SOLID STATE CARPHONE 25-M AND 10-M
SERIES J63830

HANDBOOK 1-63830R

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

Engineering Products Division

422 LANE COVE ROAD, NORTH RYDE, N.S.W.

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PART 1

INSTALLATION AND OPERATING INSTRUCTIONS

1. INTRODUCTION

The AWA Solid State Carphone Series J63830 is a frequency-modulated radio-telephone which fully complies with the requirements of the Australian Post Office for equipment employed in privately owned land mobile radio-telephone service.

2. IDENTIFICATION TABLE

P.M.G. Ident. Number	AWA Type Number	Frequency Range	Transmitter Output	Receiver Modulation Acceptance
25-M/1	1J63830	70- 85 MHz	25 W	5 kHz
25-M/2	2J63830	156-174 MHz	25 W	5 kHz
10-M/3	3J63830	70- 85 MHz	10 W	5 kHz
10-M/4	4J63830	156-174 MHz	10 W	5 kHz
25-M/61	61J63830	70- 85 MHz	25 W	15 kHz
25-M/62	62J63830	156-174 MHz	25 W	15 kHz
10-M/63	63J63830	70- 85 MHz	10 W	15 kHz
10-M/64	64J63830	156-174 MHz	10 W	15 kHz

NOTE: Throughout this Handbook, the terms "narrow band" and "wide band" are used to differentiate between equipment intended for 30 kHz channel separation and 60 kHz channel separation, respectively.

3. GENERAL DESCRIPTION

The transmitter/receiver unit is designed for underdash mounting and is completely self-contained. The microphone is permanently wired into the transmitter section via a coiled cord which is anchored to the case at the point of egress. The press-to-talk button is located in the microphone case.

The top and bottom covers of the transmitter/receiver case are secured at the rear by spigots and at the front by screws which enter floating nut plates on the moulded plastic front panel. Removal of these covers gives complete access to all preset components and test points in the transmitter and receiver sections.

Small components in the equipment are mounted above and below a horizontal shelf rivetted to the side and rear panels of the case. Three of the sub-assemblies are printed wiring boards, the fourth being a printed board-heat sink assembly. (The function of each sub-assembly can be found by referring the type numbers to the bounded areas on the circuit diagrams.)

Components not suitable for mounting on the printed boards are mounted on the underside of the tray. The loudspeaker is mounted on the front panel.

Connection to the aerial feeder is made via a coaxial connector at the rear of the case, this connector being an integral part of a low-pass filter the other side of which is connected to the aerial change-over relay.

The battery leads are located at the rear of the case, both leads being fused via polarised "in lead" fuse holders.

A socket for an extension loudspeaker (15 Ω) is mounted on the left hand side panel near the internal loudspeaker.

4. INSTALLATION KIT

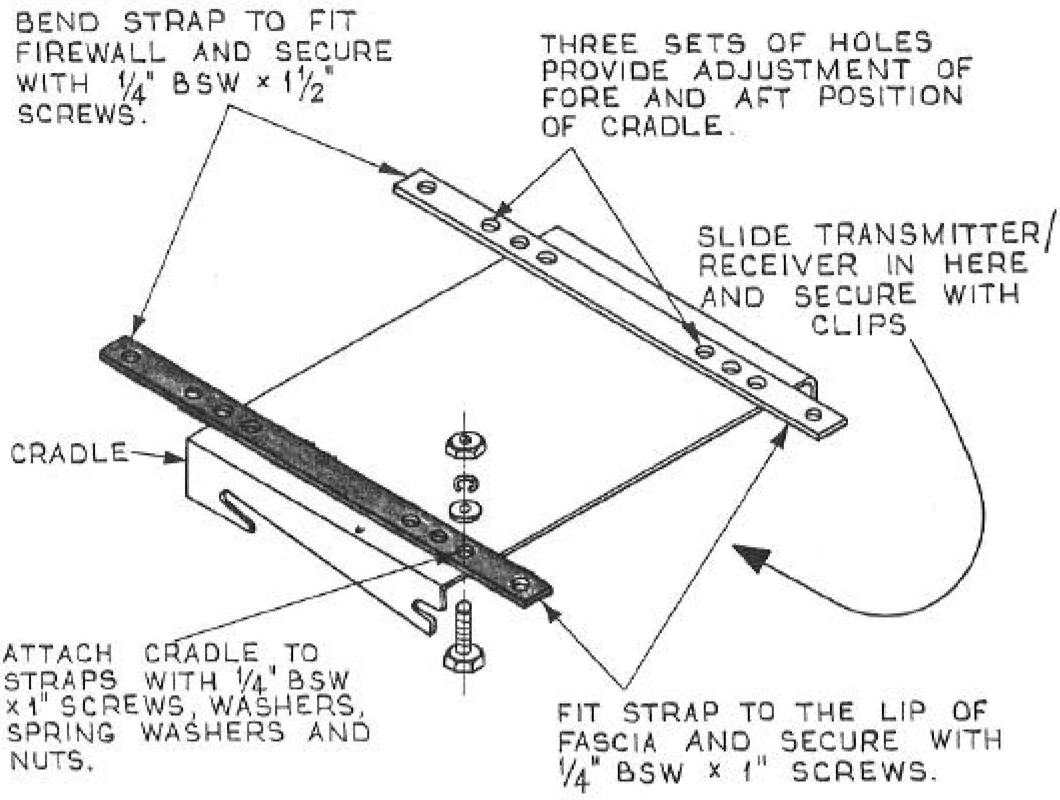
The installation kit contains the following items:

	Qty	Part or Code Number
Microphone Clip	1	211522
Mounting Cradle	1	63838X3
Cradle Strap	2	61968V14
Aerial Cable Assembly	1	63094V7
Battery Cable Assembly	1	63838V10
Fuse-link, Glass Cartridge, 10A	2	370074
Clamp, Utilux H250	6	208942
Clamp; Utilux H962	6	208101
Grommet Material, 3/8 inch	4	591062
Screw, No. 6 x 3/8 inch, Self Tapping	12	760374
Screw, 10-32 UNF x 3/4 inch, Pan Head, Steel	2	778452
Screw, Whitworth, 1/4 x 1 inch, Hexagon Head, Steel	6	746732
Screw, Whitworth, 1/4 x 1.1/2 inches, Hexagon Head, Steel	2	746748
Nut, 10-32 UNF, Steel	2	493490
Nut, Whitworth, 1/4 inch, Steel	8	493981
Washer, 2 BA, Brass	2	921002
Washer, 2 BA, Lock, Internal Teeth	2	921212
Washer, 1/4 inch, Steel	8	921858
Washer, 1/4 inch, Spring	8	921658

5. LOCATION AND FITTING OF MOUNTING CRADLE

The location of the transmitter/receiver in the vehicle will be influenced by the type of vehicle and the requirements of the user, but the recommended arrangement is to fit the mounting cradle horizontally below the fascia panel in a position giving easy access to the operating controls.

Fitting details for the mounting cradle are shown in the sketch below.



INSTALLATION OF CRADLE

6. CABLES

The aerial cable is fitted with a coaxial connector and should be cut to the shortest practicable length after having been routed from the transmitter/ receiver to the aerial mounting hole.

The battery cable assembly is supplied completely fabricated and ready for installation. The cables should be connected directly to the BATTERY TERMINALS and any surplus length should be doubled back along the cable or formed into a neat coil and then secured to the firewall behind the fascia panel. If the battery cables are shortened by cutting at the battery end, solderless lugs should be refitted; cable fracture adjacent to the lugs may result from the use of soldered fittings.

Sufficient slack should be allowed in the aerial and battery cables to permit the transmitter/receiver to be removed from the mounting cradle for adjustments and "in vehicle" servicing.

CHECK CABLE POLARITY - RED IS POSITIVE

7. AERIAL

Mounting details for the aerial are supplied with the aerial kit.

The efficiency of the aerial is dependent upon the area, flatness, and horizontality of the surface on which it is mounted, best results being obtained when it is mounted at the centre of the metal roof or canopy of the vehicle. Siting at any other position on the vehicle, e.g. front deck, rear deck, or sun visor, will reduce the efficiency of the aerial and also upset the omni-directional characteristics. These two factors, either singly or in combination, will severely limit the radius of communication in certain directions.

The length of the aerial is governed by the operating frequency, but the theoretical length for a particular frequency can be modified by the configuration of the vehicle. When the aerial is centrally mounted on the roof or canopy of the vehicle, satisfactory results will be obtained if the aerial is cut to the length indicated on the Frequency versus Length nomogram supplied with the aerial. For multi-channel installations, the aerial should be cut to the middle frequency; for 2-frequency simplex installations, the aerial should be cut for the transmitter frequency.

Best results will be obtained when the aerial is cut to give minimum voltage standing wave ratio. If a v.s.w.r. meter is available, the aerial should be cut about an inch longer than indicated on the nomogram and then progressively shortened by one-eighth of an inch at a time until minimum v.s.w.r. is obtained. A ratio of not worse than 1.5 : 1 should be possible.

When the aerial is mounted at a position other than the centre of the roof or canopy, acceptable performance will be obtained only by cutting the aerial for minimum voltage standing wave ratio.

IMPORTANT: The vehicle must be well clear of any metallic structures when measuring the voltage standing wave ratio.

Should an existing aerial be used, the length should be verified before connecting the transmitter/receiver unit.

8. PREPARATION OF TRANSMITTER/RECEIVER FOR INSTALLATION

The transmitter/receiver will have been delivered in either of the following categories:

(i) Aligned and netted to the channel (or channels) specified by the customer.

(ii) Not aligned to any particular channel (or channels).

For units in the first category, only the transmitter power amplifier section may require adjustment. The procedure for determining whether adjustment is necessary follows in Sub-Section 8.1 (25 watts output) or Sub Section 8.2 (10 watts output) below.

NOTE: The procedures in Sub-Sections 8.1 and 8.2 require a wattmeter. If such an instrument is not available, the transmitter should be loaded into the installation aerial as described in Sub-Section 9.3 below.

Units in the second category will require complete alignment of the transmitter and alignment of the r.f. section of the receiver. The pertinent alignment procedures for such units will be found in Part 3, "Maintenance Instructions".

When checking the units as described in Sub-Sections 8.1 and 8.2 below it is essential that the battery supply voltage be 13.6 volts. If the unit is being supplied from the vehicle battery, the engine should be running at a speed equivalent to 30 miles per hour in top gear or at a speed which produces a "charge" indication on the vehicle ammeter.

8.1 Check of Transmitter Power Amplifier Section in 25-M Units

CAUTION: Excessive currents can flow in transistors that are incorrectly loaded; therefore the p.t.t. button should be operated for a minimum period when measuring the performance in step 3 below.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator (e.g. AWA Type 1M58052) to the aerial connector.

2. Connect a 0-100 μA meter (1 kΩ internal resistance) in series with a 3.9 kΩ resistor between:

   (i) test points 12 (+) and 11 on 70-85 MHz units, or
   (ii) test points 10 (+) and 9 on 156-174 MHz units.

3. Operate the p.t.t. button and check the power output and the meter reading. If the power output is not less than 20 watts and the meter reading is within the limits of 35-50 μA (low band) or 40-50 μA (high band), the unit can be installed without further adjustment; if the performance is not as stated, the power amplifier section must be realigned as laid down in Part 3, Sub-Section 11.3 or Sub-Section 11.4.

4. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

8.2 Check of Transmitter Power Amplifier Section in 10-M Units

CAUTION: Excessive currents can flow in transistors that are incorrectly loaded; therefore the p.t.t. button should be operated for a minimum period when measuring the performance in step 3 below.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator (e.g. AWA Type 1M58052) to the aerial connector.

2. Connect a 0-100 μA meter (1 kΩ internal resistance) in series with a 3.9 kΩ resistor between:

   (i) test points 11 (+) and 10 on 70-85 MHz units, or
   (ii) test points 9 (+) and 8 on 156-174 MHz units.

3. Operate the p.t.t. button and check the power output and the meter reading. If the power output is not less than 10 watts and the meter reading is within the limits of 40-60 μA (low band) or 40-65 μA (high band), the unit can be installed without further adjustment; if the performance is not as stated, the power amplifier section must be re-aligned as laid down in Part 3, Sub-Section 11.5 or Sub-Section 11.6

4. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

9. INSTALLATION CHECKS AND ADJUSTMENTS

When checking or adjusting the transmitter as laid down in Sub-Sections 9.1 to 9.3 below, it is essential that the supply voltage be maintained at the same level as during the pre-installation checking (or alignment). Refer to the paragraph immediately preceding Sub-Section 8.1 above for recommendations in this regard.

9.1 Transmitter Loading in Pre-Aligned 25-M Units

1. Connect the battery leads to the unit via the polarised "in-lead" fuses.

2. Connect the aerial to the unit via the same r.f. line voltage indicator used during the pre-installation checks (or alignment) of the transmitter.

3. Connect a 0-100 μA meter in series with a 3.9 kΩ resistor between the following test points on the transmitter power amplifier section.

   (i) Test points 12 (+) and 11 on 70-85 MHz units.

   (ii) Test points 10 (+) and 9 on 156-174 MHz units.

4. Operate the p.t.t. button and note the r.f. line voltage and the reading on the 0-100 μA meter. Compare these figures with the reference figures obtained during the pre-installation checks (or alignment) when the equipment was working into a wattmeter.

   If the line voltage is within ±20% and the meter reading is within ±5 μA of the reference reading, the aerial matching is satisfactory and no further adjustments are necessary.

   A line voltage within ±20% of the reference figure accompanied by a meter reading just outside the limits stated above indicates that the aerial is not correctly matched and necessitates slight adjustment of the transmitter output circuit. If the meter reading is too high, increase the loading capacitance (C25 low band, C23 high band) and then re-tune (C24 low band, C22 high band) until the meter reading is within tolerance consistent with highest line voltage; if the meter reading is too low, decrease the loading capacitance and then re-tune to obtain satisfactory performance.

   A departure of more than 20% in line voltage or a meter reading greatly outside the limits indicates that the aerial system is faulty and should be investigated for incorrect aerial length, open circuit, or short circuit.

5. Disconnect the test equipment.

9.2 Transmitter Loading in Pre-Aligned 10-M Units

1. Connect the battery leads to the unit via the polarised "in-lead" fuses.

2. Connect the aerial to the unit via the same r.f. line voltage indicator used during the pre-installation checks (or alignment) of the transmitter

3. Connect a 0-100 μA meter in series with a 3.9 kΩ resistor between the following test points on the transmitter power amplifier section.

   (i) Test points 11 (+) and 10 on 70-85 MHz units.

   (ii) Test points 9 (+) and 8 on 156-174 MHz units.

4. Operate the p.t.t. button and note the r.f. line voltage and the reading on the 0-100 μA meter. Compare these figures with the reference figures obtained during the pre-installation checks (or alignment) when the equipment was working into a wattmeter.

   If the line voltage is within ±20% and the meter reading is within ±5 μA of the reference reading, the aerial matching is satisfactory and no further adjustments are necessary.

   A line voltage within ±20% of the reference figure accompanied by a meter reading just outside the limits stated above indicates that the aerial is not correctly matched and necessitates slight adjustments of the transmitter output circuit. If the meter reading is too high, increase the loading capacitance (C21 low band, C14 high band) and then re-tune (C19 low band, C13 high band) until the meter reading is within tolerance consistent with highest line voltage; if the meter reading is too low, decrease the loading capacitance and then re-tune to obtain satisfactory performance.

   A departure of more than 20% in the line voltage or a meter reading greatly outside the limits indicates that the aerial system is faulty and should be investigated for incorrect aerial length, open circuit, or short circuit.

5. Disconnect the test equipment.

9.3 Transmitter Loading Using R.F. Line Voltage Indicator

When a wattmeter is not available, the transmitter power amplifier section can be aligned and loaded directly into an aerial of 50 Ω nominal impedance by using a r.f. line voltage indicator as an arbitary indicator of r.f. output.

The procedure is the same as laid down in Sub-Sections 11.3, 11.4, 11.5, and 11.6 of Part 3 except that the references to the wattmeter are read as references to the r.f. line voltage indicator. The adjustments should be repeated until either of the following states is reached:

(i) The collector current of the p.a. output stage reaches the following limits:

For 25-M 70-85 MHz Units:	40 μA
For 25-M 156-174 MHz Units:	50 μA
For 10-M 70-85 MHz Units:	45 μA
For 25-M 156-174 MHz Units:	45 μA

(ii) The r.f. line voltage shows no increase for an increase in the collector current of the p.a. output stage, i.e. tuning has reached the point of optimum efficiency. Because tuning must progress beyond the correct point to ensure identification of that point, it will be necessary to reduce the loading slightly (by increasing the output capacitance), re-adjust the p.a. tuning, and then carefully increase the loading to point of optimum efficiency.

10. NETTING

Units delivered from the factory or capital city depots will have been netted to assigned channel frequencies under the supervision of the relevant licensing authority and should not be altered. The following instructions are given solely to outline the procedures involved in netting.

10.1 Receiver Netting

Receiver netting is checked by observing the discriminator current on a 20-0-20 μA meter connected between pins 13 and 14 on the receiver r.f. - i.f. amplifier board whilst receiving a signal whose frequency is known to be accurately adjusted to the assigned channel frequency. If the meter reading is greater than ±2 μA, the appropriate trimmer should be adjusted to give a centre zero reading.

10.2 Transmitter Netting

Transmitter netting can be checked against a frequency counter of sub-standard accuracy or a correctly netted receiver. When using a receiver it is advisable to cross-check with another receiver in the system.

11. OPERATING INSTRUCTIONS

NOTE: The transmitter/receiver does not require any warm-up period and is ready for immediate use after switching on.

11.1 Receiving

1. Set the VOLUME control to mid-position.

2. Turn the MUTING control clockwise until a click indicates that the power switch has operated.

3. Adjust the VOLUME control for a moderate noise output.

4. Slowly advance the MUTING control until the noise output just ceases.

5. Select the desired channel.

11.2 Calling

1. Depress the button on the microphone case and speak into the microphone at a normal conversational level from a distance of approximately six inches.

2. Release the button when finished speaking otherwise the reply will not be heard. When the reply is heard, adjust the VOLUME control to the desired listening level.

11.3 Switching Off

The current drain of the receiver is such that failure to switch off will not result in a completely discharged battery overnight, however the partial discharge may cause difficulty in starting the engine particularly in low temperatures.

Because no pilot lamp has been provided (to reduce battery drain), it is recommended that a physical check of the power switch be made before vacating or garaging the vehicle.

End of Part

PART 2

TECHNICAL INFORMATION

1. SPECIFICATION

The Solid State Carphone satisfies the requirements laid down in P. M. G. (Aust.) Specification for Radio Equipment Employed in Privately Owned Land Mobile Service (Angle Modulated). Additional performance data are given below.

NOTE: The performance figures for the receiver and transmitter are valid for a supply of 13.6 volts.

1.1 General

Frequency Ranges:	70 MHz to 85 MHz or 156 MHz to 174 MHz
Number of Channels:	Up to six (maximum separation should not exceed 300 kHz)
Aerial Impedance:	50 ohms (unbalanced)
Supply Voltage:	12 V to 15 V d.c. (positive or negative active)
Current Drain:	
Receive:	80 mA (muted)
Transmit:	3.5 A for 25 W output 1.5 A for 10 W output
Dimensions:	10.6 x 3 x 9.5 inches (269 x 76 x 241 millimetres)
Weight:	7 lb 8 oz (3.4 kg)

1.2 Receiver

Type:	Double conversion superheterodyne with crystal-controlled oscillators.
First I.F.:	10.7 MHz

Modulation Acceptance:	±5 kHz (narrow band) or ±15 kHz (wide band)
Frequency Stability:	±0.0015% between -10 °C and +60 °C referred to actual frequency at 23 °C using "cold" crystal to AWA Specification 56046D97 (See also Sub-Section 1.4 below.)
Single Signal Selectivity:	
Narrow Band:	Less than 6 dB down at ±7.5 kHz and more than 60 dB down at ±15 kHz
Wide Band:	Less than 6 dB down at ±16 kHz and more than 60 dB down at ±30 kHz
Sensitivity:	Not less than 20 dB quieting for 0.8 μV input from 1 50 Ω source
Spurious Responses:	At least 80 dB below rated sensitivity
Signal-to-Noise Ratio:	Better than 24 dB (narrow band) or 34 dB (wide band) for signals of 0.8 μV deviated to full modulation acceptance by a 1 kHz tone
Muting:	The noise output level in the absence of signal is reduced by not less than 40 dB when the muting control is correctly adjusted. When the muting control is fully clockwise, the receiver will be unmuted by a fully deviated signal of 1 μV.
Audio Output:	3 watts (maximum)
Audio Distortion:	Less than 10% at 3 watts output
Audio Response:	Referred to 1 kHz, the response is +1±2 dB at 500 Hz falling to -10±2 dB at 3 kHz. (This response ensures good intelligibility.)
Power Consumption:	80 mA (muted) 800 mA (full output)

1.3 Transmitter

Power Output:	25 watts or 10 watts
Spurious Emissions:	Less than 2.5 μW

Frequency Stability:	Within ±0.0015% of assigned centre frequency between 0 °C and 60 °C (reference 23 °C) using "cold" crystal to AWA Specification 56046D63 (See also Sub-Section 1.4 below.)
Noise Level:	
Narrow Band:	Better than 45 dB referred to ±5 kHz deviation
Wide Band:	Better than 55 dB referred to ±15 kHz deviation
Modulation:	Phase; preset deviation control
Modulation Capability:	Modulation index of 12
Audio Response:	Within +1 to -3 dB of a 6 dB/octave (rising) characteristic from 500 Hz to 3 kHz
Audio Distortion:	Less than 10% for 1 kHz at ±5 kHz deviation
Microphone:	Variable reluctance; output level of approximately -40 dBm
Audio Clipping:	An audio peak clipper prevents the preset deviation from exceeding the specified limits of ±5 kHz or ±15 kHz. The clipper provides about 10 dB of clipping for normal speech levels.
Power Consumption:	
25 W Output:	3.5 A
10 W Output:	1.5 A

1.4 Crystal Frequencies

a. Receiver

For 70-85 MHz: Crystal Frequency = (Channel Frequency - 10.7 MHz) ÷ 2

For 156-174 MHz: Crystal Frequency = (Channel Frequency - 10.7 MHz) ÷ 4

b. Transmitter

Crystal Frequency = Channel Frequency ÷ 27

2. RECEIVER

The receiver consists of three main sub-assemblies, viz the input filter, the r.f. - i.f. amplifier printed board, and the audio amplifier and muting printed board. The r.f. - i.f. board is located in the upper part of the case with the other two sub-assemblies being located in the lower part.

2.1 Input Filter

The input filter exhibits band-pass characteristics and offers protection against interference from unwanted signals. The filter is tuned by adjustment of the slug in each of the three sections, correct adjustment of each slug being indicated by an increase in the current in the metering circuit of the first limiter stage.

Incorrect adjustment of the filter will bring about deterioration of quieting.

2.2 R.F. - I.F. Amplifier Board

The r.f. - i.f. board contains all the r.f. and i.f. circuits including the discriminator. For purposes of explanation the board will be considered in three parts, viz r.f. amplifier and first mixer, 10.7 MHz stages and second mixer, and limiters and discriminator.

a. R.F. Amplifier and First Mixer

A tuned-base/tuned-collector configuration is used in the r.f. amplifier (VT1) which is capacitively coupled to the first mixer (VT2). The injection signal for the mixer is derived from a crystal oscillator and multiplier.

The crystal oscillator (VT3) operates in the third overtone mode on specific frequencies in the vicinity of 30-40 MHz and feeds a multiplier (VT4) the output of which is fed via TR3 to the emitter of the first mixer. The multiplier functions as doubler in units for 70-85 MHz or as a quadrupler in units for 156-174 MHz and produces an injection signal 10.7 MHz below the signal frequency.

b. 10.7 MHz Section and Second Mixer

The 10.7 MHz output from the first mixer is fed via C34 to a crystal filter (Q1), correct terminating characteristics for the filter being provided by L5/C15 (reactive) and R22 (resistive). In the output circuit of the filter, TR4/C20 and R23 provide the correct terminating characteristics. The input and output characteristics vary with the type of filter and require different values for C34, R22, and R23. The values for these components for a particular type of filter can be found in a table on the circuit diagram.

The signal from the filter is fed via a tuned amplifier stage (VT5) to the second mixer (VT7) where it is heterodyned with a 10.245 MHz signal from the second oscillator (VT6) to produce the low i.f. signal at 455 kHz.

c. Limiters and Discriminator

The 455 kHz signal from the second mixer is amplified in VT8 and then passes through two limiter stages (VT9 and VT10) before being fed to a Foster-Seeley discriminator. Saturation of the first limiter occurs at an input signal level at the aerial connector of approximately 1 μV.

2.3 Audio Amplifier and Muting Board

The audio amplifier and muting board contains three audio stages and the muting circuit, the output from the board being fed to the Class B output stage (29VT1 and 29VT2) via a driver transformer (29TR1).

Audio signals from the discriminator are fed to the first audio stage (4VT1) via the VOLUME control, capacitors 29C8 and 4C1 providing the desired degree of de-emphasis. Muting of the loudspeaker is achieved by controlling a switching transistor (4VT4) in the emitter circuit of the audio driver (4VT3).

In the absence of signal, noise voltages from the discriminator are amplified in two cascaded noise amplifiers (4VT5 and 4VT6), the collector circuit of the second stage being broadly tuned to 10 kHz. The output from 4VT6 is rectified in a voltage doubler (4MR1, 4MR2) which is biased by a +ve voltage derived from the MUTING control. The voltage appearing at the output of the rectifier is the sum of the rectified noise voltage and the bias voltage and is sufficient to hold the switching transistor (4VT4) at cutoff.

When a signal is received, the diminution of the noise voltage permits conduction in the switching transistor thus unmuting the receiver. Circuit constants in the muting circuit are such that, when the MUTING control is set to the position giving maximum -ve bias (maximum clockwise rotation), an input signal level of approximately 1 μV at the aerial connector will unmute the receiver.

3. TRANSMITTER

The transmitter consists of two main sub-assemblies, viz the exciter-multiplier printed board and the r.f. power amplifier section. The exciter-multiplier board is located in the upper part of the case and the power amplifier section is located on the underside of the tray.

3.1 Exciter-Multiplier Board

Two types of exciter-multiplier board are used; type 2R63835 in 70-85 MHz units and type 3R63835 in 156-174 MHz units. The circuit configurations are similar, the main difference being an additional buffer stage in the type 3R63835 board.

The various circuits on the boards are described below.

a. R.F. Stages

The oscillator stage (VT5) operates in the fundamental mode at one twenty-seventh of the channel frequency and feeds a phase modulator.

In the modulator, audio signals are applied to a varicap (C25*) connected across the primary of TR1. The variations in the capacitance of the varicap caused by the audio signal produce a phase-modulated signal in the secondary of the transformer. The phase-modulated signal is then tripled in each of three multiplier stages (VT6, VT7, and VT8). In type 3R63835 boards a buffer stage follows the third multiplier.

* And C59 in 156-174 MHz units.

b. Audio Section

The audio section accepts the output of a variable reluctance microphone and includes a clipper and low-pass filter.

Speech signals from the microphone are amplified in VT2 and then pre-emphasised in C5 in the coupling circuit to the second speech amplifier (VT3). The second speech amplifier functions as a clipper on -ve peaks while the biased diode MR2 conducts on +ve peaks thus producing a symmetrically clipped waveform. This waveform is de-emphasised by C8 and then amplified in VT4 before being introduced into the modulator via the low-pass filter and the preset deviation control (RV1). The response above 3 kHz is sharply attenuated by the low-pass filter.

The clipper serves the dual purpose of preventing over-modulation and greatly increasing the average depth of modulation. The de-emphasis imposed by C8 attenuates the harmonic components in the clipped waveform.

The ultimate rising characteristic of the transmitter is evolved by the phase modulator.

c. Voltage Regulator

Regulation of the supply to the audio section and the oscillator is provided by a series regulator (VT1) in the supply +ve rail. The reference voltage for the regulator is obtained from a Zener diode (MR1).

3.2 R.F. Power Amplifier Section

The r.f. power amplifier section is built on a large heatsink which is insulated from the chassis. All components, with the exception of those in the first stage, are mounted on the heatsink; the first stage is assembled on a printed wiring board.

a. Power Amplifier in 25-M Units

The power amplifier sections for the 70-85 MHz and 156-174 MHz bands are of similar circuit configuration and consist of three cascaded Class C amplifiers driving a Class C output stage employing two transistors in parallel.

Because of the low Q of the tuned inter-stage coupling circuits and the inherent characteristics of transistors, the method of adjustment varies considerably from the methods employed in the adjustment of the tank circuits in valve Class C stages. Whereas in a valve tank circuit it is customary to tune for a dip in the anode current, these low Q coupling circuits are adjusted for a peak in collector current of the driven stage. In practice the stages are progressively adjusted in sequence until the desired power output consistent with permissible collector currents inall stages is obtained.

The procedures in Part 3 should be studied closely (preferably in conjunction with the circuit diagram) before any attempt at aligning the transmitter is made.

b. Power Amplifiers in 10-M Units

The power amplifier sections in 10-M units are similar to the corresponding sections in 25-M units except for the absence of the parallel-pair output stage.

In 10-M units the third amplifier stage becomes the output stage and feeds the aerial via an output circuit of the same configuration as in the corresponding 25-M unit.

4. AERIAL FILTER

A low-pass filter is interposed between the aerial connector and the aerial changeover relay contacts.

This filter minimises harmonic radiation and is a sealed unit. In the event of suspected failure, the filter should be returned to the manufacturer for investigation.

5. POWER CONTROL AND REVERSE POLARITY PROTECTION

Power control is exercised by a double-pole switch which is incorporated in the MUTING control. This switch operates when the MUTING control is moved from the fully anticlockwise position and applies the supply voltage to the receiver section and to the p.t.t. circuit.

Protection against reverse polarity is afforded by two diodes. Diode *MR1 in the p.t.t. circuit prevents operation of the p.t.t. relays *RLA and *RLB, and diode 4MR3 in the audio amplifier and muting board excludes the supply from the entire receiver section.

Operation of the p.t.t. button causes operation of relays *RLA and *RLB which effect double-pole switching of the supply to the transmitter section and aerial changeover.

* Prefix 28, 29, 30 or 31 depending upon type of equipment.

End of Part

PART 3

MAINTENANCE INSTRUCTIONS

1. INTRODUCTION

Maximum utilization of a radiotelephone system can be achieved only when unserviceable elements in the system are restored to a serviceable state with minimum delay; therefore proper maintenance procedures are of vital importance in maintaining the efficiency of the system.

A thorough understanding of the principles of frequency modulation and a knowledge of the behaviour of solid state devices in r.f. power amplifiers will be of invaluable assistance in maintaining the equipment. The procedures laid down in this Handbook have been planned to facilitate maintenance and should be rigidly adhered to.

Efficient maintenance also demands proper test equipment. In the list of test equipment appearing in Section 3 below, the minimum acceptable performance specification is given for many instruments. Test instruments of inferior performance should not be used.

2. RECOMMENDED MAINTENANCE PROCEDURES

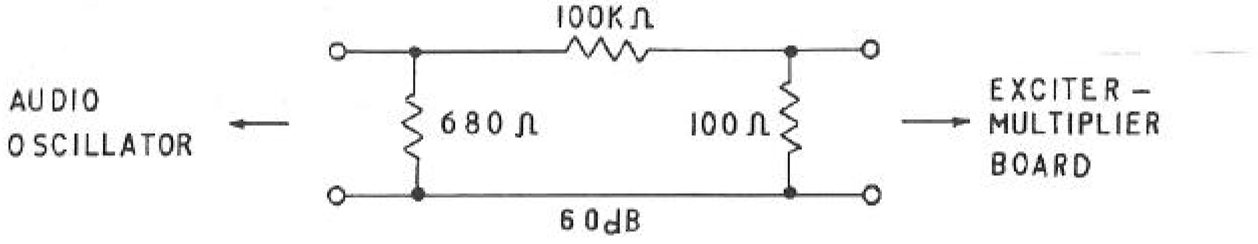
It is inevitable that the aging of certain components in the equipment will bring about a deterioration in performance. Because of this, it is recommended that the equipment be subjected to a performance test at yearly intervals. Should the equipment fail any part of the performance test, then a complete alignment should be undertaken. This alignment should quickly reveal the faulty stage.

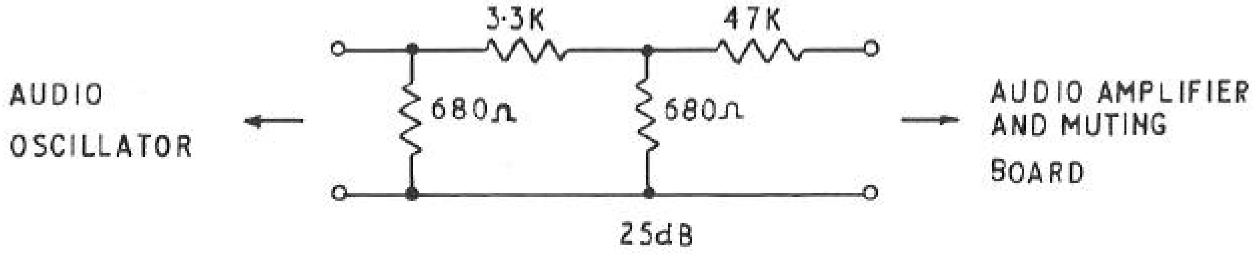
Following the identification of the faulty stage, the specific cause of the deterioration in performance will usually be revealed by a voltage check around the active elements in the stage.

3. TEST EQUIPMENT

The test equipment required to service the transmitter/receiver is listed below. Details of significant specifications are given wherever applicable together with recommended instruments.

F.M. Monitor:	Frequency range to suit transmitter; accuracy of peak deviation measurement ±5%; response flat between 300 Hz and 6 kHz. (Ratcliffe F.M. Monitor Model 600A)
V.H.F. Wattmeter:	Range 0-25 W; input impedance 50 Ω; accuracy ±5%. (Marconi R.F. Power Meter TF1152/1)
Distortion and Noise Meter:	Capable of reading up to 10% distortion and -50 dB noise; accuracy ±5%. (AWA Distortion and Noise Meter A51932)
Signal Generator:	Frequency ranges 70 MHz to 85 MHz or 156 MHz to 174 MHz, 10.7 MHz, with incremental frequency control; high short-term stability; accuracy of attenuator calibration ±1 dB; leakage less than 0.25 μV at highest frequency; low source impedance; provision for external modulation by audio and sawtooth (sweep) voltages. (Marconi A.M./F.M. Signal Generator TF995A/5 modified for sweep operation)
Audio Oscillator:	Range 300 Hz to 6 kHz; accuracy ±5%; low distortion; low noise. (AWA Audio Frequency Oscillator A57321 or A57150)
Oscilloscope:	Frequency range d.c. to 3 MHz; sensitivity 100 mV/cm; sweep voltage outlet. (Telequipment S51B)
Crystal:	455 kHz; tolerance ±0.005% at 25 °C; series resonant.
R.F. Line Voltage Indicator:	Recommended type is AWA 1M58052.
Vacuum Tube Voltmeter:	Accuracy better than 5% on all ranges. (AWA Voltohmyst)
Attenuator Pads:	60 dB and 25 dB as below.





Detector Assembly:	As shown in Sub-Section 10.5
Meters:	20-0-20 μA 0-100 μA
Resistors:	15 Ω, 3 W 27 Ω, 1 W 1 kΩ, 1/4 W 3.9 kΩ, 1/4 W 10 kΩ, 1/4 W 22 kΩ, 1/4 W

4. SUPPLY VOLTAGE DURING MAINTENANCE

The supply voltage must be maintained at exactly 13.6 volts during all tests or when making adjustments.

5. DISABLING OF TRANSMITTERS

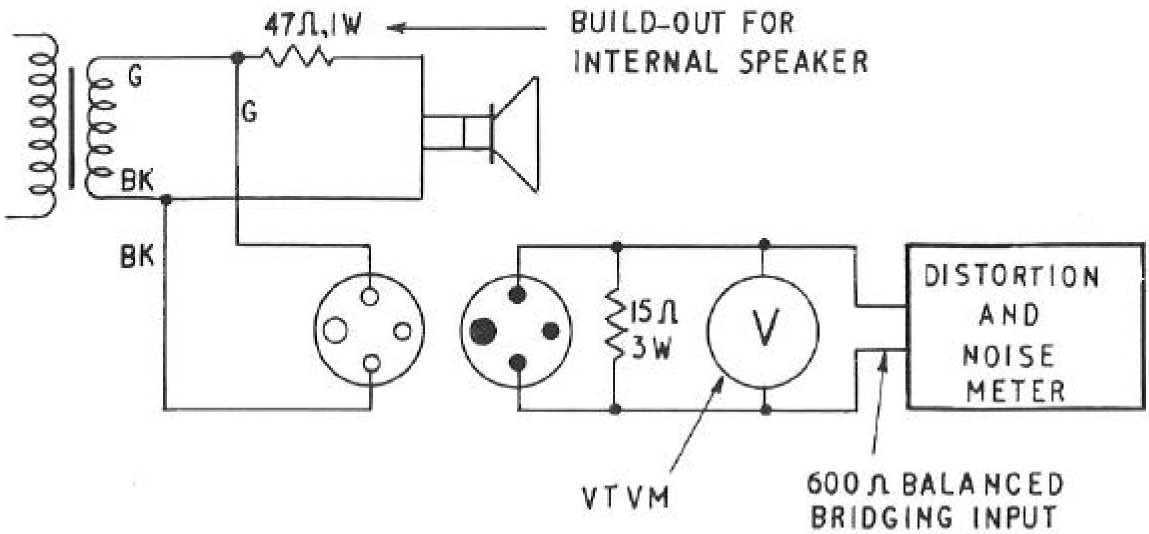
Because the press-to-talk circuits are active when the power switch is operated, it is recommended that the transmitter crystal be removed whenever a signal generator is connected to the aerial connector.

6. RECEIVER PERFORMANCE TESTS

The tests described below permit evaluation of the performance of a correctly aligned receiver. It should be understood that all figures quoted apply to a new unit and that slight deterioration will occur with aging of components. Realignment should be considered only when the deterioration in performance is indicative of incipient failure.

In the tests described below it is assumed that:

(i) the signal generator is connected to the aerial connector and has been adjusted to give a centre-zero reading between pins 13 and 14 on the receiver r.f. - i.f. amplifier board, and
(ii) the internal speaker has been built-out with a 47 Ω (1W) resistor and the test equipment connected to the extension loudspeaker socket as shown below.



6.1 Quieting

1. Adjust the generator to give a signal level 0.8 μV at the aerial connector.

2. Set the MUTING control fully anticlockwise.

3. Switch off the signal and set the distortion and noise meter to a convenient reference for the measurement of noise.

4. Switch on the signal and measure the quieting; this should be greater than 20 dB.

6.2 Audio Characteristics

1. Adjust the generator to give a signal level of 100 μV at the aerial connector and deviate the signal ±5 kHz (narrow band) or ±15 kHz (wide band) with a 1 kHz tone.

2. Set the MUTING control fully clockwise.

3. Set the VOLUME control fully clockwise and measure the audio output level. This level should be not less than 3 W (6.7 V in 15 Ω).

4. To measure distortion, reduce the output level to 3 W (6.7 V in 15 Ω). The distortion should be less than 10%.

5. To measure frequency response, reduce the deviation to ±3 kHz (narrow band) or ±10 kHz (wide band) and set the VOLUME control to give an output level of 0.5 W (2.7 V in 15 Ω). Set the distortion and noise meter to a convenient reference and measure the response at 500 Hz and 3 kHz, maintaining the deviation at ±3 kHz or ±10 kHz. The frequency response should be as follows:

   500 Hz +1±2 dB
   1 kHz 0 dB (reference)
   3 kHz -10±2 dB

6. To measure signal-to-noise ratio, deviate the signal ±5 kHz or ±15 kHz with a 1 kHz tone and set the signal level to 0.8 μV. Adjust the VOLUME control to give an output level of 1 W (3.9 V in 15 Ω) and set the distortion and noise meter to a convenient reference. Switch off the modulation. The residual noise should be at least 24 dB (narrow band) or 34 dB (wide band) below reference level.

6.3 Muting Characteristics

1. Switch off the signal generator.

2. Set the MUTING control fully anticlockwise and set the VOLUME control to mid-position.

3. Set the distortion and noise meter to a convenient reference level.

4. Rotate the MUTING control clockwise until the receiver is just muted. The residual noise should be 40 dB below reference level.

5. Set the MUTING control fully clockwise and switch on the generator. Deviate the signal ±5 kHz or ±15 kHz with a 1 kHz tone and set the generator for minimum output.

6. Slowly increase the signal level until the receiver is just unmuted, i.e. both noise and tone are audible. The input level should be less than 1 μV.

7. RECEIVER VOLTAGE ANALYSIS AND METERING

7.1 Voltage Analysis

Refer to circuit diagrams.

7.2 Metering

a. Second Mixer and 455 MHz Amplifier

A current of 20 μA at the first limiter metering point should be produced by an open-circuit signal level of 400 μV to 800 μV at 10.7 MHz injected at pin 8 on the r.f. - i.f. amplifier board via a .1 μF blocking capacitor.

The first limiter current can be measured by a 0-100 μA meter connected in series with a 22 kΩ series resistor between test points 17(-) and 18 on the board. The earth lead of the signal generator should be connected to pin 7 on the board.

b. 10.7 MHz Amplifier

An open-circuit signal level of 40 μV at 10.7 MHz injected via a 0.1 μF blocking capacitor at pin 6 on the r.f. - i.f. amplifier board should produce a first limiter meter reading of 20 μA to 40 μA. (The actual meter reading becomes a reference reading for the measurement of r.f. gain.)

c. R.F. Section

The reference meter reading obtained in (b) above should be produced by an input signal level (from a 50 Ω source) of 0.4 μV to 0.8 μV (low band) or 0.6 μV to 1.2 μV (high band) at the aerial connector.

d. Discriminator

The discriminator can be metered with a 20-0-20 μA meter connected between test points 13 and 14 on the r.f. - i.f. amplifier board.

When a 10.7 MHz signal at a level of 10 mV is injected via a 0.1 μF blocking capacitor at pin 8 on the r.f. - i.f. amplifier board, detuning the input signal 15 kHz either side of 10.7 MHz should produce a meter deflection of not less than 10 μA.

8. TRANSMITTER PERFORMANCE TESTS

The following procedure permits complete evaluation of the transmitter performance.

1. Connect a wattmeter and a f.m. monitor to the aerial connector. Set the monitor for a flat response and ensure that the monitor output is correctly loaded.

2. Connect a distortion and noise meter across the monitor output.

3. Disconnect the blue and white leads from pins 9 and 10, respectively, on the exciter-multiplier board and connect an audio oscillator to the pins via a 60 dB pad as detailed in Section 3, "Test Equipment", above.

4. Measure the power output.

5. Set deviation control (RV1 on the board) fully clockwise.

6. To measure frequency response, set the audio oscillator to 3 kHz and adjust the signal level to produce ±5 kHz deviation. Set the distortion and noise meter to a convenient reference level and measure the frequency response at 500 Hz, 1 kHz, and 6 kHz by maintaining a constant audio signal level. The frequency response should be as follows:

500 Hz	-4±1 dB
1 kHz	-7.5±1.5 dB
3 kHz	0 dB (reference)
6 kHz	Greater than -11 dB

7. To measure distortion, set the audio oscillator to 1 kHz and adjust the signal level to produce ±5 kHz deviation. The distortion should be less than 10%.

8. To measure audio sensitivity, set the audio oscillator to 3 kHz and adjust the signal level to produce ±5 kHz deviation. The audio input level to the pad should be between 0.5 V and 1.5 V r.m.s.

9. To measure clipping, connect an oscilloscope between pins 19 and 11 on the exciter-multiplier board and set the audio oscillator to 1 kHz. Increase the signal level until clipping is just evident on the oscilloscope pattern. The audio input level to the pad should be between 1 V and 3 V r.m.s.

10. To measure transmitter noise, follow the procedure laid down in Sub-Section 11.8, "Adjustment of Deviation", below.

9. TRANSMITTER VOLTAGE AND CURRENT ANALYSIS

9.1 Voltage Analysis

Refer to circuit diagrams.

9.2 Current Analysis

A 0-100 μA meter (1 kΩ internal resistance) and specified series resistors are necessary to measure the currents of the metered stages.

The various test points to which the meter is connected and typical meter readings are shown in the following tabulation.

	Test Point +ve	Test Point -ve	Series Resistor	Meter Reading
a.	Exciter-Multiplier Board (25-M and 10-M; 70-85 MHz)			
	13	17	Nil	55 μA
	13	16	3.9 kΩ	16-36 μA
	13	15	10 kΩ	23-36 μA
b.	Exciter-Multiplier Board (25-M and 10-M; 156-174 MHz)			
	13	17	Nil	66 μA
	13	16	3.9 kΩ	15-28 μA
	13	15	10 kΩ	17-23 μA
	13	14	10 kΩ	33-55 μA
c.	Power Amplifier Section (25-M; 70-85 MHz)			
	12	5	1 kΩ	40-60 μA
	12	9	1 kΩ	20-35 μA
	12	10	1 kΩ	40-60 μA
	12	11	3.9 kΩ	35-50 μA
d.	Power Amplifier Section (25-M; 156-174 MHz)			
	10	3	3.9 kΩ	20-30 μA (30 μA max.)
	10	7	1 kΩ	25-50 μA
	10	8	1 kΩ	40-65 μA
	10	9	3.9 kΩ	40-50 μA

	Test Point +ve	Test Point -ve	Series Resistor	Meter Reading
e. Power Amplifier Section (10-M; 70-85 MHz)				
	11	5	1 kΩ	40-60 μA
	11	9	1 kΩ	20-35 μA
	11	10	1 kΩ	40-60 μA
f. Power Amplifier Section (10-M; 156-174 MHz)				
	9	3	3.9 kΩ	20-30 μA (30 μA max.)
	9	7	1 kΩ	25-50 μA
	9	8	1 kΩ	40-65 μA

10. RECEIVER ALIGNMENT

10.1 455 kHz Amplifier Section

IMPORTANT: In the alignment procedures for the 455 kHz amplifier section and the discriminator as detailed in Sub-Sections 10.1 and 10.2 below, a signal at 10.7 MHz is injected into the second mixer stage thus avoiding the requirement for a suitable 455 kHz generator. To ensure proper alignment of these stages it is essential that a crystal (or other frequency sub-standard) be used when adjusting the signal frequency to centre the signal in the output of the second mixer on exactly 455 kHz.

1. Set the slug of TR6 to one-eighth inch below the top of the can.

2. Connect a 20-0-20 μA meter between test points 13 and 14 on the r.f. - i.f. amplifier board.

3. Connect a 0-100 μA meter via a 22 kΩ series resistor between test points 17 (-) and 18 (i.e. first limiter metering).

4. Connect the signal generator between pins 8 (active) and 7 using a 0.1 μF blocking capacitor.

5. Tune the signal generator in the vicinity of 10.7 MHz until a centre-zero reading is obtained on the discriminator meter. Adjust the signal level to give a reading of approximately 20 μA on the 0-100 μA meter.

6. Hold a 455 kHz crystal between the junction R47/C62 (i.e. collector of VT8) and chassis.

7. Slowly vary the frequency of the input signal (about 3 μA either side of centre zero) until a sharp dip is found in the first limiter meter reading. This dip indicates an output signal from the second mixer of exactly 455 kHz. Remove the crystal.

   NOTE: The dip in the meter reading is extremely sharp and will be observed only if the frequency of the input signal is varied very slowly.

8. Adjust TR9 for maximum meter reading, reducing the input level as necessary to keep the meter reading less than 20 μA.

9. Transfer the meter and series resistor from test point 16 to test point 17. Adjust the input level to give a meter reading of less than 20 μA.

10. Adjust TR8 and TR7 in that order for maximum meter reading, reducing the input level as necessary to keep the meter reading less than 20 μA.

11. Measure the input level for a meter reading of 20 μA. The input level should be between 400 μV and 800 μV.

12. Measure the bandwidth at the -6 dB points by increasing the input level by 6 dB and then detuning the signal generator each side of 10.7 MHz until the reference meter reading of 20 μA is regained. The -6 dB points should fall between 30 kHz and 35 kHz either side of 10.7 MHz, with a maximum asymmetry of 3 kHz. Excessive asymmetry can be corrected by slight re-adjustment of TR7.

10.2 Discriminator

1. Connect and calibrate the signal generator as in step 2 to 6 inclusive of Sub-Section 10.1 above.

2. Increase the level of the 10.7 MHz signal to 10 mV.

3. Detune TR11 by screwing the slug one-eighth inch out of the can.

4. Adjust TR10 for maximum deflection on the meter.

5. Screw TR11 slug clockwise until a centre-zero reading is obtained.

6. Detune the signal generator 15 kHz either side of 10.7 kHz and if necessary adjust TR10 to give equal deflections on the meter.

7. Reset the signal generator to 10.7 MHz. If the meter does not read centre-zero, repeat steps 7 and 8 until the discriminator is balanced.

8. Measure the deflection when the signal generator is detuned 15 kHz either side of 10.7 MHz. The meter reading should be not less than 10 μA. (A deflection of less than 10 μA is indicative of loss of sensitivity in VT9 or VT10 stages.)

10.3 10.7 MHz Amplifier and 10.245 MHz Oscillator

1. Connect the signal generator between pins 6 (active) and 7 (earth) on the r.f. - i.f. amplifier board using a 0.1 μF blocking capacitor. Adjust the signal generator to give a centre-zero reading on a 20-0-20 μA meter connected between test points 13 and 14 on the r.f. - i.f. amplifier board.

2. Connect a 0-100 μA meter via a 22 kΩ series resistor between test points 17 (-) and 18.

3. Adjust the level of the input signal to give a reading of less than 20 μA on the meter.

4. Adjust TR4 and TR5 for maximum meter reading, reducing the input level as necessary to keep the meter reading less than 20 μA.

5. Check the starting of the 10.245 kHz oscillator by switching the receiver off and on several times. If the oscillator starting is erratic screw the slug of TR6 in until reliable starting is achieved.

6. Set the generator output level to 40 μV (open-circuit). The meter reading should be between 20 μA and 40 μA. Note the meter reading.

10.4 Radio Frequency Section

NOTE: Steps 1 and 2 below are necessary only when setting up a receiver to new channels.

1. Determine the crystal frequencies from either of the following formulae:

   For 70-85 MHz: Crystal Frequency = (Channel Frequency - 10.7 MHz) ÷ 2

   For 156-174 MHz: Crystal Frequency = (Channel Frequency - 10.7 MHz ÷ 4

2. Insert the crystals and remove the slug from TR3.

3. Connect a 0-100 μA meter between test points 2(-) and 18 on the r.f. - i.f. amplifier board.

4. Select the mid-frequency channel.

5. In units already set up to a channel, detune TR3 by screwing the slug four turns either in or out.

6. Adjust TR2 for maximum meter reading.

7. Adjust L3 for maximum meter reading.

8. Re-adjust TR2 for maximum meter reading and then screw the slug into the can until the meter reading falls to 80% of the maximum reading. The minimum limit is 20 μA. Note the reading.

9. Adjust TR3 for minimum meter reading. (The slug must first be replaced if performing an initial alignment.) The meter reading should be between 40% and 60% of the deflection noted in step 8 above.

10. Connect a signal generator to the aerial connector and adjust the generator to give a centre-zero reading on a 20-0-20 μA meter connected between pins 13 and 14.

11. Connect a 0-100 μA meter in series with a 22 kΩ resistor between test points 17(-) and 18.

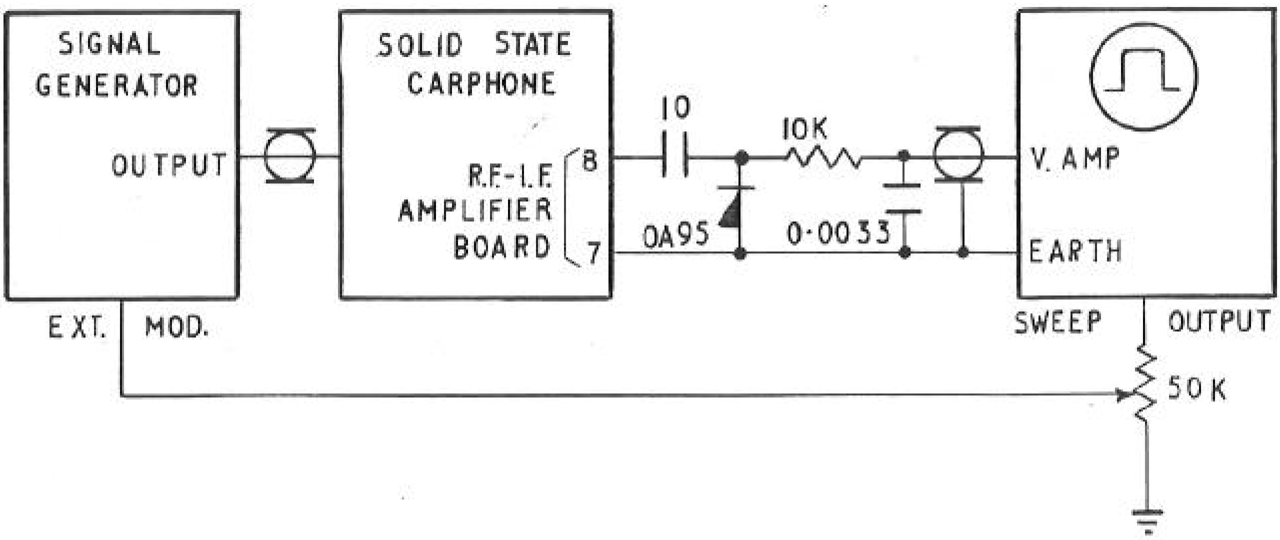
12. Adjust L2, L1 and TR1 in that order for maximum meter reading at test point 17, reducing the input level as necessary to keep the meter reading less than 20 μA.

13. Adjust the three slugs in the receiver input filter for maximum meter reading at test point 17, reducing the input level as necessary to keep the meter reading less than 20 μA.

14. Adjust the signal generator to give the reference reading as obtained in step 6 of Sub-Section 10.3 above. The input signal level (50 Ω source) should be between 0.4 μV and 1 μV.

10.5 Sweep Alignment of 10.7 MHz Filter

1. Connect the test equipment as shown in the diagram below.



2. Set the generator output to about 2 μV and adjust the frequency until a pattern appears on the oscilloscope.

3. Adjust the sweep output potentiometer to produce a pattern of useful width, then adjust the sweep speed to the lowest frequency consistent with a usable trace (about two sweeps per second).

4. Adjust L5 and TR4 alternately until optimum flatness within the passband is obtained. The residual ripple should not exceed 2 dB.

NOTE: Ripple is the difference between the maximum and minimum excursions of the trace within the passband.

10.6 Adjustment of Muting Sensitivity

1. Remove the lead from pin 1 on the audio amplifier and muting board.

2. Connect an audio oscillator to pins 1 (active) and 11 via a 25 dB pad as detailed in Section 3, "Test Equipment", above.

NOTE: A clip should be used to connect with pin 11 because the existing lead to this pin carries the supply +ve.

3. Set the MUTING control fully clockwise.

4. Connect a v.t.v.m. across 4C12 on the board with the active lead of the instrument to the -ve side of the capacitor. Set the instrument to the -5 V scale.

5. Set the audio oscillator to 10 kHz and slowly increase the signal level from zero until the reading on the v.t.v.m. just begins to increase, i.e. cut-off point of 4VT4.

6. Adjust 4L1 for maximum meter reading.

7. Reduce the signal level to zero and then slowly increase the level until 4VT4 is just cutting-off as indicated by a slight increase in the meter reading.

8. Measure the input level to the 25 dB pad. The level should be between 2 V and 3 V r.m.s.

   If the input level is below 2 V, the capacitance of 4C13 should be reduced progressively to the next preferred value until the input level is within tolerance.

9. Increase the input level to the pad to 4.5 V r.m.s. and slowly rotate the MUTING control in an anticlockwise direction. Conduction in 4VT4 (i.e. a sharp fall in the meter reading) should occur within the range of the control.

11. TRANSMITTER ALIGNMENT

11.1 Exciter-Multiplier in 70-85 MHz Units

A 0-100 μA meter and specified series resistors are necessary when aligning the exciter-multiplier. The +ve lead of the meter is connected to test point 13 with the -ve lead connected via a series resistor to the designated test points.

NOTE: Steps 1 and 2 below are necessary only when setting up a transmitter to new channels.

1. Determine the crystal frequencies from the formula:

   Crystal Frequency = Channel Frequency $\div$ 27

2. Insert the crystals.

3. Select the mid-frequency channel.

4. Connect a 50 Ω non-reactive load to 2SKA.

5. Set the deviation control (2RV1) fully anticlockwise.

6. Set the slug of 2L2 to just below the top of the can.

7. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	17	Nil	2TR1 2L3 2L2	Maximum Minimum 55 μA
b.	16	3.9 kΩ	2L4 2L7	Maximum Minimum
c.	15 *	10 kΩ	2L8 2L12 2L13	Maximum Minimum Maximum
d.	17	Nil	2TR1 2L2	Maximum 55 μA
e.	16	3.9 kΩ	2L3 2L4	Maximum Maximum (Typically 16-36 μA)
f.	15 *	10 kΩ	2L7 2L8	Maximum Maximum (Typically 23-36 μA)

* Erratic meter readings at this test point indicate instability in 2VT8. This condition can be remedied by increasing the emitter resistor (2R39) to 150 Ω.

8. Disconnect the test meter and restore the coaxial connection to the power amplifier section at 2SKA.

11.2 Exciter-Multiplier in 156-174 MHz Units

A 0-100 μA meter and specified series resistors are necessary when aligning the exciter-multiplier. The +ve lead of the meter is connected to test point 13 with the -ve lead connected via a series resistor to the designated test points.

NOTE: Steps 1 and 2 below are necessary only when setting up a transmitter to new channels.

1. Determine the crystal frequencies from the formula:
   Crystal Frequency = Channel Frequency $\div$ 27
2. Insert the crystals.
3. Select the mid-frequency channel.
4. Connect a 50 Ω non-reactive load to 3SKA.
5. Set the deviation control (3RV1) fully anticlockwise.
6. Set the slug of 3L2 to just below the top of the can.
7. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	17	Nil	3TR1 3L3 3L2	Maximum Minimum 66 μA
b.	16	3.9 kΩ	3L4 3L7	Maximum Minimum
c.	15	10 kΩ	3L8	Maximum
d.	14	10 kΩ	3TR2 3L12	Maximum Maximum
e.	17	Nil	3TR1 3L2	Maximum 66 μA
f.	16	3.9 kΩ	3L3 3L4	Maximum Maximum (Typically 15-28 μA)
g.	15	10 kΩ	3L7 3L8	Maximum Maximum (Typically 17-23 μA)
h.	14	10 kΩ	3L12 3TR2	Maximum Maximum (Typically 33-55 μA)

8. Disconnect the test meter and restore the coaxial connection at 3SKA.

11.3 Power Amplifier for 70-85 MHz in 25-M Units

A 0-100 μA meter and specified series resistors are necessary when aligning the power amplifier section. The +ve lead of the meter is connected to test point 12 with the -ve lead connected via a series resistor to the designated test points.

CAUTION: The p.t.t. button should be operated for minimum periods during the early steps of alignment to avoid the prolonged flow of excessive current in improperly loaded transistors.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator to the aerial connector.

2. Set the following capacitors as indicated.

   13C3 to minimum capacitance
   13C14 to mid-position
   13C25 to maximum capacitance

3. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	5	1 kΩ	13C2	Maximum
b.	9	1 kΩ	13C7	Maximum
c.	5	1 kΩ	13C3 13C2	Maximum Maximum
d.	Repeat c. until the meter reading reaches 50 μA <u>or</u> maximum value.			
e.	10	1 kΩ	13C12	Maximum
f.	11	3.9 kΩ	13C15	Maximum
g.	Wattmeter	-	13C24 13C25 13C24 13C14 13C15 13C24	Maximum Slight increase Maximum Maximum Maximum Maximum
h.	5	1 kΩ	13C2	Maximum
j.	9	1 kΩ	13C7	Maximum
k.	5	1 kΩ	13C3) 13C2)	Maximum or 60 μA

Test Point	Series Resistor	Component	Meter Reading

1. Repeat e. to k. inclusive until maximum power output is obtained. Typical meter readings are as follows:

Test point 5	40-60 μA
Test point 9	20-35 μA
Test point 10	40-60 μA
Test point 11	35-50 μA

4. If the power output is less than 20 watts or the meter readings are not within the specified limits, the value of 13R1 should be increased progressively to the next preferred value (18 Ω, 22 Ω, etc. up to 47 Ω) until an output of 20 watts is obtained. (The alignment procedure of step 3 above must be repeated after each increase in value of 13R1.)

5. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

11.4 Power Amplifier for 156-174 MHz in 25-M Units

A 0-100 μA meter and specified series resistor are necessary when aligning the power amplifier section. The +ve lead of the meter is connected to test point 10 with the -ve lead connected via a series resistor to the designated test points.

CAUTION: The p.t.t. button should be operated for minimum periods during the early steps of alignment to avoid the prolonged flow of excessive current in improperly loaded transistors.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator to the aerial connector.

2. Set the following capacitors as indicated.

   14C2 to mid-position
   14C3 to minimum capacitance
   14C11 to mid-position
   14C12 to minimum capacitance
   14C14 to mid-position
   14C15 to mid-position
   14C22 to mid-position
   14C23 to mid-position

3. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	7	1 kΩ	14C7	Maximum
b.	3	3.9 kΩ	14C2	Maximum
			14C3	Maximum
c.	Repeat b. until the meter reading reaches approximately 20 μA.			
d.	8	1 kΩ	14C11	Maximum
e.	9	3.9 kΩ	14C15	Maximum
f.	Wattmeter	-	14C22	Maximum
			14C23	Slight increase
			14C22	Maximum
			14C15	Maximum
			14C14	Maximum
			14C22	Maximum
g.	7	1 kΩ	14C7	Maximum
h.	8	1 kΩ	14C11	Maximum
			14C12	Maximum

j. Repeat d. to h. inclusive until maximum power output is obtained. Typical meter readings are as follows:

Test point 3	20-30 μA
Test point 7	25-50 μA
Test point 8	40-65 μA
Test point 9	40-50 μA

4. If the power output is less than 20 watts or the meter readings are not within the specified limits, capacitors 14C2 and 14C3 should be re-adjusted to give slight increases in the meter reading at test point 3 until an output of 20 watts is obtained. (The alignment procedures d. to j. of step 3 above must be repeated after each adjustment of 14C2 and 14C3.)

CAUTION: The maximum permissible meter reading at test point 3 is 30 μA.

5. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

11.5 Power Amplifier for 70-85 MHz in 10-M Units

A 0-100 μA meter and specified series resistors are necessary when aligning the power amplifier section. The +ve lead of the meter is connected to test point 11 with the -ve lead connected via a series resistor to the designated test points.

CAUTION: The p.t.t. button should be operated for minimum periods during the early steps of alignment to avoid the prolonged flow of excessive current in improperly loaded transistors.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator to the aerial connector.

2. Set the following capacitors as indicated.

   15C3 to minimum capacitance.
   15C21 to maximum capacitance.

3. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	5	1 kΩ	15C2	Maximum
b.	9	1 kΩ	15C7	Maximum
c.	5	1 kΩ	15C3 15C2	Maximum Maximum
d.	Repeat c. until the meter reading reaches 50 μA or maximum value.			
e.	10	1 kΩ	15C12	Maximum
f.	Wattmeter	-	15C19 15C21 15C19 15C12 15C21	Maximum Slight increase Maximum Maximum Maximum
g.	5	1 kΩ	15C2	Maximum
h.	9	1 kΩ	15C7	Maximum
j.	5	1 kΩ	15C3) 15C2)	Maximum or 60 μA

Test Point	Series Resistor	Component	Meter Reading

k. Repeat e. to j. inclusive until maximum power outputs is obtained. Typical meter readings are as follows:

Test point 5	40-60 μA
Test point 9	20-35 μA
Test point 10	40-60 μA
Wattmeter	Not less than 10 W

4. If the power output is less than 10 watts or the meter readings are not within the specified limits, the value of 15R1 should be increased progressively to the next preferred value (18 Ω, 22 Ω, etc. up to 47 Ω) until an output of 10 watts is obtained. (The alignment procedure of step 3 above must be repeated after such increase in the value of 15R1.)

5. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

11.6 Power Amplifier for 156-174 MHz in 10-M Units

A 0-100 μA meter and specified series resistors are necessary when aligning the power amplifier section. The +ve lead of the meter is connected to test point 9 with the -ve lead connected via a series resistor to the designated test points.

CAUTION: The p.t.t. button should be operated for minimum periods during the early steps of alignment to avoid the prolonged flow of excessive current in improperly loaded transistors.

1. Connect a wattmeter of 50 Ω nominal impedance via a r.f. line voltage indicator to the aerial connector.

2. Set the following capacitors as indicated.

    16C2 to mid-position
    16C3 to minimum capacitance
    16C11 to mid-position
    16C12 to minimum capacitance
    16C13 to mid-position
    16C14 to mid-position

3. Make the following adjustments in the order stated.

	Test Point	Series Resistor	Component	Meter Reading
a.	7	1 kΩ	16C7	Maximum
b.	3	3.9 kΩ	16C2	Maximum
			16C3	Maximum
c.	Repeat b. until the meter reading reaches approximately 20 μA.			
d.	8	1 kΩ	16C11	Maximum
e.	Wattmeter	-	16C13	Maximum
			16C14	Slight increase
			16C13	Maximum
			16C12	Maximum
			16C11	Maximum
			16C13	Maximum
f.	7	1 kΩ	16C7	Maximum

g. Repeat d. to f. inclusive until maximum power output is obtained. Typical meter readings are as follows:

Test point 3	20-30 μA
Test point 7	25-50 μA
Test point 8	40-65 μA

4. If the power output is less than 10 watts or the meter readings are not within the specified limits, capacitors 16C2 and 16C3 should be re-adjusted to give slight increases in the meter reading at test point 3 until an output of 10 watts is obtained. (The alignment procedures d. to j. of step 3 above must be repeated after each adjustment of 16C2 and 16C3.)

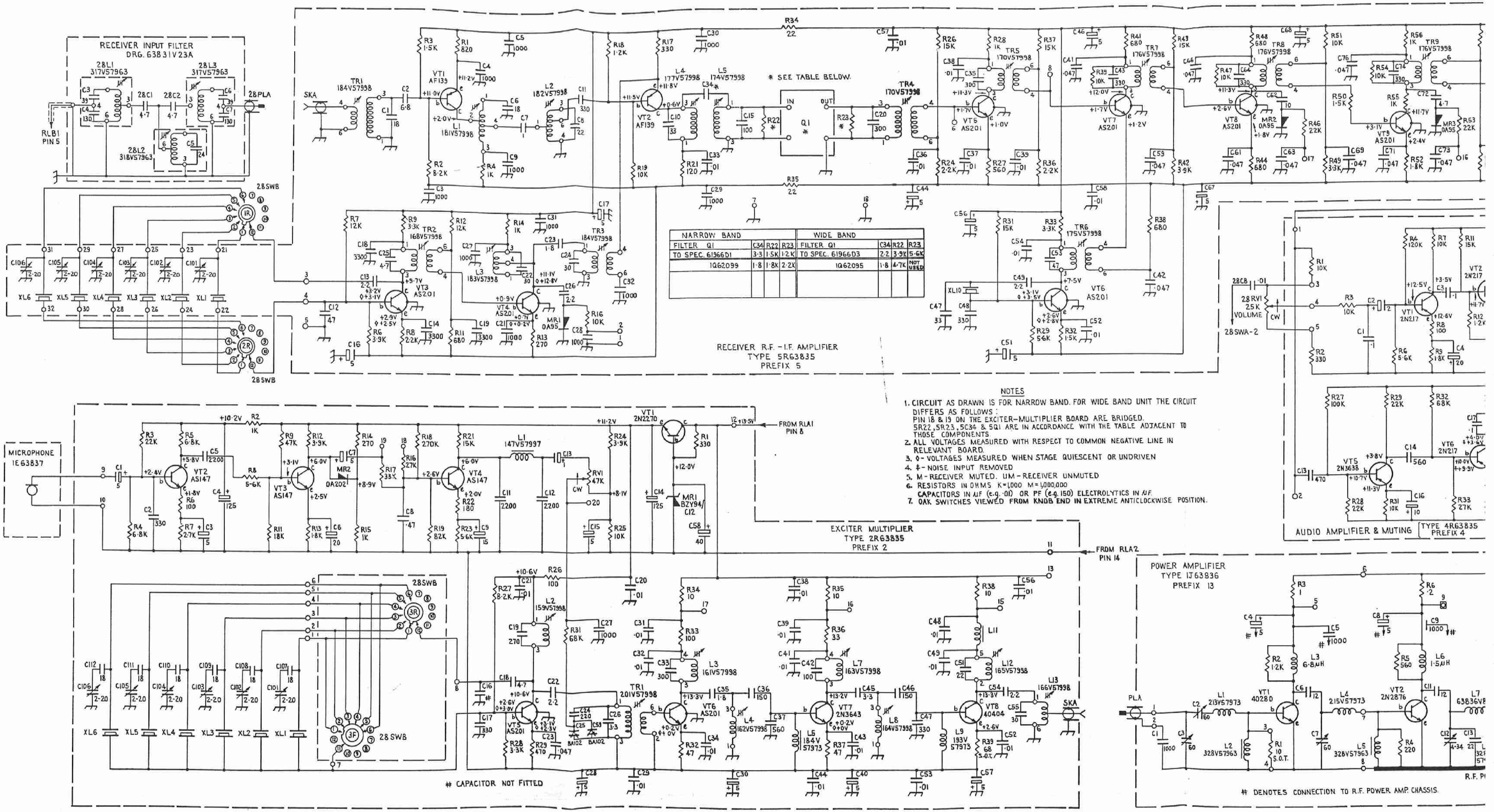
CAUTION: The maximum permissible meter reading at test point 3 is 30 μA.

5. Record the reading on the line voltage indicator for reference when the transmitter is connected to the aerial.

11.7 Modulator

1. Connect a wattmeter and a f.m. monitor to the aerial connector. Set the monitor for a flat response and ensure that the monitor output is correctly loaded.

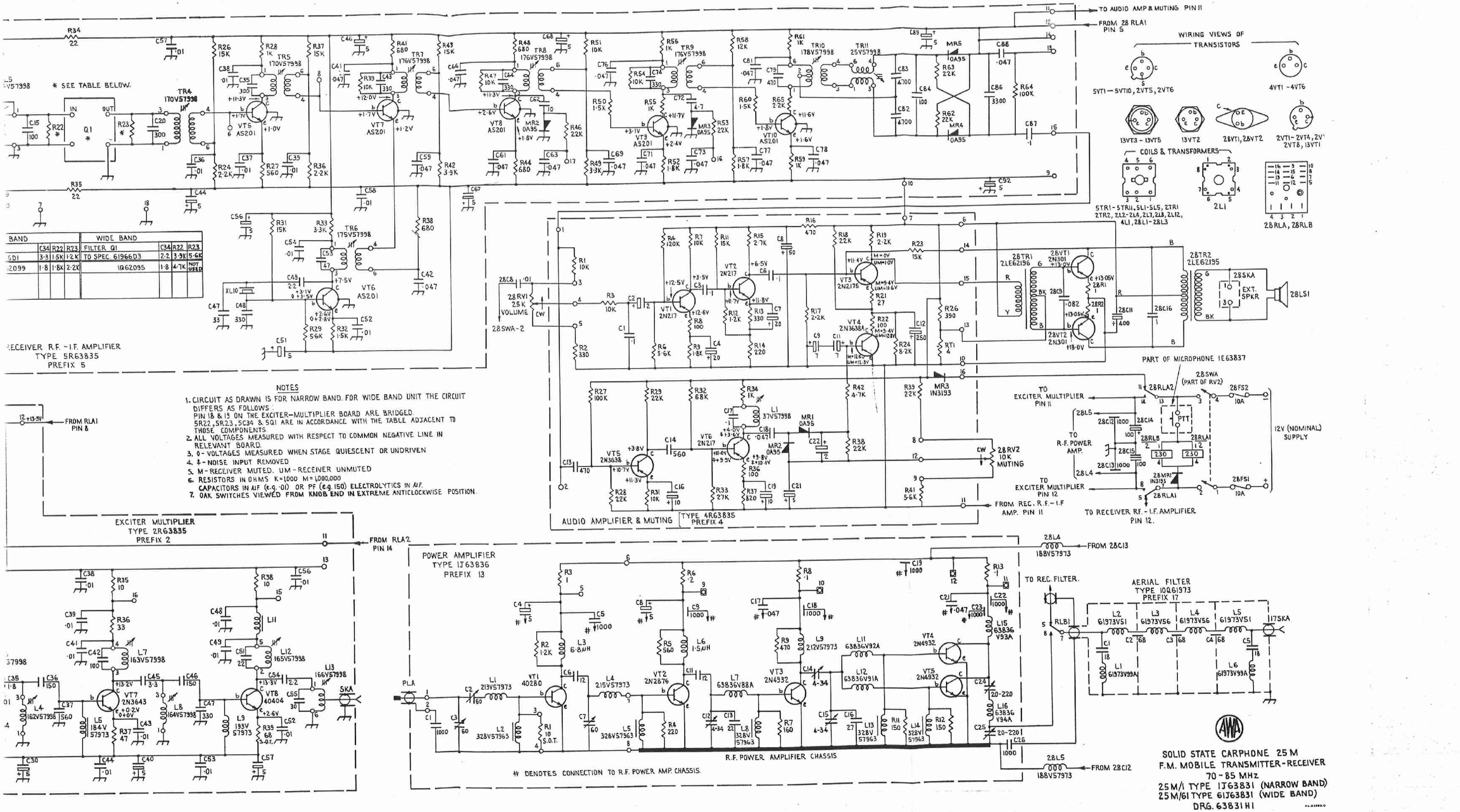
2. Connect a distortion and noise meter across the monitor output.



NARROW BAND				WIDE BAND			
FILTER Q1	C34	R22	R23	FILTER Q1	C34	R22	R23
TO SPEC. 61966D1	3·3	1·5K	1·2K	TO SPEC. 61966D3	2·2	3·9K	5·6K
1Q62099	1·8	1·8K	2·2K	1Q62095	1·8	4·7K	NOT USED

NOTES

1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT DIFFERS AS FOLLOWS:
   PIN 18 & 19 ON THE EXCITER-MULTIPLIER BOARD ARE BRIDGED.
   5R22, 5R23, 5C34 & 5Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS.
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD.
3. ◊ - VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ‡ - NOISE INPUT REMOVED
5. M - RECEIVER MUTED. UM - RECEIVER UNMUTED
6. RESISTORS IN OHMS K=1,000 M=1,000,000
   CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF.
7. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION.



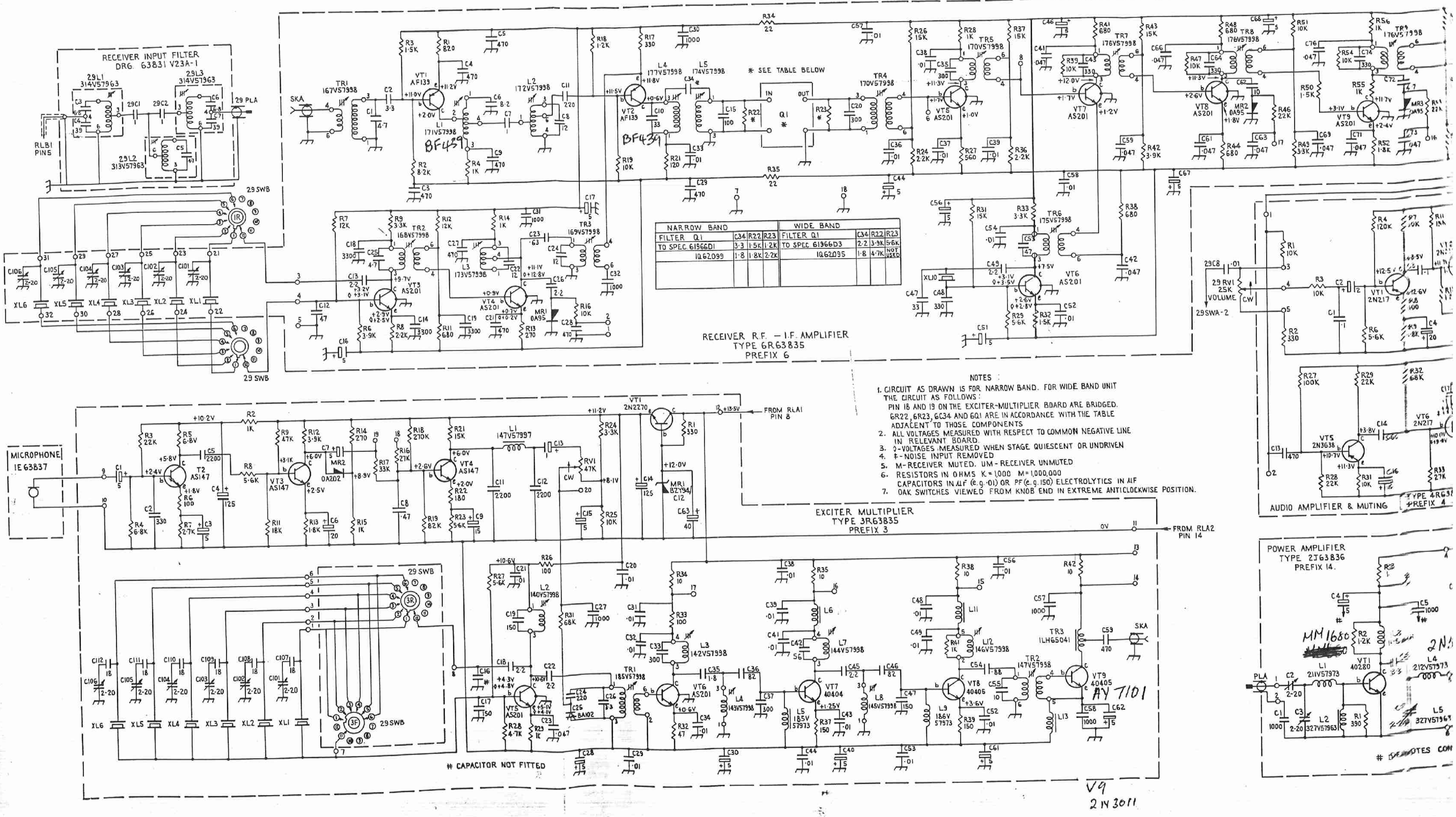
BAND	C34	R22	R23	WIDE BAND FILTER Q1	C34	R22	R23
...SD1	3·3	1·5K	1·2K	TO SPEC. 6196603	2·2	3·9K	5·6K
...2099	1·8	1·8K	2·2K	1Q62095	1·8	4·7K	NOT USED

NOTES

1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT DIFFERS AS FOLLOWS:
   PIN 18 & 19 ON THE EXCITER-MULTIPLIER BOARD ARE BRIDGED.
   5R22, 5R23, 5C34 & 5Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS.
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD.
3. 0 - VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ‡ - NOISE INPUT REMOVED
5. M - RECEIVER MUTED. UM - RECEIVER UNMUTED
6. RESISTORS IN OHMS K=1000 M=1,000,000
   CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF.
7. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION.

AWA

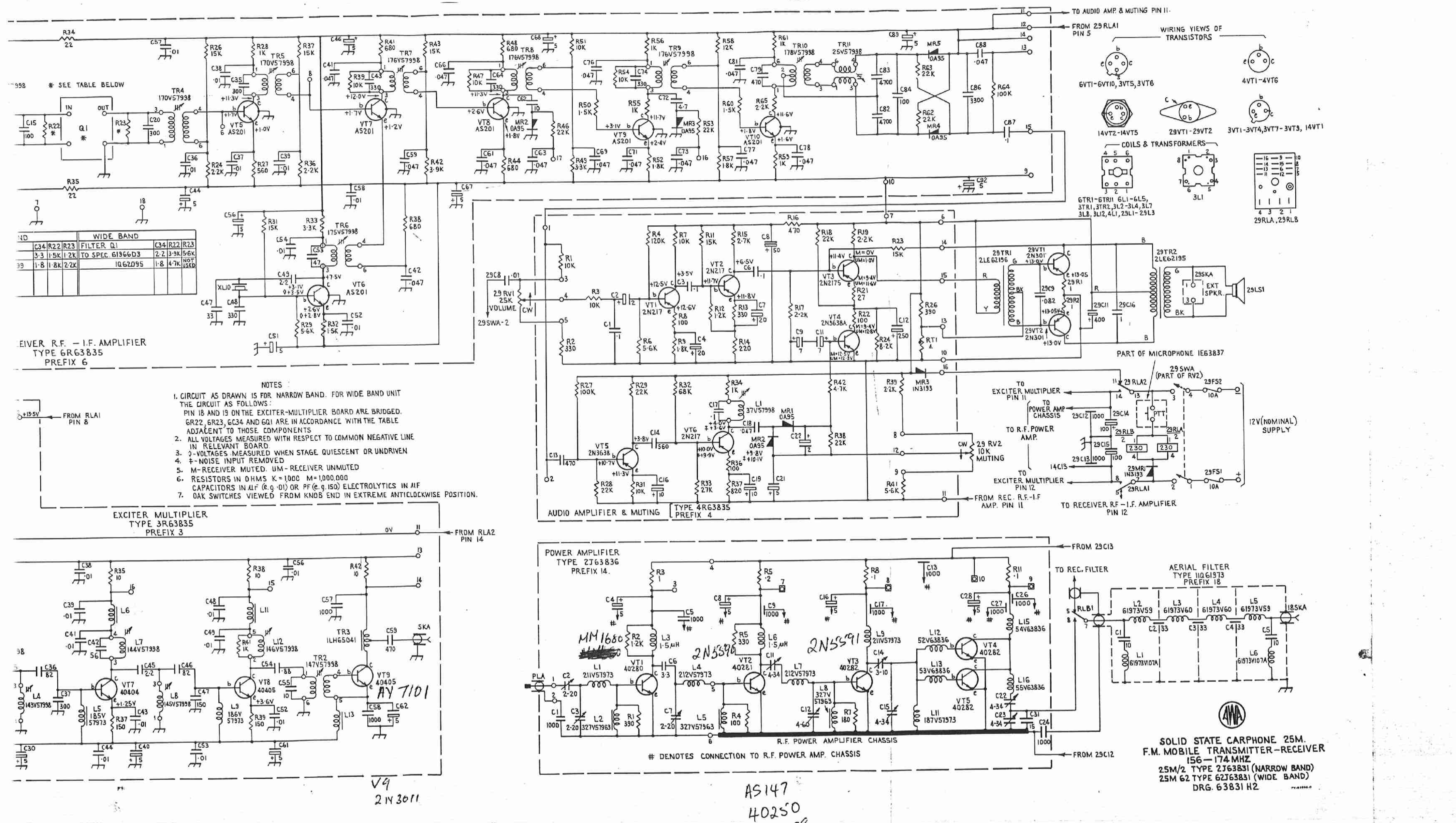
SOLID STATE CARPHONE 25M
F.M. MOBILE TRANSMITTER-RECEIVER
70 - 85 MHz
25M/1 TYPE 1J63831 (NARROW BAND)
25M/61 TYPE 61J63831 (WIDE BAND)
DRG. 63831H1



NARROW BAND	C34	R22	R23	WIDE BAND	C34	R22	R23
FILTER Q1				FILTER Q1			
TO SPEC 61966D1	3·3	1·5K	1·2K	TO SPEC 61966D3	2·2	3·9K	5·6K
10.62099	1·8	1·8K	2·2K	10.62095	1·8	4·7K	NOT USED

NOTES :

1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT AS FOLLOWS:
   PIN 18 AND 19 ON THE EXCITER-MULTIPLIER BOARD ARE BRIDGED.
   6R22, 6R23, 6C34 AND 6Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD.
3. ◊-VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ‡-NOISE INPUT REMOVED
5. M-RECEIVER MUTED. UM-RECEIVER UNMUTED
6. RESISTORS IN OHMS K=1,000 M=1,000,000
   CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF
7. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION.



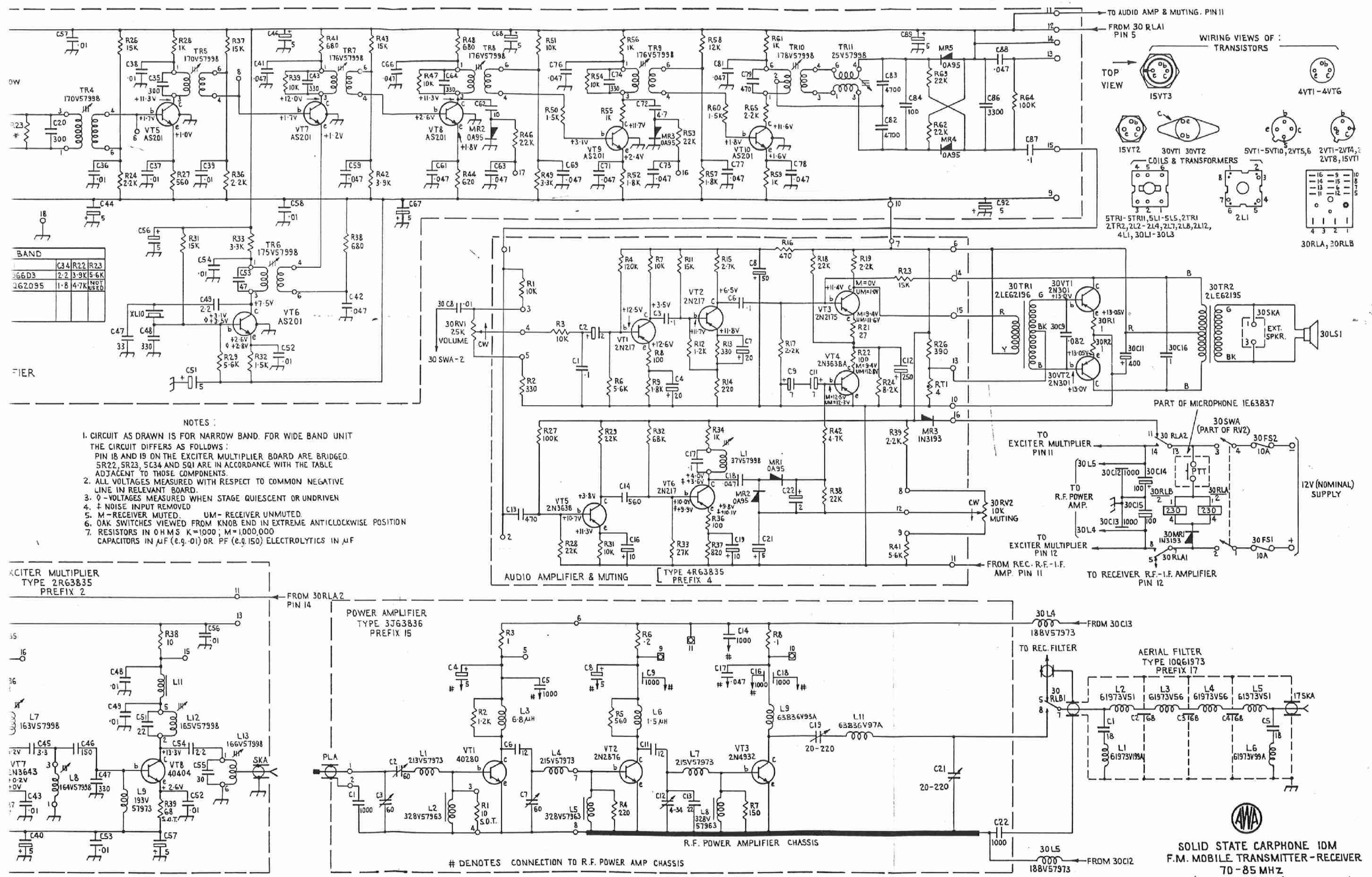
…ND	C34	R22	R23	WIDE BAND FILTER Q1	C34	R22	R23
	3·3	1·5K	1·2K	TO SPEC. 61966D3	2·2	3·9K	5·6K
…99	1·8	1·8K	2·2K	1Q62095	1·8	4·7K	NOT USED

NOTES

1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT AS FOLLOWS:
   PIN 18 AND 19 ON THE EXCITER-MULTIPLIER BOARD ARE BRIDGED.
   6R22, 6R23, 6C34 AND 6Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD
3. ()-VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ǂ-NOISE INPUT REMOVED
5. M-RECEIVER MUTED. UM-RECEIVER UNMUTED
6. RESISTORS IN OHMS K = 1,000 M = 1,000,000
   CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF
7. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION.

AWA

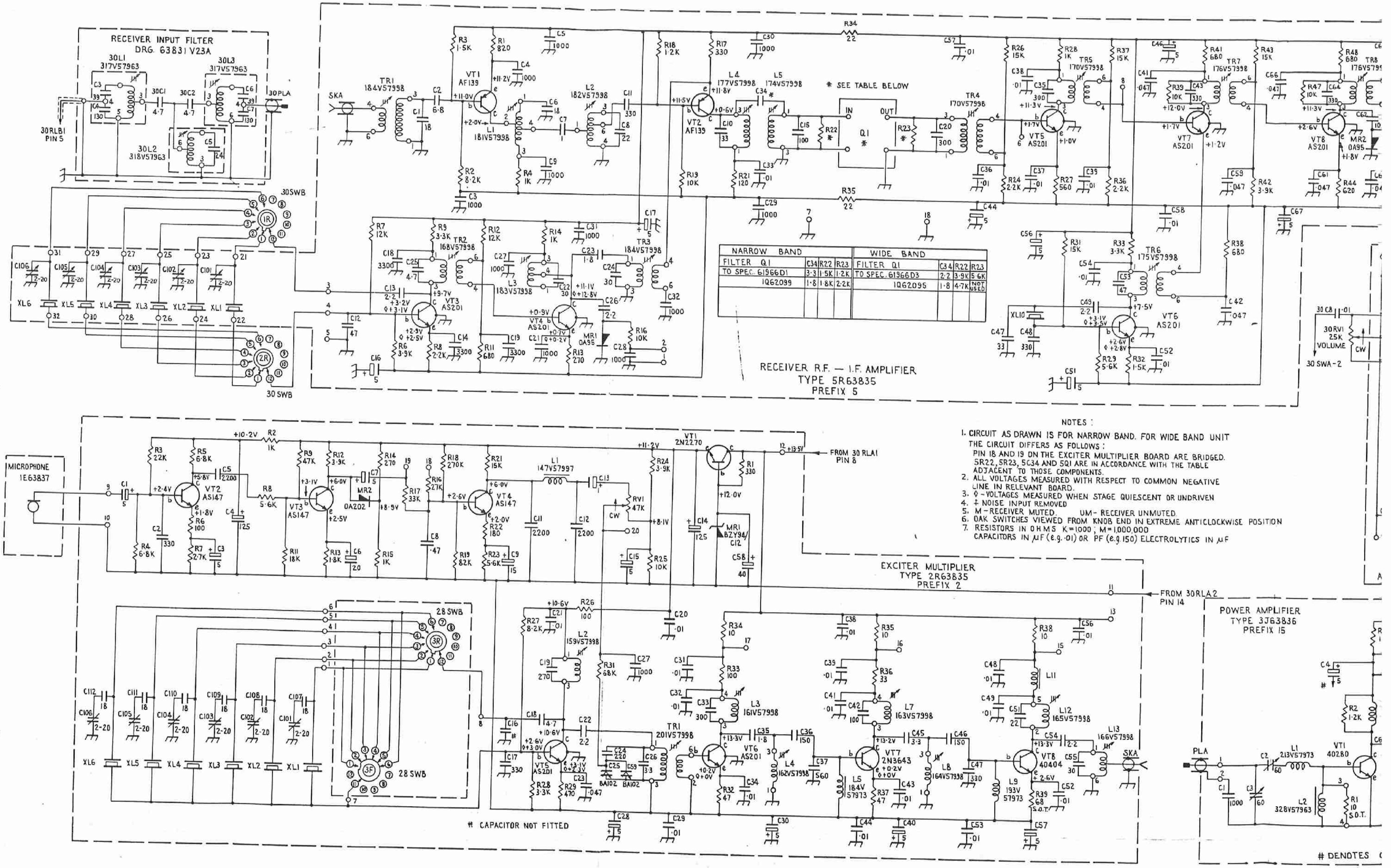
SOLID STATE CARPHONE 25M.
F.M. MOBILE TRANSMITTER-RECEIVER
156 – 174 MHZ
25M/2 TYPE 2J63831 (NARROW BAND)
25M 62 TYPE 62J63831 (WIDE BAND)
DRG. 63831 H2



NOTES :

1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT DIFFERS AS FOLLOWS:
   PIN 18 AND 19 ON THE EXCITER MULTIPLIER BOARD ARE BRIDGED.
   5R22, 5R23, 5C34 AND 5Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS.
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD.
3. 0 - VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ‡ NOISE INPUT REMOVED
5. M - RECEIVER MUTED. UM - RECEIVER UNMUTED.
6. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION
7. RESISTORS IN OHMS K=1,000 ; M=1,000,000
   CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF

SOLID STATE CARPHONE 10M
F.M. MOBILE TRANSMITTER - RECEIVER
70 - 85 MHz
10M/3 TYPE 3J63831 (NARROW BAND)
10M/63 TYPE 63J63831 (WIDE BAND)
DRG. 63831H3


RECEIVER INPUT FILTER
DRG. 63831 V23A
30L1
317V57963
30L3
317V57963
30L2
318V57963
30RLB1
PIN 5
30PLA
30SWB
RECEIVER R.F. — I.F. AMPLIFIER
TYPE 5R63835
PREFIX 5
* SEE TABLE BELOW
NARROW BAND
FILTER Q1
TO SPEC. 61966D1
1Q62099
C34 R22 R23
3·3 1·5K 1·2K
1·8 1·8K 2·2K
WIDE BAND
FILTER Q1
TO SPEC. 61966D3
1Q62095
C34 R22 R23
2·2 3·9K 5·6K
1·8 4·7K NOT USED
30RV1
25K
VOLUME
30 SWA-2
MICROPHONE
1E63837
FROM 30 RLA1
PIN 8
EXCITER MULTIPLIER
TYPE 2R63835
PREFIX 2
FROM 30RLA2
PIN 14
POWER AMPLIFIER
TYPE 3J63836
PREFIX 15
28 SWB
CAPACITOR NOT FITTED
DENOTES
NOTES :
1. CIRCUIT AS DRAWN IS FOR NARROW BAND. FOR WIDE BAND UNIT THE CIRCUIT DIFFERS AS FOLLOWS :
PIN 18 AND 19 ON THE EXCITER MULTIPLIER BOARD ARE BRIDGED.
5R22, 5R23, 5C34 AND 5Q1 ARE IN ACCORDANCE WITH THE TABLE ADJACENT TO THOSE COMPONENTS.
2. ALL VOLTAGES MEASURED WITH RESPECT TO COMMON NEGATIVE LINE IN RELEVANT BOARD.
3. ϕ - VOLTAGES MEASURED WHEN STAGE QUIESCENT OR UNDRIVEN
4. ‡ NOISE INPUT REMOVED
5. M - RECEIVER MUTED. UM - RECEIVER UNMUTED.
6. OAK SWITCHES VIEWED FROM KNOB END IN EXTREME ANTICLOCKWISE POSITION
7. RESISTORS IN OHMS K=1000 ; M=1,000,000
CAPACITORS IN μF (e.g. ·01) OR PF (e.g. 150) ELECTROLYTICS IN μF