PAM TRANSISTOR PORTABLE Model 710

General Description : Two-waveband, portable superheterodyne receiver using eight transistors and operating from 6-volt battery supply. Ferrite-rod aerial. Receiver uses printed-circuit technique.

Power Supply : Four 1·5-volt cells. Suitable types are: Ever Ready U2, Drydex T20, Vidor V0002, G.E.C. BA6103, Petrix 601. Consumption, 9 mA. with no signal. Since the output stages are operated in push–pull Class B conditions, the battery current will increase greatly with increasing output, and should be about 35 mA. at 50 mW. output.

Wavebands : M.W.–L.W.

Transistor Types and Functions :

Code	*Function*	*Type*	*Alternative Type*	*Collector, volts*	*Collector, mA.*	*Base, volts*	*Emitter, volts*
V1	Oscillator	V6/R3	V6/R6	−4·1	0·70	−1·35	−1·6
V2	Mixer	V6/R3M	V6/R6M	−5·7	0·35	—	—
V3	1st I.F.	V6/R3	V6/R6	−6·0	0·22	−1·45	−1·35
V4	2nd I.F.	V6/R2	V6/R3	−6·0	0·50	−1·45	−1·3
V5	Detector	V6/R2	V6/R3	−5·2	0·16	−1·55	−1·4
V6	A.F. amplifier	V10/30A	V10/50A	−5·4	6·0	−0·6	−0·4
V7	Output	V10/30A	} V10/15A or	−6·0	0·6	−0·2	−0·1
V8	Output	V10/30A	} V10/50A	−6·0	0·6	−0·2	−0·1

Measurements taken on M.W. band with no signal input, gang fully meshed, and using Avo Model 8 testmeter (20,000 ohms/volt).

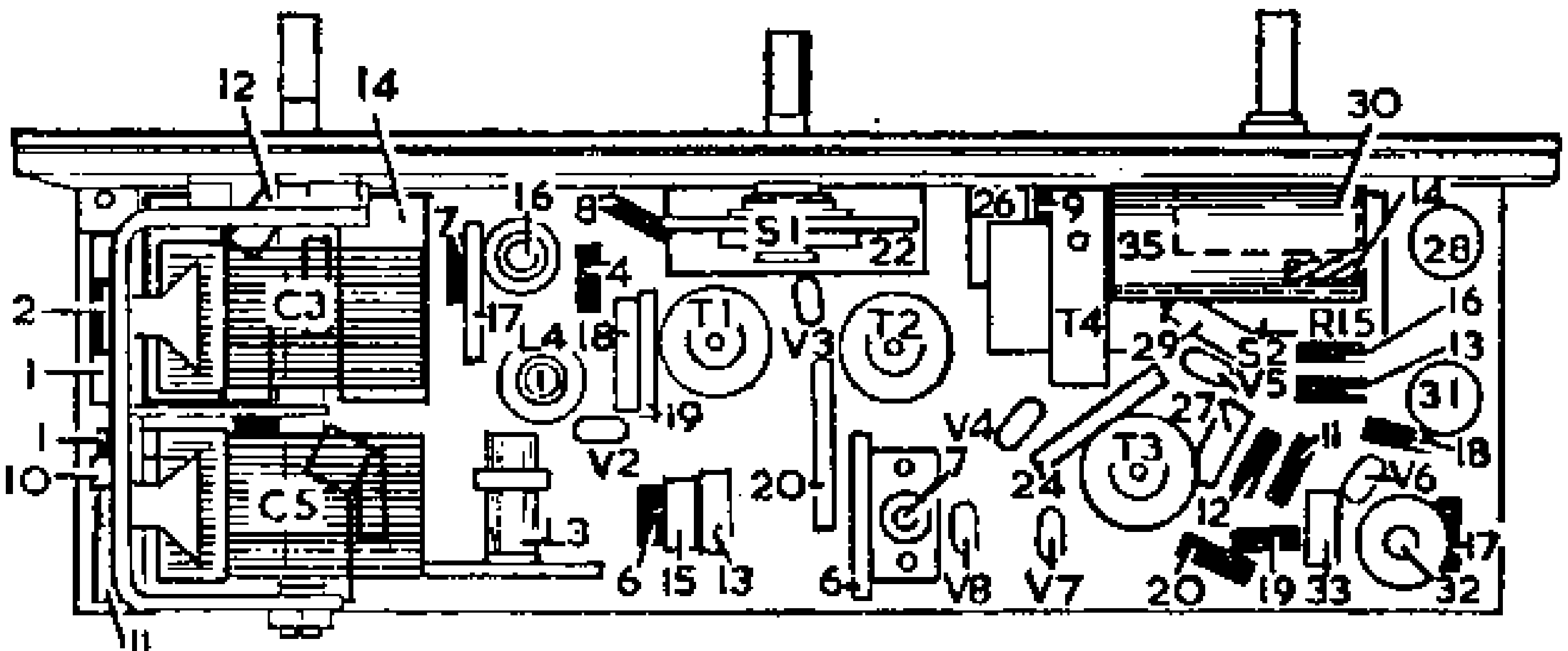
Base and emitter current values are not given, since the introduction of a meter into either of these circuits would alter the base-emitter bias and thus affect the measurement. In general, the base-to-emitter D.C. potential should not exceed 250 mV.

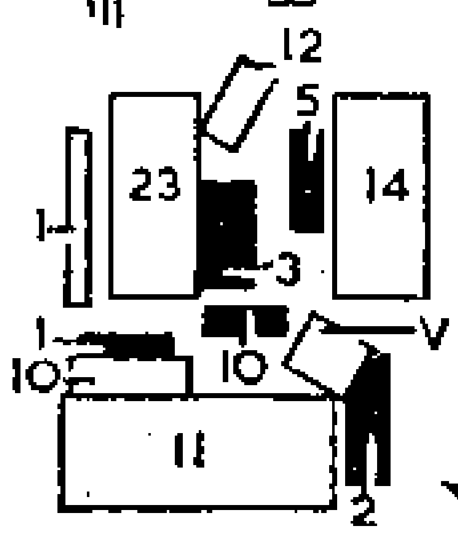
Servicing Notes : The receiver should operate satisfactorily down to a battery voltage of 4 volts, and in checking a faulty receiver this should be measured first. A transistor fault is unlikely and other components should be carefully investigated before suspecting a transistor fault. It is most important to note that a transistor may be permanently damaged if the base is connected to the negative side of the battery, or if continuity tests are attempted with the transistor in circuit. If a transistor is to be removed or replaced in the circuit a heat trap, such as a pair of pliers, should be provided between the soldering-iron and the transistor during soldering.

Generally, fault finding can be carried out on this receiver in the usual way. A test signal should be connected into the circuit via a 0·1-μF. capacitor to ensure that the transistor D.C. conditions are not altered.

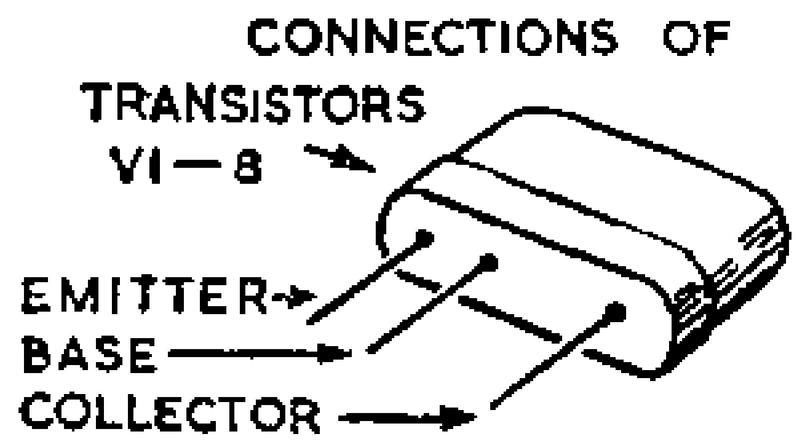
It should be noted that the transistor emitter corresponds roughly to a valve cathode, a transistor base to a valve grid and a transistor collector to a valve anode. The base-input impedance is low (roughly 200–1000 ohms),

NOTE:-RESISTORS SHOWN SOLID BLACK





POSITION OF COMPONENTS BENEATH GANG CONDENSER



and the collector output impedance relatively high (4000–20,000 ohms). The class B output stages are operated in a common collector circuit which is similar to cathode-loaded valve stage and provides a power gain but no voltage gain. The receiver does not have an output transformer but employs a high-impedance centre-tapped loudspeaker (impedance at 400 c/s., 55 ohms per section, 120 ohms total).

Receiver output should be measured by connecting an A.C. voltmeter (e.g., Avometer) on 10-volt A.C. range across the whole of the loudspeaker coil: 2·4 volts reading is then equivalent to 50 mW. output.

If it is necessary to replace either of the I.F. stages, the neutralising procedure, given below, should be followed.

Alignment Procedure : Note that operations (1) to (5) to be made on chassis; (6) to (9) to be made on complete receiver with back door and batteries in position; (6) and (8) should be carried out only if a replacement aerial is fitted. Operations (5) and (9) to be made using a 10-volt meter with a resistance of not less than 10,000 ohms connected between V5 collector and chassis, optimum tuning being indicated by a *minimum* reading on the meter.

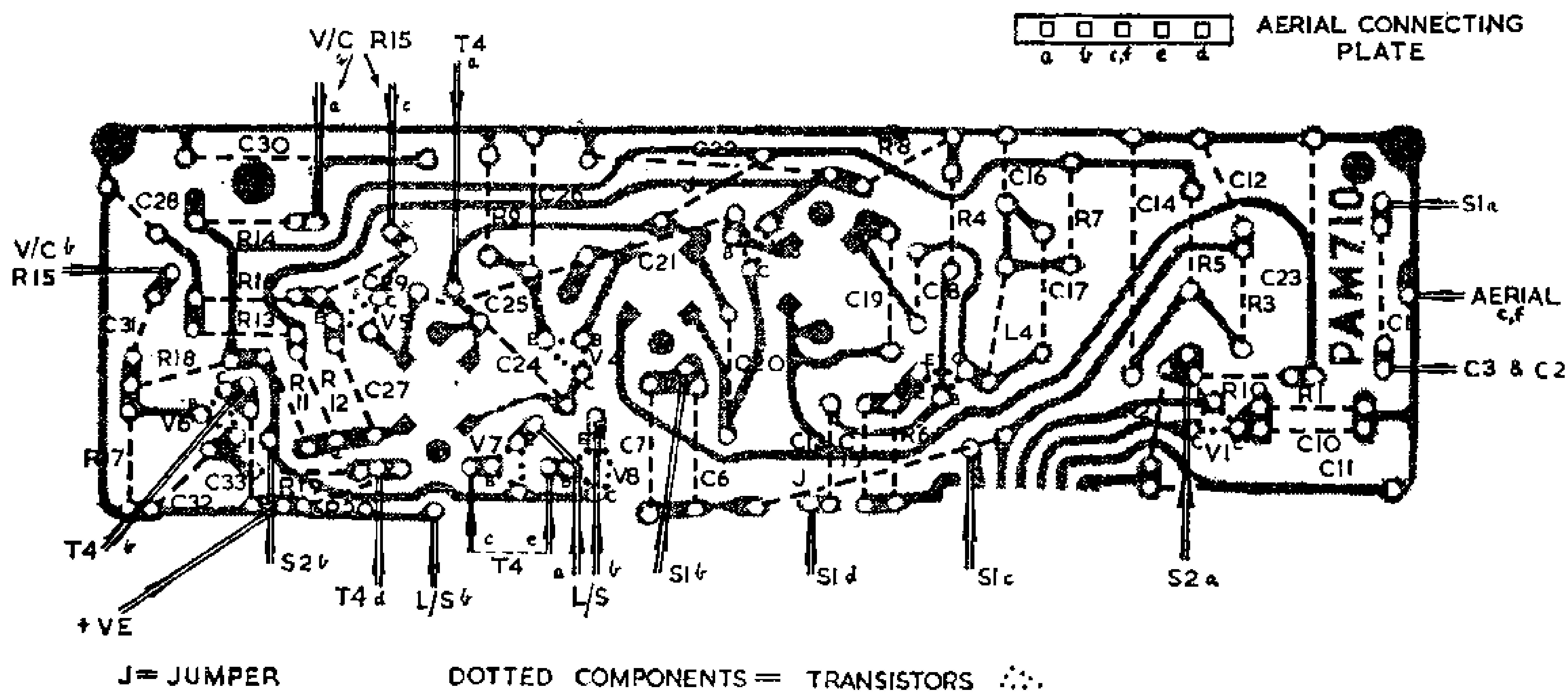
Apply Signal as Below	*Set Controls to*	*Adjust in Order for Maximum Output*
(1) 315 kc/s. between chassis and junction of S1 and C13	L.F. end of M.W.	Ferrite cores of T3, T2, T1 Dust core of L4
(2) As (1) but 600 kc/s.	M.W. 500 m.	Dust core of L3
(3) As (1) but 1500 kc/s.	M.W. 200 m.	C2
(4) Repeat (2) and (3) until calibration is correct		
(5) Connect L.W. aerial—L.W. Light Programme	L.W. 1500 m.	C7 (see note above)
(6) 600 kc/s. injected by allowing generator lead to lie near aerial rod	M.W. 500 m.	Adjust end turns of L2
(7) As (6) but 1500 kc/s.	M.W. 200 m.	C4
(8) Repeat (6) and (7) until tracking is correct. Seal L2 with polystyrene dope		
(9) L.W. Light Programme	L.W.	C8 (see note above)

Neutralising Procedure : *2nd I.F. amplifier :* (1) Connect valve voltmeter (approximate range 1–20 mV.) between V4 base and chassis. (2) Connect signal generator via a 0·1-μF. capacitor between V4 collector and chassis. (3) Connect V2 emitter to chassis via a 0·1-μF. capacitor. (4) Set the signal generator to give an output of approximately 400 mV. at 315 kc/s. (5) Connect first a 33-pF. capacitor from V5 base to V4 base and note valve voltmeter

Circuit Diagram—Pam Transistor Portable Model 710

Capacitors.					
C1	790 pF. (2%)	C13	0·01	C24	2000 pF. (2%)
C2	3–35 pF.	C14	50 (12 v.)	C25	Selected 33 to 68 pF.
C3	523 pF.	C15	0·01	C26	0·1
C4	4–50 pF.	C16	25 (12 v.)	C27	0·01
C5	523 pF.	C17	1200 pF. (2%)	C28	25 (12 v.)
C6	895 pF. (1%)	C18	33 pF. (10%)	C29	0·01
C7	3–50 pF.	C19	1200 pF. (2%)	C30	50 (12 v.)
C8	4–50 pF.	C20	2000 pF. (2%)	C31	5 (12 v.)
C9	270 pF.	C21	Selected 100 to 220 pF.	C32	50 (12 v.)
C10	0·01	C22	1	C33	0·002 (400 v.
C11	50 (12 v.)	C23	50 (12 v.)	C34	0·5
C12	0·04			C35	1

Resistors.			
R1	2200 (10%)	R10	1000
R2	2700 (10%)	R11	33k (5%)
R3	100	R12	2200 (10%)
R4	22k	R13	330 (10%)
R5	2700 (10%)	R14	1000
R6	27	R15	3k (Pot.)
R7	1000	R16	390 (10%)
R8	2700 (10%)	R17	10k (5%)
R9	2700 (10%)	R18	33k (5%)
		R19	33 (10%)
		R20	33 (10%)



reading. Then try in turn 39-, 47-, 56- and 68-pF. capacitors and select that which gives the lowest reading on the valve voltmeter. The lower value capacitor should be used if two capacitors give similar readings. Note that the correct value is expected to lie between 33 and 68 pF.

1st I.F. amplifier : (1) Connect valve voltmeter between V3 base and chassis. (2) Connect signal generator via a 0·1-μF. capacitor between V3 collector and chassis. (3) Connect V2 emitter to chassis via a 0·1-μF. capacitor. (4) Set signal generator to 315 kc/s. to give an output of approximately 400 mV. (5) Connect first a 100-pF. capacitor from V4 base to V3 base and note valve-voltmeter reading. Then try in turn 120-, 150-, 180- and 220-pF. capacitors and select that which gives the lowest reading on the valve voltmeter. Should two capacitors give similar readings, select the lower value. Note that the correct value is expected to lie between 100 and 220 pF.

Printed-circuit Notes: All components except the neutralising capacitors are located on top of the chassis. To avoid damaging printed circuits use a soldering-iron (60 watts maximum) with a small tip when replacing parts. Clean and tin replacement parts, and then melt the circuit solder before insertion into panel. To avoid running into adjoining circuits, use as little as possible. For quick replacement, resistors and capacitors may be replaced by clipping out defective component and soldering the new one to the connecting wire from the original part. Open or damaged sections of the printed circuit can be repaired by soldering a jumper of ordinary wire across the connection points. Where the need arises for testing on the printed-circuit side of the chassis plate, the insulating varnish covering must first be scraped away from the test points.

Replacement of Batteries: When replacing batteries ensure that each battery has the end with the brass terminal placed against the spring contact.

Circuit Modifications : R21 (470 ohms) has been added between slider of volume control and C31. On early receivers a 50-μF. electrolytic capacitor was used for C22: if this requires replacement a 1-μF. paper capacitor is preferable.

Supplement to Electrical Trader,

"TRADER" SERVICE SHEET

1271

PAM 710

Transistorized Battery Portable employing Printed C

EMPLOYING eight Pye transistors, a printed circuit for valve and component connections, and a ferrite rod internal aerial, the Pam 710 is a 2-band all-dry battery portable. The tuning range is 175-568m, with pre-set tuning at 1,500m. It operates from four 1.5V cells.

Release date and original price: March, 1956, £22 14s 10d. Purchase tax and battery extra.

CIRCUIT DESCRIPTION

M.W. aerial coil **L1** is tuned by **C2** which forms one section of the tuning gang. Pre-set L.W. aerial tuning by **L2**, **C4**. Coils **L1** and **L2** are mounted at opposite ends of a length of ferrite rod to form the internal aerial. Outputs from the tuned aerial circuits are fed via low impedance tappings on the coils to mixer transistor **TR1**.

The local oscillator is formed by **TR2** with tuning coil **L5** and reaction coil **L4**. M.W. tuning by **C11**, **C12** and M.W. tracking by **C13**; L.W. pre-set tuning by **C14**, **C15**. Output of **TR2** is injected into **TR1** emitter circuit via **L3**.

TR3 and **TR4** operate as a two-stage earthed-emitter I.F. amplifier with I.F. coils and transformers **L6**, **L7**; **L8**, **L9**; **L10**, **L11**. **TR3** neutralizing by **C21**, and **TR4** neutralizing by **C25**. "Top" I.F. transformer coupling by **C19**.

Intermediate frequency 315 kc/s.

TR5 operates as collector-bend signal detector, being biased to the bottom bend of the characteristic. A.F. component in its output is developed across volume control **R14**, which operates as load resistor, and is passed via **R17**, **C31** to **TR6** which operates in a class A driver stage. I.F. filtering by **C28**, **C29**.

D.C. component of the detected output from **TR5**, as developed across emitter resistors **R15**, **R16**, **R12**, is tapped of **R12** and fed back as A.G.C. bias to **TR4**. Standing bias for **TR4** and **TR5** is also developed across **R12** which together with **R10** and **R11** forms an "H.T." potential divider.

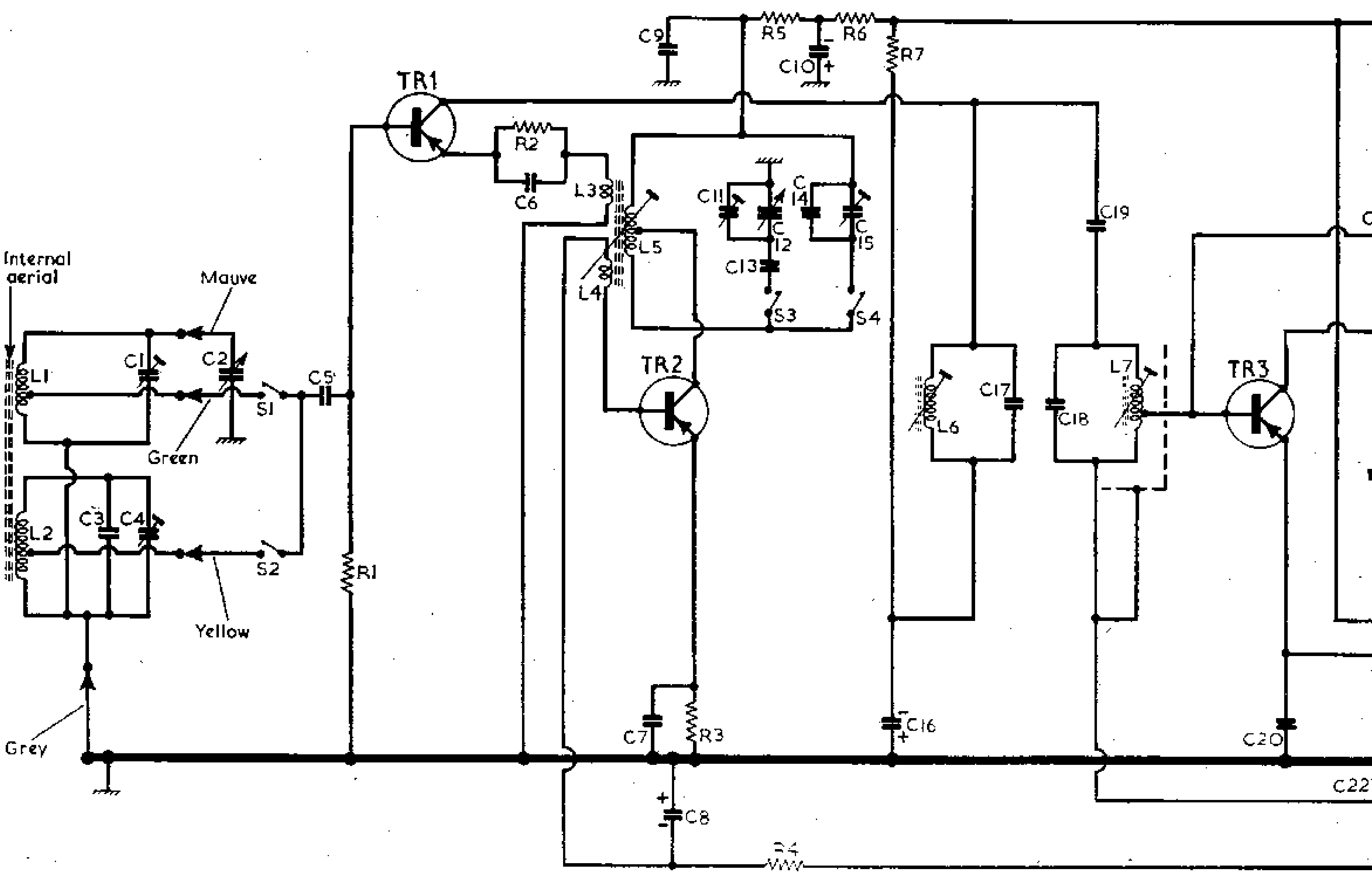
Amplified output from **TR6** is coupled via driver transformer **T1** to **TR7** and **TR8** which operate in a common-collector class B push-pull output stage. The outputs of **TR7** and **TR8** are directly-connected to the centre-tapped high-impedance speaker **L12**. Tone correction by **C33** and **C34**.

GENERAL NOTES

Switches.—**S1-S4** are the M.W./L.W. switches ganged in a single rotary unit on the control panel. This unit is indicated in the rear illustration of the chassis (location reference B1) where the individual switch contacts are identified. Switches **S1**, **S3** close for M.W. operation and **S2**, **S4** close for L.W. operation.

Battery.—Four separate 1½V cells are employed and should be inserted in their holders on the receiver back cover with the brass battery terminals pressing against the spring contacts. Battery types recommended by the manufacturers are: Ever Ready U2; Drydex T20; Vidor V0002; G.E.C. BA6103; Pertrix 601.

Transistors.—As an aid to following the transistor circuitry in the circuit diagram it should be remembered that the transistor emitter, base and collector correspond to the cathode, grid and anode of



Circuit diagram of the Pam 710 transistor portable. **TR1** operates as mixer and **TR2** as local oscillator. I.F. amplifiers T

Circuit Chassis

Appearance of the Pam 710.

a triode valve. However, whereas the valve is a voltage operated device with a high grid input impedance, the transistor is essentially a current operated device with a low base input impedance (200-1,000Ω) and a relatively high collector output impedance (4-20kΩ). As the transistors used in this receiver are p-n-p types (indicated by the direction of the arrow on the emitter) it should also be noted that the voltages applied to it are in the oppo-

(Continued column 1 overleaf)

COMPONENT VALUES AND LOCATIONS

CAPACITORS		Values	Locations
C1	M.W. aerial trim	50pF	A2
C2	M.W. aerial tuning	523pF	A1
C3	L.W. tuning	270pF	A2
C4	L.W. tuning	50pF	A2
C5	TR1 base coupling	0·01μF	B2
C6	TR1 bias decoup.	0·01μF	B2
C7	TR2 bias decouplings	0·005μF	A2
C8	TR2 bias decouplings	50μF	A2
C9	H.T. decoupling	0·04μF	A1
C10	H.T. decoupling	50μF	A1
C11	M.W. osc. trim.	35pF	A1
C12	M.W. osc. tuning	528pF	A1
C13	M.W. osc. tracker	790pF	A2
C14	L.W. osc. tuning	895pF	B2
C15	L.W. osc. tuning	50pF	C2
C16	H.T. decoupling	25μF	B1
C17	I.F. tuning	1,200pF	A2
C18	I.F. tuning	1,200pF	B2
C19	I.F. coupling	33pF	B2
C20	TR3 emitter decoup.	1·0μF	B2
C21[1]	TR3 neutralizing	180pF	B2
C22	Bias decoupling	50μF	A2
C23	I.F.T. tuning	0·002μF	B2
C24	TR4 emitter decoup.	0·1μF	C2
C25[1]	TR4 neutralizing	47pF	C2
C26	I.F.T. tuning	0·002μF	C2
C27	H.T. decoupling	50μF	D1
C28	I.F. by-passes	0·01μF	C2
C29	I.F. by-passes	0·01μF	D1
C30	TR5 emitter decoup.	25μF	D1
C31	A.F. coupling	5μF	D1

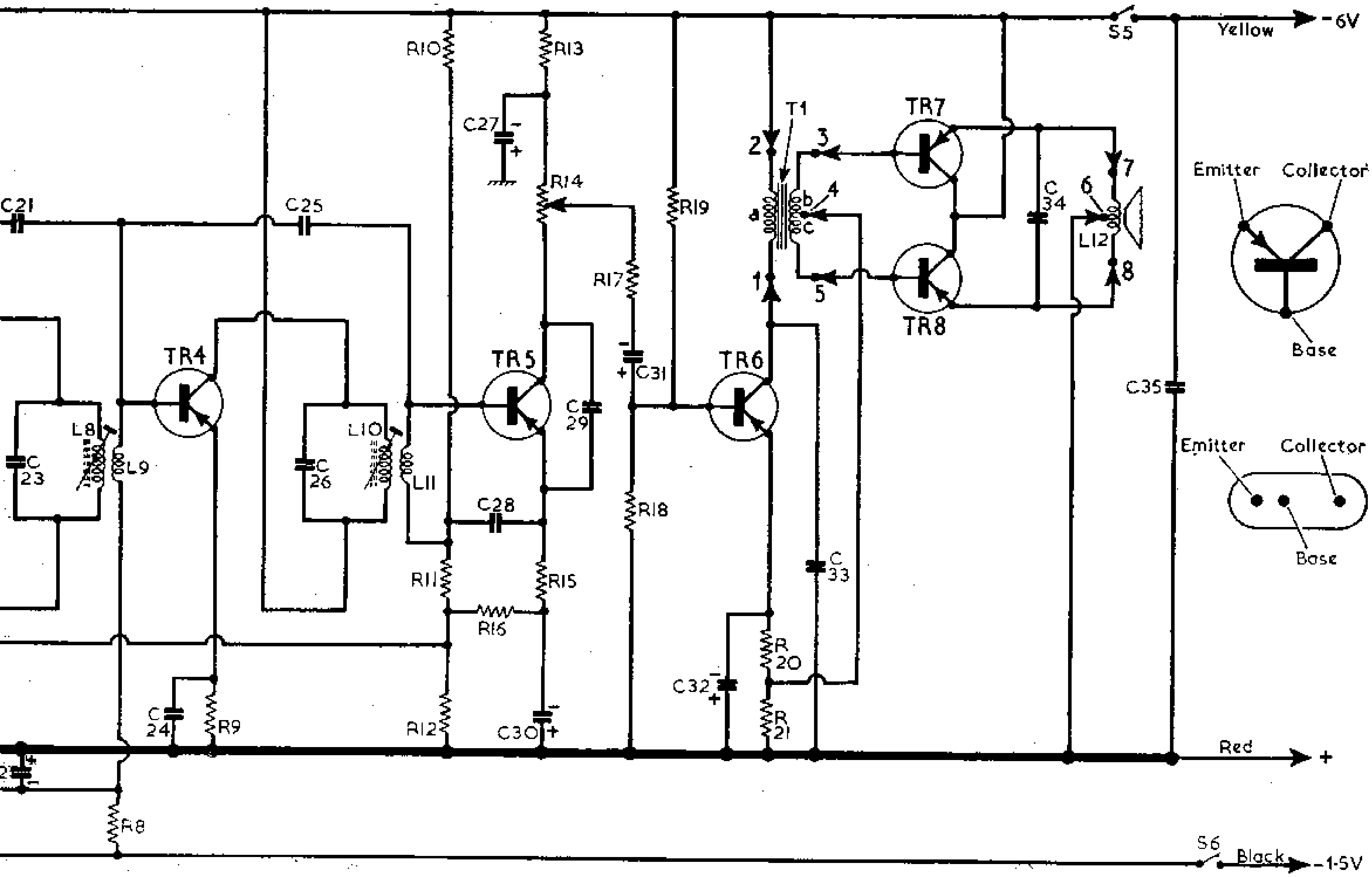
(Continued in next column)

[1]See "Neutralizing Procedure" overleaf.

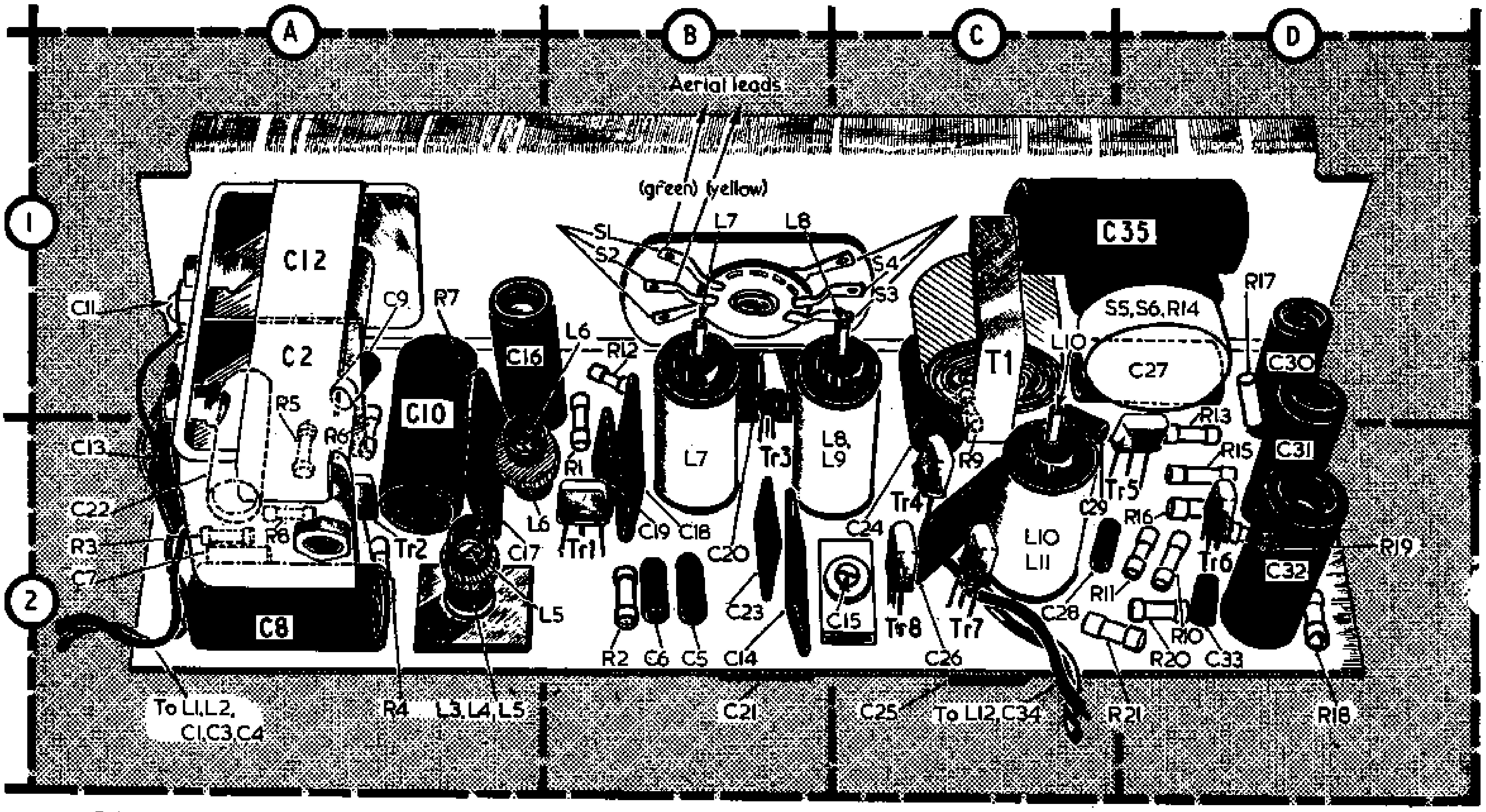
CAPACITORS (Contd.)		Values	Locations
C32	TR6 emitter decoup.	50μF	D2
C33	Tone correctors	0·002μF	D2
C34	Tone correctors	0·5μF	C2
C35	Battery by-pass	1·0μF	C1

RESISTORS		Values	Locations
R1	TR1 base return	22kΩ	B2
R2	TR1 bias	27Ω	B2
R3	TR2 bias	2·2kΩ	A2
R4	Bias decoupling	2·7kΩ	A2
R5	H.T. feeds	100Ω	A2
R6	H.T. feeds	2·7kΩ	A2
R7	H.T. feeds	1kΩ	A1
R8	Bias decoupling	1kΩ	A2
R9	TR4 bias	2·7kΩ	C2
R10	Bias potential divider	33kΩ	D2
R11	Bias potential divider	2·2kΩ	D2
R12	Bias potential divider	2·7kΩ	B1
R13	H.T. feed	1kΩ	D2
R14	TR5 load V.C.	3kΩ	D1
R15	TR5 bias	390Ω	D2
R16	TR5 bias	330Ω	D2
R17	Tone corrector	470Ω	D1
R18	TR6 bias potential divider	10kΩ	D2
R19	TR6 bias potential divider	33kΩ	D2
R20	TR6, TR7, TR8 bias resistors	33Ω	D2
R21	TR6, TR7, TR8 bias resistors	33Ω	C2

("Other Components" table in col. 1 overleaf)



TR3, TR4 are neutralized by C21 and C25 respectively. TR7 and TR8 operate in an emitter-loaded class B output stage.



Three-quarter rear view of the chassis. The individual band switch contacts are identified in location reference B1.

OTHER COMPONENTS		Approx. Values (ohms)	Locations
L1	M.W. aerial coil ...	0·5	A2
L2	L.W. aerial coil ...	3·0	A2
L3	Osc. coupling coil	—	A2
L4	Osc. reaction coil...	—	A2
L5	Osc. tuning coil ...	3·0[1]	A2
L6	1st I.F.T. ... Pri.	3·0	B2
L7	1st I.F.T. ... Sec.	1·4[2]	B1
L8	2nd I.F.T. ... Pri.	1·2	C1
L9	2nd I.F.T. ... Sec.	0·2	C1
L10	3rd I.F.T. ... Pri.	1·2	C2
L11	3rd I.F.T. ... Sec.	0·5	C2
L12	Speech coil ...	110·0[3]	C2
T1	Driver trans. a	80·0	C1
	b	180·0	
	c	180·0	
S1-S4	Band switches ...	—	B1
S5, S6	Batt. sw., g'd R14	—	D2

[1]*Tapped at* 1·5Ω.
[2]*Tapped at* 0·2Ω *from* C22.
[3]*Tapped at* 55Ω.

General Notes—*continued.*

site polarity to those applied to a valve. Fault tracing can be carried out in the usual way remembering that a transistor failure is unlikely, and that the receiver should operate satisfactorily down to a battery voltage of 4V. Signal tracing should be carried out using an 0.1μF D.C. blocking capacitor in the signal generator "live" lead to prevent disturbing the transistor D.C. circuits.

Transistors may be permanently damaged if the full negative battery voltage is connected to their bases, or if continuity measurements are made with them in circuit. If a transistor has to be removed or replaced, a heat shunt such as a pair of pliers should be clamped across the transistor leads between the transistor and the soldering iron during the soldering or unsoldering of its leads.

CIRCUIT ALIGNMENT

1.—Remove chassis from carrying case (see instructions under "Dismantling") leaving the battery leads connected.

2.—Connect output of signal generator between chassis and junction of **S1, C5.**

3.—Switch receiver to M.W. and turn gang to maximum capacitance.

4.—Feed in a 315kc/s signal and adjust the cores of **L10** (C2), **L8** (C1), **L7** (B1) and **L6** (B1) for maximum output. Repeat these adjustments until no further improvement results.

5.—Tune receiver to 500m, feed in a 600 kc/s signal and adjust the core of **L5** (A2) for maximum output.

6.—Tune receiver to 200m, feed in a 1,500 kc/s signal and adjust **C11** (A1) for maximum output. Repeat this adjustment and operation 5 until calibration is correct.

7.—Connect 10,000 ohms-per-volt meter, switched to 10V range, between **TR5** collector and chassis. Switch receiver to L.W. and adjust **C15** (C2) on the L.W. Light programme for minimum reading on meter. Disconnect meter and signal generator, replace chassis in cabinet and place back cover in position.

8.—Lay the signal generator output leads close to the ferrite rod internal aerial, tune receiver to 200m, feed in a 1,500 kc/s signal and adjust **C1** for maximum output. This trimmer is accessible through right-hand side hole in base of carrying case, viewing case from rear.

9.—Connect 10,000 ohms-per-volt meter, switched to 10V range, between **TR5** collector and chassis. Switch receiver to L.W. and while receiving L.W. Light programme, adjust **C4** for minimum reading on meter. This trimmer is accessible through left-hand side hole in base of carrying case, viewing case from rear.

10.—If the internal aerial has been replaced, the inductance of **L1** should be adjusted as follows. Open back cover sufficiently to give access to **L1.** Lay signal generator leads near the ferrite rod internal aerial. Tune receiver to 500m, feed in a 600 kc/s signal and adjust the position of the turns of **L1** nearest the end of the rod for maximum output. Close back cover.

11.—Repeat operations 8 and 10 until calibration is correct. Seal the end turns of **L1** with polystyrene dope, and then adjust **C4** as explained in operation 9.

NEUTRALIZING PROCEDURE

If **TR4** is replaced, carry out neutralizing adjustments 1-5 below. If **TR3** is replaced, carry out adjustments 6-9 in the next column. Apparatus required for these adjustments comprises a 0-20mV valve voltmeter, a signal generator, and two 0.1μF capacitors.

2nd I.F. Amplifier

1.—Connect valve voltmeter between chassis and **TR4** base.

2.—Connect output of signal generator, via one 0.1μF capacitor in the live lead, between chassis and **TR4** collector, and connect the second 0.1μF capacitor between chassis and **TR1** emitter.

4.—Adjust the signal generator to give an output of approximately 400mV at 315 kc/s.

5.—Disconnect **C25** (location reference C2), and connect in its place, in turn, the following capacitors: 39pF, 47pF, 56pF and 68pF, noting the readings on the valve voltmeter. Select the capacitor which gives the lowest meter reading and connect it in circuit. If two capacitors are found to give similar meter readings, the one having the lower capacitance should be used. Disconnect valve voltmeter and signal generator.

1st I.F. Amplifier

6.—Connect valve voltmeter between chassis and **TR3** base.

7.—Connect signal generator, via the 0.1μF capacitor, between chassis and **TR3** collector.

8.—With the second 0.1μF capacitor connected between chassis and **TR1** emitter, feed in a 400 mV, 315 kc/s signal.

9.—Disconnect **C21** (B2), and connect in its place, in turn, the following capacitors: 120pF, 150pF, 180pF and 220pF, noting the readings on the valve voltmeter. Select the capacitor which gives the lowest meter reading and connect it in circuit. If two capacitors are found to give similar meter readings, the one having the lower capacitance should be used. Disconnect valve voltmeter, signal generator and 0.1μF capacitors.

PRINTED CIRCUIT PLATE

To avoid damaging the printed circuit when replacing components, a soldering iron having a small bit and rated at not more than 60 watts should be used.

To save time, resistors and capacitors may be replaced by clipping out the defective component so as to leave enough of its connecting wire on the circuit plate to solder to the new component.

In some cases components are mounted in such a way that this method cannot be used. To replace such a component it is necessary to unsolder it completely from the printed circuit. First the connection should be heated from the printed circuit side of the plate and all the surplus solder brushed away from the joint. Care should be taken not to overheat the connection. Then insert a knife blade between the circuit foil and the bent over component lead and bend the lead perpendicular to the plate. When this has been done to both of the component leads it should be fairly easy to withdraw the leads through the holes in the circuit plate.

The leads of the replacement component should be cut to the correct length, tinned and pushed through the holes in the circuit plate while melting the solder on the printed side of the plate. A minimum of solder should be used when soldering components into place to prevent bridging adjacent leads in the printed circuit.

Open-circuit or damaged sections of the printed circuit can be repaired by soldering a link of connecting wire such as 22 s.w.g. tinned copper, across the damaged section.

Where it is necessary to take voltage readings from the printed circuit side of the plate, the insulating varnish must be scraped from the test points.

DISMANTLING

Removing Chassis.—Pull off knobs, taking care when removing the large tuning knob to see that the flats on both sections of the tuning spindle are in line;

remove back cover by unscrewing two knurled screws at base of cabinet and pulling lower edge of cover outwards by means of tab;

supporting chassis with one hand remove four 4BA chassis bolts (with washers) from top of carrying case and withdraw chassis.

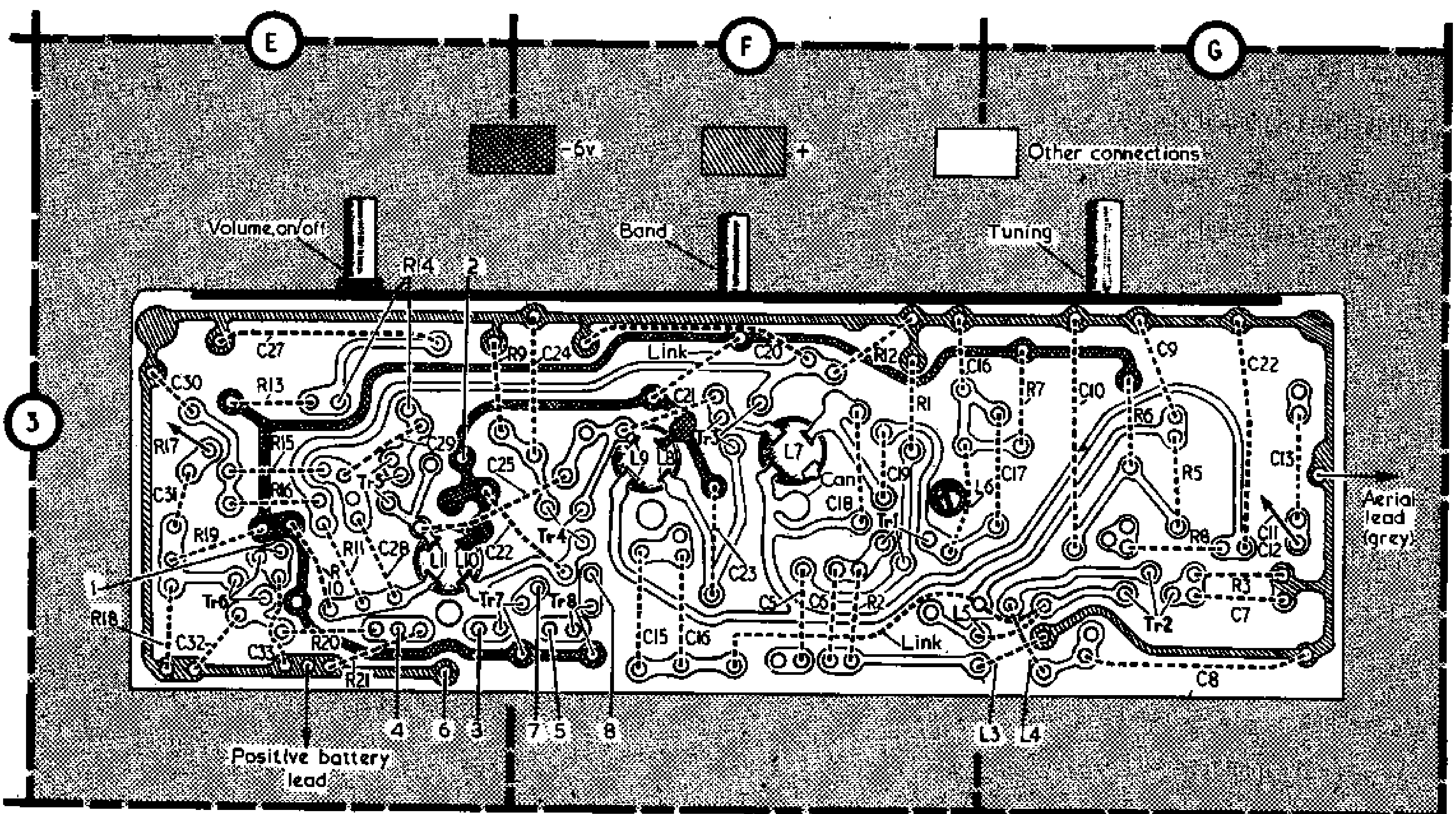
TRANSISTOR ANALYSIS

Transistor voltages given in the table are those derived from the manufacturers' information. They were measured with a 20,000 ohms-per-volt meter, chassis being the positive connection in every case. The receiver was tuned to the high wavelength end of M.W., but there was no signal input.

No base or emitter current values are given in the table as the introduction of a meter into either of these circuits alters the base-emitter bias and thus influences the currents. In general the base to emitter D.C. potential should not exceed 250mV.

As the output stage is operating under class B conditions, the total current drawn from the batteries will increase with increased audio output, and should be about 35mA for an output of 50mW (2.4V A.C. across **L12**). With no signal input the total battery current is 9mA.

Transistor	Emitter (V)	Base (V)	Collector	
			V	mA
TR1 V6/R3M ..	—	—	5.7	0·35
TR2 V6/R3 ...	1·6	1·35	4·1	0·7
TR3 V6/R3 ...	1·35	1·45	6·0	0·22
TR4 V6/R2 ...	1·3	1·45	6·0	0·5
TR5 V6/R2 ...	1·4	1·55	5·2	0·16
TR6 V10/30A ...	0·4	0·6	5·4	6·0
TR7 V10/30A ...	0·1	0·2	6·0	0·6
TR8 V10/30A ..	0·1	0·2	6·0	0·6



Underside view of the printed circuit plate showing the circuit connections. The positive and −6V battery connections are coded as indicated by the key above the plate. Connections 1-8 in E3, F3 correspond with numbered connections in the circuit diagram.

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