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ARI.23057
STANDBY UHF TRANSMITTER RECEIVERS

(UEL Type D103, D303)

GENERAL AND TECHNICAL INFORMATION AND REPAIR AND RECONDITIONING INSTRUCTIONS

BY COMMAND OF THE DEFENCE COUNCIL

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Ministry of Defence

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Chapter 1

GENERAL DESCRIPTION AND OPERATING INSTRUCTIONS

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Fig. 1. ARI. 23057

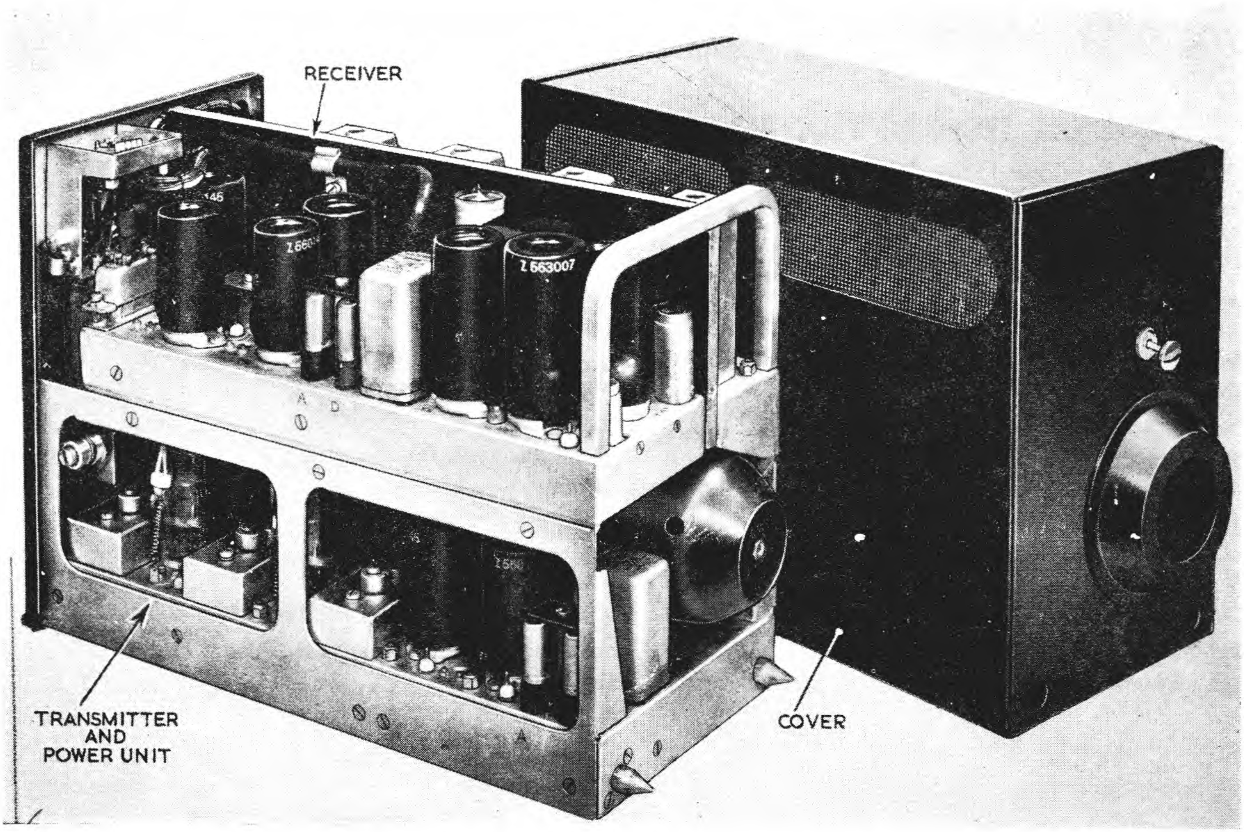


Fig. 2. TR.10056 with the cover removed

Introduction

1. ◀The ARI.23057 consists of the transmitter-receiver TR.10056 and the mounting Type 1031.▶ A general view of the ARI.23057 is given in fig. 1. It is primarily for use as a standby u.h.f. transmitter-receiver to provide R/T communication between aircraft and the ground, between aircraft and also between aircraft and ships. The frequency range of the transmitter-receiver is 238 Mc/s to 248 Mc/s but it will be normally used as a single frequency channel equipment operating at a frequency of 243 Mc/s. Facilities are included to permit an additional channel to be used at a frequency between 242 Mc/s and 244 Mc/s. The effective range of the equipment is approximately 100 miles at altitudes exceeding 10,000 feet. The dimensions of the equipment are given in the leading particulars and they are such that the transmitter-receiver is mechanically interchangeable with the v.h.f. transmitter-receiver TR.2002.

2. The general construction of the equipment is illustrated in fig. 2. The transmitter and the receiver are separate sub-assemblies; the receiver is contained in the upper chassis, while the lower chassis contains the transmitter, modulator and also the power unit.

3. The transmitter-receiver has been designed for operation from a 24V battery power supply, the overall consumption being about 85 watts. Facilities are included in the system to permit the equipment to be operated from the standard 28V d.c. supply of an aircraft.

Transmitter

4. A block diagram of the transmitter-receiver is given in fig. 3 at the end of this chapter. From this it will be seen that the transmitter consists of the crystal-controlled oscillator valve V16 which also functions as a frequency doubler. When the transmitter is being used at the normal standby radiated frequency of 243·0 Mc/s, the frequency of the crystal is 40·5 Mc/s and, therefore, the output frequency of V16 is 81 Mc/s. This signal is fed to the r.f. amplifier valve V17 and thence to the push-pull amplifier and frequency-trebler stage V18a and V18b. The output frequency of this stage is the radiated frequency of 243·0 Mc/s. The output of V18a and V18b is then fed to the push-pull r.f. amplifier valve V19a and V19b and from this stage via the relay contact HTA2 to the aerial system. The unmodulated r.f. power output is about 3 watts.

Modulation

5. The a.f. output from the microphone circuit is fed into the first a.f. amplifier valve V12a of the modulator unit. The output of this stage is fed to the clipper circuit consisting of MR1 and MR2 which limit the amplitude of the a.f. input to the second a.f. amplifier valve V12b to a predetermined level and, therefore, compensates for varying levels of speech input to the microphone circuit. The a.f. output of V12b is fed to the valve V13 which functions as a phase inverter to provide the correctly phased inputs to the push-
lifier valves V14 and V15

The output of these two valves is fed to the primary windings of the modulation transformer T8. The secondary winding of this transformer is connected in series with the HT supply to the anodes and screen grids of the push pull RF amplifier valve V19a/b and also with that to the screen grids of the push pull RF amplifier valve V18a/b. From this it follows that the RF output from this amplifier is amplitude modulated at audio frequency.

Sidetone

6. Side tone is used to provide an indication of the audio frequency modulation at the aerial system. This is achieved by the rectifier MR3 which demodulates the signal fed to the aerial, the demodulated output of the rectifier is fed to the AF output valve V9 of the receiver and thence to the telephones.

Intercommunication

7. When the equipment is switched for reception, intercommunication facilities are available. These are obtained by taking the amplified microphone output from the first AF amplifier valve V12a of the modulator and feeding it to the AF amplifier V7b of the receiver and thence via the output stage V9 to the telephones.

Receiver

8. The receiver employs a double-conversion superheterodyne circuit and it incorporates a noise limiting stage and an AGC system. For normal operation, the frequency of the received signal fed from the aerial via the relay contact HTA2 to the first RF amplifier valve V1 is 243·0 Mc/s. The local oscillator consists of the crystal controlled oscillator valve V10 which also functions as a frequency trebler. The fundamental frequency of the crystal is 37·0833 Mc/s and, therefore, a frequency output of 111·25Mc/s is provided by V10. This signal is fed to the valve V11 which operates as an RF amplifier and also as a frequency doubler. The output from V11 is at a frequency of 222·5 Mc/s and it is fed, together with the received 243·0 Mc/s signal, to the first frequency changer valve V2. The difference frequency of 20·5 Mc/s (first IF) is fed from the frequency changer to the valve V3 which functions as the second RF oscillator and also the second frequency changer. The oscillator is crystal-controlled at a frequency of 18·5 Mc/s and the resultant second IF of 2 Mc/s is fed via three stages of IF amplification, valves V4, V5 and V6, to the detector and the AGC valves, V8a and V8b respectively. The demodulated output from the detector valve V9a is fed via the noise limiter valve V7a to the last two AF stages of the receiver, V7b and V9, and thence to the telephones. From an input signal of 2·5 microvolts, 30 per cent modulated, the audio output is about 200 milliwatts.

Noise limiter

9. The object of the noise limiter stage V7a is to suppress interference from transient noise signals of relatively large amplitude.

AGC

10. The AGC valve V8b provides automatic gain control for the IF amplifier valves V4 and V5, and also for the first and second frequency changer valves, V2 and V3 respectively. The AGC characteristics are such that when the input signal changes from 5 microvolts to 10 millivolts, the audio output does not change more than 6 dB.

Power supplies

11. The DC input power supply is normally obtained from a 24V battery, but facilities are included to permit the transmitter-receiver to be operated from the standard 28V DC supply (normally available in an aircraft) through a suitable dropping resistor. The power consumption when transmitting is approximately 85 watts.

12. The DC supply is connected to the equipment by a 2-core cable which is connected via a 2-pole socket to the BATTERY plug on the front panel of the equipment. The heaters of the various valves are provided with their power directly from the DC source, for which purpose a series-parallel arrangement is used. The HT supply is obtained from a rotary motor-generator which provides an output of 200V and this is connected in series with the battery supply to make a total of 224V.

OPERATING INSTRUCTIONS

Introduction

13. There are no operational controls on the front panel of the equipment. However, there is a preset modulation percentage control on the panel which should not be disturbed by the operator as it is for setting-up purposes only and should be adjusted only by qualified tradesmen during servicing procedure.

Controls and their functions

14. The operational controls are normally incorporated in the intercommunication system of the aircraft and the arrangements may differ slightly according to the type of aircraft and its overall requirements. The various relays for operating the transmitter-receiver are contained inside the equipment and the control leads are brought out to a 12-pole plug on the front panel. The plug is then connected via the appropriate cable to the intercommunication system to provide the following facilities :—

(1) ON/OFF switch. This operates the power supply relay connecting the DC supply to the motor generator and also to the heaters of the various valves in the equipment.

(2) Press to talk switch. This operates the relay which performs the following functions :—

(a) Transmit position :—

HT is connected to all stages of the transmitter. HT is disconnected from the receiver except for the output valve which remains in circuit for sidetone purposes (*para.* 6).

Aerial disconnected from the receiver and connected to the transmitter.

(b) Receive position :—
HT is connected to all stages of the receiver. HT is disconnected from all stages of the transmitter except the microphone amplifier stage in the modulator unit. This stage in conjunction with the last two AF stages of the receiver provide intercommunication facilities while the equipment is switched to the receive position.

(3) A third relay in the equipment can, if required, be connected to external switching to provide facilities for changing the crystal in circuit when the transmitter/receiver has been installed to operate either of two frequency channels (*para.* 1). Under normal single-channel operating conditions, the circuit is so arranged that the single crystal remains in operation regardless of the position of the crystal selector switch (if incorporated).

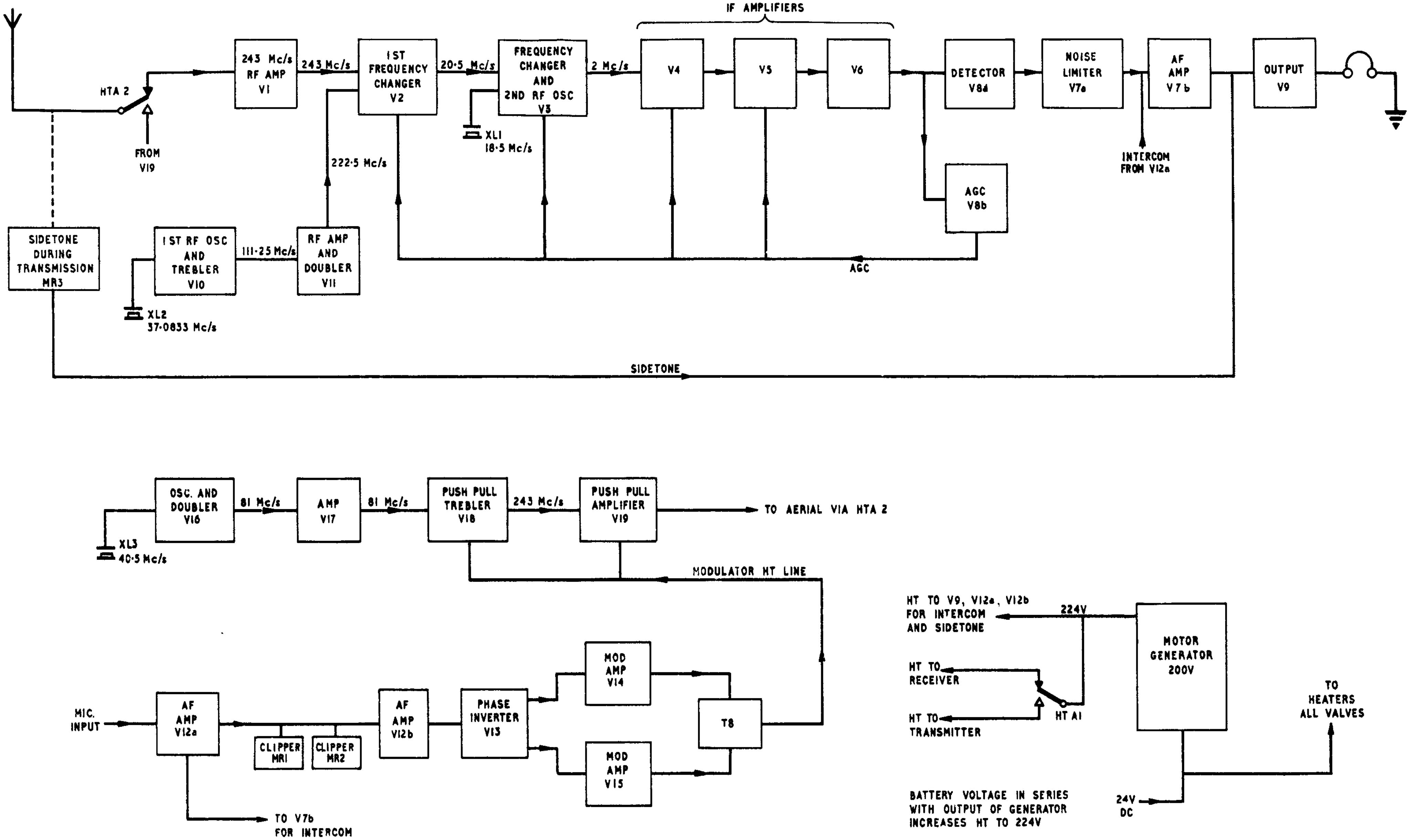
Operating

15. Because of the differences which can exist between installations in the various types of aircraft, it is not possible to give precise operating instructions. However, as the equipment is primarily intended as a standby transmitter/receiver, it can be assumed that there will probably be two main reasons for using this equipment and they are as follows :—

(1) A failure of the main UHF R/T communication equipment, in which case it will only be necessary to switch to the standby position which will automatically connect the aircraft power supplies to the standby equipment. The microphone, telephones and the press to talk switch of the normal installation can now be used in the usual manner.

(2) A failure of the normal power supplies and it is required to operate the standby equipment from the standby battery of 24V. Both the power supplies and the R/T communication switches should be set to the standby positions, after which the operating procedure is the same as given in sub-para. (1).

Note . . .
When the equipment is being operated from the normal standby battery and no other load is applied, the period of operation is about thirty minutes. Care must be taken, therefore, to conserve the battery and to ensure that the standby battery is not used for ground testing purposes.



AIR DIAGRAM 6141 A/MIN.

ISSUE 1. PREPARED BY MINISTRY OF SUPPLY FOR PROMULGATION BY AIR MINISTRY ADMIRALTY

Transmitter – receiver Type TR.10056: block diagram

Fig. 3

SW 366

Chapter 2

(completely revised)

CIRCUIT DESCRIPTION

CONTENTS

ILLUSTRATIONS

INTRODUCTION

1. A general description of the transmitter-receiver Type TR.10056 is given in Part 1, Chap. 1 which also includes a block diagram (fig. 3) at the end of that chapter. The circuit of the transmitter-receiver is given in fig. 2 at the end of this chapter. The frequency range of the equipment is from 238 MHz to 248 MHz. Although facilities exist for operating the equipment on two frequency channels, one of which is normally 243 MHz and the other not below 242 MHz or above 244 MHz, the transmitter operated as a single channel equipme refore be delivered

by the manufacturer prepared for single-channel operation. To prevent any possibility of the operational crystal being switched out of circuit, dummy crystals are fitted in the second channel positions and the circuit arrangements are such that the sockets of the operational crystals are permanently connected in circuit.

2. The equipment includes numbered test points to facilitate alignment testing and servicing of the transmitter-receiver.

POWER SUPPLIES

3. The transmitter-receiver is operated from a separate d.c. battery supply of 24V. However, it can be operated from the aircraft standard d.c. supply of 28V, provided that a suitable dropping resistor is incorporated. The nominal value of this resistor is approximately 1 ohm. The 24V supply is controlled by an external u.h.f. standby switch incorporated in the communication system of the aircraft. When the u.h.f. standby switch is closed, the relay LT/1 is energised and its contact completes the 24V supply circuit to the motor generator MG1 and to the heaters of the valves. The inductors L9 and L10 isolate the motor from r.f. The d.c. output of the generator is 200V which is connected in series with the 24V battery supply to provide a total of 224V h.t. for the transmitter-receiver. The capacitor C68 serves as a suppressor to reduce interference at the receiver caused by sparking at the brushes of the generator. This capacitor also provides smoothing for the h.t. output of the generator.

4. The heaters of the various valves of the transmitter-receiver are connected in series-parallel across the 24V battery. The resistors R68 and R69 serve as shunts across the heaters of the valves V6, V9, V13, V17 and half of V18 to ensure that the total resistance of the heater network is such that the voltage applied to the individual heaters is within the normal operating tolerances. The heaters are decoupled to r.f. by the capacitors C76 to C82, and the inductors L11 and L12 provide additional decoupling for the heater of V1.

5. The h.t. supply from the generator is fed direct to the a.f. amplifier valve V9 for transmitter sidetone purposes (para. 27). The h.t. is also fed direct to the modulator and amplifier valve V12 of the transmitter for intercommunication purposes (in conjunction with V9) (para. 28). Simultaneously, h.t. is fed via the relay contact HTA1 (in its normally closed position) to all the valves of the receiver, other than V9. From this, it follows that closing the u.h.f. standby switch brings the receiver into operation.

RECEIVER

General

6. The receiver is a double conversion superheterodyne type and includes an a.g.c. system and also a noise limiting circuit. Facilities for intercommunication are also incorporated in the equipment. Th the receiver is such that for a 30% modulated, the

audio output will not be less than 50 milliwatts. The ratio of signal to noise will never be less than 10 dB.

R.F. amplifier

7. The aerial is connected via SKTE, the contacts HTA2, the rejector circuit comprising L21, C104 and L22, SKTA and PLA to the first r.f. amplifier (V1) tuned to the mid-signal frequency of 243MHz. The rejector circuit prevents the introduction to the receiver of unwanted B.B.C. Radio 3 broadcasts, the third harmonic of this transmission being 1.941 MHz and within the acceptance frequency of the 2 MHz i.f. output. The grid and anode circuits of V1 are tuned to 243 MHz by the preset capacitors C4 and C5 respectively. The filter circuit, consisting of the inductor L1 and the preset capacitor C1, serves to reduce second channel interference; the filter is tuned by C1 to a frequency of 202 MHz. The filter circuit, consisting of L2 and C2, is tuned by the preset slug of L2 to serve as a rejector for frequencies of 20.5 MHz which correspond with that of the first i.f. The r.f. output of V1 together with the output from the first r.f. oscillator stages V10 and V11 is fed to the first frequency changer valve V2.

First r.f. oscillator

8. The pentode valve V10 functions as the first r.f. oscillator and also as the frequency trebler, and the pentode V11 operates as an amplifier and a frequency doubler. Although provision is included to permit the receiver to function as a two-channel equipment (para. 29), the socket of the operational crystal XL2 is permanently wired in circuit when the transmitter-receiver is being used on the single-channel frequency of 243 MHz. Under these circumstances, the crystal XL2 in the grid circuit of V10 operates at a frequency of 37.0833 MHz and this circuit is tuned by the preset inductor L5. The inductor L6 in the anode circuit of V10 is tuned by the preset capacitor C63 to three-times the frequency of the crystal. This r.f. output of 111.2499 MHz is fed via C64 to the amplifier and frequency doubler valve V11, the anode circuit of which is tuned by the preset capacitor C67 to a frequency of 222.5 MHz.

First frequency changer

9. The signal frequency of 243 MHz from the r.f. amplifier V1 and the first oscillator frequency signal output from V11 are both fed to the grid of the first frequency changer V2. The anode circuit of this valve includes the transformer T1 tuned by the preset slugs of the primary and secondary windings to the first intermediate frequency of 20.5 MHz which is the difference between the signal and the first oscillator frequencies.

Second frequency changer and i.f. amplifier

10. The r.f. output of the first frequency changer V2 is fed to the heptode valve V3 which operates as the second r.f. oscillator and the sec [illegible] frequency of the second oscillat [illegible] al XL1, operating

at a frequency of 18.5 MHz and connected between the screening grid and the control grid of V3. The oscillator circuit is set to this frequency by the preset capacitor C14. The first i.f. of 20.5 MHz is fed from the secondary winding of transformer T1 to the mixer grid of frequency changer V3. The anode circuit of this valve includes the transformer T2.

11. The transformers T2, T3 and T4 are stagger-tuned to ±30 kHz with respect to the centre frequency of 2 MHz, whereas T5 is tuned to the centre frequency. The response of the amplifier is as follows:-

(1) At frequencies ±30 kHz with respect to the centre frequency of 2 MHz, the output must not fall by more than 6 dB when compared with that obtained at 2 MHz.

(2) At frequencies of ±80 kHz with respect to the centre frequency of 2 MHz, the output must fall by more than 60 dB when compared with that at 2 MHz.

12. The 2 MHz signal from the last i.f. stage is fed from the secondary winding of T5 to the double diode valve V8. The diode section V8a functions as the detector (para. 13), and the section V8b operates as the a.g.c. rectifier (para. 18).

Detector and noise limiter (fig. 1)

13. The cathode of the diode detector valve V8a is provided with a positive bias of approximately 2.8V taken from the junction of the voltage divider network R27 and R28 connected across 12V d.c. obtained from a tapping on the valve heater network which is supplied from the 24V battery. Under no signal conditions, this bias also provides partial muting to reduce the receiver noise, thereby giving a quieter background noise in the headset telephones. The detector valve V8a operates in conjunction with the noise limiting circuit incorporating the triode section V7a of the double triode V7. The resistors R24 and R25 are each 47 kilohms and they constitute the load of the detector valve V8a (R26 is included in the network for metering purposes and can be neglected when considering the operation of the noise limiter). The anode of the noise limiter V7a is connected to the junction of resistor R24 and R25; the cathode of this valve is connected to the long time constant network R30 and C50 which is across the load resistors of the detector. Consequently, half the d.c. voltage developed across the load is applied to the anode of the limiter V7a and the whole of the load voltage to its cathode.

14. When an unmodulated carrier is applied to the detector V8a, a rectified voltage is applied across the load resistors R24 and R25, and the anode of the limiter V7a becomes negative with respect to earth, the potential being equal to half that appearing across the load resistors. The capacitor C50 becomes charged and maintains a steady d.c. negative potential with respect to earth. The negative potential, applied to the cathode of V7a via R29, is almost twice that applied to the anode of V7a and the valve co

15. When a modulated carrier is fed to the detector valve V8a, the anode potential of the noise limiter valve V7a fluctuates at a.f. and audio signals are fed through this valve, via the capacitor C49 and potentiometer RV1, to the grid of the a.f. amplifier V7b. The potentiometer RV1 is a preset control to adjust the level of the a.f. drive to the a.f. amplifier stages.

16. When noise impulses of relatively high amplitude and short duration are superimposed on the modulated signal, the negative potential at the anode of the noise limiter V7a increases with respect to earth. However, because of the short duration of these pulses and the long time constant of R30/C50, these impulses cause little or no change on the capacitor C50. From this it follows that for the short duration of these noise impulses, the anode is negative with respect to the cathode and the noise limiter ceases to conduct.

A.F. amplifier

17. As stated in para. 15, the level of the a.f. drive to the a.f. amplifier is set by the preset potentiometer RV1 from which the signal is fed via the grid stopper R35 to the control grid of the first triode a.f. amplifier V7b. This valve is resistance-capacitance coupled to the a.f. output pentode V9. The anode circuit of V9 includes the output transformer T6 and audio output is taken from the secondary winding of this transformer to the plg PLD and thence, via the aircraft intercommunication system, to the telephones. The a.f. amplifier, consisting of V7b and V9, can be used in conjunction with the modulator section of the transmitter for intercommunication purposes (para. 28).

Automatic gain control

18. The diode V8b functions as the a.g.c. rectifier. A delay bias of about 10V for the a.g.c. circuit is obtained by connecting the cathode of V8b to the junction of the potential divider network R33 and R34 connected across the h.t. supply. The signal output from the final stage (V6) of the i.f. amplifier is fed via C51 to the anode of V8b and the rectified negative d.c. voltage developed across the a.g.c. load resistor R31 is decoupled and smoothed by capacitor C52 and the resistor R32. The a.g.c. voltage is fed to the control grids of the first frequency changer V2, the second r.f. oscillator V3 and the first two stages V4 and V5 of the second i.f. amplifier. The range of the a.g.c. is such that when the r.f. signal input to the first r.f. amplifier (V1) increases from 5 microvolts to 10 microvolts, the a.f. output does not increase by more than approximately 6 dB.

TRANSMITTER

General

19. After the u.h.f. standby switch has been selected and the normal press-t [illegible] relay HTA/2 is energised from the [illegible] relay contact HTA2 changes over a [illegible] t to the r.f. power

amplifier of the transmitter. The relay contact HTA1 also changes over and connects the h.t. supply to all the valves of the transmitter, except for V12 of the modulator. This valve is provided with h.t. direct so that it can be used also for intercommunication purposes on receive when the u.h.f. standby switch is selected. The r.f. power output is approximately 3 watts. The output impedance to the aerial system is 50 ohms.

R.F. circuits

20. The pentode V16 functions as the crystal oscillator and also as a frequency doubler. The crystal XL3 operating at a frequency of 40.5 MHz is connected in the grid-cathode circuit of V16 and the circuit is peaked by the preset inductor L13. Although there are facilities to include an additional crystal for operating the transmitter on either one of two channels, a dummy crystal is fitted in the position marked XL5 and the socket of the operational crystal is permanently wired in the circuit for single channel operation on 243 MHz.

21. The anode circuit of V16 is tuned by the preset capacitor C88 to twice the frequency of the crystal XL3 and the resultant 81 MHz signal is coupled via C89 to the pentode r.f. amplifier V17, the anode circuit of which is tuned by the preset capacitor C91.

22. The output of the r.f. amplifier is coupled via capacitors C93 and C94 to the control grids of the double-tetrode V18 which is connected as a push-pull amplifier, its anode circuit being tuned by the preset capacitor C96 to three times the 81 MHZ signal from the r.f. amplifier V17. The resultant signal of 243 MHz is the final frequency which is fed via capacitors C97 and C98 to the control grids of the double-tetrode V19. This valve is connected in push-pull and serves as the power amplifier. Inductor L19 in the anode circuit of this stage is tuned by the preset capacitor C101. The output of V19 is inductively coupled through L20 to the aerial system.

Modulator

23. The transmitter is amplitude-modulated by the modulator stage which incorporates two a.f. amplifiers, clipper circuits, phase inverter and the final amplifier stage. The operational sensitivity of the modulator is such that, from an a.f. input of approximately 10 mV (open circuit), the output of the modulator produces about 80% modulation of the r.f. carrier. The modulation frequency response for a constant level of a.f. input is within $\pm$3 dB over the frequency range of 500 Hz to 3000 Hz with reference to the response obtained at 1000 Hz. At frequencies below 500 Hz, the response reduces at a rate exceeding 5 dB per octave when related to the response obtained at 500 Hz.

24. The microphone signal is fed to the balanced 200 ohm primary winding of the microphone transformer T7, the secondary winding of which is coupled to the triode a.f. amplifier V12a. This valve is re via the clipper stage MR1 and MR V3 to the a.f.

amplifier stage V12b.

25. The object of the clipper stage is to limit the amplification of relatively high levels of speech input at the microphone to a predetermined value, thereby permitting the transmitter to be operated at the maximum modulation percentage with minimum distortion. The level at which clipping begins is set by adjusting the bias applied to the clipper circuit. The bias is obtained via the potentiometer RV2 which is connected across the 24V d.c. supply. The level of the a.f. input to the control grid of the triode a.f. amplifier V12b is set by adjusting the MOD GAIN control RV3.

26. The output of V12b is resistance-capacitance coupled to the pentode phase invertor V13 operating as a triode. This valve provides the paraphase a.f. voltages to drive the push-pull modulator amplifier stage consisting of the tetrodes V14 and V15 The anode circuits of these valves includes the modulation transformer T8, the secondary winding of which is in series with the h.t. supply to the screen grid of the trebler stage V18a and V18b, and also with the h.t. supply to the screen grid and anode of the power amplifier valves V19a and V19b. The a.f. output from the modulator will cause the h.t. fed to these valves to fluctuate at the a.f. and amplitude modulate the r.f. output of the transmitter. Modulating the screen grid of V18a and V18b in addition to the screen grid and anode of V19a and V19b permits the maximum percentage of modulation to be obtained with minimum distortion. The MOD GAIN control RV3 is normally adjusted to obtain about 80% modulation.

Sidetone on transmit

27. Sidetone facilities are made available by means of a rectifying circuit coupled by stray capacitance to the aerial circuit of the transmitter. Not only does this method permit the operator to monitor the modulation but also it is an indication that the r.f. output of the transmitter is being modulated at audio frequency. The sidetone circuit consists of the rectifier MR3, resistors R91 and R92 and also the capacitor C102. When the equipment is switched to transmit by the press-to-talk switch, the h.t. supply is disconnected from all the receiver valves with the exception of the final a.f. amplifier valve V9. The rectified a.f. voltages developed across the sidetone load resistor R92 are fed via C102, R39 and C55 to the grid of the a.f. amplifier V9. The a.f. output at this stage is then routed to the telephones via the aircraft intercommunication system.

INTERCOMMUNICATION

When switched to receive

28. Intercommunication can be made available through the aircraft intercommunication system when the equipment is switched to receive by operating the u.h.f. standby switch. For this purpose, the [illegible] the modulator stage of the transm [illegible] fier stages V7b and V9 are used. [illegible] plifier V12a is part

of the transmitter, the circuit arrangements are such that h.t. is also fed to this valve whenever the receiver is in operation. The a.f. signals from the microphone of the normal intercommunication system are fed via the microphone transformer T7 to the microphone amplifier V12a, the output of which is fed via C70 and R54 to the cathode of the a.f. amplifier V7b which is resistance-capacitance coupled to the a.f. amplifier V9. The output of this valve is routed to the telephones forming part of the aircraft's intercommunication system.

TRANSMITTER-RECEIVER, TWO-CHANNEL OPERATION

Introduction

29. Facilities are included in the transmitter-receiver to permit its operation on either of two channels. Normally, one of these channels operates on the frequency of 243 MHz (the GUARD channel). For satisfactory operation, the frequency of the second (ALTERNATIVE) channel must be between 242 MHz and 244 MHz (subject to the limits of separation quoted in the Note below). When the two operational frequencies are 243 MHz and 243.8 MHz, the transmitter-receiver circuits must be aligned on the higher frequency (i.e. 243.8 MHz). After alignment at the higher of the two frequencies, the r.f. power output trimming capacitor (C101, fig. 2) must be adjusted to provide equal output on both channels.

Note...

In the event of the equipment being used on two channels which do not include the frequency of 243 MHz (para. 29), care must be taken to ensure that the two frequencies used are not separated by more than 1 MHz, otherwise the power output of one of the channels will be considerably reduced. This is because the r.f. circuits can be pre-tuned to the frequency of one channel only.

CAUTION...

When setting-up the equipment for two-channel operation, it will be necessary to disturb the run of the wiring; care must be taken to ensure that the wiring is dressed correctly to prevent it being trapped, which might inadvertently cause a short circuit of the power supply.

30. Two crystal holders are included in the crystal oscillator circuit (V16) of the transmitter and also in the first r.f. oscillator (V10) of the receiver. When used for single channel operation, the sockets of the crystals used for 243 MHz operation are permanently connected in circuit to prevent any possibility of their being switched out of circuit.

Setting-up for two channel operation

31. The procedure for setting-up the equipment for operation on either of the two channels is as follows:-

(1) Remove the shorting link across the centre pair of contacts of r

(2) Remove the shorting link across the centre pair of contacts of relay RCS/2.

(3) Remove the dummy crystals from the XL4 and XL5 positions.

(4) The frequency of the crystal used in the transmitter must be one-sixth of the required final frequency. Fit the selected crystal into the XL5 position.

(5) The frequency of the crystal used in the first r.f. oscillator of the receiver must be equal to one-sixth of the difference between the received signal frequency and the first intermediate frequency of 20.5 MHz. For example, for a channel frequency of 242 MHz the crystal frequency shall be equal to:-

$$\frac{242 \text{ MHz} - 20.5 \text{ MHz}}{6} = 36.9166 \text{ MHz}$$

Fit the selected crystal into the XL4 position of the receiver.

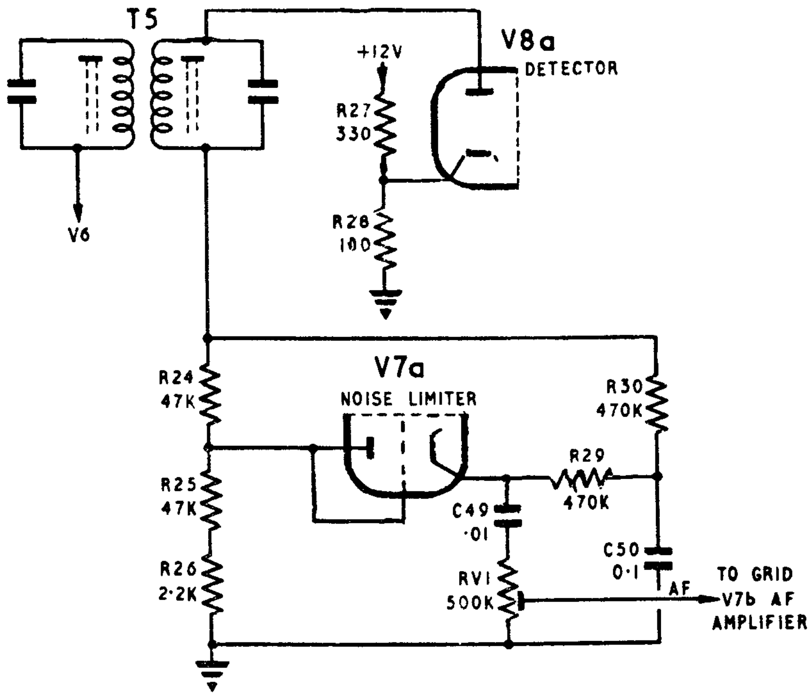


Fig. 1 Noise limiting circuit: simplified

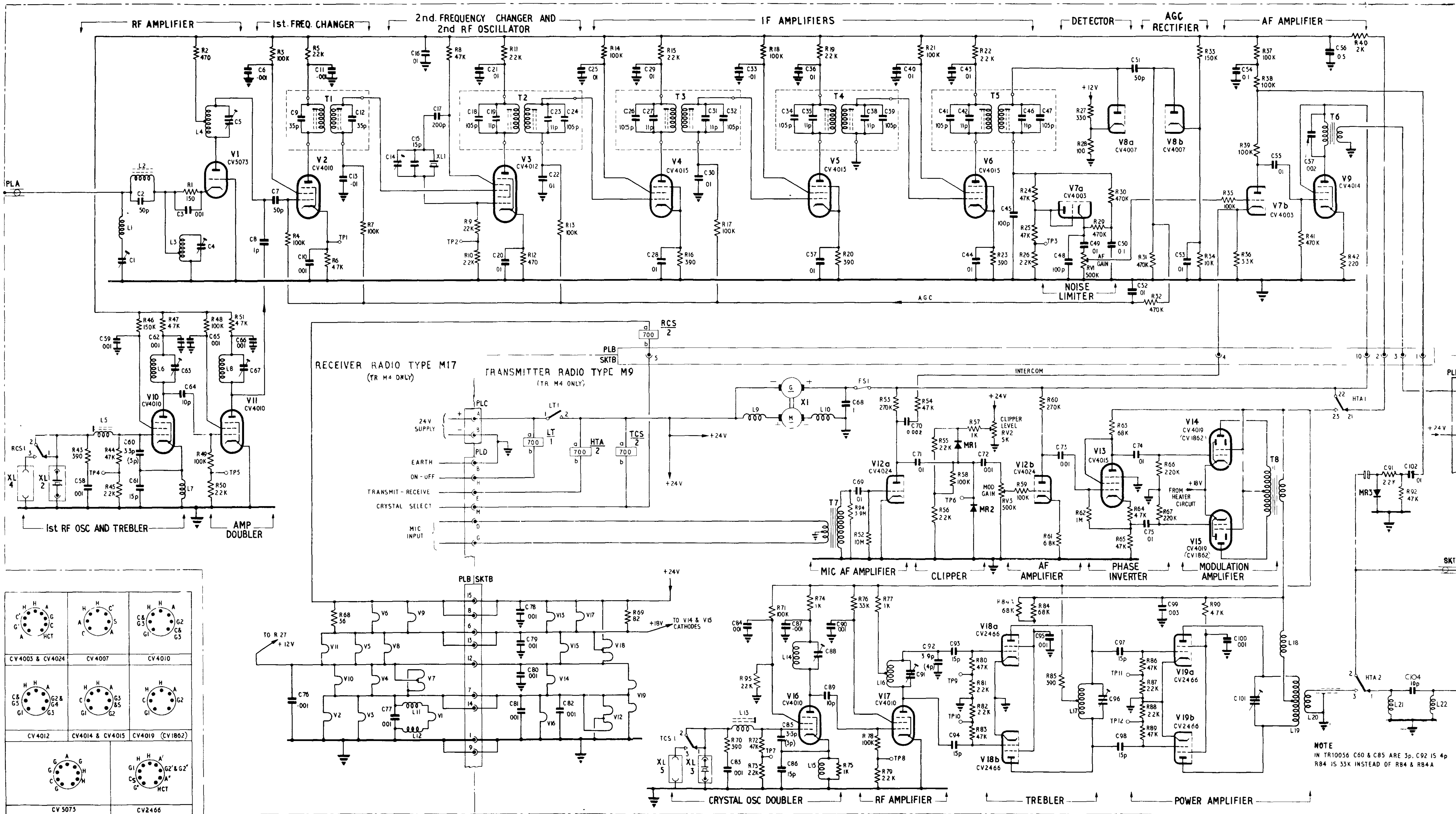
Crystal switching

32. When it is … nsmitter-receiver as a two-channel … o connect an exter-

nal channel selector switch between pole M of plug PLD and the chassis (earth). The switch controls the operation of receiver crystal selector relay RCS/2 and also that of the transmitter TCS/2. One contact only of each relay is in use and they each serve as a change-over switch for the appropriate crystals

33. For normal operation using crystals XL2 in the receiver and XL3 in the transmitter, the crystal switch remains on open-circuit and these two crystals are connected in the appropriate receiver and transmitter circuits by relay contacts RCS1 and TCS1 respectively. The receiver and transmitter are operated by selecting the u.h.f. standby switch and the press-to-talk switch in the normal manner.

34. When it is required to operate the transmitter-receiver on the alternative channel, it is necessary to operate the crystal selector switch in addition to the u.h.f. standby switch. The 24V d.c. supply is thereby connected via relay contacts LT1 to the receiver and transmitter crystal selector relays, RCS/2 and TCS/2 respectively. The relays are energised and contact RCS1 changes over to bring crystal XL4 into operation ; relay contact TCS1 also changes over to connect crystal XL5 into the circuit of the transmitter. Both the transmitter and receiver are now ready for use when the press-to-talk switch is operated



XL4 AND XL5 ARE POSITIONS FOR 2 CHANNEL OPERATION WHEN REQUIRED

CIRCUIT INCLUDES MODS No 6349 (TR. 10056) 8535, A2583, A3069, A4069

Transmitter receiver Type TR. 10056 & TR.M4: circuit

AIR DIAGRAM-MIN
116D-0110-MDI
ISSUE 4 [redacted]

Chapter 3

CONSTRUCTION

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Introduction

1. A general view of the transmitter-receiver TR.10056 is given in Part 1, Chap. 1, fig. 1 while the equipment with the cover removed is shown in fig. 2 of the same chapter. The assembly consists of three main parts, as follows:—

(1) The cover.

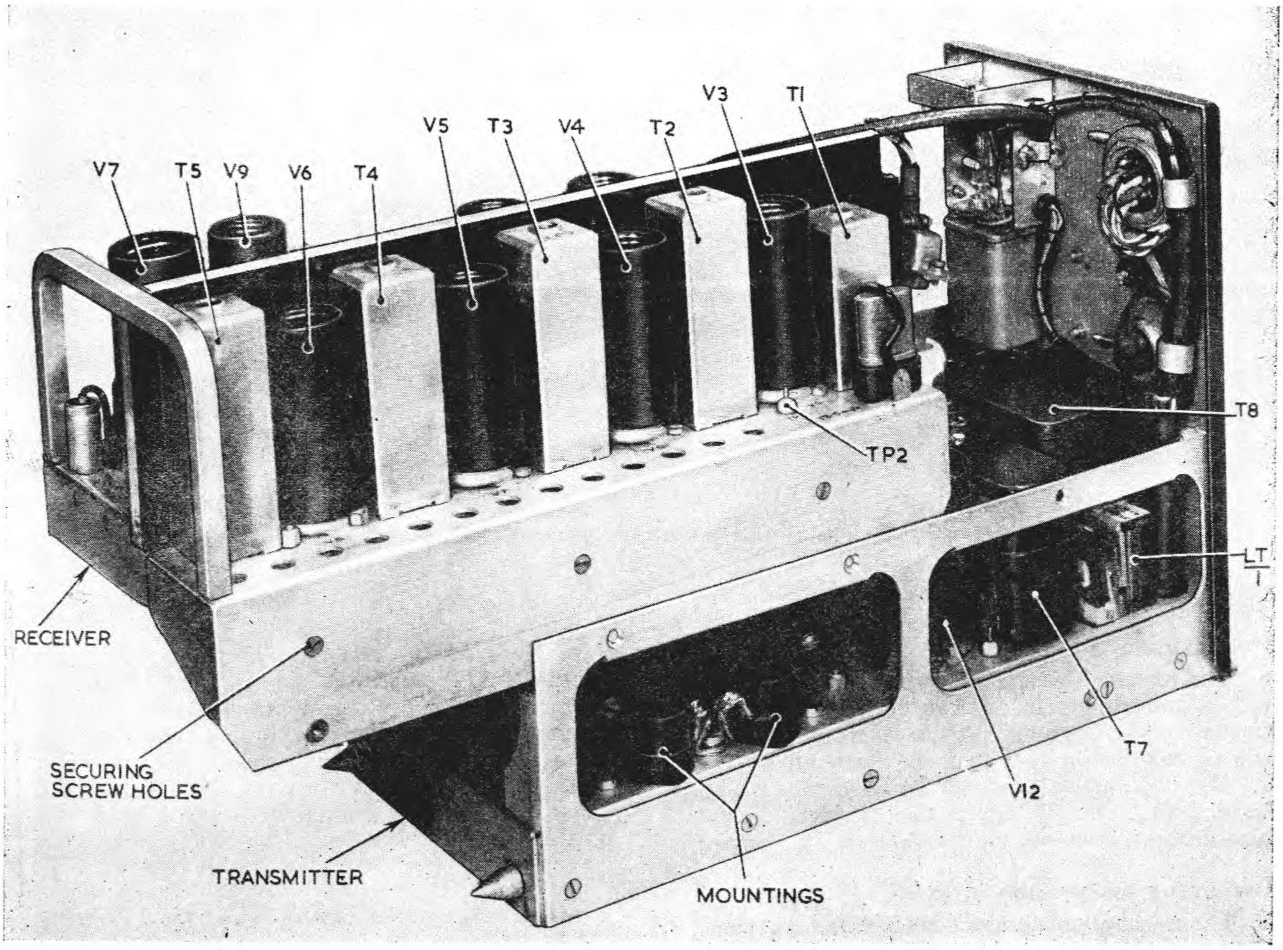
(2) The receiver sub-assembly.

(3) The transmitter sub-assembly which includes the modulator and the power unit.

2. The weight and dimensions of the equipment are given in the leading particulars at the beginning of Part 1.

Cover

3. The cover is an open fronted case which is secured to the equipment by a single captive screw at the rear of the cover. Four apertures, enclosed with fine wire mesh, are cut into the sides of the cover for ventilation purposes.



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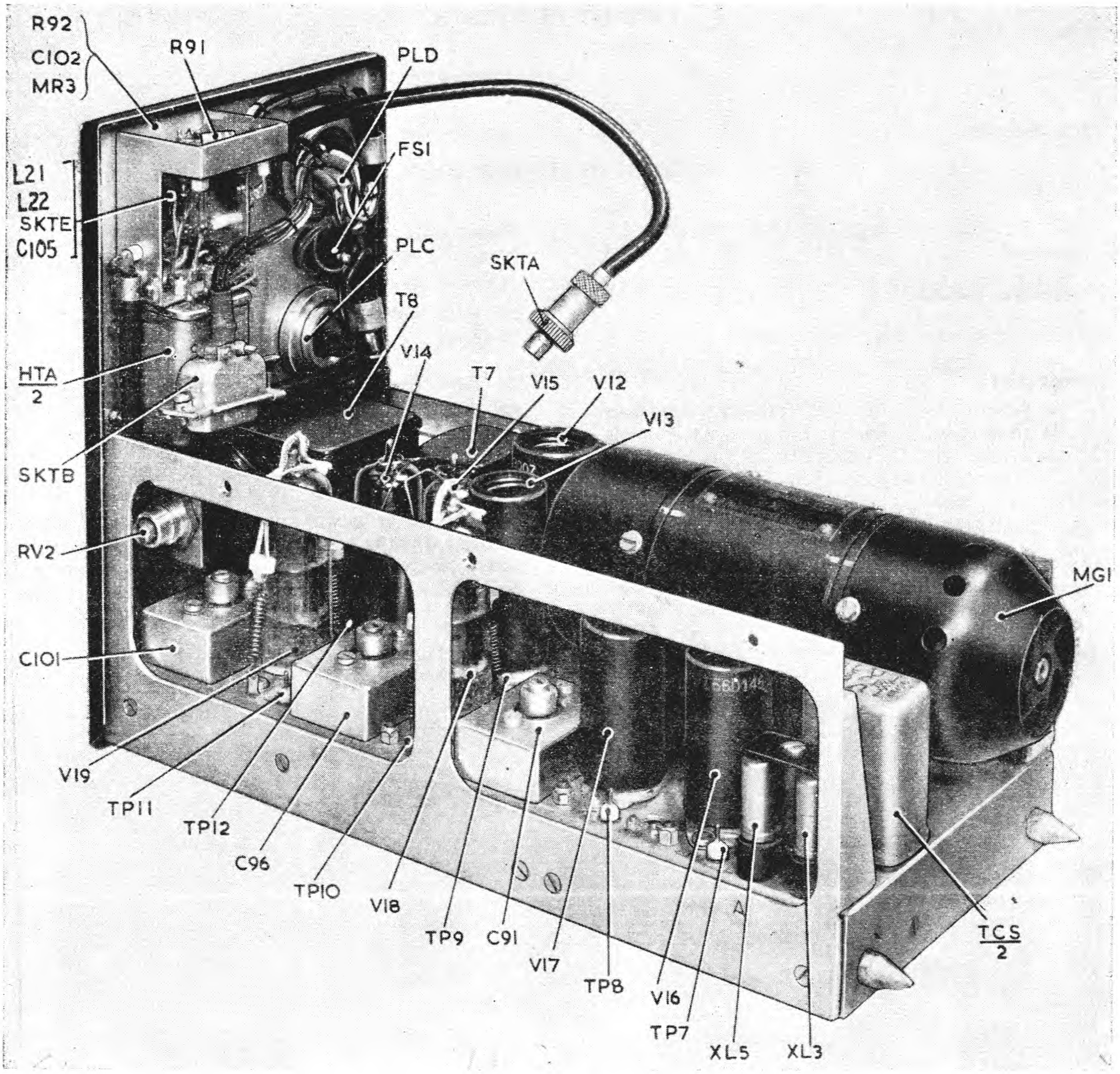


◀ **Fig. 2. Transmitter sub-assembly** ▶

Main assembly (*fig.* 1)

4. The receiver sub-assembly chassis is the upper deck of the equipment. It can be separated from the main chassis by removing three screws on either side of the chassis and two on the front panel, and also unplugging the socket SKTB and the aerial socket SKTA (*fig.* 2). After this the receiver can be withdrawn from the main chassis.

Transmitter sub-assembly (*fig.* 2)

5. The transmitter sub-assembly includes the front panel and the main chassis. The top side of the chassis supports the motor gei
also all the valves of the tran:
attached to the shaft of the m

provide forced-air cooling. The preset controls of the tuning capacitors for aligning the transmitter circuits are brought out to the top of the chassis, while those of the tuning inductors are to be found underneath the chassis (*fig.* 3). The crystals XL3 and XL5 are at the rear of the chassis and jointly secured in position by a clip and one screw. The crystal switching relay $\frac{TCS}{2}$ is at the rear of the chassis while the HT relay $\frac{HTA}{2}$ is attached to the rear of the front panel.

rts the various plugs and

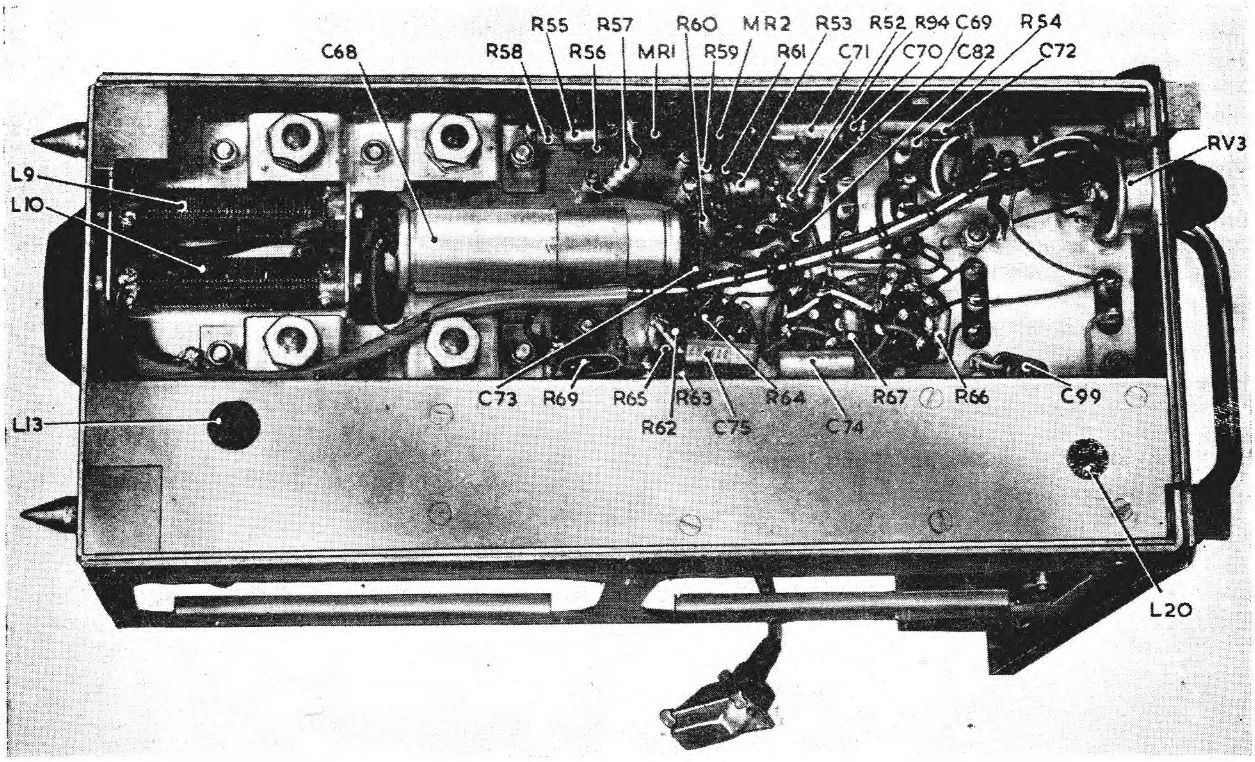
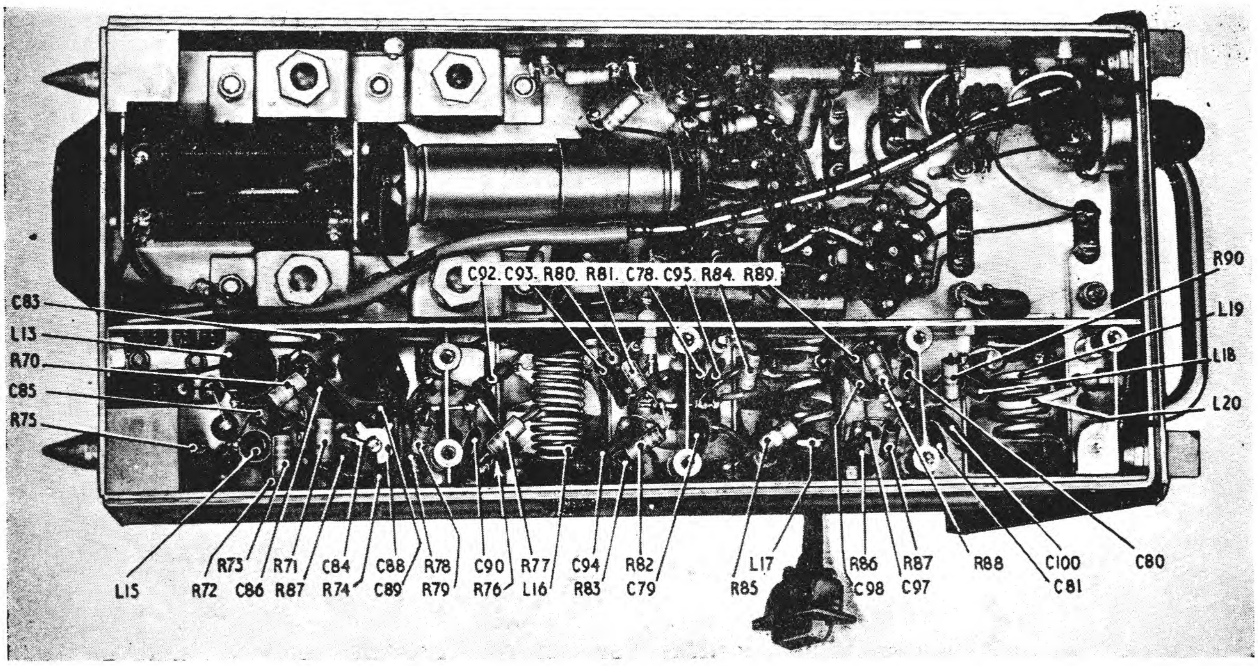


Fig. 3. Transmitter sub-assembly—underside

sockets used for connecting the equipment to the external services, access to them is at the front of the panel. The preset control RV2 for setting the level at which the clipper circuit operates is attached to a bracket secured to the rear of the panel. The MOD GAIN control RV3 is also on the panel but its control is brought out to the front of the panel. The sidetone circuit components consisting of R91, R92, C102 and MR3 are supported on a shelf attached to the rear of the panel.



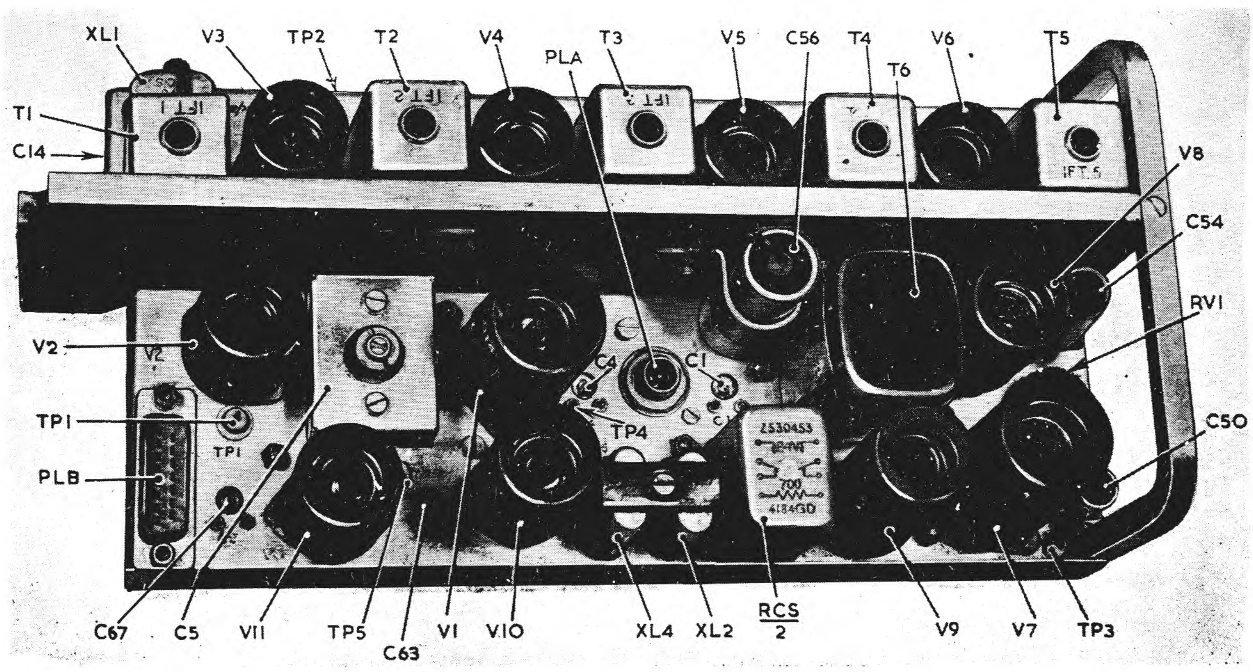
[illegible] over removed

7. The underside of the chassis (*fig.* 3 *and* 4) supports the smaller components of the power unit and the transmitter. Those belonging to the transmitter are enclosed by a cover secured to the chassis by seven screws. It is emphasized that when this cover is removed for servicing purposes, care must be taken to avoid disturbing the coils L16, L17, L19 and L20 as they have been carefully adjusted, by spacing their turns during pre-alignment of the equipment by the manufacturer, to ensure that the tuning capacitors are set to the centre of their capacitance before final alignment is commenced. Final alignment is accomplished with the cover secured by its screws to the chassis. Two apertures are provided in the cover, one permits access to the preset control of L13 in the circuit of the crystal oscillator whilst the other gives access to the aerial coupling coil L20.

Receiver sub-assembly (*fig. 5*)

8. The top of the chassis of the receiver sub-assembly supports all the valves, the various transformers, the crystals, crystal switching relay RCS/2 and the preset controls of the tuning capacitors C1, C4, C5, C63 and C67. The crystals XL2 and XL4 are jointly held in position by a clip and a single screw, while the crystal XL1 is secured by a spring type clip. The preset control of the AF GAIN potentiometer RV1 is located at the rear of the chassis near the valve V7.

9. The underside of the chassis, shown in fig. 6 and 7, supports the smaller components of the receiver circuits. The control for the preset tuning capacitor C14 is at the front end of the chassis, while the preset tuning inductors are located in the centre of the underside of the chassis.



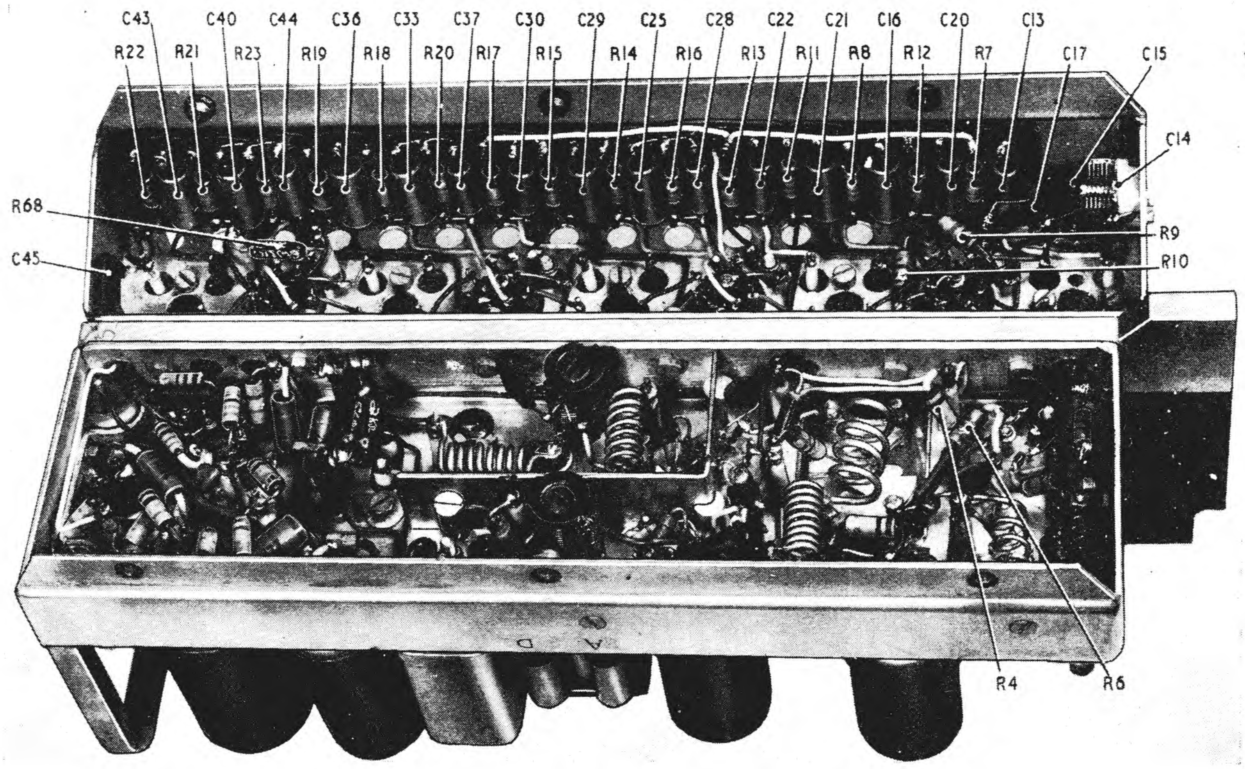
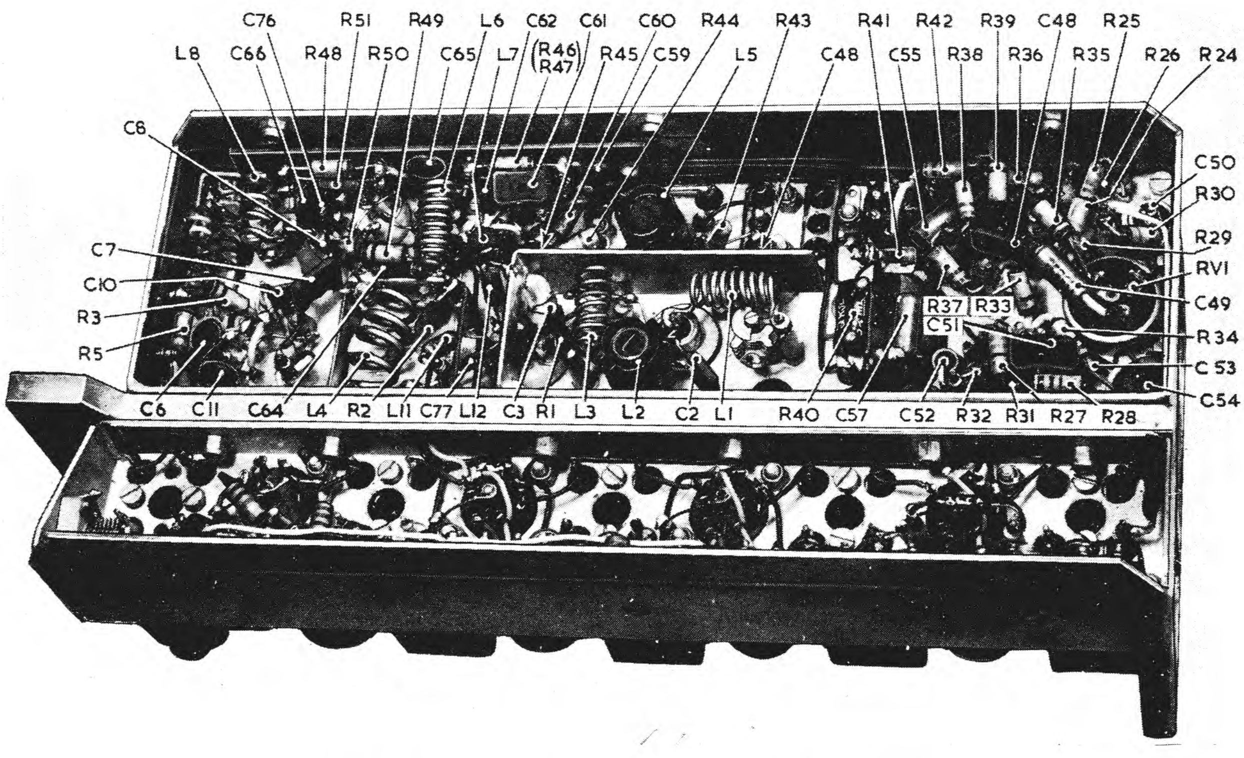


Fig. 6. Receiver sub-assembly—left-hand side



◀ Fig. 7. Receiver sub-assembly—right-hand side ▶

Chapter 4

INSTALLATION

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Introduction

1. The ARI.23057 incorporates the transmitter-receiver TR.10056 which is a u.h.f. crystal-controlled transmitter-receiver primarily for use as a standby R/T communications equipment in the event of the failure of either the main aircraft RT installation ARI.18124/1 or 18124/2 or the power supply to the main installation. The ARI.23057 is designed to operate from a battery supply of 24V but it can be operated via a suitable dropping resistor (para. 5) from the normal aircraft d.c. supply of 28V. For emergency purposes a separate 24V battery is included in the aircraft. Providing that only the essential aircraft instruments are being supplied from this battery and also that the ambient temperature does not fall below 0 deg. C, it will operate the TR.10056 for a period of about 30 minutes. The equipment can be installed in a non-pressurized portion of an aircraft and it may be used up to a ceiling of about 60,000 ft at ambient temperatures not exceeding 35 deg. to 40 deg. C. The emergency battery is Ref. No. 5J/3458, nickel-cadmium Type 19/VO/7, capacity 7 a.h. Its weight is $16\frac{3}{4}$ lb.

2. The ARI.23057 must be installed to operate in conjunction with the normal intercommunication system of the aircraft and the installation includes switches to permit the selection of either the normal R/T communication system or the standby equipment and also the appropriate power supply. The selection of the required system is under the control of the pilot of the aircraft and, therefore, the switches must be installed in a position readily accessible to him. Intercommunication is automatically available through the TR.10056 when the equipment is switched to receive (Chap. 2).

3. The TR.10056 is normally used on the G or guard channel only but facilities do exist for using it on one of two channels. The second A or alternative channel must operate at a frequency within 1 Mc/s above or below the frequency of the guard channel. When the equipment is delivered by the manufacturer it is fitted with dummy crystals in the A (alternative) channel position and links are fitted in both the transmitter and receiver portions to prevent the crystals of the G or guard channel being switched out of circuit. If it is required to set up the equipment to function as a two-channel system, the dummy crystals must be exchanged for the appropriate active crystals and the shorting links removed. In Naval aircraft the alternative channel switch is fitted as a standard part of the installation. An emergency press to talk button is also fitted in Naval aircraft. This is to provide alternative transmit facilities in the event of a failure of the normal press-to-talk circuit.

Neither the alternative channel switch nor the emergency press-to-talk switch is at present being fitted in aircraft of the Royal Air Force.

4. There are no operational controls on the TR. 10056. There is, however, one preset control on the front panel of the equipment for setting the modulation percentage but is should not normally require adjustment while the aircraft is airborne.

Power supply 28V

5. When the TR.10056 is to be operated from the normal aircraft d.c. supply a dropping resistor must be included in series with the equipment and the supply line. The normal value of this resistor is 1 ohm and it must be capable of dissipating 16 watts. The ohmic value of the resistor will depend upon the supply lines in a given aircraft and it must be calculated so that the d.c. supply to the transmitter portion is 24V on load. The current taken from the supply when the transmitter is operating is about 3·9 amperes. The power supply selector switch should have a label engraved POWER NORMAL/STANDBY.

Composition of installation

6. The equipment constituting the ARI.23057 is illustrated in Part 1, Chap. 1, fig. 1. The composition of a typical installation in an aircraft is listed in Table 1. The transmitter-receiver TR.10056 and the relay unit Type 102A are removable items while the remaining items listed in Table 1 are fixed. The installation also includes a socket coupler to permit the test set Type 15077 to be used for servicing at the aircraft.

TABLE 1

Composition of aircraft installation

Item	Ref. No.	Nomenclature	Qty.	Dimensions (approx.)	Weight (approx.)
1	10D/20773	Transmitter-receiver TR.10056	1	4·7 in. × 11·5 in. × 7·23 in.	10 lb. 10¼ oz.
2	10AJ/212	Mounting Type 1031	1	—	12¼ oz.
3	10F/17827	Relay Type 1028	1	2·6 in. × 5·12 in. × 2·8 in.	1 lb. 6 oz.
4	10B/16920	Aerial, aircraft, Type 11789	1	Dia. 2¼ in. Hgt. 13½ in.	1 lb. 10 oz.
5	5J/3458	Battery, nickel-cadmium, Type 19/VO/7, 7 a.h.	1	—	16 lb. 12 oz.
6	▶◀	◀Series dropping resistor	1	See (para. 5) and Appendix 'A' of aircraft concerned▶	
7	5C/430	Block terminal Type B, 2-way	As required		
8	5C/432	Block terminal Type B, 3-way	As required		
9	5930-99-0510300	Switch S.P.S.T.	1	(Naval aircraft only)	
10		Switch S.P.D.T.	2		
11		Label for channel selection engraved A/GUARD	1	(Naval aircraft only)	
12		Label for power selection engraved POWER NORMAL/STANDBY	1		
13		Label for u.h.f. normal or standby equipment engraved U.H.F. NORMAL/STANDBY	1		

Installation (fig. 3 at end of the chapter)

Aerial, aircraft, Type 11789

7. The aerial, aircraft, Type 11789 (fig. 1) is a whip type aerial; the length of the rod is cut to correspond with half a wavelength at the frequency of the guard channel (243 Mc/s). The aerial mounting has 8 holes to permit the mounting to be secured, in conjunction with a special flange, to the aircraft. This flange is to be made by the aircraft manufacturer so that it follows the shape of the aircraft structure to which the aerial is to be bolted. The aerial should be sited so that its omni-directional properties are not impaired. In addition, the siting should ensure that the length of the r.f. coaxial cable uniradio 67 is kept as short as possible and in any case it should not exceed 50 ft. The minimum bending radius of the r.f. connector is 2 inches. The connector should be cleated firmly but care must be taken not to distort the cable. The base of the aerial incorporates a socket for mating with a plug Type UG573A/U.

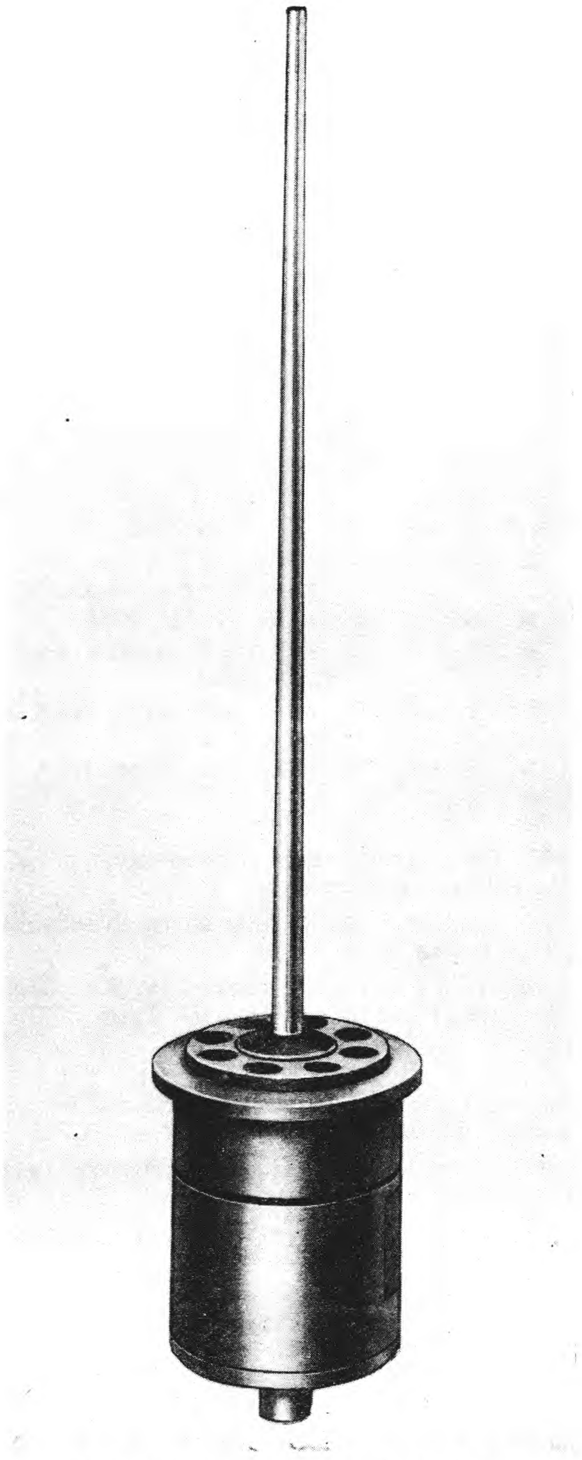

Fig. 1. Aerial, aircraft, Type 11789

*Transmitter-receiver TR.*10056

8. The following conditions should be satisfied when installing the transmitter-receiver:—

(1) It should be installed in a horizontal position, so that it is level when the aircraft is in level flight.

(2) The length of the r.f. cable (uniradio 67) from the unit to the aerial system must be as short as possible and in any case should not exceed 50 feet.

(3) Sufficient space must be available in front of the transmitter-receiver for the following reasons:—

(a) To allow the connectors to be fitted to the front panel of the unit.

(b) To permit the unit to be easily removed from its mounting Type 1031.

(c) Sufficient space must be allowed above and at the sides of the unit to allow for full flexing of the resilient mounts on the mounting Type 1031.

Mounting Type 1031

9. The mounting is shown in Part 1, Chap. 1, fig. 1. It is fitted with a 4-lb. anti-vibration mounting at each of its four corners. The transmitter-receiver chassis incorporates two spring-loaded locating dowels which locate into two apertures at the rear of the mounting. The front of the mounting supports two bolts and captive knurled nut fasteners located with two screwed-on projections at the front of the transmitter-receiver to secure this unit into the mounting. It is essential that these are fastened securely when the equipment is installed. The mounting should be secured to the aircraft structure through the 0·166 dia. holes which pass through the centre of the anti-vibration mountings. The fixing centres are 6·0 in. × 2·88 in.

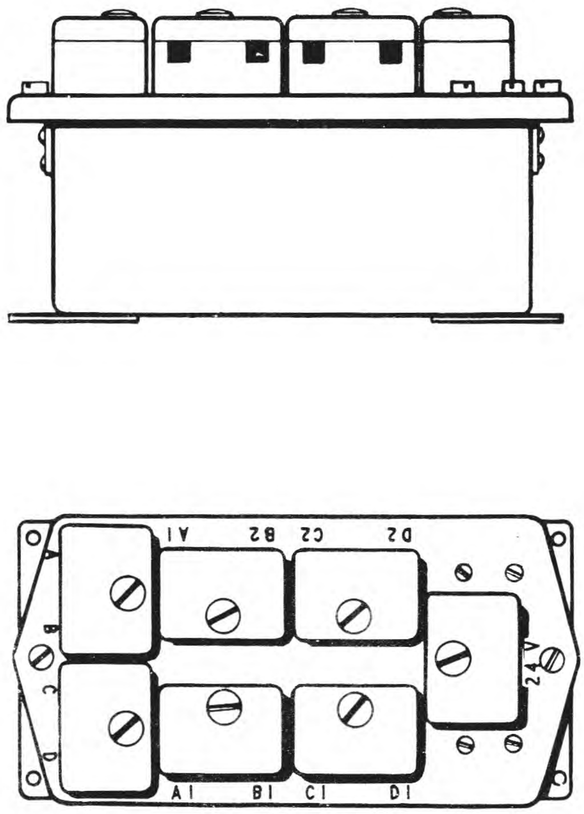

Fig. 2. Relay unit Type 102A

Relay unit Type 102A

10. The relay unit Type 102A is illustrated in fig. 2. The unit contains two GPO type 600 relays and these are used in conjunction with the U.H.F. NORMAL/STANDBY switch to change over the microphone and telephones of the inter-communication system to either the normal u.h.f. equipment (ARI.18124/1 or 18124/2) or to the u.h.f. standby set ARI.23057. The switch position is to be provided with a label engraved U.H.F. NORMAL/STANDBY. In the NORMAL position the relays are energized and the microphone and telephones are switched to the normal u.h.f. equipment. In the STANDBY position of the switch the relays are not energized and they connect the microphones and telephones to the standby set. The external connections to the relay unit are shown in the installation diagram fig. 3 at the end of the chapter. The relay unit can be mounted in any convenient position, the fixing centres for which are 4·7 in.×2·15 in., while the four holes through which the unit may be secured to the aircraft each have a diameter of 0·1495 in.

Note . . .

As an alternative to the relay unit Type 102A an approved type of sealed relay could be substituted.

Interconnections

11. The interconnections are shown in the installation diagram fig. 3. Only eight poles of the CONTROL twelve-pole plug on the front panel are in use. The cable to be used is as follows:—

Ref. No.	*Nomenclature*
6D/3213	Cable miniature electrical 6D DEF 10
6145-100023	

12. The cable described in para. 11 provides for six of the poles used while unipren 4 is used with the remaining poles. One end of the connector is terminated with a 12-pole socket for mating with the CONTROL plug on the front panel of the transmitter-receiver TR.10056, while the other end is left open for connecting as shown in fig. 3. The unipren 6 leads are used for the d.c. supply but where the d.c. supply circuits are lengthy, to avoid excessive volt drop, unipren 12 should be used. The system includes a socket coupler wired into the loom of the cabling to provide facilities for using the test set u.h.f. Type 15077 for servicing purposes. The socket coupler should be mounted on a bracket secured to the aircraft in a position which provides easy access for using the test set u.h.f. Type 15077. The details of the plug and socket terminations of the various connectors are given in Table 2.

Note . . .

On the relay unit Type 102A (fig. 2 and 3) the engraving 24V on the battery terminal block was for use with certain other aircraft installations. In this installation it serves as a terminal block for the aircraft d.c. supply of 28V.

13. *Connector* 1 (*fig.* 3).—The functions of the six miniature electric leads of connector 1 are as follows:—

Pole	*Colour*	*Function*
B	Blue	Earth. negative for press to talk and negative for telephones
H	White	ON/OFF for the TR.10056
E	Red	Via relay unit Type 102A to press to talk switch
J	Yellow	Via relay unit Type 102A to telephones
D	Green	Via relay unit Type 102A to microphone
G	Black	(as above)

14. The unipren 4 leads of connector 1 provide the following services:—

(1) Pole M is used with the alternative channel switch.

(2) Pole F is used to connect the d.c. supply of 24V to the test set u.h.f. Type 15077.

15. *Connector* 2 (*fig.* 3).—Connector 2 is used in conjunction with the socket coupler of the test socket. The details are as follows:—

(1) Poles D, E, F, G and J have the same functions as connector 1 (*para.* 13).

(2) Pole H (blue) is used for earth, press to talk negative and telephones negative.

(3) Poles A and B are connected by unipren 6 to the positive and negative of the 28V d.c. supply respectively.

Table 2

Connector terminations (*fig.* 3)

From	End A	Insert	To	End B
BATTERY plug on TR.10056	Socket Mk. 4, 2-pole 5935-99-056-0090	0	Power supply terminal block	Open
AERIAL socket on TR.10056	Plug 5935-99-943-4155	—	Aerial Type 11789	Plug Type UG/573A/U
CONTROL plug on TR.10056	Socket Mk. 4, 12-pole 5935-99-056-0180	0	Terminal blocks for control, mics and tels	Open
Terminal blocks control, mics and tels	Socket coupler 12- [illegible]	0	To test set u.h.f. [illegible]	

(4) Poles J and K of the test socket should be linked together.

16. *Connector* 3.—Connector 3 links the microphone, telephone, press to talk, alternative channel and ON/OFF terminal blocks of connector 1 to the terminal blocks associated with the relay unit Type 102A, the alternative channel switch and also the u.h.f. selector switch. These terminal blocks are marked MIC, TELS, PTT, ALTERNATIVE CHANNEL and ON/OFF.

Two-channel operation

17. The equipment delivered by the manufacfacturers is set for operation on one channel at a frequency of 243 Mc/s and to change it for operation as a two-channel equipment it is necessary to remove the dummy crystals and also the links (*para.* 3) in accordance with the instructions contained in Part 1, Chap. 2. The single-pole channel switch labelled A/GUARD should be connected to earth and to the appropriate terminal block by unipren 6 and then by unipren 4 to pole M of the 12-pole socket (which mates with the 12-pole plug on the transmitter) (*fig.* 3).

Functional servicing

18. To provide facilities for using the test set u.h.f. Type 15077 for servicing the transmitter-receiver TR.10056, a test socket (*fig.* 3) is included in the installation for connecting the transmitter-receiver to the test set. After the installation is completed, the transmitter-receiver should be serviced using the test set as described in Part 2, Chap. 1.

Chapter 3

CONSTRUCTION

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Introduction

1. A general view of the transmitter-receiver TR.10056 is given in Part 1, Chap. 1, fig. 1 while the equipment with the cover removed is shown in fig. 2 of the same chapter. The assembly consists of three main parts, as follows:—

(1) The cover.

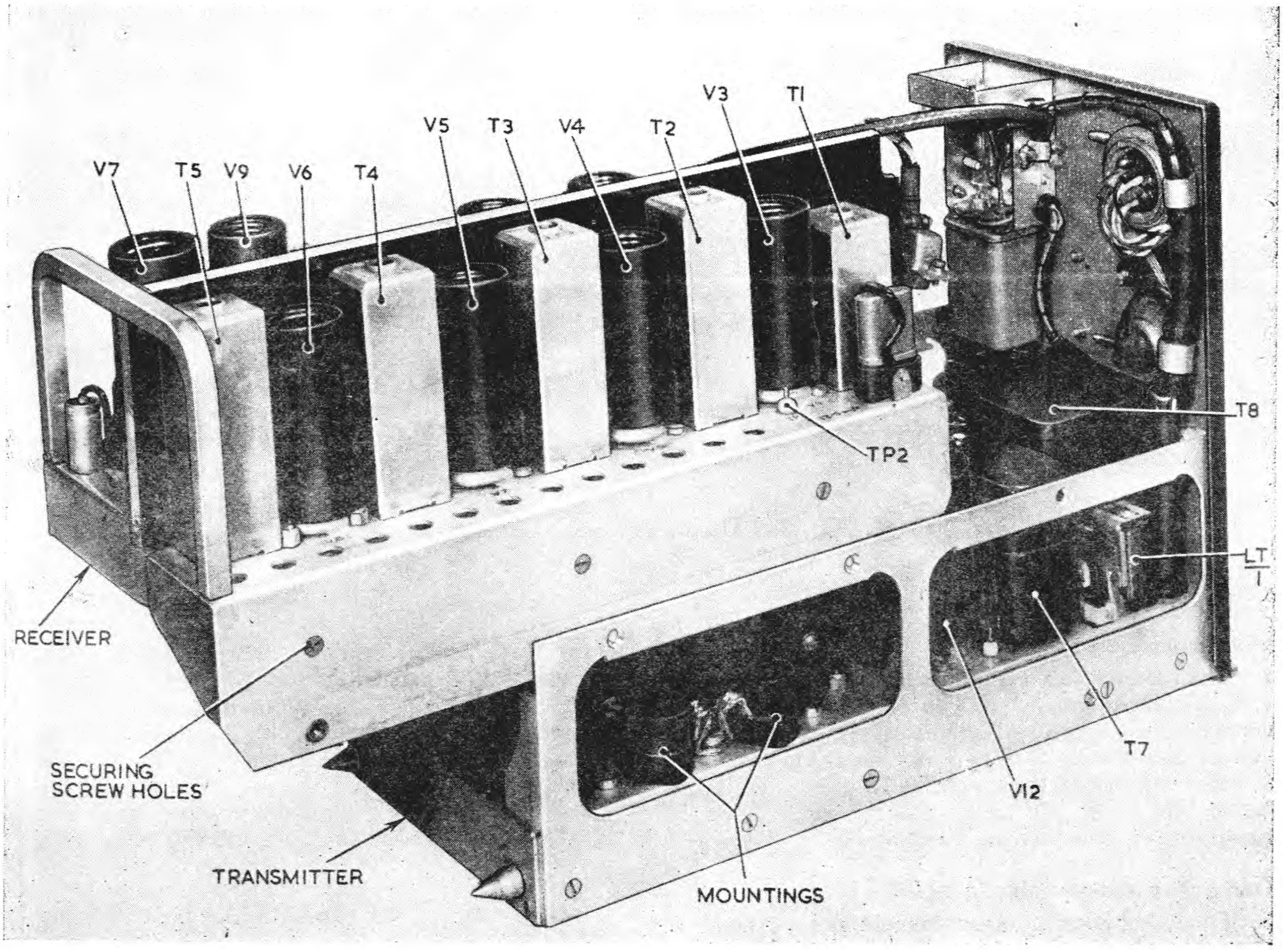
(2) The receiver sub-assembly.

(3) The transmitter sub-assembly which includes the modulator and the power unit.

2. The weight and dimensions of the equipment are given in the leading particulars at the beginning of Part 1.

Cover

3. The cover is an open fronted case which is secured to the equipment by a single captive screw at the rear of the cover. Four apertures, enclosed with fine wire mesh, are cut into the sides of the cover for ventilation purposes.



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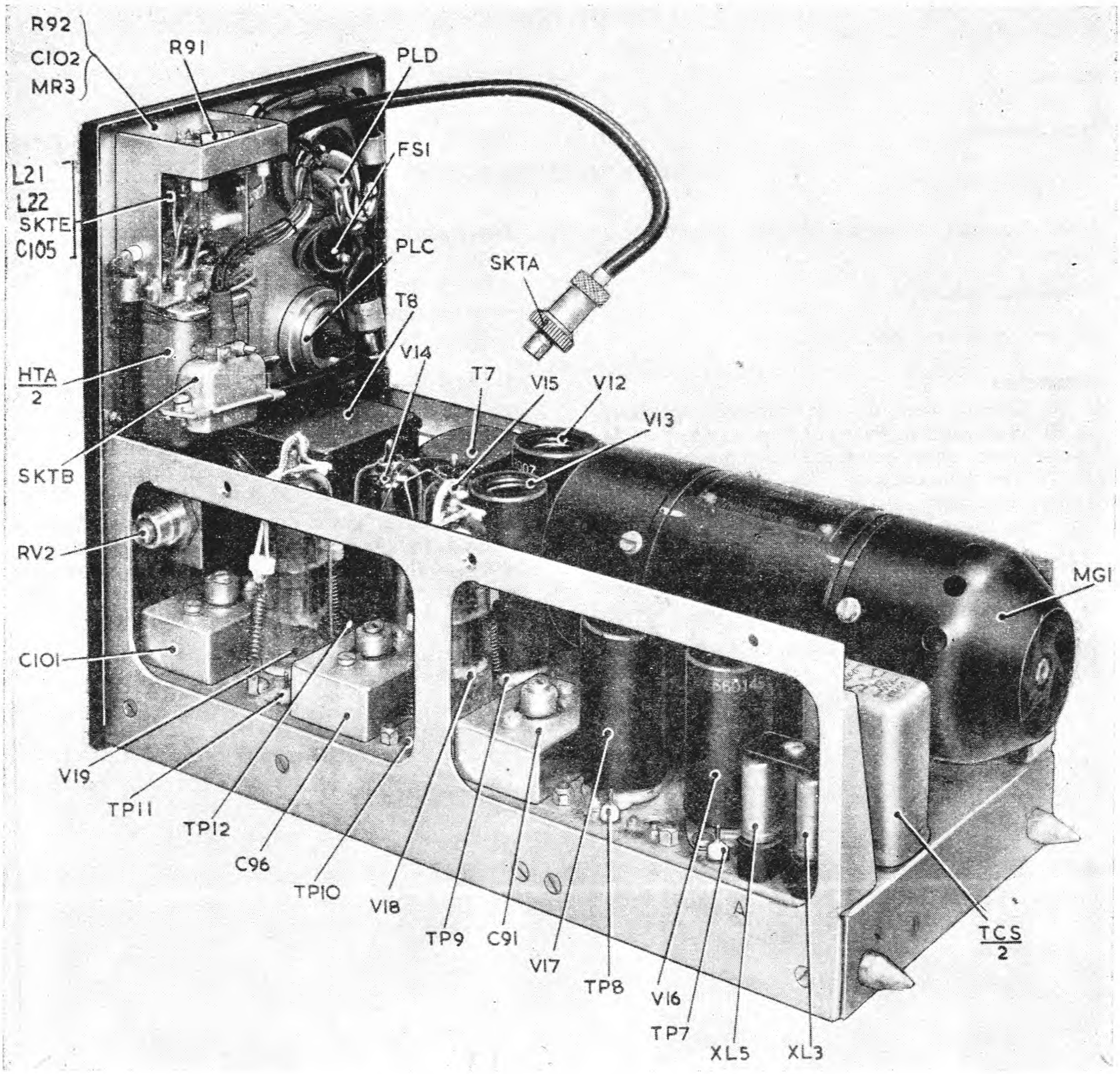

◀ **Fig. 2. Transmitter sub-assembly** ▶

Main assembly (*fig.* 1)

4. The receiver sub-assembly chassis is the upper deck of the equipment. It can be separated from the main chassis by removing three screws on either side of the chassis and two on the front panel, and also unplugging the socket SKTB and the aerial socket SKTA (*fig.* 2). After this the receiver can be withdrawn from the main chassis.

Transmitter sub-assembly (*fig.* 2)

5. The transmitter sub-assembly includes the front panel and the main chassis. The top side of the chassis supports the motor gene
also all the valves of the transm
attached to the shaft of the mot

provide forced-air cooling. The preset controls of the tuning capacitors for aligning the transmitter circuits are brought out to the top of the chassis, while those of the tuning inductors are to be found underneath the chassis (*fig.* 3). The crystals XL3 and XL5 are at the rear of the chassis and jointly secured in position by a clip and one screw. The crystal switching relay $\frac{TCS}{2}$ is at the rear of the chassis while the HT relay HTA is attached to the rear of the front panel.

the various plugs and

Chapter 5

TRANSMITTER-RECEIVER TYPE M4
(Completely revised)

CONTENTS

TABLES

General description

1. The transmitter-receiver Type M4 is part of the ARI.23057 and was introduced into Service use by the embodiment of modification No. 6285 to transmitter-receiver Type 10056. In addition, some units are modified by the manufacturer during production. Before incorporation of this modification into the trans mitter-receiver Type 10056, it is essential that modifications numbered 6137 and 6349 are embodied in the equipment. Brief details of these modifications are given in para. 7 to 11. In all instances, the instructions for the embodiment of these modifications must be obtained from Topic 2 of this air publication.

2. The original transmitter-receiver Type 10056 had an operating ambient temperature limit of 30°C at altitudes of up to 60 000 ft. The transmitter-receiver Type M4 is introduced to raise this ambient temperature operating limit to 45°C at altitudes of up to 60 000 ft. This is achieved by changing a number of capacitors, resistors and crystals for components which have more suitable temperature characteristics. The changes make very little difference to the physical appearance and layout of the equipment and, consequently, the general views of the TR.10056 given in Part 1, Chap. 1 apply equally well to the transmitter-receiver Type M4. When the TR.10056 is modified, the label on the front panel is changed for one bearing the new transmitter-receiver nomenclature of the TR.M4.

Construction and installation

3. The transmitter-receiver Type M4 comprises:-

(1) Transmitter, radio Type M9
(2) Receiver, radio Type M17.

The reference numbers of both equipments are given in the Leading Particulars.

4. The equipment uses the original mounting tray Type 1031 as shown in Part 1, Chap. 1, fig. 1. There is no appreciable alteration to the constructional details or to the layout of components and so the details given in Part 1, Chap. 3, together with the accompanying illustrations, apply to the TR.M4.

5. As the TR.M4 forms part of the ARI.23057, the installation details given in Part 1, Chap. 4 also apply to this transmitter-receiver.

Circuit description

6. The circuit for the TR.M4 and the TR.10056 is given in Part 1 Chap. 2, fig. 1 which also shows the values of certain components that are different in each transmitter-receiver. These differences are also listed in para. 9. In addition to the component value differences, types of crystals with an improved temperature coefficient are used in the TR.M4 and these are listed in para. 10. None of these changes affects the description of the circuit given in Part 1, Chap. 2.

Modification No. 6137

7. Modification No. 6137 must be incorporated into the TR.10056 before Modification No. 6285. Because of variations in the lengths of mountings Type 1031, it is occasionally difficult to tighten the securing nuts when the transmitter-receiver is fitted into a mounting. Modification No. 6137 overcomes this difficulty by introducing longer locating pins Type 119 (Ref. No. 10AC/2013) for fitting to the transmitter chassis. This modification is No. 2 on the label of the transmitter Type T.12351 of the TR.10056.

Modification No. 6349

8. Modification No. 6349 must be incorporated into the TR.10056 before Modification No. 6285. In the receiver of the TR.10056 it was found that, because of the wide variation of contact potential of valves CV4003 in the V7b position of the receiver, grid current could flow, resulting in a reduction of the audio output. From an input of 5 mV, the output could be reduced from 50 mW to as low as 10 mW. Modification No. 6349 changes the values of R38 and R39 in the anode circuit of V7b to 100 kilohm. This increases the anode current and consequently, the cathode voltage to a figure in excess of the contact potential. This prevents the audio output from falling below 50 mW from an input of 5 mV. The modification is No. 2 on the label of the receiver Type R.12352 of the TR.10056.

Modification No. 6285

9. Modification No. 6285 is introduced to convert the TR.10056 to the TR.M4 for the reasons given in para. 2. Although a number of components are changed when this modification is embodied those changes which alter the values of components (as shown in the circuit of Part 1, Chap. 2, fig. 1) are listed in Table 1.

TABLE 1

Mod. No. 6285 - change of component values

Reference	TR.10056	TR.M4
C60	3pF	3.3pF
C85	3pF	3.3pF
C90	4pF	3.9pF
*R84	33 kilohm	68 kilohm
*R84A	Not fitted	68 kilohm

*In TR.M4 the resistors R84 and R84A are wired in parallel.

10. The three crystal units are changed as shown in Table 2.

TABLE 2

Mod. No. 6285 - change of crystal units

Equipment	TR.10056 original item	TR.M4 new item	Circuit Ref. Pt.1,Ch.2, Fig.1
Receiver unit	ZDJ/18500 crystal unit, quartz, DEF 5271	ZDK/18500.0 crystal unit, quartz, 18500 kHz	XL1
	ZDJS/370833 crystal unit, quartz DEF.5271	ZDKS/37083.3 crystal unit, quartz 37083.3 kHz	XL2
Transmitter unit	ZDJS/40500 crystal unit, quartz, DEF.5271, style D	ZDKS/40500.0 crystal unit, quartz, 40500 kHz	XL3

11. The Modification No. 6285 also requires the fitting of new labels to show that the equipment has been changed to the following type reference, namely:-

Transmitter-receiver Type M4 comprising:
Transmitter, radio Type M9
Receiver, radio Type M17.

Modifications No. A2583 and No. A4069

12. Modification No. A2583 introduces a rejector circuit, consisting of L21 [illegible] eakthrough of B.B.C. broadcasts to [illegible] g. 1). Service ex-

perience later showed that the mechanical design of the inductors was unsatisfactory. Modification No. A4069 introduced a modified, more suitable inductor and changed the value of the capacitor C104.

Modification No. A3069

13. Modification No. A3069 introduces a resistor (R94) and substitutes a capacitor (C70) of increased value to standardise the input impedance and input voltage level of the equipment with that existing in other u.h.f. standby transmitters-receivers.

Chapter 6

TRANSMITTER-RECEIVER RADIO 5821-99-945-6726

GENERAL AND CIRCUIT DESCRIPTION

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LIST OF ILLUSTRATIONS

GENERAL DESCRIPTION

Introduction

1. The transmitter receiver radio 5821–99–945–6726 was originally known as the transmitter receiver Type M6. The transmitter receiver radio differs from the TR.10056 and the TR.M4, described in Part 1, Chap. 1 and 5 respectively, in respect of its power unit and its operational ambient temperature limits. In addition there are differences in component layout and construction. Otherwise, the information contained in Part 1, Chap. 1 is applicable to the transmitter receiver radio.

2. The transmitter receiver radio consists of the following sub-units:—

(1) Transmitter radio, 5821–99–945–9782.

(2) Receiver radio, 5821–99–945–9783.

(3) Converter d.c., ◀5821–99–946–1961.▶

(4) Suppressor, transient voltage. ◀5915–99–945–6727.▶

3. A general view of the transmitter receiver radio is given in fig. 1. The mounting used to support the equipment is the mounting Type 1031, this is shown in Part 1, Chap. 1, fig. 1, while its Ref. No. is given in the leading particulars at the beginning of Part 1.

4. A view of the transmitter receiver radio with its cover removed is shown in fig. 2.

Power supplies

5. The equipment is designed for operation from a d.c. supply of 24V but a dropping resistor (Part 1, Chap. 4) is included in the installation to permit it to be operated from a d.c. supply of 28V. It can be operated from a battery supply of 24V for a period of about 60 minutes, while it can be used from any aircraft's normal supply of 28V for prolonged periods.

6. The h.t. supply of about 250V is provided by the converter d.c. (para. 20) which is a transistorized power unit.

7. The l.t. supply for the heaters of the various valves is obtained by connecting them in a series-parallel arrangement across the d.c. supply of 24V.

8. With a d.c. supply of 24V the power consumption is nominally:—

Receiver 65W (72W maximum)

Transmitting 86W (96W maximum).

9. The d.c. converter is designed for operation from a nominal supply of 21·5V. When the load on the d.c. supply of the aircraft changes to a different level it is possible for transient voltages to be developed which could damage the transistors of the d.c. converter. The transient voltage suppressor unit (para. 16) is capable of limiting the input to the d.c. converter to a safe value providing transients do not exceed 80V.

Ambient temperature limit

10. The transmitter receiver radio may be operated at altitudes up to 60,000 feet and in temperatures of up to 55° centigrade.

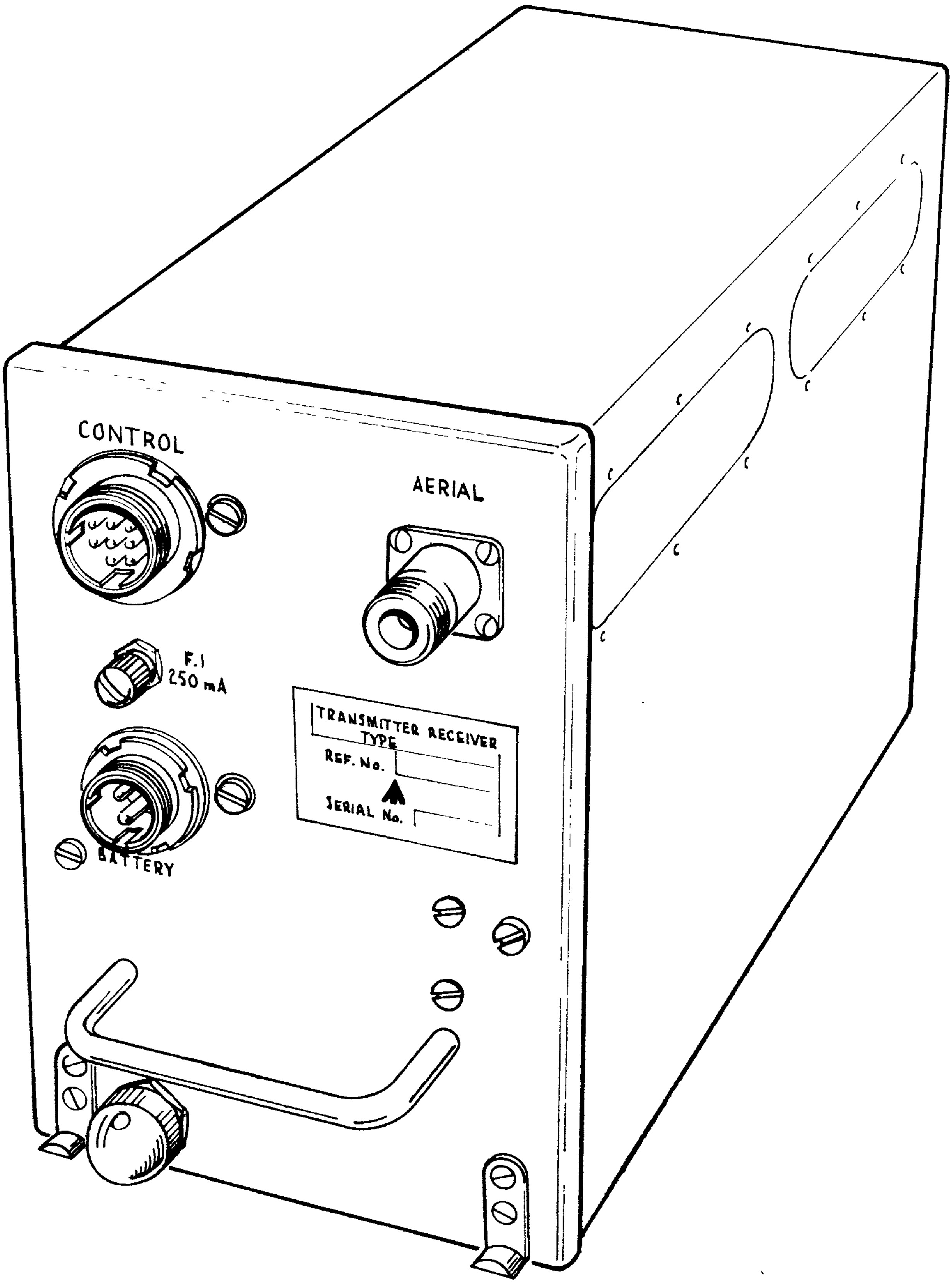


Fig. 1. Transmitter receiver radio 5821–99–945–6726

Operating instructions

11. The operating instructions for the transmitter receiver radio are similar to those given in Part 1, Chap. 1.

Installation

12. The details of a typical installation for the transmitter receiver radio are similar to those Chap. 4.

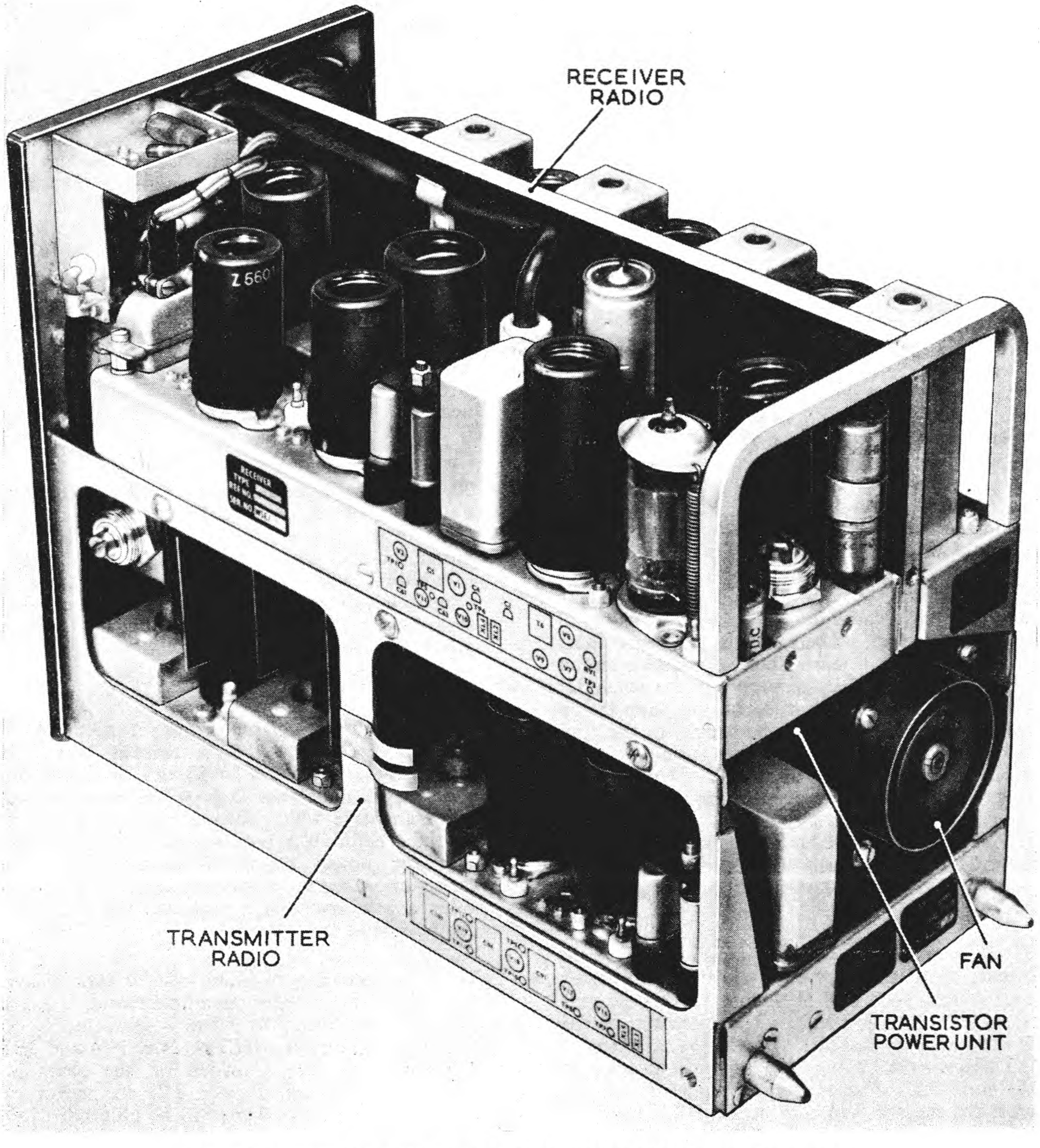


Fig. 2 Transmitter receiver radio 5821-99-945-6726: cover removed

CIRCUIT DESCRIPTION

General

13. The circuit of the transmitter-receiver radio is given in fig. 3 at the end of this chapter. With the following exceptions the circuit details given in Part 1, Chap. 2 are applicable to the transmitter-receiver radio:—

(1) To permit the equipment to be operated up to the altitude and temperature limitations in para. 10, a number of components have been substituted by items having better temperature characteristics.

(2) A transient voltage suppressor is incorporated into the equipment to safeguard the transistors in the d.c. converter.

(3) A transistorized d.c. converter is used in place of the rotary transformer to provide the h.t. supplies.

14. Although quite a number of components are different, those which differ in value from those used in the circuit description given in Part 1, Chap. 2 [illegible] follows:—

C60	3·3p instead of 3p
C85	3·3p instead of 3p
C90	3·9p instead of 4p
R84A and R84B	Each 68K and connected in parallel instead of R84, value 33K.

Crystals

15. The crystals used in the transmitter-receiver radio are also different and they are as follows:—

Transmitter radio	ZDKS/40500·0 Crystal unit quartz 40500 kc/s	XL3 fig. 3
Receiver radio	ZDK/18500·0 Crystal unit quartz 18500 kc/s	XL1 fig. 3
Receiver radio	ZDKS/37083·3 Crystal unit quartz 37083·3 kc/s	XL2 fig. 3

Transient voltage suppressor

16. The suppressor unit should function in such a way as to protect the transistors of the d.c. converter in accordance with the provisions of the B.S. 2G.100, Part 3. If due to fault conditions, the capacity of the d.c. load on the aircraft supply is changed from about 75% to 25% of the nominal full load, the d.c. voltage could rise to about 80V for a period of about 40mS. The over-voltage would then decay until it reached static conditions in about 10 seconds. This limit of 10 seconds for the over-voltage is determined by the over-voltage relay in the faulty d.c. power supply circuit. These transients could cause damage to the transistors of the d.c. converter. Therefore, to safeguard these transistors, the transient voltage suppression circuit is incorporated. The d.c. supply to the converter is obtained from the output of the suppression circuit, which ensures that the supply to the converter is relatively constant with transient voltages varying from about 30V up to 80V. Under static d.c. conditions there is a drop of about 2·5V across the transient suppressor unit and, therefore, with an input of 24V to this unit, the output should be about 21·5V. Transient conditions of up to 80V should not increase the output from the suppressor unit to more than 27V.

17. The transient voltage suppression circuit consists of the filter L9 and ◀C104▶, the Zener diode MR5, R93, and R94, and the n-p-n transistors VT1, VT2 and VT3. The d.c. supply is fed via the half-wave rectifier MR4 to the collector of VT3 and via MR4 and R93 to the collectors of VT1 and VT2. The d.c. supply is also connected across the resistor R94 and the Zener diode MR5, the junction of these two components being connected to the base of the transistor VT3. The turn over voltage of the Zener diode MR5 is 27V and, therefore, below this value MR5 is nonconductive and the base current of VT3 is constant. This base current controls the operation of the two output transistors VT1 and VT2, therefore, under static d.c. conditions the output of the suppression unit remains constant at about 21·5V.

18. When a transient above the turn-over voltage of the Zener diode MR5 is developed, the diode conducts and the resultant current flows through the resistor R94. The voltage drop across the resistor increases, thus tends to maintain the potential at the base of VT3 and also the associated base current at the same levels as those occurring under d.c. conditions. This stabilizes the output at VT1 and VT2, so that with a transient of 80V, the d.c. output should not exceed 27V.

19. The function of R93 is to equalize the loads on the two output diodes VT1 and VT2. The half-wave rectifier MR4 is to safeguard the transistors in the event of the d.c. supply being connected to the equipment with reversed polarity.

Converter d.c. (fig. 3)

20. The various components of the d.c. converter unit are prefixed 2. Some of the components of this unit are mounted on the chassis of the transmitter radio as shown in Part 1, Chap. 7, fig. 3. In addition, when the d.c. converter is obtained as a separate sub-unit, these components are provided separately. The components affected are as follows:—

2C1, 2C2, 2C3, 2C4 and 2R5.

22. The point B2 of the primary winding of 2T1 is coupled via the half-wave rectifier 2MR1 and 2R3 to the collectors of 2VT1 and 2VT2 and thus a degree of unbalance is provided between these two transistors which ensures that the conditions for the generation of oscillations are present whenever the power supply is switched on. The capacitor ◀2C1▶ connected across 2MR1 provides a low impedance path for the oscillatory component of the system.

23. The secondary winding of 2T1 is connected to the full-wave rectifier circuit consisting of 2MR2 to 2MR5, the output of which is smoothed by the filtering components ◀2C2▶, 2C3, 2C4 and 2R5. Three tappings are provided on the secondary winding of the transformer 2T1 to permit the output of the d.c. converter to be adjusted to the required level. The tapping SEC. 2 is the position which will be used normally. The nominal output of the d.c. converter is as follows:—

(1) With the equipment switched to receive, it is about 235V

(2) With the equipment switched to transmit, it is about 215V

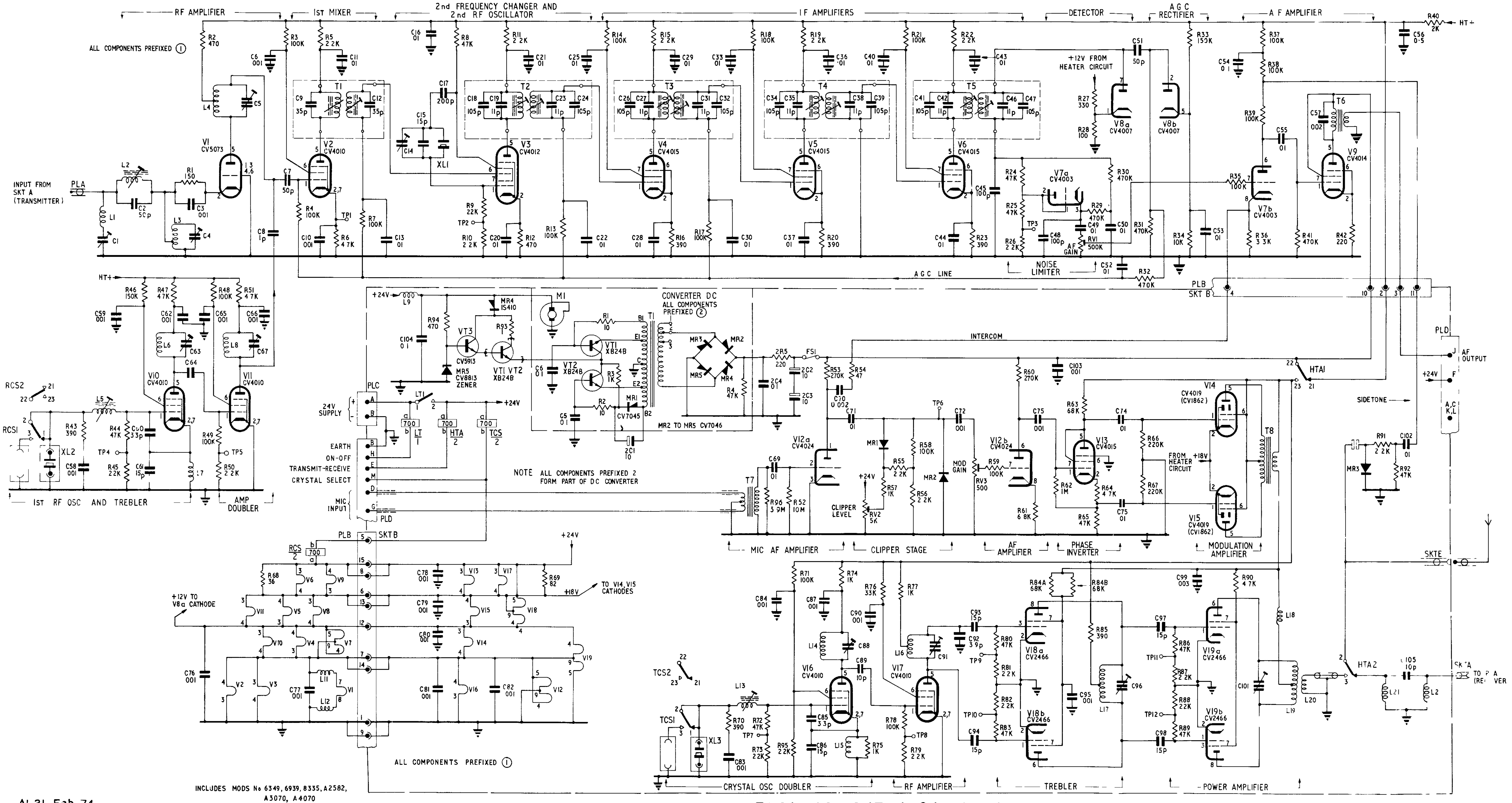
Cooling

24. Cooling is provided by the air blower 2M1 which is driven by the d.c. supply of 24V fed direct to the motor in the d.c. convertor unit.

Notes...

1. Modifications No. A2582 and No. A4070 are introduced to prevent breakthrough of the B.B.C. radio transmissions at the 243 MHz input circuit of the receiver. These were caused by a local radio transmitter operating on a frequency of 90.1 MHz. The earlier Modification No. A2582 introduced a filter circuit comprising L21, L22 and C105 in the aerial input circuit of the receiver (see fig. 3). Later Service experience showed that the mechanical design of the inductors was unsatisfactory. Modification No. A4070 introduced a modified, more suitable inductor design and changed the value of the capacitor C105.

2. Modification No. A3070 introduces a resistor (R94) and substitutes a capacitor (C70) of increased value to standardise the input impedance and input voltage level of this equipment with that existing in other u.h.f. standby transmitters-receivers.



Transmitter-receiver 5821-99-945-6726: circuit

AIR DIAGRAM-MIN
116D-011C-MD2
BY COMMAND OF THE DEFENCE COUNCIL FOR USE IN THE ROYAL NAVY/ROYAL AIR FORCE
ISSUE 2 Prepared by MOD(PE)

Chapter 7

TRANSMITTER RECEIVER RADIO 5821-99-945-6726

CONSTRUCTION

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LIST OF ILLUSTRATIONS

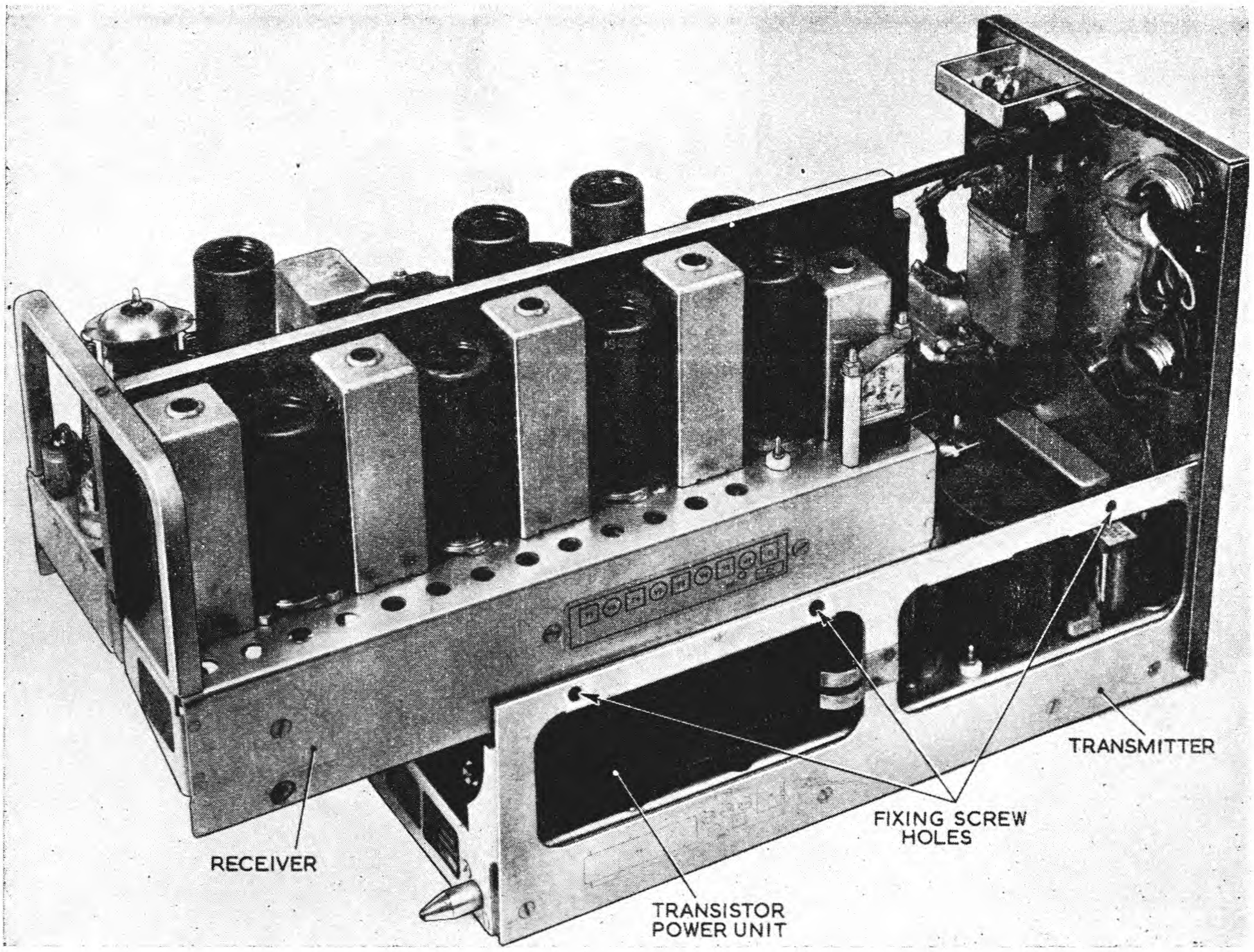


Fig. 1. Transmitter receiver radio: receiver partially removed

Introduction

1. The construction of the transmitter receiver radio 5821-99-945-6726 is similar to the information given in Part 1, Chap. 3 and therefore this chapter will contain only details of the differences between the transmitter receiver radio and the equipment described in Part 1, Chap. 3.

2. The transmitter receiver radio consists of the following main sub-assemblies:—

(1) The cover.

(2) The transmitter radio.

(3) The receiver radio.

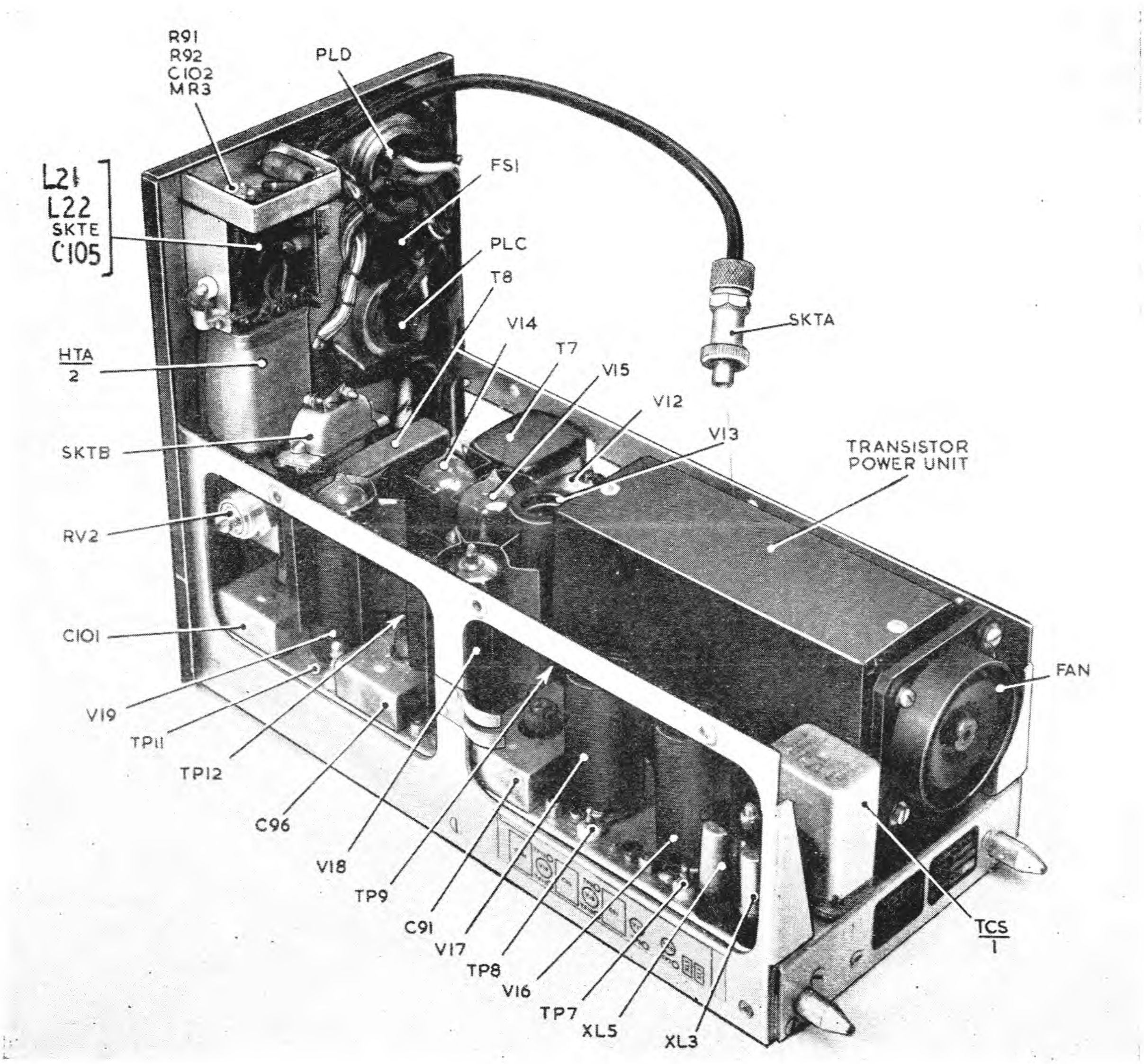
(4) Suppressor transient voltage unit.

(5) Converter d.c.

3. The chief differences (para. 1) are in respect of the d.c. converter which is a transistorized power supply unit and the associated transient voltage suppressor device. These items take the place of the rotary transformer which provides the h.t. in the equipment described in Part 1, Chap. 3.

4. The transmitter receiver radio consists of two main sub-assemblies, the receiver radio on the upper deck and, underneath, the transmitter radio which also includes the main chassis assembly and the front panel. The equipment is shown in fig. 1 with the receiver radio partially removed.

5. The receiver radio can be separated from the transmitter radio by removing three screws on either side of the equipment and also two in the front panel. Then after unplugging the sockets



◀ **Fig. 2. Transmitter radio** ▶

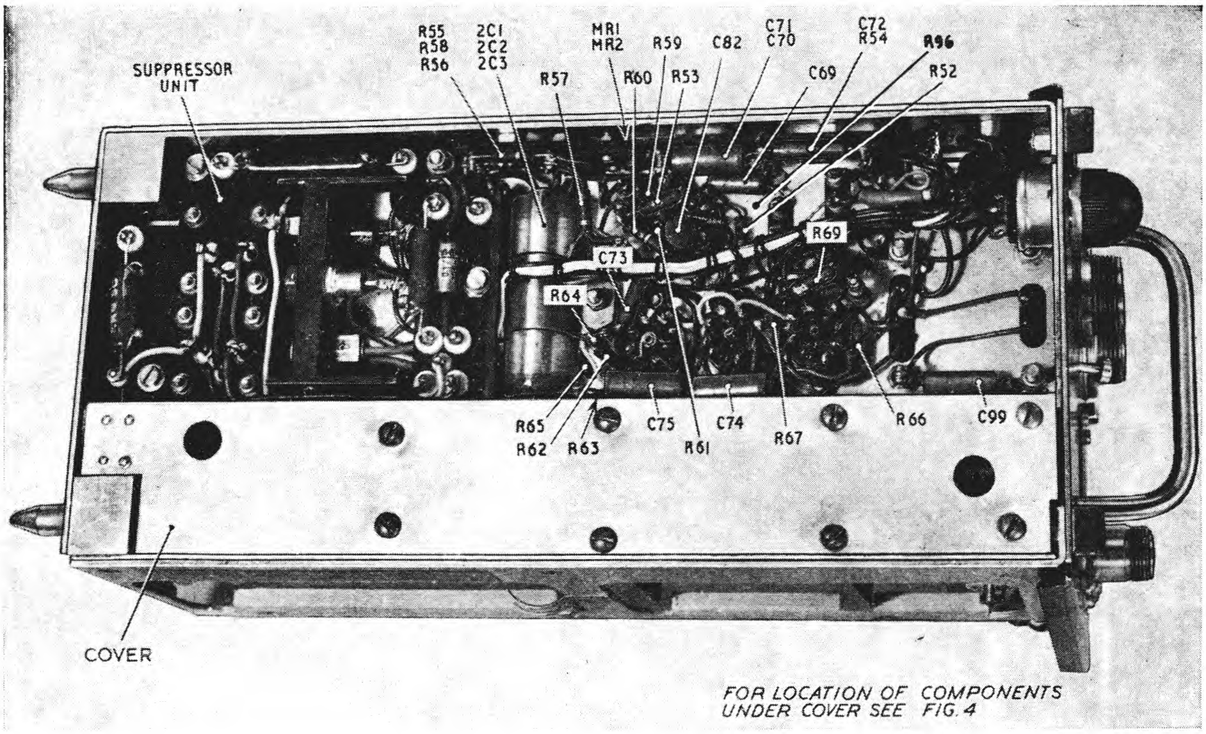


Fig. 3. Transmitter radio : underside

SKTA and SKTB, the receiver can be removed.

Transmitter radio (fig. 2)

6. The top side of the chassis of the transmitter radio supports the d.c. converter unit and the cooling fan, although a few of the components of the converter are located on or near the transient voltage suppressor unit which is on the underside of the transmitter radio chassis (fig. 3).

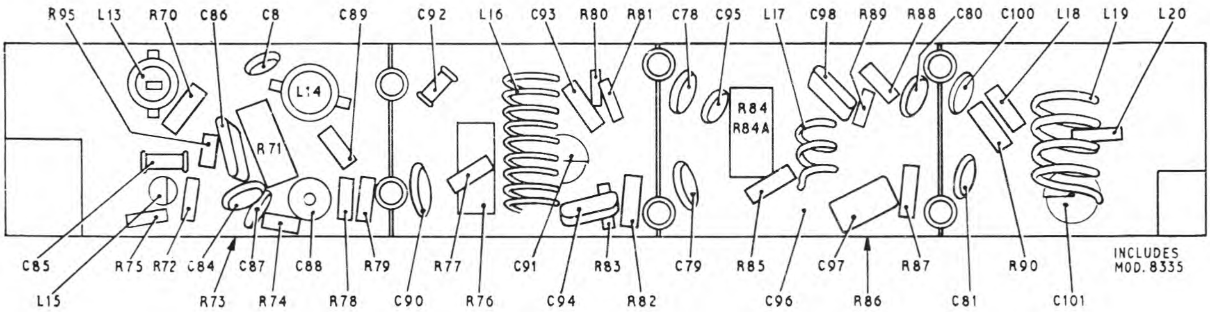
7. The location of the various components of the transmitter radio is given in fig. 2, 3 and 4. From fig. 2 it will be seen that a different type of screening can is used for some of the valves. Otherwise the information regarding the transmitter described in Part 1, Chap. 3 remains unchanged.

Receiver radio

8. The component location for the receiver radio is given in fig. 5, 6 and 7 and except for the repositioning of a few of the components, the general construction remains unchanged from that given in Part 1, Chap. 3.

Suppressor transient voltage unit (fig. 8)

9. The transient voltage suppressor unit consists of a chassis assembly made of aluminium and is separated from the chassis assembly of the transmitter radio by three pillars, through which screws are fitted for securing the unit in position. The location of the various components is given in fig. 8. The components 2R5 and 2C4 of the d.c. converter unit are also mounted on the suppressor unit.



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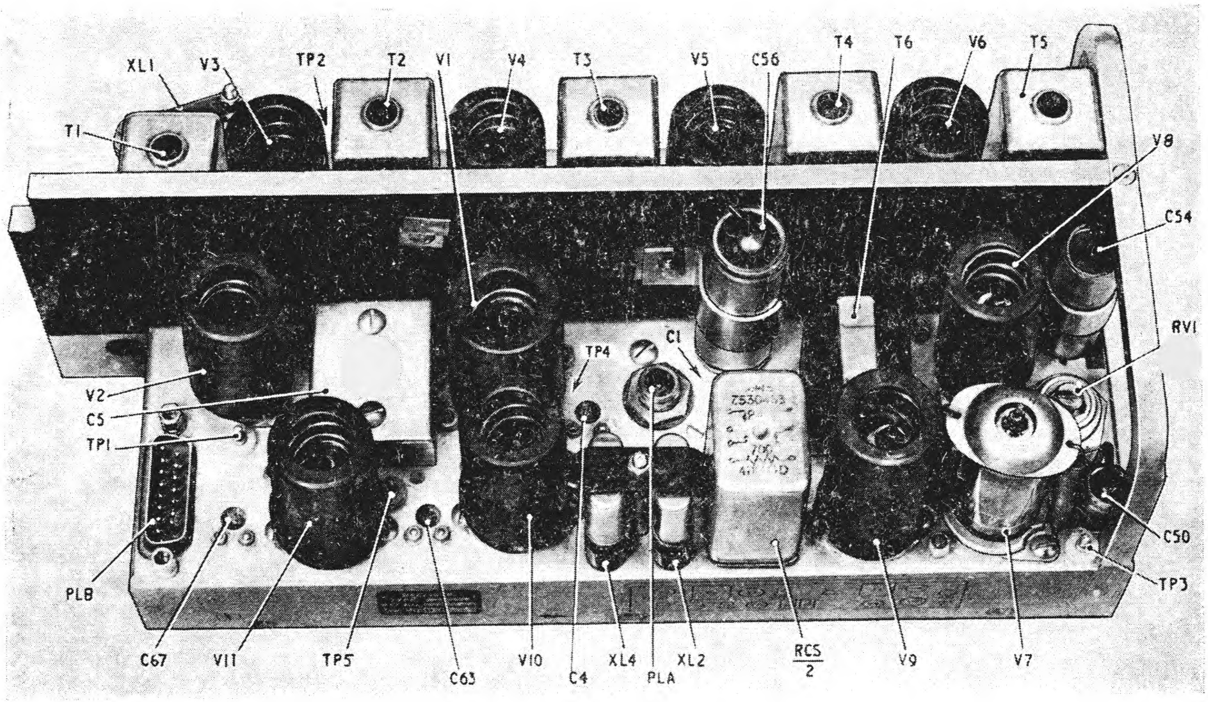
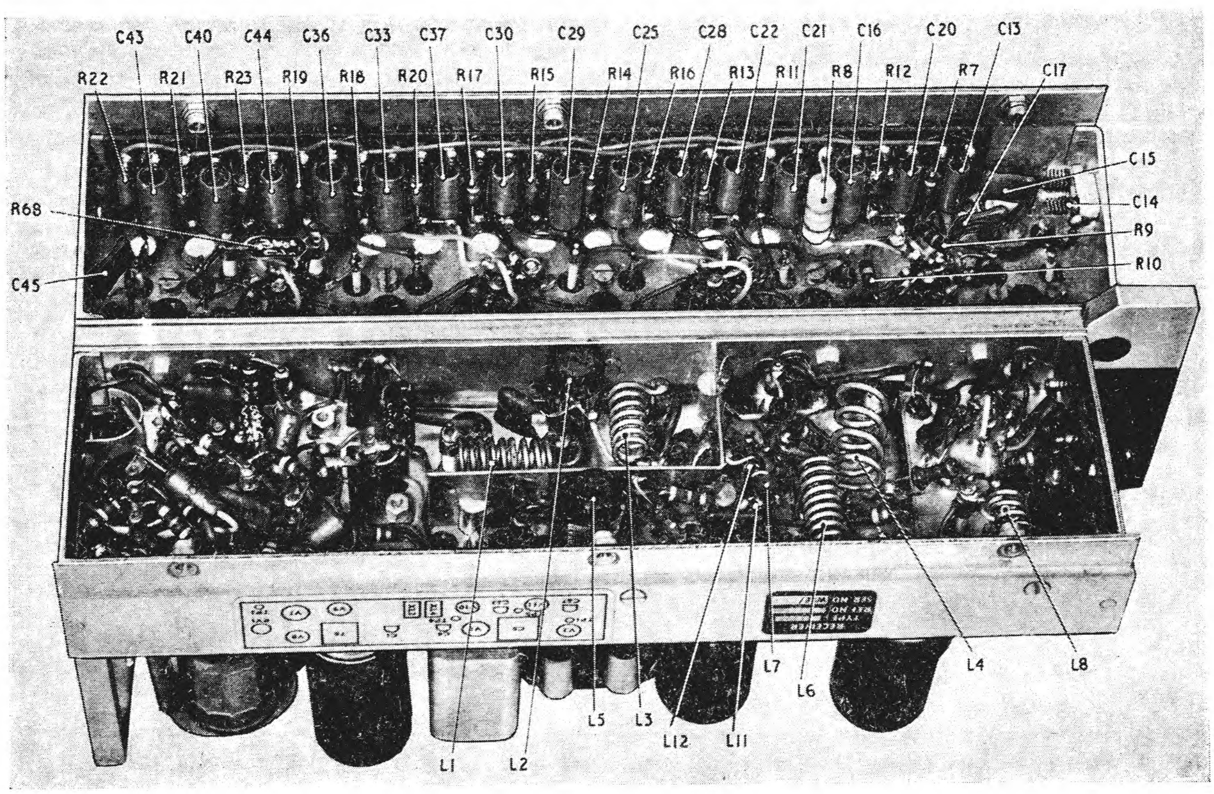


Fig. 5. Receiver radio



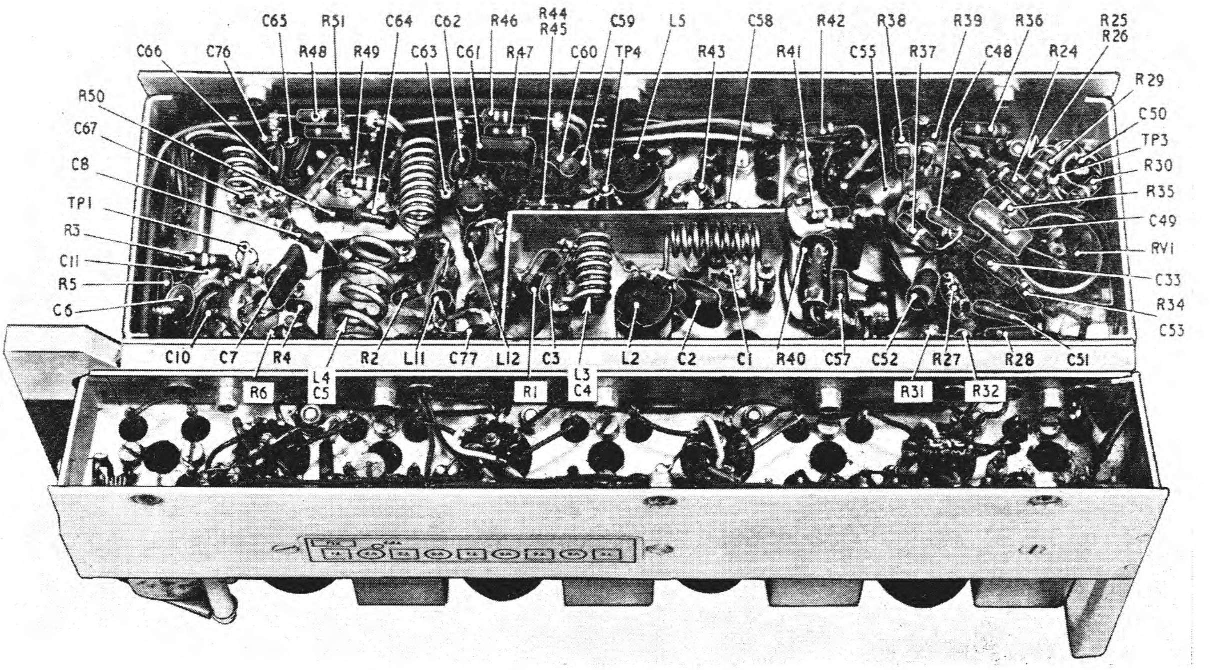


Fig. 7. Receiver radio: right-hand side

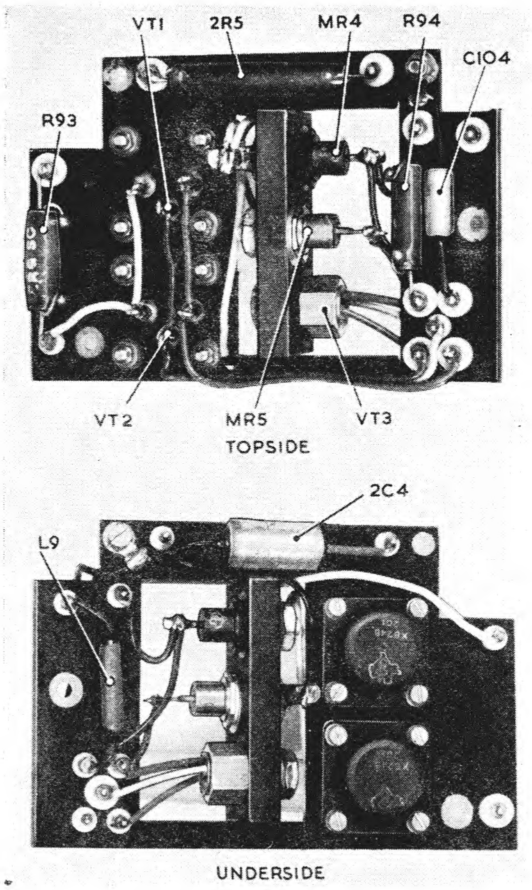


Fig. 8. Suppressor transient voltage

Converter d.c. (fig. 9)

10. The converter d.c. is of rectangular shape and enclosed by a cover which is secured by two screws to the chassis of the converter. The converter is secured to the main chassis of the transmitter radio by four screws, one at each corner. To gain access to these screws it is necessary to remove the transient voltage suppressor unit. The location of some of the components on a panel on top of the converter is shown in fig. 9, while the other items are located as follows:—

(1) 2VT1, 2VT2, 2MR1 and 2R3 are on the panel under the blower motor.

(2) 2R5 and 2C4 are mounted on the transient voltage suppressor unit (fig. 8).

(3) 2C1, 2C2 and 2C3 are on the underside of the chassis of the transmitter radio and can be seen in fig. 3.

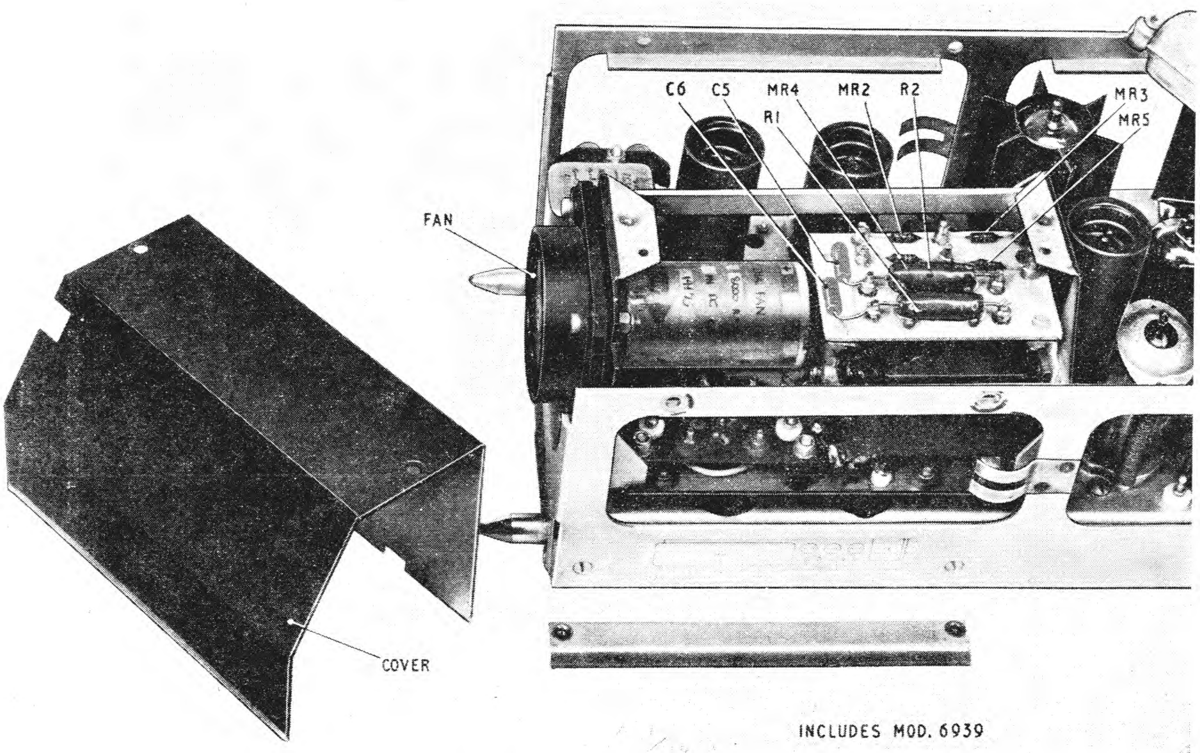


Fig. 9. Converter d.c.

Chapter 8

NAVAL TYPE 698

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LIST OF ILLUSTRATIONS

Introduction

1. The Naval Type 698 consists of a low-power, two-channel u.h.f. transmitter-receiver installation for use in vehicles based at Royal Naval Air Stations.

2. The transmitter-receiver is crystal controlled and can be operated on either of two pre-tuned channels within the frequency range of 238 Mc/s to 248 Mc/s. The equipment can be tuned accurately to one channel only and, therefore, to limit the reduction in the performance on the other channel, it is advisable to ensure that the frequencies of the channels are not separated by more than one megacycle.

3. The major items of the equipment are given in para. 4 and, unless otherwise stated, the reference numbers are to be found in the Leading Particulars at the beginning of Part 1.

4. The major items constituting the Naval Type 698 are as follows:—

(1) One of the following transmitter-receivers:—

(a) TR.10056 described and illustrated in Part 1, Chap. 1.

(b) TR.M4 described and illustrated in Part 1, Chap. 5.

(c) Transmitter-receiver radio (Ref. No. 5821–99–945–6726). This equipment was formerly known as the transmitter-receiver Type M6 and is described and illustrated under its new title in Part 1, Chap. 6.

(2) Mounting tray Type 1031 (Part 1, Chap. 1, fig. 1).

(3) Control, radio set (Ref. No. 5895–A.P.164323).

(4) Aerial, Type 11789 (Ref. No. 10B/16920).

5. The TR.M4 differs from the TR.10056 in that it incorporates the changes introduced by modification number 6285 to raise the ambient temperature at which the equipment can be operated to 45°C at altitudes of up to 60 000 ft. In addition to changing a number of components to types which possess better temperature characteristics, this modification introduces a new label to change the title from TR.10056 to TR.M4. Further details of the differences are to be found in Part 1, Chap. 5. Both the TR.10056 and the TR.M4 are fitted with rotary power units to provide the h.t. supply.

6. The transmitter-receiver radio (5821–99–945–6726) is a later version of this type of u.h.f. equipment. In addition to having an operational ambient temperature limit of 55°C at altitudes of up to 60 000 ft., it uses a transistorized power unit instead of a rotary power unit for the h.t. supply. Further details of this equipment are to be found in Part 1, Chap. 6.

7. For ground use only it is considered that these equipments, which all use the same type of mounting tray (para. 4), can be interchanged without detriment to the operational performance of the installation.

Associated equipment

8. A number of additional items of equipment are required for use with the Naval Type 698.

These are as follows:—

(1) Loudspeaker with an impedance of 600 ohms (Ref. No. A.P.57723).

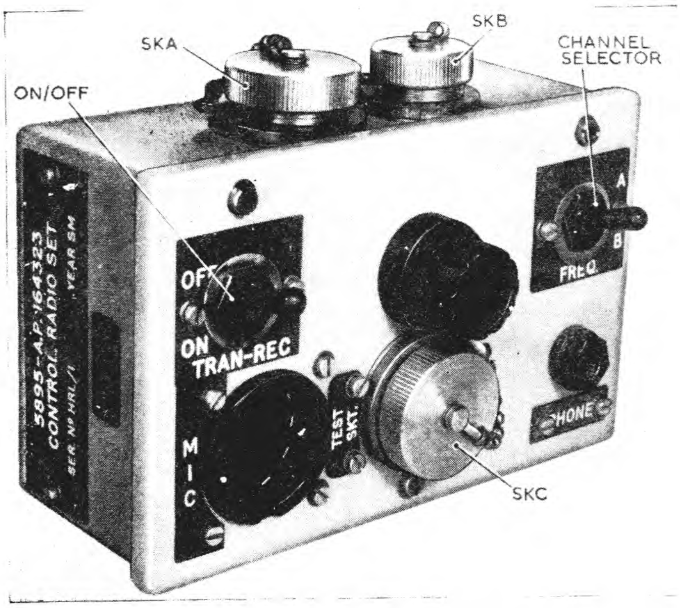


Fig. 1. Control radio set (A.P.164323)

(2) Electro-magnetic microphone with 11-pole plug and lead (Ref. No. 5965–A.P. 197604).

(3) Head set and lead (Ref. No. A.P.4966A).

Power supplies

9. The equipment requires a d.c. supply of 24V, which is provided by a battery installed in the vehicle. The power consumption is about 70 watts. Where facilities exist for charging the battery while the transmitter-receiver is being operated, a voltage regulator or a series limiting resistor should be in circuit between the power supply and the transmitter-receiver, to safeguard the latter from a voltage overload. The value of the series resistor should be about 1 ohm.

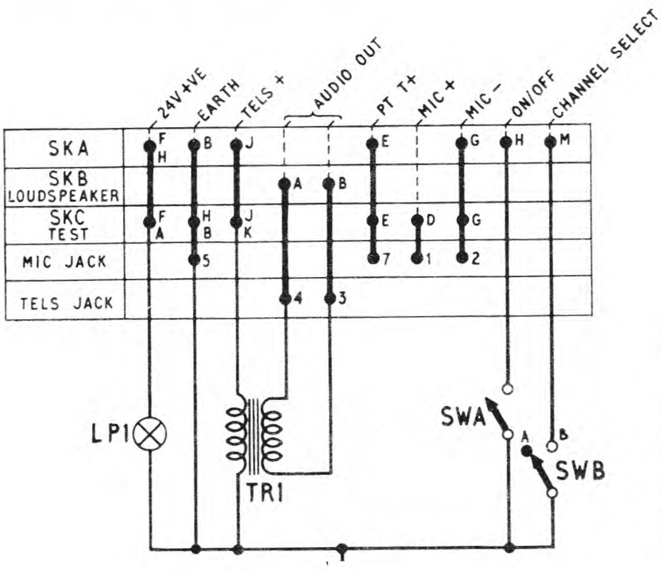


Fig. 2. Control radio

Control radio set

10. The control radio set (control unit) is shown in fig. 1, while the circuit is in fig. 2 and the wiring diagram in fig. 3. The control unit provides facilities for operating and testing the transmitter-receiver. The functions of the switches, sockets and other items are as follows:—

(1) OFF/ON TRAN-REC switch SWA. This provides facilities for switching the power supplies to the transmitter-receiver.

(2) The panel light, controlled by an external switch, serves to indicate that the power supply is available.

(3) FREQ switch SWB. This permits the required channel A or B to be selected as required.

(4) Microphone and telephone jacks.

(5) Socket SKA. This provides facilities for connecting the control unit to the transmitter-receiver.

(6) Socket SKB. This socket is for use with the loudspeaker.

(7) TEST SKT. This serves as a test socket into which the test set u.h.f. Type 15077 (part of test set u.h.f. equipment Type 15056) can be connected to make the following tests:—

(a) Measure the d.c. supply.

(b) Measure the a.f. output of the receiver.

(c) Measure the receiver sensitivity.

(d) Measure the r.f. power output of the transmitter.

(e) Measure the modulation percentage of the r.f. output of the transmitter.

(f) Measure the reflection coefficient of the installation, aerial system and cables.

(g) Monitor the sidetone to assess the quality of the R/T transmission.

11. The circuit of the control unit includes the transformer TR1 which is used to match the 150 ohm output of the receiver of the transmitter-receiver to the 600 ohm impedance of the loudspeaker. When the OFF/ON TRAN-REC switch SWA is set to the ON position the relay LT/1 in the transmitter-receiver is operated, the contact of which completes the power supplies for the heaters of all the valves and also the h.t. power unit to receiver only. However, when being used for R/T reception, facilities can be made avail-

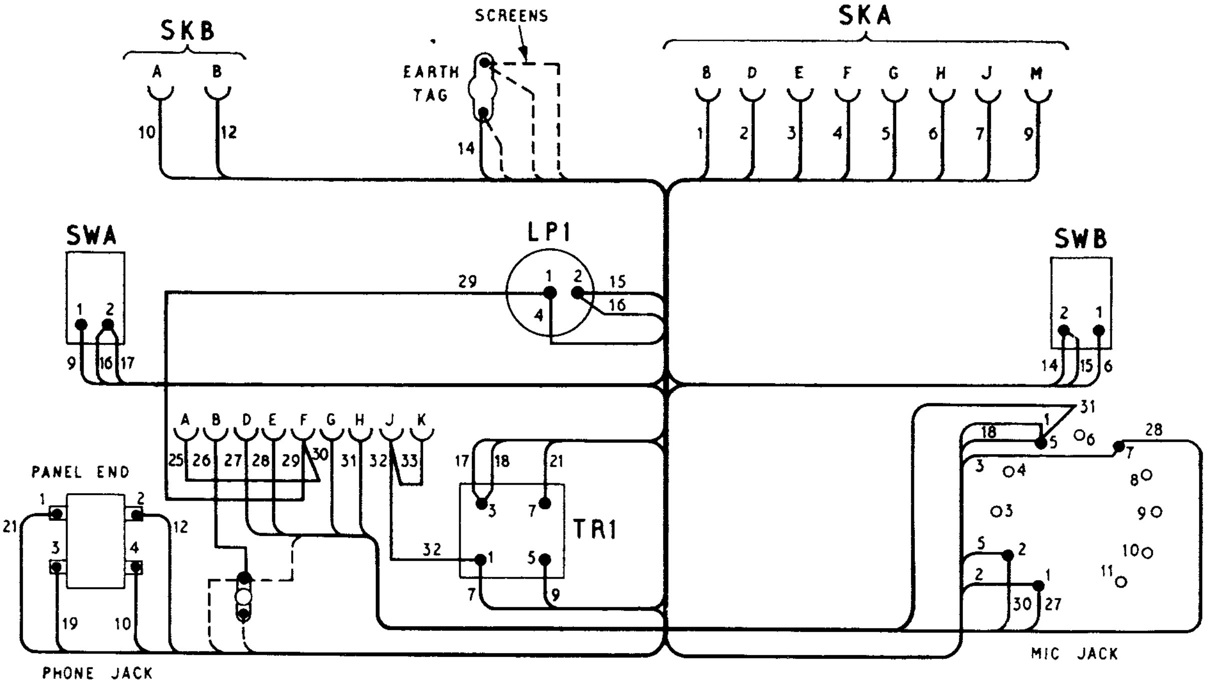


Fig. 3. Control radio set (A.P.164323): wiring

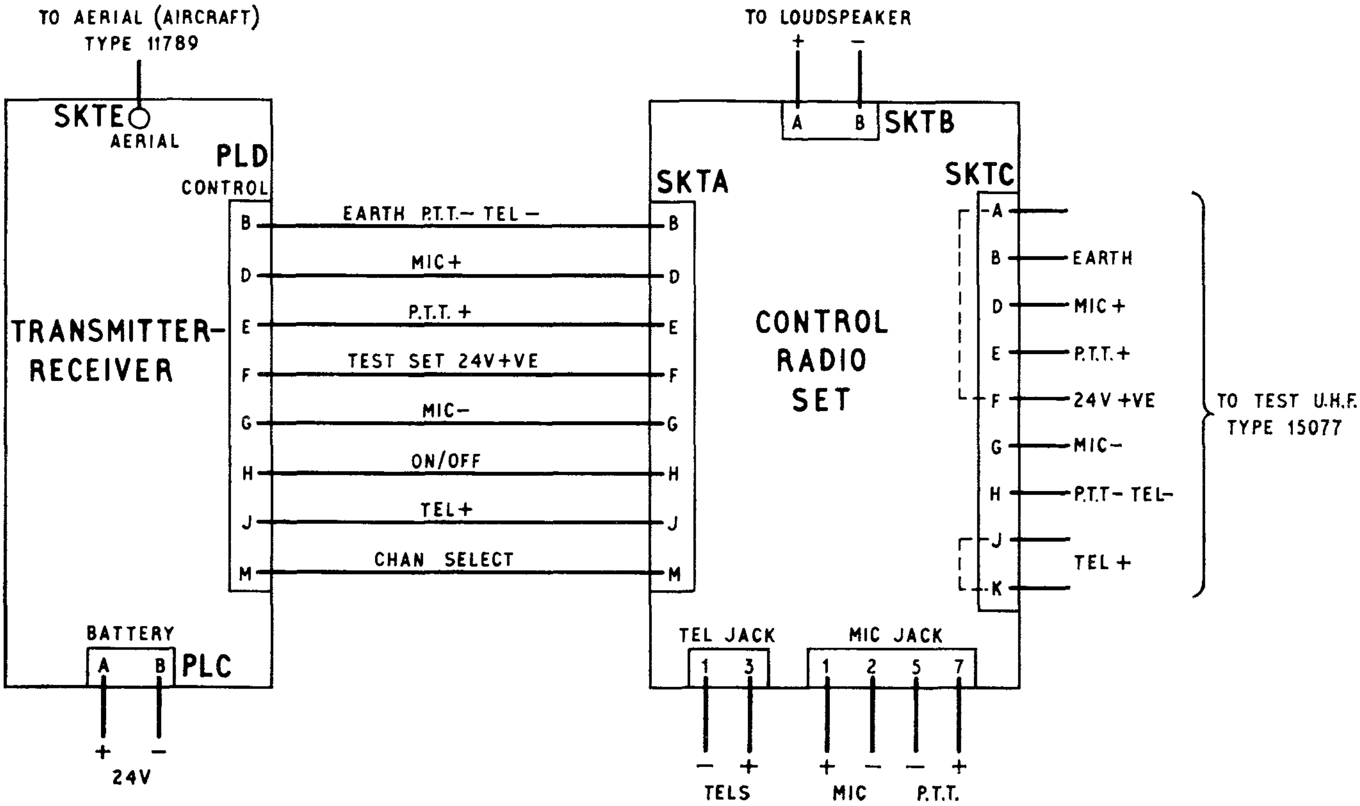
able between the driver and the crew of the vehicle. When the appropriate PRESS TO TALK switch of the installation is pressed the relay HTA/2 is operated, which, through its contacts, completes the h.t. circuit for the transmitter and also changes the aerial from the receiver to the transmitter. When the FREQ. switch SWB is set to channel B, the relays TCS/1 and RCS/1 are operated to change the channel crystals of the transmitter and receiver respectively. Sidetone facilities are available during transmission. The pole to pole interconnections between the transmitter-receiver, the control, radio set and associated equipment is given in fig. 4.

Aerial system

12. The aerial, aircraft, Type 11789 is a whip type aerial, and the length of the rod is about 11 inches. The aerial mounting has eight holes through which it can be secured, in conjunction with a flange, to any suitable surface such as the roof of a vehicle. Further details and an illustration of the aerial can be found in Part 1, Chap. 4.

Installation

13. The installation details will differ according to the type of vehicle in which the equipment is being fitted. General information concerning the installation will be found in B893; this is the installation specification for the Type 698 and associated equipment to be fitted in vehicles at Royal Naval Air Stations.



◀ **Fig. 4. Naval Type 698: interconnections** ▶

Chapter 9

(completely revised)

FILTER, RADIO INTERFERENCE 5915-99-970-0362

CONTENTS

Para.

Fig.

INTRODUCTION

1. The transmitter-receiver, radio 5821-99-652-3788 uses the convertor d.c. which is a transistorized power supply unit. Experience has shown that the convertor can cause interference with other radio equipments in the aircraft. The filter, radio interference was introduced to prevent this happening.

2. The filter is illustrated in fig.1. The reference number and dimensions are as follows:-

Reference Number	5915-99-970-0362 (Manufacturer's reference D170)
Dimensions (overall)	Width 9.68cm (3.81in) Height 7.46cm (2.94in) Depth 5.08cm (2.00in)

The approximate weight is 0.32kg (0.71b)

3. The introduction of modification A7660 makes the filter a composite part of the transmitter-receiver, radio 5821-99-652-3788, the filter being attached to the handle on the front panel of the transmitter-receiver, radio.

CIRCUIT DESCRIPTION

4. The circuit diagram of the filter, comprising a low frequency choke and reservoir capacitor, is shown in fig.2. The d.c. convertor (see Chap.7, para.10 of this Part) operates at a frequency of between 550Hz and 650Hz and it is possible for transient spikes to be developed, having amplitudes of up to 30V. The spikes can be transmitted down the power supply lines of the transmitter-receiver and cause interference with other items of radio equipment. The filter limits this interference by reducing the amplitude of the spikes by a ratio of not less than 30:1. The filter is connected in the d.c. power supply lines to the transmitter-receiver.

CONSTRUCTION

5. The filter consists of a case with a socket (SKTA) at the rear, for connecting to the power supply plug (marked BATTERY) on the front panel of the transmitter-receiver. The power input plug (PLA) through which the 28V d.c. is connected, is normally on the right-hand side of the filter but it can be mounted on the front panel of the filter if required.

6. Previous to the incorporation of modification A7660, the filter was mounted by spring clips to the front carrying handle of the transmitter-receiver. Subsequent to the incorporation of modification A7660, the filter is securely bolted to the carrying handle with a clip, retainer and 6 BA $\frac{1}{4}$in. long brass bolt with washer and hexagonal brass nut. Additionally, when modification A7660 is incorporated, the identification label is fitted to the underside of the filter box.

INSTALLATION

7. As stated in para.4 the filter is connected between the aircraft's d.c. power supply and the BATTERY plug on the front panel of the transmitter-receiver. The installation of the filter is straightforward and can be executed with comparative ease. Because of this, it was not thought necessary to modify the typical installation drawing given in Chap.4, fig.3 of this Part. To remove the filter from the handle of the transmitter-receiver, release the clip, retaining by removing the 6 BA nut and bolt.

8. The plug and socket are identified as follows:-

(1) SKTA 5935-99-056-0090, socket electrical (free) male shell, size 1, two pole. Insert position 0.

(2) PLA 5935-99-056-0050, plug electrical (fixed) female shell, size 1, two-pole. Insert position 0.

SERVICING

9. Servicing instructions for the filter unit are given in Topic 6, Chap.3.

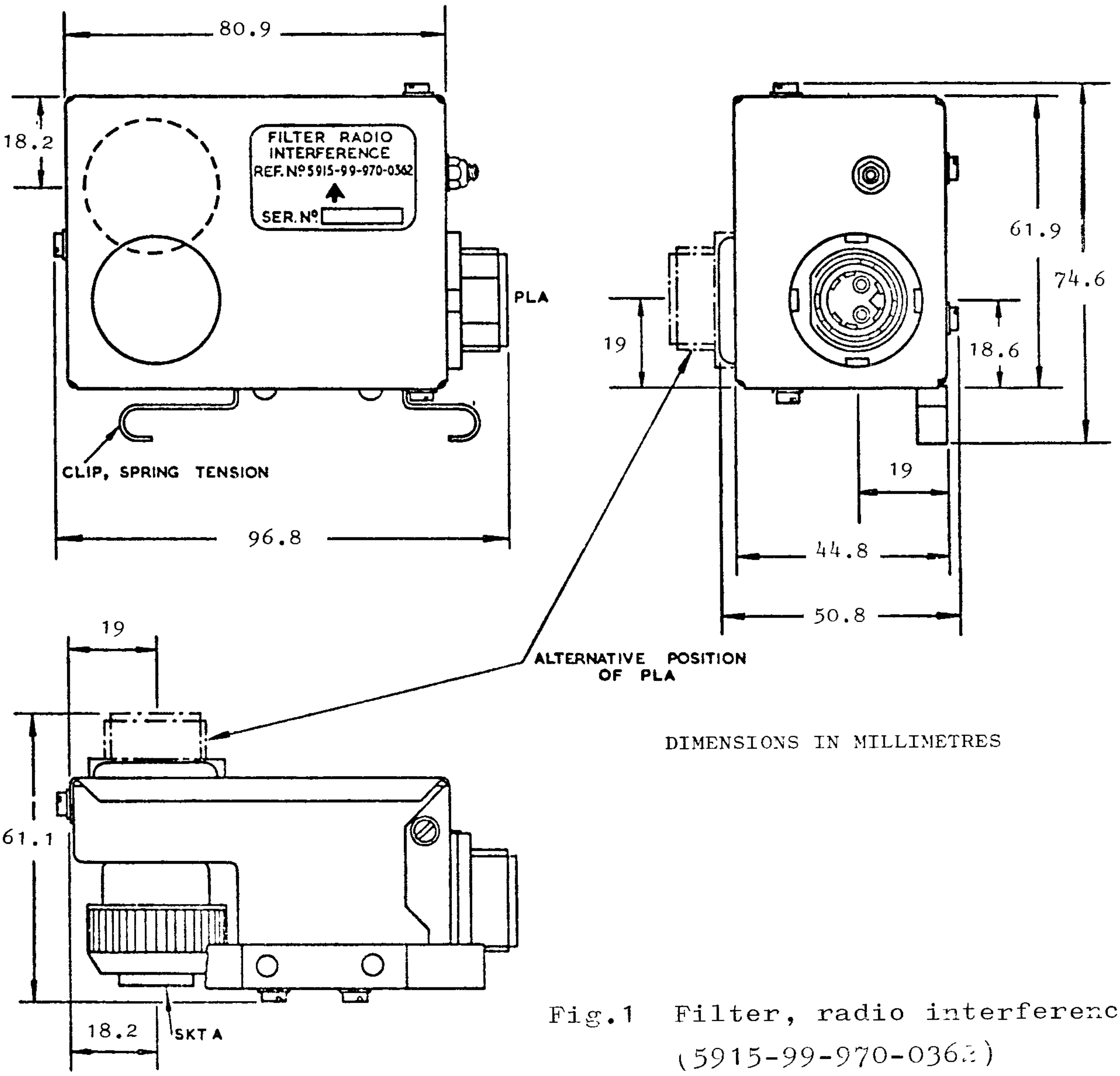
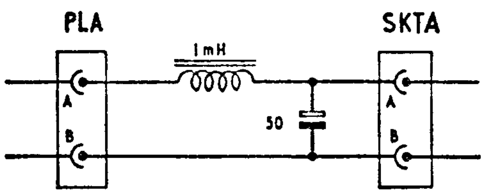


Fig.1 Filter, radio interference (5915-99-970-0362)



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Chapter 2

TRANSMITTER RECEIVER RADIO 5821-99-945-6726—REPAIR

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Introduction

1. The servicing of the transmitter receiver radio, with the exception of the d.c. converter and the transient voltage suppressor unit is the same as that given in Vol. 1, Part 2 and Vol. 6, Part 2, Chap. 1. The information concerning cleaning, mechanical servicing, wiring and soldering is also contained in Vol. 6, Part 2, Chap. 1. Insulation tests should only be made when the insulation is suspect and care must be taken to ensure that vulnerable components such as transistors are not damaged.

Transistors—precautions

2. During servicing operations the following general precautions should be observed:—

(1) In general transistors have somewhat low resistance values and care must be taken not to apply potentials to them in excess of their rating.

(2) Ensure that the power supplies are always connected with the correct polarity.

(3) Avoid the use of any excessive heat particularly in soldering operations. This can be achieved by holding the lead, to be soldered, with a pair of pliers held between the soldering point and the transistor.

(4) Always disconnect the supply before making any connections to the associated circuit or using a soldering iron.

(5) Before using a test instrument ensure that its terminal potential is within the safety limit. If necessary insert a limiting resistor between the test instrument and the circuit to be tested.

(6) When using a signal generator it is advisable to use an isolating capacitor.

(7) When making measurements with the supplies connected, take care that components are not shunted by instruments having low internal resistances.

(8) Ensure that the soldering iron is of the correct thermal capacity, earthed or supplied from an isolating transformer.

(9) When making adjustments, use non-conducting tools or screwdrivers insulated almost to the actual tip.

Continuity tests

3. A d.c. resistance exists between the electrodes of a transistor. The relative value of the resistance between any two electrodes is dependent upon the polarity of the internal battery supply of the ohmeter used for making the test. The ohmeter should either have an internal resistance of not less than 1 000 ohms or an external resistor of a similar value. Table 1 contains the relative values of the resistance between the electrodes of a n-p-n transistor according to the polarity of the connections of the .test equipment.

TABLE 1

N-P-N transistor—relative values of d.c. resistance between electrodes

Electrode and test meter polarity connections					Relative ohmic values
Base	Negative	to	Collector	Positive	High
Base	Positive	to	Emitter	Negative	Low
Base	Negative	to	Emitter	Positive	High
Emitter	Positive	to	Collector	Negative	High
Emitter	Negative	to	Collector	Positive	Meduim

Wiring

4. The wiring diagrams for the transmitter and receiver portions of the transmitter receiver radio are similar to those given in Chap. 1 of this Volume, the differences are almost entirely confined to the d.c. converter and the transient voltage suppressor unit. The wiring diagrams for these two items are given in fig. 1 and 2 respectively.

Converter d.c. (*fig.* 1)

5. The component location of the d.c. converter is given in Vol. 1, Part 1, Chap. 7, fig. 9. It must be remembered that the following components, although forming part of the circuit of the converter, are located as given below. If a new converter is to be fitted it is essential to ensure that these additional components are serviceable and in situ.

Component	*Location*
2C1, 2C2, 2C3	Transmitter radio chassis
2C4 and 2R5	Suppressor transient voltage unit

Removal

6. To remove the d.c. converter for servicing or renewal it is necessary to remove the transient voltage suppressor unit first. The procedure is as follows:—

(1) Remove the three screws securing the suppressor unit to the chassis of the transmitter radio and take care not to lose the three spacing pillars.

(2) The suppressor unit can be folded back; the fly leads are of sufficient length to allow this to be done.

(3) Take out the two screws securing the cover of the d.c. converter and remove the cover.

(4) Unsolder the leads coloured black, red, yellow and grey which connect the d.c. converter to the remainder of the equipment.

(5) Take out the four screws securing the d.c. converter to the chassis of the transmitter radio and remove the d.c. converter.

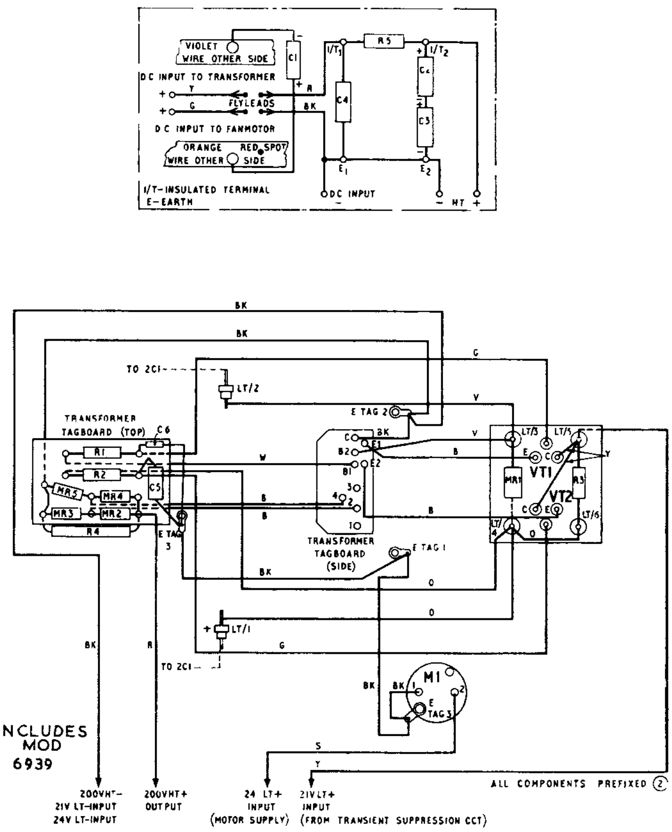
Fitting

7. To fit the d.c. converter, the procedure described in para. 6 should be followed in the reverse order. When soldering the leads it is essential to safeguard the transistors by following the procedure given in para. 2 as far as it is applicable.

Voltage and current tests

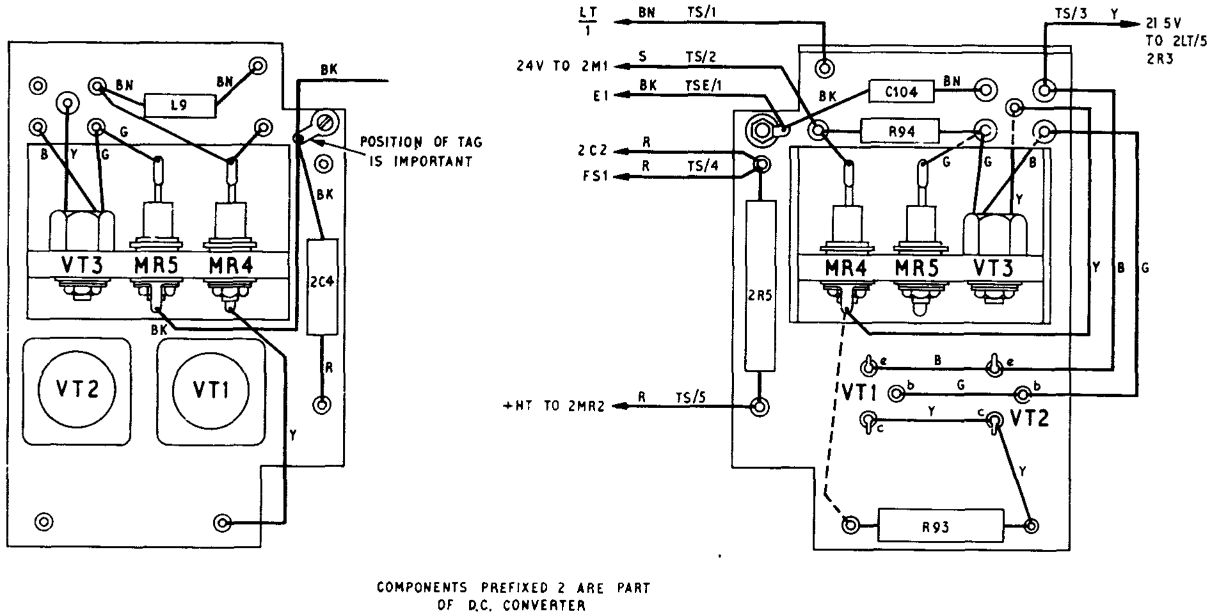
8. When the d.c. converter is being tested as an independent sub-unit, a test rig should be made up locally incorporating the dummy loads and components connected as shown in fig. 3. The details lf these components are as follows:—

Component	*Details*	*Load*
R1	4750 ohms ± 5%	50mA (A)
R2	2000 ohms ± 5%	100mA (B)
R3	1400 ohms ± 5%	150mA (C)
C1	10 mfd 50V	
C2	5·mfd 300V	
S1	Three-way switch	



◀ **Fig. 1. Converter d.c.: wiring** ▶

9. The voltage and current measurements quoted in Table 2 are to be made with a multimeter Type 9980 or similar. The table gives the d.c. input voltages and currents, also the outputs to be obtained with the appropriate load A, B or C switched into circuit. In addition it also states the tapping of the transformer T1 of the converter to be used for each measurement. When servicing is completed the transformer tapping should be set to the number 2 tapping position which is the one normally used.



◀ **Fig. 2. Suppressor transient voltage: wiring** ▶

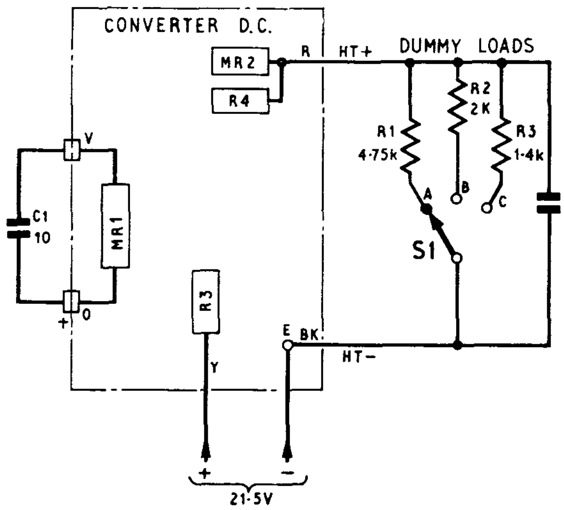


Fig. 3. Converter d.c.: test circuit

TABLE 2

Converter d.c.—voltage and current tests

Input d.c.	T1 tapping	Load	Input current Min.	Input current Max.	Output voltage h.t. Min.	Output voltage h.t. Max.
21·5V	3	A	0·9A	1·1A	240V	250V
21·5V	2	A	1·0A	1·2A	250V	260V
21·5V	1	A	1·1A	1·3A	260V	270V
17·5V	1	A	0·85A	1·1A	210V	220V
21·5V	3	B	1·7A	1·9A	230V	240V
21·5V	2	B	1·8A	2·1A	240V	250V
21·5V	1	B	1·9A	2·2A	250V	260V
17·5V	1	B	1·6A	1·8A	205V	215V
21·5V	3	C	2·2A	2·5A	225V	235V
21·5V	2	C	2·35A	2·65A	234V	245V
21·5V	1	C	2·6A	2·85A	245V	255V
17·5V	1	C	2·1A	2·35A	200V	210V

Ripple

10. The peak ripple test is made by connecting the oscilloscope CT414 (or other similar type) across the output of the dummy load, that is across C2. The measurement should be made with the transformer set to Tapping 1, d.c. input to 21V and the load switch to position C (fig. 3). The peak ripple should not exceed 5%.

Switching frequency

11. The switching frequency should be between 550 Hz and 660 Hz. The measurement is made with the same conditions as described in para. 10, but if the oscilloscope is connected across the smoothing capacitor C2, the switching frequency will be half that of the ripple. If the measurement is made between the capacitor C1 and earth, then the frequency will be that displayed on the oscilloscope.

Suppressor transient voltage unit (fig. 2)

12. The component location for the transient voltage suppressor unit is given in Vol. 1, Part 1, Chap. 7, fig. 8, while the wiring diagram is in fig. 2 of this chapter.

Removal

13. If the suppressor transient voltage unit is to be removed for servicing or renewed the procedure is as follows:—

(1) Unsolder the connections between the suppressor unit and the transmitter radio at TS/1, ◀ TS/2, ▶ TS/3, TS/4, ◀ TS/5 ▶ and TSE/1 of the suppressor unit.

(2) Remove the three screws securing the suppressor unit to the chassis of the transmitter radio and take care not to lose the three spacing pillars. The suppressor unit can now be removed.

Fitting

14. The procedure is the reversal of the removal instructions (para. 13); care should be taken to ensure that the soldering conditions described in para. 2 are followed in as far as they apply to safeguard the equipment.

Attenuation

15. The voltage drop across the suppressor unit should be measured and it should not normally exceed about 2·5V. The procedure is as follows:—

(1) Connect a resistor of 12 ohms ±5%, 50 watts, across the output of the suppressor unit, that is between TSE/1 and TS/3.

(2) A d.c. supply of 25V should be connected to the suppressor unit with its positive to TS/1 and the negative to TSE/1.

(3) Using the multimeter measure the output across the load resistor (sub-para. (1)), the result should be not less than 21V and not greater than 22V.

Caution . . .

During the over-voltage test described in para. 16, *the d.c. supply of* 32*V must not be applied for more than* 10 *seconds.*

Over-voltage test

16. With the conditions the same as those described in para. 15, connect a d.c. supply of 32V to the suppressor unit with the positive to TS/1 and the negative to TSE/1 for a period not exceeding 10 seconds. The output should be not less than 24·5V and not greater than 27V.

Transient voltage test

17. The suppressor unit should function so that it protects the transistors of the d.c. converter from over-voltages occurring in the d.c. supply from the aircraft. These may rise to an amplitude of 80V for a period of about 40mS, after which they decay and static conditions are reached in about 10 seconds. Further information on this subject is to be found in Volume 1, Part 1, Chap. 6.

18. Where suitable test equipment is available it is recommended that the suppressor unit should be tested to ensure that it is functioning within the prescribed limits by feeding pulses having a duration of about 40mS and an amplitude of not less than 80V and not exceeding 85V to the input of the suppressor unit. The frequency of the pulses should not exceed one every 10 seconds. The double-beam oscilloscope CT414 can be used to monitor both the input and output voltages. The load resistor of 12 ohms remains connected as described in para. 15. The procedure is as follows:—

(1) Ensure that the output of the pulse generator is not less than 80V and not greater than 85V; also that the p.r.f. is not more than one every 10 seconds.

(2) Connect the CT414 to the input of the suppressor unit as follows:—

(a) Y1 to TS/1 and E1 to TSE/1 (input).

(b) Y2 to TS/3 and E2 to TSE/1 (output).

(3) Set the controls of the CT414 as follows:—

(a) Amplitude of Y1 and Y2 to 10V/cm.

(b) Time base controls to 80mS/cm.

(c) Beam switch to 150 kHz.

(4) Connect the pulse generator to the input of the suppressor unit, that is across TS/1 and TSE/1 and using the CT414 ensure that:—

(a) The input is not less than 80V and not greater than 85V.

(b) That the output of the suppressor unit does not exceed 27V.

Chapter 3

(completely revised)

FILTER, RADIO INTERFERENCE 5915-99-970-0362 : SERVICING

CONTENTS

INTRODUCTION

1. The filter, radio interference is described in Topic 1, Part 1, Chap.9 of this publication. Prior to the introduction of modification A7660 the filter can be removed by sliding it off the carrying handle of the transmitter-receiver. Subsequent to the incorporation of modification A7660, the filter can only be released by removal of the 6 BA nut and bolt which holds the retaining clip.

TEST EQUIPMENT

2. The following test equipment is required to service the filter unit, namely:-

(1) Signal generator Type HP 8640A

(2) Oscilloscope CT531

INTERCONNECTIONS AND WAVEFORMS

3. Connect the filter unit to the test equipment as shown in fig.1; the input and output waveforms are also shown on this figure.

CAUTION...

> <u>When conducting the test described in para.4 it is essential that the 400Hz signal is applied to the filter for the minimum of time necessary to do the test. It must be disconnected from the unit immediately the test is completed. Failure to do so may cause damage to the unit.</u>

RADIO INTERFERENCE TEST

4. Signal generator Type HP 8640A (or equivalent) is used to provide the square-wave test signals at a frequency of 400Hz and peak-to-peak level of 20V ±2V. The output measured on the oscilloscope should be a triangular waveform, fig.1(c), of not more than 1.5V and free from interfering spikes. Proceed as follows:-

(1) Connect the oscilloscope:-

(a) Y1 to pole A of PLA of the filter unit
(b) Y2 to pole A of SKTA of the filter unit
(c) earth connection to pole B of SKTA.

(2) Connect the signal generator low frequency output to pole A of PLA, connecting the earth terminal to pole B of the same plug.

(3) Set the oscilloscope sensitivity to:-

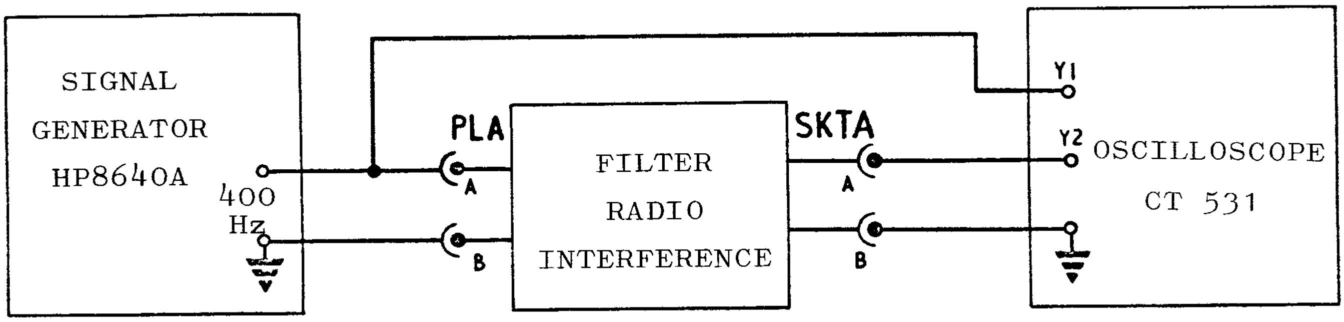
(a) Y1 to 10V/cm
(b) Y2 to 300mV/cm

(4) Set the frequency of the signal generator to 400Hz and adjust the output so that the peak-to-peak amplitude of the Y1 trace is 20V ±2V, fig.1(b).

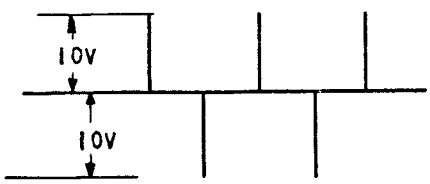
(5) The output displayed on the Y2 trace of the oscilloscope, fig.1(c), should be:-

(a) a triangular waveform not exceeding 1.5V peak-to-peak
(b) free from interfering spikes.

5. The above test completes the servicing of the filter. Disconnect the test equipment and restore the filter to its attachment on the transmitter-receiver.



(a) INTERCONNECTIONS FOR TESTING



(b) INPUT WAVEFORM
Y1 TRACE

(c) OUTPUT WAVEFORM
Y2 TRACE

Fig.1 Filter, radio interference (5915-99-970-0362): test interconnections & waveforms