TECHNICAL INSTRUCTION

RM. 1

RADIO MICROPHONE EQUIPMENT

TRANSMITTER TYPE TM3/1

AND

RECEIVERS TYPE RC4/1 AND RC4/1A

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AMENDMENT RECORD

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CIRCUIT DIAGRAMS AT END

Fig. 1. Radio Microphone Transmitter TM3/1

Fig. 2. Radio Microphone Receiver RC4/1

Fig. 3. Line-up Tone Oscillator OS2/17

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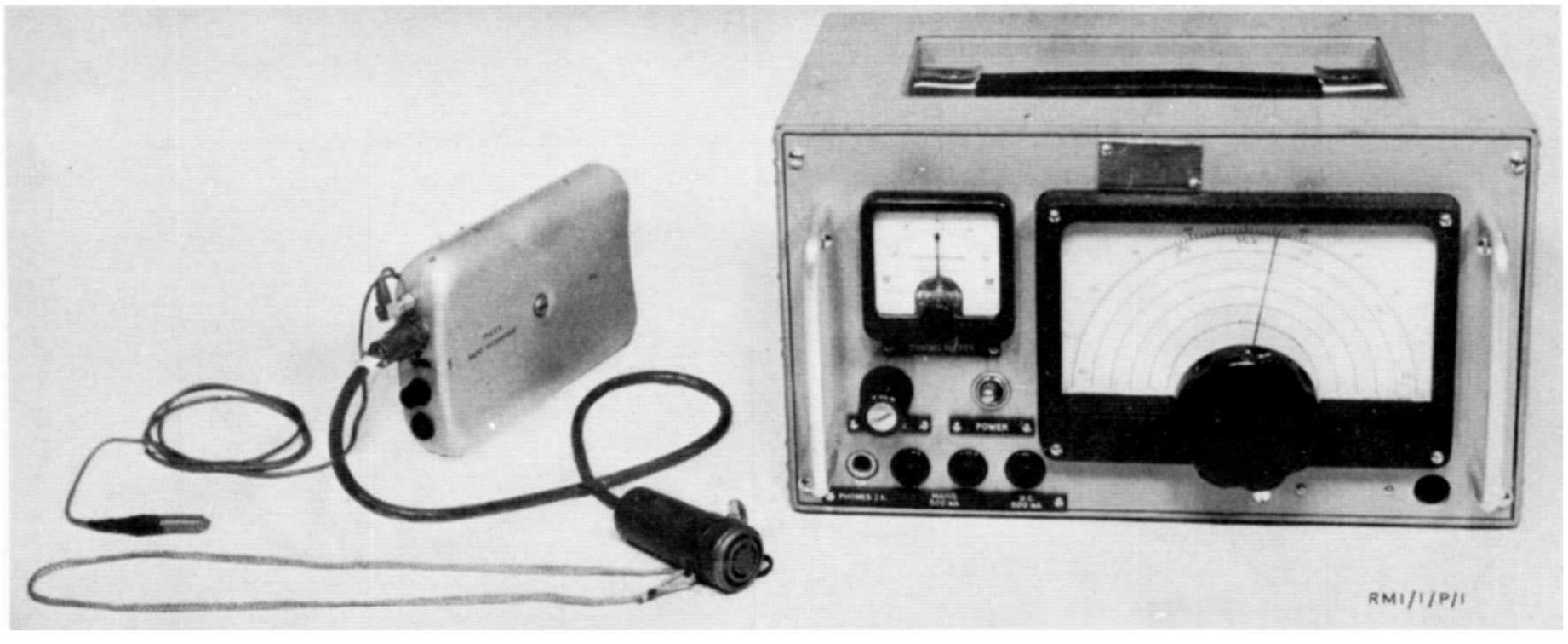


Fig. 1.1. General Appearance of Radio Microphone Transmitter and Receiver

RADIO MICROPHONE EQUIPMENT

TRANSMITTER TYPE TM3/1 AND RECEIVERS TYPE RC4/1 AND RC4/1A

SECTION 1

INTRODUCTION

This Radio Microphone Equipment comprises a miniature f.m. battery-driven transmitter Type TM3/1 and associated microphone, together with a specially designed receiver Type RC4/1 capable of operating from an external battery or mains. The equipment, which uses transistors throughout, replaces transmitter Type XFM/4 and receiver Type HR/20, both of which employed valves. The operating frequency of the receiver is continuously adjustable in the range 45 Mc/s to 65 Mc/s, while that of the transmitter can be preset to any required point within this range.

The transmitter is intended to be carried on the person of the user, and is built into a conveniently-shaped pocket-sized metal case. An external aerial, about one-quarter wavelength long, is required and this is usually concealed in the user's clothes; alternatively, the screen of the microphone lead can be used.

Any approved B.B.C. microphone of 30 or 300 ohms impedance is suitable, recommended types being the BK-6B or 4037A. Alternatively, a double crystal lapel microphone can be used.

Receiver RC4/1A is similar to receiver RC4/1, but is intended only for portable use. It has an internal battery in place of a mains unit, and is provided with a telescopic aerial and a carrying case.

Fig. 1.1 shows the general appearance of transmitter and receiver. The size of the transmitter is about 5 in. by 3 in. by 1 in., while the receiver dimensions are 11 in. by 6 in. by 9 in. The respective weights are 12 oz and 10 lb.

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SECTION 2

TRANSMITTER TM3/1

2.1 General Description

The transmitter consists of three parts, an audio amplifier, a variable-frequency oscillator and multiplier circuit and, lastly, an output stage. Each part is built on its own printed circuit board, interconnected as shown in Fig. 2.1, which also shows the connections of a 4-pin input socket for three types of microphone.

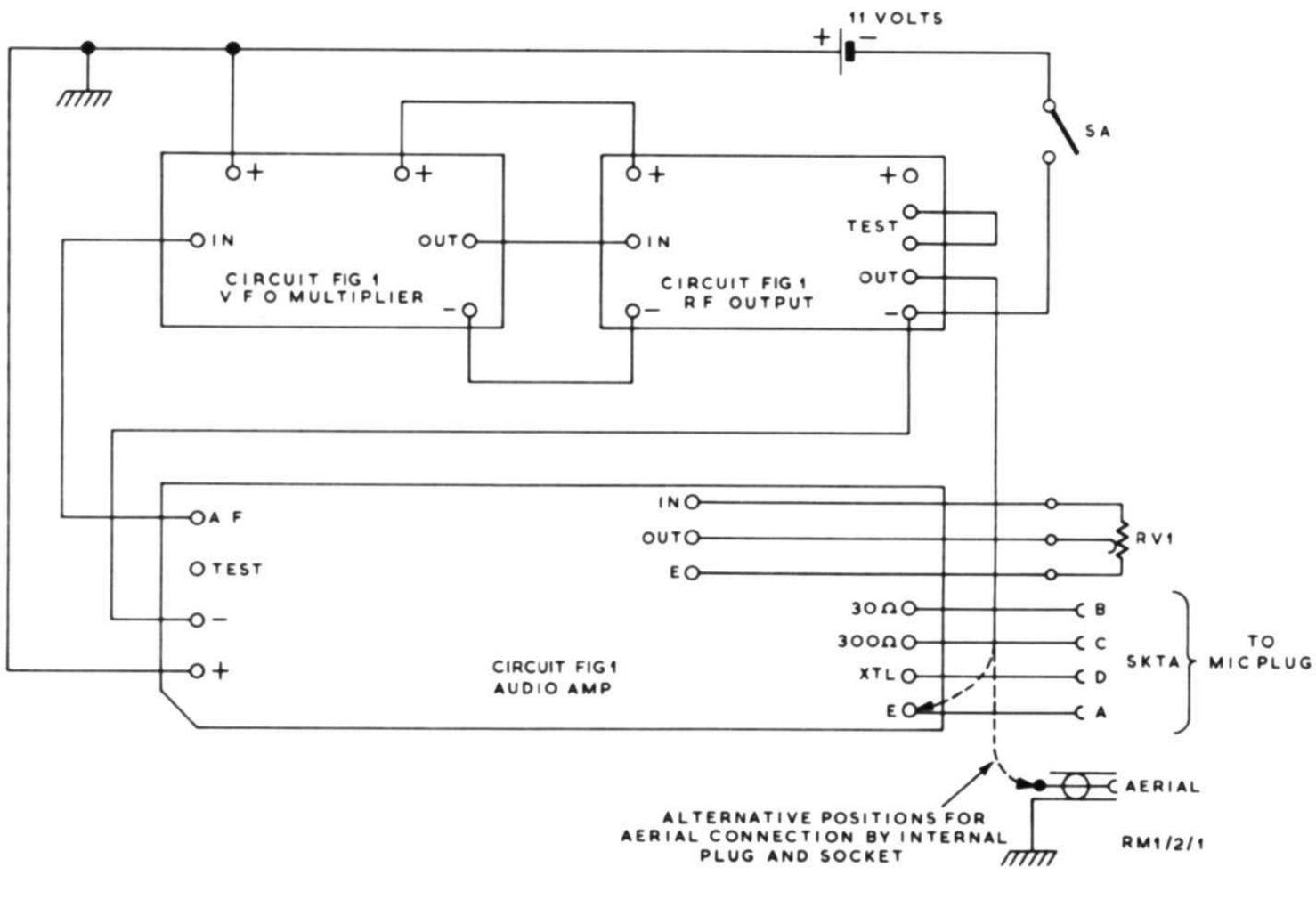


Fig. 2.1. Schematic of Transmitter

Fig. 2.2 is a photograph of the transmitter with its case open. The screening can on the right contains the variable-frequency oscillator and multiplier circuit. The input microphone transformer of the audio amplifier can be seen at the top left.

The audio amplifier uses four amplifying stages together with two stages feeding a diode limiter, the purpose of which is to prevent over-modulation on abnormally loud signals such as can occur, for example, under O.B. conditions. The amplifier feeds into the v.f.o. and multiplier circuit. This employs two transistors operating as oscillator and tripler, while modulation is carried out by a capacitor diode. The modulated output from

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the tripler is passed directly to the r.f. output unit which employs a buffer amplifier and class-C output stage.

A special battery is required, giving an initial on-load voltage of 11 volts and a continuous-drain service life of about 6 hours.

2.2 Circuit Description

A circuit diagram of the radio microphone transmitter is given in Fig. 1.



Fig. 2.2. Transmitter with Case Open

2.2.1 Audio Amplifier

The three inputs to the audio amplifier, which individually accept 30-ohm, 300-ohm and crystal microphones, are each provided with a 6-μH r.f. choke in series to decouple the microphone lead to r.f. when it is used as an aerial. The earth connection to the microphones is similarly decoupled and for the same reason.

The three types of microphone must be accepted without switching and this is done by the use of a miniature plug (small enough to go through a buttonhole) wired according to the microphone in use, as indicated in Fig. 2.1. An input transformer is used, having a step-down ratio of 16·3 to 1 to accommodate crystal microphones. The secondary of the transformer is used as a step-up auto transformer for 30-ohm microphones. Unfortunately, in this case, the primary shunt capacity, appearing in parallel, causes some loss at the high audio frequencies. 300-ohm microphones are fed in directly to the base of TR1 in parallel with the transformer secondary winding.

These compromise arrangements have to be accepted in view of the acute space limitation. They are reasonably satisfactory in practice for all types of programme material using the radio microphone.

TR1 is a common-emitter amplifier with negative feedback from R4 to increase the input impedance. From the collector of TR1 the signal passes via C4 and RV1, the main volume control, to TR2. TR2 is an emitter-follower stage used to isolate the volume control from the automatic gain-limiter circuit, embodying the four diodes MR1, MR2, MR3 and MR4.

From TR2, the signal passes via C7, R10 and C9 to the base of TR3 which, with TR4, forms a negative feedback pair having a very high input impedance. This high impedance is necessary to complete the isolation of the limiter stage. TR3, a common-emitter amplifier with negative feedback from R17, is directly coupled to TR4, an npn transistor. The collector circuit of TR4 includes R17 as part of the load resistance and this greatly increases the degree of negative feedback. The gain of TR3 and TR4 together is roughly equal to the ratio of the values of R19 and R17.

The output from TR4 is split two ways, one through C17, C21 and R20 to the v.f.o. circuit and the other via C18 to the base of TR5, a common-emitter stage having a high input impedance due to negative feedback across R26. TR6, an emitter-follower stage, is directly coupled to TR5 and feeds the limiter at low impedance from R28.

The limiter consists principally of the two diodes, MR1 and MR2, which are to audio frequencies effectively connected in parallel. These diodes form with R10 a variable potential divider across the load of TR2, the feed to TR3 being taken from the tapping point and then through C9. The a.c. resistance of the diodes depends on the d.c. flowing in them. This d.c. is obtained by rectifying the signal output from TR6 with the diodes MR3 and MR4 and smoothing with C10 and C13. Thus the ratio of the potential divider is increased or reduced as the signal increases or reduces. The purpose of the limiter is to prevent accidental overload, and it is effectively inoperative at normal signal levels. The capacitors C11 and C12 short-circuit the diodes at carrier frequency. This prevents rectification of stray pickup signals which might otherwise cause feedback troubles.

C21, which is in parallel with R20 in the output to the v.f.o. stage, gives a small lift at the high audio frequencies to compensate for loss in the input microphone transformer.

R21 is chosen on test to give a transmitter deviation of ±19 kc/s if a zero-level 600-ohm tone source is connected between TEST and earth.

2.2.2 V.F.O. and Multiplier Circuit

The input from the audio amplifier circuit is applied via the choke L1 to the capacitance diode D1 which, at radio frequencies, is connected across the tuned circuit L2-C5, in the collector circuit of TR1, the oscillator. The oscillation occurs in the range 15 Mc/s to 22 Mc/s and is maintained by feedback through C6.

The Zener diode, in conjunction with R8, stabilises the d.c. supply to the oscillator as the battery runs down. However, to obtain the high degree of stability necessary, the cathode of the capacitance diode is returned to a small negative voltage. This is obtained from the potential divider consisting of R1 and R24 in the audio amplifier circuit. This compensates for the finite slope of the Zener diode and the voltage across the diode D1 remains sensibly constant during the useful life of the battery.

L1, C1 and C2 form a filter to prevent r.f. feedback into the a.f. amplifier.

The output of the oscillator is passed through the small capacitor C7, to the tripler stage, consisting of TR2 operating as a common-emitter amplifier with a high emitter-biasing resistor, R7. The high bias voltage, in conjunction with the comparatively high input signal level, results in a collector current rich in harmonics. The tuned output circuit, L3 and C9, resonates at the third harmonic, i.e. 45 Mc/s to 66 Mc/s, and signals at this frequency are passed on via C10 to the r.f. output stage.

2.2.3 R.F. Output Stage

The input from the v.f.o. and multiplier circuit is taken directly to the base of TR1, a common-emitter stage, with a tuned transformer in the collector circuit. The purpose of this stage is to act as a buffer between the v.f.o. and the output stage and to provide sufficient drive for the class-C output transistor, TR2. TR2 is an npn transistor, biased so that only positive-going signals can be accepted. Signals in the negative direction carry the base/emitter junction well into the cut-off region.

The output transformer is matched to the aerial by means of the π coupler consisting of C7, L1 and C8. The a.o.t. capacitor, C6, is only fitted if neutralising is found to be necessary, when it should be made as small as

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possible in order to avoid loss of output. L2 isolates the TEST point from the r.f. output.

2.3 General Data

Frequency Correction

The frequency correction provided by ZD1 in the v.f.o. unit, in conjunction with the a.o.t. resistance R24 in the audio amplifier unit, should be such that the output frequency does not change by more than 5 kc/s as the battery voltage drops from 11 to 10 volts.

Frequency Stability

The frequency drift should not exceed ±50 kc/s after one hour and ±70 kc/s after two hours, when operating at about 50 Mc/s.

Deviation

With zero-level input to the TEST point in the audio amplifier circuit, the deviation should be 19 ±2 kc/s.

Power Output

The r.f. power output should not be less than 120 mW.

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SECTION 3

RECEIVERS RC4/1 AND RC4/1A

3.1 General Description

The RC4/1 and RC4/1A are fully-transistorised f.m. receivers operating in the range 45 Mc/s to 65 Mc/s. They are of the superheterodyne type, and on one sub-chassis have input, r.f.-and-mixer, and oscillator-and-buffer stages. These stages are followed by three i.f. amplifiers, a limiter, a Foster-Seeley discriminator, an a.g.c. amplifier, a monitoring amplifier and a line-up oscillator Type OS2/17.

All the r.f. and i.f. stages are designed on the a.c.-coupled cascode principle, and each comprises a common-emitter stage aperiodically coupled to a common-base stage which has a tuned output circuit. In order to derive the maximum benefit from the cascode coupling, the two halves of each stage are mounted in separate screening boxes. This isolates the high-impedance output of the common-base transistor from the high-impedance input of the preceding common-emitter transistor, and considerably increases the inherent stability of the receiver. The arrangement has the further advantage of allowing low-impedance coupling between the stages and permits a compact mechanical layout.

Extensive use is made of printed circuit techniques, each circuit being mounted on a separate board and contained within its own copper screening can. This method of construction reduces the instability troubles normally encountered with transistor r.f. and i.f. amplifiers.

The receivers are continuously tunable over the frequency band with the aid of a slow-motion dial. A centre-zero tuning meter and a.f. monitoring jack are provided.

Receiver RC4/1 normally draws power from the mains, but in the event of power failure it will automatically change over to an external 24-volt supply if connected. When mains power is restored, the receiver automatically reverts to it.

Receiver RC4/1A is intended for portable use and uses an internal battery with no provision for mains power working. It is provided with a telescopic aerial and carrying case.

The line-up oscillator, Type OS2/17 (which was not fitted to early receivers) consists of an 860-c/s constant-amplitude phase-shift oscillator built on an individual printed board and mounted inside the receiver. The oscillator is brought into use by means of a pushbutton. Tone is then provided at the output of the receiver equal in amplitude to the signal

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which would be obtained when receiving a signal from transmitter TM3/1 deviated to ±19 kc/s.

Figs. 3.1 and 3.2 are two views of a receiver removed from its case. The four cans visible in Fig. 3.1 house from left to right the limiter and three i.f. amplifiers. Behind the i.f. cans on the right, the r.f. unit can just be seen with the aerial socket above it. The monitoring amplifier is on the left above two relays, RLA and RLB. The circuit plate of the line-up oscillator OS2/17 can be seen at the bottom right. Fig. 3.2 shows the underside of a receiver. The can at the top houses the discriminator, while the coaxial socket on the left is SKTB (Fig. 2). The a.f. monitoring jack is at the bottom right. To the right of the aerial input socket at the top are the mains input plug, the 24-volt input plug and the a.f. output plug.

3.2 Circuit Description

A circuit diagram of the receiver is given in Fig. 2, while Fig. 3 shows the line-up oscillator OS2/17.

3.2.1 Input and Mixer Stages

The input, r.f.-and-mixer, and oscillator stages are built together on a sub-chassis, being in effect assembled around the 3-gang tuning capacitor, C1a, C1b and C1c. The components comprising each stage are assembled on small printed boards and the whole construction is very compact.

The input signal from the aerial socket, SKTA, is taken to a tap on the aerial-tuning coil, L1, C1a being the main tuning capacitor, with C2 as trimmer. C52 sets the minimum capacitance in the circuit, swamping stray capacitances. L2, which is not coupled electromagnetically to L1, feeds the signal to TR1 from a tap. The complete circuit, consisting of L1, L2 and associated capacitors, provides a fairly selective input circuit, as well as a satisfactory degree of impedance matching between the aerial and TR1.

TR1 is a common-emitter amplifier with negative feedback from R4 in its emitter circuit to increase the input impedance and reduce damping on L2. The output from TR1 is passed via C8 to the low-impedance input circuit of TR2, operating as a common-base amplifier. In the collector circuit of TR2 is the r.f. tuning inductor L3, with its associated capacitors, C1b, C12 and C53.

The signal from TR2 passes via C11 to TR3, a common-emitter amplifier forming the first half of the r.f.-and-mixer cascade pair. Negative feedback from R12 raises the input impedance of TR3 to match the high output impedance of TR2.

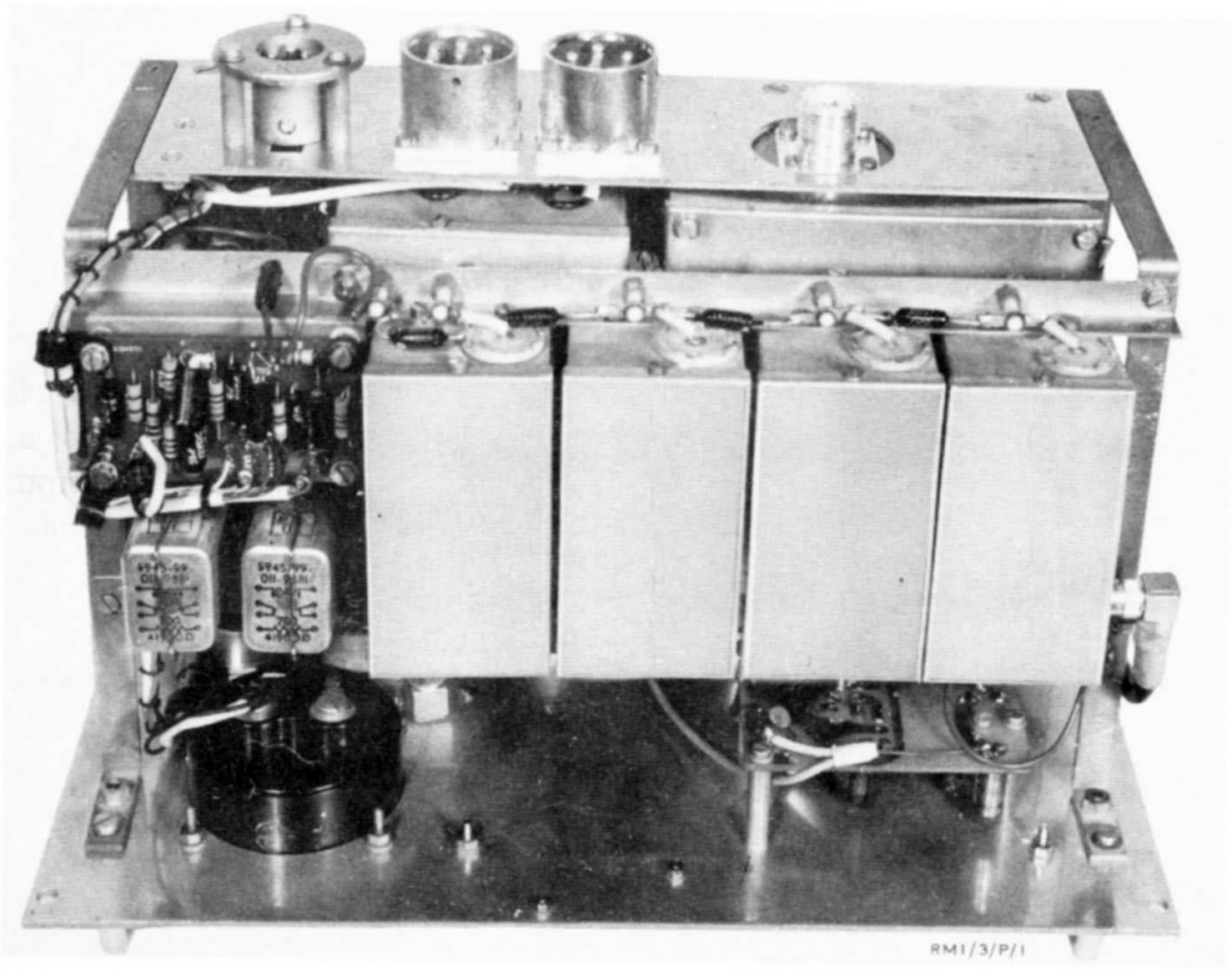


Fig. 3.1. Receiver Removed from Case: Top View

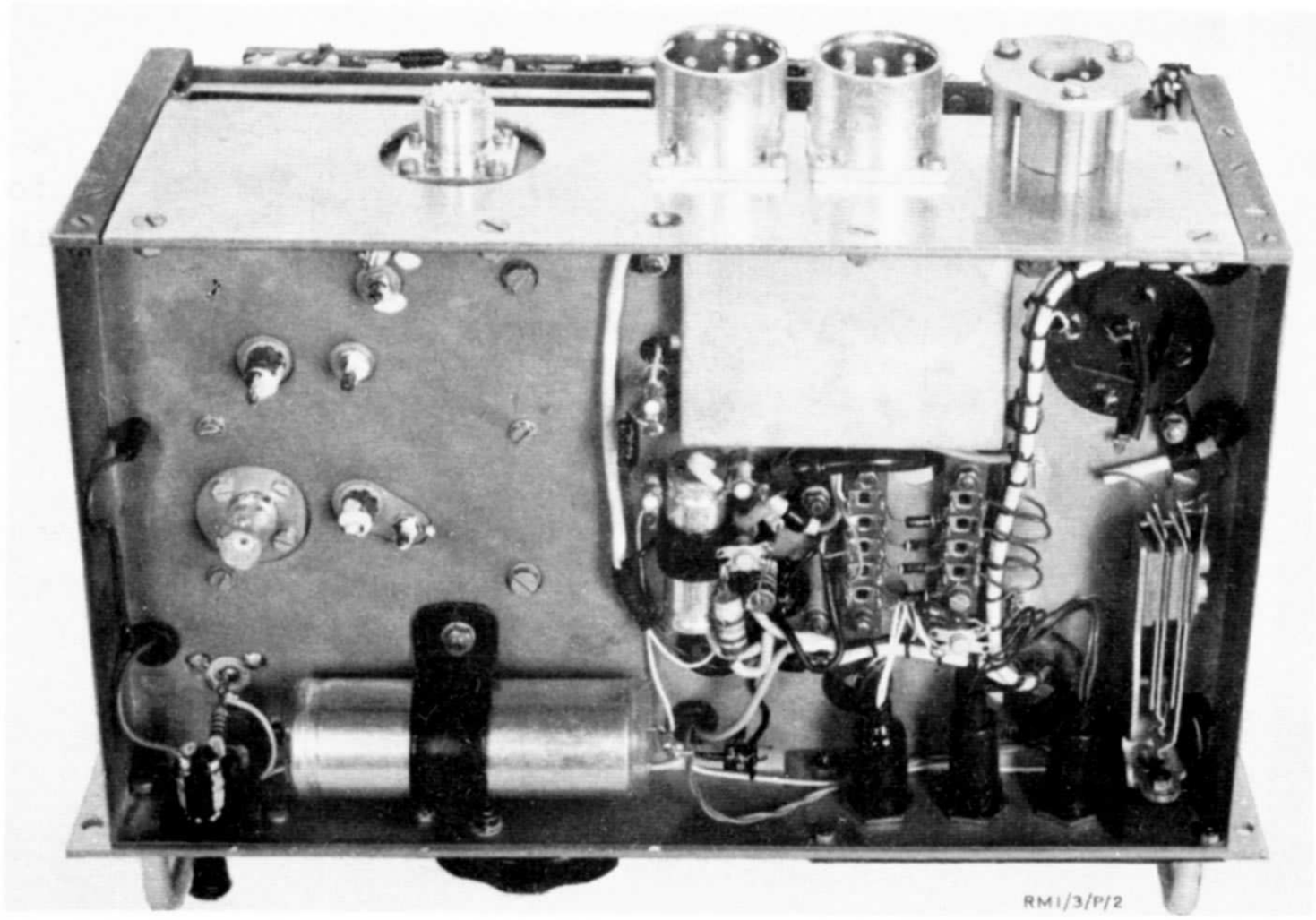


Fig. 3.2. Receiver Removed from Case: Bottom View

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There are two inputs to TR3, one via C11 from TR2 and one via C54 and C55 from the oscillator buffer stage TR4, situated in the next compartment of the screening can.

The mixed output from TR3 collector circuit passes via socket SKTC to socket SKTJ and thence to the emitter of TR6, which forms the second half of the r.f.-and-mixer pair. This is a common-base stage having a high output impedance for feeding the primary of the tuned i.f. coupling in its collector circuit. This coupling consists of L10 and L11 with L9 as the common inductance between them and C28 and C30 as tuning capacitors.

The bandwidth of the r.f. stages is about 2 Mc/s, with a gain of about 15 dB.

3.2.2 Oscillator and Buffer Amplifier

TR4 is the oscillator buffer amplifier and serves to isolate the oscillator. As its collector circuit is connected in parallel with the high impedance coupling between TR2 and TR3, TR4 uses the common-base mode in order to give the necessary high output impedance.

The oscillator, TR5, uses a Colpitts-type circuit, the tuned circuit, consisting of L8 and C1a, being in effect connected between the collector and the common base with the emitter capacitively tapped up the inductance.

3.2.3 I.F. Amplifiers

TR7 is the first i.f. amplifier and the input to its base is obtained from a 3/1 tap on L11. TR7 operates in the common-emitter mode with negative feedback from R28 to keep the input impedance reasonably high. The diode MR10, in parallel with the base/emitter junction of TR7, improves the general performance of the receiver under conditions of high signal strength such as can easily occur when the wearer of the radio-microphone transmitter approaches the receiver.

MR10, which is a general-purpose diode, is under normal circuit conditions reverse-biased and presents a capacitance of about 20 pF to L17. Under very high signal conditions, rectification occurs at the base/emitter junction of TR7, the emitter tending to become negative with respect to the base. When this occurs the reverse bias on MR10 is reduced and so is its capacitance, thus detuning the previous tuned circuit, causing a reduction of signal level. The diode also prevents the base/emitter junction from being driven too far into the cut-off region on the positive half-cycle of the signal.

The output from TR7 passes through the screening can to the emitter of TR8 which, with TR9, operates in a similar way to TR6 and TR7.

From the collector of TR9 the signal passes via C44 to the emitter of TR10, again the second half of a cascode pair. The high-impedance collector circuit of TR10 includes the transformer T1 having a tuned primary and untuned secondary. The output to TR13 is taken directly from the collector via C47, while the secondary of T1 feeds the a.g.c. diode MR1.

The first two i.f. amplifiers have a bandwidth of about 250 kc/s and a gain of 30 dB per stage. The third i.f. amplifier has a relatively wide bandwidth and a gain of 15–20 dB.

3.2.4 Limiter and Discriminator

The limiter stage consists of TR13 operating in the common-emitter mode and as its base-biasing circuit is of comparatively low resistance, the choke L20 has been included to prevent this low impedance from appearing in shunt with T1. The base of TR13 is biased to about 7·7 volts, which implies that the emitter current is between 2 and 2·5 mA in the static condition. On the negative peaks of the input the circuit limits very quickly, the maximum possible emitter current being about 2·65 mA, there then being no voltage left across the transistor. In the positive direction the limiting point is reached just as quickly as the base/emitter potential is reversed by the peaks of the signal. The time constant of C62 and R66 is sufficiently long to hold the emitter at a steady potential. The diode MR7 prevents the base/emitter junction being driven too far into the cut-off region on the positive peaks.

The output from the limiter passes via SKTE and SKTF to TR14, the discriminator pre-amplifier. This is again a common-base stage giving a high-impedance feed to the Foster-Seely discriminator. The output from the discriminator is taken via T3 which has, in series with its primary winding, the centre-zero tuning indicator M1. The potential divider formed by R75 and R76 provides a feed for the a.f. monitoring amplifier.

The limiter and discriminator pre-amplifier stages have a joint gain of 15–20 dB. The discriminator bandwidth is 700 kc/s.

3.2.5 Monitoring Amplifier

The monitoring amplifier, which is intended for headphone use only, consists of two common emitter stages in tandem, with the volume control, RV1, forming part of the base-biasing arrangements for TR16. Both stages are provided with negative feedback from resistors in their emitter circuits.

3.2.6 A.G.C. Amplifier

The a.g.c. diode is fed from the secondary of the i.f. transformer T1, the load being R44 with C48 as smoothing capacitor. This is followed by

two directly-coupled transistors; the first, TR11, operates in the common-emitter mode and the second, TR12, in the common-collector mode. TR12 has a low output impedance and forms with R86 a potential divider across the 12-volt supply. The a.g.c. voltage to TR7 and TR3 is obtained from the junction between TR12 emitter and R86. The ratio of this potential divider, which controls the voltage applied to the a.g.c. line, depends on the d.c. output from MR1, and this in turn, is a measure of the input signal level. L6 and L13 along with lead-through capacitors C14, C32 and C50, prevent r.f. feedback.

3.2.7 Power Supply Circuit

The RC4/1 receiver, as already stated, has facilities for battery or mains power working. The mains unit is conventional, a bridge rectifier consisting of MR2-5 being fed from the mains transformer T2. C60, R61 and C61 provide smoothing. The output is at 12 volts, stabilised by a Zener diode ZD1. Signal lamps ILP1 and ILP2 provide illumination for the tuning dial.

With mains power connected, relay RLA operates, breaking the 24-volt battery-supply circuit and connecting R62 across its winding to reduce the resistance in the circuit but maintaining sufficient holding current through the winding. This reduction of the holding current also assists in obtaining a quick change-over to battery working if the mains power should fail. In such circumstances, the battery circuit is completed via contacts springs A2-22 and A2-21. Relay RLB now operates and changes over the dial lights to the d.c. supply. When mains power is restored, the circuit reverts to a.c. working by the operation of relay RLA. MR6 prevents the operation of RLB when the receiver is working on mains power. During the change-over period from the one supply to the other, the 12-volt supply is sufficiently maintained by the charge in C61.

The RC4/1A always draws its power from a battery fitted within the receiver in place of a mains unit. No provision is made for change-over to an alternative supply.

3.3 General Data

Output Level

The a.f. output should be -45 dB across a 600-ohm load when the r.f. input signal has a deviation of ±19 kc/s at 1000 c/s. Variation of the input level between 5 μV and 100 μV should not cause the output level to change by more than 1 dB.

A.M. Rejection

The a.m. rejection should be better than -35 dB with an input signal

between 10 μV and 100 μV r.m.s., frequency-modulated to ±30 kc/s deviation and amplitude-modulated to 40%.

Frequency Response

The frequency response should be flat within ±3 dB between 100 c/s and 15 kc/s.

Signal/Noise Ratio

The signal/noise ratio should be better than 50 dB with an input between 100 μV and 100 mV deviated to ±75 kc/s, falling to 30 dB with an input signal of about 5 μV.

Harmonic Distortion

The harmonic distortion should be less than 1% with an r.f. input between 10 μV and 10 mV deviated to ±60 kc/s at 1 kc/s.

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SECTION 4

OPERATIONAL USE

4.1 Transmitter TM3/1

4.1.1 Aerial

The aerial as already stated may take two forms. For very restricted ranges the screen of the microphone lead may be used, while for normal use and to obtain the longest possible ranges a 3-to-4 ft length of PUF1/3 cable should be connected to the VMP socket on the transmitter and draped about the user in the most convenient way. Some experiment and compromise may be necessary before the best way is found.

Internally, the aerial in use must be connected to the output stage by means of a small wander plug located inside the case. (See Fig. 2.1.)

4.1.2 Battery

A new battery should be used for each separate transmission, although a series of transmissions following one another over a period of perhaps 4-5 hours can be done on one battery. In high ambient temperatures the life of the battery may be reduced. Note that the voltage of the battery drops suddenly as it becomes exhausted.

After changing the battery, it is desirable to switch on the transmitter some 5 or 10 minutes before it is required operationally. This allows time to prove that everything is functioning normally and to make a final check on the receiver tuning.

An external battery, e.g., a 12-volt accumulator, can be used if desirable. In these circumstances a dummy battery must be fitted between the battery clips in the case and the leads from it taken out of the case through the grommet positioned near the negative clip.

4.1.3 Tuning

The TM3/1 transmitter must be tuned to the required channel before use and this should be done as follows:

First remove the lid of the v.f.o. multiplier unit, and tune L2 to about 1/3 of the required frequency. It is preferable to do this by monitoring the v.f.o. frequency rather than the output frequency as it is very easy to select the wrong submultiple. Now tune L3 in the v.f.o. unit to resonance. This can be by using an Avometer on its 0/100-mA range, connected in place of the TEST link in the r.f. output unit, or by the use of a simple indicator,

such as a grid-dip meter, loosely coupled to L3. If an Avometer is used, some adjustment of T1 in the r.f. output unit may be necessary before any useful reading is given on the Avometer.

After adjusting L3, tune T1 and L1 in the r.f. output unit for maximum output as observed on the Radio Microphone Test Set Type TE1/6. A new test set, Type TE1/8, is being designed for the TM3/1, but in the meantime the old test set may be used without closing the lid, care being taken to ensure that the cases of the TM3/1 and the test set are connected together.

Finally retrim L3 in the tripler stage so the output frequency is correct when the lid is on the screening box. Remove the test set and connect the aerial.

It may be found that L3 does not quite tune at 45 Mc/s or at 65 Mc/s, but this is not important so long as the power output is maintained at a minimum of 120 mW as indicated on an r.f. power meter.

4.2 Receivers RC4/1 and RC4/1A

4.2.1 Aerial

The type of aerial required depends on the circumstances under which the associated radio microphone transmitter is being used. For maximum range, a Yagi array must be used, but for general service a half-wave dipole or quarter-wave rod aerial should be sufficient. When the receiver is being used in close proximity to the transmitter, a relatively inefficient aerial, such as a few feet of wire, is all that is necessary.

If a G.S.V. tunable dipole is being used, it may be tuned using the receiver as an indicator in the following way:- First set the receiver and transmitter to the required operating frequency, then detune the receiver slightly to one side as indicated by the centre-zero tuning meter, say to the positive side and just below the knee of the discriminator characteristic. Now move the transmitter physically away from the receiver until the reading is reduced to about half what it was. The receiver in this condition will be well below the effective limiting level, and if the aerial is now tuned the resonance point will be shown by a distinct peak on the tuning meter. After tuning the aerial, return the receiver to its proper operating point.

By this means, the aerial is tuned slightly, but less than 100 kc/s, away from the correct frequency. This is immaterial as the aerial tuning is very broad.

For general programme purposes, a minimum r.f. input of 50 μV is necessary, although the receiver will give acceptable communication quality with an input of only 3 μV.

4.2.2 Tuning

During the initial tuning of the receiver to the radio microphone transmitter, the two must be separated by at least 10 feet, otherwise spurious tuning positions may be observed. When the receiver is correctly tuned the tuning indicator should be at mid scale, i.e., with the pointer on zero, and movement of the tuning knob should cause the pointer to move in the same direction, e.g., a clockwise movement of the tuning knob should cause the pointer to move from left to right.

4.2.3 Line-up

With the gain control on the radio microphone transmitter set to minimum, the LINE-UP TONE pushbutton switch on the receiver should be operated, sending tone to line. This corresponds to a transmitter deviation of ±19 kc/s. The radio microphone gain control should now be set to give the correct level, as monitored at the far end of the line, when the user speaks with normal voice.

This line-up procedure presupposes that the level control, RV1, on the tone oscillator has previously been adjusted to give the correct output. (See Section 4.3.2 below.)

Should the receiver not contain a line-up oscillator, connect a 600-ohm zero-level tone-source via a repeating-coil to the radio microphone transmitter between the TEST point on the a.f. board and the positive clip. The transmitter is now modulated to line-up tone level.

4.2.4 Receiver Type RC4/1A

This receiver is fitted with a telescopic aerial which is connected to the aerial socket by means of a wander plug. If this plug is removed any suitable alternative aerial may be used.

The operational line-up of this receiver is the same as for receiver RC4/1.

4.3 Maintenance

4.3.1 General

No routine electrical maintenance on transmitter or receiver is necessary. If any faults occur which cannot be simply and quickly eliminated, the circuit plate concerned or, if this cannot be located, the complete item, should be returned to Equipment Department who have the necessary test gear for proper servicing.

In the case of the receiver, a quick overall test, which is a useful gain

check, is to measure the a.g.c. voltage across R86 with varying input voltage to the aerial socket. The figures given below should be obtained.

Input Signal to Receiver	*A.G.C. Voltage*
2 µV	10 ±1
10 µV	6·3 ±0·5
50 µV	3·6 ±0·5
100 µV	3·0 ±0·5
500 µV	2·3 ±0·5
1 mV	2·1 ±0·5
1 to 100 mV	1·8 ±0·5

Slight variation from the limits given for low signal levels is not very significant, but at high signal levels, e.g., in excess of 500 µV, high a.g.c. readings in relation to the figures quoted indicate a loss of gain. The most likely cause of low gain is poor alignment.

The receiver cannot be readily realigned without the use of a wobbulator, and should the above test indicate a need for action, the receiver should be returned to Equipment Department.

Overall tests employing microphone, transmitter and receiver under known conditions, should, as a matter of routine, always be conducted prior to field use. These give a useful rough assessment of performance.

4.3.2 Oscillator OS2/17: Output Check

If it is required to check the level of the line-up tone output from the OS2/17 oscillator, the following procedure should be adopted.

Connect an f.m. signal generator to the input of the RC4/1 and set the output to 100 µV at 55 Mc/s, modulated at 1 kc/s to a deviation of ±19 kc/s. Having tuned the receiver to this, note the reading on a P.P.M. connected to the output. Remove the modulation of the input signal and press the line-up tone switch button, adjusting RV1 in the tone circuit (see Fig. 3) until the reading on the P.P.M. is the same as that obtained when the signal from the r.f. generator was modulated.

COMPONENT TABLE: FIG. 1

AUDIO AMPLIFIER: PAGE 1

Comp.	Loc.	Type	Tolerance per cent
C1	H2	U.C.C. SM42S 6V	
C2	H3	U.C.C. SM42S 6V	
C3	H5	T.C.C. CE5V 3V	
C4	J3	T.C.C. CE2V 6V	
C5	H5	T.C.C. CE7V 3V	
C6	K3	T.C.C. CE2V 3V	
C7	L4	T.C.C. CE2V 3V	
C8	L2	T.C.C. CE2V 3V	
C9	M4	T.C.C. CE2V 3V	
C10	L5	T.C.C. CE5V 3V	
C11	L6	Erie K350081/831	
C12	M6	Erie K350081/831	
C13	N5	T.C.C. CE5V 3V	
C14	N4	T.C.C. CE5V 3V	
C15	P7	T.C.C. CE7V 12V	
C16	P2	T.C.C. CE5V 3V	
C17	R3	T.C.C. CE2V 6V	
C18	R4	T.C.C. CE2V 6V	
C19	S5	T.C.C. CE6V 6V	
C20	T4	T.C.C. CE4V 12V	
C21	P2	Erie 831/T/12V	
L1	G2	Painton C3 No.200504	
L2	G3	Painton C3 No.200504	
L3	G3	Painton C3 No.200504	
L4	G4	Painton C3 No.200504	
R1	H2	Erie N1	2
R2	H5	Erie N1	2
R3	H2	Erie N1	2
R4	J4	Erie N1	2
R5	J5	Erie N1	2
R6	K2	Erie N1	2
R7	K5	Erie N1	2
R8	L5	Erie N1	2

COMPONENT TABLE: FIG. 1

AUDIO AMPLIFIER: PAGE 2

Comp.	Loc.	Type	Tolerance per cent
R9	M2	Erie N1	2
R10	L4	Erie N1	2
R11	L6	Erie N1	2
R12	N2	Erie N1	2
R13	M5	Erie N1	2
R14	M5	Erie N1	2
R15	N2	Erie N1	2
R16	N4	Erie N1	2
R17	P5	Erie N1	2
R18	P3	Erie N1	2
R19	P4	Erie N1	2
R20	R2	Erie N1	2
R21	R1	Painton 90	2
R22	R2	Erie N1	2
R23	R5	Erie N1	2
R24	S2	Erie N1	2
R25	S2	Erie N1	2
R26	S4	Erie N1	2
R27	S5	Erie N1	2
R28	T5	Erie N1	2

COMPONENT TABLE: FIG. 1

V.F.O. MULTIPLIER

Comp.	Loc.	Type	Tolerance per cent
C1	B13	Erie K350081/831	
C2	C13	Erie K350081/831	
C3	D14	Erie K7004/831	
C4	C9	Erie K7004/831	
C5	D10	Johnson Matthey & Co. A15E 50V	10
C6	E11	Erie K350081/831	
C7	F10	Erie N030AD	
C8	H13	Erie K350081/831	
C9	H10	Erie N030AD	
C10	H10	Erie N030AD	
C11	J13	Erie K350081/831	
L1	B11	Painton C3 No.200504	
L2	E10		
L3	G10		
R1	A13	Erie N1	2
R2	D13	Erie N1	2
R3	E9	Erie N1	2
R4	E13	Erie N1	2
R5	F9	Erie N1	2
R6	F13	Erie N1	2
R7	G13	Erie N1	2
R8	F8	Erie N1	2

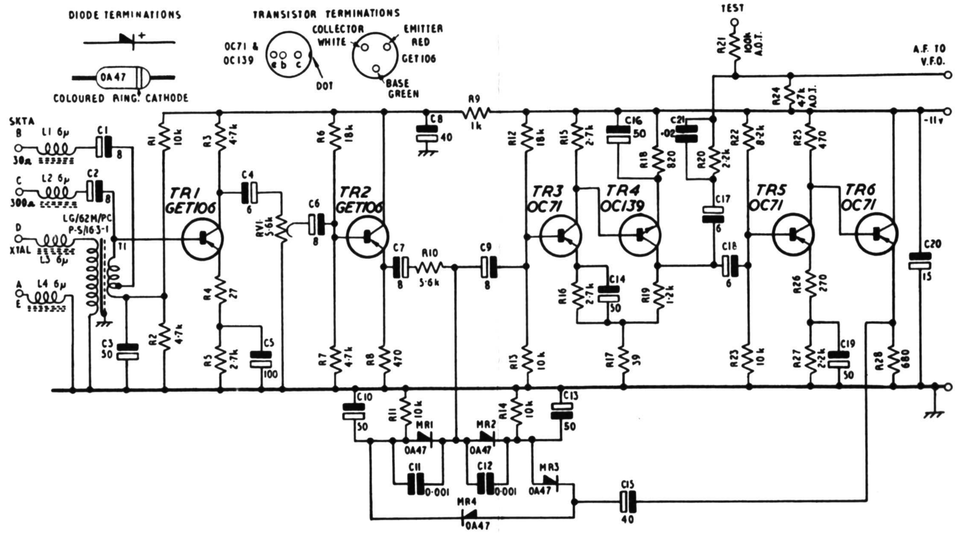
COMPONENT TABLE: FIG. 1

RADIO FREQUENCY OUTPUT

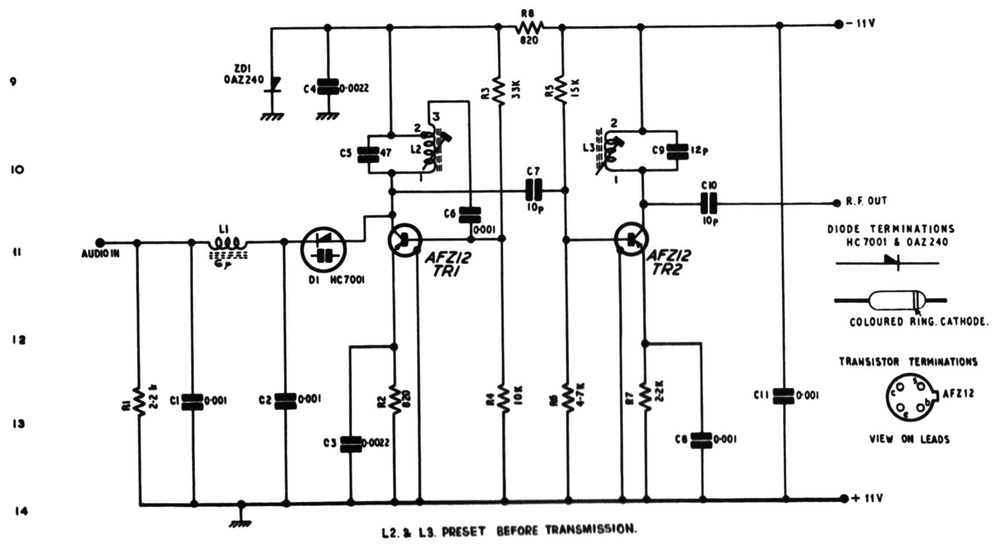
Comp.	Loc.	Type	Tolerance per cent
C1	P13	Erie K350081/831	
C2	P11	Erie N750AD	
C3	S11	Erie N030AD	
C4	S10	Erie K350081/831	
C5	T11	Erie K350081/831	
C6	V13	Erie N750AD	
C7	V14	Erie N750AD	
C8	W13	Erie N3300AD	
C9	Y13	Erie K350081/831	
L1	W13	Painton C3 No.200504	
L2	X13	Painton C3 No.200504	
R1	P11	Erie N1	2
R2	P13	Erie N1	2
R3	R13	Erie N1	2
R4	S10	Erie N1	2
R5	S13	Erie N1	2
R6	T13	Erie N1	2
T1	R11		

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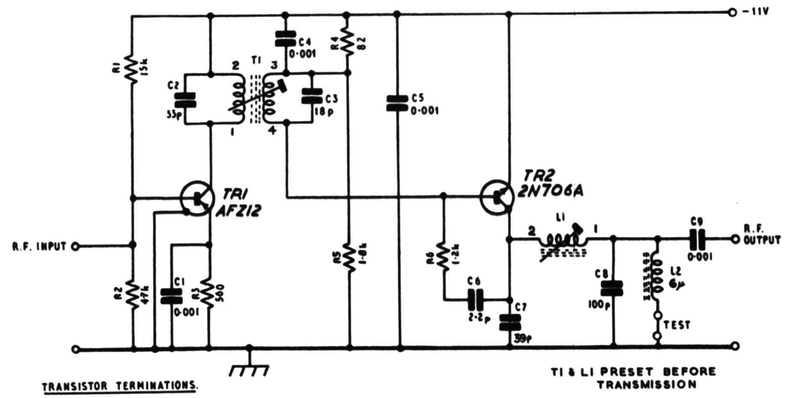


AUDIO AMPLIFIER



L2. & L3. PRESET BEFORE TRANSMISSION.

V.F.O. MULTIPLIER



T1 & L1 PRESET BEFORE TRANSMISSION

RADIO FREQUENCY OUTPUT

RADIO MICROPHONE TRANSMITTER TM3/1: CIRCUIT

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COMPONENT TABLE: FIG. 2

PAGE 1

Comp.	Loc.	Type	Tolerance per cent
C1a	A5	Wingrove & Rogers C28-143, 6-44-8pF	
C1b	F6	Wingrove & Rogers C28-143, 6-44-8pF	
C1c	M6	Wingrove & Rogers C28-143, 6-44-8pF	
C2	A5	Mullard 1004EA/12E	
C3	C5	Erie K350081/831 500V	20
C5	D2	S.T. & C. 455/LWA/2A 500V	
C6	D3	Erie K350081/831 500V	20
C7	D6	Erie K350081/831 500V	20
C8	E5	Erie K350081/831 500V	20
C9	E2	S.T. & C. 455/LWA/2A 500V	
C10	F3	Erie K350081/831 500V	20
C11	G4	S.E.C. P.F.125V	1 pF
C12	F6	Mullard 1004EA/12E	
C13	H6	Erie K350081/831 500V	20
C14	J2	S.T. & C. 455/LWA/2A 500V	
C15	K6	Erie K350081/831 500V	20
C16	L4	Erie N030AD	0·1 pF
C17	L6	Erie K350081/831 500V	20
C18	M2	S.T. & C. 455/LWA/2A 500V	
C19	M5	Hunt L5/1S 250V	3
C20	N6	Mullard 1004EA/12E	
C21	P5	T.C.C. CSM15 350V	2
C22	Q3	Erie K350081/831 500V	20
C24	Q6	Erie K7004/811 300V	25
C25	S6	Erie K7004/811 500V	
C26	S5	Erie K7004/811 500V	
C27	S3	Erie K7004/811 500V	
C28	S3	S.E.C. PF 125V	2 pF
C29	T2	S.T. & C. 455/LWA/2A 500V	
C30	U3	S.E.C. PF 125V	2 pF
C31	U5	Erie K7004/811 500V	
C32	U2	S.T. & C. 455/LWA/2A 500V	
C33	V3	Erie K7004/811 500V	

COMPONENT TABLE: FIG. 2

PAGE 2

Comp.	Loc.	Type	Tolerance per cent
C34	V6	Erie K7004/811 500V	
C35	X6	Erie K7004/811 500V	
C36	X5	Erie K7004/811 500V	
C37	X3	Erie K7004/811 500V	
C38	X3	S.E.C. PF 125V	2 pF
C39	X2	S.T. & C. 455/LWA/2A 500V	
C40	Z3	S.E.C. PF 125V	2 pF
C41	AB3	Erie K7004/811 500V	
C42	AB6	Erie K7004/811 500V	
C43	AD6	Erie K7004/811 500V	
C44	AD5	Erie K7004/811 500V	
C45	AD3	S.E.C. PF 125V	2 pF
C46	AD2	S.T. & C. 455/LWA/2A 500V	
C47	AE6	S.E.C. PF 125V	1 pF
C48	AE6	U.C.C. SM42S 6V	
C49	AF3	Erie K7004/811 500V	
C50	AJ2	S.T. & C. 455/LWA/2A 500V	
C51	Z6	Erie K7004/811 500V	
C52	B5	Erie N750AD 750V	10
C53	G6	Erie N030AD 750V	0·5 pF
C54	J3	Erie K7004/811 500V	25
C55	L3	Erie K350081/831 500V	20
C56	P7	T.C.C. CSM15	2
C57	N1	S.T. & C. 455/LWA/2A 500V	
C60	F12	Plessey CE17042/13 50V	
C61	J12	U.C.C. SC642/6LS 12V	
C62	M12	Erie K7004/811 500V	
C63	N9	Erie K7004/811 500V	
C64	R12	Erie K7004/811 500V	
C65	R12	Erie K7004/811 500V	
C66	R9	Erie K7004/811 500V	
C67	R10	Mullard E7890	
C68	R10	S.E.C. PF 125V	3 pF
C69	R8	S.T. & C. 455/LWA/2A 500V	
C70	V10	S.E.C. PF 125V	5
C71	V11	S.E.C. PF 125V	5

COMPONENT TABLE: FIG. 2

PAGE 3

Comp.	Loc.	Type	Tolerance per cent
C72	V10	Mullard E7890	
C73	W9	S.E.C. PF 125V	2 pF
C74	W11	S.E.C. PF 125V	2 pF
C75	Y12	Erie K350081/831 500V	
C76	Y9	T.C.C. CE116BR 12V	
C77	AD9	U.C.C. SM65S 12V	
C78	AE10	U.C.C. SM42S 6V	
C79	AF12	U.C.C. SM51S 6V	
C80	AF9	U.C.C. SM42S 6V	
C81	AH9	U.C.C. SM42S 6V	
C82	AH12	U.C.C. SM48S 6V	
C83	M8	S.T. & C. 455/LWA/2A 500V	
C84	Z9	U.C.C. SM149S 12V	
L1	A5	DA10837	
L2	B5	DA10838	
L3	E4	DA10839	
L4	L3	Painton 200/150	
L6	N1	Painton 200/151	
L7	K8	Painton 200/151	
L8	P4	EA11859	
L9	T3	DA10841	
L10	T3	DA10840	
L11	T3	DA10842	
L12	U1	Painton 200/151	
L13	V1	Painton 200/151	
L14	Y1	Painton 200/151	
L15	Y3	DA10840	
L16	Y3	EA11860	
L17	Y3	DA10842	
L20	K11	Painton 200/150	
L21	N8	Painton 200/151	
L22	U8	Painton 200/151	
L23	S9	DA10843	
L24	T10	DA10843	

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COMPONENT TABLE: FIG. 2

Comp.	Loc.	Type	Tolerance per cent
R1	C6	Erie N1 0·1W	2
R2	C4	Erie N1 0·1W	2
R3	D4	Erie N1 0·1W	2
R4	D5	Erie N1 0·1W	2
R5	D6	Erie N1 0·1W	2
R6	F6	Erie N1 0·1W	2
R7	H6	Erie N1 0·1W	2
R8	H3	Erie N1 0·1W	2
R9	J3	Erie N1 0·1W	2
R10	J6	Erie N1 0·1W	2
R11	J6	Erie N1 0·1W	2
R12	K5	Erie N1 0·1W	2
R13	J3	Erie N1 0·1W	2
R14	L6	Erie N1 0·1W	2
R15	M6	Erie N1 0·1W	2
R16	M3	Erie N1 0·1W	2
R17	P3	Erie 16 0·25W	10
R18	P6	Erie N1 0·1W	2
R19	R6	Erie N1 0·1W	2
R20	R3	Erie N1 0·1W	2
R21	S3	Erie N1 0·1W	2
R22	S6	Erie N1 0·1W	2
R23	T6	Erie N1 0·1W	2
R24	U6	Erie N1 0·1W	2
R25	U3	Erie N1 0·1W	2
R26	W3	Erie 16 0·25W	10
R27	W3	Erie N1 0·1W	2
R28	W5	Erie N1 0·1W	2
R29	W6	Erie N1 0·1W	2
R30	W6	Erie N1 0·1W	2
R31	W3	Erie N1 0·1W	2
R32	X6	Erie N1 0·1W	2
R33	Z6	Erie N1 0·1W	2
R34	Z3	Erie N1 0·1W	2
R35	AB3	Erie 16 0·25W	10
R36	AB3	Erie N1 0·1W	2

COMPONENT TABLE: FIG. 2

PAGE 5

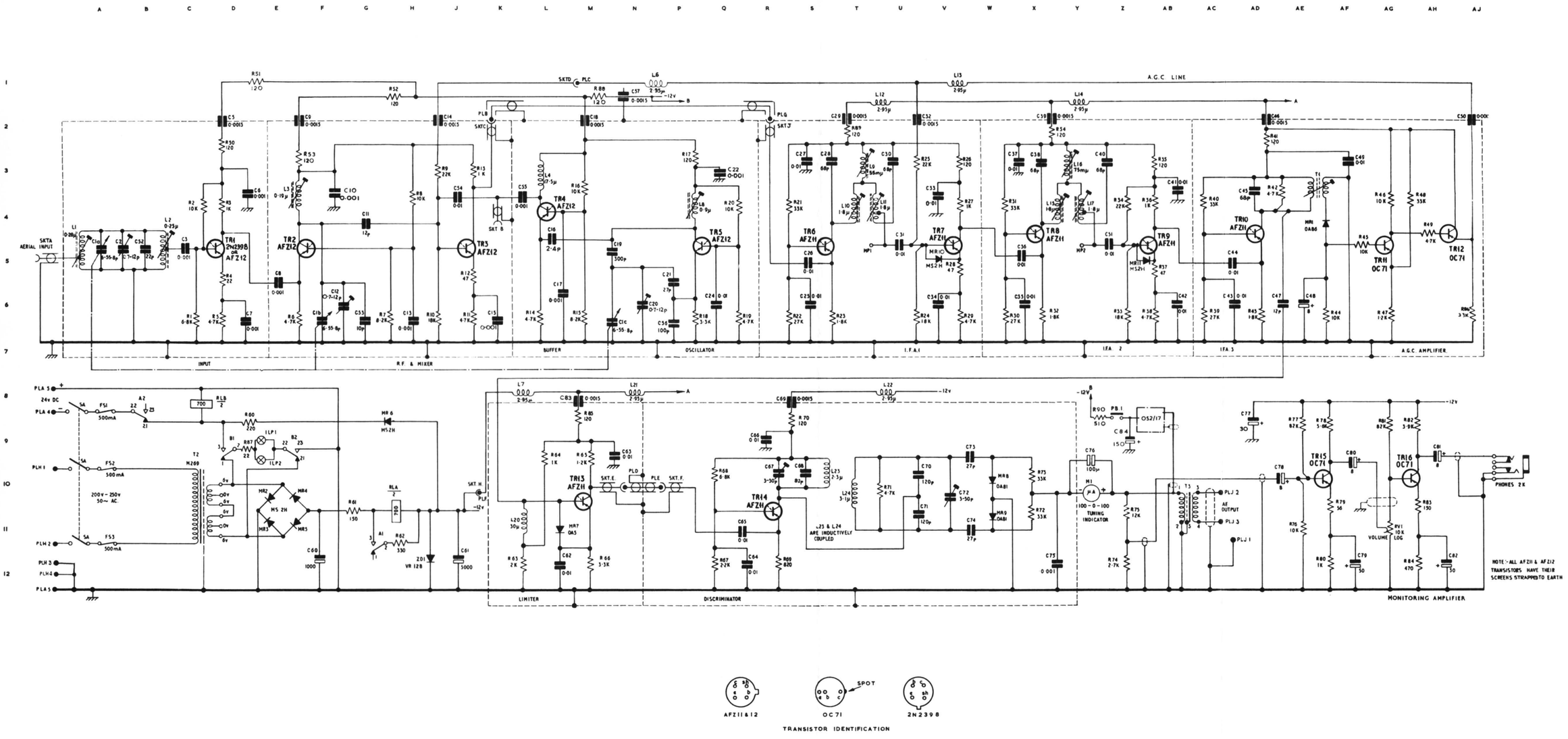
Comp.	Loc.	Type	Tolerance per cent
R37	AB5	Erie N1 0·1W	2
R38	AB6	Erie N1 0·1W	2
R39	AC6	Erie N1 0·1W	2
R40	AC3	Erie N1 0·1W	2
R41	AD2	Erie 16 0·25W	10
R42	AE3	Erie N1 0·1W	2
R43	AD6	Erie N1 0·1W	2
R44	AF6	Erie N1 0·1W	2
R45	AG5	Erie N1 0·1W	2
R46	AG4	Erie N1 0·1W	2
R47	AG6	Erie N1 0·1W	2
R48	AH4	Erie N1 0·1W	2
R49	AH5	Erie N1 0·1W	2
R50	D2	Erie 16 0·25W	10
R51	E1	Erie 16 0·25W	10
R52	H1	Erie 16 0·25W	10
R53	F3	Erie 16 0·25W	10
R54	Y2	Erie 16 0·25W	10
R60	E8	Painton MV1A 1·5W	5
R61	G11	Painton MV1A 1·5W	5
R62	H11	Painton MV1A 1·5W	5
R63	L12	Erie N1 0·1W	2
R64	L9	Erie N1 0·1W	2
R65	M9	Erie N1 0·1W	2
R66	M12	Erie N1 0·1W	2
R67	Q12	Erie N1 0·1W	2
R68	Q10	Erie N1 0·1W	2
R69	R12	Erie N1 0·1W	2
R70	S9	Erie 16 0·25W	10
R71	T10	Erie N1 0·1W	2
R72	X11	Erie N1 0·1W	2
R73	X10	Erie N1 0·1W	2
R74	Z12	Erie 109 0·25W	2
R75	Z11	Erie 109 0·25W	2
R76	AE11	Erie N1 0·1W	2
R77	AE9	Erie N1 0·1W	2

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COMPONENT TABLE: FIG. 2

Comp.	Loc.	Type	Tolerance per cent
R78	AF9	Erie N1 0·1W	2
R79	AF11	Erie N1 0·1W	2
R80	AF12	Erie N1 0·1W	2
R81	AG9	Erie N1 0·1W	2
R82	AH9	Erie N1 0·1W	2
R83	AH11	Erie N1 0·1W	2
R84	AH12	Erie N1 0·1W	2
R85	M8	Erie 16 0·25W	10
R86	AJ6	Erie N1 0·1W	2
R87	D9	Painton MV1A 1·5W	5
R88	M1	Erie 16 0·25W	10
R89	T2	Erie 16 0·25W	10
R90	Y8	Erie N1 0·1W	2

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RADIO MICROPHONE RECEIVER RC4/1 : CIRCUIT

RC4/1

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COMPONENT TABLE: FIG. 3

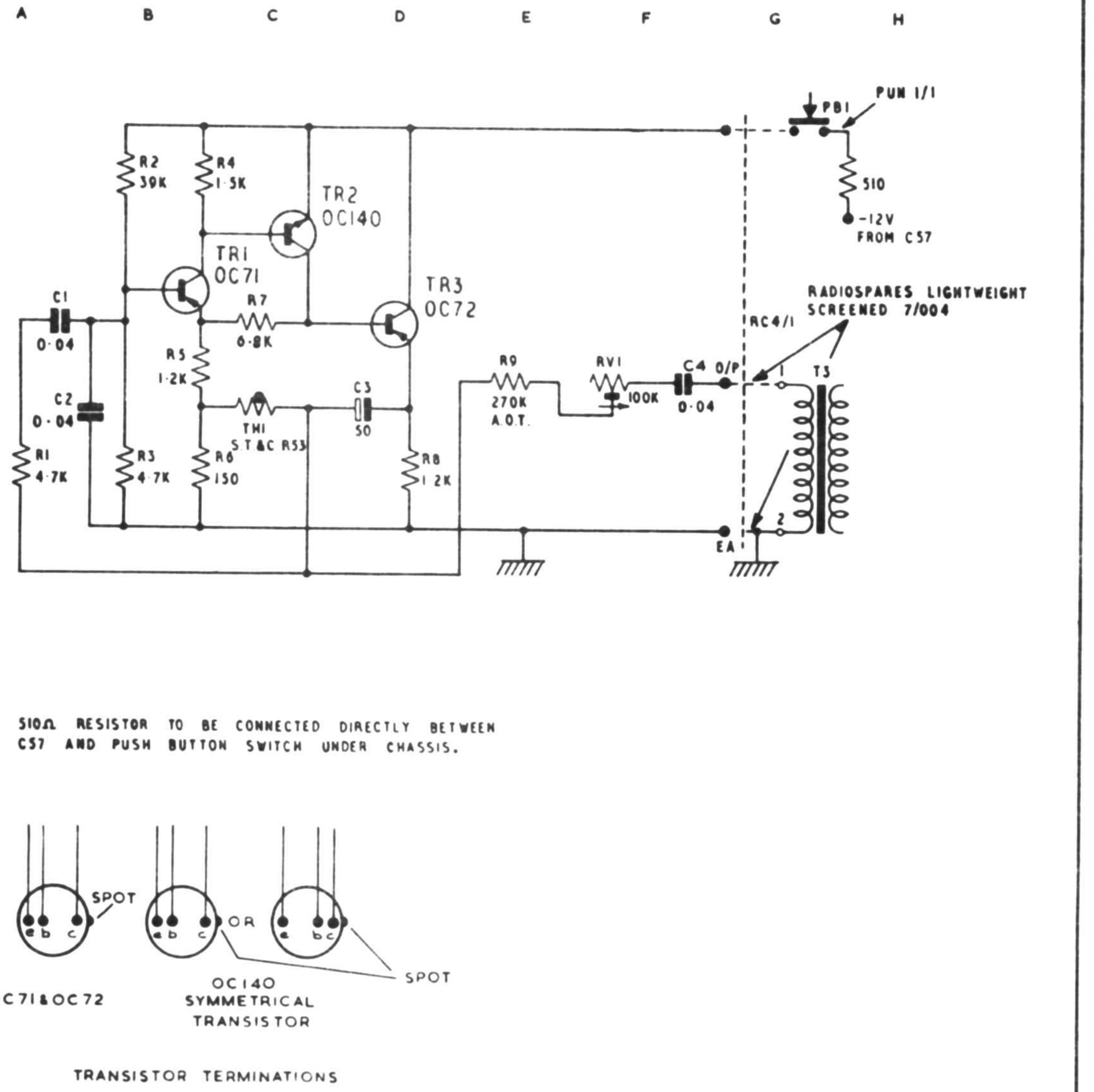
Comp.	Loc.	Type	Tolerance per cent
C1	A3	Hunt BM16KV 250V	20
C2	B3	Hunt BM16KV 250V	20
C3	D3	U.C.C. SM51S 6V	
C4	F2	Hunt BM16KV 250V	20
R1	A4	Erie N1 0·1W	2
R2	B2	Erie N1 0·1W	2
R3	B4	Erie N1 0·1W	2
R4	C2	Erie N1 0·1W	2
R5	C3	Erie N1 0·1W	2
R6	C4	Erie N1 0·1W	2
R7	C3	Erie N1 0·1W	2
R8	D4	Erie N1 0·1W	2
R9	E3	Painton 90 0·1W	2
RV1	F3	Plessey 404/1/00142/104	

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64/AIB/003
DA 11512

RM.1

FIG 3



510Ω RESISTOR TO BE CONNECTED DIRECTLY BETWEEN C57 AND PUSH BUTTON SWITCH UNDER CHASSIS.

TRANSISTOR TERMINATIONS

LINE-UP TONE OSCILLATOR OS2/17: CIRCUIT

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