and Outputs.** On left of machine: Radio/pickup, Sk4 and Sk104 (1M); microphone, Sk1 (100K); radio/diode input (100K) and line output (50K), both on Sk2; monitor headphones, Sk3 (10K). On right of machine: Line outputs, Sk6 and Sk106 (50K); extension speakers, Sk8 and Sk108 (3-7ohms).

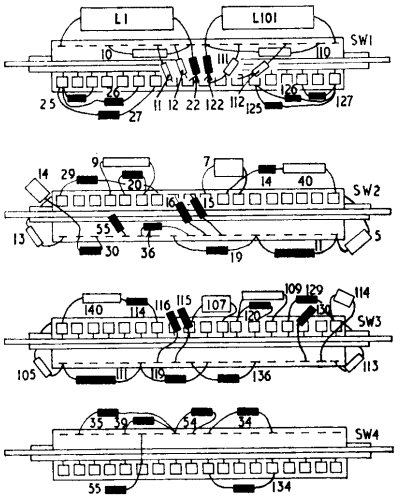
Radio diode/socket No. 2 provides both diode inputs and line outputs to enable connection to a radio or amplifier for both record and replay with a single cable. Next to external speaker sockets is an on-off switch (Sw11) for built-in speaker.

**Bias Adjustment.** Connect a valve voltmeter to test point No. 1 (on left-hand socket panel between microphone and radio/pickup sockets) and adjust C22 for a reading of 70mV. Transfer meter to TP No. 2 (just above radio diode socket) and adjust C122 similarly. Oscillator functions at 50-60kc/s.

**Head adjustments.** Record/replay head (K1/K101) should be adjusted as follows for equal distances between the four tracks. First set height of head by means of the three spring loaded mounting screws so that top edge of the core in upper head is level with top edge of tape. Then play a test tape with an 8kc/s signal at 7½ips and adjust screw at right/rear for maximum output at line output socket. After this check that tape still runs freely through guide bracket; if not, readjust height, then azimuth again until no further movement is necessary. Finally, seal screws with locking paint.

Erase head should be adjusted as follows: Set head so that top edge of upper core just protrudes above top edge of tape. Record a 1kc/s signal on both tracks at full modulation depth (as indicated on magic eye) while switched to stereo; play back this recording and adjust volume controls (R42/R142) for an output of 1V at each line output socket. Turn tape over and erase the other two tracks. Reverse tape again and replay the 1kc/s signal, when the output must not be less than 850mV. If signal is attenuated on both channels the head is too low and should be raised; if attenuated on right-hand channel only the head is too high and should be lowered.




**Sensitivities and level indicator.** Microphone, 3mV; radio diode, 5mV; radio/pickup, 150mV. To set up magic eye, proceed as follows: Connect valve voltmeters to test points 1 and 2 (on left-hand socket panel), remove bias current by shorting V104 grid to chassis and switch to 1⅞ips. Apply a 100mV signal to radio/pickup sockets (Sks 4 and 104) and advance radio/pickup gain control (R6/R106) until meters indicate 13mV. Then adjust deflection of magic eye by means of R38 so that two green bands just touch the red band.

**Frequency response.** Response of the recording amplifier at the three speeds is shown in the illustration. Measure by connecting a generator to radio/pickup input socket and valve voltmeter to test points 1 and 2. Short circuit the oscillator coil, switch to stereo record and turn gain controls to maximum. Reference output level at 1kc/s should be 4.15mV at 3¾ips. The input at Sks4 and 104 should then be between 38 and 53mV. Recording characteristic may be adjusted by L1 and L101.

Response of playback amplifier at the three speeds is as shown. Measure by connecting a 5.6ohm resistor and valve voltmeter across extension speaker sockets and applying a signal via a 47K to test points 1 and 2. Set recording gain controls to minimum, volume control to maximum, balance control to mid position, and tone control fully clockwise. Switch to stereo playback and adjust input level at 1kc/s to give a valve voltmeter reading of 580mV at 3¾ips. Input under these conditions should be between 30 and 41mV. With this same input the output should be 865mV at 1⅞ips and 490mV at 7½ips. CCIR playback curve is shown dotted as a continuation of 7½ips response; it is followed more accurately at line output sockets, some fall-away being due to output stage.

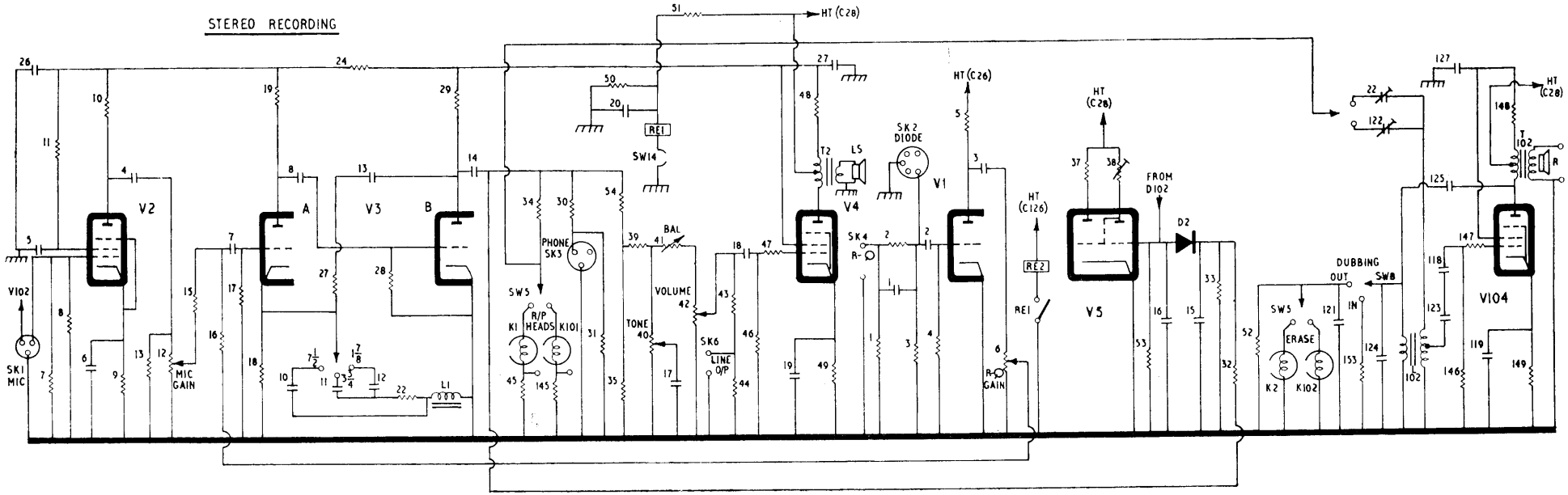
**Noise level and cross talk.** Specified signal-to-noise ratio is greater than 40dB, and channel separation better than 50dB.

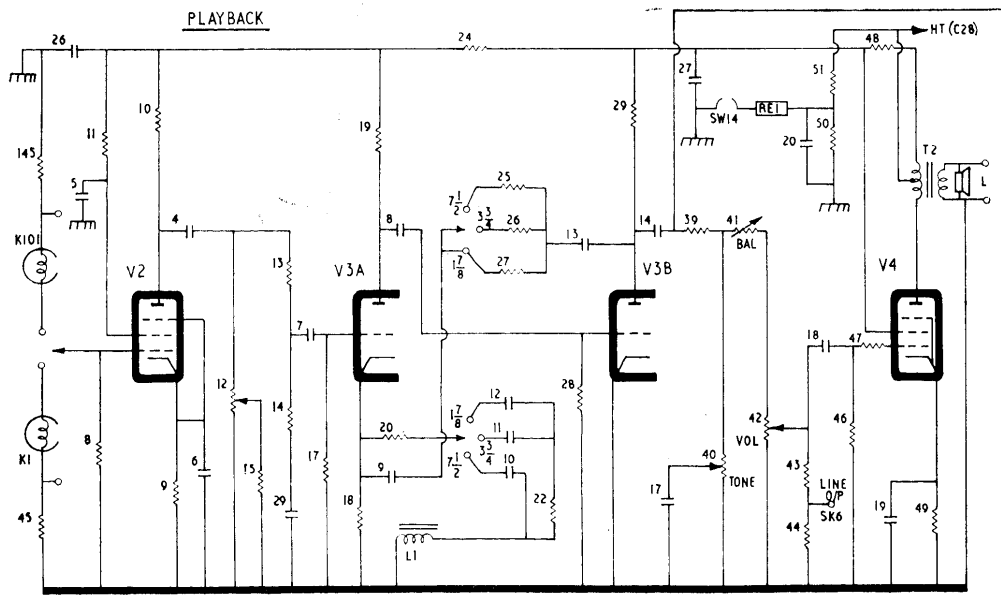
**Superimposition.** Switch No. 8 (Dubbing) disconnects erase head from oscillator circuit.

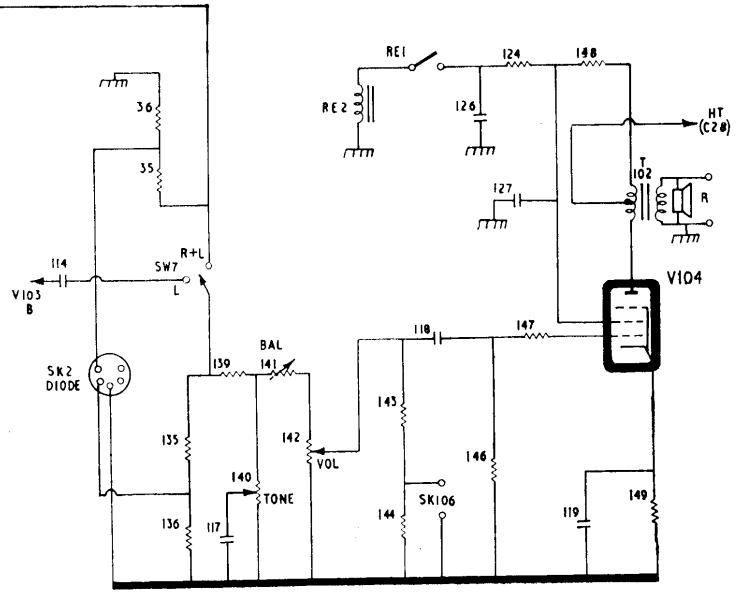
**Straight through amplifier.** PA position on selector switch provides a double amplifier circuit configuration, with gain controlled by R6/106 and R12/112, depending on input in use.

**Mechanical differences.** Models later than No. 12,261 use printed circuit sliders on Sw1-4. Circuit remains unchanged but there are minor layout differences for the associated components; these are shown in the illustrations.

From Serial No. 16,701 the erase head has


STEREO RECORDING
HT (C28)
HT (C26)
HT (C126)
V2
V3
A
B
V4
V1
V5
V104
V102
SK1 MIC
MIC GAIN
PHONE SK3
SW5
R/P HEADS
K1
K101
BAL
VOLUME
TONE
SK6 LINE O/P
SW14
RE1
RE2
T2
LS
SK2 DIODE
R GAIN
FROM D102
D2
DUBBING OUT
SW8
IN
ERASE
K2
K102
L1
T102
R


PLAYBACK
HT (C28)
V2
V3A
V3B
V4
K101
K1
SW14
RE1
T2
L
BAL
VOL
TONE
LINE O/P
SK6
L1


RE1
RE2
HT (C28)
T102
R
V104
V103 B
SW7
R+L
L
SK2 DIODE
BAL
VOL
TONE
SK106

been set obliquely and the record/replay head is positioned 1mm further toward the rear of the machine. Also, a tape pressure pin is fitted to the left-hand end of the pressure roller arm to ensure complete contact of tape with heads.

From No. 17,934 onwards, both tape guides are spring loaded, and on these models the automatic tape stop contact (Sw14) is mounted on moulded finger of right-hand tape guide assembly.

Slow rewind on some recorders is overcome on No. 10,453 onwards by replacing the 44mm dia. felt ring beneath right-hand turntable with a ring of 38mm. dia. similar to that used on left-hand turntable.

## CIRCUIT DESCRIPTION

Main illustration on page i shows complete circuit, but as switching arrangements are rather complex, separate circuits clarify the main recording and playback configurations on page iii.

**Stereo recording.** Microphone signal from Sk.1 is amplified by V2 (102), then fed to microphone gain control R12 (112). From here the signal goes to C7 (107) via R15 (115). Radio/pickup signal from Sk.4 is amplified by V1, then coupled via C3 (103) to radio/pickup gain control R6 (106), then via R16 (116) to C7. Signals combine at this point and are fed to grid of V3A (103A).

After amplification by V3A, signal is coupled to grid of V3B (103B) via C8 (108). Negative feedback from V3B anode is taken to V3A cathode via C13 (113) and R27 (127). Components C10, 11 and 12, R22 and L1 (and their equivalents in the other channel) are switched in various combinations in V3A cathode circuit to produce the required HF boost for recording purposes.

Signal at anode of V3B passes through C14 (114) and then feeds record head via R34 (134), headphone socket via R30 (130), and level indication circuit via R32 (132). C15 (115) attenuates the high frequencies to ensure a flat input to the magic eye.

For monitoring purposes the signal passes from C14 via R54, R39, R41 and R42 (volume), then via R43 to the line output socket (Sk.6) and via C18 and R47 to V4 for speaker monitoring (left-hand channel only).

On record, V104 (the other O/P stage) functions as bias oscillator in conjunction with L102 and is coupled to erase heads via C125 and to recording heads via trimmers C22/122. When superimposing, the erase heads are disconnected by Sw8 and R153 connected in their place.

**Mono recording.** When switched for mono recording the track selector Sw5 switches one or other of the record/replay heads to output of left-hand channel amplifier and disconnects the erase head for track not being used. In all other respects the mono set-up is the same as for stereo recording.

**PA amplifier.** The stereo recording configuration applies to the PA condition with the following exceptions. Treble boost circuits in V3 cathode are disconnected by Sw6; signal at V3B anode passes via C14, R39, R41, C18 and R47 to V4 grid; R42 is inoperative, gain being controlled by input controls R6 and R12.

**Stereo playback.** Signal from playback head is amplified by V2 and then fed via C4, R13 and C7 to V3A grid. Signal is then fed from V3A anode to V3B grid via C8. Negative feedback is applied from V3B anode to V3A cathode via C13 and a network of components providing frequency correction for the three speeds. Basically, C9 provides the rising low frequency response in conjunction with R25-27, while R20, C10-12, R22 and L1 provide top lift.

From V3B anode the signal passes through C14; then via R35 to diode socket Sk2; and via R39, R40 (tone control), R41 (balance), to R42 (volume). Signal at slider of R42 is passed via R43 to line output socket and also via Sw12 (13), C18 and R47 to output stage V4, and thence to the speaker.

Sw11 contacts in V4 grid circuit are part of internal speaker switch; when the latter is in the OFF position, C18 is connected to chassis. Sw12 is operated by extension speaker socket Sk8 (108), and when a plug is pushed into this socket, V4 is again supplied with signal. Sw13 safeguards V104 when right-hand channel speaker is not connected.

**Mono playback.** Set-up here is as for stereo playback, except that only the left-hand amplifier is used. Sw5 connects either one or other of playback heads into circuit. When Sw7 is operated the signal is fed to both output stages in parallel.

**Automatic tape switch.** Whenever tape is in motion on the machine Sw9 is operated and one side of Re1 is connected to voltage divider R50/51, the other side going to one pole of Sw14. When Sw14 is shorted by metallised strip on tape, Re1 is energised, thus completing circuit from Re2 to chassis. Re2 then operates pushbutton locking bar to disconnect tape drive.

## MECHANICAL ADJUSTMENTS

**Brakes.** Braking force of left-hand brake should be 100-200gms anti-clockwise; it may be checked as follows. Depress stop button, place a full 5in. reel on the left-hand turntable and make a knot in the end of the leader tape. Place the arm of a spring pressure gauge in the knot and measure the force necessary to make the reel turn anti-clockwise; this should lie within the stated limits. The force necessary to turn the reel clockwise should be 35-85gms.

Use the same method to check braking forces on right-hand reel; these should be 100-350gms clockwise and 65-85gms anti-clockwise. Adjust force if necessary by anchoring spring in alternative hole on brake bar.

**Pressure roller.** This should press against capstan with a force of 800gms in recording or playback position. Measure by placing arm of spring pressure gauge against pressure roller spindle and noting pressure necessary to just pull roller from capstan. Adjustment is by re-hooking end of spring in one of the holes provided.

Roller should pull tape along heads with a force of 400-1,000gms. To measure this, place a full reel of tape on right-hand turntable, feed tape past heads and capstan, and make a knot in the leader. Place arm of pressure gauge in knot, pull to the left, then depress playback button. Force necessary to hold tape in equilibrium should be 400-1,000gms. If the correct force is not obtained, check that contact surfaces between roller and capstan are clean; if necessary, increase tension on pressure roller.

**Pressure pad.** This pad should press against the record/playback head without jamming against the protection cap. The force should be such that a pull of 15-25 gms is required to pull the tape past the head from a full reel on the left - hand turntable with the playback button depressed. Adjustment is by bending the protection cap spring.

**Tape guide.** This should be mounted in such a way that the finger points to the middle of the capstan.

**Lubrication.** It is essential to ensure that PVC bearing beneath right-hand friction disc is adequately greased, otherwise disintegration will result, with consequent change in height adjustment.

**Idler wheels.** Each idler wheel, when in operation, should press against flywheel and pulley with a force of 400-500gms. When none of the speed buttons is depressed, the idlers should be spaced at least 0.5mm from the flywheel and pulley.

**Turntables.** With stop button depressed the underside of turntables should be 1mm above coupling pads. This distance can be adjusted by adding PVC rings beneath the friction disc. With fast wind button depressed the turntables should lie evenly on the three coupling pads.

To check friction coupling, place a full 7in. reel on the turntable and measure the force necessary to make the reel turn by coupling gauge to leader tape. On the right-hand reel the force should be 18±2gms. anti-clockwise and 23±2gms. clockwise. On the left-hand reel the force should be 8-10gms anti-clockwise. If these values are not correct, felt ring and top of friction disc should be cleaned with carbon tetrachloride.

| COMPONENT RATINGS | |
|---|---|
| **Capacitors** | |
| 500V: C1 9 15 123 | |
| 350V: C26-28 | |
| 250V: C29 124 130 | |
| 125V: C2 16 17 21 | |
| 30V: C19 20 | |
| 12.5V: C6 | |
| All others 400V wkg. | |
| **Resistors** | |
| 1W: R49 149 | |
| All others ½W. | |

| Inductors | ohms |
|---|---|
| L1, L101 ... | 52.0 |
| L102 ... ... | 4.9 |
| T1 (prim-approx.) | 18+22.0 |
| T1 (HT sec) ... | 75.0 |
| T2, T102 (prim) | 180+15.5 |
| T2, T102 (sec) ... | 1.5 |
| K1, K101 | 1,650.0 |
| K2, K102 ... | 1.9 |
| Re 1 ... ... | 40.0 |
| Re 2 ... ... | 95.0 |
| Motor ... | 40/40.0 |



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