SECTION 11

O.B. EQUIPMENTS: AM11 AND OT2 SERIES

SUITCASE O.B. OUTFIT OT2/2B

Introduction

The OT2/2B is an assembly of equipment by means of which a simple outside broadcast can be carried out without the attendance of an engineer. Fig. 11.1 shows the complete outfit which consists of a leather suitcase in which is carried a microphone, headphones, microphone-to-line amplifier, medium-wave cue receiver, output cable and connector, telephone calling equipment and 12-volt battery. The suitcase measures 16 in. by 10 in. by 5½ in. and the complete outfit weighs 15¼ lb.

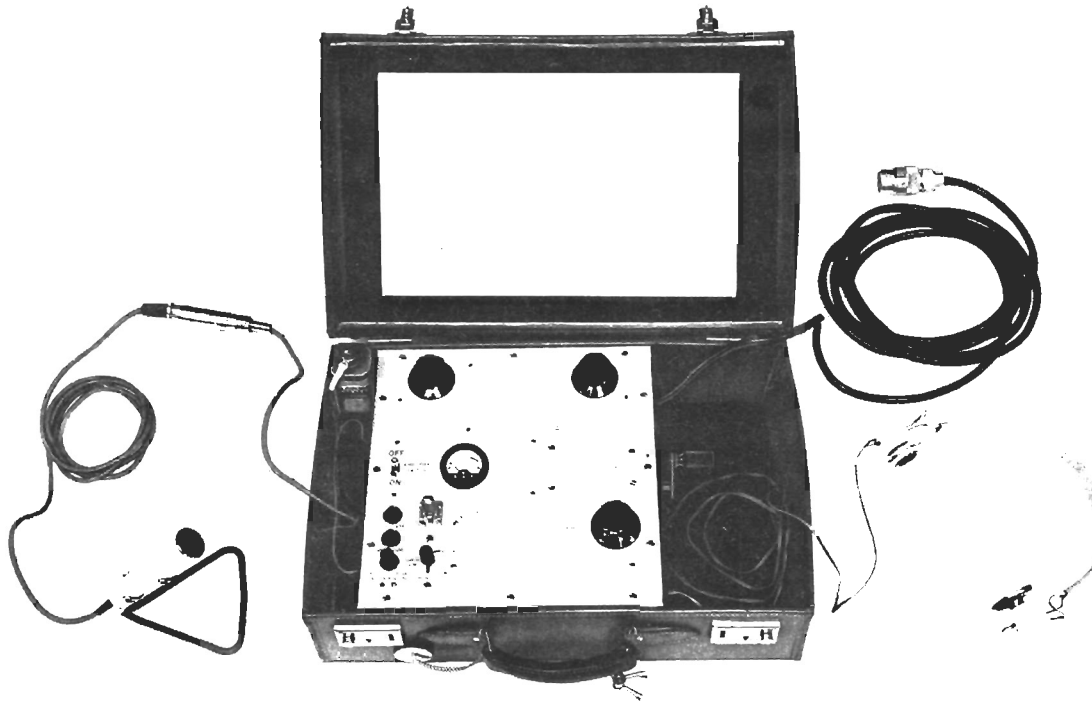


Fig. 11.1. Suitcase O.B. Outfit OT2/2B

The type of microphone normally used is the piezo-electric Acos MIC39 shown in Fig. 11.1 and for this a wire desk-stand, covered with rubber tubing to prevent rattling when it is used on a hard surface, is provided. A lip microphone can be substituted but this must be carried separately from the suitcase and requires an additional matching transformer, described later.

The headphones are Amplivox type 11225, of 3000 ohms impedance, and are permanently connected to the equipment.

The output socket is connected to a receptacle at the O.B. site, and this provides connections between the OT2/2B and the studio centre on two lines, one for programme and referred to in this Instruction as the music line, and the other for control.

The amplifier and cue receiver use transistors in all stages and are usually powered from a 12-volt layer-type dry battery. Alternatively a DEAC

nickel-cadmium battery can be used and charged in situ through a socket on the front of the suitcase.

The cue receiver is a superheterodyne type using a ferrite-rod aerial and can be tuned over the band 550-1600 kc/s.

The microphone and headphones are used for telephone communication with the studio centre, as well as for sending programme to line and for listening to the output of the cue receiver respectively. A hand-generator is used to call the studio and return-rings are indicated by a buzzer.

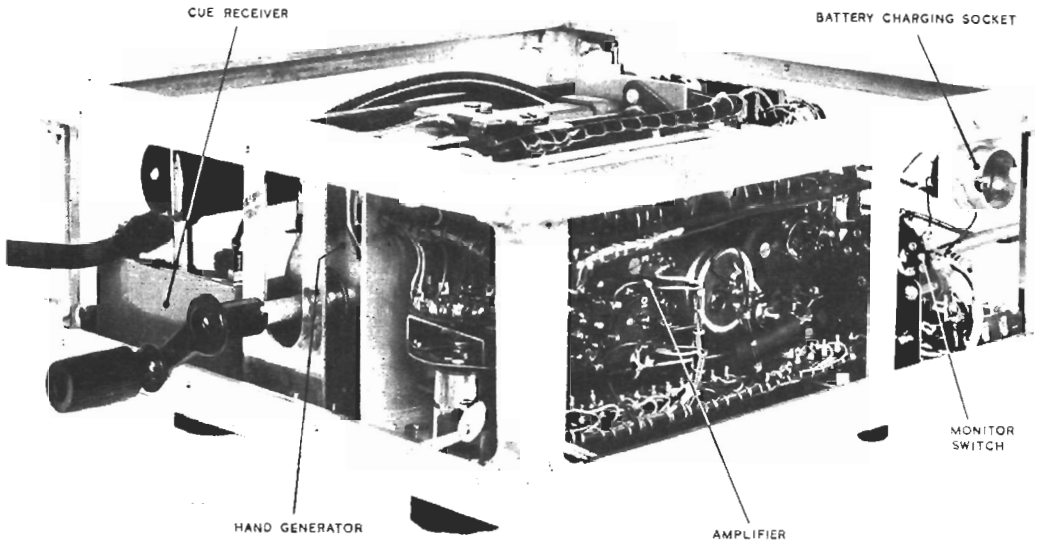


Fig. 11.2. OT2/2B : Equipment Framework removed from Suitcase

Apart from the microphone and headphones, battery and output cable, all of the equipment is mounted in an angle-section aluminium framework ; Fig. 11.2 shows this removed from the suitcase. The framework can be lifted out after removal of four fixing studs from the bottom of the case.

For this illustration the screening cover of the amplifier was taken off. The ferrite-rod aerial for the receiver is mounted for protection in a paxolin tube which can be seen attached to the receiver screening cover. Also visible in this photograph are the telephone hand-generator and battery-charging socket.

General Circuit Description

Fig. 11.3 shows the general circuit diagram of the OT2/2B. The microphone cable is permanently connected to the amplifier input terminals and in the cable is a connector which enables a lip microphone and matching transformer to be substituted for the crystal microphone usually fitted. The output of the amplifier feeds the music line through contacts of the *Change-over Lines* key-switch. The key-switch enables the functions of the two lines to be exchanged if this is made necessary by the line characteristics. In the normal (vertical) position of the key the contacts are in the positions shown in Fig. 11.3 and the headphones are connected to the control line when the *Monitor* switch is in the normal position (2) shown. In position 1 the headphones are connected to the amplifier output, enabling the microphone and amplifier to be checked, and in position 3 to the output of the cue receiver. Section SBc of the switch makes the battery supply to the receiver.

The telephone facility uses both lines, the control line for ringing in both directions and for headphone reception, and the music line for speech using the microphone and amplifier. Ringing out is effected with the hand-generator, the output of which is connected to the control line through the cut-out contact HG1 when the generator is operated. Incoming ringing signals are rectified by MR1 and smoothed by the 16-μF capacitor to operate the high-speed relay RLL, and contact L1 closes to make the battery supply to the buzzer.

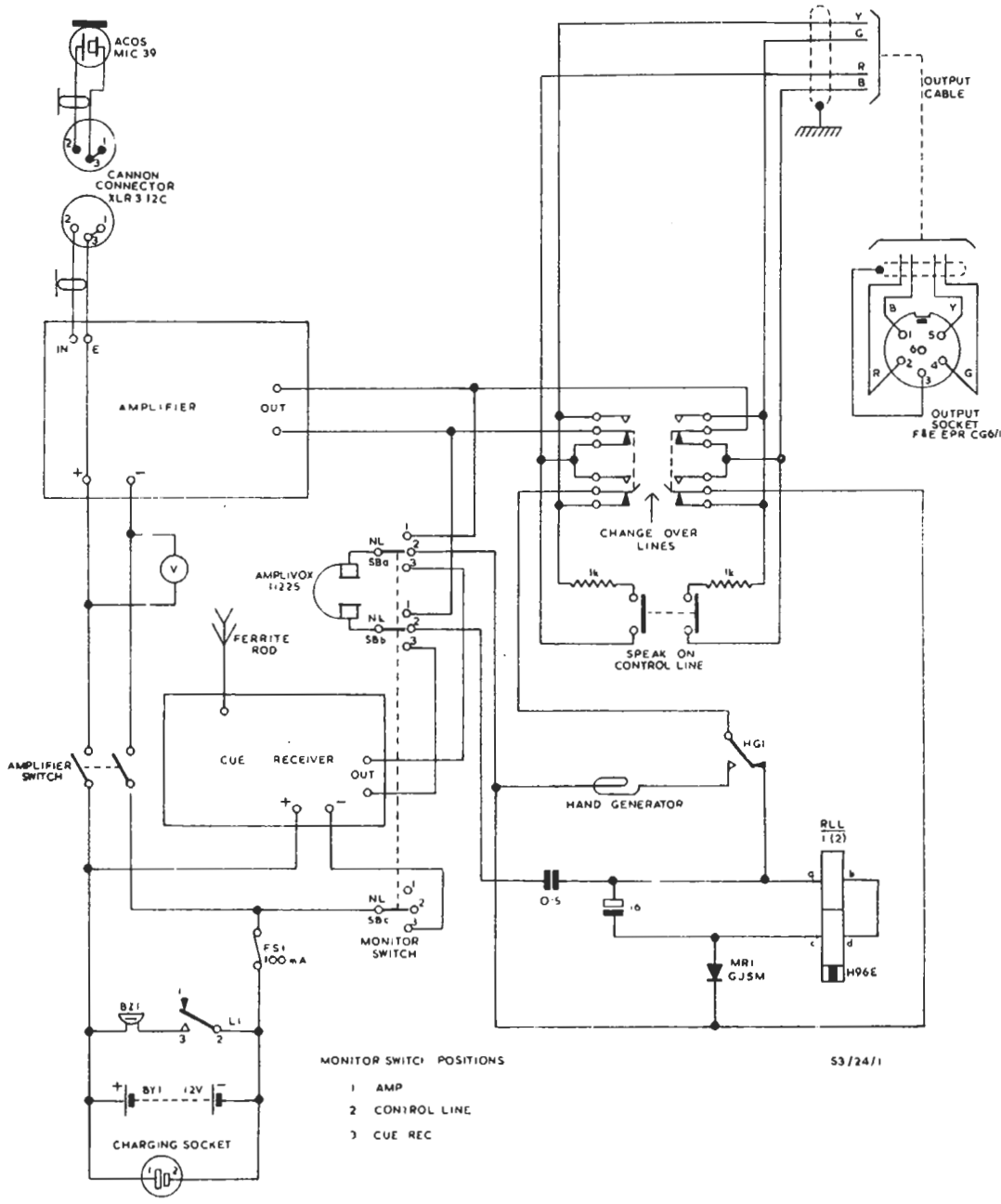


Fig. 11.3. OT2/2B : General Circuit Diagram

If incoming speech is received normally but a fault on the music circuit prevents two-way communication, the two lines can be paralleled through the 1-kilohm padding resistors by pressing the *Speak on Control Line* button.

The positive side of the battery supply is earthed in the amplifier. The negative side is fused and a spare fuse is carried in a holder on the top panel of the outfit.

Transformer for Lip Microphone

When a lip microphone is used with the OT2/2B it is approximately matched to the amplifier input by means of a transformer having a turns ratio of 1 : 10.

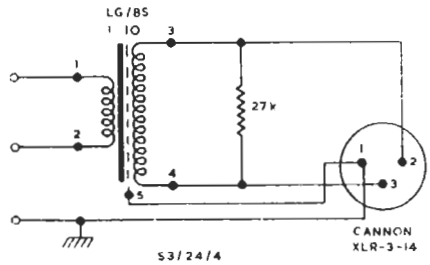


Fig. 11.4. OT2/2B : Matching Transformer for Lip Microphone

Fig. 11.4 shows the circuit arrangement of the transformer which is mounted in a metal box, 4 in. by 4 in. by 2 in., having terminals for connection to the lip microphone. A chassis-mounting Cannon plug makes connection with the socket in the microphone lead to the OT2/2B.

Microphone-to-Line Amplifier

The amplifier used in the OT2/2B has a high input impedance, to match the crystal microphone, and a low output impedance (about 85 ohms) suitable for feeding directly to short O.B. lines. The voltage gain is set by a switch which allows adjustment in four 3-dB steps to a maximum of 57 dB and, with steady tone input, the amplifier will deliver + 17 dB to a 240-ohm load.

Simplified Circuit Diagrams

Simplified d.c. and a.c. circuit diagrams of the amplifier are in Fig. 11.5(a) and (b) respectively. For stabilisation of d.c. operating conditions the transistors are connected in three d.c. feedback pairs, VT1 and VT2, VT3 and VT6, VT4 and VT5. The arrangement is illustrated in Fig. 11.5(a) from which all components associated only with the signal path have been omitted. In each feedback pair the base of the first transistor is connected to a point in the emitter circuit of the second and the feedback loop for the pair is completed by a connection from the collector of the first transistor to the base of the second. This second connection is direct for VT1 and VT2 and is made through load and decoupling resistors in the other pairs. The feedback-pair arrangement effects a greater degree of stabilisation, and therefore of thermal stability, than can be obtained by the more usual base potential-divider circuit.

In addition to protecting the transistors against thermal runaway, two other considerations make a high degree of stabilisation necessary in the amplifier. The first is that a rise in the collector current of VT1 would increase the noise generated in the first stage and would also alter the input impedance. The second consideration is that of achieving a good balance of the direct currents flowing in the primary winding of the output transformer, under varying temperatures.

Fig. 11.5(b) is a simplified signal-circuit diagram of the amplifier. All the transistors are connected in the common-emitter arrangement. The first three stages are in cascade and negative feedback is applied from the emitter of VT3 to that of VT1. The collector load of VT3 is a tapped resistor forming the *Volume to Line* gain control, the tapped-off voltage from which feeds VT4. VT5 and VT6 are connected in an emitter-coupled or long-tailed pair arrangement, the input voltage to VT5 being that developed across the common emitter resistor R_E. A tertiary winding on the output transformer applies negative feedback through R21 to the emitter of VT4.

Complete Circuit Description (Fig. 8)

The complete circuit diagram of the amplifier used in the OT2/2B is in Fig. 8. The high input impedance necessary for use with a crystal microphone is achieved by the use of a turns ratio of 10 : 1 in the input transformer and by the application of series negative feedback from VT3 to the emitter of VT1. The input impedance is stabilised against changing transistor characteristics by the shunting resistor R4. The capacitor C2 is included to make the phase characteristics of the feedback loop at high frequencies substantially independent

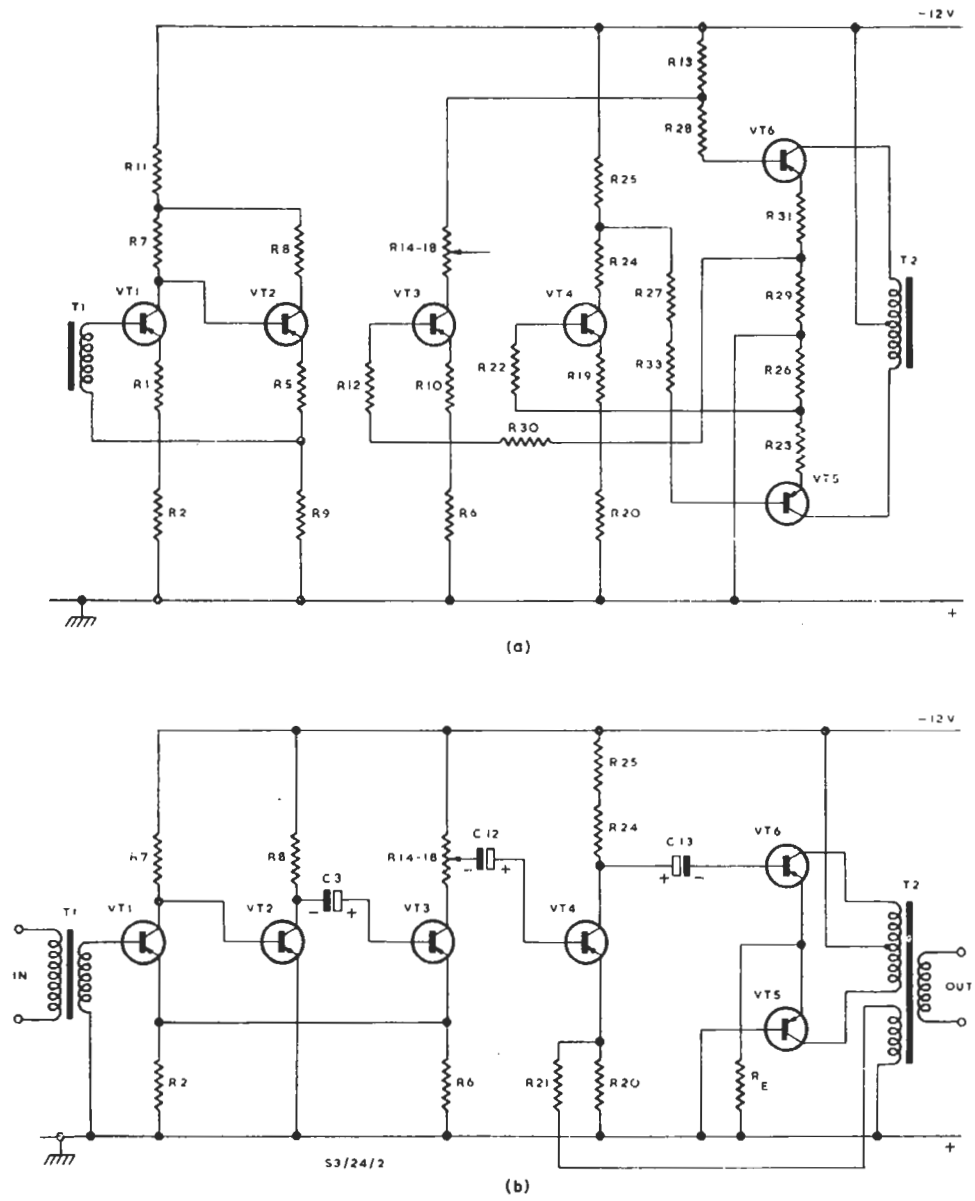


Fig. 11.5. OT2/2B : Simplified Circuit Diagrams of Amplifier

(*a*) *D. C. Circuit*
(*b*) *A. C. Circuit*

of the characteristics of the microphone and input transformer.

The collector load of VT3 consists of the resistors R14 to R18 which are tapped by the *Volume to Line* switch SA. The scale calibrations for this control are arbitrary, the actual gain of the amplifier for the five positions being — 6, — 3, 0, — 3, + 6 dB relative to the gain of 51 dB when the switch is in the *Normal* position. VT3 and VT6 form one of the d.c. feedback pairs described and, as the gain between these two transistors is considerable, VT3 is decoupled from VT6 at audio frequencies by R13, C8 and R30, C9.

The push-pull output transistors VT5 and VT6 are driven at the base of VT6 through C13. The resistors R23, R26, R29, R31 are necessary for the d.c. bias and feedback arrangements but the emitters of VT5 and VT6 are connected together at audio frequencies by C16. R23, R26 are thus effectively in parallel with R29, R31 as far as the signal is concerned. The base of VT5 is effectively earthed by C14 and the output transistors operate as a long-tailed pair. R27 and R33 are part of the d.c. arrangements of VT5.

Negative feedback of about 17 dB is applied from the tertiary winding of the output transformer T2, and C15, R32 across the primary winding are phase-correcting components to increase the margin of stability.

Mechanical Details

Fig. 11.6 shows the amplifier removed from the aluminium framework of the outfit. To remove the amplifier the connections to the tag panel are unsoldered, the knob of the *Volume to Line* switch is removed and four instrument-headed 4BA screws are removed from the top panel. The screening cover can be slid off after its 4BA securing screws are removed.

With the exception of the input and output transformers, C9, C16 and the *Volume to Line* switch, all components are mounted on two printed wiring cards. The cards are numbered 1 and 2 and are indicated on the circuit diagram in Fig. 8. Input, output and battery terminals are on the tag panel, which also carries connections to the emitters of VT4, VT5 and VT6 for the checking of emitter voltages.

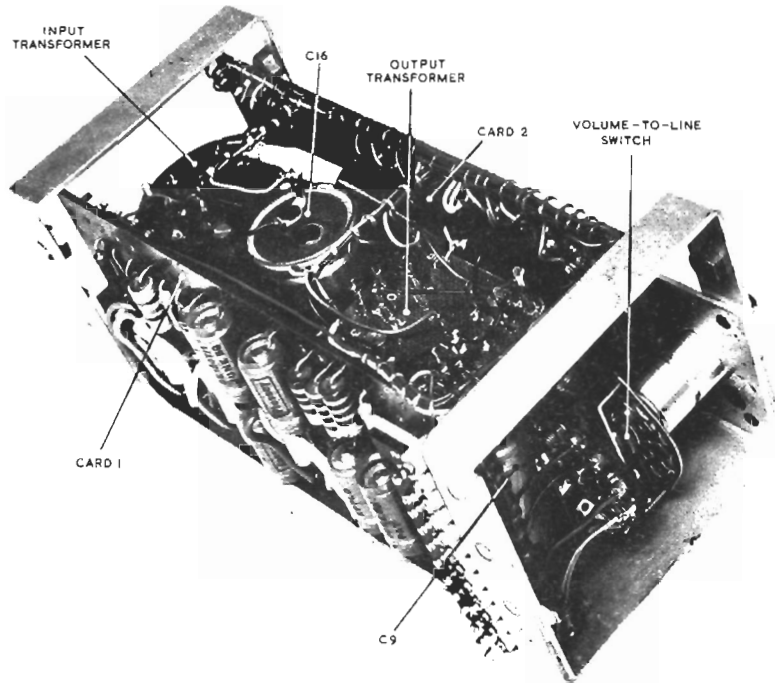


Fig. 11.6. OT2 2B : Microphone-to-line Amplifier

Amplifier Maintenance

This sub-section describes checks of amplifier performance which can be made with the usual test equipment. The accurate measurement of gain and frequency response needs specialised equipment, in particular a screened capacitor to simulate the microphone, and if the amplifier is faulty in these respects it should be returned to Equipment Department.

The following tests can be carried out without removing the amplifier from the framework, but the screening cover must be removed to give access to some of the d.c. test points.

(*a*) *Power Consumption*

The voltage of the battery must be not less than 12 volts on load and the current drawn by the amplifier should be about 33 mA.

(*b*) *D.C. Feeds*

The d.c. feed current of each transistor can be checked by measuring the emitter voltage. Access to the emitter leads of VT1, VT2 and VT3 is available at the lugs to which the leads are soldered on Card 1, the upper card when the screening cover is removed. Similar connections for VT4, VT5 and VT6 can be made to the tags labelled *e4*, *e5* and *e6* respectively on the amplifier tag panel. The emitter voltages, measured with a Model 8 Avometer, should be close to the following typical figures.

Transistor	*Emitter Voltage*
VT1	3·9
VT2	5·6
VT3	0·4
VT4	0·4
VT5	3·6
VT6	3·6

(*c*) *Gain*

A check of the amplifier voltage-gain at 1 kc/s can be made using the arrangement indicated in Fig. 24.7. With the *Volume to Line* switch at *Normal* the gain should be 51 ± 1 dB. The change in gain for the five switch positions, relative to the normal gain of 51 dB, should be as follows :

Switch Position	*Relative Gain (dB)*
−2	−6 ± 1
−1	−3 ± 0·5
0	0
+1	+3 ± 0·5
+2	+6 ± 1

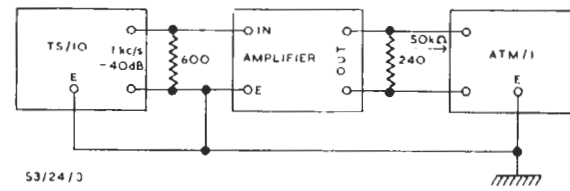


Fig. 11.7. OT2/2B : Arrangement of Equipment for Checking Voltage-gain of Amplifier

Cue Receiver

This is a superheterodyne type covering the frequency range 550 to 1600 kc/s and having an intermediate frequency of 470 kc/s. A modified commercial printed-wiring card carries all components except the aerial coils which are mounted on a ferrite aerial rod attached to the screening cover of the receiver. The arrangement of the transistors and components on the card is shown in Fig. 11.8.

Circuit Description (Fig. 9)

The complete circuit diagram of the cue receiver is in Fig. 9. The four transistors are connected in the common-emitter arrangement and the collector currents are stabilised by means of base potential-dividers. VT1 is connected as a self-oscillating frequency changer and is followed by two intermediate-frequency stages VT2, VT3. In these two stages unilaterisation, or compensation of the feedback within the transistors, is effected by the components R7, C5 and R8, C6. These are arranged to provide, in each stage, external feedback of equal amplitude and opposite polarity to that within the corresponding transistor.

Detection is by the point-contact diode D1,

which is forward-biased from the potential-divider formed by R4, R5 and the volume control in order to increase the efficiency of detection. The diode also provides a.g.c. to the base of VT2 through R5.

The output transistor VT4 feeds the headphones via the output transformer T6 and has negative feedback to its base circuit from the secondary winding of T6.

Receiver Maintenance

If the receiver needs re-alignment it should be returned to Equipment Department.

(a) Power Consumption

The voltage of the battery must not be less than 12 volts on load and the current drawn by the receiver should be about 7 mA.

Transistor	*Emitter Voltage*
VT1 (measured across R3)	1·25
VT1* (measured across R3)	0·7
VT2	0·8
VT3	1·3
VT4	0·9

*With oscillator disabled by short-circuiting tuned winding of T2.

Operating Instructions

The following operating instructions are printed on a sheet attached to the inside of the lid of each suitcase.

1. On arrival at venue take out existing connector in lines socket and insert connector attached to the Suitcase Equipment.

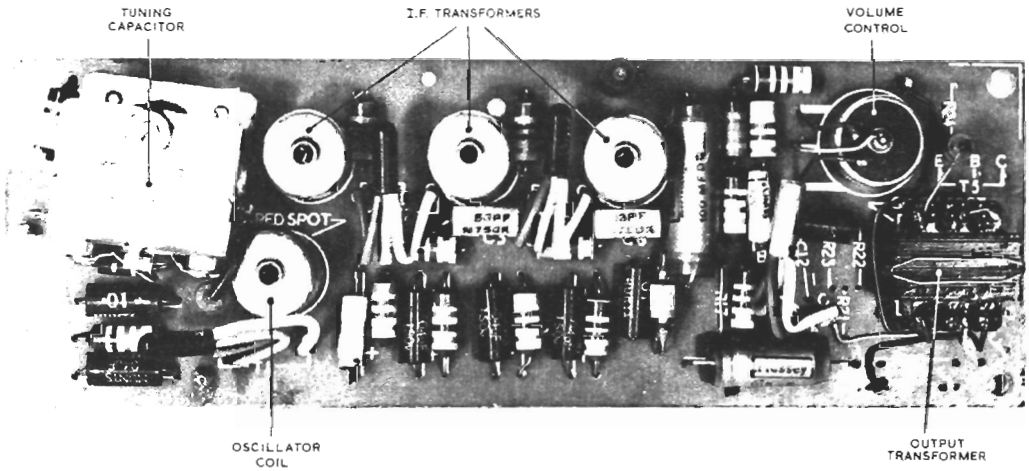


Fig. 11.8. OT2/2B : Cue Receiver

(b) D.C. Feeds

To check the transistor emitter voltages, the screening cover of the receiver must be lifted and this can be done without removing the receiver from the framework. It may be necessary to unsolder the battery and output leads but there is sufficient slack in the leads from the ferrite-rod aerial to the receiver card to allow the cover to be moved far enough to give access to the test points.

With the tuning capacitor at maximum capacitance, the emitter voltages should be close to the typical values which follow.

2. Put *Amplifier* switch (which is situated on the left hand side of Panel) to ON position.
3. Put on headphones and with amplifier switched on, press black key marked *Monitor* to the UP position marked *Amplifier*, talk into the microphone and check that amplifier is working.
4. TO ESTABLISH CONTACT WITH THE CONTROL ROOM
   Make sure that the *Change-over Lines* key is in the vertical position, operate hand ringer in side compartment, put on headphones and await reply. If no reply is received after a few attempts.

lift handle of *Change-over Lines* key, and push down to other position and ring again. When a reply is obtained, establish communication by talking into the microphone, listening on headphones. If you should still have trouble in contacting the Control Room, although you can hear them on headphones calling you, press switch situated in bottom left hand corner of panel, marked *Press to Speak on Control Line* and talk into the microphone. Once communication has been established the *Change-over Lines* key must not be altered without arrangement with the Control Room.

5. Ask Control Room for a test ring and check that this operates the buzzer.
6. Give a speech quality and level test to Control Room, with *Volume to Line* control at normal, holding microphone approximately 9 inches away from mouth, and speaking with a normal broadcasting voice direct into the microphone. If requested adjust the volume by means of *Volume to Line* control, maintaining the same voice conditions.
7. The equipment is now ready for use and during the waiting period the headphones can be taken off as the buzzer will call if Control Room wish to contact you.
8. CUEING ARRANGEMENTS

   Cue programme may be obtained in the following ways :

   1. By arrangement with Control Room, Cue programme may be fed down control line and with the *Monitor* switch in its normal position (vertical), will automatically be heard on the headphones.
   2. A small radio receiver is incorporated in the Equipment and is switched on by pressing the *Monitor* switch to the position marked *Cue Rec.* Tuning of the receiver (which is very critical) may be effected by adjusting *Metres Tune* dial and volume may be controlled by the knob marked *Volume.*

AFTER USE SWITCH OFF AMPLIFIER SWITCH, AND RESTORE CONNECTOR AT VENUE TO ITS ORIGINAL POSITION.

AMD/661

COMPONENT TABLE: FIG. 8

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	G10	Plessey CE24/1		R10	J10	Erie 109	2
C2	E8	Hunt B818		R11	F6	Erie 109	2
C3	H8	Plessey CE19/1		R12	H10	Erie 109	2
C4	G12	Plessey CE1207/1		R13	J4	Erie 109	2
C5	H12	Plessey CE1207/1		R14	N7	Erie 109	2
C6	K10	Plessey CE1207/1		R15	N7	Erie 109	2
C7	E7	Plessey CE1206/13		R16	N6	Erie 109	2
C8	J5	Plessey CE1206/13		R17	N5	Erie 109	2
C9	L12	Plessey CE1279/1		R18	N4	Erie 109	2
C10	N6	Hunt B858		R19	P10	Erie 109	2
C11	P10	Plessey CE1207/1		R20	P12	Erie 109	2
C12	N8	Plessey CE35/1		R21	O12	Erie 109	2
C13	P7	Plessey CE24/1		R22	O8	Erie 109	2
C14	Q12	Plessey CE1207/1		R23	R11	Erie 109	2
C15	S9	Hunt B815		R24	P7	Erie 109	2
C16	T9	T.C.C. CE25AAR		R25	P6	Erie 109	2
				R26	R8	Erie 109	2
R1	F10	Erie 109	2	R27	Q12	Erie 109	2
R2	F12	Erie 109	2	R28	Q4	Erie 109	2
R4	E9	Erie 109	2	R29	R8	Erie 109	2
R5	H10	Erie 109	2	R30	O11	Erie 9	10
R6	J12	Painton MV1 (selected)	2	R31	R7	Erie 109	2
R8	H7	Erie 109	2	R32	S7	Erie 109	2
R9	H12	Erie 109	2	R33	Q12	Erie 109	2

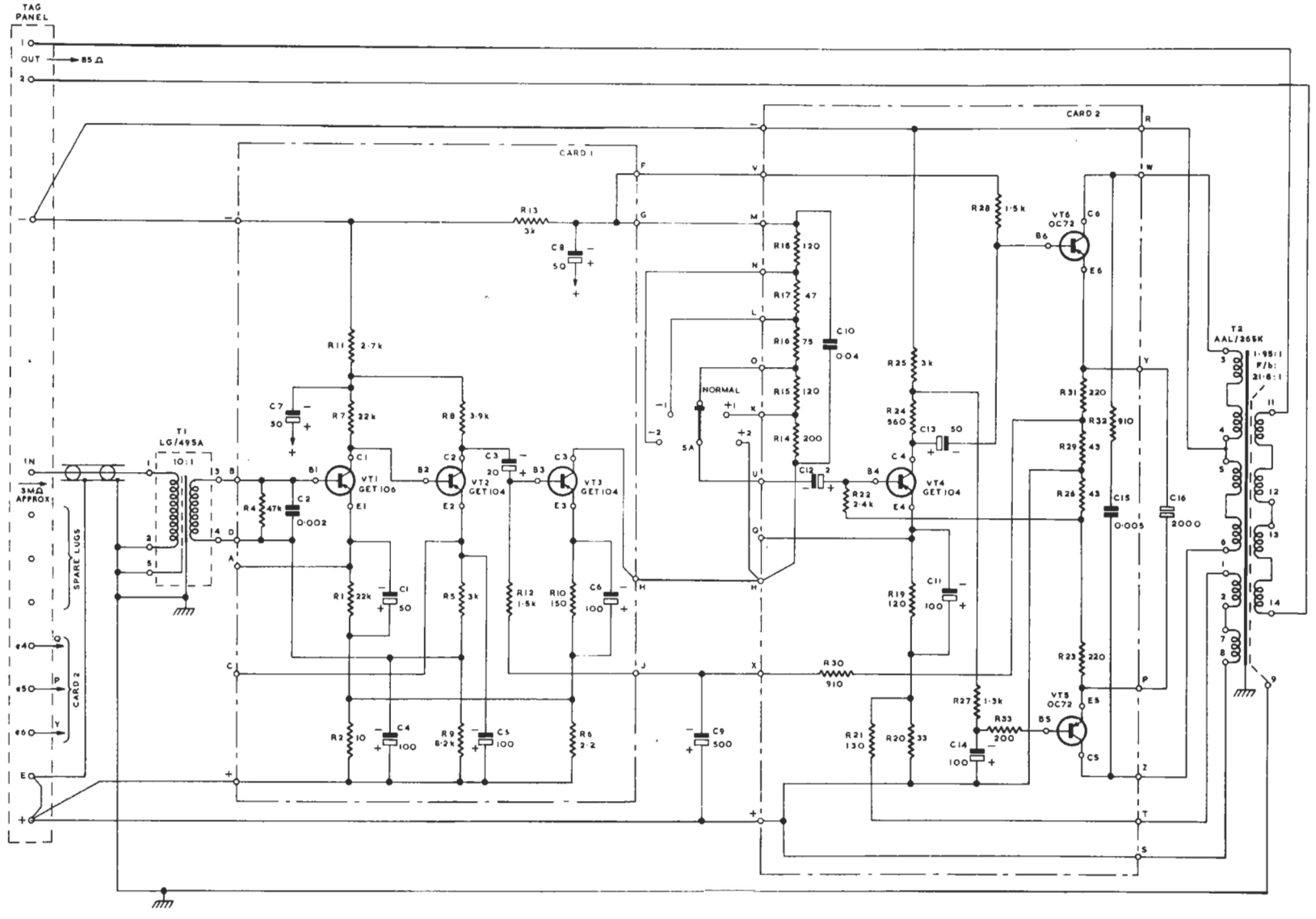
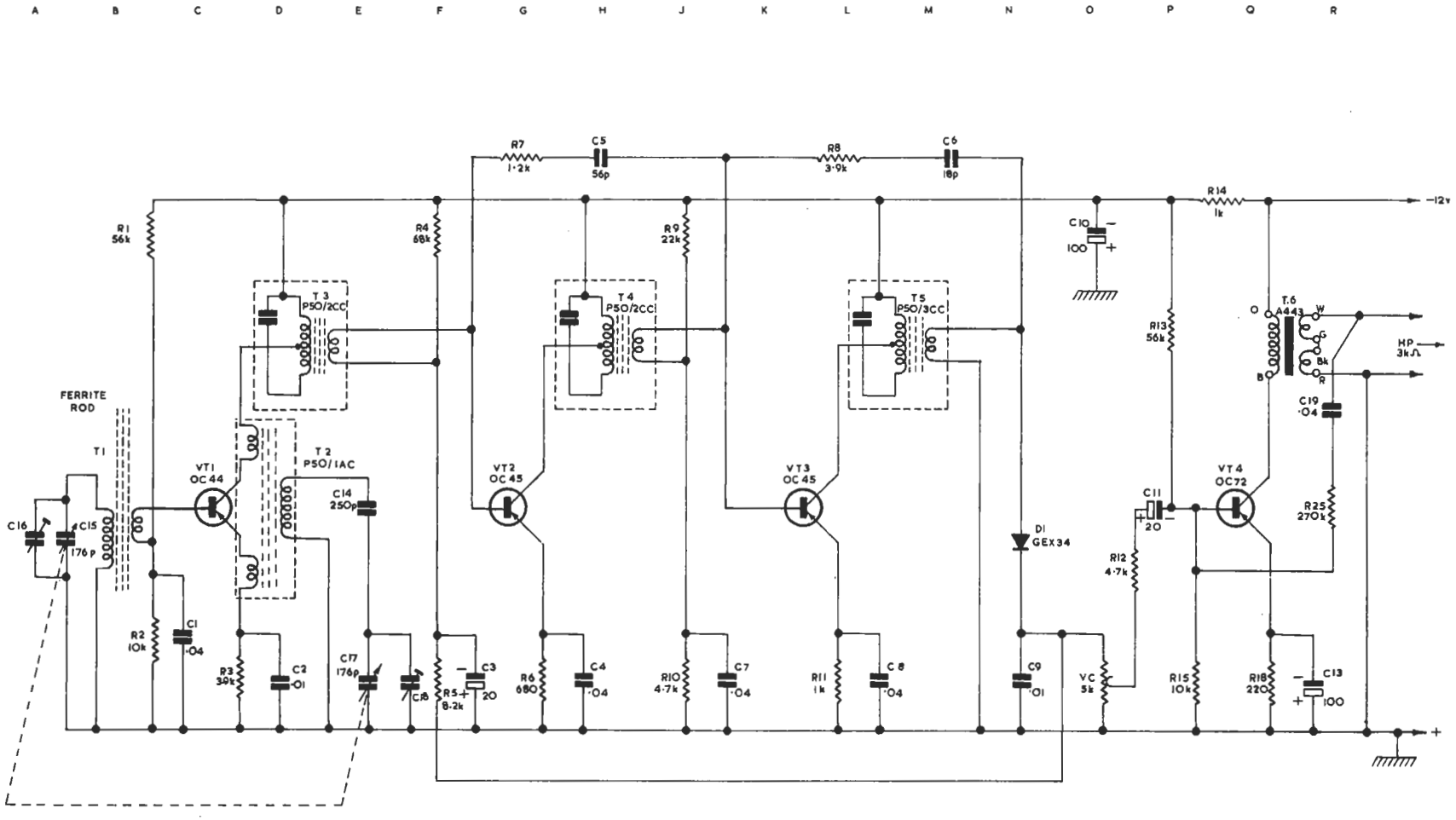


FIG 8

SUITCASE O.B. OUTFIT OT2/2B: AMPLIFIER CIRCUIT DIAGRAM

COMPONENT TABLE: FIG. 9

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	C7	Hunt B858		R1	B2	Erie 9	10
C2	D8	Hunt B810		R2	B7	Erie 9	10
C3	F8	Plessey CE19/1		R3	D8	Erie 16	10
C4	H8	Hunt B858		R4	F2	Erie 9	10
C5	H1	Erie N750K		R5	F8	Erie 9	10
C6	M1	Erie N750K		R6	G8	Erie 9	10
C7	J8	Hunt B858		R7	G1	Erie 9	10
C8	L8	Hunt B858		R8	L1	Erie 9	10
C9	N8	Hunt B810		R9	J2	Erie 9	10
C10	O2	Plessey CE1222/1		R10	J8	Erie 9	10
C11	P5	Plessey CE19/1		R11	L8	Erie 9	10
C13	R8	Plessey CE1207/1		R12	P6	Erie 9	10
C14	E5	Erie Hi-K/K		R13	P3	Erie 9	10
C15	A6			R14	Q2	Erie 9	10
C16	A6	Jackson 5265		R15	P8	Erie 9	10
C17	E8			R18	Q8	Erie 9	10
C18	F8			R25	R5	Erie 9	10
C19	R4	Hunt B858					
				VC	O8	Plessey Type M	



SUITCASE O.B. OUTFIT OT2/2B, CUE RECEIVER : CIRCUIT DIAGRAM

FIG 9