HACKER "HERALD" MODEL RP10

SERVICE MANUAL

INCORPORATING CHANGES FROM SERIAL NO. 20,0001 UPWARDS

3RD EDITION

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HACKER 'HERALD' MODEL RP10

1. GENERAL DESCRIPTION

The Hacker Herald model RP10 transistor portable is a battery operated medium and long wave A.M. broadcast receiver having seven transistors and two crystal diodes. It differs from its predecessor mainly by the introduction of the very latest R.F. transistors giving an even better sensitivity on the many non-local stations obtainable on this model, and the latest version uses a vented cabinet which is able to deal with the extended frequency range of the later model.

It is designed as a high quality domestic receiver with an unusually high standard of reproduction, provided by the use of a large loudspeaker having improved sensitivity operated in an acoustic chamber and an audio amplifier of one watt output.

Provision is made both for a car aerial socket and an audio output socket for feeding a tape recorder or a high quality amplifying system.

Versions in alternative finishes and colourings are available.

2. TECHNICAL DESCRIPTION

Operating Controls

1. Combined volume and on/off switch control.
2. Tone control, giving a flat response in the low position and a lifting treble response in the medium position. In the high position there is a further increase of treble with a bass increase in addition.
3. Wavechange switch.
4. Tuning control.

Special Features

1. Car aerial input socket.
2. Audio output socket for tape or Hi-fi amplifier.

Transistors and Crystal Diodes

AF 117 Self oscillating mixer
AF 117 I.F. amplifier
AF 117 I.F. amplifier

Transistors and Crystal Diodes cont'd..

OC 71 A.F. amplifier
OC 81D A.F. driver
OC 81 } Single ended push pull output stage
OC 81 } Matched pair
OA 79 Clamping diode
CG 64H A.G.C. and detector diode

Wavebands: Long wave 1000 – 1850 metres
Medium wave 190 – 560 metres

Battery Consumption (measured at Zero volume)
approx. 12 – 14 M/A per battery

Output: Approximately 1 watt

Batteries: Two P.P.9 Ever Ready (or equivalent 9v)

Dimensions: 12" x 8½" x 4½"

Weight: 8½ lb. with batteries

Speaker: 8" x 5" high impedance (30 ohm)

Aerial: Ferrite rod 10" long

3. REMOVAL FROM CASE

The back of the receiver is easily removed by laying it face down on a soft surface and pushing the two buttons on the underneath side. The back, being spring loaded, will then lift itself free for removal. The batteries and their wooden retaining bar must then be removed.

Three screws secure the chassis in the cabinet and must be removed to enable the chassis to be lifted at the rear end and extracted.

Should it be necessary to remove the turn-table in the event of damage; the fixing screws are accessible through the hole on the underside.

The speaker leads are fitted with sockets and may be removed by simply pulling off the speaker tags. *NOTE*:–When replacing the chassis, plug the speaker leads on, before offering into the cabinet.

4. REPLACEMENT OF COMPONENTS

Speaker

This operation is simple and the initial operation should be studied from the previous chapter.

When replacing the nuts securing the speaker, they must be tightened gradually at alternate corners of the speaker frame and none of them over-tightened. Care must be taken to ensure that the washers are replaced between the nuts and speaker and not lost between the cone and the frame.

Ferrite Rods and Aerial Coils

This operation is simple but great care must be taken in handling the very brittle rod.

Having removed the chassis from the case, it is necessary, first to remove the bonding tape securing the coils to the rod. The rod may then be removed by pulling through the rubber grommets set in the fixing brackets. The faulty aerial coil may now be unsoldered and replaced.

After replacement of either the aerial coils or the rod it will be necessary to perform a complete R.F. alignment as dealt with in chapter 6d.

Transistors

The usual caution should be observed with these components i.e. The use of heat shunts being advisable.

NOTE:–After changing any transistor in the tuner unit the I.F. and R.F. alignment must be checked as dealt with in chapter 6c,d. After changing a component or the transistors in the Audio stages, the quiescent currents must be adjusted as in chapter 7.

Condensers and Resistors

Caution must be observed when replacing these that too much heat is not dissipated in either the component or the printed board.

Excessive heat on the printed board will destroy the bonding between the copper circuit and the insulating panel.

I.F. Transformers

After replacement of either whole or part of an I.F. transformer it will be necessary to perform a complete I.F. alignment as described in chapter 6c.

Drive Cord (see Diagram)

The knobs must first be removed by loosening the grub screws

securing them to their respective shafts. The perspex scale should then be removed and the old cord removed.

If a ready made cord is not available one may be made by cutting a length of nylon cord to approximately 40". At each end of this cord a loop must be knotted such that the overall length of the cord when loosely laid out comes to 37".

Hold the receiver with the front panel facing and tuning condenser positioned on the righthand side. Open the tuning condenser fully and pass the new cord through the bottom cutout in the edge of the drum. This end should be then hooked over the spigot provided in the drum.

Thread the cord in an anti-clockwise direction around the pulleys in the front tray, complete two anti-clockwise turns around the tuning drive and pass on around the bottom-right-hand pulley to the rear pulley on the tension bracket.

From here the cord makes one complete *clockwise* turn around the drum and enters via the cut out in the top edge.

The tension spring must now be re-fitted between the rear pulley tension bracket and the chassis spigot.

When replacing the pointer it is important to line this up with the low-frequency end of the scale with the tuning condenser fully closed.

The scale may be replaced with a suitable form of adhesive tape such as "Scotchboy" or similar.

5. CIRCUIT DESCRIPTION

The car aerial socket which is coupled via C1 is switched by S1A onto the top of L1, for M/W and L2, for L/W. L1 and L2 are the aerial coils and are resonated at each end of an extra long length of ferrite rod, producing a highly selective and sensitive internal aerial.

C3 is the variable tuning element for L1 and L2 and C4 and C12 are the M/W and L/W aerial trimming condensers respectively.

The signals are fed to base of T1 via the low impedance taps on L1 via C5.

T1 is a self-oscillating mixer and operates by local oscillations produced by feedback from the collector to emitter via the low impedance windings in L3 (Osc coil).

The oscillator is tuned on M/W by C10, C15 and C16; C10 being the padding condenser, C15 the trimming condenser and C16 the variable tuning element. These same condensers tune the oscillator on L/W with the addition of C13 and C14; C13 being the trimming condenser (L/W *only*).

From T1 the signals are fed via L4 to the base of T2 which is a grounded emitter I.F. amplifier. The base bias varies according to A.G.C. conditions but is held constant in the low signal (no A.G.C.) conditions by the network R6, R11, R15 and RV1.

Collector current is stabilised by R10. CR1 (OA79) provides a variable damping effect on the primary of L4 preventing severe overloading of the I.F. stages on strong signals.

From T2 the signals are fed via L5 to the base of T3 which is also a grounded emitter I.F. amplifier. The base bias is derived from the network R12 and R13. Collector current is stabilised by R14.

From T3 the signals are fed to the detector diode CR3 from which the audio signal and the A.G.C. voltage is taken via R15 and R11 respectively.

RV1 is the volume control and the resulting A.F. developed across it is fed via R17 and C29 to the base of T4. C26, C27 and R15 conform to the usual detector filter network.

T4 is a normal grounded emitter A.F. amplifier the base bias of which is provided by the network R18 and R19.

Treble lift control is achieved at this stage by selective feedback and is made controllable by the rotation of S2A.

The Signals are fed to T5 via C32 from T4 collector.

T5 is an A.F. driver whose collector load is the primary of a phase-splitting transformer L7.

Base bias is provided by R24, R23. Bass lift is achieved here by inserting C38 and R31 via S2B in series with the normal negative feedback line from T7 collector.

T6 and T7 are D.C. coupled to the high impedance speaker (30 ohms). Base bias voltages are provided by R26, RV2, MR1, R27, RV3, MR2.

Cross-over distortion, which is a common result of low battery voltage, is greatly reduced in this output stage by the stabilizing effect of MR1 and MR2 on the quiescent collector current through T6 and T7.

T6 operates negative to chassis potential and T7 positive to chassis.

C24, C28 and C33 are the rail decoupling condensers.

S3 which is placed on the rear of the volume-control is for battery switching.

6. TEST SPECIFICATION

a) Static Voltages:–

		EMMITER	BASE	COLLECTOR
T1	AF117	–1.0V	–1.2V	–7.2V
T2	AF117	–0.7V	–1.0V	–5.4V
T3	AF117	–1.1V	–1.3V	–7.3V
T4	OC71	–0.02V	–0.03V	–4.9V
T5	OC81D	+0.6V	+0.5V	–8.9V
T6	OC81	0V	–0.15V	–9V
T7	OC81	+9V	+8.85V	0V

b) Audio Checks

Equipment required:– O/P meter of 30 ohms impedance or AVO8 on the 2.5V A.C. range across the L/S. Audio generator of 600 ohms O/P impedance. C.R.O.

1. Connect the output meter and C.R.O. across the loudspeaker leads.
2. Connect the audio generator across the volume control and turn to maximum.
3. Set tone control to 'low' and tune receiver to the L.F. end of the M/W band.
4. Inject a 1000 c/s signal and adjust input to give maximum O/P without clipping as indicated on C.R.O.

Maximum power should be approximately 900 m/W
I/P required should be approximately 20 M/V

Frequency Response

1. Repeat (4) as above but decrease I/P to give 50 m/W out at 1000 c/s.
2. Maintain this I/P level and swing generator through 50, 100, 5000 and 10000 c/s.

The change of output should be approximately:–

50 c/s	–3dbs.
100 c/s	–1db.
5000 c/s	–1db.
10000 c/s	–4dbs.

Tone Control Check

Repeat (1) as above and check the figures of list as follows.

	80c/s	5Kc/s	10Kc/s
Med.	–2dbs	+5dbs	+9dbs
High.	+5dbs	+9dbs	+11dbs

c) I.F. Alignment and Sensitivity Check

Equipment required:– O/P meter of 30 ohms impedance (or AVO as in b) R.F. generator 470Kc/s wobbulator across C4 via a 0.1 mfd condenser.

Connect the C.R.O. across the volume control and adjust both instruments to give a response display on the cathode ray tube.

NOTE:–Be careful to keep the I/P as low as practicable to stop A.G.C. giving a false indication.

Adjust the cores of L4, L5 and L6 to obtain an even response curve with ± 3Kc/s points approximately 3dbs down at either side of 470Kc/s centre frequency.

Sensitivity

With the O/P meter across the L/S terminals an I/P of not more than 20 micro-volts from the generator should produce an O/P of 50 m/W.

d) R.F. Alignment and Sensitivity Check

Equipment required:– R.F. signal generator covering 167, 200, 250, 470, 600, 666 and 1500Kc/s. All modulated at 400c/s to a depth of 30%. O/P meter of 30 ohms impedance (or AVO see 6b). Shielded radiating loop.

The last item consists of a length of copper or brass tube of a diameter suitable to clear 3 strands of 20 swg P.V.C. wire or similar. The tube is bent into a circle of approximately 10" diameter and the two ends pass through a copper or brass box approximately 2.5" square, the latter having one open side. The tube is insulated at one end from the box by a suitable rubber grommet and the other end soldered, to the box.

The lead from the signal generator should be screened and the braid soldered to the same point to which the tube is soldered. Three turns of 20 swg P.V.C.C. wire or similar is then fed through the tube and one end also soldered to the box. The other end must go via a 405 ohm 1% resistor to the inner of the screened lead from the generator.

The loop should be placed at 90° to the ferrite rod aerial in the re-receiver with approximately 24" between centres for all R.F. alignments.

M/W Alignment

1. Switch set to M/W, volume control to maximum tone control to minimum.
2. Place O/P meter across L/S leads.
3. Inject via the loop a signal of 600 Kc/s and set the pointer to 500 MTRS on the scale.
4. Tune L3 (oscillator coil) for maximum O/P.
5. Inject via the loop, a signal of 1500 Kc/s and set the pointer to 200 MTRS on the scale.
6. Adjust C15 for maximum O/P.

   NOTE:– Repeat 5 and 6 until calibration is adequate.
7. Inject via the loop a signal of 600 Kc/s and tune in receiver, adjust M/W aerial coil on the rod for maximum O/P.
8. Inject via the loop a signal of 1500 Kc/s and tune in receiver, adjust C4 for maximum O/P.

   NOTE:–Repeat 7 and 8 until no further improvements can be made.

L/W Alignment

1. Switch set to L/W, volume and tone control as for M/W.
2. Using the light programme as a signal source adjust pointer to 1500 MTRS (200 Kc/s) and adjust C13 for maximum O/P.
3. Inject via the loop a signal of 167 Kc/s and tune receiver to 1800 MTRS. Adjust L/W aerial coil on rod for maximum O/P.
4. Inject via the loop a signal of 250 Kc/s and tune receiver. Adjust C12 for maximum O/P.

   NOTE:–Repeat 3 and 4 until no further improvements can be made.

After completion of R.F. alignment is necessary to fix the aerial coils to the rod with a suitable adhesive tape i.e. 'Speedfix'.

M/W Sensitivity Check

Inject via the loop signals of 1500, 1000 and 666 Kc/s and tune receiver for maximum O/P. The input required for 50 m/W should not exceed 1 m/W.

L/W Sensitivity Check

Inject via the loop signals of 167 and 250 Kc/s and tune in receiver for maximum. The input required for 50 m/W should not exceed 1½ m/V.

7. FAULTS, CAUSES AND CORRECTIONS

C29 A.F. Coupling Condenser, 8 mfd. Short Circuit

This fault produces distortion only when tuning to the centre carrier of strong signals.

C19 A.G.C. Decoupling Condenser, 8 mfd. Short Circuit

This fault may produce either intermittent operation and low I.F. gain or instability.

Low Batteries

Although the circuitry has been designed to make the most use of the battery life, low batteries are still a common cause of distortion and should be changed if either falls below 6 volts.

Accidental mal-adjustment of RV2 or RV3

Since these components adjust the quiescent current in the O/P transistors any mis-balance will produce severe distortion. They may be re-adjusted as follows:–

Remove the wire link adjacent to MR1 and MR2 and place an 0-10 M/A or AVO8 meter across the break. RV2 should then be adjusted to give a reading on the indicator of 3 M/A. The link must then be replaced.

Remove the wire link adjacent to RV3 and place the indicator across the break, this time adjusting RV3 to give a reading of 3 M/A.

NOTE:–It is important that this adjustment is done as accurately as available equipment will allow. Ideally the two links should be replaced by two measuring devices and RV2 and RV3 adjusted together.

Instability and low gain on L/W

L/W aerial coil winding open circuit.

8. LIST OF SPARES AND PRICES

(PLEASE STATE SERIAL NUMBER WHEN ORDERING)

ITEM	C.C.T. REF.	TYPE		PRICE	DRG. NO.
Speaker	L/S 1	Goodman	8" x 5" ellip. T33/5808/30 30 ohms	35/- + P/T	
W/C Switch	S1, A, B, C, D		4 Pole 2-Way	4/6	B/10/40
T/C Switch	S2, A, B		2 Pole 3-Way	4/6	O/10/39
Vol. Control	RV1		5K ohms log. + on/off switch	6/-	
Osc. Coil	L3		P50/1F or P55/1D	6/-	
1st I.F. Transformer	L4		T81/JK or T41/1E	7/6	
2nd I.F. Transformer	L5		T82/JK or T41/2E	7/6	
3rd I.F. Transformer	L6		P90/3D or T4/3C	10/-	
4 Way Trimmer	C4, 12, 13, 15		4 x 340 pf S12-04	5/-	
Tuning Condenser	C3, 16		2 x 410 pf C77/22/30 D41/03/7 2 x 18/0075	18/6	
Transistors	T1, T2, T3 T4 T5 T6, T7	Mullard Mullard Mullard Mullard	AF117 OC71 OC81D OC81	9/6 6/6 8/- 16/- pr.	
Crystal Diodes	CR1 CR3	Mullard Supplied with 3rd I.F.T.	OA79	3/-	
Electrolytic	C17	T.C.C.	2mfd 300V	1/-	
Condensers	C19, 29, 32	T.C.C.	8mfd 50V	1/-	
"Elkmold"	C24, 33, 34, 35 C28	T.C.C. T.C.C.	100mfd 12V 300mfd 12V	1/2 1/3	
Ferrite Rod			10"	4/-	
Driver Transformer	L7		C543	9/-	
M/W Aerial Coil	L1		-	3/6	
L/W Aerial Coil	L2		-	3/6	
Rectifiers	MR1 and MR2	Westalite	819	7/6	

9. MODIFICATIONS

1. Models prior to Serial Nos. 20,600 had an 82K ohms resistor across the oscillator tank winding when the set was switched to M/W. A 3.9 ohms resistor was also in series with the emitter of T.1.

   In models after 20,600 these were removed and a crystal diode CR.3 (OA79) added in the collector circuit, R.7 being changed to 390 ohms to 680 ohms.

2. Models after Serial Nos. 22,000 had alternative I.F. transformers as follows:–

   1st T81/GH changed to T81/JK
   2nd T82/EH changed to T82/JK
   3rd P90/3C changed to P90/3D

   R.5 is changed from 1K ohms to 100 ohms and an additional resistor R.32 (47K) placed across the primary of L.4.

   The turns ratio of the L/W aerial coil was also changed but in the case of replacement it will just be necessary to quote (L/W aerial coil).

3. Models from Serial Nos. 38,000 onwards. This new receiver differs from the previous models by the following:–

   (a) A new printed board is used.
   (b) The oscillator coil is changed from P50/1F to P55/1D
   (c) The 1st I.F. transformer " " T81/JK to T41/1E
   (d) The 2nd " " " " T82/JK to T41/2E
   (e) The 3rd " " " " P90/3D to T4/3C
   (f) A 470 ohm resistor and a .04 mfd condenser known as R.34 and C.41 respectively, have been added to decouple the 3rd I.F. H.T. supply.
   (g) R.32 (82K) is increased to 120K.
   (h) C.24 (100 mfd) is increased to 300 mfd.

12. D.C. RESISTANCES OF WINDINGS, RP10

(All Readings taken in Situ)

L.1	(R.C.V.R. Switched to M/W)	overall –	0.8 ohm
		tap to tap –	0.75 ohm
L.2	(R.C.V.R. Switched to M/W)	overall –	3.2 ohm
		tap to tap –	2.9 ohm
L.3		Collector winding –	0.2 ohm
		Tank winding –	1.5 ohm
		Em winding –	0.1 ohm
L.4		Prim.	5.0 ohm
		Sec.	5.0 ohm
		Sec. Tap	0.35 ohm
L.5		Prim.	7.2 ohm
		Prim. Tap	2.5 ohm
		Sec.	7.2 ohm
		Sec. Tap	0.4 ohm
L.6		Prim.	4.0 ohm
		Prim. Tap	1.0 ohm
		Sec.	0.7 ohm
L.7		Prim.	4200 ohm
		Sec. 1 Meter lead + to base	25 ohm
		Sec. 2 Meter lead + to base	25 ohm

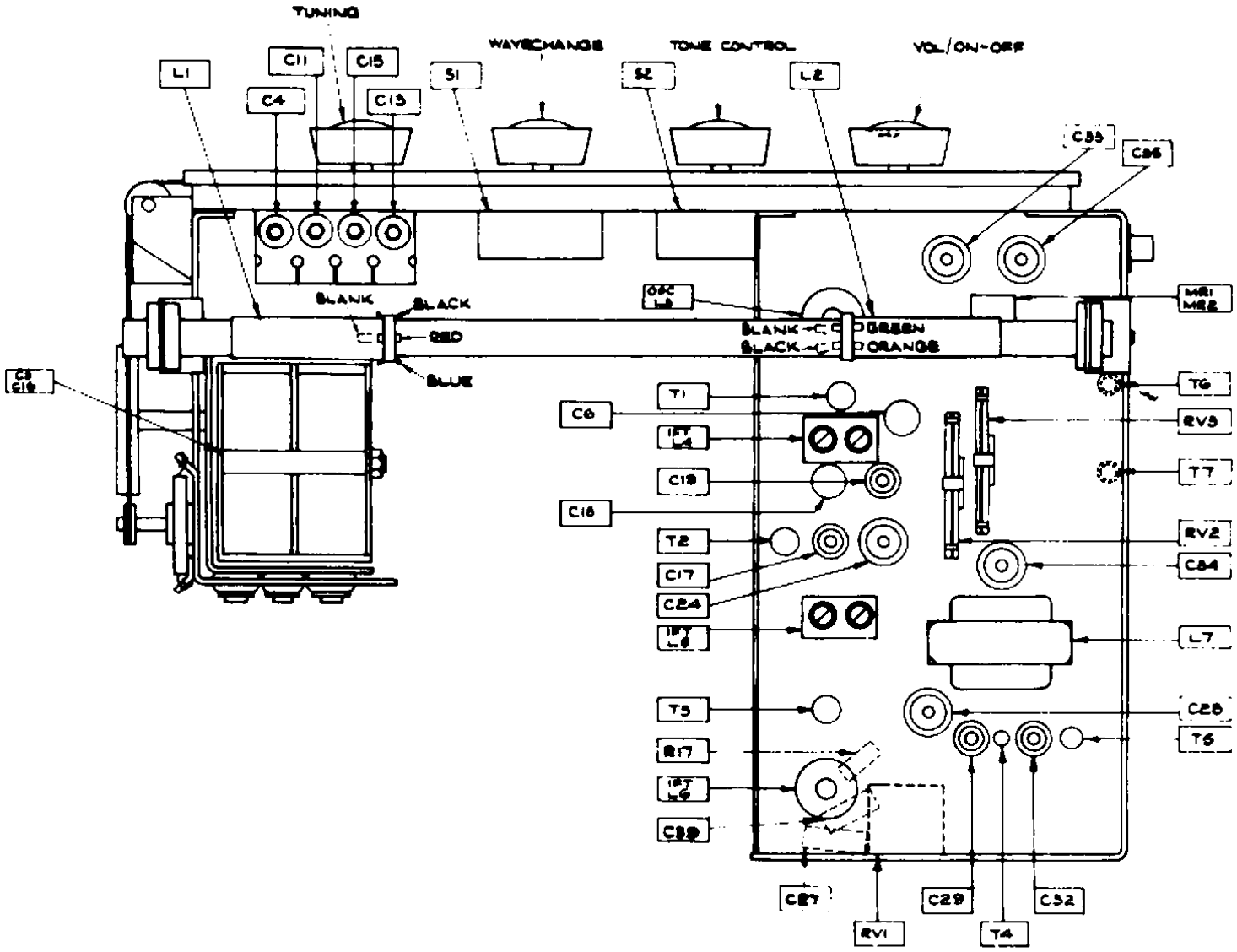
CIRCUIT COMPONENT LIST.

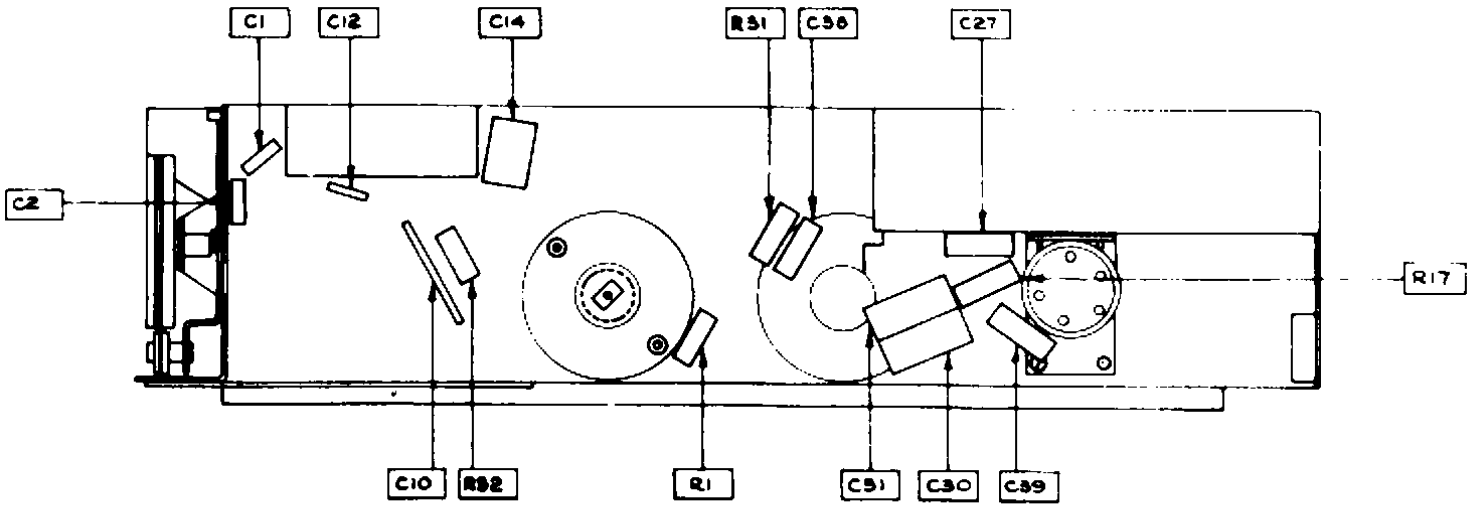
REF.	VALUE	TOL%	REF.	VALUE	TOL.
R1	180K	10	RV2	150Ω	
R2	33K	10	RV3	150Ω	
R3	6·8K	10			
R4	1KΩ	10			
R5	1KΩ	10			
R6	56K	10	C1	15 pf	10%
R7	680Ω	10	C2	47 pf	10%
R8		10	C3	410 pf	
R9	2·2K	10	C4	3-40 pf	
R10	680Ω	10	C5	·01	
R11	8·2K	10	C6	·1	
R12	22K	10	C7	·02	
R13	4·7K	10	C8	270 pf	
R14	1K	10	C9	270 pf	
R15	470Ω	10	C10	480 pf	1%
R16	3·3K	10	C11	3-40 pf	
R17	3·3K	10	C12	80 pf	5%
R18	10K	10	C13	3-40pf	
R19	180K	10	C14	350 pf	2%
R20	5·6K	10	C15	3-40pf	
R21	470Ω	10	C16	410 pf	
R22	470Ω	10	C17	2 mfd	300v
R23	180K	10	C18	·1	
R24	10K	10	C19	8 mfd	50v
R25	3·9K	10	C20	270pf	
R26	2·2K	10	C21	270pf	
R27	2·2K	10	C22	·04	
R28	3·3Ω	± 1/2Ω	C23	·04	
R29	3·3Ω	± 1/2Ω	C24	100 mfd	12v
R30			C25	250pf	
R31	470K	10	C26	·01	
R32		10	C27	·02	
R33	180K	10	C28	300 mfd	
R34	470Ω	10	C29	8 mfd	50v
			C30	·1	
			C31	·1	
			C32	8 mfd.	50v
RV1	5K		C33	100 mfd	12v

GENERAL COMPONENT LIST.

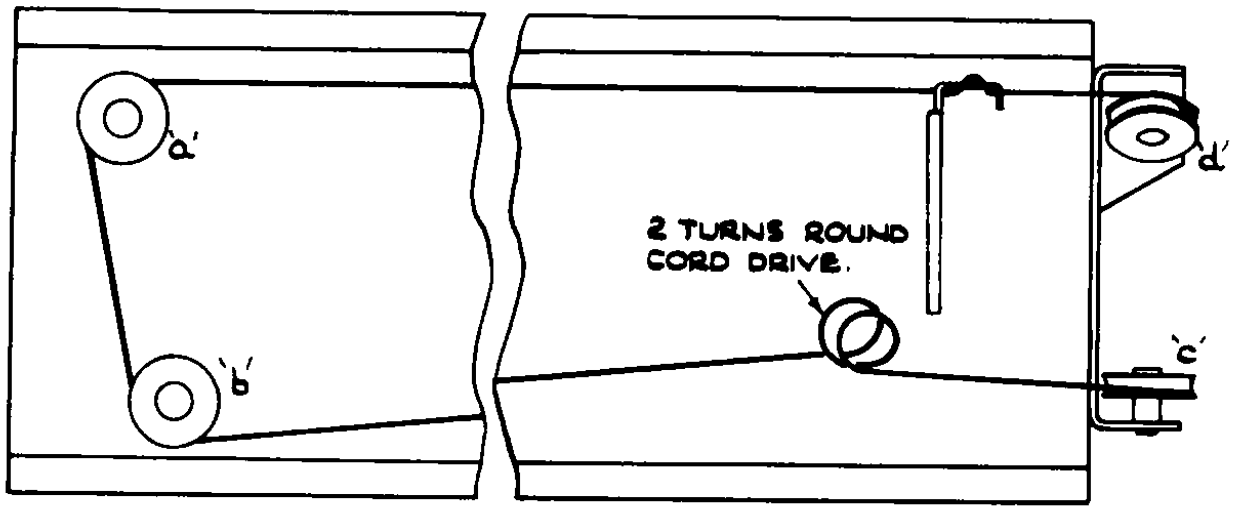
REF.	VALUE	TOL.
C34	100 mfd	12v
C35	100 mfd	12v
C36	·005	
C37	·005	
C38	·005	10v
C39	·02	
C40	25	10%
C41	·04	
CR1	CRYSTAL DIODE OA79.	
CR3	CRYSTAL DIODE OA90.	
T1	TRANSISTOR AF117	
T2	TRANSISTOR AF117	
T3	TRANSISTOR AF117	
T4	TRANSISTOR OC71	
T5	TRANSISTOR MATCHED PAIR OC81D / OC81.	
T6	TRANSISTOR MATCHED PAIR OC81D / OC81.	
T7	TRANSISTOR MATCHED PAIR OC81D / OC81.	
L1	AERIAL COIL. MEDIUM WAVE.	
L2	AERIAL COIL. LONG WAVE.	
L3	OSCILLATOR COIL. P55/1D.	
L4	1st I.F TRANSFORMER T41/1E.	
L5	2nd I.F. TRANSFORMER T41/2E.	
L6	3rd I.F. TRANSFORMER T41/3C.	
L7	DRIVER TRANSFORMER HINCHLEY 10430.	

REF.	VALUE
MR1 / MR2	METAL RECTIFIER WESTALITE PRINTED CIRCUIT VERSION 5D819
L.S.1	LOUDSPEAKER 8"X5" ELIPTICAL T33/5808/30. 4 RIBBED CHASSIS. FLUX.DENSITIY 10500. GAUSS. CONE RES. 110 C.P.S IMP. MEAN VALUE 27Ω (MIN 25Ω MAX 30Ω) MARKED 30Ω.
S1,A,B,C, D.	WAFER SWITCH 4p. 2w. TO HACKER DRG. B/10/40. ISS. 1.
S2. A,B.	WAFER SWITCH 2p. 3W. TO HACKER DRG. 0/10/39. ISS. 1.
S3	PART OF RV1.
B1 / B2	EVER READY BATRYMAX. PP9. 9 VOLTS.

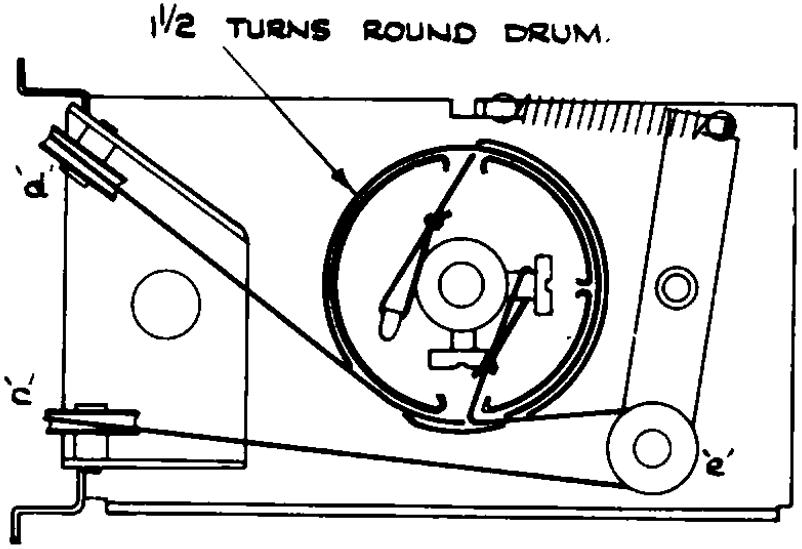




REAR VIEW
FRONT PANEL

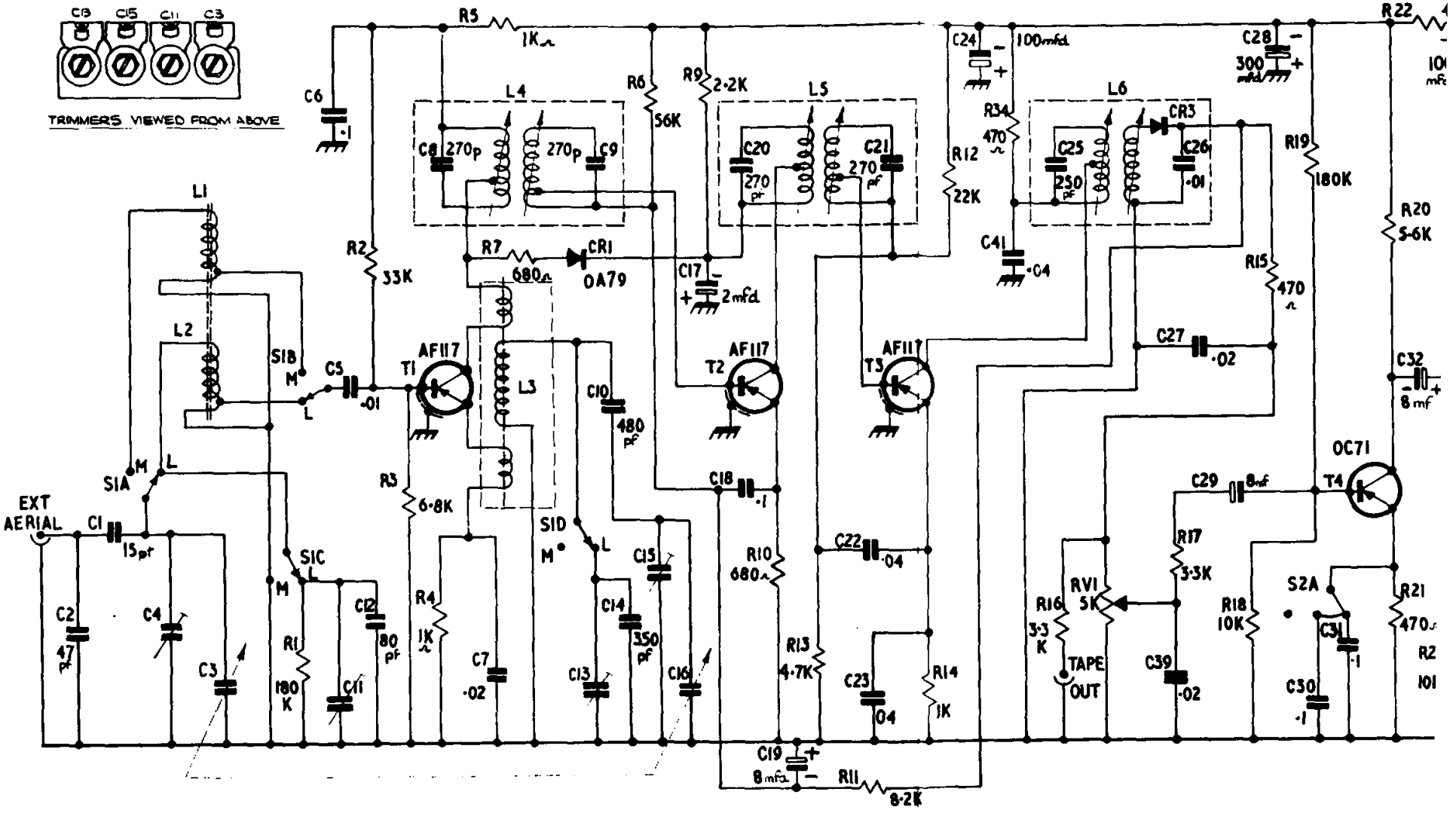


FRONT VIEW

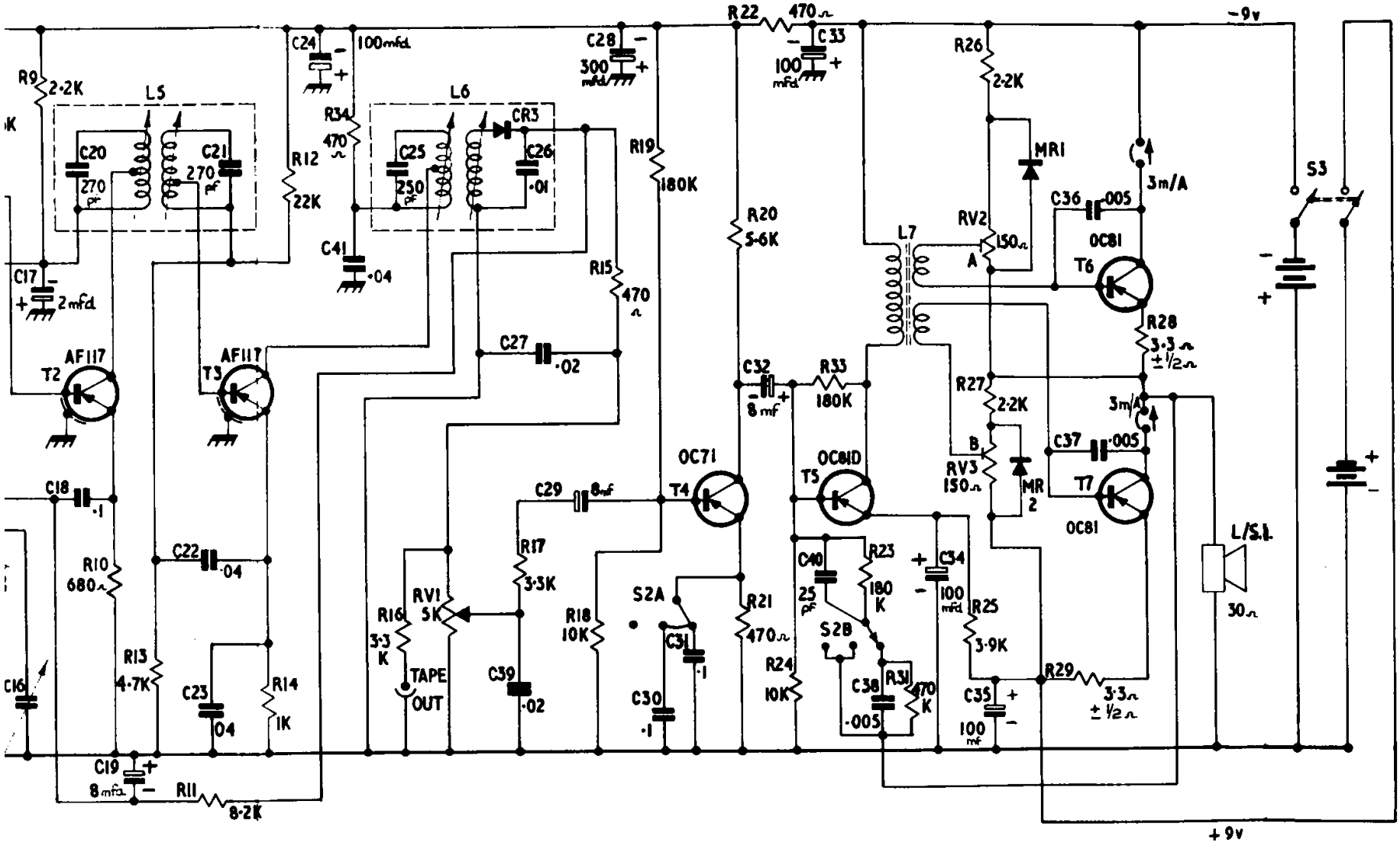


SIDE VIEW

DRAWING SHOWS CORD AND POINTER SET UP (APPROX)
FOR L.F. END OF SCALE (CAPACITOR VENTS CLOSED.)



THIS CIRCUIT IS APPLICABLE TO SERIAL No.S 20,001 ONWARDS.



HACKER RADIO LTD.					
CIRCUIT DIAGRAM. RP10. TRANSISTOR PORTABLE.					
DRN	JMH	CKD.	GJC	DRG.NO.	CD/10/77.