"His Master's Voice"

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1640
1642

STEREOPHONIC RADIOGRAMOPHONES

Service Manual

BRITISH RADIO CORPORATION LTD
21 CAVENDISH PLACE
LONDON W1

Price 2/-

N19995

Specification

GENERAL

Models 1640 and 1642 are similar seven valve (plus metal rectifier) radiogramophones, covering VHF/FM, Medium and Long waveranges. Internal aerials are fitted for reception on all waveranges as well as sockets for external aerial and earth connections. Rotary waverange switching is employed.

When switched to 'Gram' two channels are provided for the reproduction of stereophonic or monaural recordings, each channel feeding separate loudspeakers. For radio reception, the audio amplifier is switched to push-pull operation.

MAINS SUPPLY

AC mains 200 - 250 Volts, 50 c/s. For operation on 60 c/s mains, a special motor pulley may be obtained from the record changer manufacturer.

POWER CONSUMPTION

Radio: 62 Watts approximately
Gram: 77 Watts approximately

OUTPUT POWER

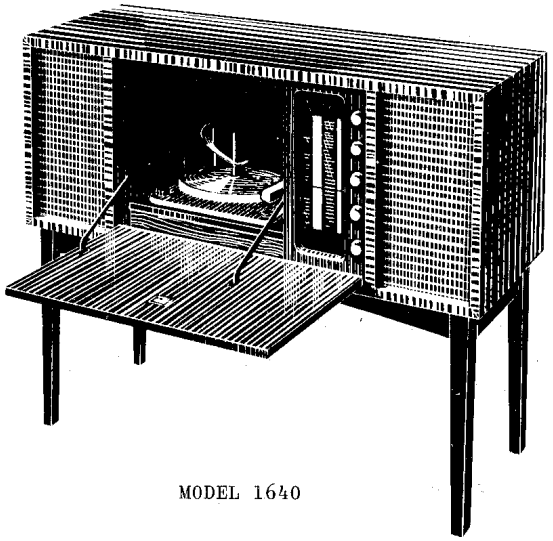
Radio: 6 Watts
Gram: $2\frac{1}{2}$ Watts (each channel)

LOUDSPEAKER (each channel)

Model 1640
8 inch diameter, with a speech coil impedance of 3 ohms.
Model 1642
8 inch x 5 inch elliptical, with a speech coil impedance of 3 ohms.

RECORD CHANGER

Model 1640 ... BSR type UA8 using stereo cartridge TC8S.
Model 1642 ... BSR type UA14 using stereo cartridge TC8S.
Replacement styli types TC8RS (stereo LP) and TC8G (78 rpm).



MODEL 1640

WAVEBAND COVERAGE		
RANGE	WAVELENGTH	FREQUENCY
Long	1130 - 1935 Metres	155 - 265 Kc/s
Medium	187 - 550 Metres	543 - 1610 Kc/s
VHF/FM	———	87 - 101 Mc/s

TAPE RECORDER FACILITIES

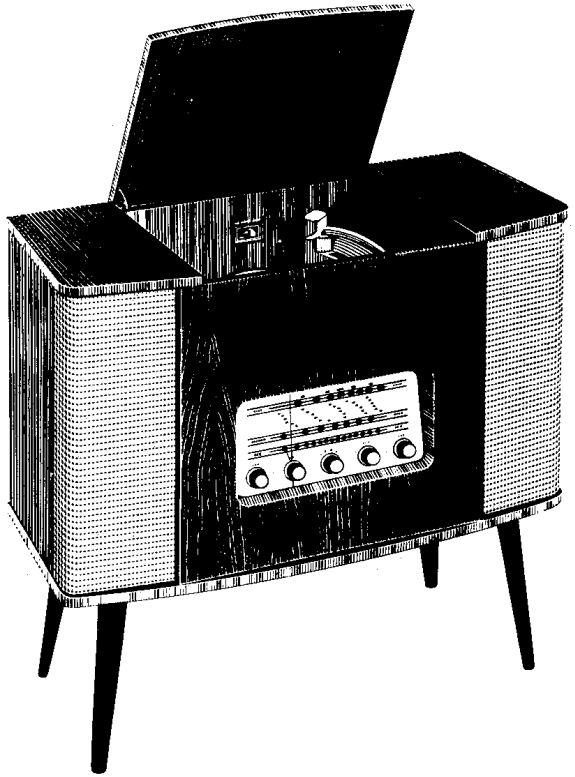
Recordings: Low impedance sockets provide a suitable outlet for making monodic recordings with an ancillary tape recorder.
Playback: High impedance input sockets are provided, enabling recorded stereo or monodic tapes to be played back through the audio channels of the radiogram.

EXTERNAL LOUDSPEAKERS

Sockets suitable for the connection of an external loudspeaker of 3 ohms impedance are provided for each channel, together with an internal loudspeaker muting switch.

CABINET DIMENSIONS

Model 1640 ... 41 inches wide x 34 inches high x 14 inches deep.
Model 1642 ... 34 inches wide x 33½ inches high x 14 inches deep.



MODEL 1642

Circuit Notes

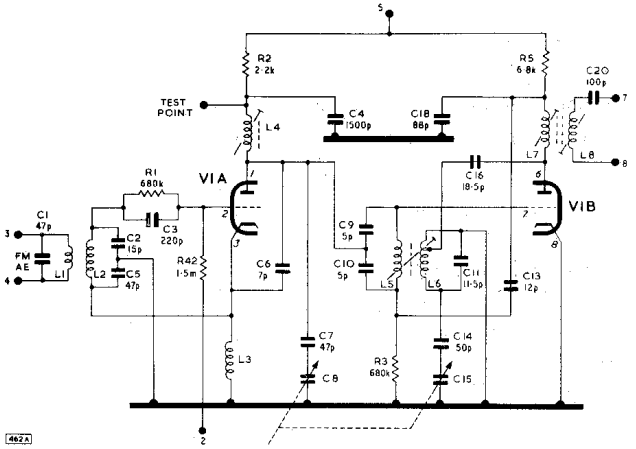
1 FM TUNER

V1A functions as a combined grid/cathode injection RF amplifier, the aerial feeder being coupled into the circuit by L1 and L2. The secondary, L2, is tuned by C2 and C5 centre tapped to chassis, dividing the signal input between the grid and cathode of V1A. L3 acts as an RF choke and provides a high impedance between the cathode and chassis for the RF signal, whilst offering a low impedance to the steady valve current. This type of operation is a compromise between the earthed grid and earthed cathode methods of operation and provides a higher input impedance than would be obtained with the earthed grid method, and neutralization is simplified. A single capacitor, C6, fitted between anode and cathode serves to neutralize the stage.

The output from V1A, developed across L4, tuned by C7 and C8 in series, is fed to the junction of C9 and C10. This serves as a signal injection point for the self-oscillating mixer, V1B, and is the null point of a bridge formed by C10, C9, C13 and C18 in series. At this point the oscillator voltage is negligible and the possibility of the oscillator radiating into the aerial circuits via the grid/anode capacitance of V1A is much reduced.

Oscillator feedback coupling is provided by L5 and L6 and the circuit is tuned by C15 in series with C14. Additive mixing takes place at the grid of V1B and the 10.7 Mc/s IF signal is selected in the anode by L7. A small amount of positive feedback is provided by C13 to offset the effect of oscillator circuits which tend to shunt L7.

L7 and L8 comprise the 1st FM IF transformer and couple the output of the tuner unit to V2 heptode, acting as an IF amplifier.



FM TUNER

2 DEMODULATION

FM

When the receiver is switched to FM the 10.7 Mc/s IF signal is developed in the anode circuit of V3 pentode across L20, tuned by C38. L20, L21 and L22 comprise the ratio detector transformer feeding A and B sections of the double diode V4. The tertiary winding, L22, provides the coupling necessary to inject the primary voltage into the secondary circuit with the correct phase relationship, while matching the low impedance of the diodes to the high impedance of the IF amplifier.

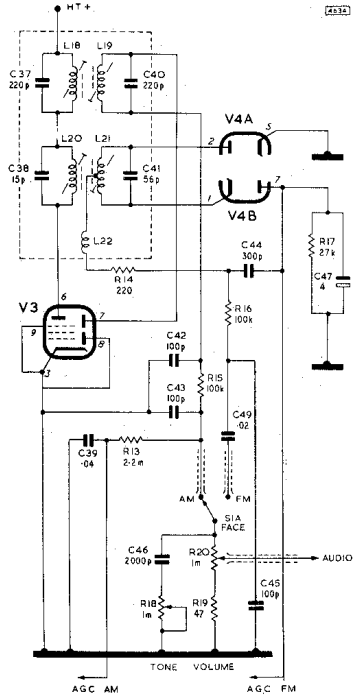
R16 and C45 form a de-emphasis network and IF filter, and the demodulated signal is coupled to the audio amplification stages via C49, S1A (face) and the tone and volume control networks.

AM

The pentode section of V3 operates as the IF amplifier and the 470 Kc/s IF signal is developed across L18 and coupled by L19 to the detector, which is one of two diode sections in V3. The other diode is unused and its anode is strapped to cathode

Audio signals are developed across the volume control, R20. This forms the diode load, and is connected into the circuit by S1A (face). The wiper of R20 is connected via C48 to the grid of V5A, the first audio amplifier.

R15 in conjunction with C42 and C43 form an IF filter and the DC component of the audio signal across R20 is taken through R13, decoupled by C39 and fed as AGC to V2 and V3 control grids. When switched to FM the detector and AGC circuits are rendered inoperative by S1A (back) which connects the junction of R13 and R15 to chassis.



DEMODULATION CIRCUITS

3a AUDIO AMPLIFICATION (RADIO)

When switched to 'radio', audio signals from the detector circuit are applied to the grid of V5A via the tone and volume control networks and C48.

V5A and B form a self balancing paraphase amplifier, providing two antiphase outputs of equal amplitude to drive the output stage V6/7. This is achieved by taking a portion of the amplified signal at V5A anode and feeding it to V5B grid via C52, R25, S2A (back) and C55. R28 functions as a feedback resistor and ensures that the outputs from V5A and V5B are balanced. The two antiphase signals, one at V5A anode, the other at V5B anode, are fed via C52 and C53 to the grids of V6 and V7.

V6 and V7 are operating in an unconventional class A push-pull circuit, biased by the voltage developed across R41 in the HT negative return circuit. The outputs from V6 and V7 drive the primaries of the output transformers T1 and T2. Although the audio signals developed in the primaries of T1 and T2 are in the anti-phase, the secondaries are connected so that the combined outputs to the loudspeakers are additive. Any even harmonic distortion produced in the output stage is in the same phase relationship in each primary winding, and, therefore, due to the connection of the secondaries, the even harmonics are cancelled out.

When switched to AM, negative feedback is applied to V5A grid via R23 and S2C (back). On FM S2C (back) switches a tone correcting network, C50, R21, into the feedback line.

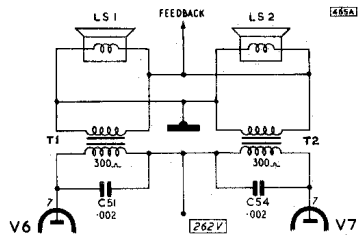
3b AUDIO AMPLIFICATION (GRAM)

When switched for record reproduction, the audio stages form two separate and identical amplifiers, one for each channel. The separate signals from the PU are fed to the left and right-hand channel amplifiers via R37 and R38 and are balanced by R36.

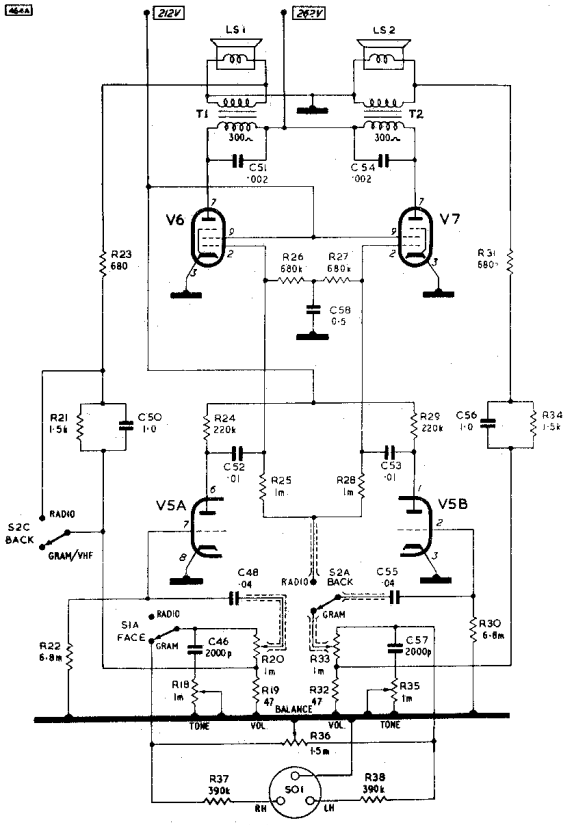
The LH channel signal is applied to V5B grid via the volume and tone control networks and C55. The amplified signal at the anode is coupled by C53 to V7 grid. V7 drives the audio output transformer T2 which feeds LS2, the LH channel loudspeaker.

Negative feedback is applied to V5B grid from T2 secondary via R31 and tone correction network R34, C56.

The RH channel amplifier is identical in operation to the LH, except that the PU input is fed to the volume (R20) and tone (R18, C46) control networks via S1A (face). T1 drives the RH channel loudspeaker LS1 and feedback is via R23, R21, C50.



Loudspeaker Circuit Arrangement for Radio Reception.



Audio Amplification Stages shown with all Switches and Loudspeaker Circuit for Record Reproduction.

Alignment

FM CIRCUITS

Note: A hexagonal trimming tool must be used for the IF transformer cores; tune to the outer peak in all cases.

Where two coil adjustments are located in the same former, the shape of the hexagonal trimming tool allows both cores to be adjusted independently from the top.

IF ALIGNMENT

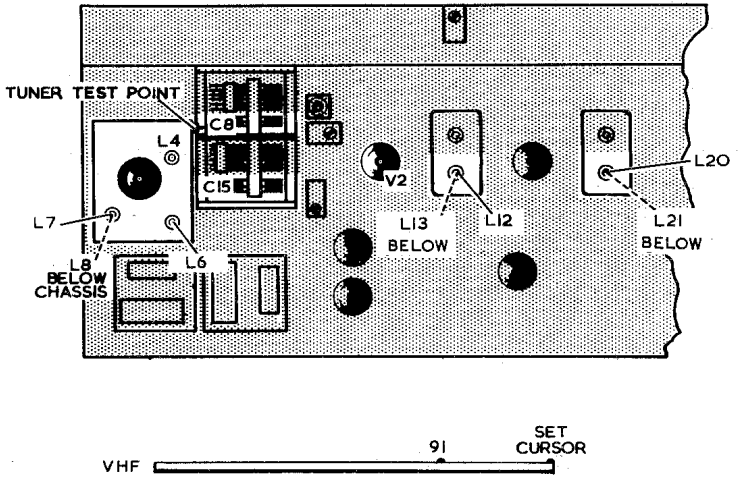
The following procedure is based on the use of a signal generator providing Band II coverage, also 10.7 Mc/s AM (30% modulated) and 10.7 Mc/s FM signals (25 Kc/s deviation) at an output impedance of 75Ω. Throughout alignment the signal input to the receiver should be adjusted to maintain an audio output of about 100 mW.

1. Switch the receiver to VHF and allow to warm up for at least ten minutes. Set the Volume control 90 degrees back from maximum and Tone control to maximum treble.
2. Inject 10.7 Mc/s FM signal via 400pF capacitor to V2 control grid and adjust L20, L21, L13 and L12 for maximum output.
3. AM rejection check.
   (a) Switch generator to 10.7 Mc/s AM and tune L21 for minimum output.
   (b) Switch generator to 10.7 Mc/s FM and check that FM output has been retained. If maximum AM rejection does not coincide with maximum FM output, tune L21 for maximum rejection at the expense of a slight reduction in FM output.
4. Unscrew the core of L8 in the VHF tuner unit so that it protrudes from the former by approximately $\frac{3}{8}$in.
5. Inject 10.7 Mc/s FM signal to the tuner TEST POINT. Adjust L7 for maximum output and then peak L8.

RF ALIGNMENT

Check that the cursor coincides with the edge of the scale opening when the tuning gang is fully closed.

1. Adjust tuning control to set cursor to 91 Mc/s on scale.
2. Inject 91 Mc/s FM signal at the aerial sockets and tune in signal by adjusting L6. If two peaks occur within the tuning range, that obtained with the core nearest the top of the former must be chosen.
3. Adjust L6 for maximum audio output with the core towards the bottom of the former.
4. Check calibration over the range.



Location of Components requiring adjustment for FM Alignment. Also shown is the scale marker.

AM CIRCUITS

IF ALIGNMENT

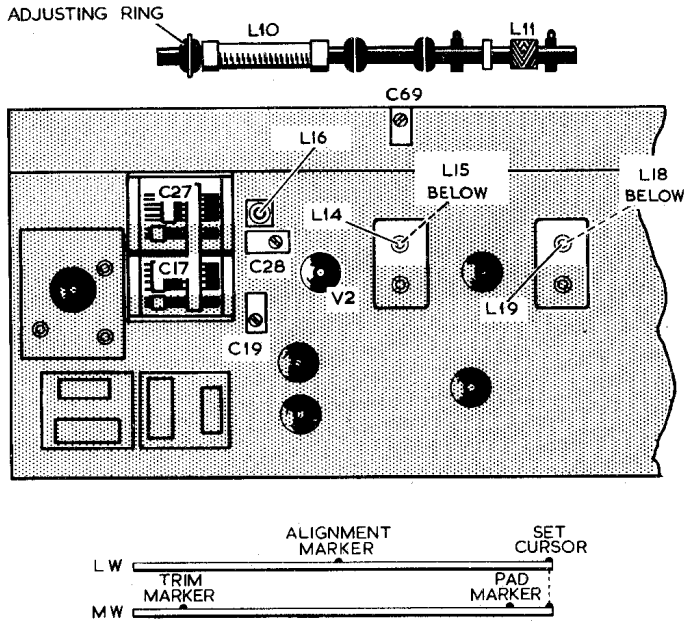
Switch receiver to MW, turn tuning gang to minimum capacitance position and volume control to maximum. Inject a 470 Kc/s modulated signal through a .01μF capacitor at V2 control grid and adjust L19, L18, L15 and L14 for maximum output.

RF ALIGNMENT

MW must be aligned first. 30% modulated signals to be injected via a loop loosely coupled to the ferrite rod aerial. With the tuning gang at maximum, set the cursor to the right hand edge of the scale opening. Pad and Trim markers are provided on MW and a calibration check point on LW.

RANGE	FREQUENCY	CURSOR POSITION	ADJUST
MW	580Kc/s 1460Kc/s	Pad Marker Trim Marker	L16, L10* C28, C19
LW	220Kc/s	Tune to Signal Check Calibration	C69, L11†
* Adjust by sliding RING along aerial rod. † Adjust by sliding COIL FORMER along aerial rod.			

NOTE:- In schedule A receivers, an adjustable LW oscillator trimmer is not fitted and L11 only is adjusted for maximum output.



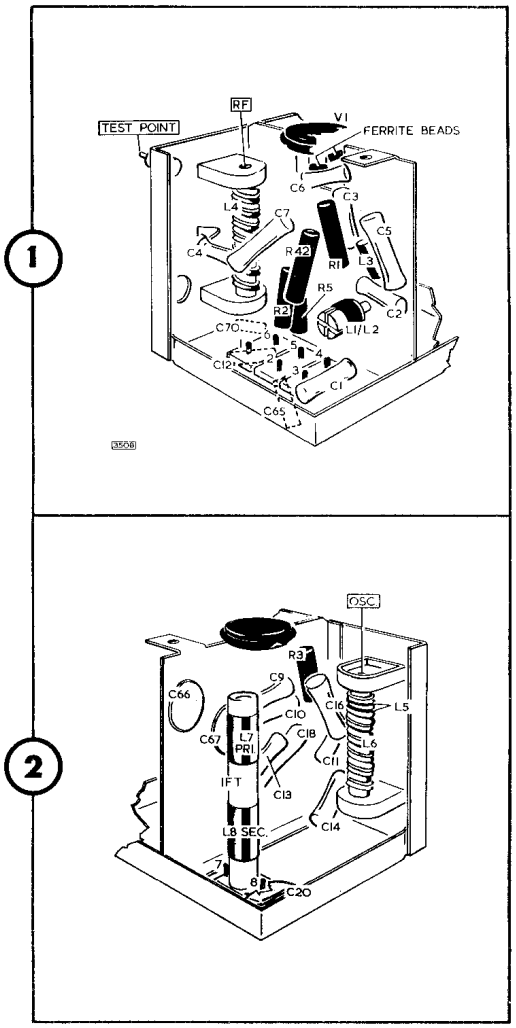
Location of Components requiring adjustment for AM Alignment. Also shown are the positions of Pad and Trim points on the scales.

COMPONENT LOCATIONS

VHF TUNER UNIT

C

C1	...	...	...	1
C2	...	...	...	1
C3	...	...	...	1
C4	...	...	...	1
C5	...	...	...	1
C6	...	...	...	1
C7	...	...	...	1
C9	...	...	...	2
C10	...	...	...	2
C11	...	...	...	2
C12	...	...	...	1
C13	...	...	...	2
C14	...	...	...	2
C16	...	...	...	2
C18	...	...	...	2
C20	...	...	...	2
C70	...	...	...	1
C65	...	...	...	1
C66	...	...	...	2
C67	...	...	...	2



L

L1	...	...	...	1
L2	...	...	...	1
L3	...	...	...	1
L4	...	...	...	1
L5	...	...	...	2
L6	...	...	...	2
L7	...	...	...	2
L8	...	...	...	2

R

R1	...	...	...	1
R2	...	...	...	1
R3	...	...	...	2
R5	...	...	...	1
R42	...	...	...	1

PRINTED BOARD

For printed board tag connections, see circuit diagram.

®

R4	D1
R6	D2
R7	D1
R8	D1
R9	E1
R10	D1
R11	E1
R12	E1
R13	E1
R14	F1
R15	E1
R16	F1
R17	F1
R22	E2
R24	E2
R25	D2
R26	D2
R27	D2
R28	D2
R29	E2
R30	E2
R39	D2
R40	F2
R41	F2

©

C19	D1
C22	D1
C23	D1
C24	D1
C25	*
C26	*
C28	D1
C29	D1
C30	D1
C31	*
C32	*
C33	E1
C34	E1
C36	E1
C37	†
C38	†
C39	E1
C40	†
C41	†
C42	F1
C43	E1
C44	F1
C45	F1
C47	F1
C48	E2
C49	F1
C52	E2
C53	E2
C55	E2
C58	D2
C59	E2
C60	E2
C61	F2
C63	E1
C64	D1

* In 1st AM and 2nd FM IFT can.

† In 2nd AM and FM Ratio Det. can.

Ⓛ

L12	D1
L13	E1
L14	D1
L15	E1
L16	D1
L17	D1
L18	E1
L19	F1
L20	E1
L21	F1
L22	F1

TAG

1	D1
2	D1
3	D2
4	D2
5	D1
6	D2
7	D1
8	D2
9	D2
10	D2
11	D1
12	D1
13	E1
14	E1
15	E2
16	E2
17	E2
18	E2
19	E2
20	E2
21	E2
22	E1
23	F1
24	F1
25	F2
26	F2
27	F1
29	D1

Service Notes

CHASSIS REMOVAL

1. Remove FM aerial plug and external aerial and earth connections.
2. Remove cabinet back.
3. Model 1640 only: Pull off control knobs.
4. From underside of chassis unscrew four 2BA chassis fixing bolts (the nuts are riveted to the chassis and cannot be removed).
5. Unscrew two 2BA mains transformer retaining nuts and free transformer.
6. Disconnect leads to internal loudspeaker, and FM aerial panel (two self-tapping screws).
7. Release ferrite rod aerial, remove tape playback-record panel (two self-tapping screws).
8. Free mains terminal block (one Phillips self-tapping screw) and release mains lead from block to record changer.
9. Unsolder pick-up leads on record changer.

The chassis is now free and may be removed from the cabinet complete with mains transformer, FM aerial panel and tape playback-record panel.

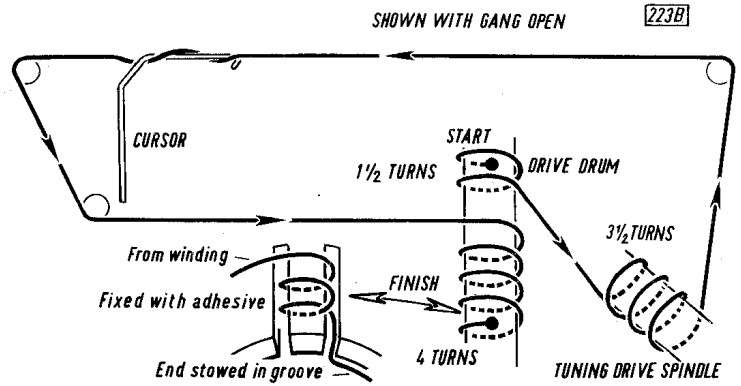
Once loudspeaker leads are removed from the output transformer, it is not necessary to remove the extension loudspeaker socket panels.

PRINTED PANEL SERVICING

When servicing the printed circuit panel, it must be remembered that excessive heat can loosen the bond between the copper conducting circuits and the insulating board. Special care must be exercised when soldering connections to the "wiring side" of the panel. When replacing a resistor or capacitor, cut out the faulty component so that as much as possible of the original lead-out wires remain so that these may be used as connections to the new component, thus avoiding whenever possible, soldering to the printed conductors. Use a small low-consumption iron and do not apply the bit for longer than is necessary to produce a sound joint.

The electrolytics C59/C60 and C61 are secured on the panel by means of clip lugs which also make electrical connections to the printed circuit. Use a heavier type iron to remove these components, applying heat and pressure to the lugs and not to the printed circuit so that when the solder melts, the lugs are pressed clear of their connecting points. A small stiff-haired brush will sometimes assist in breaking these connections.

If a section of the printed conductor becomes damaged or fused, scrape off the damaged portion and restore the connection with a jumper wire on the component side of the panel. Whenever the necessity arises, however, to solder directly to a printed conductor, use a 60 : 40 resin-cored solder and make the joint as quickly as possible to avoid overheating. Do not use a corrosive type flux.



DRIVE CORD DIAGRAM

COMPONENT TABLES

RESISTORS

All ¼ Watt carbon 20% tolerance unless otherwise stated

Ref.	Value	Rating	Function
R1	680K	10%	V1A grid leak
R2	2.2K		V1A HT feed
R3	680K	10%	V1B grid leak
R4	1.5K	10%	V1 HT feed
R5	6.8K		V1B HT feed
R6	33K	10%	V2 heptode screen grid feed
R7	2.2MΩ		V2 heptode grid leak and AGC feed
R8	47KΩ	10%	V2 triode grid leak
R9	2.7KΩ	10%	V2 heptode anode feed
R10	27KΩ	10%	V2 triode anode feed
R11	47KΩ	10%	V3 screen grid feed
R12	3.3KΩ	10%	V3 anode feed
R13	2.2MΩ		AGC time constant
R14	220Ω	10%	Ratio detector tertiary series
R15	100KΩ		Part IF filter (AM)
R16	100KΩ		Part IF filter (FM)
R17	27KΩ	10%	Ratio detector load
* R18	1MΩ	A/Log.Pot.	Tone control RH channel
R19	47Ω	10%	V5A NFB injection
† R20	1MΩ	Log.Pot.	Volume control RH channel
R21	1.5KΩ		NFB tone correction RH channel
R22	6.8MΩ		V5A grid leak
R23	680Ω	10%	NFB series
R24	220KΩ	10%	V5A anode load
R25	1MΩ	10%	V5A/B paraphase coupling
R26	680KΩ	10%	V6 grid leak
R27	680KΩ	10%	V7 grid leak
R28	1MΩ	10%	V5A/B paraphase coupling
R29	220KΩ	10%	V5B anode load
R30	6.8MΩ		V5B grid leak
R31	680Ω	10%	NFB series
R32	47Ω	10%	V5B NFB injection
† R33	1MΩ	Log.Pot.	Volume control LH channel
R34	1.5KΩ		NFB tone correction LH channel
* R35	1MΩ	A/Log.Pot.	Tone control LH channel
** R36	1.5MΩ	Lin.Pot.	Balance control
R37	390KΩ	10%	Pick-up feed RH channel
R38	390KΩ	10%	Pick-up feed LH channel
R39	560KΩ	10%	V6, V7 negative grid bias feed
R40	1.2KΩ	10% 3W	HT smoothing
R41	100Ω	5% 1W	V6, V7 grid bias
R42	1.5MΩ	10%	V1A AGC feed
R43	470KΩ	10%	L10, L11 damping

* Ganged, Part Number Model 1640 ... 13141
Model 1642 ... 13141/1

† Ganged, Part Number Model 1640 ... 13140
Model 1642 ... 13126

** Part Number Model 1640 ... 13142
Model 1642 ... 13128

CAPACITORS

All 350 V working 20% tolerance unless otherwise stated

Ref.	Value	Rating	Function and Part No.
C1	47pF	5%	L1 tuning
C2	15pF	5%	Part L2 tuning
C3	220pF		V1A grid coupling
C4	1500pF		V1A HT decoupling
C5	4.7pF	5%	Part L2 tuning
C6	7pF	½pF	Part V1A neutralizing
C7	4.7pF	5%	C8 padder
C8	Variable		VHF amp tuning 29591
C9	5pF	½pF	Oscillator/mixer signal injection
C10	5pF	½pF	
C11	11.5pF	5%	L6 tuning
C12	.01μF	10%	V1 HT decoupling
C13	12pF	5%	Part V1B IF – mixer feedback coupling
C14	50pF	5%	C15 padder
C15	Variable		VHF oscillator tuning 29591
C16	18.5pF	±½pF	Part VHF oscillator feedback coupling C185XH35
C17	Variable		L10, L11 tuning 29591
C18	88pF	2½%	Part V1B IF – mixer feedback coupling
C19	4–40pF	Trimmer	C17 trimmer 25547
C20	100pF	10%	L8 tuning
C21	140pF	2%	Part L10, L11 tuning (LW)
C22	3000pF	10%	V2 heptode screen decoupling
C23	220pF		V2 heptode grid coupling
C24	5000pF		V2 heptode neutralizing
C25	12pF	5%	L12 tuning
C26	220pF	2%	L14 tuning

CAPACITORS *continued*

Ref.	Value	Rating	Function and Part No.
C27	Variable		AM oscillator tuning 29591
C28	4–40pF	Trimmer	MW oscillator trimmer 25547
C29	220pF		AM oscillator grid coupling
C30	220pF		AM oscillator feedback coupling
C31	220pF	2%	L15 tuning
C32	12pF	5%	L15 tuning
C33	.02μF		V2 and V3 HT RF bypass
C34	3900pF	10%	V3 screen grid decoupling
C35	315pF	1%	Part L16 tuning (LW)
C36	10,000pF		V3 neutralizing
C37	220pF	2%	L18 tuning
C38	15pF	5%	L20 tuning
C39	.04μF	150V	AGC time constant
C40	220pF	2%	L19 tuning
C41	56pF	5%	L20 tuning
C42	100pF		IF filter (AM)
C43	100pF		
C44	300pF	5%	FM IF bypass
C45	100pF		IF filter and FM de-emphasis
C46	2000pF		Part tone control RH channel
C47	4μF	ELEC 100V	Ratio detector stabiliser 13210
C48	.04μF	150V	V5A grid coupling
C49	.02μF	150V	FM AF coupling
C50	1.0μF	150V	NFB tone correction
C51	.002μF	350V AC	Phase correction RH channel
C52	.01μF		V6 grid coupling
C53	.01μF		V7 grid coupling
C54	.002μF	350V AC	Phase correction LH channel
C55	.04μF	150V	V5B grid coupling
C56	1.0μF	150V	NFB tone correction LH channel
C57	2000pF		Part tone control LH channel
C58	0.5μF	150V	V6, V7 grid bias decoupling
C59	50μF	ELEC 275V	HT smoothing 13238/15
C60	50μF	ELEC 275V	
C61	100μF	ELEC 275V	HT reservoir 13229/14
C62	.02μF		Mains RF bypass
C63	5000pF		V3 heater RF bypass
C64	.01μF		V2 heater RF bypass
C65	.01μF	10%	V1A AGC line decoupling
C66	1000pF	+20–80%	V1 heater RF bypass
C67	1000pF	+20–80%	
C69	3–30pF	Trimmer	LW oscillator trimmer 13937
C70	.01μF	10%	V1 heater RF bypass

Component Tables
Continued

INDUCTORS

Ref.	Function	Part No.
L1, L2	VHF aerial input	29232
L3	RF choke	29280
L4	VHF amplifier tuning	25835
L5	V1B anode-grid coupling	29230
L6	V1B anode tuning	
L7, L8	1st FM IF	29233
L9	Aerial coupling MW & LW	29667
L10	MW ferrite rod aerial	
L11	LW ferrite rod aerial	
L12, L13	2nd FM IF	29654
L14, L15	1st AM IF	
L16, L17	Medium & Long wave oscillator	25829
L18, L19	2nd AM IF	29655
L20, L21, L22	FM ratio detector	

TRANSFORMERS

Ref.	Function	Part No.
T1	RH channel output	29392
T2	LH channel output	29392
T3	Mains transformer	29542

MISCELLANEOUS

Ref.	Function and Description	Part No.
S1-S2	Wavechange switch	1640 ... 29646/1 1642 ... 29646/1
S5	RH loudspeaker muting switch	33401
S6	LH loudspeaker muting switch	33402
PL1-PL2	Scale lamps 6.5V 0.3A	33755
S01	Pick up socket	29777
LS1-LS2	Loudspeakers, 3Ω speech coil	1640 ... 16003/18 1642 ... 16012/8
W1	HT rectifier	33426

SPARE PARTS

Description	Part No.
1640	
Cabinet	29688
Cabinet back	29750
Control knobs:	
Balance, Tone	25937/6
Tuning, Volume	
Wavechange	25937/8
(Clip for above)	45931
Cursor	29533
Felt washer for above	18450/1
Drive cord tension spring	10486
Drive drum	29535
Clip for above	37309
Lampholder	13300/2
Scale	29690
Clip for above	25480/1
Scale diffuser	29534
Clip for above	29666
1642	
Cabinet	32471
Cabinet back	32644
Control knobs:	
Balance, Tone	25493/9
Tuning, Volume	
Wavechange	25493/10
(Clip for above)	45931
(Felt washer for above)	29106/2
Cursor	29533
Felt washer for above	18450/1
Drive cord tension spring	3193
Drive drum	29535
Clip for above	37309
Lampholder	13300/2
Scale	32648
Clip for above	25480/1
Scale diffuser	29534
Clip for above	29666

MODIFICATIONS IN PRODUCTION

SCHEDULE A

C69 3-30pF LW oscillator Trimmer not fitted
C35 was 346pF

SCHEDULE B

C51 and C54 were 1800pF 400V AC in early production.

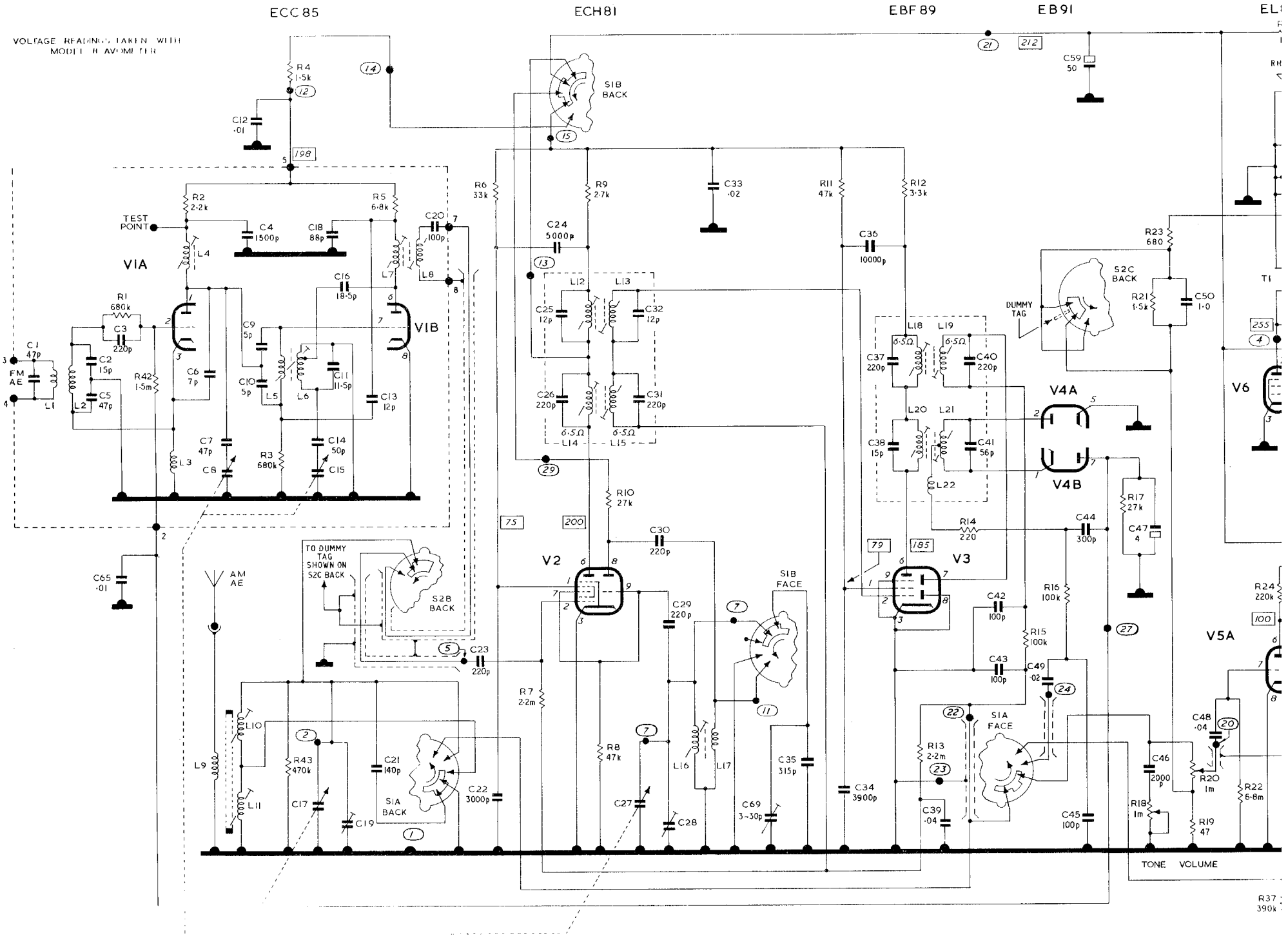
VALVES

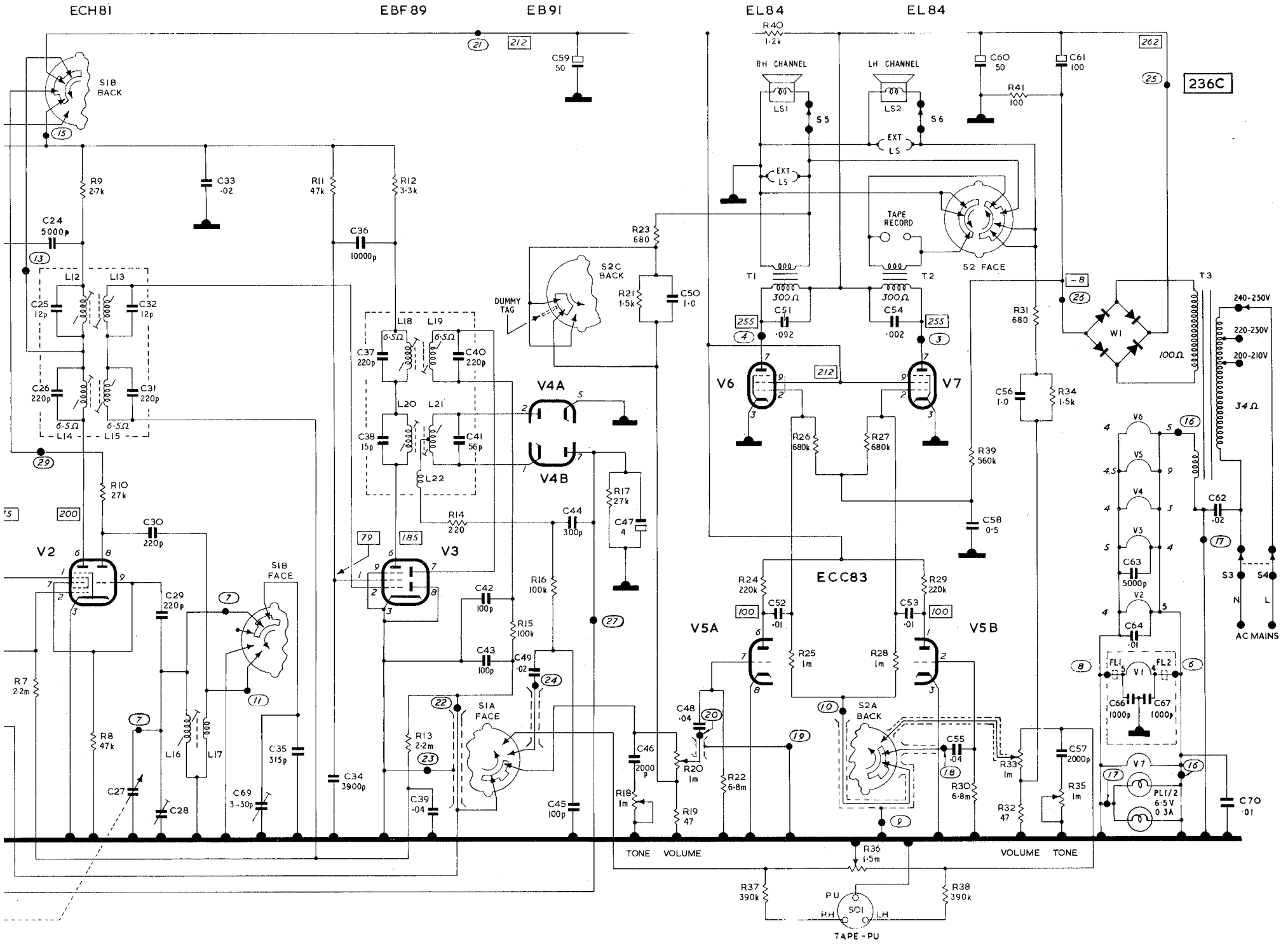
Ref.	Type	Description
V1A, V1B	ECC85	VHF Amplifier and Mixer
V2	ECH81	AM Frequency Changer FM IF Amplifier
V3	EBF89	AM-FM IF Amplifier AM Detector and AGC.
V4A, V4B	EB91	FM Ratio Detector
V5A, V5B	ECC83	RH Channel Amplifier LH Channel Amplifier
V6	EL84	RH Channel Output
V7	EL84	LH Channel Output

CIRCUIT DIAGRAM

MODELS 1640 and 1642.

Figures adjacent to the valve electrodes denote pin connections. Those in rectangles indicate voltages measured with a 20,000 Ω/Volt meter, whilst ringed figures denote tag connections on the printed board. DC resistance readings are shown against inductances where these are 1Ω or greater.


ECC85
ECH81
EBF89
EB91
VOLTAGE READINGS TAKEN WITH MODEL 8 AVOMETER
V1A
V1B
V2
V3
V4A
V4B
V5A
V6
S1B BACK
S1B FACE
S1A FACE
S1A BACK
S2B BACK
S2C BACK
TO DUMMY TAG SHOWN ON S2C BACK
DUMMY TAG
TEST POINT
FM AE
AM AE
TONE
VOLUME
R1 680k
R2 2·2k
R3 680k
R4 1·5k
R5 6·8k
R6 33k
R7 2·2m
R8 47k
R9 2·7k
R10 27k
R11 47k
R12 3·3k
R13 2·2m
R14 220
R15 100k
R16 100k
R17 27k
R18 1m
R19 47
R20 1m
R21 1·5k
R22 6·8m
R23 680
R24 220k
R37 390k
C1 47p
C2 15p
C3 220p
C4 1500p
C5 47p
C6 7p
C7 47p
C8
C9 5p
C10 5p
C11 11·5p
C12 ·01
C13 12p
C14 50p
C15
C16 18·5p
C17
C18 88p
C19
C20 100p
C21 140p
C22 3000p
C23 220p
C24 5000p
C25 12p
C26 220p
C27
C28
C29 220p
C30 220p
C31 220p
C32 12p
C33 ·02
C34 3900p
C35 315p
C36 10000p
C37 220p
C38 15p
C39 ·04
C40 220p
C41 56p
C42 100p
C43 100p
C44 300p
C45 100p
C46 2000p
C47 4
C48 ·04
C49 ·02
C50 1·0
C59 50
C65 ·01
C69 3–30p
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
L13
L14
L15
L16
L17
L18 6·5Ω
L19 6·5Ω
L20
L21
L22
6·5Ω
6·5Ω
R42 1·5m
R43 470k


ECH81
EBF89
EB91
EL84
EL84
236C
S1B BACK
S1B FACE
S1A FACE
S2C BACK
S2A BACK
S2 FACE
DUMMY TAG
V2
V3
V4A
V4B
V5A
V5B
V6
V7
ECC83
R9 2·7k
C33 ·02
R11 47k
R12 3·3k
C24 5000p
C36 10000p
L12
L13
L14
L15
L16
L17
L18
L19
L20
L21
L22
C25 12p
C32 12p
C26 220p
C31 220p
C37 220p
C40 220p
C38 15p
C41 56p
R10 27k
C30 220p
C29 220p
R7 2·2m
R8 47k
C27
C28
C69 3–30p
C35 315p
C34 3900p
R14 220
C42 100p
C43 100p
R15 100k
R16 100k
C44 300p
C45 100p
C49 ·02
R13 2·2m
C39 ·04
R17 27k
C47 4
R23 680
R21 1·5k
C50 1·0
C59 50
R40 1·2k
RH CHANNEL
LH CHANNEL
LS1
LS2
S5
S6
EXT LS
TAPE RECORD
T1
T2
300Ω
C51 ·092
C54 ·002
C60 50
C61 100
R41 100
R31 680
C56 1·0
R34 1·5k
R26 680k
R27 680k
R39 560k
C58 0·5
R24 220k
R29 220k
C52 ·01
C53 ·01
R25 1m
R28 1m
C48 ·04
R20 1m
R18 1m
R19 47
R22 6·8m
C46 2000p
C55 ·04
R30 6·8m
R33 1m
R32 47
C57 2000p
R35 1m
R36 1·5m
R37 390k
R38 390k
PU
RH
LH
SO1
TAPE - PU
TONE
VOLUME
VOLUME
TONE
W1
100Ω
T3
34Ω
240-250V
220-230V
200-210V
C62 ·02
C63 5000p
C64 ·01
C66 1000p
C67 1000p
C70 ·01
FL1
FL2
V1
PL1/2 6·5V 0·3A
S3
S4
N
L
AC MAINS