V.H F MOBILE RADIO TELEPHONE

TYPE MR820/25

RANK - BUSH MURPHY ELECTRONICS
RANK - BUSH MURPHY LIMITED
WELWYN GARDEN CITY,
HERTFORDSHIRE,
ENGLAND.

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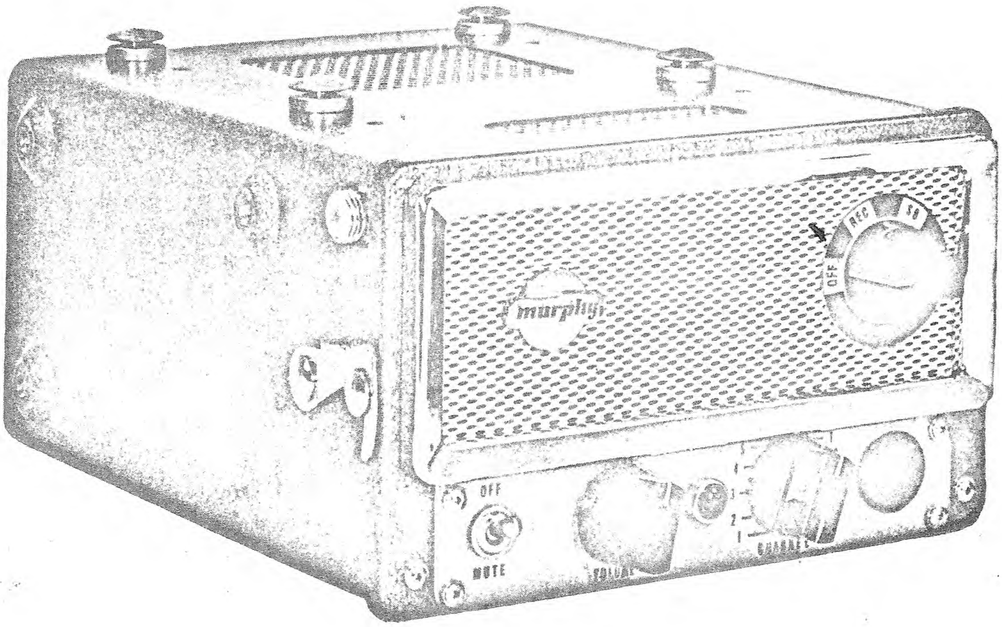

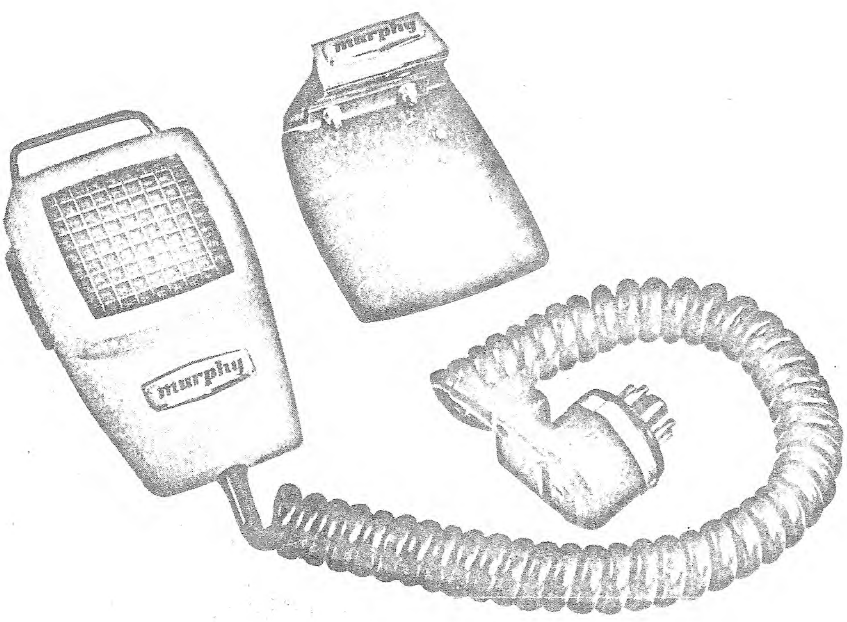

V.H.F. MOBILE
RADIO TELEPHONE
MR820

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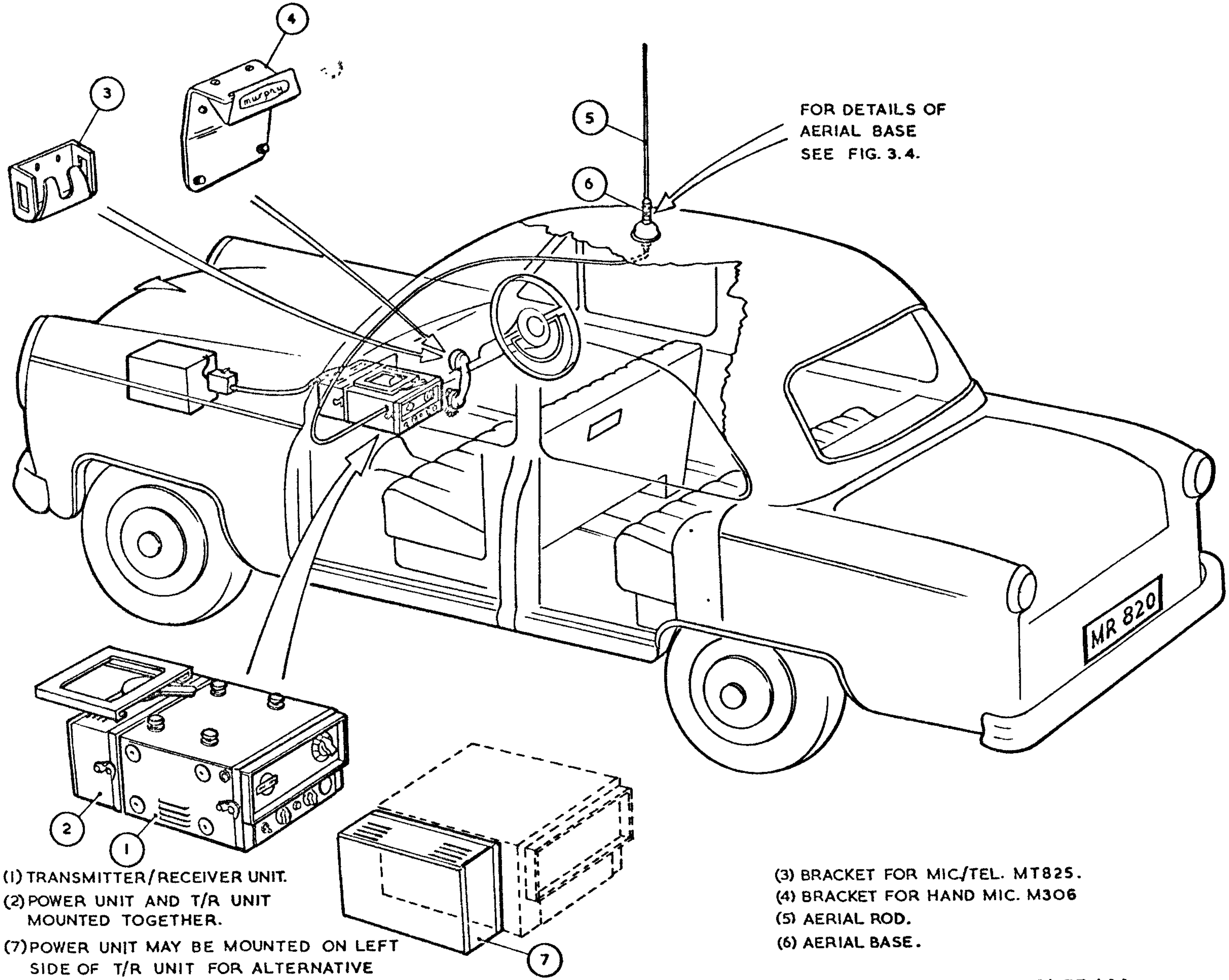

(1) TRANSMITTER/RECEIVER UNIT.

(2) POWER UNIT AND T/R UNIT MOUNTED TOGETHER.

(7) POWER UNIT MAY BE MOUNTED ON LEFT SIDE OF T/R UNIT FOR ALTERNATIVE INSTALLATION.

(3) BRACKET FOR MIC./TEL. MT825.

(4) BRACKET FOR HAND MIC. M306

(5) AERIAL ROD.

(6) AERIAL BASE.

FIG. 3.1. INSTALLATION DIAGRAM

SPECIFICATION

Facilities:	Provides up to 5 adjacent channels. The equipment is so designed that it meets the G.P.O. specification for 25 kc/s channel spacing.
Frequency Range:	40 to 174 Mc/s.
Mounting:	Provided with quick-release rack and suitable for under dash-board mounting in vehicles.
Front Panel Controls:	Function switch incorporating "OFF-REC-SB-PA" (Public Address). "VOLUME" control. Channel Selection (optional).
Optional Features:	Up to 5 channel operation. Mute setting control.

RECEIVER.

Noise Limiter:	Series thermionic diode.
Intermediate Frequencies:	1st i.f. : crystal frequency plus 0.98 Mc/s. 2nd i.f. : 0.98 Mc/s.
Selectivity:	Single Signal: $\pm$6.5 kc/s at - 6dB; $\pm$20 kc/s at -80dB Two Signal: $\pm$22 kc/s at -70dB
Frequency Stability:	$\pm$0.0015% over ambient temperature range of -10°C to +40°C.
Spurious Responses:	Better than -70dB.
Radiation:	Less than 500µV measured at aerial terminal.
Sensitivity:	2.0µV for 100mW output.
Signal/Noise Ratio:	Better than 10dB for 2µV input.
Audio Frequency Response:	-3dB at 300 c/s and 3000 c/s.
Audio Power Output:	1 watt.
A.V.C. :	12dB increase in audio output for an input 82dB above sensitivity level.
Mute Sensitivity:	Adjustable over range 1µV to 100µV.

TRANSMITTER.

R.F. Output:	4 to 6 watts.
Frequency Stability:	$\pm$0.0015% over ambient temperature range -10°C to +40°C.
Modulation Response:	The equipment is designed to give optimum speech quality over the entire system consistent with communications requirements.
Spurious Emissions:	Less than 2.5µW at any frequency more than 50 kc/s from carrier frequency.

POWER UNIT. Transistor Power Unit operating from 6, 12 or 24 volt vehicle supplies.

Power consumption:

Receive	3.4 amps	with 12.6 volt supply
Standby	4.2 amps	
Transmit	6.3 amps	

COMPLETE EQUIPMENT.

Dimensions.

Main Unit:	10in. x 8in. x 4.9in.	(254mm x 203mm x 124mm).
Power Unit:	3in. x 8in. x 4.9in.	(76.2mm x 203mm x 124mm).
Weight:	17½ lb	(7.87 kg).

V.H.F. MOBILE RADIO TELEPHONE

TYPE MR820

1. GENERAL DESCRIPTION.

1.1. The MR820 is a mobile Transmitter/Receiver designed to be fitted in all types of commercial or private vehicles. It comprises a Transmitter/Receiver Unit, Power Unit and aerial.

1.2. The T/R Unit is designed to work in the frequency bands 40 to 100 Mc/s and 100 to 174 Mc/s, the Transmitter/Receiver Unit being designated TR821/L (Low Band) and TR821/H (High Band) respectively. The transmitting frequency is crystal controlled and the receiver employs two frequency changer valves and utilises a crystal controlled oscillator.

1.3. The Power Unit incorporates two transistors, and is constructed as a separate unit capable of being attached to the rear or left-hand side of the T/R Unit (See Fig. 3.1). A quarter-wave whip aerial is supplied, which is normally mounted on the roof of the vehicle as described in Paragraph 3.3.

1.4. With the exception of the aerial the MR820 is a completely self-contained unit. Installation is particularly easy and the operation extremely simple, the controls consisting of a Main Function switch, "VOLUME" control, "OFF/MUTE" switch, and in the case of multi-channel equipment, a channel selector switch. In addition, a press-to-talk switch is incorporated in the microphone. A bracket is also supplied so that the microphone may be suspended conveniently to hand.

2. MECHANICAL DESCRIPTION.

2.1. The unit, which is housed in a robust steel case, is attached to the vehicle by a special quick-release bracket. In the average private car this would be situated under the facia board, but it can readily be adapted to suit other types of transport.

2.2. The Power Unit is a separate self-contained item which is secured to the T/R Unit by means of suitable brackets. When attached to the rear of the T/R Unit, the Power Unit plugs in directly but in other positions connection is made through a multi-way lead up to a maximum of two feet in length.

2.3. Connection to the aerial is through a co-axial socket situated at the top left-hand side of the T/R Unit. The microphone input is via a coiled expanding lead connected by an octal plug on the right-hand side of the front panel of the T/R Unit. The battery connection and the output for a Loud Hailer speaker is by means of a 6-way plug and socket on the right-hand side of the T/R Unit.

2.4. A B9A socket is located on the underside of the T/R Unit into which can be plugged the Test Meter MR510. Access to the internal assembly is obtained by releasing two catches, one on either side of the loud speaker grill, and withdrawing the unit from its case. Detailed drawings of the component layouts are given in Figs. 4 to 8 at the back of this instruction manual.

2.5. Care has been taken to provide adequate ventilation for the T/R Unit by the provision of suitable holes in the case.

3. INSTALLATION.

3.1. COMPLETE STATION.

3.1.1. Every carton of MR820 equipment delivered from Murphy Radio Limited contains the following items of equipment:

Transmitter/Receiver Unit TR821
Power Unit PU822
Aerial AE813
Quick-release Rack R804
Hand Micro-telephone MT825 and mounting bracket
or
Hand Microphone M306 and mounting bracket.

3.2. TRANSMITTER/RECEIVER INSTALLATION.

3.2.1. When the equipment is received from Murphy Radio Limited, the appropriate Power Unit (6, 12 or 24 volt) will be plugged into the back of the Transmitter/Receiver Unit.

3.2.2. Assembled in this way, the combined T/R Unit and Power Unit requires a space of 13" x 8" x 4.9" (331mm x 203mm x 124mm). When installing the unit, at least one inch clearance should be allowed on all sides for adequate ventilation.

3.2.3. If sufficient depth for normal mounting is not conveniently available, the Power Unit can be mounted on the left-hand side of the T/R Unit. A Power Unit Mounting Kit consisting of a metal plate with tapped bushes and plug retainer bracket No. 825781 and a 9" Connector T/R to P/U No. B834109 can be supplied for this purpose.

3.2.4. If no room can be found to mount the Power Unit integral with the T/R Unit, it can be mounted separately at some convenient point as close as possible to the T/R Unit. A special connecting cable B834110 can be supplied for this purpose but the maximum permissible length of extension is 24" (610mm). The Power Unit Mounting Kit No. 825781 may be used, but the Power Unit MUST BE POSITIONED IN THE SAME ATTITUDE as it would be if attached to the T/R Unit.

3.2.5. In certain installations, it may be more convenient to mount the Rack R804 on the underside of the T/R Unit, in which case the four mushroom headed screws may be transferred to the duplicate tapped holes beneath the T/R Unit case.

3.2.6. Depending on the construction of the vehicle, a special plate or bracket may be necessary for fixing the rack. The total weight of the Transmitter/Receiver Unit and the Power Unit is 17½ lb. (7.87 kg).

3.2.7. Reference to Fig. 3.1. will show a hypothetical layout of units and cabling. It will, however, be readily appreciated that no hard and fast rule can be laid down regarding actual mounting positions or the routing of cables. Due to the many differing types of vehicle in which the MR820 equipment could be installed, these factors will be governed largely by the operator's individual requirements and the form of construction of the vehicle.

3.2.8. Where Public Address facilities are required, the re-entrant horn Type LS812 (or the twin re-entrant horn LS812/2) will be supplied. A position on the Main Function switch marked "P.A." makes the necessary circuit connection by means of which the output of the modulator amplifier is fed to the re-entrant horn(s). Due to the high gain of the amplifier, it is recommended that various mounting positions be tested before actual installation is commenced, otherwise it may be found that severe acoustic feedback is experienced. It should also be pointed out that these tests should not be performed in a confined space. It will generally be found that by mounting the loudspeaker in a position well forward of the driving cab, any tendency to acoustic feedback can be eliminated.

3.2.9. The loudspeaker Type LS812 should then be installed by means of the mounting brackets and connected to Pins 3 and 6 on the 6-way connector provided.

3.3. AERIAL INSTALLATION.

3.3.1. It is essential that the aerial is mounted vertically in a position clear of all obstructions on a substantially flat surface. The best position for the aerial on a closed vehicle is undoubtedly a central position on the metallic roof. It is advisable, however, to check the position for symmetry and appearance before actually commencing to install the aerial. Various methods of doing this are shown in Fig. 3.2. below.

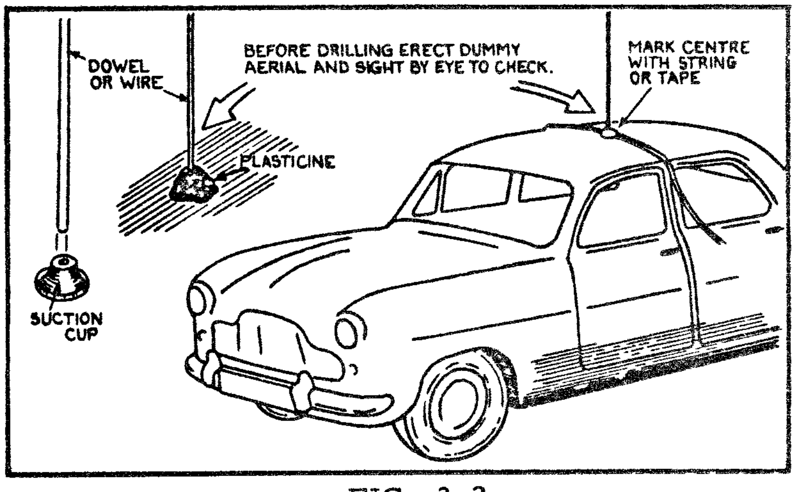

FIG. 3.2.

3.3.2. As it is necessary to have access to the bottom of the aerial base from the inside of the vehicle in order to attach the aerial feeder cable, the roof lining and interior trim of the vehicle will have to be removed. It will be appreciated that this is a skilled job and one which should only be undertaken by a craftsman.

3.3.3. In the case of vehicles having a non-metallic roof, a ground plane must be provided to enable the aerial to have the correct capacity needed to give efficient radiation properties. This ground plane can consist of a sheet of metal in the same plane as the roof and surrounding the base of the aerial. Alternatively, it can more conveniently be simulated by the use of four or more strips of flexible metal or metal braid radiating spoke-wise from the aerial base. This ground plane should, wherever possible, extend at least 3'6" fore and aft of the aerial position, be taken the full width of the vehicle and bonded to metallic side members. (See Fig. 3.3. overleaf).

3.3.4. To fit the aerial, first drill a hole in the roof of the vehicle (or mounting bracket) having a clearance of $\frac{1}{2}$". Strip down the aerial base by first removing the 4BA bolt and polythene insert from the centre of the large retaining bolt and fixing plate. Remove the large retaining bolt and fixing plate. Next, pass the retaining bolt through

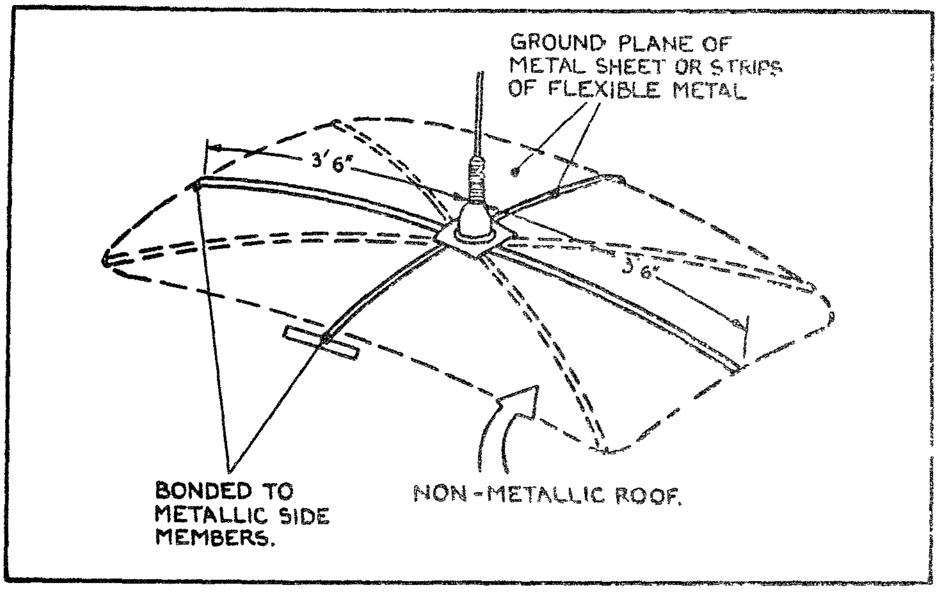

FIG. 3.3.

the fixing plate and through the hole in the roof from the interior of the vehicle. Care should be taken to ensure that the rubber sealing washer is between the aerial base and the vehicle roof (or mounting bracket) outside the vehicle. From the inside of the vehicle, position the fixing plate so that the cable cleat is conveniently located. Tighten up the retaining nut (See Fig. 3.4. below). It is essential that the fixing plate makes good electrical contact with the vehicle roof or mounting bracket. Any anti-drumming composition on the interior of the roof should be cleaned off until the bright metal is exposed.

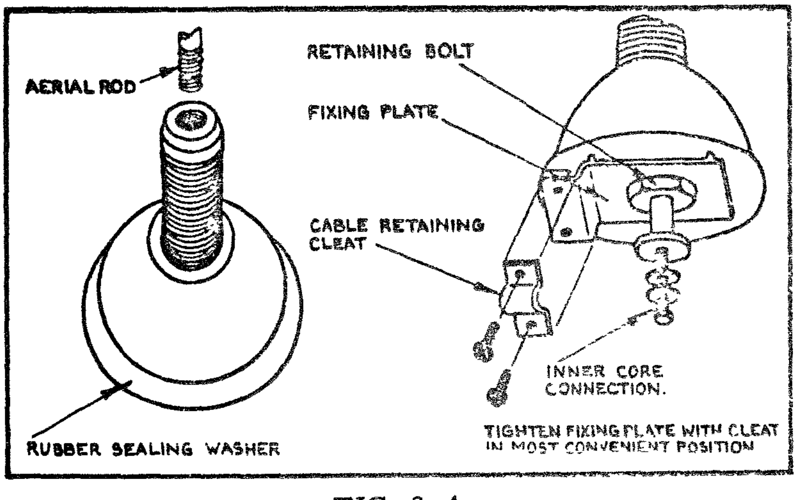

FIG. 3.4.

3.3.5. Before inserting the aerial rod it is recommended that a small quantity of silicon grease be smeared on the screw thread to facilitate future removal. Screw the aerial rod into the base, making sure that it is tightened well down.

3.3.6. The aerial feeder cable should then be connected from the co-axial socket on the T/R Unit to the aerial base, securing it with cleats where necessary. Cut the cable to the required length and strip the outer cover. The metal braiding should then be folded back and the ends trapped by the rubber sleeve. Strip the polythene insulation

The inner core is then connected to the aerial base by the hexagonal headed 4BA screw, while the metallic braid should be electrically bonded to the ground plane by clamping up in the cleat provided. Really good bonding at this point is essential to efficient operation. (See Fig. 3.5. below).

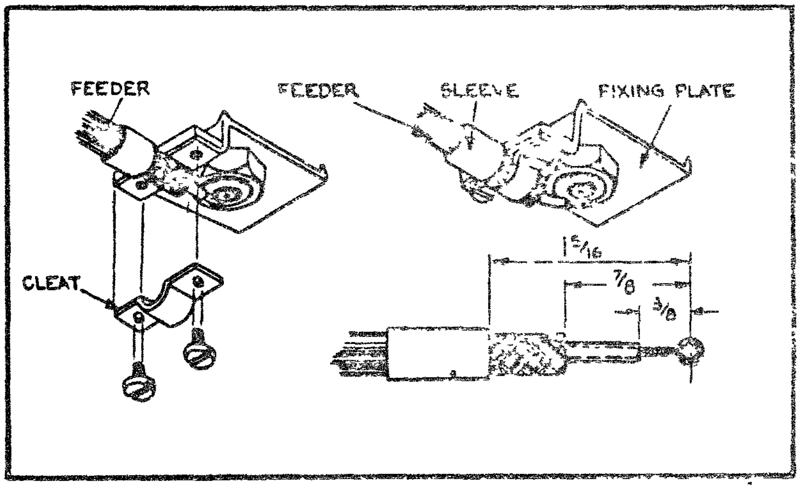

FIG. 3.5.

3.4. POWER UNIT.

3.4.1. The power supply is connected to the TR821 by means of the 6-way plug provided. In all cases the BROWN lead must be connected to the LIVE side of the battery and the GREEN lead to the vehicle chassis.

3.5. INITIAL SETTING UP.

3.5.1. Prior to despatch from the works, the equipment is accurately aligned to the frequency for which the licence is issued and the correct crystals are fitted. To ensure maximum operational efficiency, final adjustment should be made to the aerial tuning circuits to match the individual characteristics of the aerial.

3.5.2. The following installation tests are facilitated by the use of the Test Meter MR510. If no Test Meter is available, an AVO Model 8 can be used, the leads being connected to a B9A type plug as shown in the following table. Radiation tests cannot, of course, be performed by an AVO Model 8.

TEST METER MR510		AVO MODEL 8		
Switch Position	Typical Reading	Pin Connections	Avo Range	Typical Reading
Position 2	125	Positive 1 Negative 3	50 µA	20 µA
Position 3	235	Positive 1 Negative 4	50 µA	15 µA
Position 4	370	Positive 1 Negative 5	50 µA	20 µA
Position 5	125	Positive 7 Negative 8	10 mA	6.8 mA

It should be appreciated that these figures are given as a rough guide only, and considerable variations can occur in practice.

3.5.3. To check the alignment of the equipment proceed as follows :-

1. Plug the Test Meter into the test socket on the underside of the T/R Unit, switch to "SB" and allow about one and a half minutes for the valve heaters to warm up.

2. Remove the metal button on the right of the perspex panel to expose C1. Unlock the shaft of C1 by slackening the 8BA screw beside the shaft.

3. Switch to position 1 on the Test Meter MR510 and, using a signal input from the base station transmitter, tune C1 (using a non-metallic screwdriver) to obtain a maximum reading on the Test Meter. Relock the shaft by means of the 8BA screw. When making this adjustment, care should be taken that the base station signal does not overload the receiver. If necessary, the vehicle should be moved to a position some half mile away from the base station aerial. In the absence of a suitable signal, C1 can be peaked on noise and this adjustment checked and corrected during the final road test.

4. To adjust the operation of the muting circuit, first arrange for a test transmission of the weakest signal which it is required to receive. Switch the "OFF/MUTE" switch to the "MUTE" position and, using the test transmission, adjust RV2 until relay RLB just closes.

5. Disconnect the Test Meter, switch to position 'R' and stand it in a convenient position where it can be easily seen, e.g. on the bonnet of the vehicle.

6. To set up the transmitter for r.f. output, remove the MURPHY badge from the left-hand side of the loudspeaker grill to expose C130, slacken the locking screw on C130. Depress the press-to-talk switch and adjust the length of the telescopic aerial on the Test Meter until a convenient reading is obtained.

3.5.4. Adjust C130 carefully to obtain a maximum reading on the Test Meter.

3.5.5. Re-connect the Test Meter and select position 5. If necessary, adjust the Transmitter aerial coupling by means of the 6BA screw adjacent to C130 until a reading of 125 is obtained.

3.5.6. Re-lock all controls and replace the metal button and the MURPHY badge in position.

3.5.7. It is recommended that after installation and setting up has been carried out, the equipment should be given a road test, as in addition to providing a functional check on the equipment, it will determine whether any suppression of the vehicle electrical equipment is required. On vehicles of comparatively recent manufacture, the ignition system is already suppressed. On some vehicles, however, it may be necessary to suppress the ignition system and bond certain chassis members in order to cut out electrical interference. No general rule can, however, be laid down as being applicable to every type of vehicle.

4. OPERATING INSTRUCTIONS.

4.1. All operational controls are mounted on the front panel of the TR821 and consist of the following :-

4.1.1. Main Function Switch.

This is a four-position rotary switch engraved "OFF-REC-SB-PA" which provides the following conditions :-

"OFF"	All power off.
"REC"	Receiver fully operative.
"SB"	Receiver fully operative. Transmitter heaters on. Transmitter anode voltage applied on operating microphone pressel switch.
"PA"	Amplifier connected to re-entrant horn LS812 (LS812/2) and microphone 'live' on operating microphone pressel switch.

4.1.2. "MUTE" switch. This provides on/off loudspeaker muting facilities.

4.1.3. Channel selector switch. This switch is provided on multi-channel models only and provides for the selection of up to five adjacent channels according to the model obtained.

4.2. TO RECEIVE.

4.2.1. Turn the Main Function switch to the "REC" position.

4.2.2. Rotate the "VOLUME" control in a clockwise direction to a position approximately three-quarters of its full travel.

4.2.3. Allow about a minute and a half for the valve heaters to warm up. At the end of that time, with the "MUTE" switch in the "OFF" position, a hissing sound should be heard from the loudspeaker. This is atmospheric 'mush' and indicates that the receiver circuits are operating satisfactorily.

4.3. TO TRANSMIT.

4.3.1. Turn the Main Function switch to the "SB" (Standby) position and allow sufficient time for the transmitter valve heaters to warm up.

4.3.2. Depress the microphone pressel switch and speak into the microphone. This automatically disconnects h.t. from the receiver, leaving the transmitter fully operative. (It should be noted that the microphone should be held at a distance of about 2 inches from the mouth to obtain the best results).

4.3.3. If it is required to maintain a listening watch for long periods of time, the operator is recommended to turn the Main Function switch to the "REC" position as, in this position, the receiver circuits only are operative. This reduces the current drain on the vehicle batteries. When transmit facilities are again required it will be necessary to switch over to the "SB" position and wait for the transmitting valve heaters to warm up.

5. CIRCUIT DESCRIPTION

5.1. This section describes the operation of the various circuits and is intended to be read in conjunction with the circuit diagrams (Figs. 1 to 3) at the end of the book.

5.2. THE MODULATOR CIRCUITS.

5.2.1. The MR820 equipment employs a double-button carbon microphone, the energising voltage for which is obtained from the receiver negative bias supply and applied to the centre tap of the primary winding of the microphone transformer T9. The push-pull output of the secondary winding of T9 is applied to the grids of the Class A.B. modulator stage formed by V8 and V9. Output is taken from the modulation auto-transformer T8 via switch SW1a to L12 and the associated r.c. network to provide anode and screen modulation of the transmitter power amplifier valve V12. When the P.A. facility is selected, the output from the modulation transformer T8 secondary winding is applied to the external re-entrant speaker and h.t. voltage removed from the TR821 transmitting circuits.

5.3. TRANSMITTING CIRCUITS.

5.3.1. TR821/L (Low Band).

The coil L18 which forms the anode load of the master oscillator V15, is tuned to twice the fundamental crystal frequency. The output of this stage is capacitively coupled by C147 to the grid of V13 which is operated as a frequency tripler. This stage is inductively coupled via L13/L14 and outputs in push-pull are then applied to the grids of the double tetrode Power Amplifier V12. The tuned circuit consisting of C131 and L11 across the anodes of V12 is inductively coupled to the aerial tuning circuit L10 and C130. The r.f. output is taken from a tapping on L10 and applied via a contact on the transmit/receive relay RLA and the filter circuit C120/L8, to the aerial socket SK1 (See Fig. 1).

5.3.2. TR821/H (High Band).

The coil L18 which forms the anode load of the master oscillator V15, is tuned to twice the fundamental crystal frequency. The output of this stage is capacitively coupled by C147 to the grid of V14 which operates as a second frequency doubler. Outputs in push-pull from L16 are capacitively coupled via C138/C139 and applied to the grids of the double tetrode V13, this valve operating as a push-pull frequency tripler on all equipments. The anode tuned circuit of V13, consisting of C136 and L14, is inductively coupled to L13 and provides push-pull drive to the double tetrode Power Amplifier valve V12. The tuned circuit across the anodes of V12, consisting of C131 and L11, is inductively coupled to the aerial tuning circuit L10 and C130. The r.f. output is taken from a tapping on L10 and applied via a contact on the transmit/receive relay RLA and the filter circuit C120/L8, to the aerial socket SK1. (See Fig. 2).

5.4. RECEIVER.

5.4.1. The Receiver employs 10 valves in a double superheterodyne circuit. The incoming signal is fed to a pentode r.f. amplifier V1 and this is followed by the first frequency changer stage V2. The heterodyne voltage for V2 is obtained from a triode-pentode V10 operating as a two stage oscillator-multiplier. The transformer T10 in the anode circuit of the pentode section of V10 is tuned to the third harmonic of the crystal frequency. The anode circuit of the triode section of V10, consisting of L5 and C67 along with the associated tuned circuit L4/C66 is tuned to 6 times crystal frequency on model TR821/L and 9 times crystal frequency on model TR821/H.

5.5. I.F. AMPLIFIERS.

5.5.1. The first frequency changer V2 is followed by two top-capacity coupled first i.f. transformers T1 and T2. The first i.f. varies with the signal frequency and is always the crystal frequency plus 0.98 Mc/s. V3 operates as the second frequency changer, the heterodyne voltage being fed from the crystal oscillator circuit at fundamental frequency to produce the second i.f. of 0.98 Mc/s.

5.5.2. The second i.f. amplifier consists of three stages: V4, V5 and V6 which are coupled by the high Q transformers T3, T4, T5, T6 and T7. This arrangement provides most of the selectivity and gain on the receiver. The diode section of V7 operates as a noise limiter, while D1 is employed as an a.g.c. rectifier.

5.6. AUDIO OUTPUT STAGES.

5.6.1. The audio output from the detector diode D4 is developed across the series resistors R24 and R25 which form the diode load. From a tapping between these resistors, the voltage developed is applied to the cathode of the noise limiter diode V7 and then, after the removal of interference, via C53 to the volume control RV1.

5.6.2. The output from RV1 is then applied to the grid of the triode section of V7 which is the Audio Amplifier. This valve is capacitively coupled via C57 to the grid of the power output pentode valve V8.

5.7. RECEIVER MUTING.

5.7.1. The noise compensated, carrier operated muting circuit operates in the following manner: In the absence of an incoming carrier, the positive-going a.f. component of noise from T7 is applied to the grid of the triode V11A and this is balanced by a negative output taken from the noise rectifier D3. In operation, V11A is arranged to be non-conducting by the adjustment of potentiometer RV2. The triode V11B then conducts heavily because of the positive h.t. voltage applied to its grid via R59. When a carrier is received, the positive-going input to V11A causes the anode current to increase and the subsequent fall in voltage at the anode of V11A results in V11B being cut off. This causes relay RLB to release. When this relay is energised, contact RLB1 short circuits the triode grid circuit of V7 and the mute condition is obtained. When mute action is not required, the mute switch SW3 on the front panel is opened and the action of relay RLB then has no effect on the receiver audio output.

5.8. MULTI-CHANNEL EQUIPMENT.

5.8.1. Channel Selector Switch SW2 selects the transmitter and receiver crystals appropriate to the channel in use.

5.9. POWER UNIT PU822.

5.9.1. The Power Unit PU822 consists of a conventional vibrator power supply. When TR821 is switched to transmit, contact RLA1 of relay RLA selects the full secondary winding of T1 to provide the additional power required by the Transmitter.

6. RECEIVER ALIGNMENT.

6.1. In order to maintain the high standard of performance of which the equipment is capable, it is recommended that a periodic overall check of performance should be carried out.

6.1.1. It should be noted that complete re-alignment of all circuits should only be necessary when a major component affecting the tuning is replaced.

6.1.2. For complete receiver alignment the following Test Equipment is required.

1. Signal generator for 0.98 Mc/s calibrated for ±50 kc/s to enable i.f. bandwidth measurements to be made.

2. Signal generator for 10 to 20 Mc/s (1st i.f.)..

3. Signal generator for 40 to 174 Mc/s (signal frequency). For accurate signal/noise measurement, it is essential that the generator output be free from frequency modulation and the r.f. leakage should be less than 1 μV.

4. Audio Output Meter of 3 ohms impedance.

6.1.3. As the receiver operating frequency is pre-set and the receiver employs a crystal controlled oscillator, it is essential that any signal generator used for i.f. alignment shall be capable of resolving the required frequency within limits of $\pm$0.01%. To ensure that the signal generator frequency is accurately set up, it is recommended that the Crystal Calibrator XLC511 be employed. The Crystal Calibrator obtains its power from the MR820 and to achieve this V1 is removed and the Crystal Calibrator connected into the vacant valve base by means of the B7G plug provided on the instrument. If the output lead from the Crystal Calibrator is then clipped on the insulation of the grid lead to V3 and an unmodulated signal applied from the signal generator, the signal generator frequency can be accurately adjusted by the zero-beat method. Finally, disconnect the Crystal Calibrator and replace V1.

6.1.4. The standard signal generator input for all receiver alignment is modulated at 1000 c/s to a depth of 30%.

6.2. SECOND I.F. ALIGNMENT.

6.2.1. Disconnect the built-in loudspeaker by removing the lead to one side of the loudspeaker speech coil and insert a 100 ohms resistor in series with the lead.

6.2.2. Remove the receiver crystal appropriate to the channel in use. Connect a 3 ohms output meter between the 3 ohm winding of T8 and earth.

6.2.3. Disconnect the mauve lead from the stand-off insulator near V8 and V9 at the junction of R34/R35 and connect to Pin 2 of V8. Inject a signal of 0.98 Mc/s modulated at a depth of 30% by an a.f. component of 1000 c/s between the grid (Pin 1) of V6 and earth. The connection from the signal generator should be made by an isolating capacitor of 1000 pF.

6.2.4. Adjust the receiver gain control and the signal generator input to give an output of 50 mW.

6.2.5. Damp the primary winding of T7 by connecting a 4.7kΩ resistor across it. Tune the secondary winding to obtain a maximum reading on the output meter, using a non-metallic trimming tool.

6.2.6. Transfer the 4.7kΩ resistor to the secondary winding of T7 and trim the primary winding for maximum reading on the output meter (See Fig. 6.1. overleaf).

6.2.7. The same procedure should be followed for T6 and T5, transfering the signal generator connector to the appropriate grid pins, damping the primary and tuning the secondary, damping the secondary and tuning the primary windings alternately.

6.2.8. To tune T3 and T4, disconnect C18 and feed 0.98 Mc/s on to the grid of V3 and proceed as in the case of T5, T6 and T7 by damping the primary and tuning the secondary and vice-versa for each transformer in turn. Check that an input of 20 to 30 μV will give a signal/noise ratio of 10dB and an audio output of 50 mW. The

8.3. LOW BAND (40 to 100 Mc/s).

Positive Connection	Voltage (Crystal Removed)	Crystal In and Set Aligned	Avo Range
V15 anode Pin 5	200	200	1000
V15 screen Pin 7	185	200	1000
V13 anode Pin 7	240	245	"
V13 screen Pin 9	190	200	"
V12 screen Pin 7	60	110	"
L11 Centre tap	225	245	"
V13 cathode	10	8.5	25

8.4. HIGH BAND (100 to 174 Mc/s).

Positive Connection	Voltage (CrystalRemoved)	Crystal In and Set Aligned	Avo Range
V15 anode Pin 5	180	180	1000
V15 screen Pin 7	170	150	"
V14 anode Pin 5	200	200	"
V14 screen Pin 7	160	150	"
V13 screen Pin 7	40	110	"
L14 Centre tap	215	230	"
V12 screen Pin 7	55	110	"
L11 Centre Tap	195	220	"
V14 cathode Pin 2	9	14	25

All figures are in volts unless otherwise stated.

signal/noise ratio is determined by noting the reduction in the receiver output power when the signal generator modulation is switched off.

6.3. SECOND I.F. BANDWIDTH.

6.3.1. Adjust the signal generator input to give a receiver output of 50mW. with the preset gain control at maximum.

6.3.2. Increase the signal generator input by 6dB and detune the signal generator on either side of 0.98 Mc/s until the receiver output is again 50mW. Note the respective frequencies.

6.3.3. Increase the signal generator output by 70dB and detune the signal generator on either side of 0.98 Mc/s until the output is again 50mW. Note the respective frequencies.

6.3.4. The following bandwidth measurements should be obtained:

$\pm$ 6.5 kc/s at - 6dB
$\pm$18.3 kc/s at -70dB

6.3.5. It should be noted that the coupling on all transformers is pre-set at the works and should not normally require re-adjustment. If however, the bandwidth measurements obtained in the foregoing tests differ greatly from those quoted in the preceeding paragraph, the complete alignment procedure should be carefully repeated before any attempt is made to adjust the couplings. If it is considered necessary to adjust the couplings to obtain the correct bandwidths, adjustment of the coupling control in a clockwise direction will have the effect of reducing the coupling and reducing the bandwidth, whilst an anti-clockwise rotation will increase the coupling and increase the bandwidth. IF ANY ADJUSTMENT IS MADE TO THE COUPLING, THE COMPLETE FOREGOING RE-ALIGNMENT PROCEDURE MUST BE CARRIED OUT. (See Fig. 6.1. below).

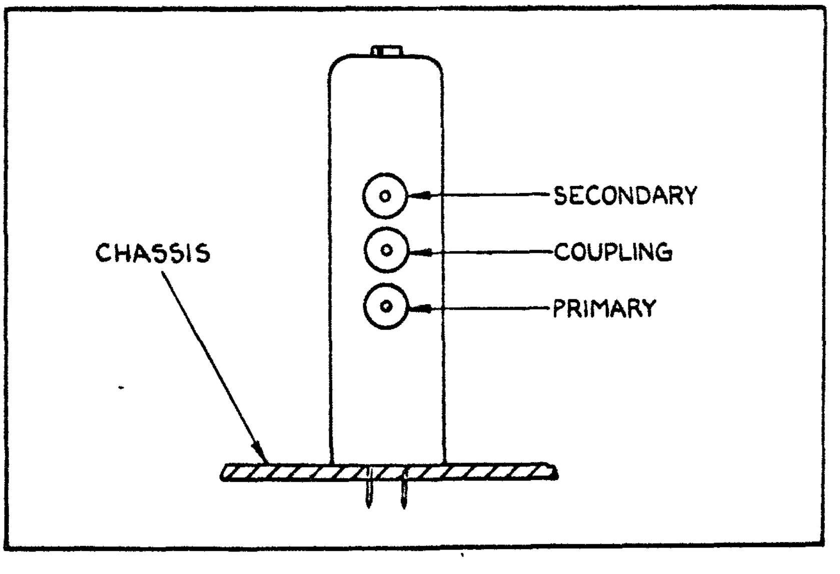

FIG. 6.1.

6.3.6. Finally, disconnect the mauve lead previously soldered to Pin 2 of V8 and re-connect this to the stand-off insulator near V9 at the junction of R34/R35. Re-connect C18 to the secondary winding of T2. Replace the crystal appropriate to the channel in use.

6.4. FIRST I.F. ALIGNMENT.

6.4.1. Set up the signal generator to the crystal frequency plus 0.98 Mc/s with 30% modulation at a frequency of 1000 c/s. Disconnect C7 from L3 and connect the output of the signal generator to the free end of C7.

16 967 16 892
98 980
17947 17872

6.4.2. Tune T1 and T2 for maximum output in each case.

6.4.3. Check that an input of 50 to 100µV will give a signal/noise ratio of 10dB and an audio output of 50mW. Disconnect the signal generator.

6.5. RECEIVER R.F. CIRCUIT ALIGNMENT.

6.5.1. Disconnect the 100kΩ resistor R42 from the chassis and between the free end of this resistor and the chassis, connect a 50µA meter (AVO Model 8, 50µA range). The positive lead of the meter should be connected to chassis and the negative lead to the free end of R42.

6.5.2. Tune the primary and secondary windings of T10, using a non-metallic trimming tool, to obtain a maximum reading on the meter.

6.5.3. Finally, disconnect the AVO Model 8 and re-connect R42 to chassis.

6.5.4. Connect the 3 ohm output meter between the 3 ohm winding of T8 and earth. Connect a signal generator, tuned to the receiver operating frequency, modulated as already described, to the aerial input socket SK10.

6.5.5. Set up the signal generator to apply a large signal to the input of the receiver and adjust C67 and C66 alternately until maximum receiver output is obtained. The signal generator output should be reduced as necessary to keep the receiver output at 50mW.

6.5.6. Adjust C1, C5 and C8 in turn for maximum receiver output, reducing the signal generator output as required to keep the receiver output level at 50mW.

6.5.7. Re-adjust C67 for maximum receiver output.

6.5.8. Re-adjust T1 and T2 for maximum receiver output.

6.5.9. Finally, check that a signal generator output of 2µV will give a signal/noise ratio of 10dB and at least 50mW audio output.

6.6. WARNING: The frequency of the crystal oscillator can be shifted considerably by adjustment of the oscillator anode circuits and first i.f. transformers. In order to prevent incorrect frequency setting due to this effect, it is essential that pulling the crystal to the required frequency should be the FINAL adjustment made to the receiver. First i.f. transformers and oscillator anode circuits must not be adjusted after the crystal frequency has been finally set.

7. TRANSMITTER.

7.1. For complete Transmitter re-alignment the following test equipment is required:

R.F. Power Output Meter.
Test Meter MR510.

7.1.1. Connect the R.F. Power Output Meter to the aerial input socket. Plug the Test Meter MR510 into the test socket provided and turn the selector switch to position 2.

7.1.2. Operate the microphone pressel switch and adjust the core of L18 for maximum reading on the meter.

7.1.3. On the TR821/H (High Band) model only, switch to position 3 on the MR510 and tune C142 for maximum reading on the meter.

7.1.4. Switch to position 4 on the MR510 and tune C136 and C134 to obtain a maximum reading.

7.1.5. Switch to position 5, tune C130 and adjust aerial coupling to give a very low or zero reading on the Power Output Meter. Tune C131 for a dip on the meter. Tune C130 for maximum output, adjust the aerial coupling by means of the screw provided and re-adjust the trimmer capacitor C130 for maximum output, ensuring that the reading on the Test Meter does not exceed 125.

7.1.6. Switch to position 4 on the MR510 and re-trim C136 and C134 for maximum output. Switch to position 5, re-trim C130 and if necessary re-adjust the aerial coupling to obtain maximum output consistent with a maximum reading of 125 on the Test Meter.

7.1.7. It should be noted that the filter capacitor C120 and coil L8 are adjusted on leaving the factory and the setting of these should not be altered.

SPECIFICATION

H.t. Supply:	140 volts 1.5mA.
Heater Supply:	6.3 volts 0.3A.
Crystal Frequency:	980 kc/s or 2.1 Mc/s.
Frequency Stability:	$\pm$0.005% over a temperature range -20°C to +70°C.
Valve Complement:	1 : EF91
Dimensions:	4.5/8 in. x 3.5/8 in. x 2.1/4 in. (117mm x 92mm x 57mm).
Weight:	1½ lb. (0.68 kg).
Finish:	Hammer grey enamel.

SCHEDULE OF SPARES

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:
J025701	Resistor fixed 100kΩ $\pm$10% ¼W	R1
J024965	Resistor fixed 1.2kΩ $\pm$10% ¼W	R2
J025317	Resistor fixed 10kΩ $\pm$10% ¼W	R3
J040622	Capacitor 15pF N.750K	C1
J052184	Capacitor 270pF Hl-KK	C2
J040602	Capacitor 10pF N.750K	C3
	2 - 3 lengths of wire twisted together	C4
XC57811	.01mfd $\pm$25% 400VW	C5
12592/91	Valve EF91	V1
A829777	Crystal 980 kc/s	XL1
A829775	Crystal 2.1 Mc/s	XL1

SERVICING

Fault Finding Procedure

Diagnosis and cure of fault conditions occurring in this equipment, will depend to some extent on the facilities available. The preliminary checks described below, can be made with a multi-range test meter of the Avo type and will serve to identify any failure in the power supplies or aerial connections etc.

(1) Switch the Radiophone ON and turn the VOL knob fully clockwise. Switch the MUTE ON and set the control as far clockwise as necessary to prevent any signals breaking through. (The muting action is such that the further the control is turned clockwise, the greater the signal input required to override the mute). A slight hissing noise should be audible from the loudspeaker. Return the VOL control to about the halfway position and switch the MUTE OFF; a high level of background noise should now be heard, together with any audio signals that might be originating from a local transmitter on the same frequency.

(2) Operate the transmitter by pressing the microphone 'press-to-talk' button. The noise from the loudspeaker will cease as the receiver is cut off and the 1.7 kc/s tone produced by the DC/DC Converter should be audible.

(3) If these checks give negative results, they could indicate complete or partial power failure, and the set should be switched off and removed from its case to establish the presence of power supplies on the rear plug assembly, PL1.

Note. The Radiophone is opened by unscewing the two bolts, one on each side of the front panel and pulling out the main chassis assembly (which is attached to the front panel). The rear plug and socket will remain attached to the main chassis and case respectively.

(4) Using the voltmeter fitted with test prods and set to the appropriate d.c. range, take a reading between pin 3 (-ve) and pin 5(+ve) on the rear socket, from inside the case. This should read the vehicle battery voltage. If there is no reading, investigate the line fuses first and if these are not blown, made continuity checks to the power supply leads between the Radiophone and battery.

(5) Next, make an insulation check between the aerial (pin 7) and earth (co-axial lead screen - pins 6 and 8). Earth in this case being the vehicle chassis, which is isolated within the set from battery +ve by means of C603.

If no fault can be found with the connections to the rear socket and ancillary wiring, attention should be turned to the set itself.

(6) A visual inspection of the fuses (on mains chassis and in DC-DC converter), wiring and printed circuit boards should be made to eliminate any obvious faults (Consult Fig.3 to establish the location of main

components). Use a meter to make continuity checks of the power distribution paths from the plug PL1, through the ON/OFF switch and T/R relay to the various boards. Fig. 2 **shows** most of the interconnecting. wiring.

If no faults are discovered during these 'static' tests, it will be necessary to supply power to the set while removed from its case. A suitable lead should be made to enable the Radiophone to be run on the bench from a mains power unit or battery and battery charger. This will be needed in any event, for the alignment operations.

(7) First check the power consumption in the receive and transmit conditions:-

'Receive' (MUTE ON - no signal): 70 - 80 mA
'Transmit': 3 - 4A at 12.6V.

Note: When taking measurements on the transmitter, it will be necessary to have it switched on for longer periods than normal. This can be most easily achieved by short-circuiting the press - to - talk switch with a piece of wire attached to the lead-through capacitors C610 and C607. As these points are rather inaccessible, a link can be made between the solenoid (black wire) of RLA, and battery +ve (brown wires on nearby tag-strip).

(8) Check the transmitter power supplies as follows:-

Tx. Output (measured between the following points - see Figs.2 and 3):

C436 and chassis	+220 to + 240V
C434 and C435	1.75V a.c. (V402 heater)

Tx. Driver (Figs. 2,8 and 9):

C428 and chassis	+220 to +240V
C426 and C427	1.2Va.c. (V401 heater)
Tags 1 and 2	-9V ±0.1V.

Aerial Relay Solenoid (Figs. 1,2 and 10):

Tags 4 and 5 on Ae. Filter Board or,
C515 and C516 on DC-DC Converter - 12 to 13V d.c.

(9) Check the receiver power supplies against battery +ve (brown leads):-

A.F./Mod. Unit (Figs. 2 and 7):

Tag 9 (grey)	-12 to -13V
Tag 7 (yellow)	-9V
Tag 3 (violet)	-9V (on 'transmit' only)

<u>R.F.Board</u> (Figs 1 and 4):

Tag 8 (grey)	-12 to -13V (on 'receive' only)
Tag 5 (pink)	-9V (on 'receive' only).

<u>I.F.Board</u> (Figs. 1 and 5)

Tag 10 (grey)	-12 to -13V
Tag 6 (pink)	-9V (on 'receive' only)

<u>A.G.C. Board</u> (Figs.1 and 6):

Tag 7 (yellow)	-9V
Tag 8(yl/bn)TP5	-3.8V(A.G.C.bias, no signal)
Tag 9 (black) TP7	-1.5V (bias to I.F. Board)
Tag 11 (orange) TP6	-1.4V(bias to R.F.Board)

<u>Note</u>: The zener-stabilised supplies should remain within ±0. 1V, regardless of nominal changes of input voltage. The readings listed above are only approximate; slight variations beyond the limits need not indicate faulty supplies.

<u>Alignment Procedure</u>

The Radiophone leaves the factory with all its circuits correctly aligned and pre-set controls adjusted for optimum performance. Re-alignment will only be required after replacemint of components whose printed circuit boards. It may also be necessary to re-align if the operating frequency is changed or if the settings of trimming components have been altered for any reason.

For complete alignment and test, all the equipment listed below will be required. Certain makes of test equipment are recommended but this does not imply that other instruments are unsuitable, rather, that measurements taken with less sensitive equipment may give misleading results.

<u>Test Equipment</u>

(1) Suitable d.c. power supply to provide 12.6V, 4A, e.g. R.B.M. PU1006, or vehicle-type battery with battery charger.

(2) R.F. Output Power Meter with 50 input impedance reading up to 10W, e.g. R.B.M. type T1/7710 or Marconi Output Test Set type TF1065A.

(3) Modulation Depth Meter to measure up to 80% modulation, e.g. R.B.M. type T1/7703 or Marconi TF1065A.

(4) R.F. Signal Generator covering the range 71.5 - 174 Mc/s, amplitude modulated and having a 50 output that can be reduced to less than 0.5 V. It should also have a 10.7 Mc/s output for i.f. alignment. The Marconi Signal Generator type TF995A fulfils these requirements.

(5) A 10.7 Mc/s crystal controlled oscillator is needed to set the signal generator precisely. The R.B.M. Crystal Check Set type 9428 is designed for this purpose (see Supplement 10A-.

(6) Audio oscillator with 200 ohms output impedance, e.g. R.B.M. type TI/7697 or Levell TG150M.

(7) A.F. Power Meter with 15ohms input impedance to read up to 3W, e.g. Marconi TF893 or TF1065A.

(8) Valve (or transistor) voltmeter to read from 1 mV to 3V at audio frequencies, e.g. Levell TM2A or TM 3A.

(9) Multi-range d.c. meter with a secsetivity of 20,000 ohms/V, e.g. Avo Model 8.

(10) Adjacent Channel Interference Indicator, e.g. R.B.M. type TI/12739. This is only required for re-setting the Tx. valve heater potentiometers,

(11) A frequency counter will be needed if it is intended to make any adjustments to the crystal oscillator circuits. However, it is suggested that sets in need of frequency adjustment are returned to the manufacturer

<u>Preliminary adjustments</u> (see Figs.1 and 2)

The Radiophone must be removed from its case and the power supply connected to the rear plug PL1 (+ve to pin 5, -ve to pin 3).

(1) Connect the r.f. signal generator to the aerial input (pins 7 and 8 or 9), via the 52ohms outlet of a 20dB matching pad. Signal generator carrier must be switched off.

(2) Check that the power unit is set to provide 12.6V, and switch on.

(3) Connect the d.c. meter (Avo or similar) with +ve lead to a convenient battery +ve point (brown wires). Switch to 10V range.
<u>Note</u> As mentioned previously, both battery +ve and -ve are isolated from main chassis metalwork, except for a.c. via C603

(4) Connect -ve Avo lead to tag 7 (yellow) on the A.F./Mod. Board and adjust RV302 to give -9V ±0.1V.

(5) Transfer Avo -ve lead to junction R326, R328 and set RV303 to give -3V

(6) Remove Avo leads and turn Radiophone over to expose the A.G.C. Board. Re-connect Avo +ve, (i.e. tag 5).Switch to 2.5V d.c. range.

(7) Connect -ve Avo lead to the -ve end of C212 and adjust RV202 to give -2V

(8) Transfer -ve Avo lead to tag 8 (yl/bn) and adjust RV201 to give -3.8V.

(9) Move Avo lead to tag 9 (black). This should be -1.5V and tag 11 should be -1.4V.

(10) Disconnect Avometer.

Receiver **Alignment** (see Figs.1,4 and 5)

Adjustment of the components RV1, L6 and particularly L9 will, to a **certain** extent affect the frequency of the local oscillator. Therefore, unless an accurate frequency counter is qvailable to recheck the frequency the operations described in paras. (3), (4) and (5) should be omitted.

(1) The signal generator should still be connected as in para (1) above, with carrier switched off.

(2) Connect Avo +ve lead to some battery +ve point near the R.F. Board. The -ve Avo lead must be connected via a 10kohms resistor (at the clip end) to the projecting wire TP3, on the track side of the R.F. Board. TP3 is at the junction of L5, R12 and C28.

(3) Turn RV1 clockwise until the oscillator volts indicated on the Avo drop to 0.5V.

(4) Adjust L6 to give the maximum reading and then re-set RV1 to give the optimum oscillator voltage for the frequency in use This will be between 0.7V at 174 Mc/s and 1.0V at 72 Mc/s,

Note If RV1 is turned in an anti-clockwise direction from the fully clockwise position, the oscillator volts should rise from zero to a maximum and then start to fall again. The sequence described above. If the oscillator volts are low, RV1 may be set at the maximum, though up to20% below the optimum is acceptable.

(6) Adjust L9 to bring the frequency to the correct value and repeat the checks in (3) and (4). If any further adjustments are necessary, recheck the frequency and set with L9.

(6) Disconnect the -ve Avo lead from TP3 and attach it to TP4, near tag 8, on the I.F. Board (leaving the 10kohms resistor in series). Switch to the 10V range.

(7) Switch on the signal generator carrier and tune a modulated signal at the frequency of the set under test. Increase the output to a level that produces a reading of between 3 and 4V on the Avo at TP4.

Note: Multi-channel sets should be switched to a frequency near the middle of the range and the signal generator tuned to that.

(8) With a plastic trimming tool, roughly tune the r.f. coils T2, L3, T1, L2 and L1 (in that order), to give the maximum reading at TP4. Keep the Avo reading below 4V by reducing the signal generator out-put as the coils are brought into tune. If it is found that an input of less than 0.5uV is required, reduce the i.f. gain instead, by turning RV101 (I.F. Board) anticlockwise.

Note: The input figures quoted throughout this alignment procedure, are the actual voltages appearing at the input to the Radiophone. When setting the signal generator attenuator, due allowance should be made for the 20dB pad in the lead; thus allowance should be made for the 20dB pad in the lead; thus a 0.5uV input requires an attenuator setting of 5.0uV.

(9) Switch off the modulation and tune the signal generator to exactly 10.7Mc/s using the 'zero beat' method with the 10.7Mc/s Crystal Check Set.

(10) Carefully tune the i.f. coils L103, L102, L101 (on the I.F. Board) and L8, T3 (on the R.F. Board) attenuating the sig. gen. as required to keep the Avo reading less than 4V. Then gen. as required to keep the Avo reading less than 4V. Then trim the r.f. coils T2, L3, T1, L2 and L1 in the same manner.

I.F.Gain, Mute and A.G.C. Checks

(1) Set the signal generator to gibe an input of 0.5uV and switch MUTE ON but leave the control at the anticlockwise end of its sweep. Switch on the modulation.

(2) Set the I.F. Gain control RV101 to a point where the mute just lifts, i.e. with Mute Level control fully anti-clockwise, a signal of 0.5uV or greater, will override the mute action.

(3) Reduce the signal input by 2dB (i.e. to 0.4uV) and the receiver should mute in about 1 to 2 seconds.

(4) Turn the Mute Level control fully clockwise and check that a signal of 2 to 10 uV is required to make the mute lift.

(5) Return the input to 0.5uV and then increase it in 20 dB steps up to 5mV while observing the Avo readings at TP4. At no time should this exceed 5.8V.

Signal to Noise Ratio

(1) Return the input to 0.5uV, switch off modulation and recheck the tuning of the signal generator with the 10.7Mc/s Check Set.

(2) Increase the input to 1.25uV, switch on the modulation and set to exactly 30%.

(3) Connect the a.f. valve voltmeter across the loudspeaker terminals, or more conveniently, to the lead-through capacitors C605, C606,(green and violet wires) behind the mic. socket SKT1.

(4) Set to the 150mV range and adjust the VOL control to give a reading of 0dB. Switch off the modulation. Carefully tune L1(R.F. Board)

to give a minimum reading on the valve voltmeter. This should be not less than -7dB and is normally about -10dB.

Transmitter Alignment

(1) Connect the power supply to the rear plug PL1 (+ve to pin 5, -ve to pin 3).

(2) Connect the aerial coaxial lead (from pin 7, and 6 or 8) to the 50ohms socket on the r.f. power and mod, meter.

(3) Connect the audio oscillator and valve voltmeter across the microphone input (socket SKT1, pins 4 and5 or, between the lead-through caps. C608 blue and C609 red).

(4) Set the audio oscillator to 1500c/s, 200ohms impedance, 10mV output range and gain control to zero.

(5) On multi-channel Radiophones, set the channel selector switch to a frequency in the middle of the range.

(6) Switch on the Radiophone and operate the transmitter by short circuiting the 'press-to-talk' switch as described in section 3.2 para(7).

(7) Set the Avometer to the 10V d.c. range and connect it between battery +ve (brown lead on lead-through C419) and TP1 (junction R406 and lead-through C420, Tx. Driver).
Note: The following readings are typical for a supply voltage of 12.5 measured at the input to the DC-DC Converter, across C504 (i.e. taking into account the volts drop caused by the chokes L504, L505).

(8) Adjust T401 (see below), T402 (Bands A,B,C&D only) and L410, to give maximum reading on the Avo, (approximately 2V on high band and 3 to 4V on low band frequencies).
Note: Do not adjust T401 unless a frequency counter is available to reset the frequency (for details see 3.7.1).
If the initial readings are very low, the Avo may be set to a more sensitive range at first and then turned back as the coils are brought into tune.
Avoid tuning to the slight dip in the tuning peak which indicates that the oscillator is squegging at 50kc/s. This point is just visible on an Avo 8.

(9) Transfer Avo -ve lead to TP2 (lead-through C429, Tx. Output) and adjust T403 and T404 for maximum output. If this is outside the limits 2.0 -2.6V, adjust the coupling of T403 through the slot in the screening can, to bring the reading to as near 2.3V as possible. This may not be feasible on high band sets, where a reading of between 1.5 - 1.8V could be regarded as satisfactory.

(10) Adjust the tank circuit trimmer C440, to give maximum reading on the r.f. power meter. This should be not less than 6.5W.
Note:- Some 'pulling' may occur between T403 and T404, and between T404 and C440.

On high band sets the coupling between L412 and L413 is adjustable through a slot in the screen. To obtain maximum output, this coupling should be varied alternately with C440.
On low band sets the coupling is fixed, but it is possible that r.f. cores have been inserted into one or more of the Aerial Filter coils during Final Test. These have the effect of considerably increasing the output and may be adjusted during alignment (with C440) as required. Under no circumstances must cores be fitted to the Aerial Filter coils of high band Radiophones.

Oscillator Frequency Check

If an accurate frequency counter is available, the oscillator trimmers C403 and T401 may be adjusted as follows:-

Loosely couple the counter to the Tx. Output coils and adjust C403 to give the correct frequency. Switch the set off, and check that the oscillator starts immediately it is switched on again. If necessary, adjust T401 and recheck the frequency.

Modulation Depth

The Mod. Level adjuster RV301 and VOGAD control RV305 are mounted on the A.F./Mod, Board and may be adjusted from the track side through holes in the board. A small screwdriver is suitable for this operation.

(1) Set the audio oscillator gain control to give an output of 1 mV measured on the valve voltmeter.

(2) Adjust RV301 to give a reading on the Modulation Depth Meter, of 50%.

(3) Increase the audio oscillator output to 3 mV and set RV305 for a modulation depth of 70%.

(4) Reduce the oscillator output to 1 mV and check that the mod. depth returns to 50%. If it does not, re-adjust RV301.

Modulator Frequency Response Check

(1) Disconnect the valve voltmeter from the microphone input, and connect it to the MOD. OUT socket on the Modulation Depth Meter.

(2) Adjust audio oscillator output to give a mod. depth of between 20 and 25% and set the valve voltmeter to a range that gives a convenient reference reading, i.e. OdB.

(3) Note the reading of the audio oscillator output meter.

(4) While maintaining this level, alter the frequency to 300 c/s, 3 kc/s and 6kc/s and note the readings on the dBscale of the valve voltmeter. They should fall within the following limits:-

300 c/s	-8 to 012 dB
1.5kc/s	OdB (reference)
3 kc/s	+1 to -2dB
6 kc/s	-17 to -23 dB

Adjusting Tx. Valve Heater Potentiometers,

The potentiometers RV501 (on DC-DC Converter) and RV603 (on Main Chassis) are inserted in parallel with the valve heaters to reduce the radiation of adjacent channel frequencies. They are set in the factory to the optimum position and should not be adjusted unless an adjacent channel interference meter is available for re-checking. If it is necessary to do this check, adjust RV603 and RV501 (in that order), to give a minimum indecation on the meter for the appropriate channel spacing.

8. VOLTAGE READINGS

8.1. The following tables of voltage readings have been compiled for the guidance of the service engineer. It should be noted, however, that these are intended to be representative only and may vary slightly from one equipment to another. A tolerance of 20% should be permitted on all figures to allow for variations of battery (or mains) voltage and component tolerances. The following readings were made with an AVO Model 8 with the Main Function switch in the "SB" position and utilising a Mains Power Unit.

RECEIVER UNIT.

Positive Connection		Voltage (Low Band)	Voltage (High Band)	Avo Range
H.T. side R32		270	270	1000
Other side R32		140	140	"
V1 anode	Pin 5	130	135	250
V1 screen	Pin 6	110	115	"
V2 anode	Pin 5	260	260	1000
V2 screen	Pin 7	265	265	"
V3 anode	Pin 5	255	260	"
V3 screen	Pin 7	265	265	"
V4 anode	Pin 5	120	120	250
V4 screen	Pin 7	120	120	"
V5 anode	Pin 5	120	115	"
V5 screen	Pin 7	120	115	"
V6 anode	Pin 5	110	125	"
V6 screen	Pin 7	110	125	"
V7 triode anode	Pin 7	45	47	"
V8 anode	Pin 5	260	265	1000
V8 screen	Pin 7	265	270	"
V10a anode	Pin 6	130	136	250
(with crystal removed)		(crystal removed)		
V10b anode	Pin 1	32	32	"
V2 cathode	Pin 2	2.2	1.5	25
V3 cathode	Pin 2	3.2	2.7	"
V6 cathode	Pin 2	1.0	1.0	"
V7 triode cathode	Pin 5	0.8	0.8	"
V8 cathode	Pin 2	11.5	11.5	"
Bias at Pin 6, SK2		2.8	3.0	"

All figures are in volts unless otherwise stated

8.2. TRANSMITTER UNIT.

The following voltage readings for both Low and High Band MR820 equipments were made with an AVO Model 8 utilising a Mains Power Unit and with the Main Function switch in the "SB" position. In every case the equipment was in the normal operating condition, a microphone being plugged in and, while a reading was made, the pressel switch on the microphone being depressed. The Transmitter output was fed to a Bird Power Output meter. This has an impedance of 51.5 ohms. Any meter of equivalent impedance could, of course, be used.

APPENDIX 1.

MR820

VALVE COMPLEMENT

RECEIVER

REF	DESCRIPTION	LOW BAND Mullard Type	LOW BAND American Type	HIGH BAND Mullard Type	HIGH BAND American Type
V1	R.F. Amplifier	EF95	6AK5	EF95	6AK5
V2	1st Mixer	EF91	6AM6	EF91	6AM6
V3	2nd Mixer	EF91	6AM6	EF91	6AM6
V4	1st I.F.	EF92	6CQ6	EF92	6CQ6
V5	2nd I.F.	EF92	6CQ6	EF92	6CQ6
V6	3rd I.F.	EF92	6CQ6	EF92	6CQ6
V7	Noise Limiter	EAC91	-	EAC91	-
V8	Receiver Output	EL91	6AM5	EL91	6AM5
V10	Local Oscillator	6U8	6U8	6U8	6U8
V11	Muting	ECC81	12AT7	ECC81	12AT7

TRANSMITTER

REF	DESCRIPTION	LOW BAND Mullard Type	LOW BAND American Type	HIGH BAND Mullard Type	HIGH BAND American Type
V9	Modulator valve (Push-pull with V8).	EL91	6AM5	EL91	6AM5
V12	Power Amplifier	QQV03-10	6360	QQV03-10	6360
V13	Driver Multiplier	EL85	6BM5	QQV03-10	6360
V14	Frequency Multiplier	EL91	6AM5	EL91	6AM5
V15	Oscillator and Frequency Multiplier	EF91	6AM6	EF91	6AM6

CRYSTAL DIODES

REF	DESCRIPTION	LOW BAND British Type	LOW BAND American Type	HIGH BAND British Type	HIGH BAND American Type
D1	A.G.C. Rectifier	*CV448	1N476	*CV448	1N476
D3	Muting	*CV448	1N476	*CV448	1N476
D4	Detector	*CV448	1N476	*CV448	1N476

* In some equipments the CV448 may be replaced by a GEX34. (1N114).

APPENDIX 2

SCHEDULE OF SPARES

Unit	Reference
TR821/H	A
TR821/L	B

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:	QUANTITY PER UNIT A	B
J024165	Resistor 10Ω±10% $\frac{1}{4}$W	R39	1	1
J024293	Resistor 22Ω±10% $\frac{1}{4}$W	R74	1	1
J024357	Resistor 33Ω±10% $\frac{1}{4}$W	(A.B)R85.(A)R77	2	1
XC69704	Resistor 43Ω±5% 2.5W	R95	1	
J024549	Resistor 100Ω±10% $\frac{1}{4}$W	R86	1	1
J024589	Resistor 120Ω±10% $\frac{1}{2}$W	R35	1	1
XC69708	Resistor 150Ω±5% 2.5W	R95		1
J024677	Resistor 220Ω±10% $\frac{1}{4}$W	R22	1	1
J024709	Resistor 270Ω±10% $\frac{1}{4}$W	R40	1	1
J024805	Resistor 470Ω±10% $\frac{1}{4}$W	R80.(B)R44	1	2
J024813	Resistor 470Ω±10% $\frac{1}{2}$W	R34	1	1
J024933	Resistor 1kΩ±10% $\frac{1}{4}$W	(A.B.)R3, 6, 10, 27, 31, 43, 45, 71, 96 (A)R83	10	9
J025005	Resistor 1.5kΩ±10% $\frac{1}{2}$W	R81	1	
B836500	Resistor 3.9kΩ±5% 8.5W	R32	1	1
J025189	Resistor 4.7kΩ±10% $\frac{1}{4}$W	R5, 7, 9, 11, 13, 16, 23, 87	8	8
J025317	Resistor 10kΩ±10% $\frac{1}{4}$W	R91	1	1
J025325	Resistor 10kΩ±10% $\frac{1}{2}$W	R63	1	1
J025349	Resistor 12kΩ±10% $\frac{1}{4}$W	R2	1	1
J025453	Resistor 22kΩ±10% $\frac{1}{2}$W	R61, 62	2	2
J025445	Resistor 22kΩ±10% $\frac{1}{4}$W	(A.B)R88.(B)R90	1	2
J025509	Resistor 33kΩ±10% $\frac{1}{4}$W	R73	1	1
J025541	Resistor 39kΩ±10% $\frac{1}{4}$W	R24	1	1
J025573	Resistor 47kΩ±10% $\frac{1}{4}$W	(A.B)R21, 25, 98, 99 (A)R82, 84	6	4
J025581	Resistor 47kΩ±10% $\frac{1}{2}$W	R72	1	1
XC25547	Resistor 39kΩ±10% Type 16 $\frac{1}{4}$W	R400	1	1
J025701	Resistor 100kΩ±10% $\frac{1}{4}$W	(A.B)R1, 19, 29, 41 42.(A)R76.(B)R84	6	6

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:	QUANTITY PER UNIT A	B
J025741	Resistor 120kΩ±10% ½W	R70	1	1
J025765	Resistor 150kΩ±10% ¼W	R54	1	1
J025829	Resistor 220kΩ±10% ¼W	(A.B)R4, 8, 12, 14 (A)R78, 79	6	4
J025861	Resistor 270kΩ±10% ¼W	R37, 38	2	2
J025893	Resistor 330kΩ±10% ¼W	R18, 26, 28	3	3
XC25445	Resistor 22kΩ±10% ¼W	R49 (TR821/1 only)	1	1
J025957	Resistor 470kΩ±10% ¼W	R15, 33	2	2
J026021	Resistor 680kΩ±10% ¼W	R97	1	1
J026085	Resistor 1MΩ±10% ¼W	R55, 56, 57, 59, 36	5	5
B834994	Resistor Var. 25kΩ±20% ¼W	RV2	1	1
B834993	Resistor Var. 250kΩ±20% ¼W	RV1	1	1
XC66697	Cap. Fixed 1pF±¼pF 750VW	C15, 16, 75	3	3
J052143	Cap. Fixed 2.7pF±¼pF 750VW	C65	1	1
XC66708	Cap. Fixed 2.7pF±¼pF 750VW	C25	1	1
J052145	Cap. Fixed 3.3pF±½pF 500VW	C69, 43, 76, 77	4	4
XC66714	Cap. Fixed 4.7pF±¼pF 750VW	C162 (5 channel only)	1	1
XC66798	Cap. Fixed 10pF±½pF 750VW	C7	1	1
J066773	Cap. Fixed 6.8pF±1pF 750VW	C73, 140, 151	3	3
XC66720	Cap. Fixed 8.2pF±¼pF 750VW	C80, 160 (TR821/1 only)	2	2
J066775	Cap. Fixed 10pF±10% 750VW 60-80 Mc/s			1
J067498	Cap. Fixed 27pF±10% 750VW 115-130 Mc/s	C150	1	
J066775	Cap. Fixed 10pF±10% 750VW 130-160 Mc/s		1	
J067501	Cap. Fixed 47pF±10% 750VW	(A)C3, 6, 68, 104 (B)C2. (A.B)C46, 92	6	3
J067503	Cap. Fixed 68pF±10% 750VW	C74, 149	2	2
J067505	Cap. Fixed 100pF±10% 750VW	C62, 63	2	2
J054080	Cap. Fixed 270pF±20% 500VW	(A.B)C55. (B)C3, 6, 68, 104	1	5
J067513	Cap. Fixed 470pF±10% 750VW	C56	1	1
XC80165	Cap. Fixed 470pF±2% 350VW	C22, 24, 26. 28, 31 35, 36, 41, 44, 47	10	10
J054085	Cap. Fixed 680pF±20% 500VW	C90, 91	2	2
WC68466	Cap. Fixed 1800pF+50% 500VW -25%	(A.B)C4, 9, 11, 13, 18, 20, 21, 23, 27, 29, 32, 34, 37, 39, 42, 49, 50, 45, 57, 59, 61, 72, 101, 102, 103, 105, 106, 107, 108, 109, 110, 111, 112, 113, 132, 133, 135, 145,		

(circuit refs. continued overleaf)

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:	QUANTITY PER UNIT A	B
		146, 147, 148, 170, 171, 172, 173. (A)C168, 169, 137, 138, 139, 143, 144. (B)C154, 155, 174	52	48
WC49447	Cap. Fixed 0.01μF±20% 150VW	C53	1	1
WC49441	Cap. Fixed 0.1μF±25% 150VW	C93	1	1
XC57811	Cap. Fixed .01μF±25% 400VW	C152, 175	2	2
XC57807	Cap. Fixed 0.1μF±25% 150V	C38, 52	2	2
XC57808	Cap. Fixed 0.25μF±25% 150VW	C33	1	1
XC74916	Cap. Fixed 2μF +50% -20% 275VW	C51	1	1
B835255	Cap. Fixed 25μF +100% -20% 25VW	C58	1	1
B835251	Cap. Var. 1-10pF	C120	1	1
J067499	Cap. Fixed 33pF±10% 750VW	(A)C2	1	
A835250	Cap. Var. 1-10pF	C83, 163 (TR821/1 only)	2	2
		C84, 85,) 86, 87,) TR821/5 164, 165,) only 166, 167)	8	8
A809206	Cap. Var. 3.5-13.5pF	(A.B)C131, 134, 136 (A)C142	4	3
B834983	Cap. Var. 3.3-25pF	C130	1	1
A820675	Cap. Var. 3.3-33.3pF	C1, 5, 8, 66, 67	5	5
A832202	Cap. Var. 5-25pF	C12, 14, 17, 19	4	4
B830388	Plug 6 way - Fixed	PL4	1	1
B833738	Plug 24 way - Fixed	PL1	1	1
B828741	Cover for 24 way Plug & Socket		2	2
A833559	Retainer Assy.		1	1
A833650	Retainer Plug Assy.		(Max (1	Max 1
B836578	Holder Lamp		1	1
A836600	Lamp 6.5V 0.15A	LP1	1	1
A809304	Lens, Red		1	1
A822151	Dial		1	1
A833674	Button (access to Trimmer)		1	1
A808707	Stop for Pots		2	2
A833541	Shaft (for Crystal Assy) (5 channel only)		1	1
A833670	Knob, marked	For RV1 and SW1	2	2
A833671	Knob, marked	For crystal assy.	1	1
A833685	Spring for Ae. Coupling		1	
A837924	Terminal Block 2 way		1	1
B830983	Case Assy.		1	1

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:	QUANTITY PER UNIT A	QUANTITY PER UNIT B
B833586	Case Welded Assy.		1	1
A808763	Bush		2	2
A808751	Latch L.H.		1	1
A808788	Latch R.H.		1	1
A808782	Washer		2	2
A833686	Screw Special		4	4
A833687	Spacer		4	4
A821561	Disc Plate		1	1
B808794	Escutcheon Assy.		1	1
B833535	Grille		1	1
A820397	Socket Co-axial Fixed	SK1	1	1
B833742	Socket 24 way Fixed	SK2	1	1
A900178	Socket Octal	SK3	1	1
C834206	Coil R.F. 60-105 Mc/s	L1		1
C834207	105-174 Mc/s		1	
C834209	Coil R.F. 60- 90 Mc/s	L2.3.5		3
C834203	90-120 Mc/s	L2.3.5	3	
C834201	120-174 Mc/s	L2.3.5	3	
C834210	Coil R.F. 60- 90 Mc/s			1
C834204	90-120 Mc/s	L4	1	
C834202	120-174 Mc/s		1	
A833511	Coil $7\frac{3}{4}$ Turns	L8		1
A833512	Coil $4\frac{3}{4}$ Turns	L8	1	
C834256	Coil R.F. 60- 80 Mc/s			1
C834255	80-100 Mc/s	L10		1
C834254	100-174 Mc/s		1	
C834220	Coil R.F. 60- 70 Mc/s			1
C834219	70- 80 Mc/s			1
C834218	80-100 Mc/s	L11		1
C834217	100-130 Mc/s		1	
C834216	130-174 Mc/s		1	
C834215	Coil R.F. 60- 70 Mc/s			1
C834259	70- 80 Mc/s			1
C834258	80-100 Mc/s			1
C834238	100-115 Mc/s	L13	1	
C834257	115-147 Mc/s		1	
C834235	147-174 Mc/s		1	
C834243	Coil R.F. 60- 70 Mc/s			1
C834242	70- 80 Mc/s			1
C834241	80-100 Mc/s			1
C834239	100-115 Mc/s	L14	1	
C834237	115-147 Mc/s		1	
C834236	147-174 Mc/s		1	

DRG OR STOCK No.	DESCRIPTION	CIRCUIT REF:	QUANTITY PER UNIT A	B
A821957	Choke R.F.	L6, 12, 15, 17	4	4
C834253	Coil R.F. 100-115 Mc/s		1	
C834247	115-130 Mc/s		1	
C834246	130-147 Mc/s	L16	1	
C834243	147-160 Mc/s		1	
C834242	160-174 Mc/s		1	
A833647	Assy. of Osc.(TX)	L18	1	1
A813171	Coil	L19	1	1
B833601	Assy. of 1st I.F. Txfr. 60-120 Mc/s	T1.2		2
B833602	Assy. of 1st I.F. 120-174 Mc/s		2	
B833495	Assy. of 2nd I.F. Txfr.	T3, 4, 5, 6, 7	5	5
C813099	Mod. Output Transformer	T8	1	1
C813100	Microphone Transformer	T9	1	1
B833641	RX. Osc. Coil 60- 74 Mc/s			
B833642	RX. Osc. Coil 74- 90 Mc/s			
B833641	RX. Osc. Coil 90-105 Mc/s	T10(Includes R400 and C71)	1	1
B833642	RX. Osc. Coil 105-138 Mc/s			
B833643	RX. Osc. Coil 138-174 Mc/s			
A833596	Relay (Ae)	RLA-1	1	1
B833599	Relay	RLB-1	1	1
B833568	Switch off. Rec. Stand-by P.A.	SW1	1	1
B833567	Switch (For crystal channel)	SW2 (TR821/5 only)	1	1
A822846	Switch On/Off	SW3	1	1
WC63218	Rectifier	D1, 3, 4	3	3
A833569	Loudspeaker	LS1	1	1
A833600	Crystals No. off according to channels	XL1-10	1-10	1-10
A803265	Crystal Holder		10	10
12592/95	Valve EF95	V1	1	1
12592/91	Valve EF91	V2, 3, 15	3	3
12592/92	Valve EF92	V4, 5, 6	3	3
12593/91	Valve EAC91	V7	1	1
12591/3	Valve EL91	(A.B)V8, 9.(A)V14	3	2
12988/2	Valve 6U8 or ECF82	V10	1	1
12590/81	Valve ECC81	V11	1	1
12797/3	Valve QQV03-10	(A.B)V12(A)V13	2	1
12591/85	Valve EL85	(B)V13		1
D833465	Rack R804A (Quick-Release)		1	1
A821494	Valveholder B9A	For V12, 13	2	2
A821338	Valveholder B7G	For V1, 2, 3, 4, 5, 6 7, 8, 9, 15.(A)V14	11	10

ANCILLARIES

DRG OR STOCK No.	DESCRIPTION			QUANTITY
	Type	Freq. Mc/s	Length	
A834089	AE813/A	60- 65	41.5"	
A834090	AE813/B	65- 70	37.5"	
A834091	AE813/C	70- 75	34.5"	
A834092	AE813/D	75- 80	32"	
A834093	AE813/E	80- 85	30"	
A834094	AE813/F	85- 90	28"	
A834095	AE813/G	90- 95	26"	
A834096	AE813/H	95-100	24"	Max. 1
A834097	AE813/J	100-110	22"	
A834098	AE813/K	110-120	20"	
A834099	AE813/L	120-130	18"	
A834100	AE813/M	130-140	16.25"	
A834101	AE813/N	140-150	14.5"	
A834102	AE813/P	150-160	13.25"	
A834103	AE813/Q	160-170	12.25"	
A834104	AE813/R	170-175	11.5"	
A834115	Aerial Base			1
D833546	Aerial Coupling Assy.			1
A833544	Coupling			1
A834117	Connector Ae. 7'6"			
A834118	Connector Ae. 12'0"			Max. 1
A834119	Connector Ae. 18'0"			
B830398	Socket 6 way for cable connectors			Max. 1
B833666	Connector (Battery) 12/24V			Lgth A/R
B833667	Connector (Battery & LS812) 12/24V			Lgth A/R
B833668	Connector (Battery) 6FT.STD. 12/24V			Max. 1
B833669	Connector (Battery & LS812) 12/24V 6 FT.STD.			Max. 1
B834109	Connector (TR to PU) 9" STD.			Max. 1
B834110	Connector (TR to PU) 24" STD			Max. 1
A833462	Loudspeaker LS812			Max. 1
1442/1	Cable Twin 14/.0076" Blk/Red (For LS installation)			A/R
1572/15	Cable Twin 110/0076 .025 R/T			A/R
D839250	Microphone Hand M306			Max. 1
D839240	Bracket Assembly for M306			Max. 1
1717/1	Cable Co-axial Telcon. AS. 93M			A/R

EQUIPMENT MODIFICATION LEAFLETS.

The Equipment Modification Leaflets issued periodically by Murphy Radio Ltd., are designed to provide information on recommended modifications to your equipment. These are classified, according to the degree of importance attached to the modification, as follows: "MANDATORY"; "ESSENTIAL"; "DESIRABLE"; "OPTIONAL".

Due to the fact that the Equipment Modification Leaflets cover recommended modifications to all radio-telephone equipments, it is recommended that this sheet, followed by the modification leaflets, should be inserted as a separate section at the end of the book and not, in the case of a composite manual, after the section for a particular equipment.

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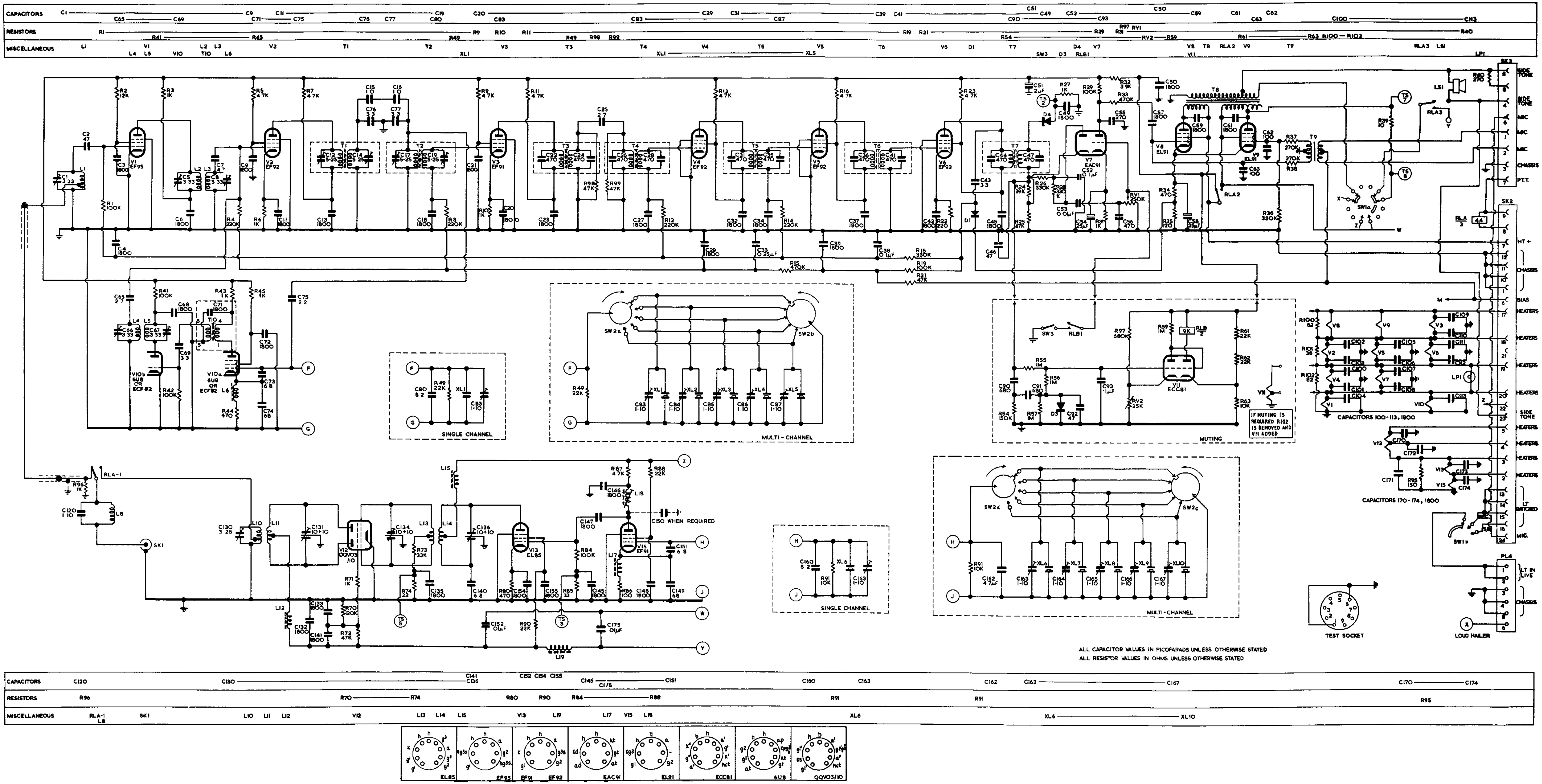
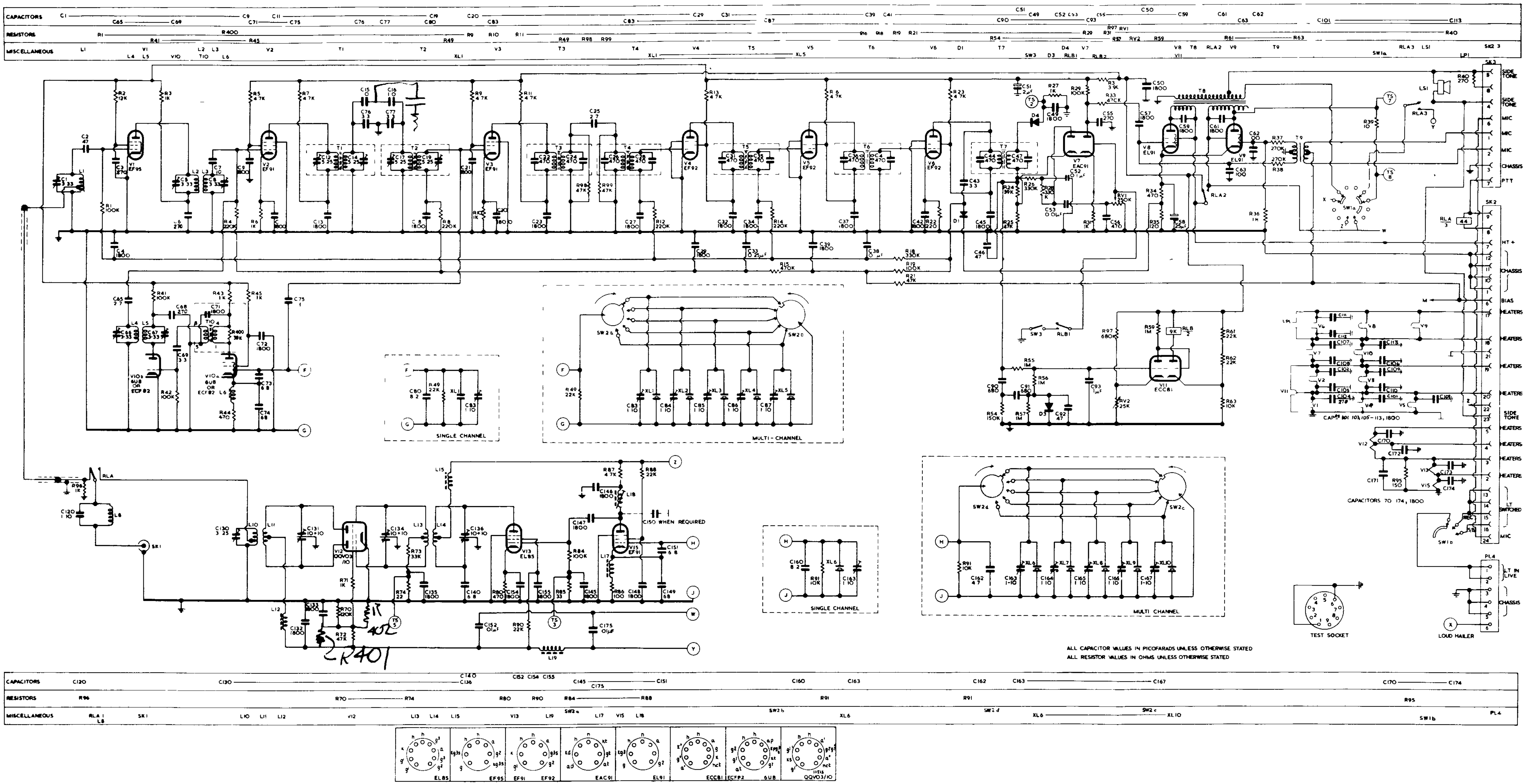


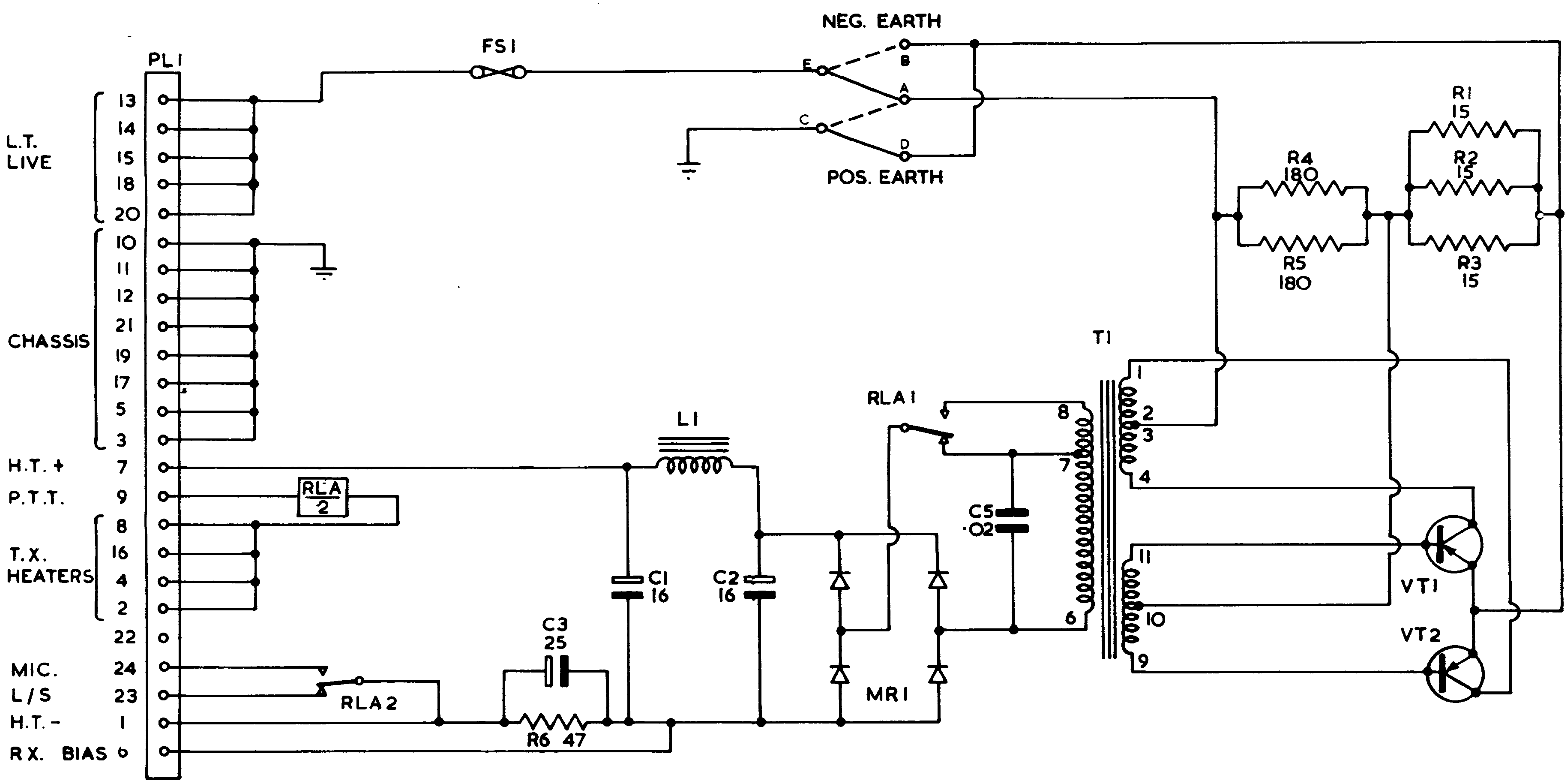
TR821/L (Low Band) E843527 FIG. 1

1160



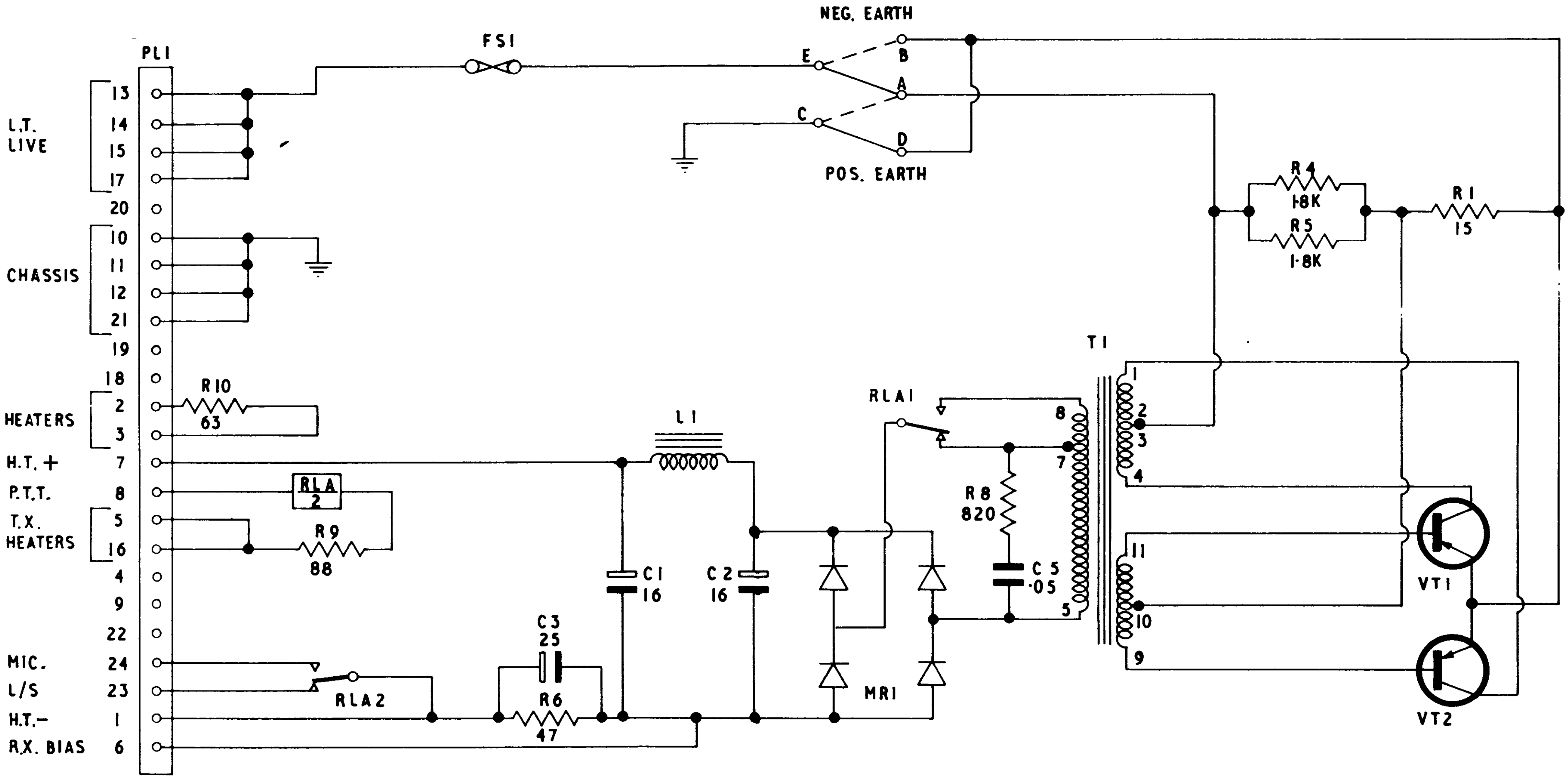
TR821/25 (Low Band) E843527

CAPACITORS		C3	C1	C2		C5			
RESISTORS	R7	R6						R4 R5	R1 R2 R3
MISCELLANEOUS		FS1	L1		MR1		T1		VT1 VT2

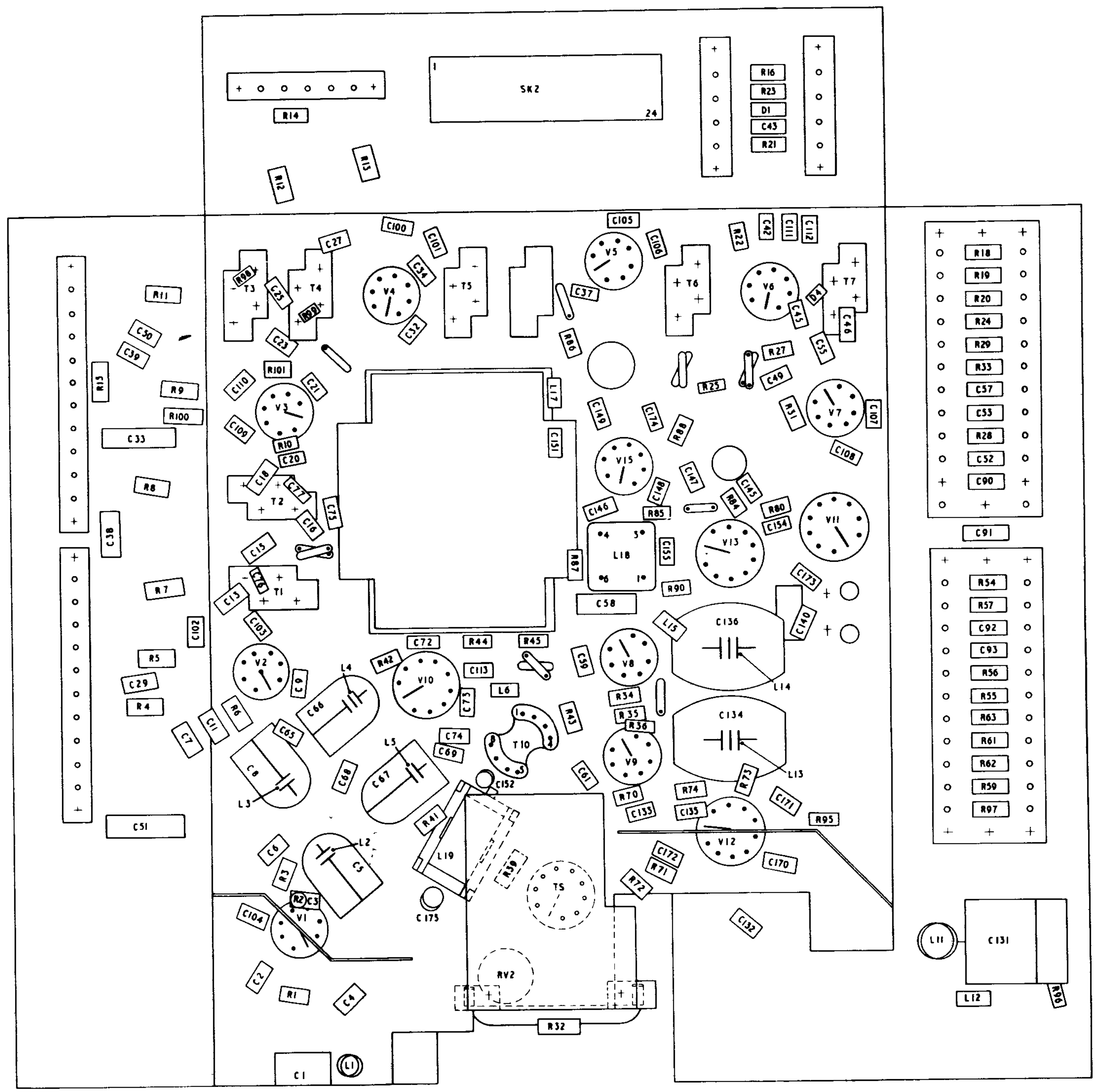


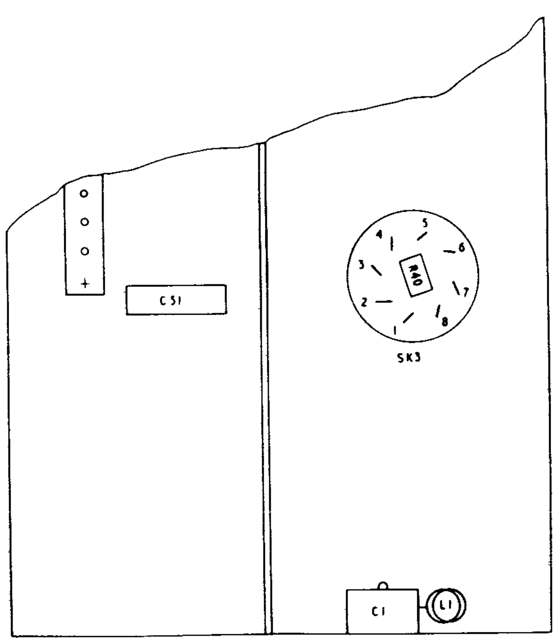
ALL RES. IN OHMS UNLESS OTHERWISE STATED
ALL CAPS IN MICROFARADS UNLESS OTHERWISE STATED

CAPACITORS	C3 C1 C2 C5
RESISTORS	R10 R9 R7 R6 R8 R4 R5 R1
MISCELLANEOUS	FS1 L1 MR1 T1 VT1 VT2

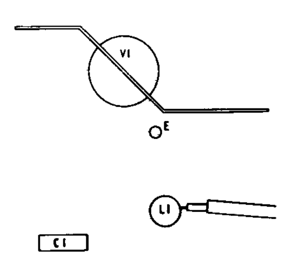


UNLESS OTHERWISE STATED,
ALL RES. IN OHMS.
ALL CAPS IN MICROFARADS.

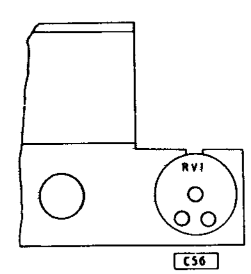


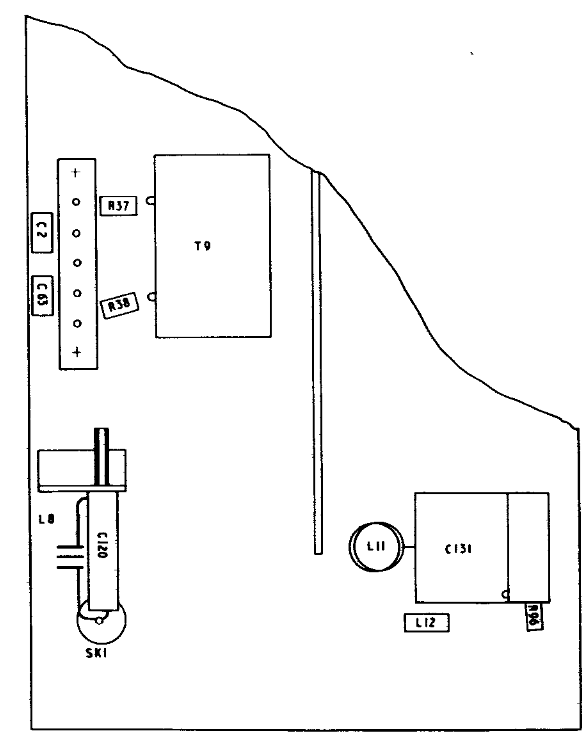


SCRAP VIEW OF SIDE PANEL SHOWING LOWER PART



SCRAP VIEW EARTHING OF C1 L1 & SCREENED LEAD

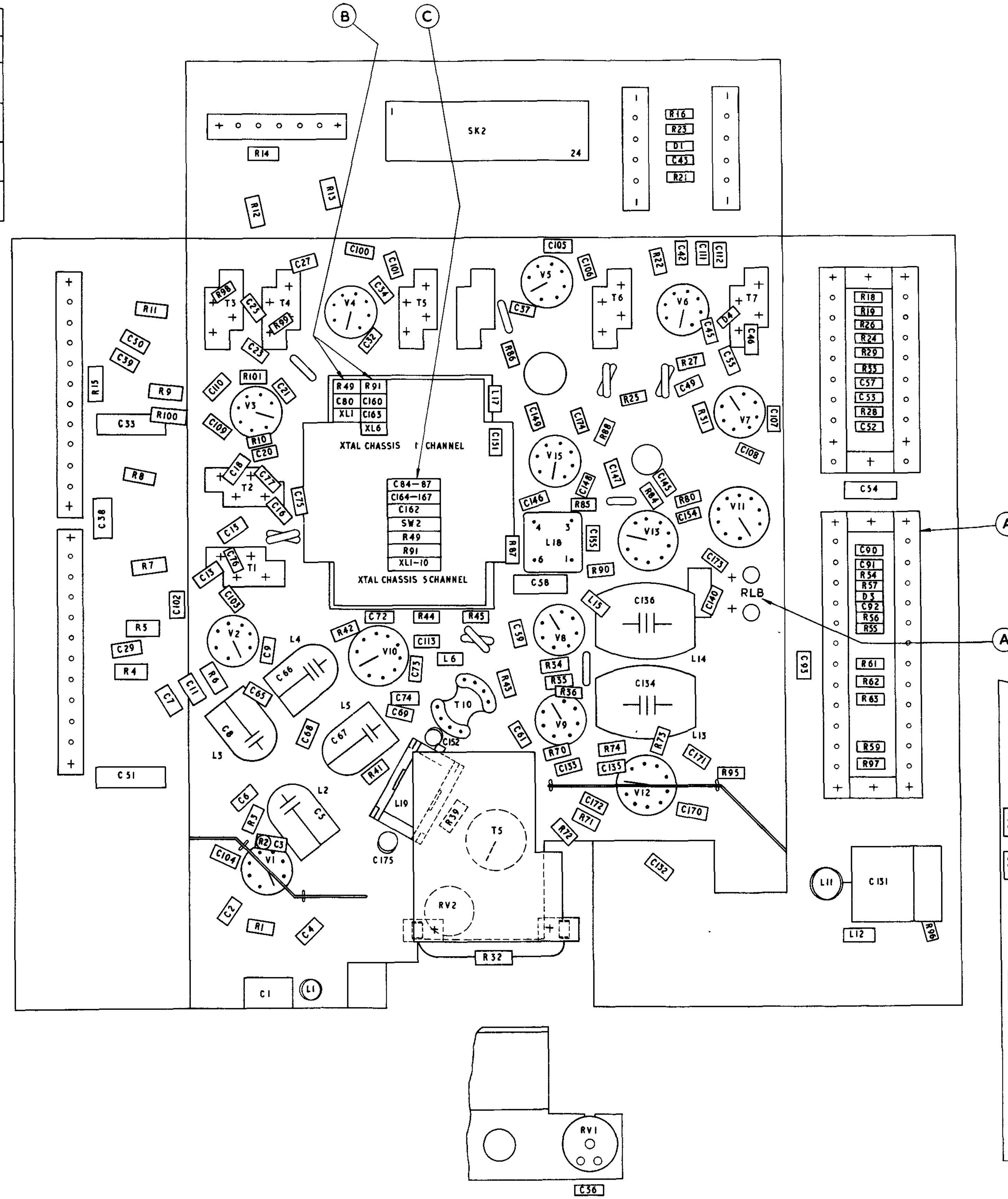


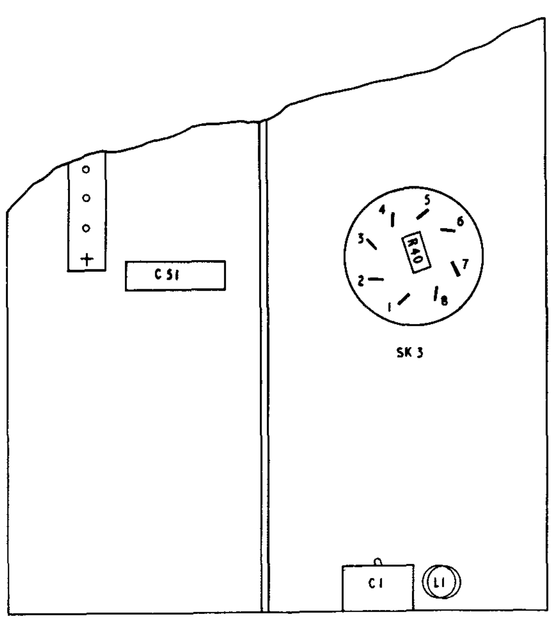


SCRAP VIEW OF SIDE PANEL SHOWING LOWER PART

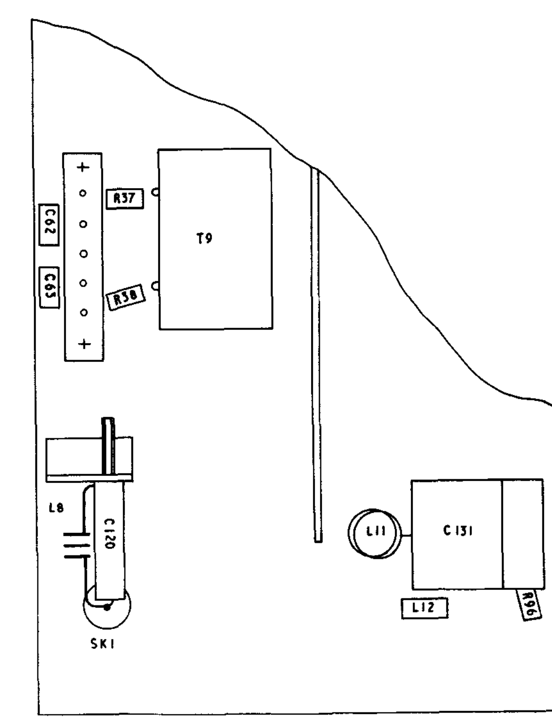
TR821/L COMPONENT LAYOUT (Low Band)

	LEGEND		
	A	B	C
TR821/L/1		R49 R91 C80 C83 C160 C163 XL1 XL6	
TR821/L/5			C84–87 R49 R91 C162 C164–167 SW2 XL1-10
TR821/L/1M	R54–57 R59 RV2 R61–63 C90–93 R97 SW3 D3 RLB	R49 R91 C80 C83 C160 C163 XL1 XL6	
TR821/L/5M	R54–57 R59 RV2 R61–63 C90–93 R97 SW3 D3 RLB		C84–87 R49 R91 C162 C164–167 SW2 XL1–10



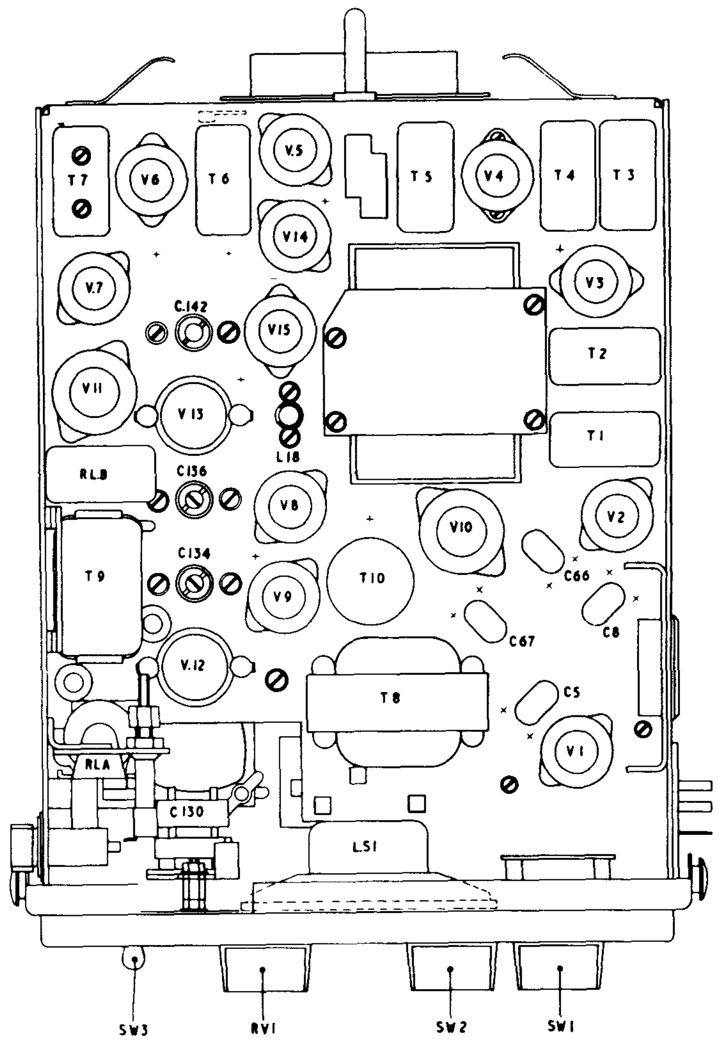


SCRAP VIEW OF SIDE PANEL SHOWING LOWER PART

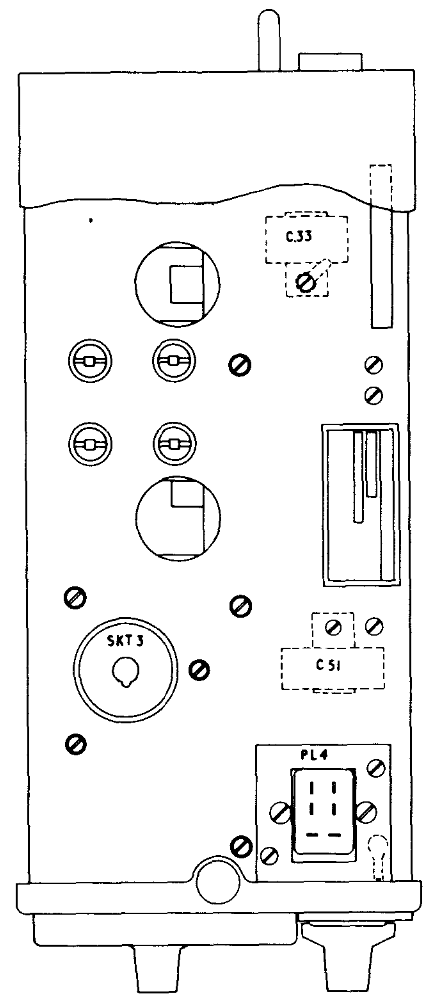


SCRAP VIEW OF SIDE PANEL SHOWING LOWER PART

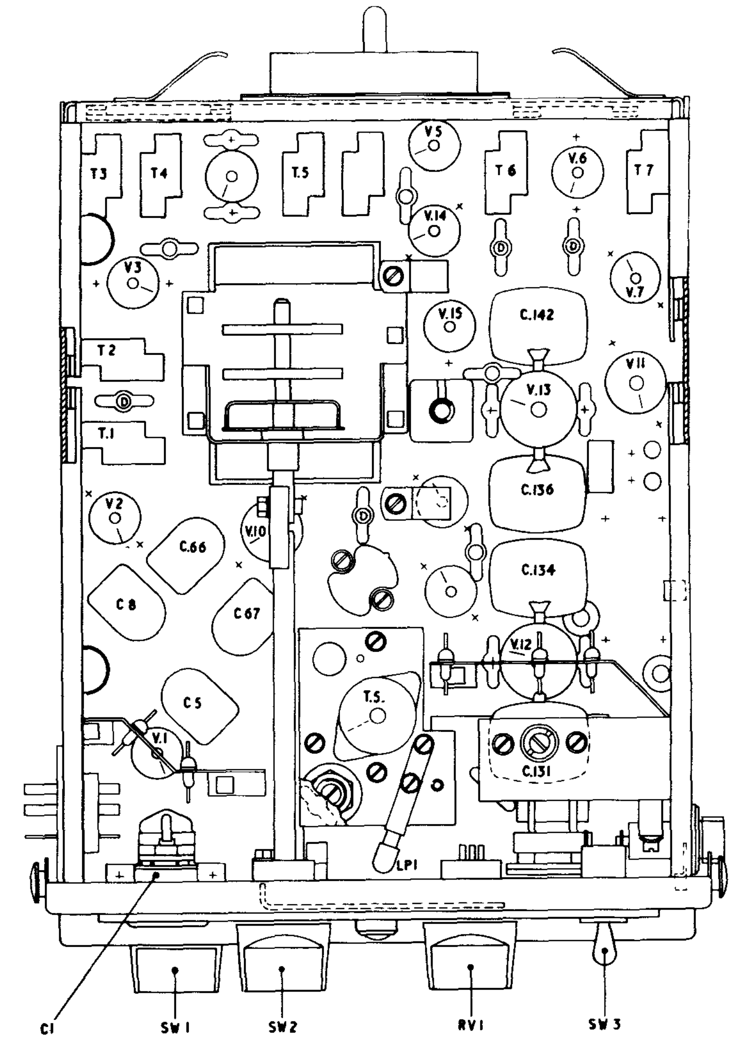
TR821/L COMPONENT LAYOUT (LOW BAND) FIG. 5



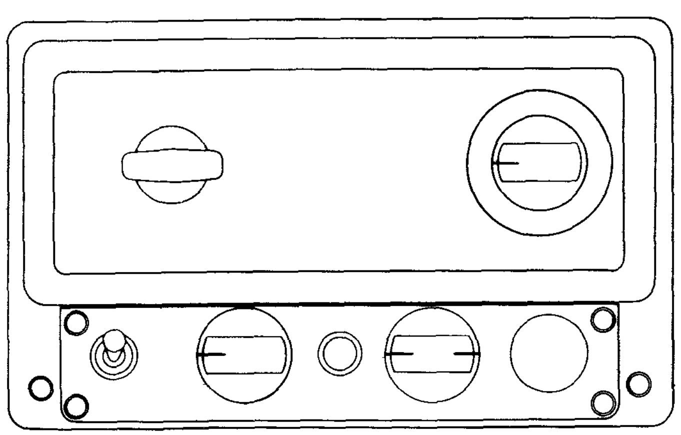
UPPER VIEW



RIGHT HAND VIEW



LOWER VIEW



FRONT VIEW

TR821 TOP VIEW (HIGH AND LOW BAND)

SUPPLEMENT 4.

TEST METER MR510

1. GENERAL DESCRIPTION.

1.1. The Test Meter MR510 is intended for use during installation tests and when re-alignment of the transmitter units of the MR806, MR820 and MR920 become necessary, both procedures being described fully in the relevant equipment handbook.

2. FACILITIES.

2.1. The Test Meter MR510 is portable and compact, being housed in an attractively styled metal case. It incorporates a micro-ammeter with the necessary double bank switch and associated switching circuits. The 500uA meter is employed to indicate the current readings at various points in the transmitter circuit, and a 470pF capacitor is included to complete the r.f. path for the detector circuit.

2.2. A telescopic aerial is employed to provide variable sensitivity on position 'R' of the switch to enable radiation from the transmitter to be checked, and a high impedance telephone receiver can be plugged into the jack socket (JK1) to enable an aural test of the transmitter modulation to be made.

2.3. The following table shows the meter indication for all positions of the selector switch-

PSN	METER INDICATION			
	MR806/L	MR806/H	MR820/L MR920/L	MR820/H MR920/H
1	Receiver detector diode current	Receiver detector diode current	Receiver detector diode current	Receiver detector diode current
2	Grid current V203, buffer amplifier	Grid current V203, frequency doubler	Grid current V13, frequency tripler	Grid current V14, frequency doubler
3	Grid current V202 frequency tripler	Grid current V202 frequency tripler	---------------- ----------------	Grid current V13 frequency tripler
4	Power amplifier grid current	Power amplifier grid current	Power amplifier grid current	Power amplifier grid current
5	Power amplifier cathode current	Power amplifier cathode current	Power amplifier anode and screen current	Power amplifier anode and screen current
'R'	In this position, the transmitted signal is picked up by the telescopic aerial, rectified by the diode MR1, and fed to the meter. The audio component of the rectifier signal is fed to the telephone jack to provide the monitor facility.			

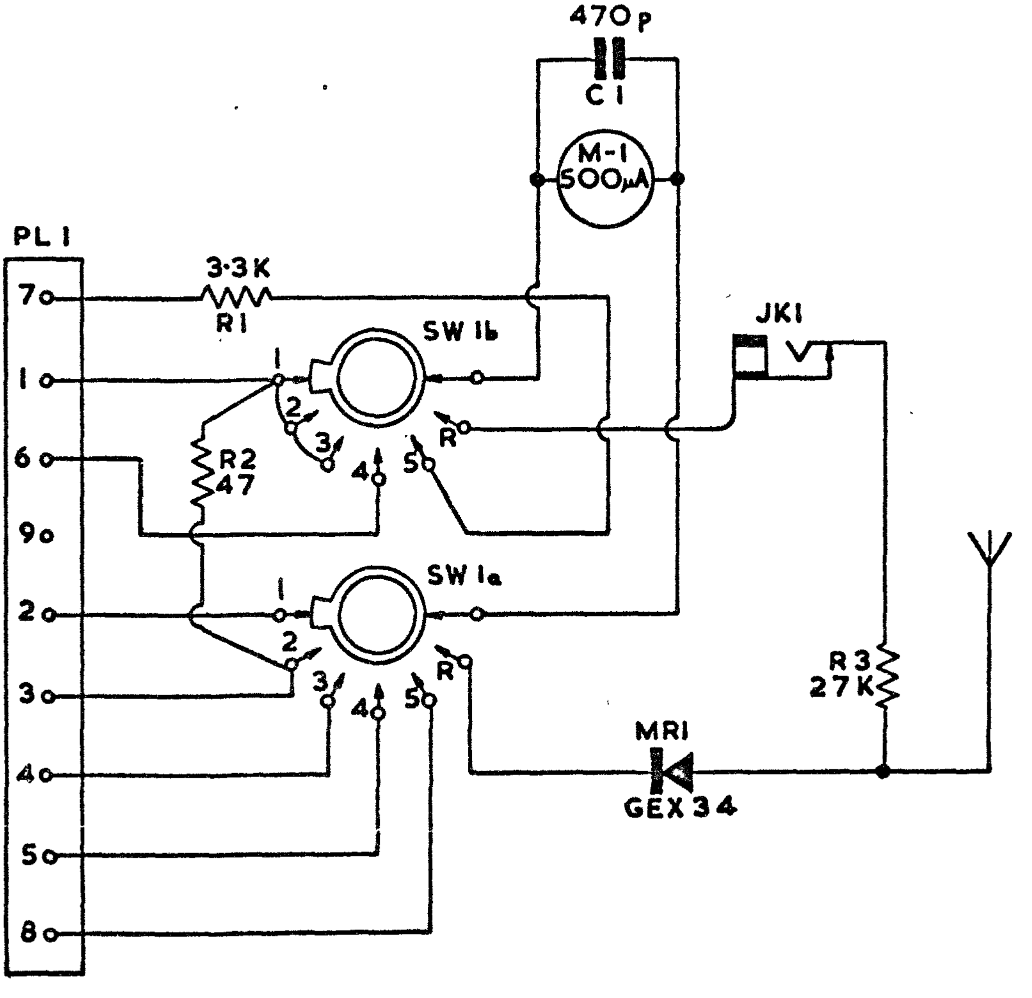
3. INSTALLATION.

3.1. Connection of the Test Meter MR510 to the transmitter unit is made by means of a multicore cable terminating in a 9 pin plug (PL1) which fits into the B9A test socket on the transmitter unit chassis. This socket is situated on the underside of the chassis of the TR821 and TR921, and on the side of the TR807 chassis.

TEST METER MR510.

SPARES SCHEDULE.

DRG. OR STOCK No.	DESCRIPTION	CIRCUIT REF.	QUANTITY
J.024421	Res. Fixed 47ohms 10% ¼W.	R2	1
XC.50480	Res. Fixed 3.3Kohms 1% ¼W.	R1	1
J.025477	Res. Fixed 27Kohms 10% ¼W.	R3	1
WC.52188	Cap. Fixed 470pF 20% 350VW.	C1	1
WC.63218	Rectifier GEX34	MR1	1
A.823159	Plug 9 way free	PL1	1
B.839135	Switch	SW1	1
B.845630	Meter	M1	1
A.823142	Jack	JK1	1



CIRCUIT DIAGRAM. TEST METER MR510. A838707.

SUPPLEMENT 7.

RADIO INTERFERENCE SUPPRESSION.

1. GENERAL.

1.1. For high quality reception when using mobile radios, effective suppression is essential. Interference-free reception is only possible if the received signal is several times stronger than the interference level. This requirement is impeded by the nearness of the strong source of interference, the variation of the distance between transmitter and receiver, and the low siting of the aerial, so anti-interference measures must be extremely efficient. Thorough suppression of interference can be achieved by means of anti-interference components, known collectively as suppressors; these suppress the undesirable signal directly at the source, thus avoiding its radiation.

1.2. Interference is caused by three groups of automobile electrical equipment, namely ignition, charging circuits, and auxiliary items such as windscreen wipers, electric clocks, etc.

2. IGNITION SYSTEMS.

2.1. Radio interference is radiated by the sparking plugs and is a high level "splashing" noise which occurs everytime a discharge takes place. It can be reduced by fitting ignition resistors which are guaranteed to maintain electrical and mechanical stability despite adverse underbonnet operating conditions, including severe electrical stressing due to high tension voltages, extremes of heat and vibration and possible contamination by petrol, oil or water.

2.2. Just as the sparking plug, the distributor is a source of interference, due to the fact that the rotor is in a non-conducting connection with the segments, so that the current has to bridge the air-gap. The rotor electrode brush in the moulded cap of most jump-spark distributors produced since 1951 is made of a specially resistive carbon compound and so serves as a resistor in the coil-to-distributor cable. (These brushes are not interchangeable with non-resistive brushes). When necessary further suppression is achieved by fitting ignition resistors in the plug cables (Fig. 1). Resistors should be located as near as possible to the points of sparking, i.e., closely adjacent to the sparking plugs.

2.3. Resistors of 5000 $\pm$ 1000 ohms are available to provide additional suppression at the distributor (Fig. 2). Their use will usually be found necessary in vehicles carrying VHF receivers. Interference due to radiation from incoming and outgoing cables is suppressed at the source. The suppressor has been given such a resistance that the sum of input and output resistance of the distributor does not exceed 10000 ohms. Resistors of the 5000 ohm value should also be used when suppressing cables in the Lucas range of camshaft speed magnetos. As a general rule, the resistive suppression of magneto plug cables should be carried out with resistors of the standard value unless unusually high engine speeds are involved, when the lower value resistors should be used.

2.4. It should be noted in passing that ignition resistors do not impair engine performance but can, in fact, lead to increased plug life.

2.5. Interference from the ignition low tension circuit can be reduced by connecting a 2μF capacitor between ignition coil terminal SW and earth, using the appropriate terminal strap according to coil case diameter (Fig. 3). This is, of course, in addition to the treatment of high tension circuits with the appropriate ignition resistors. Feed through suppression capacitors are most effective for low tension suppression. The difference between the use of these capacitors and that of the conventional type is that the supply current from the source of interference is passed through the central pin of the capacitor. One side of the central pin is connected to the source of interference, and the other side to the supply cable. Interference is thus prevented from reaching the supply cable except by the capacitor. The latter, having a very low impedance with respect to earth for interference, gives adequate suppression. For fitting capacitors, the following points must be observed:

(a) Before connecting the capacitor to the source of interference, disconnect the original cable.

(b) Keep the connection from the top of the capacitor to the source of interference as short as possible.

(c) Slide the fastening bracket as far as possible downwards and earth it as near as possible to the source of interference (after removal of any paint).

(d) Connect the original supply cable to the LOWER end of the capacitor.

(e) Keep the leads from both ends of the capacitor as far apart as possible to prevent induction of interference voltages in the supply leads.

(f) The capacitor should always be fixed to the same metal part of the car as the source of interference; e.g. do not mount the ignition-coil capacitor on the bulkhead if the ignition coil is mounted on the engine.

(g) Never fit a 2μF capacitor at places where a 0.5μF capacitor is indicated.

3. CHARGING CIRCUITS.

3.1. Interference from the dynamo can be recognised as a whine or growl which varies in pitch with engine speed. The remedy is to connect a 0.5μF capacitor between the generator output terminal "A" and earth (Fig. 4). The "A" or armature terminal is usually bigger than the "F" or field terminal, and the capacitor must NEVER be connected to the latter.

3.2. Interference emanating from the voltage regulator can be recognised by periods of continuous crackle and is caused by normal regulator action. This interference can only be eliminated or reduced by electrical filtering and no attempt should ever be made to remedy it by the indiscriminate fitting of capacitors or by tampering with the regulator contacts. Compensated voltage control boxes are available in which suitable filter circuits are incorporated.

3.3. Screened and suppressed current-voltage control boxes, incorporating feed-through capacitors are available from Messrs. J. Lucas Electrical Ltd. They are effectively suppressed over a wide band of frequencies - at least 0.2 to 200 Mc/s. Suppression of the associated dynamo is also effected in the control box and fully screened connections are therefore required between the two components.

4. AUXILIARY ELECTRICAL EQUIPMENT.

4.1. A whining interference from motor driven components such as windscreen wipers, heater fans or screen jets can be reduced or eliminated by connecting a capacitor between the insulated supply terminal of the offending component and earth.

In some circumstances a series choke may also be required.

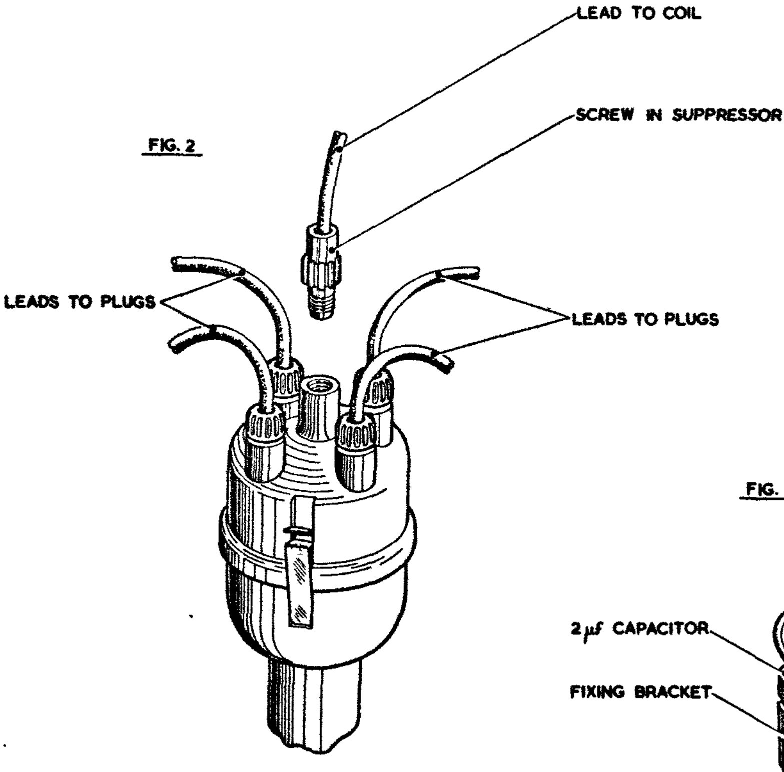
4.2. Interference from electric clocks, temperature gauges and petrol-level gauges, etc., produce interference similar to that from the voltage regulator. It can be suppressed by using a capacitor and choke as above.

5. GENERAL.

5.1. It is recommended to apply the various measures given in these instructions directly from the start, since it takes a great deal of time to investigate the necessity of each particular provision separately. Suppression of interference in separate stages costs more time and money than the direct installation of the anyway necessary components. If, after these measures have been taken, interference still persists, which is not due to faulty mounting, siting or connections of the suppressor, then contact the Electronics Service Department of Murphy Radio Limited.

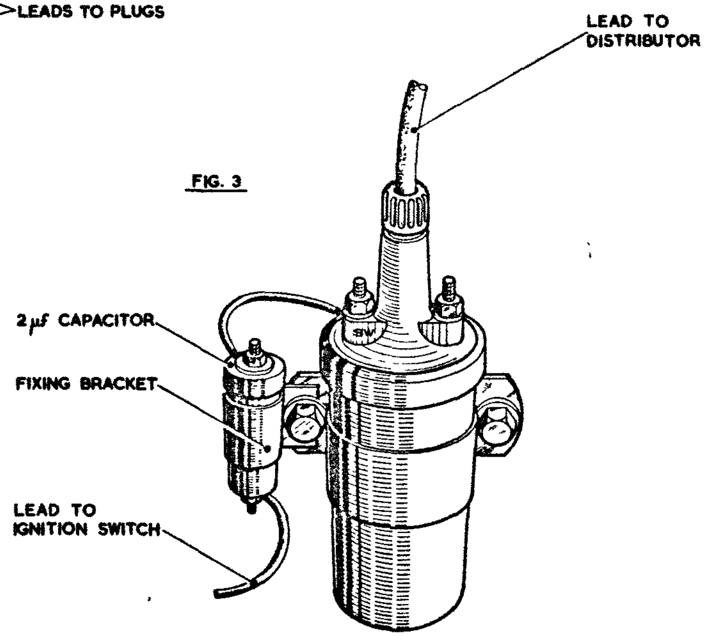
FIG. No.	STOCK No.	DESCRIPTION OF SUPPRESSOR
1	605031	Screw in resistor to suppress coil-to-distributor cable from vertical outlet.
2	605031	Cut lead resistor to suppress coil-to-distributor cable from horizontal outlet or distributor to plug cables or coil-to-distributor cables on camshaft speed magnetos.
3	855352	2μF feed through capacitor to suppress interference from ignition coil on L.T. side.
4	855353	0.5μF feed through capacitor to suppress interference from generators, windscreen wiper motors, electric petrol pumps and heater blower motors.
-	839801	3 amp choke for use in conjunction with 0.5μF capacitor to suppress small electric motors.
-	839806	7 amp choke for use in conjunction with 0.5μF capacitor to suppress small electric motors. A 7 amp choke is only necessary on heavy duty blower motors and windscreen wipers.

FIG. 2



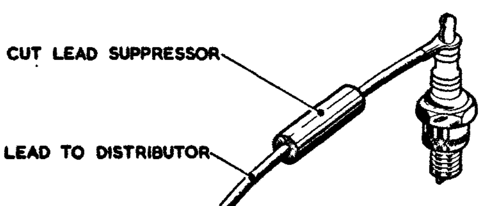
DISTRIBUTOR HEAD

FIG. 3



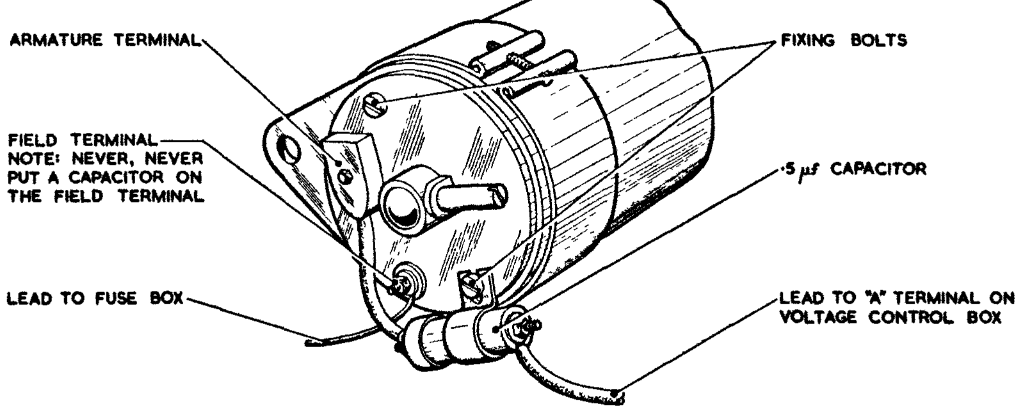
COIL

FIG. 1



SPARKING PLUG

FIG. 4



DYNAMO

SUPPLEMENT 9

CALCULATION OF CRYSTAL FREQUENCIES

For the calculation of crystal frequencies from the carrier or signal frequency the following applicable formula is used.

Fx = Crystal frequency in Mc/s
Fc = Carrier or signal frequency in Mc/s

RECEIVER

Fc	Fx FORMULA	
	25 kc/s	50 kc/s
60-90	$Fx = \frac{Fc - 0.98}{7}$	$Fx = \frac{Fc - 2.1}{7}$
90-174	$Fx = \frac{Fc - 0.98}{10}$	$Fx = \frac{Fc - 2.1}{10}$

TRANSMITTER

Fc	Fx FORMULA
	25 kc/s and 50 kc/s
60-100	$Fx = \frac{Fc}{6}$
100-174	$Fx = \frac{Fc}{12}$

SUPPLEMENT 10.

CRYSTAL CALIBRATOR TYPE XLC511

1. GENERAL DESCRIPTION.

1.1. The Crystal Calibrator Type XLC511 has been designed to provide a simple method of calibrating a signal generator to an accuracy of at least ±0.01% of the required frequency to enable the i.f. alignment of the Murphy range of V.H.F. Radio Telephones to be carried out.

1.2. Murphy V.H.F. Radio Telephones employ crystal controlled transmitters and receivers which operate with either 50 kc/s or 25 kc/s channel spacings, consequently the receivers require very accurate alignment procedures. It should, therefore, be noted, that when it is necessary to carry out i.f. alignment, the signal generator used must have an accuracy of ±0.01% of the required frequency. IN THE CASE OF THE FIXED 2ND I.F., ACCURATE SETTING UP TO THIS FREQUENCY IS ABSOLUTELY ESSENTIAL.

1.3. For purposes of this description, the Crystal Calibrator designed for use with 25 kc/s equipment is described here. The 50 kc/s model employs a 2.1 Mc/s crystal, while the 25 kc/s version uses a 980 kc/s crystal. The procedure in both cases is as described below.

1.4. The Crystal Calibrator XLC511 is housed in a small, well finished steel case.

2. CIRCUIT DESCRIPTION.

2.1. The circuit consists of a crystal controlled Colpitts oscillator (EF91), operating at the fixed 2nd i.f. of 980 kc/s. The output of this oscillator is fed to the receiver via a flexible lead provided with crocodile clips.

2.2. All power supplies for the unit are derived from the 1st r.f. stage (V101 in the case of the MR806 and V1 in the case of the MR820) of the receiver under test. This is done by removing V101 (V1) and plugging the B7G plug (PL1) provided on the XLC511 into the vacant valve base.

2.3. When PL1 is plugged into the vacant valve base, the heater supply for the oscillator valve V1 in the XLC511 is obtained from pins 3 and 4 on V1 in the receiver and applied to the same pins on the oscillator valve. The anode and screen voltages for the oscillator are supplied by pin 6 of the 1st r.f. valve base while pin 7 is earthed. Pins 1 and 5 of PL1 (control grid and anode pins of r.f. amplifier valve base) are connected via a blocking capacitor C4 which enables the calibration signal to be injected into the aerial. (See Fig. 1. overleaf).

3. SEQUENCE OF OPERATIONS.

3.1. For 2nd i.f. alignment :-

3.1.1. Insert appropriate crystal. (980 kc/s for 25 kc/s equipment, 2.1 Mc/s for 50 kc/s equipment).

3.1.2. Switch the signal generator on and allow at least one hour for the instrument to stabilize.

3.1.3. Set the signal generator to approximately 980kc/s modulated and inject the signal at the grid of the 2nd i.f. stage. Tune for maximum audio output.

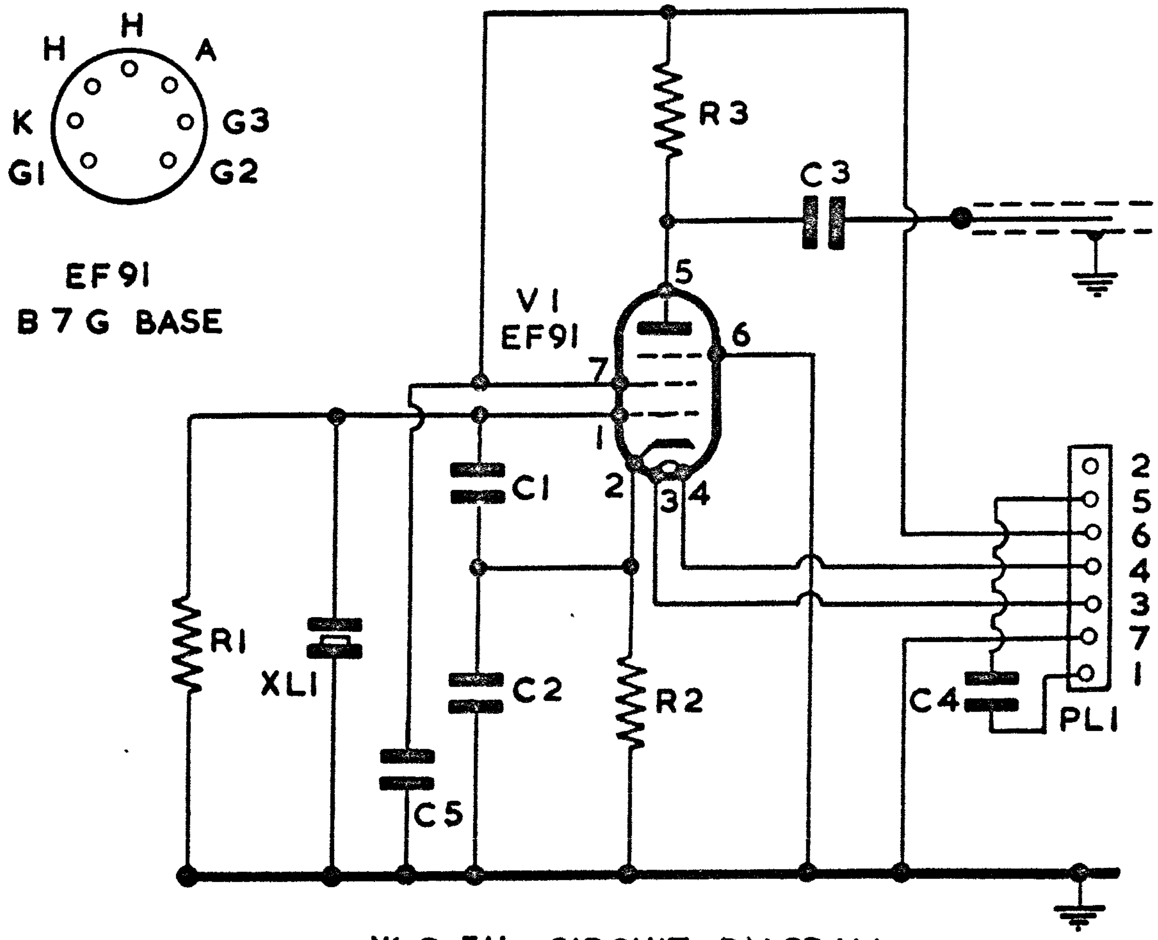
3.1.4. Switch off the modulation on signal generator.

3.1.5. Remove V1 (or V101) from the receiver and connect the Crystal Calibrator plug into the valve base of V1 and allow one minute to warm up. Clip the output lead of the Crystal Calibrator to the grid lead of the 2nd mixer V3 (or V103). This produces a heterodyne whistle in the receiver loudspeaker.

3.1.6. Tune the signal generator for zero beat.

3.1.7. The signal generator is now calibrated to 980kc/s to an accuracy of ±0.005%.

3.1.8. Disconnect the Crystal Calibrator power supply and output connectors, replace V1 (or V101) switch the modulation of the signal generator on and proceed with 2nd i.f. alignment as described in the equipment handbook. On completion of the alignment, re-check that the signal generator has remained on frequency.



XLC 511 CIRCUIT DIAGRAM

FIG. 1