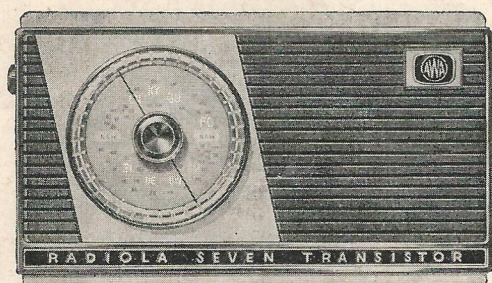


## TECHNICAL INFORMATION AND SERVICE DATA



# RADIOLA TRANSISTOR SEVEN PORTABLE MODEL 147P

Issued by

AMALGAMATED WIRELESS (AUSTRALASIA) LTD.

### GENERAL DESCRIPTION

Model 147P is a compact, lightweight battery-operated portable containing seven transistors and three crystal diodes. It is a superheterodyne receiver designed for the reception of the Medium Wave Band.

Features of design include: Ferrite Rod Aerial; high-gain I.F. transformers; Autodyne converter; high-sensitivity 2 $\frac{3}{4}$ -in. permanent magnet speaker; printed circuit giving compact size.

### ELECTRICAL AND MECHANICAL SPECIFICATIONS

Frequency Range ..... 540-1,600 Kc/s  
(555-187.5 metres)

Intermediate Frequency ..... 455 Kc/s

Battery Complement ..... 9 volt Eveready type 2362

#### Battery Consumption:

For zero audio output ..... 10 mA

For 50 mW audio output ..... 30 mA

#### Transistor Complement:

AWV 2N412	Converter
AWV 2N410	1st I.F. Amplifier
AWV 2N410	2nd I.F. Amplifier
AWV 2N406	Audio Amplifier
AWV 2N408	Driver
AWV 2N408	Output
AWV 2N408	Output

Three GEX 34 crystal diodes are also used as:

- (1) Audio Detector and A.V.C., (2) Converter Clamp, and
- (3) Overload Diode.

#### LOUDSPEAKER:

2 $\frac{3}{4}$ " Permanent Magnet No. 50000.

V.C. Impedance at 400 c/s ..... 15 ohms

Undistorted Power Output ..... 150 mW

#### CONTROLS:

Tuning Control—front left hand of cabinet.

On/Off Volume Control—right hand end of cabinet.

#### DIMENSIONS:

Height .... 3 $\frac{9}{16}$ "; Width .... 6"; Depth .... 1 $\frac{1}{8}$ "

Weight with Battery ..... 1 $\frac{1}{4}$  pounds



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## PRINTED BOARD REMOVAL

Remove the tuning knob by unscrewing its centre locking screw and twisting the knob free.

Slacken off the captivated rear retaining screw and remove the cabinet back.

Close the gang, remove the volume control knob and the three board mounting screws may be removed.

Lift the board from the cabinet and roll it over exposing the wiring side. The speaker may be disconnected if required but in general this is not necessary.

Installation of the printed board is the reverse of the above procedure. When replacing the tuning knob, make sure the gang is fully closed (clockwise) and set the pointer across the arrow heads near the state monograms before partially tightening the knurled locking screw. Switch the receiver on and tune to some known station. The pointer should fall across the centre of the station marking; if it does not, turn the knob past the end of its free travel in the appropriate direction to cancel out the error. Finally tighten locking screw.

## D.C. RESISTANCE OF WINDINGS

WINDING	D.C. RESISTANCE IN OHMS	WINDING	D.C. RESISTANCE IN OHMS
Ferrite Rod T1:		Driver Transformer T6:	
Primary	*	Primary	300
Secondary	1.8	Secondary	300
Oscillator Transformer T2:		Output Transformer T7:	
Primary	*	Primary	50
Secondary	1.2	Secondary	1.4
I.F. Transformers T3, T4 and T5:			
Primary	1.2		
Secondary	*		

The above readings were taken on a standard board, but substitution of materials during manufacture may cause variations and it should not be assumed that a component is faulty if a slightly different reading is obtained.

\*Indicates less than 1 ohm.

## MECHANICAL REPLACEMENT PARTS

ITEM	PART No.	ITEM	PART No.
Boss, Tuning Spindle	39106	Earphone	307000
Bracket, Speaker Mounting	39108	Fret, Large	39101
Cabinet Back	37783	Fret, Small	39102
Cabinet Front	37782	Knob, Tuning	39096
DIAL SCALES:		Knob, Volume	39104
N.S.W.	37916	Pouch, Earphone	39095
VIC.	37917	Pouch, Receiver	193111
QLD.	37918	Screw, Back Retaining	39109
S.A.	37919	Screw, Tuning Knob	39105
W.A.	37920	Strap, Carrying	39094
TAS.	37921		

When ordering, always quote the above Part Numbers and in the case of coloured parts such as cabinets, knobs, etc., the colour plus the Part Number.



## ALIGNMENT TABLE

ORDER	CONNECT HIGH SIDE OF GENERATOR TO:	TUNE GENERATOR TO:	TUNE RECEIVER TO:	ADJUST FOR MAXIMUM PEAK OUTPUT:
1	Aerial Sect. of Gang	455 Kc/s	H.F. Limit	Core T5
2	Aerial Sect. of Gang	455 Kc/s	H.F. Limit	Core T4
3	Aerial Sect. of Gang	455 Kc/s	H.F. Limit	Core T3
Repeat steps 1, 2 and 3 until maximum output is obtained‡				
4	Inductively coupled* to Rod Aerial	600 Kc/s	600 Kc/s	L.F. Osc. Core Adj. (T2)†
5	Inductively coupled* to Rod Aerial	1,620 Kc/s	Gang fully open	H.F. Osc. Adj. (C4)
6	Inductively coupled* to Rod Aerial	1,500 Kc/s	1,500 Kc/s	H.F. Aerial Adj. (C2)°
Repeat steps 4, 5 and 6				

\* A coil comprising 3 turns of 16 gauge D.C.C. wire about 12 inches in diameter should be connected across the output terminals to the generator, placed concentric with the rod aerial and distant not less than 1 foot from it.

† Rock the tuning control back and forth through the signal.

° Rock generator back and forth through the signal as there is some pulling effect on this adjustment.

‡ These transformers are a very high Q miniature type, the construction of which is shown in Fig. 5. It should be appreciated then that the amount of travel for the tuning

core to cover its tuning range is much smaller than on normal i.f. transformers. Tuning the i.f. thus becomes more critical and the following hints will prove useful.

(a) The tuning tool used should be a small metal screw-driver whose tip fits cleanly into the tuning core.

(b) When turning the core do not use any downward pressure as the threaded boss has enough resilience to detune the i.f. after the pressure has been relieved.

(c) The threads on the boss may be damaged if the core is wound in and forced against the winding bobbin. This should never happen as only a light torque is needed to turn the tuning core normally.

## SERVICING NOTES

### INTRODUCTION

This publication is intended to help servicemen understand the operation of this receiver, and, by giving detailed step by step service procedure, enable them to satisfy their customers with a minimum of work.

The material has been arranged under headings such as "dead", "weak", etc., corresponding to the customer's usual description when requesting service.

The many "service hints" listed in this manual should not be regarded as indicative of the amount of trouble to be expected. Many of the hints given are similar to everyday "run-of-the-mill" troubles found in vacuum-tube radios and would not be mentioned except for the fact that miniature transistor radios are a new experience for many servicemen.

By using an organised test procedure, transistor radio servicing can be made easy for the serviceman and satisfying for the customer.

### Test Equipment.

The servicing of transistor receivers generally does not involve much additional specialised test equipment beyond that normally used on vacuum tube circuits. It is essential, however, that the voltmeter used for all measurements be a comparatively high impedance type, i.e., 20,000 ohms per volt or better. There are several multimeters on the market which are suitable, e.g. the A.W.A. Voltomyst which is a VTVM type and the Model 8 A.V.O. Whatever meter is used a low d.c. voltage range is essential, preferably 2.5 volts full scale or less. Probably the simplest way to check the impedance of a multimeter is to set it on the 10 VDC range and connect across its terminal a 9 volt battery, in series with a 100,000 ohms resistor. A reading of 6 volts or better indicates that the meter is at least 20,000 ohms per volt. The cheaper and generally used multimeters are 1,000 ohms per volt and under the above conditions these would read 0.9 volts.

A Cathode Ray Oscilloscope can be of great assistance in transistor servicing, both on audio and r.f. testing. The main requirements for the C.R.O. are high sensitivity on the Y

amplifier and good high frequency response. Generally any CRO used for TV servicing is adequate, e.g. A.W.A. Type IA 56031.

There are several transistor testers available on the market but the majority of these are expensive and the amount of usage by the serviceman does not generally justify the cost. A simple transistor tester may be constructed in accordance with the circuit below and will provide adequate service information.

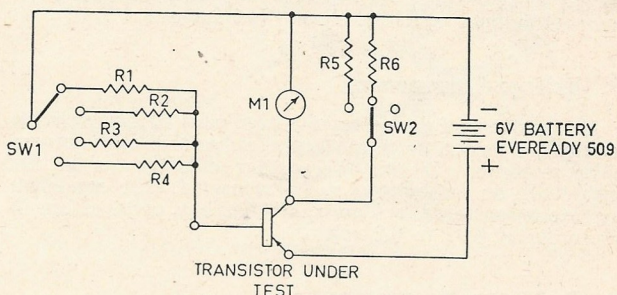


FIG. 1—SIMPLE TRANSISTOR TESTER.

### PARTS.

M1—1mA F.S.D. ammeter.

SW1—1 pole, 4 position switch.

SW2—1 pole, 3 position switch.

R1—1.2 Megohms :  $\beta$  0-200

R2—680 K ohms :  $\beta$  0-100

R3—330 K ohms :  $\beta$  0-50

R4—39K ohms : Match 2N408 or 2N270 Output

R5—Adjust for 20 mA full scale.

R6—0.1 ohms or 1 foot of 5 amp. fuse wire.



Switch SW1 selects the range of  $\beta$  and SW2 selects the current range on the collector current meter.

The mid position of SW2 is a safety precaution; if the transistor is faulty it could draw excessive current and damage the meter if switched to the 1mA or 20 mA F.S.D. position. Hence if the meter deflects in the mid position the transistor is faulty.

A battery polarity change over switch for NPN transistors could also be incorporated if desired.

To avoid damaging components and the printed wiring due to excessive heat, special soldering irons are recommended. For all general work an ORYX 12 watts iron is most useful, while for removal of i.f. and audio transformers a heavier 40-60 watts type with a  $\frac{3}{8}$ " bit filed flat at  $45^\circ$  will provide the best results (see Fig. 9). Care should be taken that the soldering iron frame is earthed as 50c/s leakage to the iron tip can damage transistors during soldering.

As the primary impedance of the output transformer is in the order of 600 ohms any output meter, such as A.W.A. Output Meter M8832, capable of working into such an impedance may be used for output measurements. Probably the easiest indication of audio output is to connect an A.C. meter, e.g. Voltomyst or AVO Model 8, across the speaker terminals. A reading of 0.86 volts across the 15 ohms speaker indicates 50 mW audio output.

## TEST METHODS

The procedure to be used in servicing transistor radios is much the same as used with vacuum tube radios. They both employ the superheterodyne circuit, they both pick up a minute signal voltage on an antenna, amplify it and apply it to a loudspeaker.

The test procedure differs only because of the low impedances and the low voltages which are found in transistor radios and in the case of this particular model because of the small size and the use of printed circuit.

**TEST THE BATTERY FIRST.** Do not perform any service work when using a weak battery to operate the receiver. Do not accept any performance deficiency as being due to a weak battery unless it has been proven by comparison when using a new battery.

### 1. Signal Tracing.

Signal tracing is a method of servicing that is applicable to any communication circuit. Either signal tracing or the similar method of signal injection is well adapted to the servicing of transistor radios. Signal level indication can be had by listening to the sound at the loudspeaker or by the methods outlined in the section on "Test Equipment".

### 2. Voltage Measurement.

Measurement of d.c. voltages is even more important in the servicing of miniature transistorised radios than with vacuum tube receivers. The most important difference is in the magnitude of the voltage to be measured. The maximum voltage encountered is 9 volts, and the bias voltages are in the order of 0.05 to 0.2 volt.

### 3. Resistance Measurement.

Although servicing by resistance measurement is one of the most common methods used for testing vacuum tube radios, this method has severe limitations when applied to the testing of circuits which contain transistors. Transistors will conduct an electric current when the terminal voltage is supplied from an ohmmeter just as readily as when the voltage is supplied from the radio battery. Because of this transistor conductivity misleading indication will be obtained and the transistors themselves can be permanently damaged by using resistance measurement.

If resistance measurements are to be made in a transistor radio, the transistors should be removed from the circuit to be tested. Generally, in the case of printed boards, it is easier to disconnect one lead of the suspect component than to remove the associated transistors when measurements are being made.

## 4. Current Measurement.

Individual current measurements are seldom made in servicing printed circuit receivers because of the difficulty of making such measurements. However, an overall current measurement is easily taken and should be made to assist in diagnosing trouble.

## 5. Preliminary Tests.

Regardless of what the stated complaint may be the following overall conditions should be checked:

- (a) Condition of the battery (voltage with the set turned on).
- (b) Overall current drain with no signal input (should be in the range 9-12 mA).
- (c) Soldered connections. Turn the radio on with maximum volume. While listening to the loudspeaker gently wiggle all visible components and leads with an insulated tool such as an alignment tool.
- (d) Sensitivity as determined by a listening test.
- (e) Distortion as determined by a listening test.

## CIRCUIT CONDITIONS AND THEIR EFFECT ON SERVICE PROCEDURE.

### Circuit Impedances.

In vacuum tube receivers, both the input (grid) and output (plate) circuits are high impedances. A common practice to determine whether or not a circuit is alive is either touch a finger or short to chassis with a screwdriver various points and listen for possible effects through the loudspeaker.

In transistor radios the input (base) circuit has very low impedance 500 $\Omega$ -1000 $\Omega$  and the output (collector) circuit has medium impedance 20K-50K $\Omega$ . The "finger-test" method described above will provide no indication in a transistor radio and the "screwdriver method" could easily result in permanent damage to the transistor.

Figure 2 is an illustrated comparison of the circuit impedances.

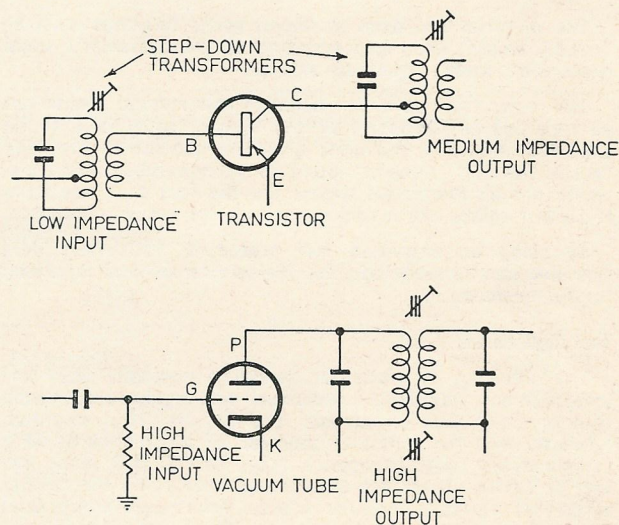


FIG 2—COMPARISON OF IMPEDANCES IN TRANSISTOR VS. VACUUM TUBE RADIOS.

Since generally the circuits in a transistor radio are not high impedance, it is not necessary to use low capacity probes in conjunction with oscilloscopes.

As impedance matching is important in any transistor radio, both audio and i.f. transformers have a step-down ratio, and when signal tracing, a pronounced signal voltage loss will be encountered between primary and secondary.



## DC Voltages at Transistor Terminals.

The maximum terminal voltage encountered in this receiver is 9 volts, and as all the transistors are P-N-P types the collector and base voltage are negative with respect to the emitter. Just as with vacuum tubes a small voltage at the input of a transistor is used to control the output current, but this voltage, the base-emitter bias voltage, is of the order of 0.1 to 0.2 volt. Excluding the converter transistor, bias voltages outside these limits will result in distortion.

## A.V.C. System.

In this model an "overload diode" is used to reduce the sensitivity on strong signals. The A.V.C. voltage changes the current in the 1st i.f. transistor T2 and thus reduces the d.c. voltage across the overload diode. This causes the diode to conduct and reduce the gain of the converter i.f. transformer.

Fig. 3 shows the relevant part of the circuit.

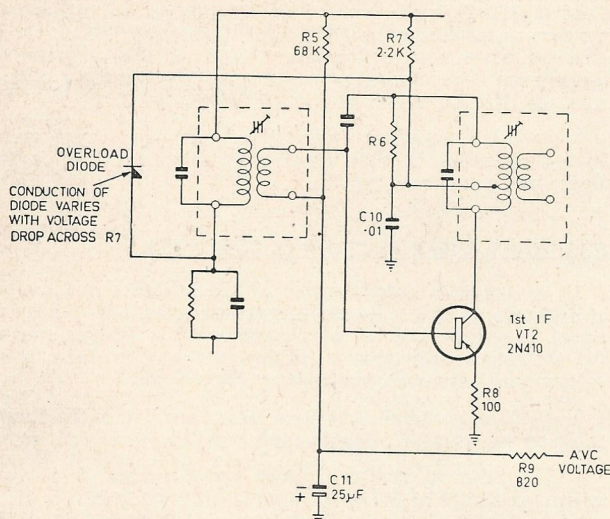


FIG. 3—OVERLOAD DIODE SYSTEM AND A.V.C.

## Transistor Currents and Bias Voltages.

In a vacuum tube as the negative bias voltage is increased the plate current decreases. In a transistor the reverse occurs; as the base-emitter bias is increased the collector current increases.

The Audio output stage is Class B push-pull, which causes the battery current to increase rapidly with signal. Under no signal conditions the total receiver current is 10 mA approximately and with 50 mW audio output the current rises to approximately 30 mA.

## PROCEDURE WHEN RECEIVER IS DEAD.

1. Turn the receiver on and check battery voltage. Under usual conditions the receiver should continue to operate at least until the battery has dropped to two-thirds of its rated voltage when new, i.e. six volts. If there is any doubt about the battery use a new one for test purposes. Carry out Section 5 of Test Methods, preliminary tests (a), (b) and (c).

2. Having ascertained that the battery being used is satisfactory, hold the set up to your ear and switch the receiver on and off. Clicks should be heard through the speaker. No clicks could mean an open circuit speaker voice coil, a faulty switch, an open circuit associated with the earphone jack or output transformer.

3. If a gentle hiss is heard through the loudspeaker with the volume control at maximum then it is almost certain that the audio stages are working satisfactorily and that the fault lies in the detector or r.f. end of the receiver. At this stage remove the board from the cabinet.

4. Use a voltmeter to check all voltages shown in the circuit diagram, (positive side of meter to positive of battery) allowing a tolerance of  $\pm 15\%$  on all emitter and base

voltages. If there is a discrepancy between any measured and quoted voltage check the associated circuitry. Open circuit resistors, improperly soldered connections (dry joints) and shorted capacitors are the most likely causes.

In general the component to be suspected last is the transistor. No potential difference between base and emitter, measured either directly in the case of a normal multimeter or by subtracting emitter from base potential when using a VTVM with one side earthed, usually signifies a short circuit external to the transistor, but in the odd case can signify breakdown of the base-emitter junction in the transistor itself.

Note that in the converter due to self bias when oscillating, the potential between base and emitter will vary between  $+0.05$  and  $-0.05$  volt. A voltage greater than  $-0.1$  volt signifies that the converter is not oscillating.

5. If no hiss is heard in the loudspeaker with the volume control at maximum and the speaker, output transformer secondary winding and the earphone jack are operating correctly (this may be checked with an ohmmeter), and all voltages are normal in the audio stages, the fault will be an open circuit coupling capacitor.

6. If the fault has been found to be in the r.f. end of the receiver first check whether the oscillator circuit is operative. If there is any doubt after the voltage check has been made, either check with an oscilloscope at the converter emitter or close the gang and pick up the oscillation on another receiver tuned across the range between 2UE and 2KY (950-1050 Kc/s.). This will appear as an unmodulated carrier.

7. If the oscillator is working, (a) connect the ground lead of a signal generator to the +ve side of the battery (board earth), (b) set generator to 455 Kc with audio modulation, (c) connect a capacitor (say 0.01 to 0.1  $\mu$ F) in series with the high-side signal generator lead and (d) set the generator to give almost maximum output. Then touch the free end of the capacitor to transformer side of the diode detector, thence to the bases of 2nd and 1st i.f. stages and the converter. The faulty stage should be apparent. If the signal is heard at each of these points the fault lies in the aerial circuit.

8. To make a circuit isolation of a component without removal of either terminal, with a sharp knife cut through the printed wiring to that component as shown in Fig. 4. This wiring break is then easily bridged with a soldering iron. However this method should only be used where absolutely necessary.

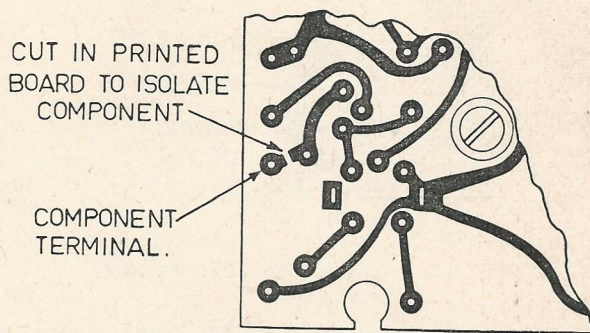


FIG. 4—COMPONENT ISOLATION ON PRINTED CIRCUIT BOARD.

## PROCEDURE WHEN THE RECEIVER IS "WEAK".

Use a new battery and give the receiver a listening test to determine whether the fault is in the audio section or in the i.f. section.

If the receiver has low i.f. sensitivity it may provide full volume on local stations and distant stations will be weak or not heard at all. If the receiver has low audio sensitivity then even local stations will not give full volume, but distant stations will probably be received.

## PROCEDURE WHEN RECEIVER HAS LOW AUDIO GAIN.

1. Measure all voltages around the audio section and compare against the quoted values. If there is a marked discrepancy remove the associated transistor and check all components which could be at fault.



2. If the voltages are satisfactory check all electrolytic capacitors by shunting with another capacitor (connected in the correct polarity) of approximately the same value. This applies to the emitter bypass capacitors as well as the interstage coupling capacitors.

3. Measure the d.c. resistance of the audio transformer windings. Low audio gain can easily be caused by the internally shorted turns in either the driver or the output transformers and often signal tracing by means of an audio generator may not readily disclose the trouble. Before making resistance measurements disconnect the transformer leads. Note that due to variations in the wire used, the resistance can vary appreciably and the transformer still be satisfactory. As a general rule the expected resistance variation is  $\pm 20\%$ .

4. If an audio generator is available the audio sensitivity may be checked. The input at 1000 c/s to the top of the volume control required for 50 mW output is approximately 0.25 mV. Difficulty may be experienced in making this measurement as, owing to the high audio gain, the earthing of the generator and the receiver is critical and, without care, misleading results can be obtained. The required signal at the base of VT5 is approximately 3 mV and is an easier measurement to make.

#### PROCEDURE WHEN RECEIVER HAS LOW I.F. GAIN.

1. Check the i.f. alignment (see page 3). Connect the generator to the aerial section of the gang and peak the i.f. transformers. These transformers are a very high Q miniature type, the construction of which is shown in the following cross sectional diagram. It should be appreciated then that the amount of travel for the tuning core to cover the tuning range is much smaller than on normal i.f. transformers. Tuning the i.f. thus becomes more critical and the following hints will prove useful.

- The tuning tool used should be a small metal screw-driver whose tip fits cleanly into the tuning core.
- When turning the core do not use any downward pressure as the threaded boss has enough resilience to detune the i.f. after the pressure has been relieved.
- The threads on the boss may be damaged if the core is wound in and forced against the winding bobbin. This should never happen as only a light torque is needed to turn the tuning core normally.

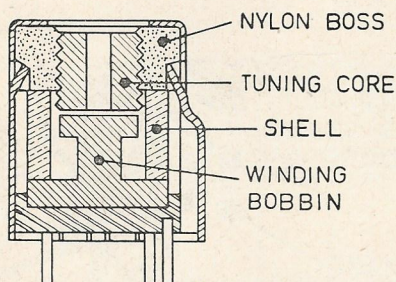


FIG. 5—I.F. TRANSFORMER CONSTRUCTION.

2. When a resonance peak is reached, there should be a very definite decrease in the output with only one eighth of a turn in either direction. A transformer having a broadly resonant peak should be replaced.

3. If a transformer can not be peaked at 455 Kc/s the trouble can be due to a defective transformer, 330 pf tuning capacitor or transistor. Always check the soldering of the transformer and transistor before replacing these components as a high resistance connection may cause the trouble.

4. Incorrect bias across the overload diode will cause loss of gain in the converter stage. The bias should be between 1 volt and 2.5 volts and may be measured directly with a multimeter or by subtraction with a VTVM with one side earthed. This should be checked if VT2 has been replaced, and if the bias is outside of tolerance, R5 (68K ohms) should be altered slightly to ensure correct operation of the overload diode.

5. The fault may be isolated readily to one particular stage by means of the signal generator. Tune the generator to 455 Kc/s with audio modulation and always work with

the volume control at maximum and a fairly low audio output. Using the generator output applied to the collector of VT3 as a reference to give a measured audio output then, for the same audio output, the required output from the generator should be

- at base VT3 : 1/100 of reference (—40db)
- at base VT2 : 1/500 of reference (—54db)
- at base VT1: 1/10,000 of reference (—80db)
- at aerial section of gang : 1/600 of reference (—56db)

If all these figures are satisfactory check the diode detector and associated components.

The diode may be checked with an ohmmeter with an internal voltage not greater than 9 volts, the forward resistance being in the order of 1,000 ohms and the back resistance in the order of 100,000 ohms.

6. If the fault has not yet been isolated, check the oscillator alignment. This may be done by setting the tuning close to 600 Kc/s and away from any station and adjusting the core of the oscillator coil for maximum noise. This is very effective when near a fluorescent light. If this adjustment gives much improvement, proceed with the complete alignment as detailed in the alignment table page 3.

7. Where a transistor stage shows low gain, shunt each bypass capacitor in that stage with another capacitor to detect an open circuit bypass.

#### PROCEDURE WHEN RECEIVER IS DISTORTED

1. For accurate determination of the existence and origin of distortion in any radio receiver there is no substitute for a signal generator and an oscilloscope. After finding where the distortion originates a voltage check (especially bias voltage) will assist in pin-pointing the trouble.

2. If there is complete lack of bass frequencies the fault could be in the A.V.C. bypass capacitor C11.

3. The base to emitter voltage on the Class B output transistor should be 0.1 to 0.17 volts. Low voltage will give what is termed "Crossover Distortion" and is most noticeable on low volume (see Fig. 6). If the bias voltage cannot be measured accurately check the collector currents in the output stage. These should be between 1 and 2.5 mA for each transistor. Note that the thermistor is temperature sensitive and if heated should be allowed to cool to room temperature before making bias measurements.

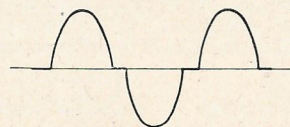


FIG. 6—CROSSOVER DISTORTION.

4. For minimum distortion the output transistors should be matched for push-pull operation. This is achieved when on high output levels the waveform is evenly clipped as in Fig. 7.

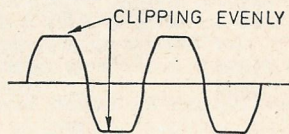


FIG 7—CORRECTLY MATCHED OUTPUT TRANSISTORS.

The waveforms obtained with a mismatched pair at low output and high output are shown in Figs 8 (a) and (b). A waveform similar to 8 (c) indicates one transistor inoperative.

5. Distortion can occur on local stations if there is excessive bias on the overload diode. If the bias, with no signal input to the receiver, is greater than 2.5 volts the point at which the overload diode conducts will be altered and the first transistor may overload before the diode starts its limiting action. (Refer to section 4 Low I.F. Gain.)



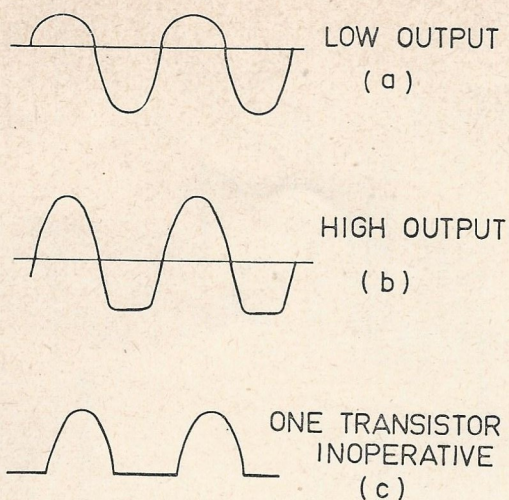


FIG. 8—MIS-MATCHED OUTPUT TRANSISTORS.

#### PROCEDURE WHEN RECEIVER IS UNSTABLE..

1. Check the battery. Instability can occur due to the high internal resistance of a flat battery resulting in low frequency "motorboating".
2. Open circuit high tension bypass capacitors will result in either i.f. or audio instability dependant on the position in the circuit. This also applies to C18 the 0.1 uf filter capacitor across the volume control.
3. Poor earthing of the tuning capacitor may result in i.f. instability.
4. Faulty neutralising capacitors will cause instability in the i.f. stages. The nominal value of these is 4.7 pf and it has been found in isolated cases on other models that the value has risen in service and caused heterodyne whistles on all stations. This is best checked by substitution.
5. A faulty converter clamp diode will cause excessive oscillator voltage and render the converter stage unstable (most noticeable at the high frequency end of the band).

#### PROCEDURE WHEN RECEIVER IS INTERMITTENT.

1. The most likely cause is an incorrectly soldered connection. Resolder any suspected connections.
2. Look for excess solder that will make contact only when the receiver is placed in its case, particularly on the area of the board directly over the speaker.
3. If physical examination does not enable the trouble to be localised, it will be necessary to use signal tracing or signal injection to localise the fault.

#### COMPONENT REMOVAL AND REPLACEMENT.

1. ALWAYS USE A SOLDERING IRON WHICH IS VERY CLEAN AND JUST HOT ENOUGH TO ACHIEVE A QUICK SOLDERING OPERATION AS PROLONGED APPLICATION OF HEAT WILL DAMAGE THE PRINTED WIRING.
2. Before installing a replacement component it is advisable to clear the contact hole by heating the contact area and pushing a tapered stainless steel wire into the hole. Small screwdriver kits are available on the market containing a suitable spiked bit.
3. To remove an i.f. transformer or oscillator coil it is desirable to have a suitable tip on the soldering iron as shown in Fig. 9. All seven connections on the transformer may be freed simultaneously and the transformer pulled from the board. This is the only satisfactory method; any other method using smaller irons will generally result in damage to either the board or the transformer or to both. The construction of the transformer is shown in Fig 5.
4. Transistors may be removed in a similar manner to the i.f. transformers using the  $\frac{3}{8}$ " bit on the ORYX iron.
5. The volume control may be removed readily by cutting the wires to the three terminals and removing the nuts from the mounting screws.
6. The audio transformers may be removed by first disconnecting the five leads and then moving each mounting lug by approximately  $\frac{1}{2}$ " at a time until both lugs are free.

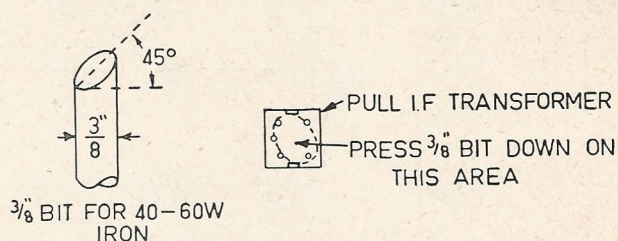
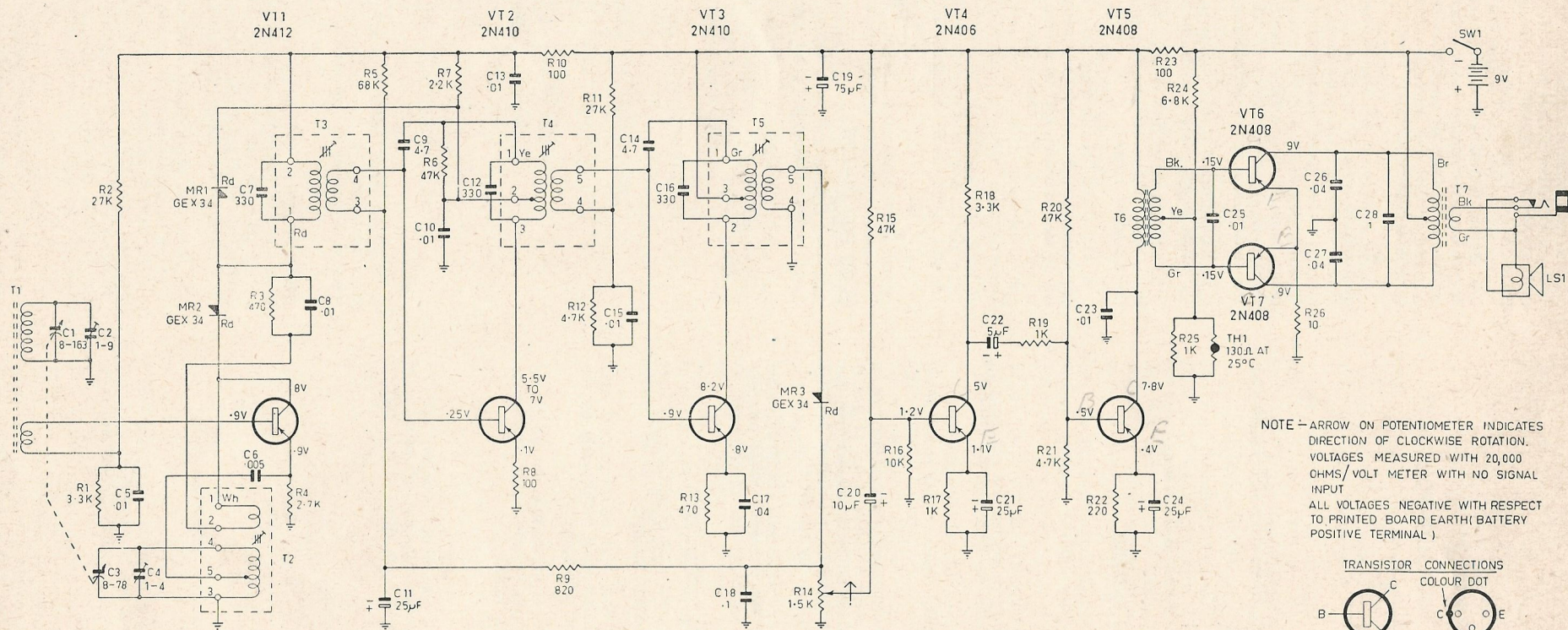
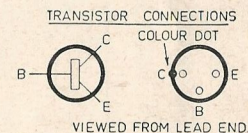


FIG. 9—SOLDERING BIT AND I.F. REMOVAL.





NOTE - ARROW ON POTENTIOMETER INDICATES DIRECTION OF CLOCKWISE ROTATION. VOLTAGES MEASURED WITH 20,000 CHMS/VOLT METER WITH NO SIGNAL INPUT. ALL VOLTAGES NEGATIVE WITH RESPECT TO PRINTED BOARD EARTH (BATTERY POSITIVE TERMINAL)



NOTE: R6 on latest chassis is 100K ohms.

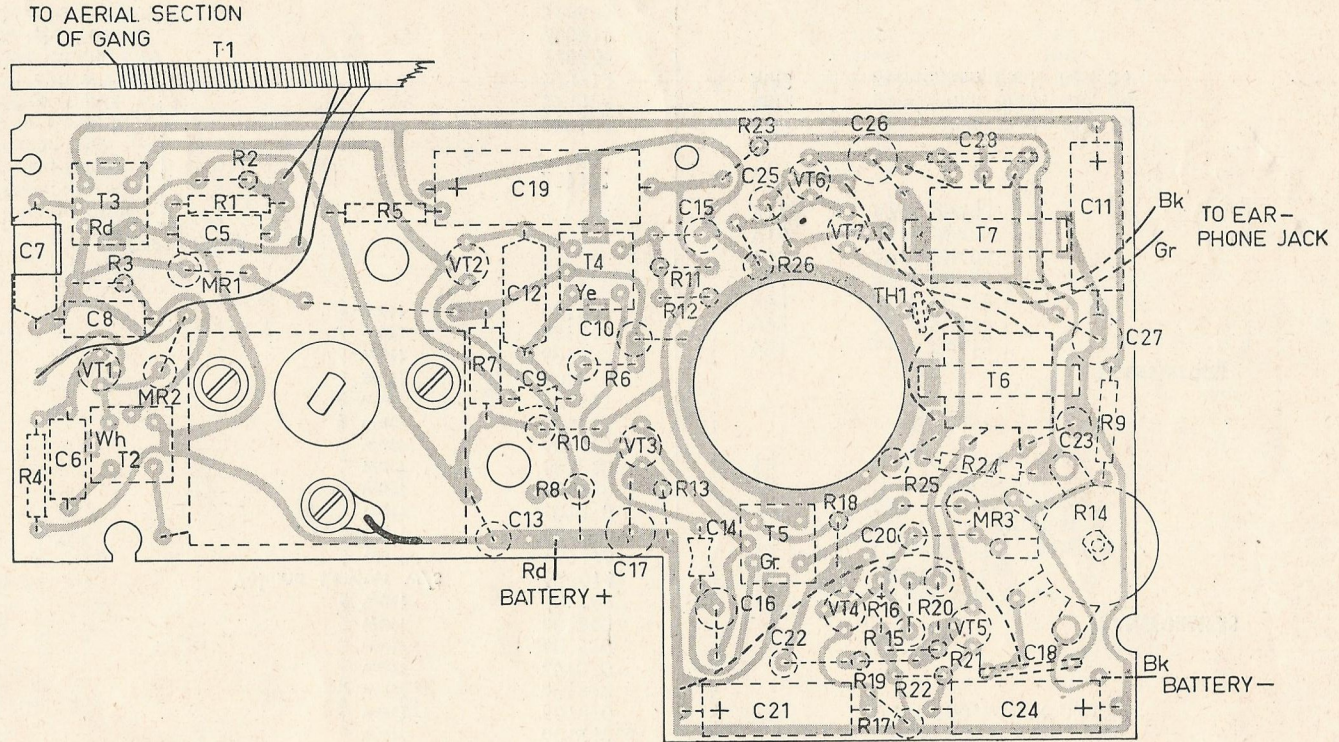


## 6

6



## COMPONENT LOCATION



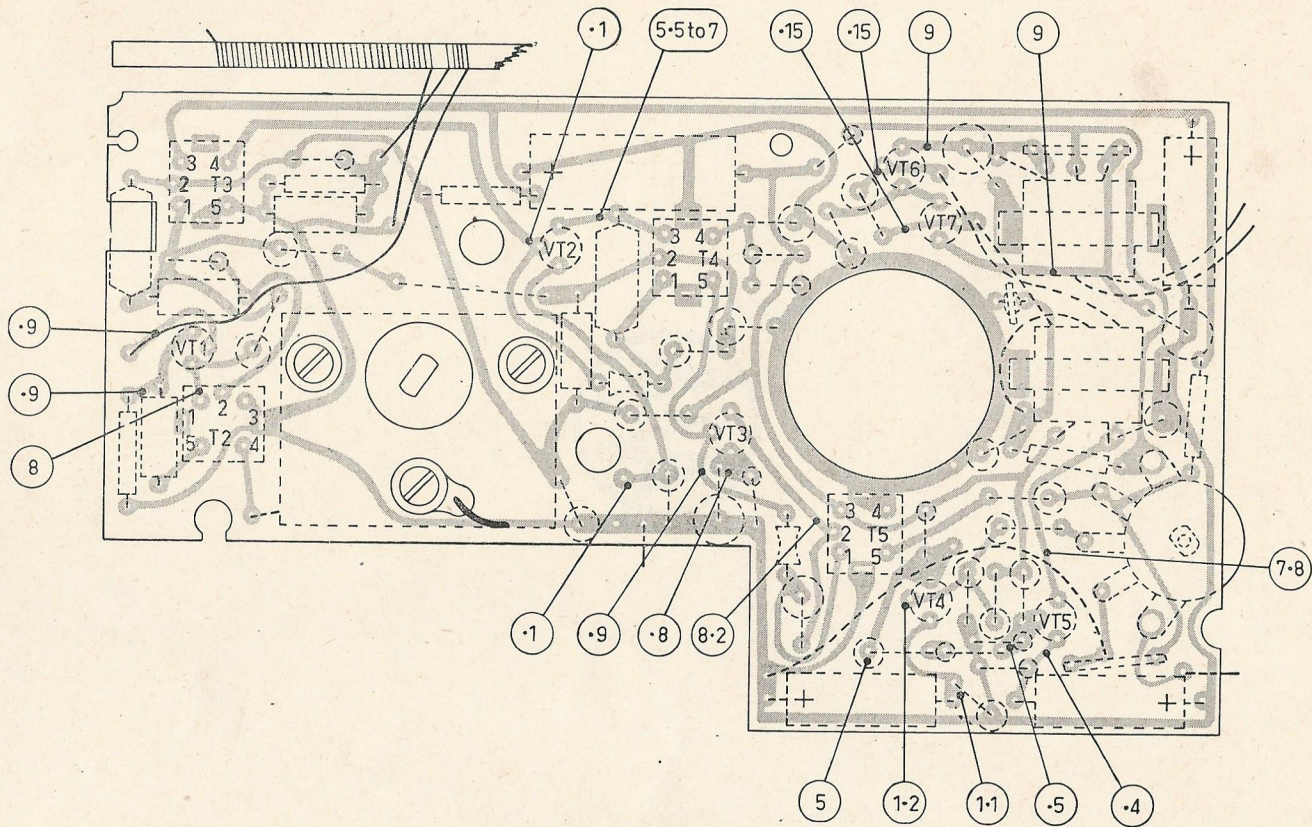
The assemblies represented above are viewed from the wiring side of the board.

The printed wiring, on the near side of the board, is presented in phantom view superimposed on the component layout of the reverse side.



## VOLTAGE CHART

All voltages negative with respect to printed board earth (positive terminal of battery).



The assemblies represented above are viewed from the wiring side of the board.

The printed wiring, on the near side of the board, is presented in phantom view superimposed on the component layout of the reverse side.