E · M · I SERVICE LTD.

"HIS MASTER'S VOICE" 1404
MARCONIPHONE 892

SERVICE MANUAL

4 Valve 3 Waveband Battery Superhet

CONTENTS

Part No. 20640

March, 1940

SPECIFICATION

PHYSICAL.

Height	... ...	... 14⅛ inches.
Width	... ...	... 18½ inches.
Depth	... ...	... 11 inches.
Net Weight	...	... 25½ lb. (with batteries).

BATTERIES.

L.T. Type GFG4 ...	...	2 volt 24 AH accumulator.
H.T. Cat. No. B498	...	120 volt.
Consumption	...	H.T. 10 mA maximum 5 mA economy } average. L.T. 0·6 A.

WAVE RANGES.

Manual—

Short Waves	...	16·5 to 50 metres.
Medium Waves	...	192 to 570 metres.
Long Waves	...	720 to 2,050 metres.

RATED OUTPUT.

Maximum, 0·4 watt.

VALVES.

Marconi X24 (V1)	...	Frequency Changer.
,, Z21 (V2)	...	I.F. Amplifier.
,, HD24 (V3)	...	Detector, A.V.C. and L.F. Amplifier.
,, KT2 (V4)	...	Output Valve.

LOUDSPEAKER AND EXTRA LOUDSPEAKERS.

This is a large diameter permanent-magnet with extra high flux magnet speaker. For resistance data see page 7.
One extra low-resistance loudspeaker may be connected to the sockets provided, and should be adjusted to a 5 ohms impedance. To silence the internal speaker remove the plug from the third socket in the E.L.S. panel.

WARNING.—Do not remove this plug unless an extra loudspeaker is connected.

CIRCUIT DESCRIPTION

AERIAL CIRCUIT.

High impedance inductive coupling is employed on all bands to high-efficiency tuned circuits. The medium and long wave coils are iron-cored (L4 and L6).

FREQUENCY CHANGER.

A triode-hexode (X24) valve is used. Inductive and capacitive coupled circuits (L7, L8 and L9, L10) are used on M.W. and S.W. to produce oscillations, whilst on long waves a capacity coupled (C9) is used ; the intermediate frequency is 465 kc/s.

I.F. AMPLIFIER.

The first iron-cored I.F. transformer (L12, L13), of very stable characteristics, is in the anode circuit of V1 and couples to the high slope Z21 I.F. amplifier. This valve has I.F. transformer (L14, L15) coupling it to the second detector valve.

SECOND DETECTOR.

The second detector is V3. A tuned secondary feeds the signal diode which has a load resistance R7, VR1, with the signal tapped off through C12 to the grid of the triode portion. The A.V.C. diode is fed through C13 and the voltages produced across R11, R12, etc., are applied to V1 and V2.

OUTPUT STAGE.

Resistance capacity (R9, C15) coupling is employed between the HD24 and the KT2 output valve. Bias for this valve (and smaller amounts for V1 and V2) is derived from the voltage drop across R15 in the main H.T.— lead. The switch S2 is the " Battery Economy Control." Opening this switch inserts a 10,000 ohm resistance in the main H.T. + lead and thus effects an economy in current consumption.

PRELIMINARY TESTS

1. **Battery and H.T. Current Test.**—The H.T. battery should read at least 65 volts on load. To ascertain if the H.T. current is correct measure voltage between chassis and H.T.—with economy switch to " maximum " and a new H.T. battery the voltage should be approximately 3·5 volts. If value is low suspect valves, short circuited R15 or open circuit grid resistances. If high check valves, H.T. feed wiring and C16.

2. **L.F. Test.**—If the L.F. side of the receiver is O.K. a whistle should result when top grid V3 (HD24) is touched, volume fully up, earth disconnected. This result but no radio indicates a fault in V1, V2 or possibly V3. If no result is obtained from this test connect a small battery or ohmmeter across the extra L.S. sockets. A definite " click " indicates that the speech coil circuit is continuous.

3. **H.F. Test.**—Elimination of the earlier parts of the circuit can be done by contacting the aerial lead on to fixed vanes VC1. This eliminates the coupling circuit L1, 3 and 5, and medium wave results should be obtained but with whistles and loss of selectivity.

4. **Oscillator Test.**—No radio results may be brought about by failure of V1 to oscillate. To check this, connect a voltmeter across R4 and note normal reading with VC2 short circuited. The latter reading will be greater if the valve is oscillating.

CONDENSER DRIVE

The special wire drive fitted to these models should not often require renewal, but if it is necessary it is essential to use only the correct wire (Specification S2447, Code No. 390/04001). Approximately 48 inches will be required for one drive.

1. Form a loop with an opening approximately $\frac{1}{8}$ inch in diameter at one end. It will be found that the twisted part of the wire can readily be soldered.

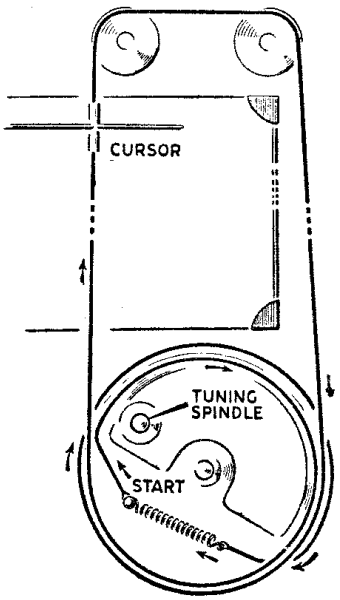
2. Remove scale and remove pointer from broken wire by carefully opening the pressed up channel section.

3. Assemble the pointer to the new wire (by pinching up the channel section) apprximately $9\frac{3}{4}$ inches from the loop end.

4. Turn the gang condenser vanes fully in and assemble the loop on to the pin in the drive disc as shown.

5. Wind the wire and assemble the tension spring as shown, passing the wire through the end of the spring and tensioning the latter. Twist wire, solder, and cut off surplus. The white felt discs at the ends of the pointers should rest against the glass scale when it is assembled.

6. Replace glass scale and check calibration. If inaccurate, the pointer can be carefully slid up or down on the wire as required.



H.F. TESTS AND ADJUSTMENTS

This model is fitted with a coil unit comprising all tuning coils, the press-button switch and trimmer condensers.

In general, the iron-cored inductances are very stable and unless repair work or replacement has been carried out on the coil itself it is rarely necessary to re-adjust these inductances when ganging. The usual symptom of mis-matched inductances is low sensitivity at the high end of the wave-scale.

GANGING

Always follow any adjustment to the I.F. trimmers with complete R.F. alignment (L.W., M.W., S.W.) but where work has been done or sensitivity is low on a specific band it is necessary only to regang this band.

A screened oscillator (16–2,000 metres) with an attenuator, an output meter, a trimmer screwdriver, and a S.W. inductance trimming tool are required.

In carrying out all ganging operations the input to the receiver from the oscillator must be kept low and progressively reduced as the circuits are brought into line so that the output meter reading does not exceed 50 mW or 0·5 volts. The output meter should be connected between the anode V4 (KT2) and chassis if it is of the high resistance type, or across the E.L.S. sockets if a low resistance A.C. voltmeter is being used.

I.F. GANGING.

Set receiver to M.W., volume control and Economy switch to "maximum," and gang condenser to minimum. Inject signal to V1 top cap (via a 0·1 mfd. condenser) leaving grid connexion in position, and chassis.

1. Tune oscillator exactly to 465 kc. (645·2 metres).

2. Adjust TC5, TC4, TC3 and TC2 in that order for maximum output.

3. Check adjustment in the same order.

SETTING OF TUNING POINTER.

Before commencing R.F. ganging operations it is essential to check the position of the wave-scale and pointer in relation to the gang condenser.

1. Turn gang condenser to minimum.

2. See that the pointer registers accurately on the 192 metre mark in the M.W. calibration.

3. If adjustment is necessary pointer can be carefully slid up or down the drive wire.

MEDIUM AND LONG WAVES.

Set receiver to M.W., other control as for Short Waves. See "Setting of Tuning Pointer" above. Oscillator connected to A and E sockets.

1. Set gang condenser to minimum, and tune oscillator to exactly 192 metres (1,562 kc.).

2. Adjust TC6 for maximum output.

3. Set oscillator and receiver (by scale) to 220 metres (1,363·6 kc.) and adjust TC1 for maximum output.

4. Set oscillator and receiver (by scale) to 530 metres (566 kc.) and adjust the cores of L10 and L4 for maximum. Unless either of these coils has been changed very little adjustment should be necessary.

5. Repeat operations 1, 2 and 3 several times if necessary.

6. Set oscillator and reciver to 720 metres (416·7 kc.) and adjust TC7 for maximum output.

7. Set oscillator and receiver to 1,750 metres (171·4 kc.) and adjust L11 for maximum output.

8. Set oscillator and receiver to 1,400 metres (214·3 kc.) and adjust L6 for maximum output.

9. Repeat operation 6.

SHORT WAVES.

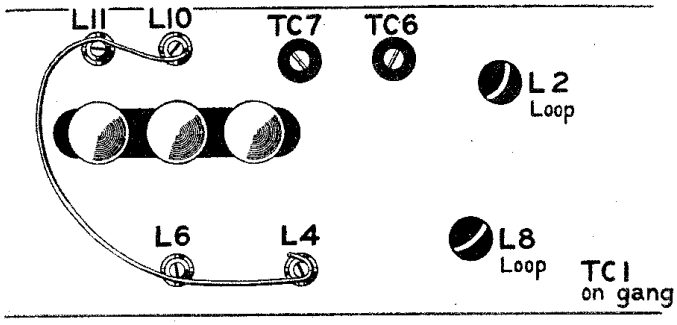
Connect oscillator to A and E Sockets via a S.W. dummy aerial device. Set receiver to S.W., volume fully up and Economy switch to "maximum."

1. Inject signal of 50 metres (6 Mc.), set tuning pointer to 50 metres and adjust loops in L8 and L2 for maximum output.

2. Repeat several times if necessary until no further increase in output can be obtained.

3. Check that receiver will tune in 16·8 metres (17·86 Mc.).

After ganging do not alter position of pointer in relation to the gang condenser. If the above instructions have been correctly carried out the calibration should be satisfactory.



CONTINUITY CHECKS

Resistance values ± 20 per cent.

Component.	Measured.	Switch.	Resistance.
L1	Across ends	—	0·7 ohms.
L2	Top cap V1 and chassis	S.W.	0·1 ohms.
L3, L5, R1	Aerial socket and chassis	M.W. L.W.	83·0 ohms (L3 + L5). 24·0 ohms (L3).
L4, L6, R17, R10	Top cap V1 and AVC diode socket V3 ...	M.W. & L.W.	0·46 megohms. (L4 2·25 ohms.) (L6 17·5 ohms.)
L7	Across ends	—	0·8 ohms.
L8	Across ends	—	0·1 ohms.
L9	Across ends	—	1·75 ohms.
L10	Across ends	—	3·0 ohms.
L11	Across ends	—	7·5 ohms.
L12	H.T.+ lead and mixer anode socket V1 ...	" Maximum " (S2) ...	4·5 ohms.
L13, R12	Top cap V2 and chassis	—	0·35 megohm. (L13, 4·5 ohms.)
L14	H.T.+ lead and anode socket V2	" Maximum " (S2) ...	4·5 ohms.
L15, R7, VR1	Diode and chassis socket V3	—	0·73 megohms. (L15 4·5 ohms.)
For transformers, loudspeaker, etc.	See circuit diagram.		

VALVE TABLE

(Voltage, Current and Resistance Tests.)

Values ± 20 per cent.

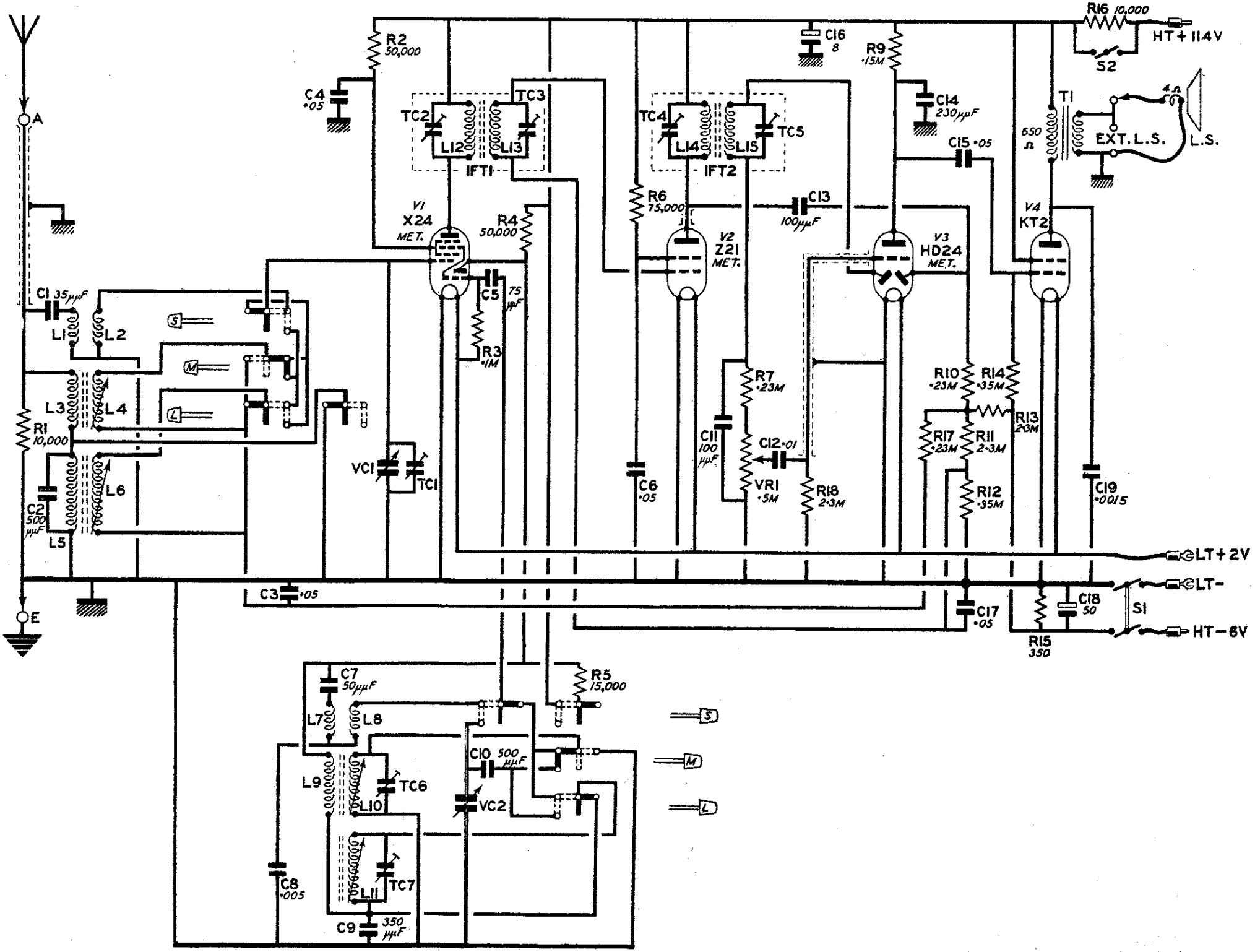
Voltage and current readings taken with an H.T. battery reading 120 volts on load, economy switch in " maximum " position, aerial disconnected, receiver switched to M.W. and tuned to point of no reception. Resistance readings (in ohms) taken with batteries disconnected and valves removed.

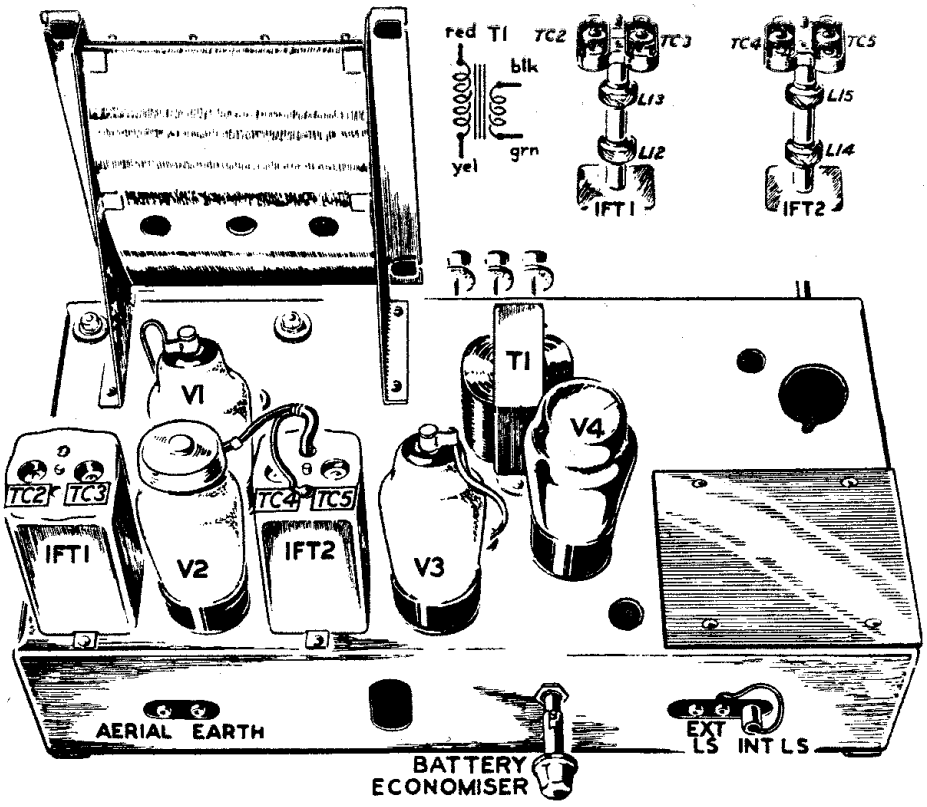
S = Short circuit. ∞ = Open circuit.

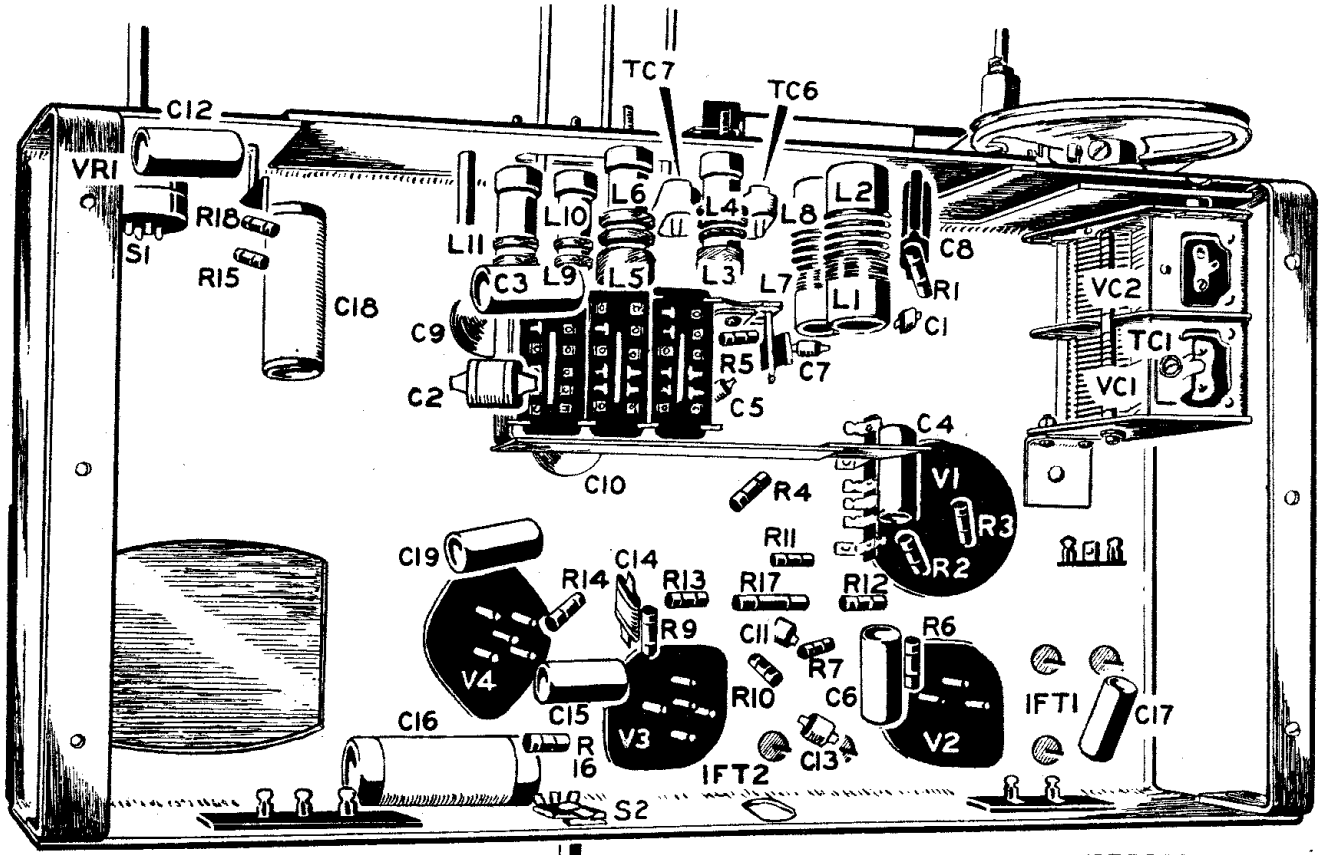
	Anode.			Screen.			Bias.	Control Grid.
	Volts.	Milliamps.	Resistance to Chassis.	Volts.	Milliamps.	Resistance to Chassis.	Volts.	Resistance to Chassis.
V1 (X24)	Mxr. 117 Osc. 50	0·7 1·3	∞	70	0·9	∞	1·8*	2·88 M.
V2 (Z21)...	117	0·9	∞	83	0·35	∞	0·25*	0·35 M.
V3 (HD24)	57	0·35	∞	—	—	—	—	2·3 M.
V4 (KT2)	112	4·6	∞	117	0·9	∞	3·5	0·35 M.

Total H.T. current ... ... 10·0 mA approximately.
Total L.T. current ... ... 0·6 A approximately.

Owing to the high resistances of the bias network these values cannot be measured with a meter.


A
E
R1 10,000
C1 35μμF
L1
L2
L3
L4
L5
L6
C2 500 μμF
S
M
L
R2 50,000
C4 .05
TC2
TC3
LI2
LI3
IFT1
VC1
TC1
C3 .05
V1 X24 MET.
R4 50,000
C5 75 μμF
R3 .1M
C6 .05
TC4
TC5
LI4
LI5
IFT2
R6 75,000
C13 100μμF
V2 Z21 MET.
R7 .23M
C11 100 μμF
C12 .01
VR1 .5M
R18 2.3M
C16 8
R9 .15M
C14 230μμF
C15 .05
V3 HD24 MET.
R10 .23M
R14 .35M
R13 .23M
R17 .23M
R11 2.3M
R12 .35M
V4 KT2
C19 .0015
T1
650 Ω
4Ω
EXT. L.S.
L.S.
R16 10,000
HT + 114V
S2
LT + 2V
LT −
S1
HT − 6V
C17 .05
C18 50
R15 350
C7 50μμF
L7
L8
L9
L10
L11
TC6
TC7
C8 .005
C9 350 μμF
C10 500 μμF
VC2
R5 15,000


red
T1
blk
grn
yel
TC2
TC3
L13
L12
IFT1
TC4
TC5
L15
L14
IFT2
V1
T1
V4
TC2
TC3
TC4
TC5
IFT1
V2
IFT2
V3
AERIAL
EARTH
BATTERY
ECONOMISER
EXT
LS
INT LS


TC7
TC6
C12
VR1
R18
S1
R15
C18
L11
L10
L6
L4
L8
L2
C8
C3
L9
L5
L3
L7
L1
R1
C9
C1
VC2
TC1
VC1
C2
R5
C7
C5
C4
C10
R4
V1
R3
R2
C19
R11
C14
R14
R13
R17
R12
R9
C11
R6
V4
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C15
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C6
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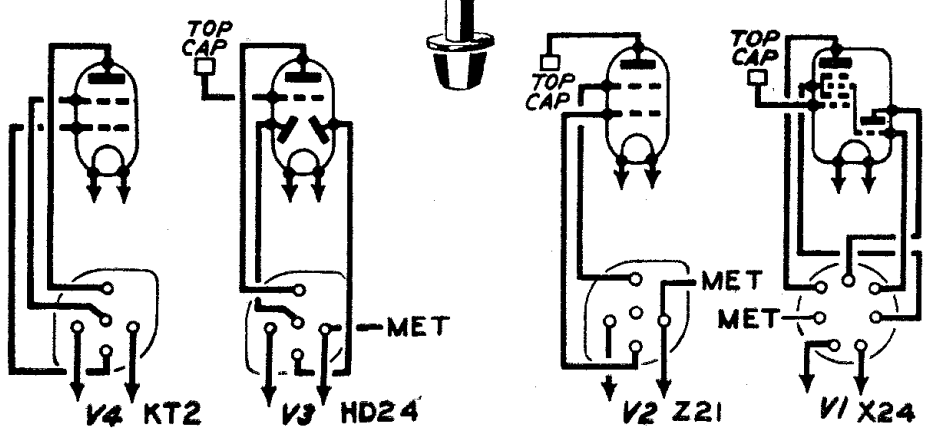
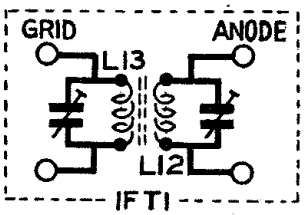
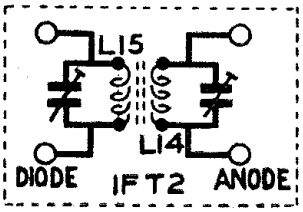
C17
C16
R16
V3
IFT2
C13
V2
S2


TOP CAP
MET
V4 KT2
V3 HD24
TOP CAP
MET
TOP CAP
MET
V2 Z21
V1 X24


GRID
ANODE
L13
L12
IFT1


L15
L14
DIODE
IFT2
ANODE

SPARE PARTS LIST

Description of Part.	Part No.
INDUCTANCES.	
Push button and coil unit.	30840E
L1, L2—Short wave aerial coil.	27388E
L3, L4—Medium wave aerial coil.	27389E
L5, L6—Long wave aerial coil.	27389F
L7, L8—Short wave oscillator coil.	27388D
L9, L10—Medium wave oscillator coil.	27389D
L11—Long wave oscillator coil.	27389G
L12, L13—IFT 1.	26330AW
L14, L15—IFT 2.	26330AW
T1—Output transformer.	22624AK
LS1—Loudspeaker.	27410M
CONDENSERS.	
VC1, VC2, TC1—Tuning condenser.	18712K
TC2, TC3—Double trimmer condenser.	26350AC
TC4, TC5—Double trimmer condenser.	26350BR
TC6, TC7—Double trimmer condenser.	26350BP
C1—35 mmfd.	22164F
C2—500 mmfd.	22001E
C3—0·05 mfd.	24900W
C4—0·05 mfd.	24900W
C5—75 mmfd.	22164K
C6—0·05 mfd.	24900W
C7—50 mmfd.	22164J
C8—0·005 mfd. ± 5%.	20387S
C9—350 mmfd. ± 2%.	30433P
C10—500 mmfd. ± 2%.	30433H
C11—100 mmfd.	22164L
C12—0·01 mfd.	24900N
C13—100 mmfd.	22164L
C14—230 mmfd.	22001AD
C15—0·05 mfd.	24900W
C16—8 mfd., 125 v. electrolytic.	17250K
C17—0·05 mfd.	24900W
C18—50 mfd., 12 v. electrolytic.	17250F
C19—0·0015 mfd.	24900C
RESISTANCES.	
R1—10,000 ohms, $\frac{1}{4}$ w.	24150F
R2—50,000 ohms, $\frac{1}{4}$ w.	24150J
R3—0·1 megohm, $\frac{1}{4}$ w.	24150L
R4—50,000 ohms, $\frac{1}{4}$ w.	24150J
R5—15,000 ohms, $\frac{1}{4}$ w.	24150AH
R6—75,000 ohms, $\frac{1}{4}$ w.	24150K
R7—0·23 megohm, $\frac{1}{4}$ w.	24150M
R8—0·5 megohm, $\frac{1}{4}$ w.	24150N
R9—0·15 megohm, $\frac{1}{4}$ w.	24150AJ
R10—0·23 megohm, $\frac{1}{4}$ w.	24150M
R11—2·3 megohms, $\frac{1}{4}$ w.	24150AM
R12—0·35 megohm, $\frac{1}{4}$ w.	24150AK
R13—2·3 megohms, $\frac{1}{4}$ w.	24150AM
R14—0·35 megohm, $\frac{1}{4}$ w.	24150AK
R15—350 ohms ± 5%, $\frac{1}{2}$ w.	30020BX
R16—10,000 ohms, $\frac{1}{4}$ w.	24150F
R17—0·23 megohm, $\frac{1}{4}$ w.	24150M
R18—2·3 megohms, $\frac{1}{4}$ w.	24150AM
VR1—0·5 megohm.	27655EY
S1—On-Off switch.	27655EY
S2—Battery economy switch.	31570A

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