KOLSTER-BRANDES LIMITED

FOOTSCRAY SIDCUP KENT

MODEL

OP21

TRANSISTOR RHAPSODY

SERVICE DATA

ISSUED FEB., 1958

SPECIFICATION

The OP 21 is a six-transistor, two waveband portable receiver for operation from a self-contained battery.

BATTERY: 9 V. Centre Tapped. Nominal life: 150 hours at 4 hours/day continuous use.

Make	*Type No.*
Ever Ready	PP11
Drydex	DT11

WAVERANGES: Long Waveband 150–270 Kc/s. (2,000–1,100 M.).
Medium Waveband 525–1,610 Kc/s. (570–185 M.).

CONTROLS: Press Buttons: L.W. and on. M.W. and on. Off. Volume Control.

TRANSISTOR COMPLEMENT:

		FUNCTION
TX1	Mullard OC44	Oscillator-Mixer
TX2	Mullard OC45	1st I.F. Amplifier
TX3	Mullard OC45	2nd I.F. Amplifier
TX4	Mullard OC71	Audio Driver
TX5, TX6	Mullard OC72	Push-pull Output

Diode Detector: Mullard OA70

DIMENSIONS: Height 7 ins. Width $9\frac{3}{4}$ ins. Depth $3\frac{1}{2}$ ins.

CIRCUIT DESCRIPTION

The OP 21 is a six-transistor superhet receiver. A ferrite rod aerial is provided, having separate windings for Long and Medium Waveband reception. L1 is the medium wave aerial coil and is a spaced winding on the rod for maximum efficiency. On Long Waves L1 and L3 are connected in series and the circuit is padded out by means of capacitors C1 and C2. The output of the aerial is matched to the low impedance of the mixer-oscillator transistor TX1 by means of the coupling windings L2 and L4.

Transistor TX1 operates as an inductively coupled oscillator. L7 is the tuned winding on the oscillator coil, L5 and L6 being the collector and emitter coupling windings respectively. The number of turns on L6 has been adjusted to inject into the emitter circuit the voltage giving optimum conversion efficiency. The I.F. is 470 Kc/s. and the oscillator frequency is always higher than the signal frequency.

Two stages of I.F. amplification are used. The I.F. transformers have tuned primaries and untuned secondaries. For correct matching to the transistors, the primary is tapped for the negative supply line connection. In order to eliminate the inherent feedback in the transistors which could cause instability, neutralisation is employed via capacitors C8 and C11.

A germanium point-contact diode is used as detector and also provides an A.G.C. voltage which is applied to the base of transistor TX2. It should be noted that unlike a valve receiver, the A.G.C. voltage is positive with respect to the earth line.

The volume control is a variable resistor in series with the base of transistor TX4, the input impedance of which is about 1 KΩ. Transistor TX4 feeds the output stage through the phase-splitting transformer, L14.

The output stage is a so-called "single-ended push-pull" circuit. The two output transistors TX5, TX6 are connected in series across the battery supply and are biased by means of resistors R15, R16, R17, R18, R19 and R20 almost to collector current cut-off. The speaker load is connected between the collector of TX6 and the centre tap of the battery, no output transformer being required. The D.C. current through the speaker is negligible, being only the out-off balance current through the two output transistors.

The input is applied in antiphase from the two secondary windings of L14 between base and emitter of the two output transistors. Thus, when a signal is applied TX5 will be conducting when TX6 is turned off and vice-versa. The circuit through the transistors is completed via the loudspeaker: with TX5 conducting the current will flow out of the battery via the speaker and with TX6 conducting the current will flow into the battery via the speaker. Thus, the complete amplified signal will be applied to the speaker. In order to provide the transistors with the optimum load for maximum power output and minimum distortion, the loudspeaker is wound to an impedance of 33 Ω, which is ten times higher than usual.

Negative feedback is applied from the speaker into the base of TX4. The low frequencies fed back are reduced by the network R21, R22 and C19 in order to improve the overall frequency response.

REMOVAL OF CHASSIS FROM CABINET

1. Open cabinet and remove battery.
2. Remove tuning knob and pointer holding the gang condenser steady inside the cabinet with the other hand. The knob and pointer are push fits on the gang condenser spindle.
3. Remove the three chassis fixing screws.
4. Withdraw the chassis from the cabinet.

ALIGNMENT INSTRUCTIONS

The following equipment will be required:

1. A.M. signal generator covering the range 140–1600 Kc/s.
2. Power output meter or A.C. voltmeter.

Alignment

1. The oscillator operates at a higher frequency than the signal on both bands.
2. Set the tuning pointer to the datum mark with gang at maximum capacity.
3. Keep the input signal as low as possible reducing it progressively as the sensitivity increases with alignment.
4. Measurements to be made with the R.F. signal modulated 30 per cent. at 400 c/s.
5. I.F. Alignment should be carried out as follows:
   Connect signal generator via 0·1 μF. capacitor to the mixer base available at the edge of the board. Feed in 470 Kc/s. signal, gang at maximum capacity, on medium wave.
   Adjust cores for maximum gain in the following order: L12, L10, L8.
   Repeat this adjustment as necessary to optimum.
6. Connect the signal generator to a test coil* situated axially in relation to the aerial coils on the ferrite rod. This is necessary as no aerial or earth terminals are provided.
7. R.F. Alignment should be carried out in the order shown below. Operations should be repeated as necessary until scale accuracy with maximum sensitivity is attained.

Operation	*Input Frequency*	*Wave Band*	*Pointer Position*	*Adjustments*
1.	600 Kc/s.	M.W.	500 M. Mark	Osc. Core L7. Move Aerial Winding L1 along ferrite rod.
2.	1350 Kc/s.	M.W.	222 M. Mark	Osc. Trimmer T2. Aerial Trimmer T1.
3.	225 Kc/s.	L.W.	1335 M. Mark	Move Aerial Coil L3 along ferrite rod. Whilst rocking gang for optimum.
4.	176 Kc/s.	L.W.	1700 M. Mark	Move Aerial Coil L3 along ferrite rod. Whilst rocking gang for optimum.

Operation 4 should be carried out only in case the output at 175 Kc/s. is more than 3 dB down on that at 225 Kc/s.

* Twelve turns of P.V.C. insulated connecting wire on a 2-inch diameter former.

COIL AND TRANSFORMER DATA

Circuit Ref. No.	Function	Approximate Resistance in ohms
L3, L4	L.W. AERIAL COIL	3
L14	INTERSTAGE TRANSFORMER	
	1st Winding	60
	2nd Winding	350
	3rd Winding	80

ALL OTHERS LESS THAN ONE OHM.

VOLTAGE CHART

Voltages measured with a voltmeter having 20,000 ohms/volt impedance

TRANSISTOR	CIRCUIT REFERENCE	BASE	EMITTER	COLLECTOR
OC44	Oscillator Mixer	·51	·68	7·5
OC45	1st I.F. Amplifier	·53	·44	7·5
OC45	2nd I.F. Amplifier	·18	·04	7·5
OC71	Audio Amplifier	·69	·56	7·1
OC72	Push-pull	4·5	4·3	8·7
OC72	Push-pull	·18	·01	4·3

Total H.T. Current, 9 mA. Power Output ·180 W. for 10% distortion

All voltages measured between transistor electrodes and positive terminal of battery

All measurements taken with controls set for minimum gain and no applied signal

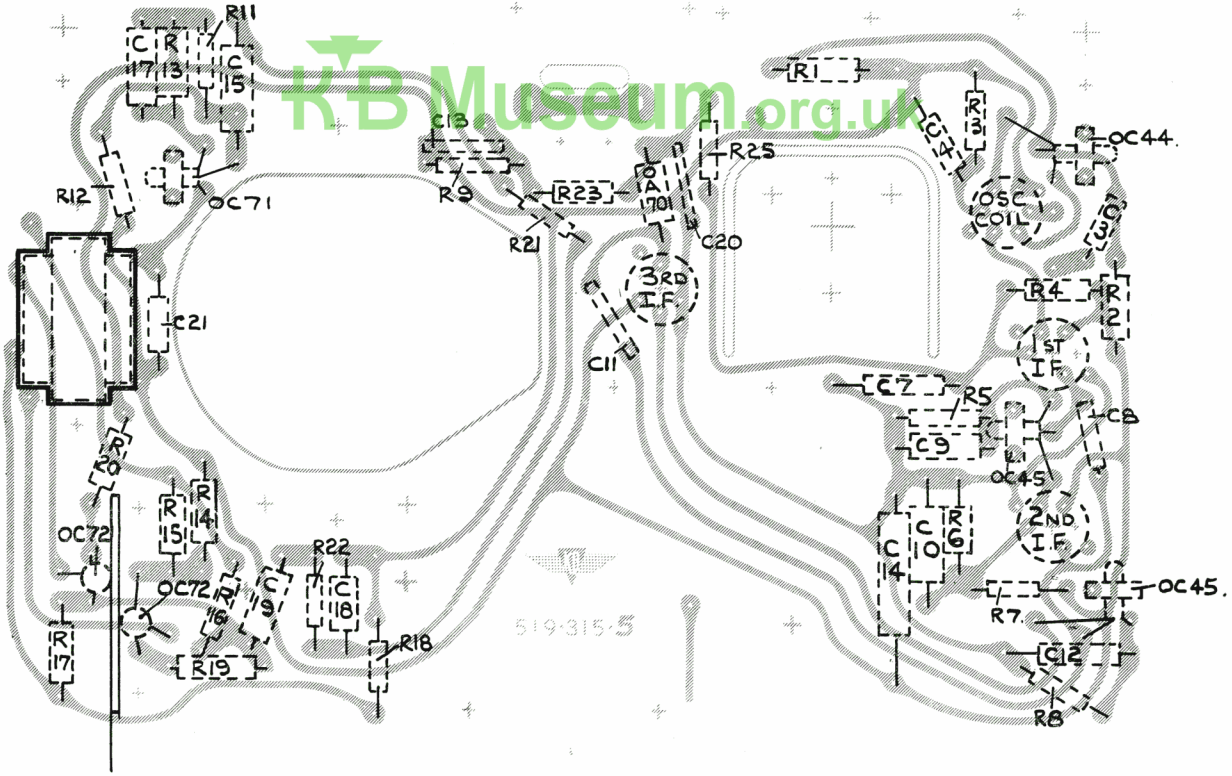
SPARES LIST

PRICES ARE SUBJECT TO ALTERATION WITHOUT NOTICE

Component	Colour Code	Circuit Ref.	Part No.	Price
Cabinet Assembly ...	... ...	...	519/4/B	50/–
COILS:				
Osc. Coil Assembly ...	Green ...	...	519/48	11/6
1st & 2nd I.F. Coil Assembly	White ...	...	519/50	10/–
Final I.F. Coil Assembly ...	Blue ...	...	519/51	15/6
CONDENSERS:				
.003 µF. ± 10% 350 V. ...	... ...	C3, 21	KPM 20	1/–
.004 µF. ± 10% 150 V. ...	... ...	C19	KPM 24	1/–
.01 µF. 150 V. ...	... ...	C4	KPM 19	1/–
.03 µF. + 80 — 20% 500 V.	... ...	C13, 20	KC 113	1/–
.04 µF. 150 V. ...	... ...	C10, 12	KPM 35	1/–
16 µF. 3 V. ...	... ...	C7	KEM 118	4/6
32 µF. 1.5 V. ...	... ...	C15	KEM 122	3/–
50 µF. 6 V. ...	... ...	C17	KEM 119	3/–
50 µF. 12 V. ...	... ...	C14	KEM 120	2/6
20 pF. ± 2% 350 V. ...	... ...	C11	KST 244	1/–
56 pF. ± 2% 350 V. ...	... ...	C8	KST 248	1/–
115 pF. ± 1% 350 V. ...	... ...	C1	KST 243	1/–
360 pF. ± 1% 350 V. ...	... ...	C5	KST 5	1/–
420 pF. ± 1% 350 V. ...	... ...	C6	KST 245	1/–
1250 pF. ± 2% 350 V. ...	... ...	C2	KST 103	1/–
0·25 µF. 200 V. ...	... ...	C9	KT4	2/–
Gang Condenser	... ...	...	505/210/1	17/6
Knob Assembly	... ...	...	505/132	7/–
Pointer	... ...	...	505/188	6d.
Handle Assembly	... ...	...	480/142/B	5/–

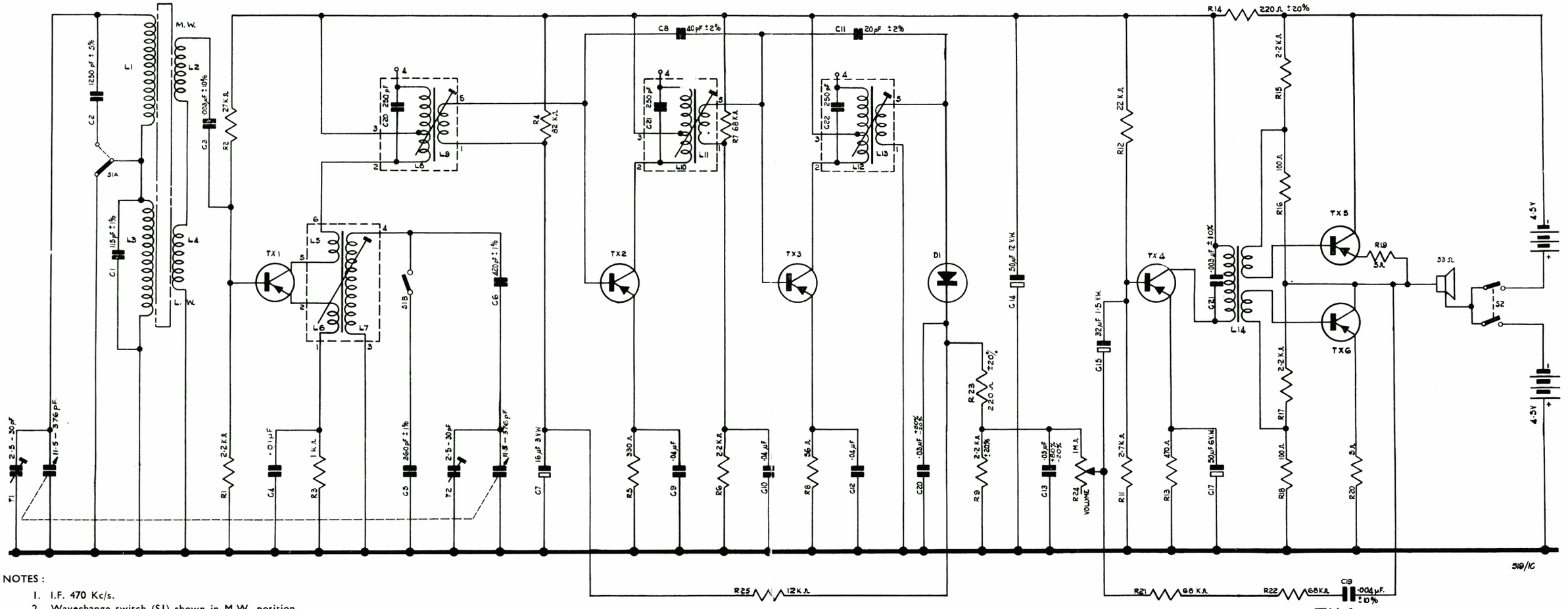
Component	Colour Code	Circuit Ref.	Part No.	Price
4 Pin Plug	... ...	...	519/206	6d.
Battery Plug & Lead Assy.	... ...	...	519/125	1/6
Potentiometer 1 MΩ ...	... ...	...	457/251/5	5/6
Push Button Unit	... ...	...	457/123	5/6
RESISTORS				
5 Ω ± 10% ½ W. ...	... ...	R19, 20	R050FEH	1/–
56 Ω ± 10% ½ W. ...	... ...	R8	R560FE	1/–
100 Ω ± 10% ½ W. ...	... ...	R16, 18	R101FEM	1/–
220 Ω ± 10% ½ W. ...	... ...	R14, 23	R221HEM	1/–
330 Ω ± 10% ½ W. ...	... ...	R5	R331FEM	1/–
470 Ω ± 10% ½ W. ...	... ...	R13	R471FEM	1/–
1 KΩ ± 10% ½ W. ...	... ...	R3	R102FEM	1/–
2.2 KΩ ± 10% ½ W. ...	... ...	R1, 6, 15, 17	R222FEM	1/–
2.2 KΩ ½ W. ...	... ...	R9	R222HEM	1/–
2.7 KΩ ± 10% ½ W. ...	... ...	R11	R272FEM	1/–
12 KΩ ± 10% ½ W. ...	... ...	R25	R123FEM	1/–
22 KΩ ± 10% ½ W. ...	... ...	R12	R223FEM	1/–
27 KΩ ± 10% ½ W. ...	... ...	R2	R273FEM	1/–
68 KΩ ± 10% ½ W. ...	... ...	R7,21,22	R683FEM	1/–
82 KΩ ± 10% ½ W. ...	... ...	R4	R823FEM	1/–
Rod Aerial Assembly ...	... ...	...	519/30	9/6
Scale	... ...	...	519/200	3/3
Speaker Assembly ...	... ...	...	505/250/1	28/3
Spring Catch Assembly ...	... ...	...	505/148	6d.
Interstage Trans.	... ...	...	519/83	10/6

PRINTED CIRCUIT



Note—C18 now deleted

TX1 OC44 | TX2 OC45 | TX3 OC45 | D1 OA70 | TX4 OC71 | TX5 OC72



NOTES :

1. I.F. 470 Kc/s.
2. Wavechange switch (S1) shown in M.W position.
3. All Resistors are ± 10% ½W. unless otherwise stated.
4. All Condensers are ± 20% 150V.W. unless otherwise stated.
5. C8 is now 56pF.
6. C9 is now 0·25μF.

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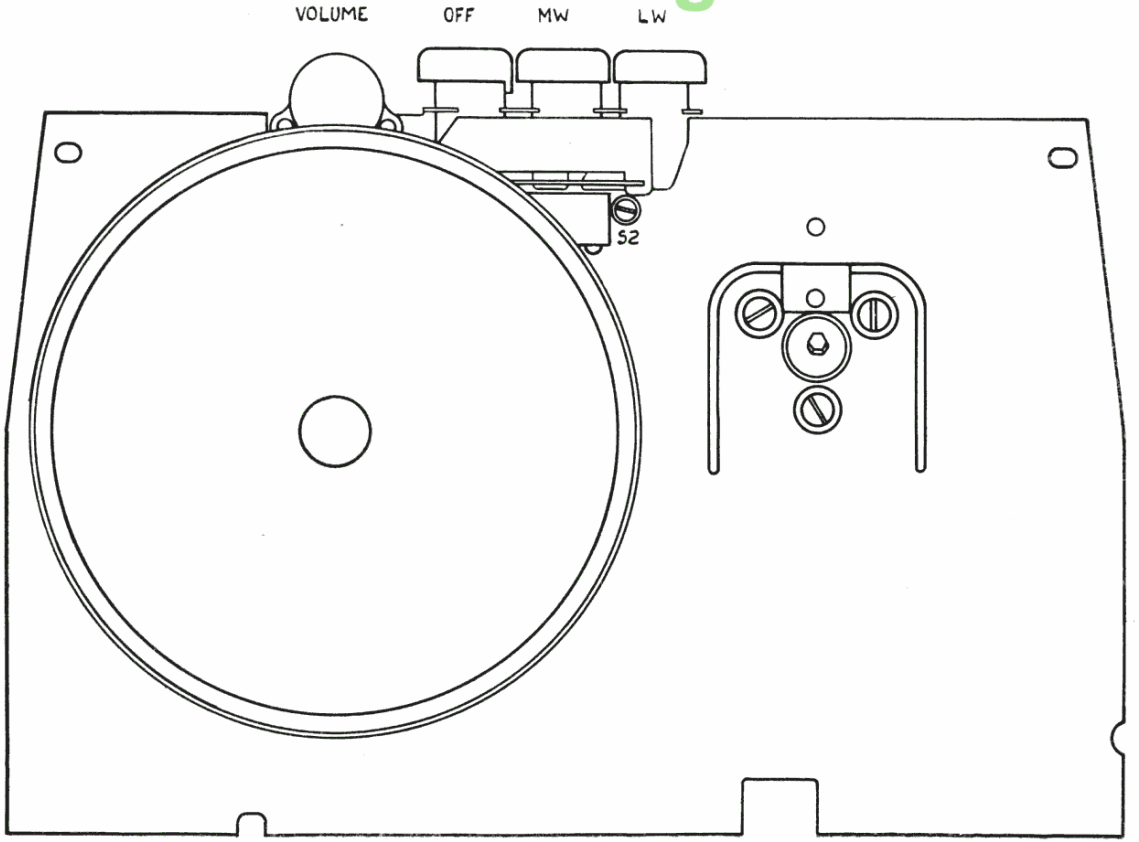
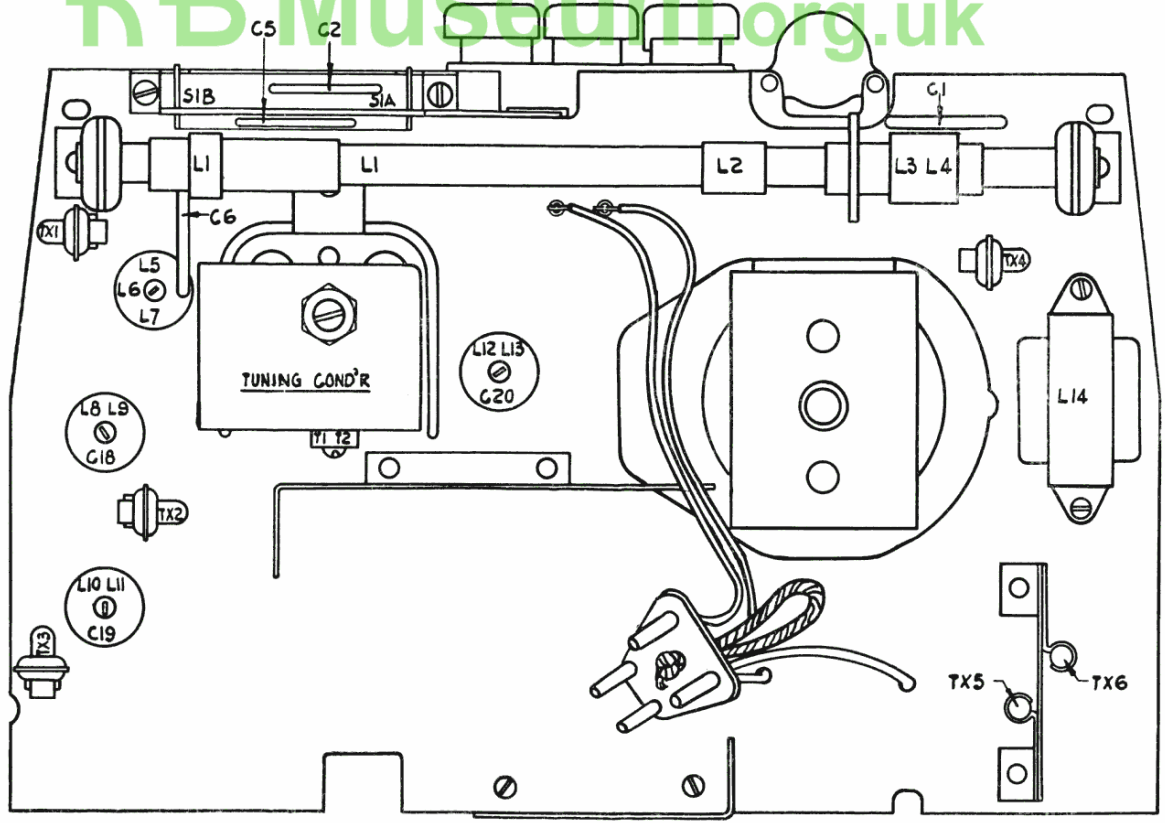
FRONT OF CHASSIS



NOTE : PRINTED CIRCUITRY
DETAILS SHOWN SEPARATELY

REAR OF CHASSIS



NOTE :- PRINTED CIRCUITRY
DETAILS SHOWN SEPARATELY