Service Manual

Pye Telecommunications Ltd

VHF FM MOBILE RADIOTELEPHONE Type M294

Publication Ref No. TP267

WARNING

Certain semiconductor devices used in this equipment contain Beryllium Oxide. If inhaled, dust from this oxide can be toxic.

No danger can arise from normal handling but no attempt should be made to tamper with these devices.

They should not be discarded with industrial or domestic waste.

This Service Manual is for the maintenance of Pye Telecommunications equipment. The performance figures quoted are typical and are subject to normal manufacturing and service tolerances.

The right is reserved to alter the equipment described in this manual in the light of future technical development.

VHF FM MOBILE RADIOTELEPHONE

TYPE M294

SERVICE MANUAL

ISSUE 1

NOVEMBER 1979

PYE TELECOMMUNICATIONS LIMITED CAMBRIDGE ENGLAND
Printed in England

TP267

AMENDMENT LIST

Changes made to the equipment described in this publication are published as amendments which are dated and consecutively numbered.

Reprints will incorporate all the amendments to date and an entry to this effect will be recorded on the amendment list below. Each page affected by amendment action will bear the amendment number as a suffix to the reference number eg TP123/4 indicates that the page has been corrected by amendment number 4.

Should it be necessary to raise the issue of a publication the amendment numbering will recommence with No. 1.

Amend't No.	Date	Initials	Remarks

ERRORS & OMISSIONS

The usefulness of this publication depends upon its accuracy. Whilst every endeavour has been made to minimise errors, some may exist. It is therefore requested that any errors or omissions noted be advised as follows:—

Please quote:

a) Title of publication
b) TP No. and issue No.
c) Last amendment No. received
d) Page and/or Fig. No. in error

Please send to:

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Mariners Way
Cambridge CB4 1BN
England

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SECTION 1

GENERAL INFORMATION

SUMMARY OF DATA

General

Operation	A3, single or two-frequency simplex
Modulation	Phase (frequency)
Frequency bands	1. A Band 148–174 MHz* 2. B Band 132–156 MHz 3. M Band Tx 105–108 MHz, Rx 138–141 MHz 4. P Band Rx 96–106 MHz, Tx 79–88 MHz 5. E Band 68–88 MHz *This publication pertains to A Band equipment only, less options. Details of options and other frequency bands will be issued as information becomes available.
Channel Spacing	12,5 kHz (S) 20 kHz (R) 25 kHz (V) 25 kHz (C) temperature controlled
No. of Channels	Single, or 1 to 6 channels
Operational environment	This equipment is designed for operation from –30°C to +60°C and meets EIA recommendations or relevant national specifications
Frequency stability	(i) Standard ±10 ppm over the range –30°C to +60°C (ii) ±5 ppm, over range –10°C to +60°C, optional, all bands (iii) ±5 ppm over range –30°C to +60°C, optional. A and B bands only, using thermistor temperature controlled crystals
Power supply	12V (Nominal) DC supply. Negative ground
Current consumption	Receive (standby) approx. 300 mA Transmit – approx. 5 amps at 25W output power
Operator controls	On/Off switch Volume Channel selector (multiple channel only) Options controls (when fitted).
Indicator Lamps	(i) 'On' indicator lamp – green. Light pipe diffuses light through graphics and edge lights volume and on–off control. It also illuminates channel numbers (when fitted). (ii) Tx indicator lamp – red (iii) Various indicator lamps depending on options
Cabinet radiation	To CEPT specification
Dimensions	Main unit: 180 mm x 52 mm x 190 mm Speaker unit: 146 mm x 95 mm x 67 mm

Weight	Main Unit: 2,5 kg Speaker Unit: 0,5 kg
Options*	(i) ±5 ppm, −30°C to +60°C A and B bands only. 1 to 6 channels, ±5 ppm, −10°C to +60°C, all bands (ii) A200 add-on amplifier (iii) Range of selective call modules (iv) CTCSS (Tone squelch). Single tone or 6-tone selectable (v) Selective call and CTCSS combined (vi) Transmission timer, incorporated in microphone (vii) Desk-top power supply type AC200 PU (viii) Up to 6 ft. extended control with microphone/ Controller. Single channel only. Includes volume control, On lamp. Tx call and Busy lamps, and provision for squelch defeat. (ix) Transportable case (P200 PU)

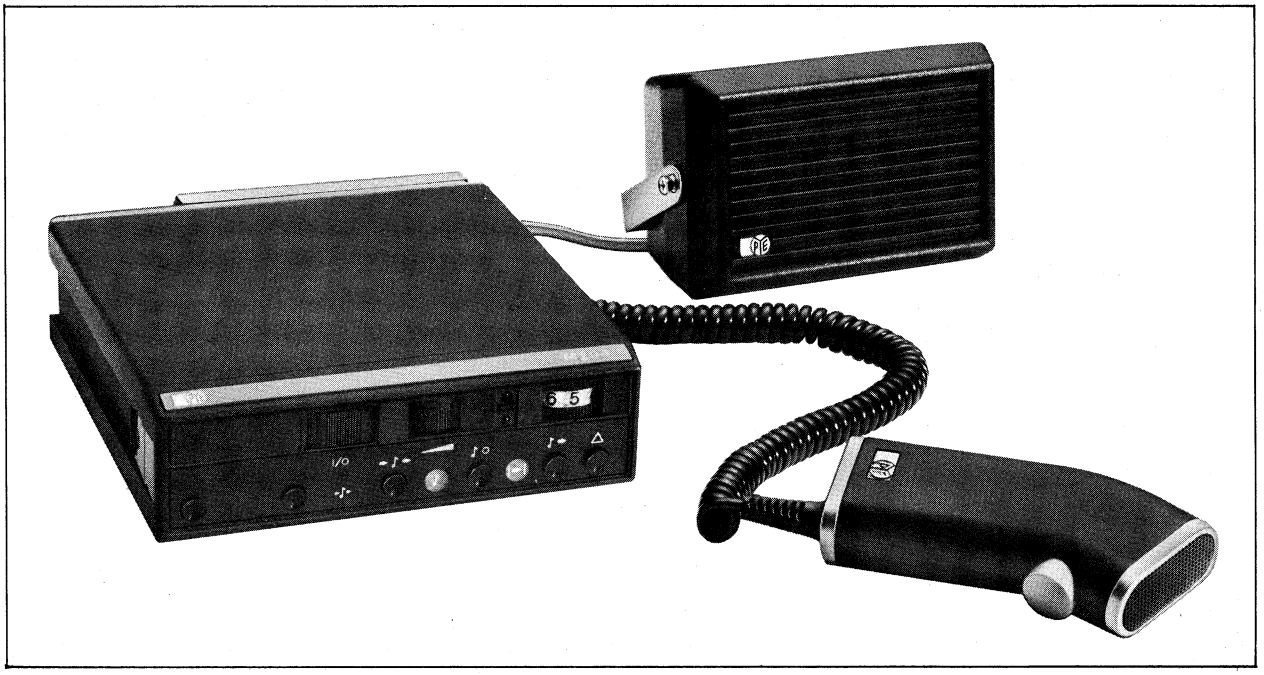
Receiver

Input Impedance	50Ω
SINAD ratio	12 db SINAD at 0.31µV PD signal input at 60% modulation with 1 kHz tone
Audio output	Minimum 3W with less than 5% distortion into 3Ω load. Alternatively speakers can be connected in parallel resulting in 6W into a 1,6Ω load with less than 10% distortion.
Audio distortion	Less than 5% at 60% modulation with 1 kHz
Audio response	+1 db to −3 db of a 6 db per octave de-emphasis characteristic between 300 Hz and 3 kHz.
Spurious response attenuation	Better than 80 db, including adjacent channel and image frequency
Squelch sensitivity	Adjustable between 0.15µV and 0.6µV PD
Switching bandwidth	±0.2% of mean operating frequency 0,5 % mulig

Transmitter

Output impedance	50Ω
Power output	(i) 25W minimum (30W typical) at 13,2V DC input (ii) 6W 10W or 15W (iii) 70W minimum using A200 amplifier.
Spurious outputs	Each less than 0.25µW
Modulation deviation	±2.5 kHz for 12,5 kHz channel spacing ±4 kHz for 20 kHz channel spacing ±5 kHz for 25 kHz channel spacing

Audio response	+1 db to −3 db of a 6 db per octave pre-emphasis characteristic between 300 Hz and 3 kHz
Modulation distortion	Less than 3% at 60% system deviation
Switching bandwidth	±0.5% of mean operating frequency
Modulation sensitivity	Adjustable between 1mV and 25mV for 60% system deviation. (Normally set to 4mV).



INTRODUCTION

The Pye M294 is a front-mount VHF FM mobile radiotelephone designed for two-way communication between mobiles and a base station. The equipment operates on fixed, crystal-controlled frequencies in the range 68—174 MHz, using either single or two-frequency simplex working.

Single and multiple channel versions of the radiotelephone are available; in multiple channel sets, provision is made for up to six communication channels, spaced within the equipment switching bandwidth. Frequency stabilities to meet various requirements are offered as options.

The receiver delivers 3W at less than 5% distortion into a 3Ω load. Alternatively, the use of two loudspeakers in parallel allows the receiver to deliver 6W at less than 10% distortion into a 1,6Ω load. This arrangement is intended for use in environments having a high level of background noise.

The transmitter can generate a modulated carrier of 25W minimum into a 50Ω load. Power output can be increased to 70W minimum by means of an add-on amplifier type A200. Transmitter output is continuously adjustable down to 6W by means of a potentiometer. However, equipments are normally despatched preset to either 6W, 10W, 15W or 25W.

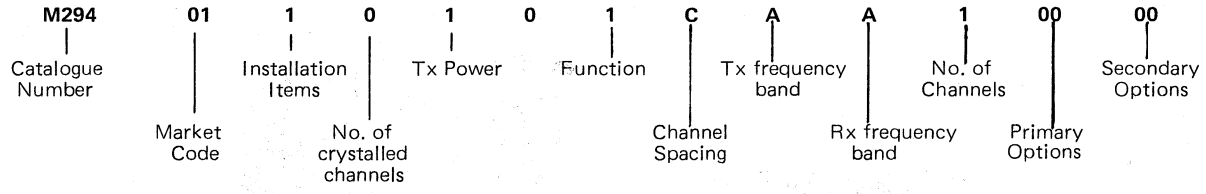
The power supply is 12V nominal, negative ground, with provision for switching auxilaries via the transmitter/receiver on/off switch. A 24V/12V regulator unit type VR200 can be used with 24V DC, negative ground systems.

The complete installation comprises a compact transmitter/receiver, external loudspeaker, fist mic, and associated fixings. Space is reserved within the transmitter/receiver for optional signalling modules, whose status and related visual information is displayed on the front panel.

EQUIPMENT VARIATIONS

Equipment Label

The make-up of an equipment will vary according to the role in which it is used; a code number being shown on the Equipment Label (together with the catalogue and serial numbers) attached to the transmitter/receiver case. A typical equipment number is given below:—



Frequency Label

The transmit and receive frequencies for each channel, when known, are shown on the frequency label attached to the transmitter/receiver case. Should the equipment be supplied "less crystals" it should be checked on the recommended test frequencies as detailed under 'Test Frequency Crystal Information' in Section 2 of this publication.

Market Code

01 — Standard Production

Installation Items

The equipment can be supplied (by agreement) as follows:—

Code 1 With standard mounting kit and loudspeaker
2 With standard mounting kit less loudspeaker

No. of Crystalled Channels

0 — Less crystals
1—6 — No. of crystalled channels

Tx Power

1 — 25 watts
2 — 15 watts
3 — 10 watts
4 — 6 watts

Function

1 Less tone options, front panel fitted with 'M294' Label
2 Less tone options, front panel less 'M294' label

Channel Spacing

S	–	12,5 kHz
R	–	20 kHz
V	–	25 kHz
C	–	25 kHz – equipment fitted with temperature controlling device

Transmitter Frequency Band

See page 1.1

Receiver Frequency Bands

See page 1.1

No. of Channels

1	Single channel
6	Six channels

Primary Options

00	Less options
20	Fist microphone (can be supplied inclusive of transmission timer)

Secondary Options

00	Less options

SECTION 2

INSTALLATION AND OPERATION

PRE-INSTALLATION CHECKS

CAUTION
'Pozidriv' screws are used in this equipment. Use only the appropriate size of 'Pozidriv' screwdriver.

1. Unpack container and check items against Contents List given in this section.

   Note: Pye Telecommunications Ltd, or their authorised agents, must be notified by letter within ten days of receipt of equipment, if any damage or shortages are found.

2. Fit 6,3A fuse into fusebox, and connect power supply to equipment, ensuring that the live is fused, and that supply polarity is correct (–ve ground). Adjust the power supply for 13,2V output.

3. Using a Signal Generator, Audio Output meter, and RF Output meter, check equipment serviceability as follows:–

   Notes: 1. The following check is intended only as a means of rapidly checking equipment serviceability. It does not replace or preclude any of the tests and adjustments quoted in Section 4 of this handbook.

   2. Crystals are normally fitted before shipment, and the Frequency label (equipment case) suitably inscribed with details of Tx and Rx frequencies for each channel. Should the equipment be shipped less crystals, it should be checked on the recommended Test Frequencies detailed on page 2.2.

   (a) Connect audio output meter to loudspeaker socket and connect signal generator to antenna socket, ensuring press-to-talk switch cannot be accidentally operated.

   (b) Adjust signal generator to receiver channel frequency, modulated 1 kHz at 60% system deviation. Set signal level to 1μV PD.

   (c) Press the Off/On button, and check that the 'On' Lamp is lit. Select the required channel by rotating the channel selector switch until the appropriate number appears in the centre of the aperture. Using a marker oscillator in the vicinity of the 1st IF stage, adjust the generator frequency for a zero beat. Check that an output of 3W is obtainable by adjusting the volume control.

   (d) Disconnect signal generator and audio output meter.

   (e) Connect RF output meter to the antenna socket and carry out Operating Instructions for TRANSMIT. With power supply set to 13,2V, check that power output is to specification.

NETTING PROCEDURE

Equipment required

Power Supply, set to 13,2V
Frequency Counter

Obtain access to transmitter/receiver circuitry.

Connect power supply (set to 13,2V), loudspeaker, and antenna to equipment.

Receiver: With carrier received from the base station, hold marker oscillator near IF section. Adjust appropriate crystal coil core for zero audio beat note. Repeat for each crystalled channel.

Transmitter: Loosely couple frequency counter to antenna socket. Transmit (carrier only) and check frequency displayed on counter. Adjust transmitter oscillator coil, if necessary, for correct channel frequency. Repeat for each crystalled channel.

TEST FREQUENCY CRYSTAL INFORMATION (for equipment supplied less crystals)

Band	Tx or Rx	fx	Multiplication	fc	Rx Injection Frequency (MHz)
A	Tx Rx	9,9125 48,7	fc/16 $\frac{fc - 10,7}{3}$	158,6 156,8	 146,1

fx = Test crystal frequency (MHz)
fc = Test frequency (MHz)

CONTENTS LIST (Items required for installation)

Description	Part No.	Remarks
M294 transmitter/receiver	AT00236	including carrier plate
Loudspeaker assembly	AT10877/2	
Microphone and lead assembly	AT29692/02	
Handset assembly		where appropriate
Cradle assembly	AT12405	
Power lead assembly	AT36440	
Microphone rest	276661	
Cable Clamp	BT16043	Microphone Lead } Included when micro-phone is used
Support	BT26617	Microphone Lead }
Antenna	Despatched separately	
Extractor tool	BT28971	Cradle
3-way terminal block	BT30081	
6,3A fuse	FF99055	
Fuseholder	FH02839	
Plug	FP13711	Antenna feeder
Scr. st. pan slot S/T No. 10 x ½"	QQ41208/X	2/loudspeaker 4/cradle
Scr. st. pan slot S/T No. 6 x ¾"	QW41212/X	2/fuseholder, 2/mic. rest 2/connector block
Ty raps	QA04464	
Scr. No. 6 x 12,5 mm pozi pan	QJ07663/X	2/Cable clamp

INSTALLATION

Equipment Required

Circle cutter, holesaw, or socket punch
Drills (see sizes below)
Electric drill for drilling mounting holes
Soldering Iron
Screwdrivers for mounting screws

Drill sizes:—

Drill for No. 6 self-tapping screw — 2,8 mm
Drill for No. 10 self-tapping screw — 3,4 mm

Notes: 1. The cradle to be fitted can be used as a marking-out template.

2. Cables should be routed away from areas of extreme heat and possible battery acid leakage. Wherever possible, existing holes in the bulkhead should be used. If metalwork has to be drilled, ensure that the new holes are fitted with grommets.

Procedure

1. Check package against Contents List above.

2. Determine location of installation.

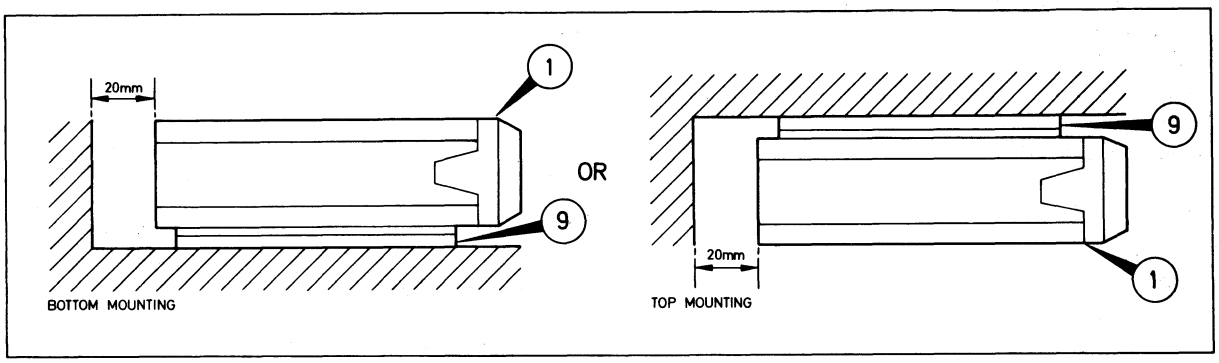
Notes: Ensure that the location of the cradle assembly is compatible with:

(i) safety of the vehicle occupants
(ii) ease of equipment operation when seat belts, if fitted, are worn
(iii) ease of equipment extraction

Avoid mounting in line with air flow from heater or air-conditioning vents.

Avoid mounting in small enclosed spaces (e.g. glove lockers), especially if the unit is to be used frequently or for long periods in the transmit condition.

To prevent excessive self-heating, the unit should have an unobstructed airflow space of at least 20 mm from the rear and any two of the remaining four sides.

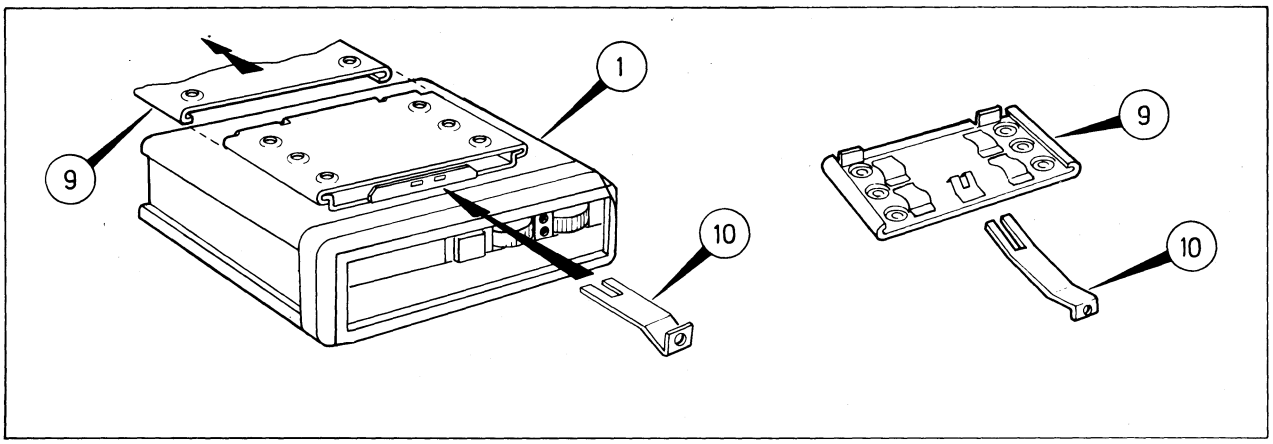


When finalising the locations of the items to be installed the lengths of the following cables should be noted:

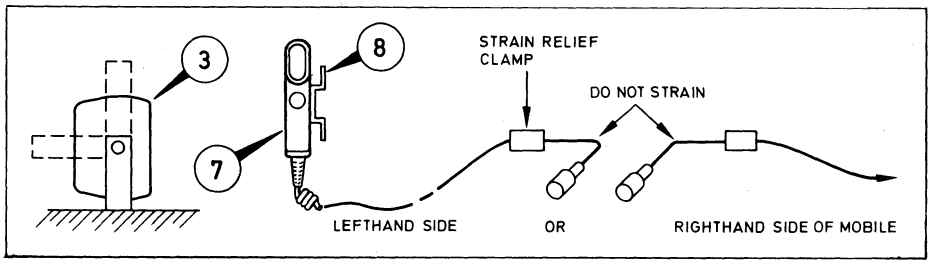
Power leads	—	170 mm
Antenna flying lead	—	170 mm
Microphone flying lead	—	170 mm
Loudspeaker Lead (attached to M294)	—	170 mm
Loudspeaker Lead (attached to loudspeaker)	—	1000 mm

3. Remove cradle assembly using the extractor tool supplied with the bagged items.

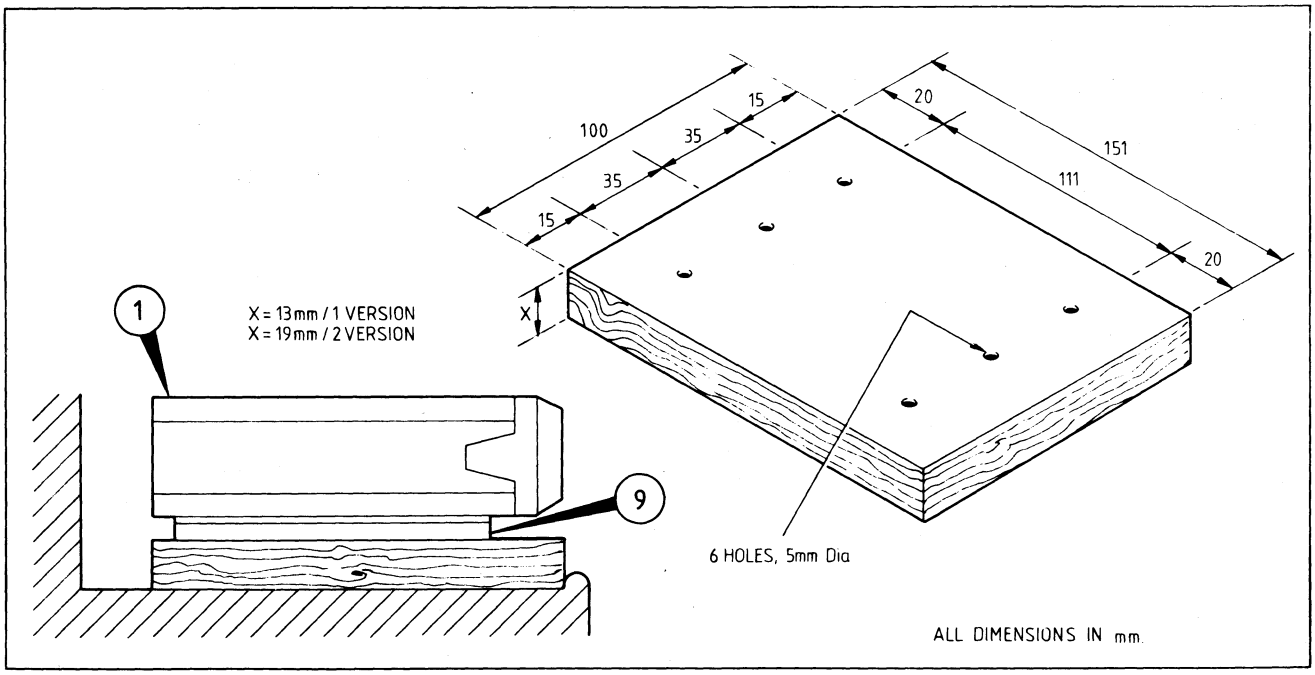
Note: The equipment is supplied with the carrier plate fitted to the top side of the outer casing. To reverse the location, remove the four screws securing the rear panel to the case. Next remove the front panel by releasing the screw fixing on each side. Withdraw the chassis and turn it through 180°. Refit chassis, and both front and rear panels.



4. Install cradle assembly (locating spring to front), loudspeaker, microphone rest, and strain relief clamp.



If required to mount the equipment on a ledge or shelf having a lip along its leading edge, the equipment cradle can be mounted on a locally manufactured wooden block, details of which are shown. This arrangement facilitates easy extraction of the equipment.



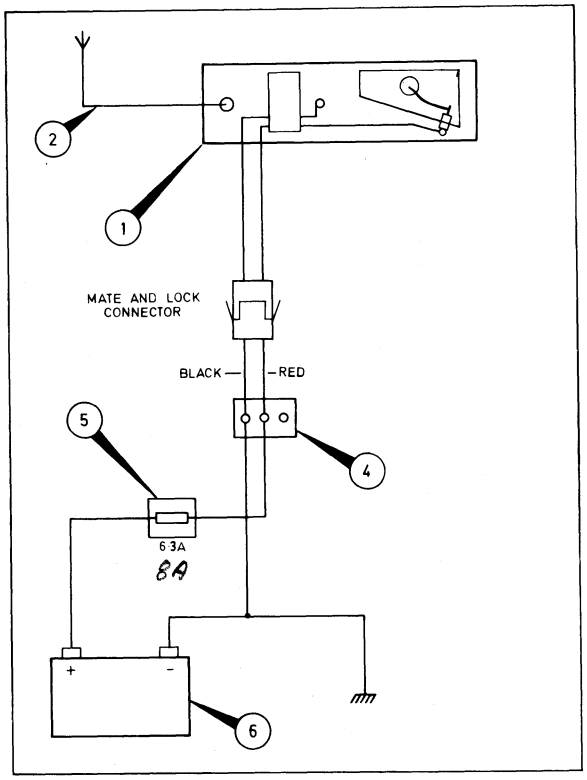
5. Mount antenna. See Antenna Fixing Instructions for details. Connect feeder plug ensuring that the clamp nut is tight enough to ensure both a good fit and good retention.

6. Connect vehicle battery to installation supply.

12V Supply

CAUTION

This equipment can only be used with a negative ground supply.



Notes: Cable (not supplied), used between battery and connector block should be 63/0.2 mm

Power leads are colour coded:
Red – positive
Black – negative

(i) Secure fuse box ⑤ close to battery ⑥

(ii) Wire from battery to connector block, ④ routing positive lead via fuse box.

(iii) Connect power leads to terminal block ④ and connect to M294 flying lead via the mate 'n' lock connectors.

(iv) Connect loudspeaker ③

(v) Connect antenna feeder plug to antenna flying lead.

(vi) Connect microphone plug to flying lead. Finger tighten the bayonet locking ring.

(vii) Slide all protective boots into position.

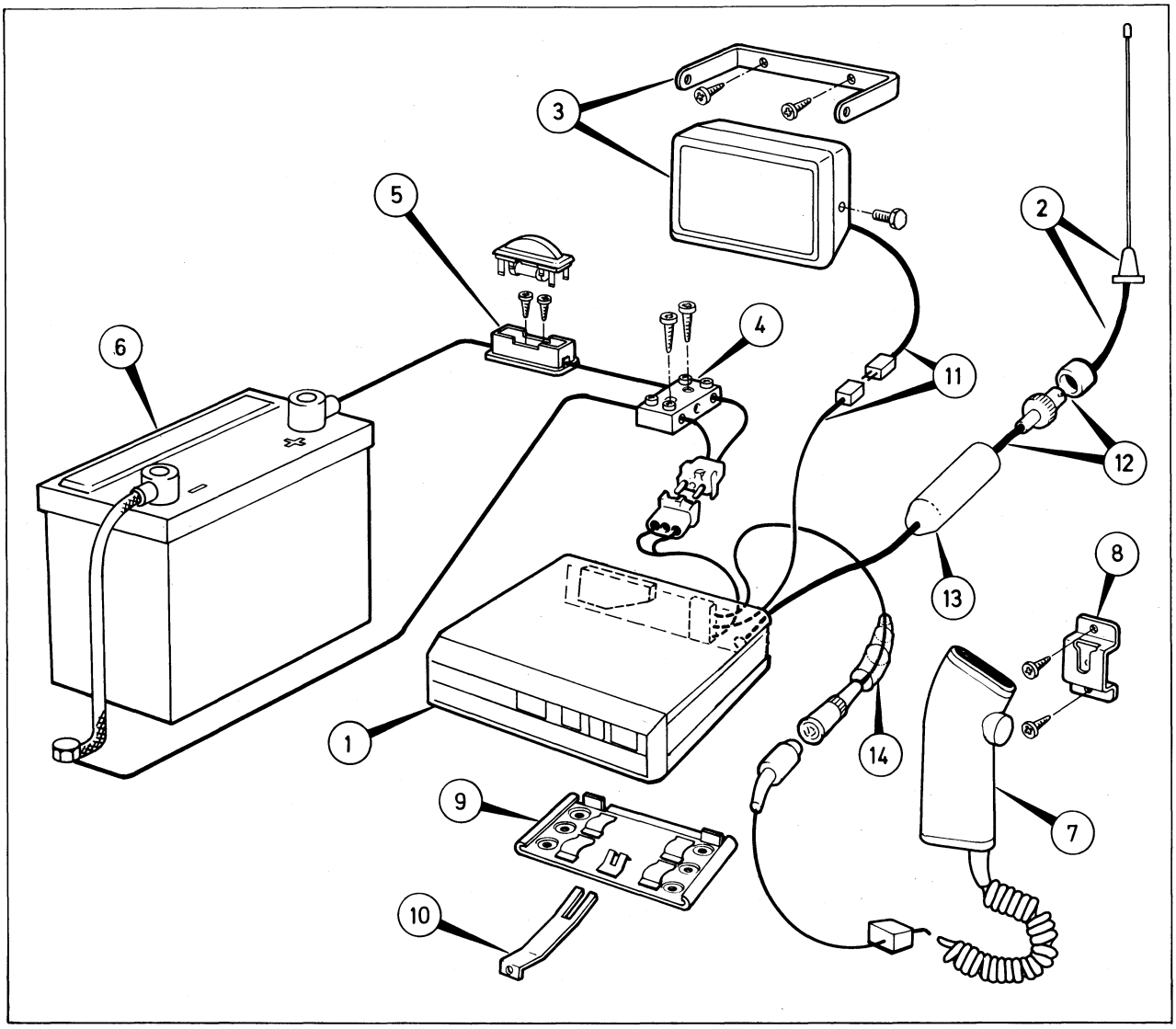
CAUTION

Protective boots must be correctly positioned in order to avoid accidental short-circuiting due to contact with other vehicle wiring.

(viii) Use tyraps to secure leads and finalise installation

CAUTION

Before switching on the radiotelephone, ensure that the polarity of the power supply connections agrees with the cable coding.



LEGEND

NOTE: These indicator numbers only apply to drawings shown in this Installation Procedure

1. Transmitter/Receiver
2. Antenna and Feeder Cable
3. Loudspeaker Assy.
4. 3-Way Connector Block
5. Fuse Box
6. Battery
7. Microphone and Lead Assy (showing strain relief clamp)
8. Microphone Rest
9. Cradle Assy.
10. Cradle Extractor tool
11. Loudspeaker Lead
12. Antenna Lead
13. Protective Boot for Antenna Connectors
14. Protective Boot for Mic. Connectors

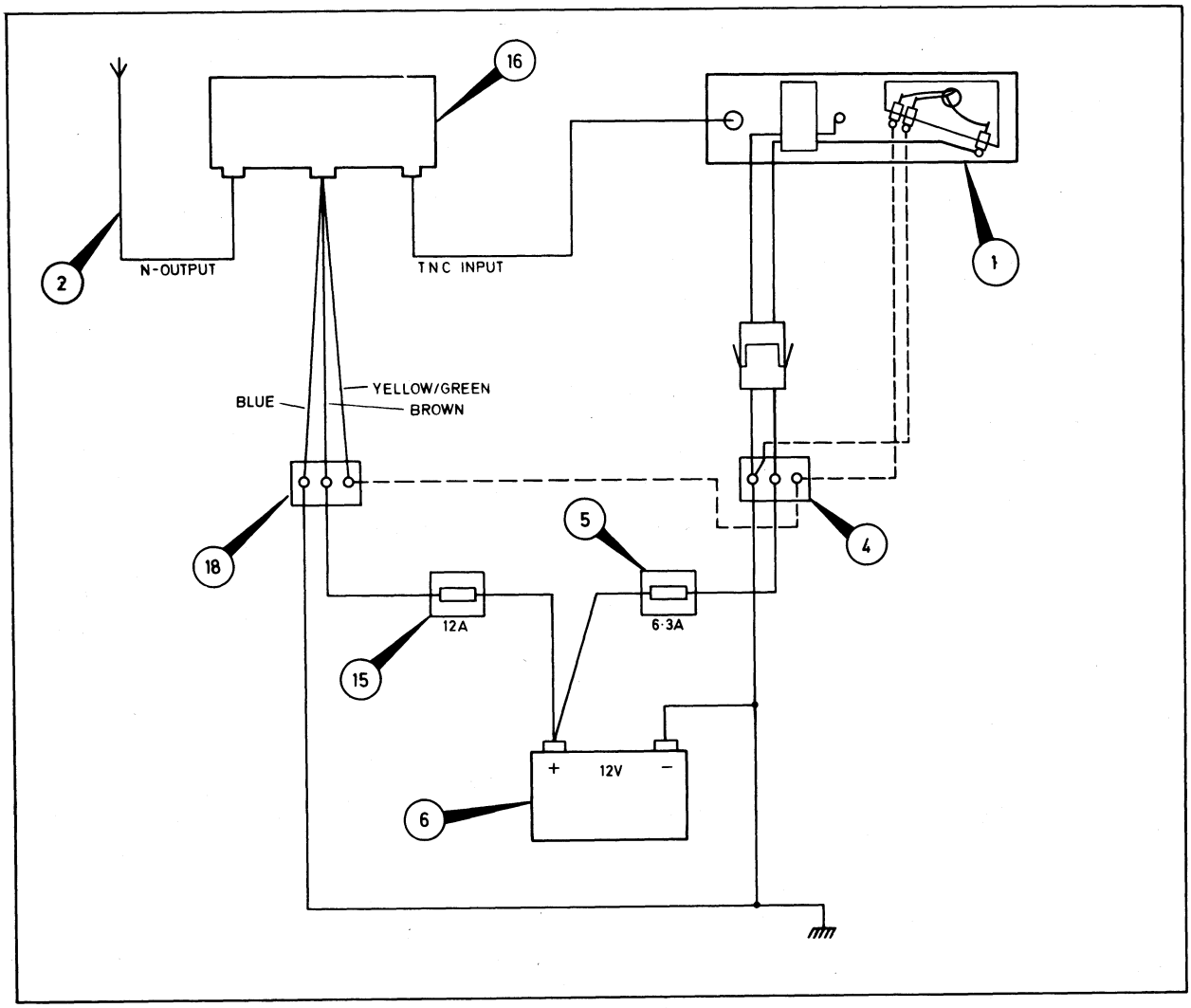
CONNECTION OF ANCILLARIES

AMPLIFIER A200 (Not suitable for 24V systems)

Notes: *Independant wiring, fused at 12A, is required for the A200 power supply, which must, in this application, be negative ground only.*

A 3-core cable is supplied. Fixing screws and their sizes and disposition are contained in the bagged items supplied with the A200.

The amplifier unit is contained in a weatherproof die-casting, which should if possible be mounted in a clean dry location.

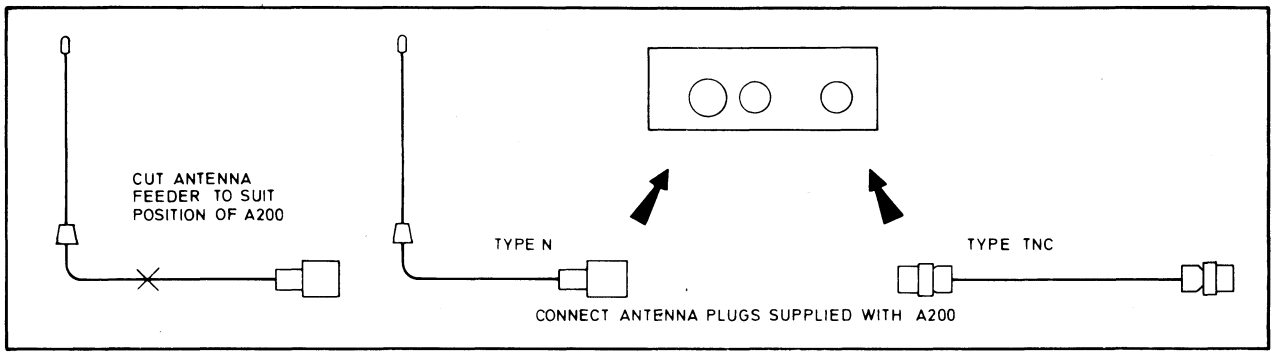


1. Site the amplifier (16) on the route of the antenna feeder. Fix the mounting plate and secure amplifier to it, with SKB (N-type socket) nearest the antenna.

2. Cut the antenna feeder to suit amplifier location. Terminate the free end of the coaxial cable still attached to the antenna with the N-type plug and terminate the free end of that attached to the radiotelephone with the TNC plug. Connect plugs to the appropriate amplifier socket.

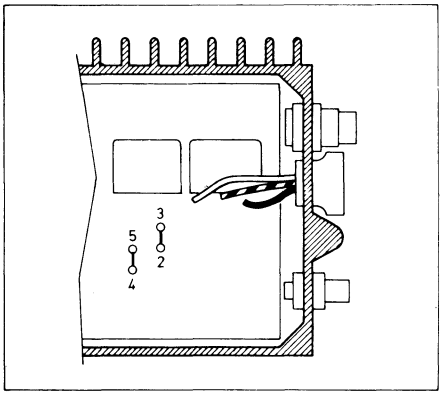
3. Position terminal block (18) within 0,5 metres (1'8") of the amplifier, and connect the amplifier 3-core cable to it.

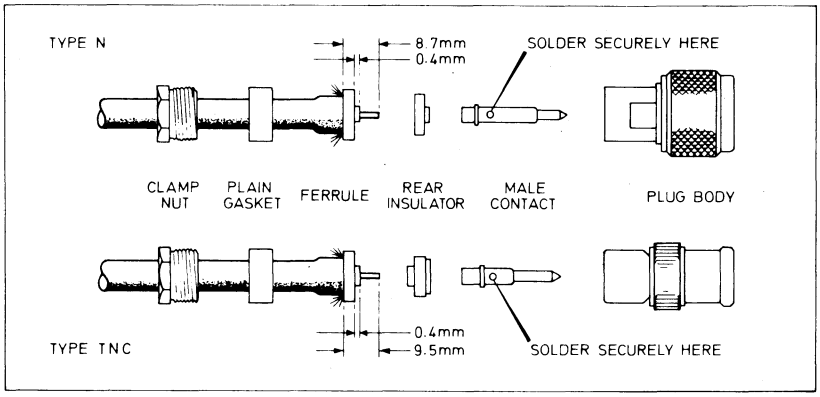
4. Fit fuse holder (15) close to the battery. Connect the permanent wiring from the vehicle battery to terminal block (18) fusing the live lead at 12A.

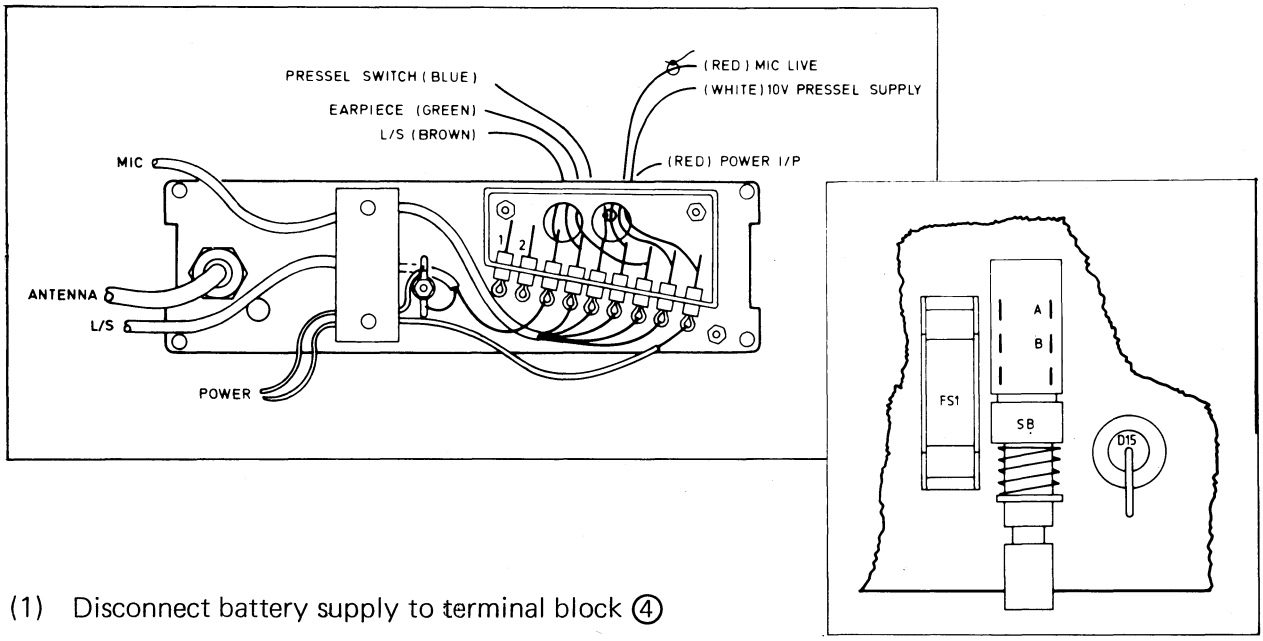


The A200 power supply is now permanently connected, and the amplifier is switched by the presence of an RF signal.

Should power switching from the radiotelephone Off/On switch be required, proceed as follows:—







(1) Disconnect battery supply to terminal block ④

Note: Wire is not supplied for steps (2) and (3).

(2) Connect a wire between the yellow/green core of the A200 cable at terminal block ⑱ and the unused part of terminal block ④

(3) Remove the M294 rear panel cover. Release the four pozidriv screws securing the rear panel to the M294 case. Slide the PWB and rear panel assembly clear of the case and locate the spare feedthrough capacitors 1 and 2; also locate spare tags A and B of the Off/On switch. Connect a wire from the yellow/green core connection at terminal block ④ to feedthrough capacitor 1. Wire from feedthrough capacitor 1 to tag A of the Off/On switch. Wire from tag B to feedthrough capacitor 2. Wire from feedthrough capacitor 2 to the negative connection (black core) at

terminal block④ Refit the PWB and rear panel into the M294 case and tighten the four pozidriv screws. Re-fit the M294 rear panel cover.

(4) Remove the top cover of the A200 and cut links 2/3 and 4/5 on the motherboard.

(5) Re-connect battery leads to terminal block ④

VOLTAGE REGULATOR VR200 (–ve ground only)

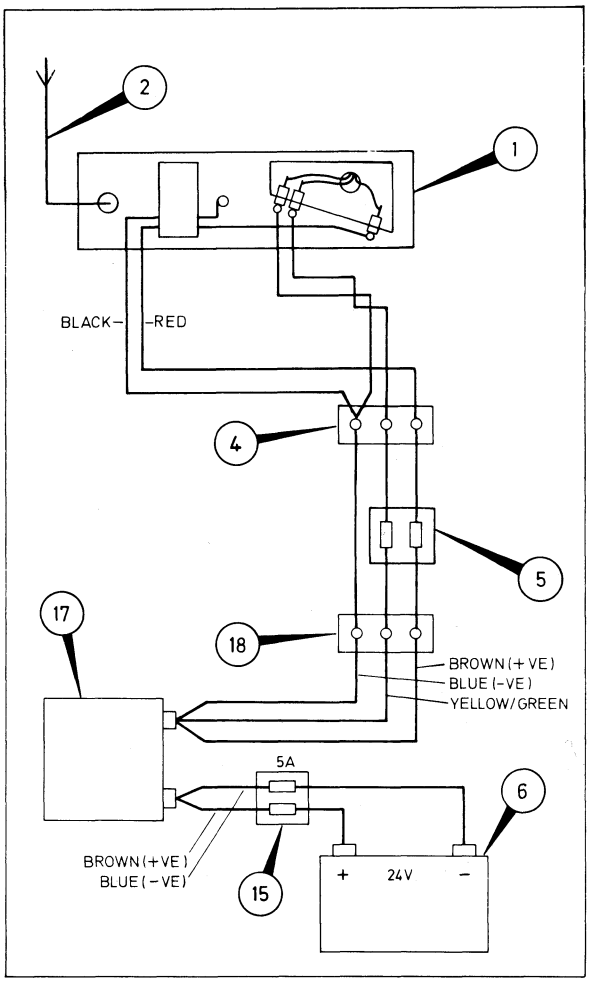
Regulator VR200 ⑰ required.

1. Connect 24V supply to VR200 ⑰ input, fusing both leads at 5A.

2. Connect VR200 12V output to terminal block ⑱ fusing positive and negative leads (brown and blue) at 6.3A.

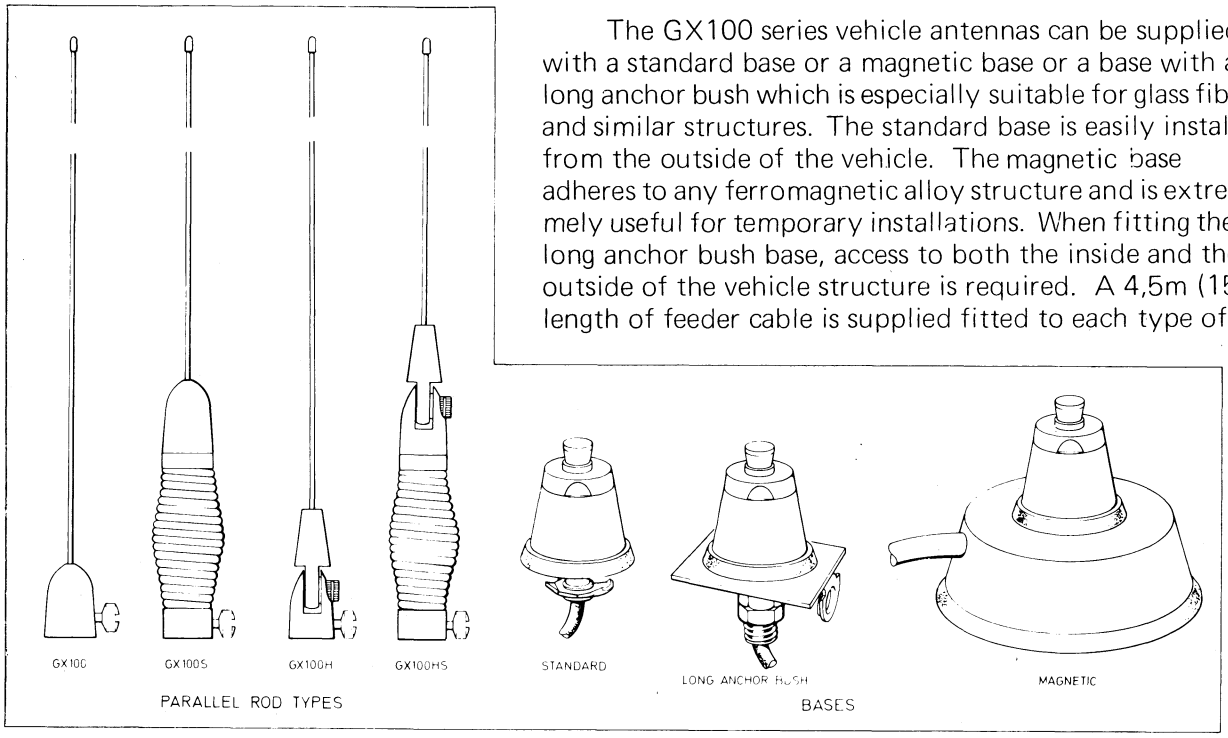
3. Connect M294 power leads to terminal block ④ as shown.

4. Remove the M294 rear panel cover. Release the four pozidriv screws securing the M294 rear panel to its case and slide out the PWB and rear panel assembly. Locate spare feedthrough capacitors 1 and 2; also locate tags A and B of the Off/On switch. Connect a wire (not supplied) between the negative connection (black core) at terminal block④and feedthrough capacitor 1. Connect a wire between feedthrough capacitor 1 and tag A. Connect a further wire between tag B and feedthrough capacitor 2. Finally connect a wire between feedthrough capacitor 2 and the VR200 yellow/green core at terminal block④ Refit the PWB and rear panel into the M294 case. Tighten the four pozidriv screws and re-fit the rear panel cover.



ANTENNA INFORMATION

VHF QUARTER-WAVE VEHICLE ANTENNA (GX 100 SERIES)



The GX100 series vehicle antennas can be supplied with a standard base or a magnetic base or a base with a long anchor bush which is especially suitable for glass fibre and similar structures. The standard base is easily installed from the outside of the vehicle. The magnetic base adheres to any ferromagnetic alloy structure and is extremely useful for temporary installations. When fitting the long anchor bush base, access to both the inside and the outside of the vehicle structure is required. A 4,5m (15ft) length of feeder cable is supplied fitted to each type of base.

The antenna rod assemblies are clamped to the base with a coin-slot screw, making removal for carwash etc. an easy operation. An Allen screw, which is also supplied, can be used as an alternative to discourage the unauthorised removal in areas where vandalism is prevalent.

IDENTIFICATION

Except for the standard fixed parallel rod type GX100, suffix letters are used to identify the items included in the make-up of the antennas. The suffices are read from the top of the antenna downwards e.g. GX100TS is a tapered rod with a spring. The following suffix letters are used; S = spring; H = hinge mounting; HS = hinge and spring; T = tapered; TS = tapered with spring. The various combinations available in the series are detailed in table 1.

The standard base is supplied unless a special is indicated by /mag, or /LAB.

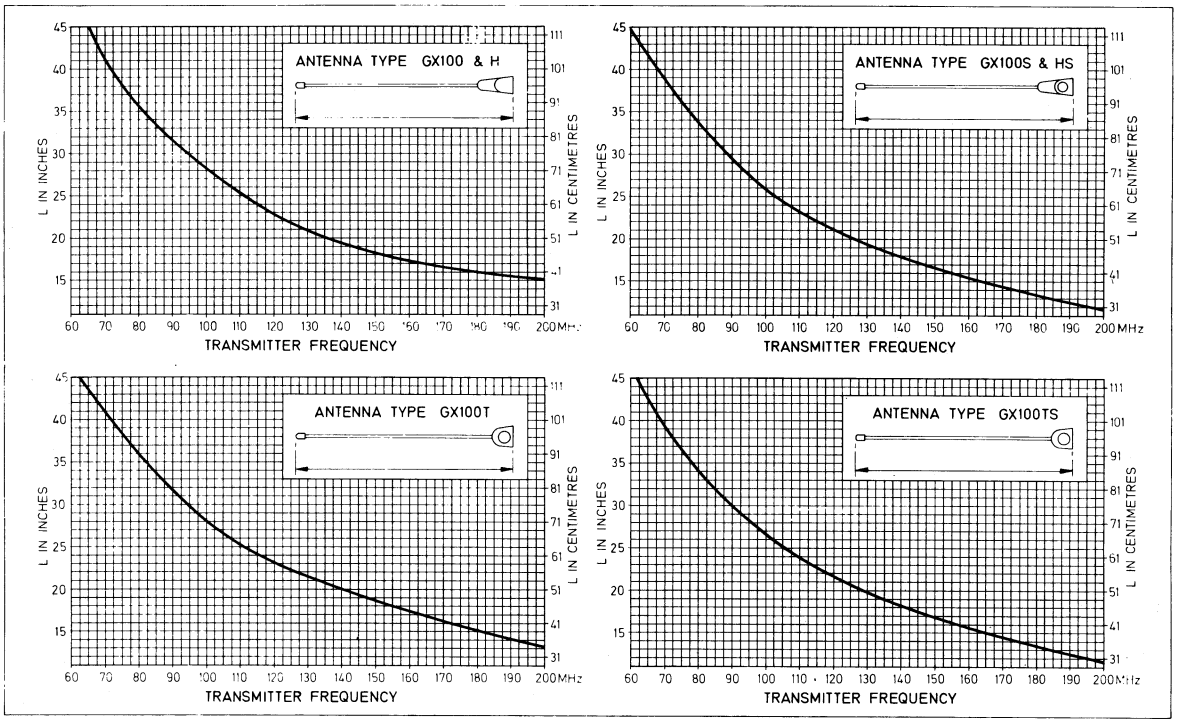
TABLE 1

Type	Rod	Rod Assembly Ref. No.	Base Assembly Ref. No.	Max. Height Inc. Base Standard mm (in)	Max. Height Inc. Base Magnetic mm (in)
GX100	Parallel	9638599	9638613	1108 (43⅝)	1140 (44⅞)
GX100S	Parallel	9638600	(standard) or	1168 (46)	1180 (44¼)
GX100H	Parallel	9638601	9638632	1118 (44)	1150 (45¼)
GX100HS	Parallel	9638602	(Magnetic) or	1176 (46⅜)	1208 (47⅝)
GX100T	Tapered	9638603	9638633	1108 (43⅜)	1140 (44⅞)
GX100TS	Tapered	9638604	(Long Anchor Bush)	1168 (46)	1200 (47¼)

Cutting Length

The antenna rods can be supplied in standard length or cut to suit specific frequencies. If they are supplied uncut, the length required for an operational frequency can be determined from the following charts. The antenna must be cut to length for the transmitter frequency. If the antenna is to be used with multi-channel equipment cut the antenna for the lowest transmit frequency.

For Quarter-wave antennae not supplied with an antenna cutting chart, the antenna rod length from the top to the ground plane = $\frac{7137cm}{\text{Freq. (MHz)}}$



Fitting GX100 Series

Standard Base. When using the standard base the antenna can be fitted from the outside of the vehicle. First select the optimum location on the vehicle and drill a 16mm (⅝ in.) diameter hole. Pass the end of the feeder cable through the hole.

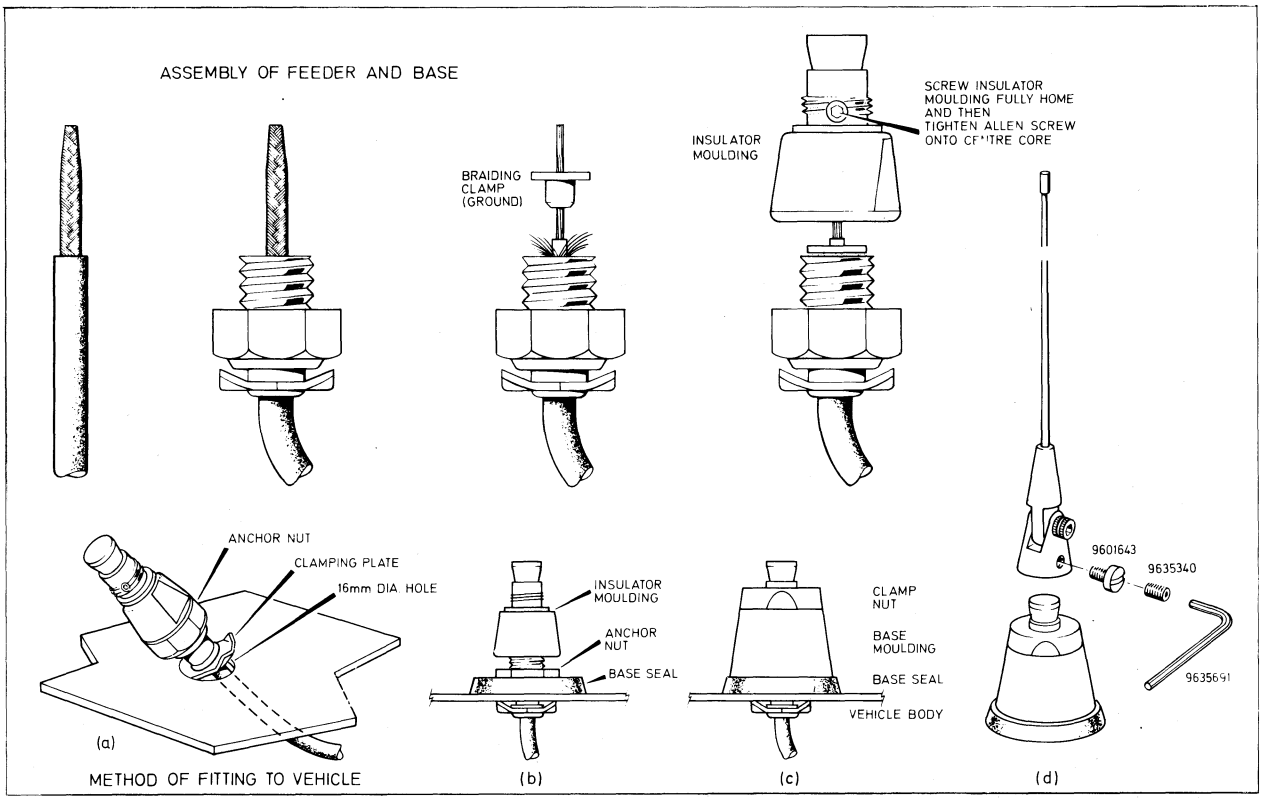
NOTE: the feeder cable is fitted to the base at the factory. Should it prove necessary to change the cable at any time the method of assembly is overleaf.

Remove the cover nut from the base and slacken the clamping nut back against the centre core connector insulating nut. Take care not to turn the insulating nut as the centre core is either crimped or soldered into the connector. Insert the clamping plate through the hole as shown in fig. (a) below. Pull the clamping plate against the vehicle body ensuring that the four upturned corners are resting evenly about the hole and tighten the clamping nut, fig (b). When clamped the corners bite through the paintwork to give a good connection to the metal of the vehicle body. Place the rubber washer over the base. Check that the spring clip is in position inside the brass stub of the cover nut to engage the centre core connector when assembled, see fig. (c). Screw the cover nut firmly against the rubber washer.

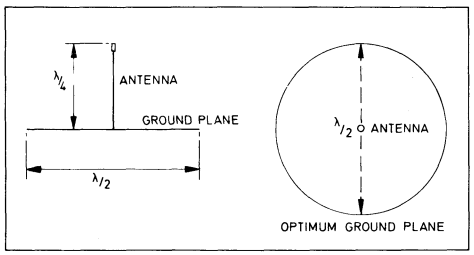
If necessary cut the rod to length and assemble with spring (if fitted) and secure the rod assembly to the base using either the coin slot screw or the Allen grub screw, see fig. (d).

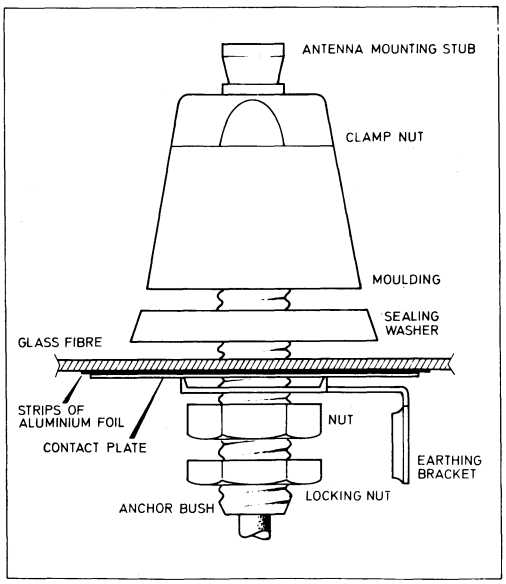
Check the insulation and continuity of the antenna from the mobile end of the feeder. Secure the feeder throughout its length and ensure it will not be damaged by sharp edges or moving parts.

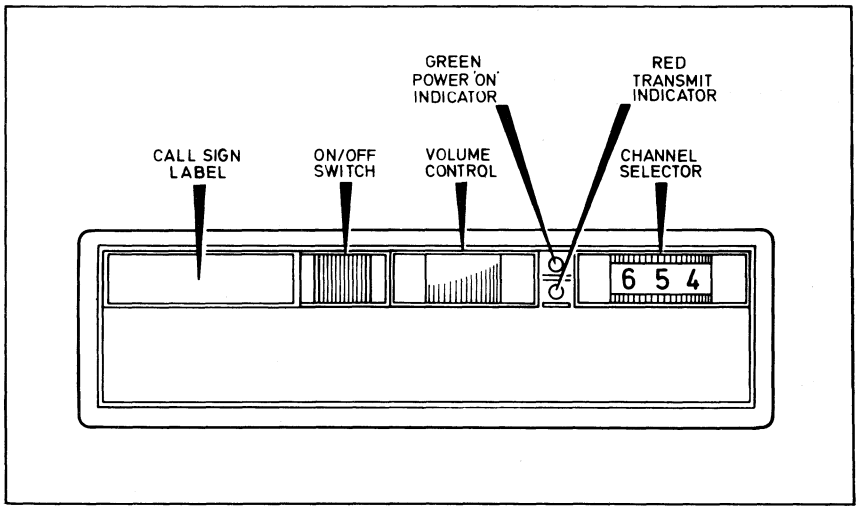
Long Anchor Bush. When fitting the long anchor bush base, clear access to both the inside and the outside of the vehicle bodywork is required. When the base is fitted to a fibre-glass body, a ground plane is required for optimum efficiency. This ground plane should consist of strips of aluminium alloy or similar conducting material fitted to the inside surface at the selected antenna site, and should be as near to λ/2 diameter as possible.



Drill a (12,7 mm) (0,5 in) hole through the structure. Remove the locking nut, earthing bracket and contact plate from the anchor bush and slide them off the feeder cable, remove the cover nut and rubber sealing washer. Pass the feeder cable through the hole in the structure, then contact plate, the earthing bracket, the nut and the lock nut. Place the sealing washer in position, screw on the cover nut and attach the antenna rod assembly using the coin slot or Allen grub screw. Run the cable over the best route to the radiotelephone avoiding sharp bends and jagged edges. Assemble rod and check insulation as described for ***Standard Base.***







Controls

All controls, with the exception of the press-to-talk switch on the fist microphone, are located on the front panel of the transmitter-receiver. Reading from left to right, these controls are:—

(a) Off/On switch — this push-button switch makes or breaks the power supply to the radio-telephone.

(b) Volume control — adjusts the speech level at the loudspeaker, volume increases as control is moved from left to right.

(c) Channel selector (when fitted) — selects required channel.

Indicators

(a) Filament lamp — Provides a green point of light. With equipment switched on, this lamp diffuses light, via a light pipe, through graphics and edge-lights volume and on/off controls. It also illuminates channel numbers when fitted.

(b) Tx On — Provides red point of light when press-to-talk switch is operated.

Reception

(a) Press the Off/On button. Check that the green point of light appears.

Note: In some applications, the equipment will be switched only by the vehicle ignition switch. In such cases, the on-off switch is left in the 'On' position.

(b) Select the required channel by rotating the channel switch until the required number appears at the centre of the window.

(c) Set volume control to mid-position. On receipt of a call, adjust control for suitable listening level.

Transmission

(a) To avoid interfering with other users of the operating channel, first listen out to ensure that no transmissions are being made.

(b) Operate the press-to-talk switch; check that the red Tx On indicator is lit.

(c) Holding the microphone one or two inches from the lips, speak clearly across its top in a normal conversational tone.

(d) Use correct operating procedure and keep transmissions short. Release press-to-talk switch as soon as the message is finished. Check Tx On indicator is extinguished.

(e) Return the microphone to its rest.

Switching Off

To switch off the set, press the Off/On switch once (unless ignition switching is used) and check that the On lamp is extinguished.

SECTION 3

TECHNICAL DESCRIPTION

GENERAL DESCRIPTION

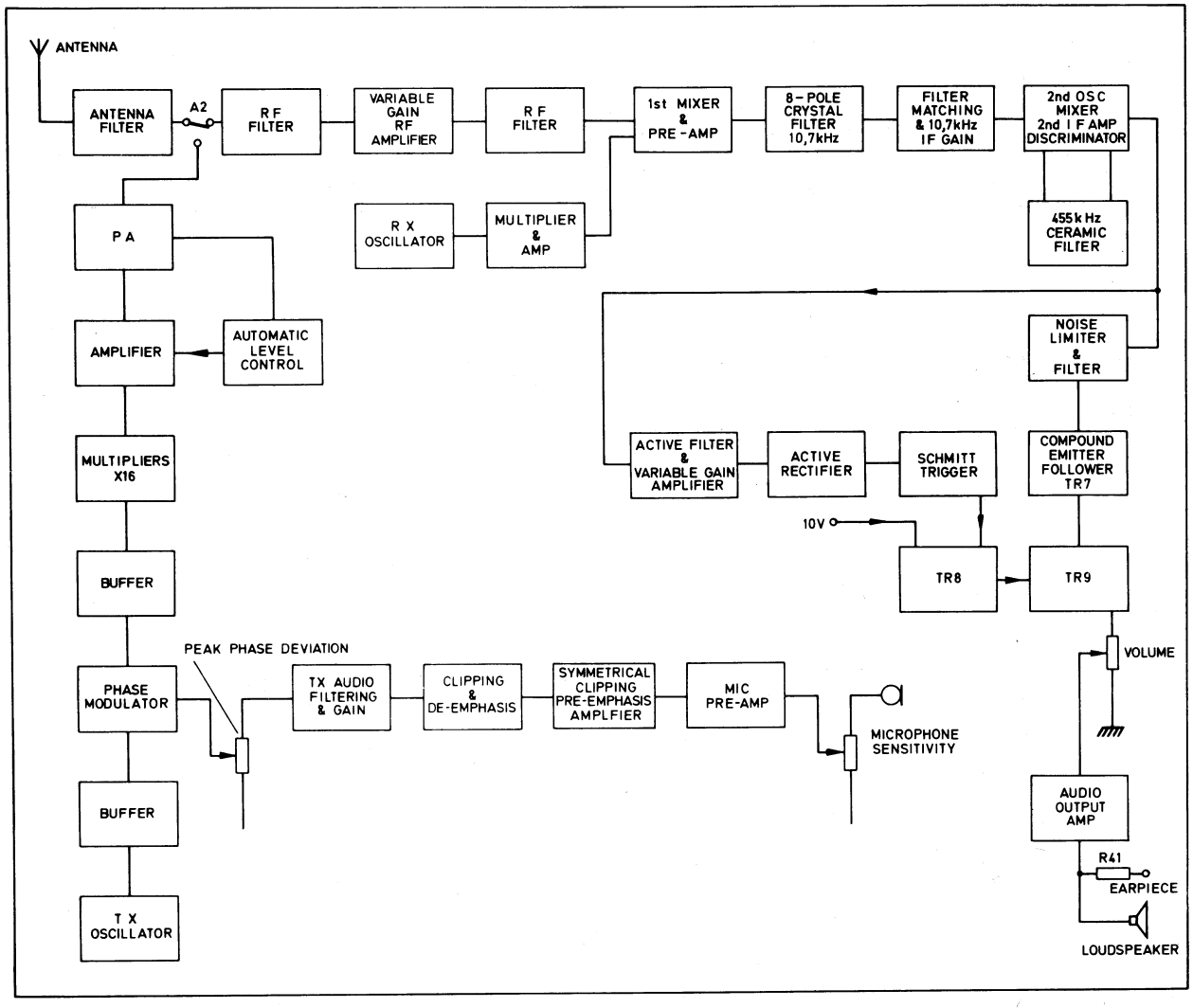


Fig. 3.1 Block Schematic Diagram – Transmitter/Receiver

Receiver

Received signals are routed via the antenna filter and the relaxed change-over contact A2 to a two-stage RF filter, and thence to a variable-gain common-gate RF amplifier. A further 3-stage RF filter follows, which, together with the first RF filters, provides image channel rejection.

Oscillator frequency is multiplied, amplifier and applied to the mixer stage, where it is combined with the RF signal to produce the 1st IF at 10,7 MHz. An IF pre-amplifier stage matches into an 8-pole 10,7 MHz crystal filter.

After filtering an emitter follower buffer stage and a common emitter voltage amplifier applies the signal to IC1, comprising 2nd oscillator, 2nd mixer, 2nd IF amplifier, and discriminator. The AF output, takes two paths; one to the squelch circuit, the other to a noise limiter and filter, and via TR9 to an IC audio output amplifier which delivers either 3 watts into a 3Ω load or alternatively 6W into a 1,6Ω load (2 x 3Ω speakers in parallel).

TR9 is gated on by TR8, itself gated on and off by the Squelch Schmitt trigger.

Transmitter

Microphone signals are fed via a sensitivity control RV5 to a pre-amplifier stage followed by a pre-emphasis amplifier. After clipping and de-emphasis, the AF is filtered, amplified, and applied to the Phase modulator via the Peak Deviation control RV6.

Oscillator frequency is combined with the AF at the Phase Modulator, which is buffered at its input and output. This arrangement isolates the modulator and results in very low modulation distortion.

After four stages of doubling to final frequency, the modulated RF is amplified and passed via the antenna filter and energised contact A2 to the antenna. An automatic level control (ALC) circuit is incorporated which maintains output at a substantially constant level. Power output is nominally 25W into a 50Ω load, but this can be continually adjusted down to 6W by adjustment of RV7.

POWER SUPPLIES AND SWITCHING

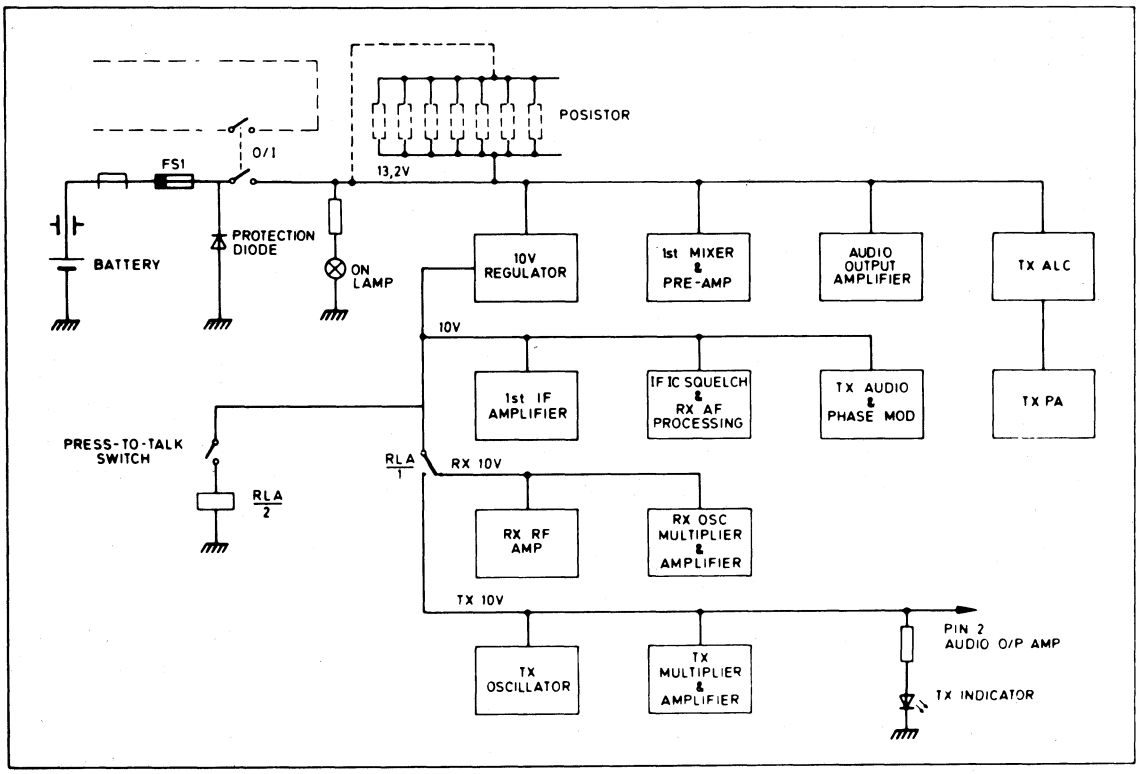


Fig. 3.2 Power Supplies and Switching

The battery 13,2V positive supply is fed via a feedthrough capacitor and a ferrite bead to the 8A fuse FS1 and one pole of the Off/On switch. A shunt diode is incorporated as protection against reverse polarity. The spare pole of the Off/On switch may be used for switching ancillaries such as A200 or VR200.

Switched 13,2V is applied to the 10V Regulator, 1st Mixer and IF Pre-amplifier, Audio Output Amplifier, and the TX ALC (Automatic Level Control) circuit, which in turn feeds the PA. A filament lamp LP1 provides a point of green light when the Off/On switch is closed and also gives illumination to transceiver controls and labels for night use.

Regulated 10V is applied to the 1st IF Amplifier, IC1, Squelch and AF Processing, Tx Audio and Phase Modulator, and the press-to-talk switch. Relaxed contact RLA1 routes 10V to the RX RF Amplifier, RX Oscillator, multiplier and amplifier, and the Squelch Schmitt trigger.

Operation of the press-to-talk switch causes RLA/2 to be energised. RLA1 transfers regulated 10V to the Tx 10V line, supplying Tx Oscillators, Tx Multipliers, and the Tx indicator LED1, which provides a red point of light. RLA2 (shown on Fig. 1) transfers the antenna filter from the RF amplifier stage to the PA output.

Voltage Regulator

The circuit consists of a series limiter TR39, controlled by TR37 via TR38; short-circuit protection being provided by D14.

The regulated voltage is sampled by TR37 and compared with the 8V reference level. Any error signal is amplified by TR38 and applied to TR39 base to maintain a stable output of between 9,8 and 10,2 volts.

R179 ensures that the regulator starts under all normal conditions.

When a short-circuit is present, D14 (together with TR38), switches off TR39 to protect the regulator, which resumes normal operation when the short-circuit is lifted.

R176 is a "select-on-test" component which sets the output voltage at between 9,8 and 10,2 volts for a 13,2V input.

DETAILED DESCRIPTION

Receiver

RF signals are routed via the antenna filter and relaxed changeover contact A2 to an RF filter L1, C1, C2, C3, L2, incorporating two high-Q resonators. This filter reduces interference due to intermodulation and other causes. A variable-gain common-gate RF amplifier follows, whose gain, preset by RV1, can be set for either best sensitivity or best intermodulation. TR1 is followed by a further stage of filtering comprising three resonators L3, L4, L5. These three, together with the initial two, provide image channel rejection.

The modified Colpitts oscillator employs a series resonant overtone crystal operating at its third harmonic. Exact frequency is set by the trimmer L9–L14, as appropriate (see also "Netting Procedure" in Section 2). When the 5 ppm frequency stability option is exercised, crystal stability is achieved by the use of self-regulating resistors, known as pozistors. These are positioned adjacent to the crystals, and kept in thermal contact with them by means of an insulating plastic cover.

L15 is tuned to the third harmonic which is amplified by TR12 and filtered by L16, L17 to provide the injection frequency. Signal frequency is added to the injection frequency across L17 and applied via C21 to the gate of mixer TR2, with L6, L7, tuned to the 1st IF at 10,7 MHz. Mixer gain is kept low, to obtain a good intermodulation figure. This arrangement necessitates a pre-amplifier stage TR3, tuned by L7. An 8-pole crystal filter FL1 is fed from L7, and provides the majority of the adjacent channel rejection.

TR4 is an emitter follower which matches the crystal filter to a gain stage TR5. The 2nd oscillator, 2nd mixer, 2nd IF Amplifier, and Discriminator are all incorporated on IC1, whose external circuitry includes the 2nd oscillator crystal, a 455 kHz ceramic filter FL2, which reduces noise bandwidth and improves adjacent channel rejection, and the discriminator tuned circuit L8, C36, C37, tuned to the 2nd IF at 455 kHz.

Audio output from the discriminator takes two paths, one to the Squelch circuit, the other to a variable-gain stage TR6, whose gain is set by RV2. This provides a steady audio output both to tone options, when fitted, and the Audio amplifier. Clipper D3, D4 form part of the noise limiter stage, with de-emphasis provided by R27, C42, C43, while TR7 and its associated components form an active high-pass filter to reduce low frequency audio noise.

Audio is gated to the Audio Output Amplifier IC2 via the emitter follower TR9, itself gated on and off by TR8 and the action of the Squelch circuit. RV3 is the Volume Control. IC2 is a short-circuit-proof thermally protected amplifier capable of delivering in excess of 3 watts into a 3Ω load, or alternatively 6 watts into a 1,6Ω load (2 x 3Ω speakers in parallel). Pin 2 of IC2 is taken to the Tx 10V line via R189 so that the amplifier is muted during transmissions. TR10 is provided as a busy lamp drive for use with tone options.

Squelch

Under no-signal conditions IC1 output consists substantially of noise, which is applied to the active filter TR36 and its associated components, where a band lying above 15 kHz is extracted. The filtered noise is then applied via TR13 to a temperature compensated amplifier TR14, whose gain is set by RV4 (Preset Squelch Control). After amplification, the noise is passed to, the active rectifier IC3, the limiting characteristic of which cuts off frequency components in excess of 25 kHz. Due to the disposition of D5, D6, amplification is much greater on the positive going half-cycles of input signal than it is on the negative. IC3 thus behaves as a rectifier, whose output is smoothed by R80, C79, and applied to the Schmitt trigger TR15, TR16. With TR15 in conduction, TR16 is switched off; this in turn switches off TR8, cutting off TR9 collector potential, and breaking the audio path.

With a signal present, the noise content of the discriminator output falls, causing the filter output to fall. IC3 output falls, and the Schmitt trigger changes its state. TR8 is switched on; in turn driving on TR9 to complete the audio path.

Transmitter

Microphone signals are applied via the Mic. Gain control RV5 to the microphone pre-amplifier TR17; the prime function of this stage being to mute the microphone during transmission of in-band audio signalling tones, when such options are fitted. The tone circuits are arranged so that the bias on TR17 is removed thus inhibiting the stage.

Audio is then passed to a 2-stage pre-emphasis amplifier TR18, TR19, with a 6 db/octave slope. R95 is a "select-on-test" component whose value is chosen for optimum symmetry. D9, D10 form a diode limiter circuit, followed by de-emphasis components R105, C96. A 2 stage active low-pass filter TR20, TR21 removes unwanted high-frequency components prior to the signal being matched into the phase modulator by the emitter-follower TR22 and the Peak Phase Deviation control RV6.

The oscillator TR25 is crystal controlled and operates in the fundamental, series resonant mode, the exact frequency of oscillation being set by the trimmer L18—L23, as appropriate. When the 5 ppm frequency stability option is exercised, crystal stability is achieved by the use of self-regulating resistors, known as pozistors. These are positioned adjacent to the crystals, and kept in thermal contact with them by means of an insulating plastic cover.

A buffer stage TR24 applies oscillator RF to the Phase Modulator TR25. The signal at TR25 collector is the phasor sum of the direct component, fed forward via C119, and a component amplified by TR25, this latter being amplitude modulated by the AF signal. The resultant phase modulated output is fed to a clipping buffer stage TR26 which removes the amplitude modulation. TR27 and TR28 are FET frequency doublers, each stage contributing some gain. The high output impedance of FET's allow uptapped coils to be used in the drain tuned circuits of these stages. A further pair of doublers using bipolar transistors TR29, TR30 bring the RF up to final frequency; total multiplication being sixteen.

TR31, TR32, TR35 and TR36 form an amplifier chain capable of delivering 25 watts into a 50Ω load via the elliptic-function antenna harmonic filter, which reduces unwanted outputs to less than 0,25µW.

Automatic Level Control

The purpose of this circuit is to maintain the PA output substantially constant despite fluctuations in drive level and supply voltage by maintaining a constant current supply to TR35 and TR36.

R168 is a low value resistor which samples the current drawn by the PA, thus producing a voltage drop. This is added to a portion of the voltage across D11, D12, determined by the setting of RV7. This voltage sum is applied to TR34 base, controlling the degree to which TR34 conducts, and thence the amount of current shunted from TR33 base. Hence if the PA current tends to rise TR33 reduces the supply voltage to TR32 thus reducing the PA drive.

SECTION 4

SERVICING

PRECAUTIONS AND GENERAL INFORMATION

Routine Frequency Adjustments

This equipment uses quartz crystal control of its channel frequencies. Whilst this is extremely reliable and accurate, it is important to realise that crystals 'age' slightly and require periodic re-adjustment. The netting procedure (see section 2) must be carried out as a matter of routine at least twice a year. The requirement for this adjustment is independent of equipment usage since the 'ageing" effect occurs even during careful storage, and is greater when the equipment is new.

Pozidriv Screws

Only the correct size of pozidriv screwdriver should be used release or tighten any of this type of screw found in the M294. The use of any other screwdriver type can result in severe damage to the screwhead.

Replacement of Wire-ended Components

When replacing wire-ended components, ensure that the wires do not produce more than 1 mm beyond the track surface. Failure to do this may result in short-circuiting the component to the casing.

Soldering

Soldering operations should be kept to a minimum.
Ensure that the supply is disconnected before soldering.
Printed circuit tracks should be clean before applying solder and soldering iron should be kept to the minimum required for practical purposes.

Always check that the hole in the printed circuit track is clear of solder before fitting a component.

Wherever possible, a low-voltage DC soldering iron should be used, with an earthed bit. This type of soldering iron must be used when replacing a field-effect transistor.

When soldering wire ends into plated-through holes, ensure that the solder flows through the hole to emerge on the other side of the board.

Printed Circuits

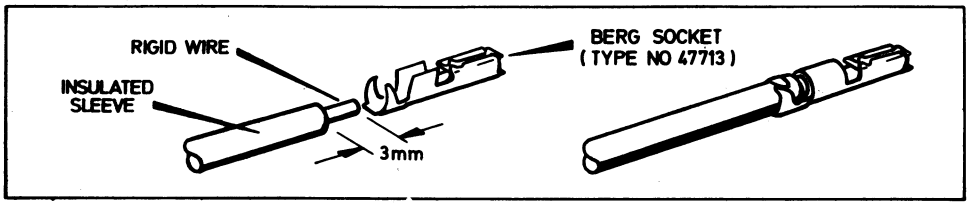
Take particular care not to bend the printed circuit board when removing or replacing it, or when working on it. Bending can cause hairline breaks in the printed circuit track, such breaks being very difficult to locate. Do not connect test leads to a printed circuit track.

Fault-Finding – Integrated Circuit (IC's)

Should an IC failure be suspected, all associated external components must be checked, thus preventing the original cause of failure from damaging the replacement item.

Test Points (TP's)

Test points take the form of Berg pins, whose locations are silk screened on the component side of the board. It is recommended that a suitable connector and lead is locally made to fit the pins, as shown in the diagram below:—



Measuring Points (MPs)

Measuring points give an indication of equipment performance at these points when specified levels of RF or AF are injected at stated locations. Physical location of MP's are shown on the layout diagram. Test equipment required to measure the levels quoted is included in the list shown under "Test Equipment Required".

CONSTRUCTION

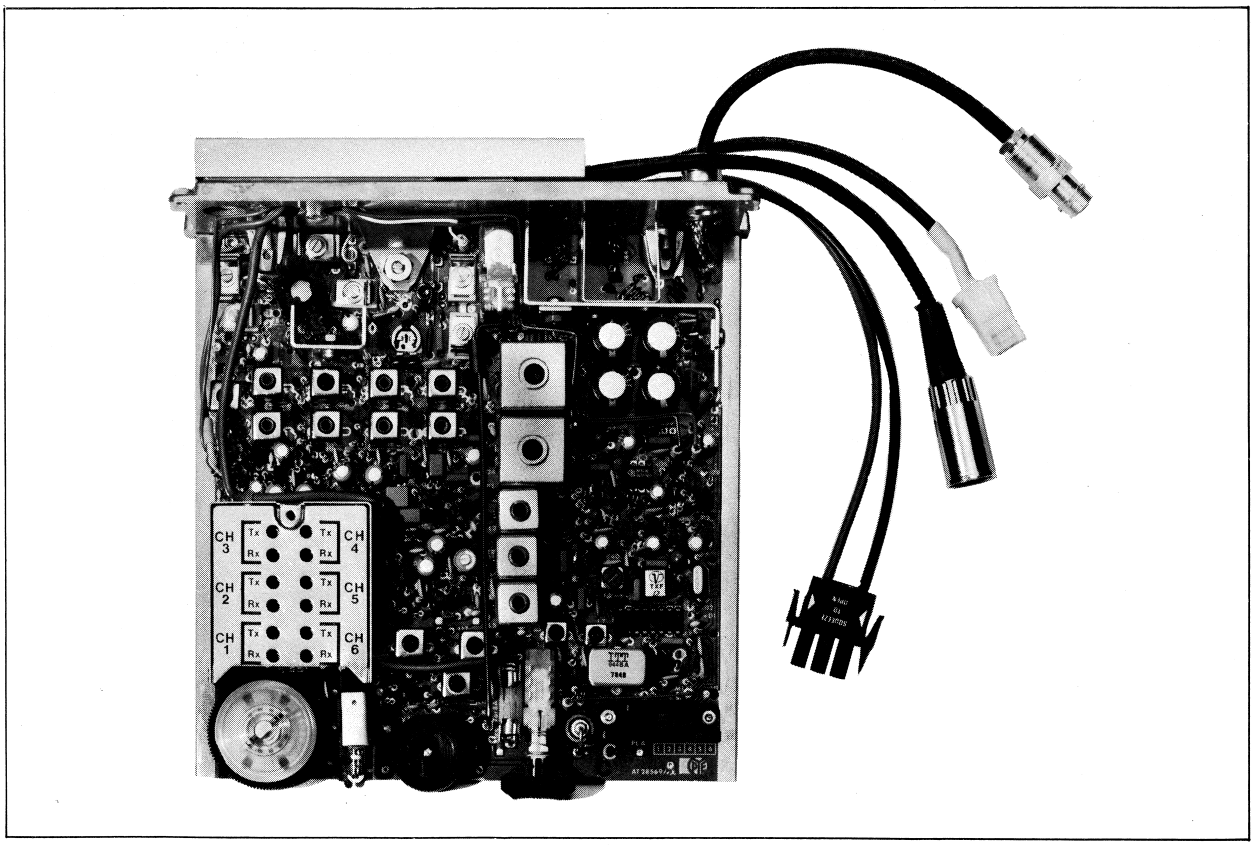
All transmitter and receiver circuitry is accommodated on a single printed wire board, secured by means of lugs and screws to an aluminium block, which serves both as a rear panel and as a heatsink for the transmitter PA transistor TR36. The rear panel is also fitted with a row of nine feed-through capacitors, which connects to the equipment by means of flying leads entering via rear panel holes.

Tin-plated copper screens on the component side of the PWB accommodate the antenna filter and crystals. These screens suppress unwanted interaction with adjacent circuitry; in addition the antenna filter screen acts as a heatsink for the 10V regulator and the Rx Audio Output IC.

Operator controls are carried on the leading edge of the PWB together with the red Tx On indicator, and the filament lamp, whose light is diffused via a light pipe over the controls and front panel legend. A green lens accommodated on the moulded front panel provides a green point of light when the equipment is switched on.

The case is extruded aluminium, with two pairs of parallel grooves provided on its inner side surfaces. One pair of grooves accommodates the PWB, while the other pair accommodate signalling option modules. The front cover is a tough plastic moulding, internally metallised to give electrical shielding.

Options are supplied complete with front panel escutcheons and are automatically connected to the transmitter-receiver when slid into the grooves and secured by one screw at each side.



EQUIPMENT ACCESS

Tools Required

2m Allen Key
Pozidriv Screwdriver

1. Using the pozidriv screwdriver, remove the four screws securing the rear panel to the PWB.

2. The rear panel complete with PWB, may now be withdrawn from the case, providing access to the PWB.

CRYSTAL INFORMATION

Receiver

Band	Carrier Frequency (fc) MHz	Crystal Frequency (fx) MHz	Crystal Range (MHz)	Crystal Spec.
A	148 – 174	$\frac{fc - 10,7}{3}$	45,76 to 54,44	~~T71~~ AP30

Transmitter

Band	Carrier Frequency (fc) MHz	Crystal Frequency (fx) MHz	Crystal Range (MHz)	Crystal Spec.
A	148 – 174	fc/16	9,25 to 10,875	~~T93 Rx~~ AP29

Note: Specifications apply to the UK only, information for other areas being provided on request. Failure to fit the crystals specified for your area may infringe type approval regulations and/or temperature environmental requirements.

TEST EQUIPMENT REQUIRED

The following is a list of recommended test equipment for the alignment, fault location, and repair of the M294. Equivalent types may be used, provided that due corrections are made for any differences in characteristics, particularly with reference to input and output impedances.

Power Supply	8 – 16V, 6A	Kingshill 18VC10
RF Output Meter	50Ω, 50W	Termaline 6154
Multimeter	20,000Ω	Avo 8 or Pye TMIA*
Diode probe	10kΩ	Local manufacture, not required if Pye TMIA is used
Marker oscillator	10,7 MHz	Pye PT507
RF Signal generator	FM	Marconi TF2015
Trimming tools		Pye AT00007
AF Signal generator		Levell TG200 DM
Modulation meter		Marconi TF 2300B
T-attenuator	–40 db signal sampler	Signal Sniffer Marconi 54452–011
Distortion and SINAD meter		Marconi TF893A
AF millivoltmeter		Hewlett Packard 333A

**Note: If an AVO8 or similar multimeter is used, it is recommended that a Probe set such as those shown below be employed. All leads connected to such a probe should be as short as possible.*

Meter probes – Radio Spares Type 1 *423–431 (Red + Black)*
or Meter probes – Radio Spares *423–633 (Red)*
423–649 (Black)

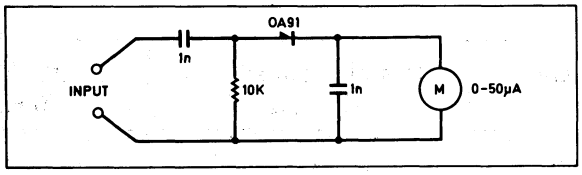


Fig. 4.1 Diode Probe Circuit Diagram

ALIGNMENT PROCEDURES

Unless otherwise stated, the following conditions obtain:–

1. All signal levels are expressed in PD RMS
2. All test voltage readings are expressed with respect to negative.
3. All tests are taken with a power supply of 13,2V
4. Receiver output load is 3Ω
5. All receiver measurements taken at zero beat.

Preliminaries:

1. Obtain access to motherboard. All core-tuned coils except L1 and L2 to be tuned with the core away from PWB. L1 and L2 tuning point is the one nearest the PWB.
2. Keep transmit time to a minimum to avoid excessive heating and interference problems.
3. Connect AVO negative lead to rear panel.

Voltage Checks

1. Measure voltage on pin H. Check that this voltage is 10V ±0,2V. If necessary, select R176 from the range 100Ω to 470Ω to obtain this figure.

Leakage Current

1. Switch is set off. Check that supply current is less than 1µA. Switch on and check that green lamp lights.

RECEIVER ALIGNMENT

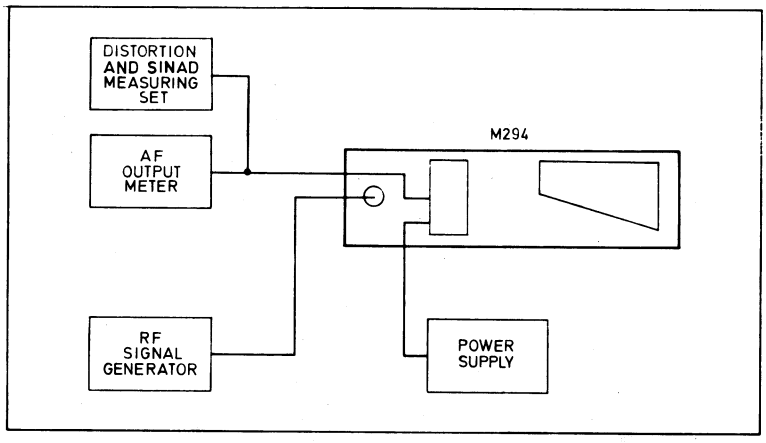


Fig. 4.2 Connection of Test Equipment – Receiver Testing

1. Select channel frequency closest to middle frequency of band covered. Set cores of coils L15, L16, L17 flush with the tops of their formers.

2. Connect multimeter set to 2,5V DC range to TP1. Adjust L15 for max., and L16 for min.

3. Connect multimeter, set to 10V DC range, to TP7. Adjust L16, L17, L15, L16 and L17, in that order, for maximum.

4. Set RV1, RV2 and RV4 fully anticlockwise. Set signal generator to carrier frequency, CW with output 19mV. Connect signal generator to antenna input and obtain zero beat with the marker oscillator.

5. Tune L1–L7 in order for best quieting, reducing signal input level as necessary.

6. Modulate input signal 1 kHz at 60% peak deviation (i.e. 1,5 kHz for 12,5 kHz channel spacing, 2,4 kHz for 20 kHz spacing, or 3 kHz for 25 kHz spacing). Set generator level to 3µV. Tune L8 for maximum audio output. Adjust L7 for least distortion.

   Adjust RV2 for 100 mV at option pin E.

7. Reduce signal input to 0.25 µV and adjust L1–L6 in order for best SINAD. Connect multimeter, set to 10V DC, to TP7, and adjust L17 for maximum.

   Remove multimeter from TP7 and adjust RV1 for 12 dB SINAD, re-adjusting L17 if necessary. If 12 dB SINAD cannot be obtained, a minimum of 9 dB is acceptable. Repeat this test for each crystalled channel.

8. Switch off modulation, adjust RV4 so that the squelch is just open. Re-apply modulation, check that squelch remains open.

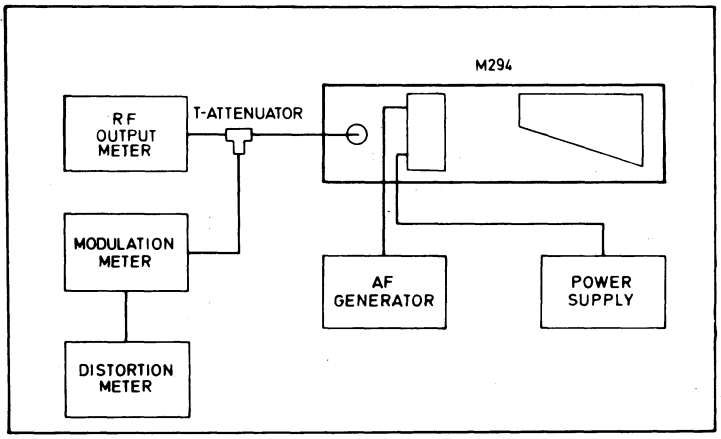


Fig. 4.3 Connection of Test Equipment – Transmitter Testing

1. a) Connect test equipment as shown above.

   b) Key transmitter and check that Tx lamp lights.

   c) Set controls as follows:–

Microphone Sensitivity	RV5 – mid position
Peak deviation	RV6 – mid position
Power output control	RV7 – fully clockwise

   d) Select channel frequency closest to centre of band covered.

2. Connect multimeter, set to 10V DC, to TP2. Adjust C119 for maximum and L26 for minimum.

3. Transfer multimeter connection to TP3. Adjust L27 for maximum, and L28 for minimum.

4. Transfer multimeter connection to TP4. Adjust L29 for maximum and L30 for minimum.

5. Transfer multimeter connection to TP5. Adjust L31 for maximum, L32 for minimum, and L34 for maximum.

6. Connect the diode probe to C162, Adjust L26–L32, L34 and L35, in order, for maximum diode probe reading.

7. Adjust C185 for minimum capacity. Adjust C158 and C163 initially for maximum supply current. When power is registered on the RF output meter, re-adjust C158 and C163 for maximum output power.

   Adjust C172 and C177 together for maximum power
   Adjust C183 and C185 together for maximum power.

8. Repeat step 7 until absolute maximum power is obtained. Check that output is greater than 25 watts. Adjust RV7 and check that power can be reduced to 6 watts. Re-set RV7 for 25 watts output.

9. Reduce the power supply to 10,8 volts. Check that power output is greater than 15 watts.
   Increase the power supply to 15,6 volts. Check that power output is less than 30 watts.
   Reduce power supply to 8 volts. Check voltage on option pin J is greater than 7,5V DC.
   Restore power supply to 13,2V.

Audio Alignment

1. Set AF oscillator to 1 kHz at 2mV. Feed this signal to the microphone input. Adjust C119 for approximately maximum deviation, and then tune C119 for minimum distortion.

2. Increase input level to 40mV and adjust RV6 for peak system deviation (see Transmitter Data in Section 1). If necessary, choose a value of R95 for maximum symmetry.

3. Reduce input level to 4mV and adjust RV5 for 60% peak system deviation.

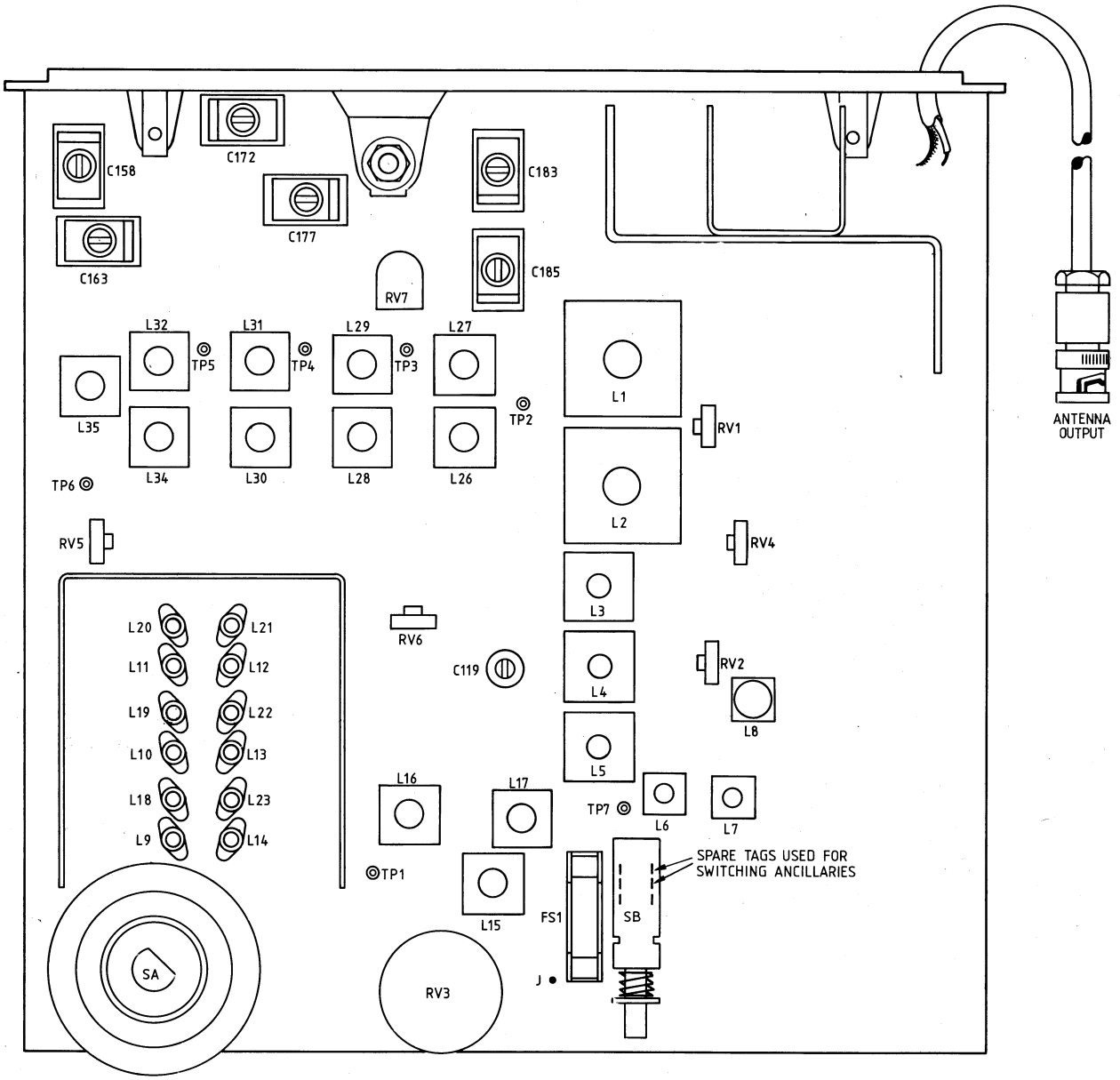


Fig. 4.4 Alignment Diagram

SECTION 5
PARTS I

NOTATION

In the following Parts Lists component values are designated as follows:—

Capacitors Values given in micro Farads unless otherwise stated

22 = 22 micro Farad (F x 10^{-6})
22n = 22 nanoFarad (F x 10^{-9})
22p = 22 picoFarad (F x 10^{-12})

Fractional values shown thus:

2µ2 = 2,2 microFarad (F x 10^{-7})F
2n2 = 2,2 nanoFarad (F x 10^{-10})F
2p2 = 2,2 picoFarad (F x 10^{-13})F

Resistors Value given in Ohms unless otherwise stated

22 = 22 ohms
22k = 22 kilohms (Ohms x 10^{3})
22M = 22 Megohms (Ohms x 10^{6})

Fractional values shown thus:

2Ω2 = 2,2 ohms
2k2 = 2,2 kilohms = (22 x 10^{2})
2M2 = 2,2 Megohms = (22 x 10^{5})

ORDERING OF SPARE PARTS

When ordering spares, please quote the description and Part No. of the item and the part number of the sub-assembly on which it is used together with the equipment code number given on the identity plate fixed to the equipment.

The right is reserved to fit alternative types of semiconductors with equal or improved performance to those quoted in the Parts List.

ABBREVIATIONS

cadmium	cad	steel	st
carbon film	c. film	printed wiring board	PWB
ceramic	cer	polyester	poly
countersunk	csk	tubular	tub
electrolytic	elect	wire wound	w.w.
		parts per million	ppm

VHF FRONT MOUNT

MOBILE RADIOTELEPHONE TYPE M294

AT00236

A0 Band = 148–174 MHz

MISCELLANEOUS ***See headed list**

Description	Part No.	Remarks /Code/Band
Machined case	AT13609	**Item 3** Including **Item 10**
Carrier	BT16826	**Item 9**
Installation items	AT29604/-	*
Front Panel Assembly	AT13655/-	**Item 1** including **Item 2**
M294 General Assembly	AT13660/-	*
Boot, crystal	BT36528	according to option
Channel blanking plate	BT20158	Single channel only
Microphone Assembly	AT29692/02	*
Microphone rest assembly	276661	
Scr. st. pan slot S/T No. 6 x ¾	QW41206/X	2/mic rest assembly
Scr. st. slot, csk, M3 x 6 mm	QJ08536/Q	2/Front panel
Scr. st. pozi, csk, M2,5 x 10 mm	QJ11947/B	4/Rear panel
Scr. st. pan, pozi, M2,5 x 5 mm	QJ11944/B	1/Cover to oscillator screen
Installation instructions	TP819	
Operating instructions	TP960	
Scr. st. pan pozi, M3 x 4 mm	QJ11913/X	4/Carrier to case

INSTALLATION ITEMS	AT29604/01–	for equipment supplied with standard mounting kit and loudspeaker
	AT29604/02–	for equipment supplied with standard mounting kit less loudspeaker
consisting of:–		
Bagged Items	AT29605	See headed list
Power Lead Assembly	AT35440	Fitted with mate 'n' lock plug
Loudspeaker Assembly	AT10877/02	/01 see headed list
Cradle Assembly	AT12405	/01, /02
Bagged Items AT29605, consisting of		
Extractor Tool	BT28971/01	
3-way terminal block	BT30081	
6,3A fuse	FF99055	
Fuseholder	FH02839	
Plug, BNC straight 50Ω	FP99100	1/Antenna feeder
Scr. st. pan slot S/T No. 10 x ½	QQ41208/X	2/loudspeaker, 4/cradle
Scr. st. pan slot S/T No. 6 x ¾	QW41212	2/fuseholder, 2/connector block
Tyraps	QA04464	As required

LOUDSPEAKER ASSEMBLY AT10877/02

consisting of:–

Loudspeaker	FS11525
2-way housing	FT10535
Tin plated pin	FT10537
Insulating sleeve	FS22184/04
Identification sleeve	FS22192/06
Cover	BT15372/01
Bracket	BT11251
Label (Pye)	BT18990
Mounting strap	BT27020
Cloth, rear cover	BT27318
Speaker grille	BT35823
Captive nut	QA00114

LOUDSPEAKER ASSEMBLY AT10877/02 Contd.

Description	Part No.	Remarks/Code/Band
Washer, st. 2BA	QA13002/A	2/Strap to cover
Spring washer	QA13464/B	2/Strap to cover
Screw hex, pozi, No. 10B x 20 mm	QJ06645/X	
Scr. st. pan, pozi, 4/20 x ¾	QJ08268/A	

MICROPHONE ASSEMBLY AT29692/02

consisting of:—

Insert Assembly	AT13420
Pressel Assembly	AT13421
Switch	FS07193
Grille	BT35824
Coiled lead assembly	AT11405/01
Case Front assembly	AT13422
Case Back assembly	AT13423

M294 GENERAL ASSEMBLY AT13660/--

AT13660/01 — Single channel, 25 kHz channel spacing, A band TX, A band RX
AT13660/02 — Six channel, 25 kHz channel spacing, A band TX, A band RX
AT13660/03 — Single channel, 12,5 kHz channel spacing, A band TX, A band RX
AT13660/04 — Six channel, 12,5 kHz channel spacing, A band TX, A band TX, A band RX
AT13660/05 — Six channel, 25 kHz channel spacing, temperature compensated A band TX, A band RX

consisting of:—

Link assembly	AT12514/02	LK1
PWB Assembly	AT28569/--	TX/RX See headed list **Item 8**
Rear Panel Assembly	AT13675/01	See headed list **Item 4**
Can	248343	Modified to BJ34060. 1/L1, 1/L2
Screen, PA	BT26306	
Screen, PA driver	BT26310	
Support moulding	BT26618	Lampholder/led
Interconnection housing	BT37517	
Lampholder	FL17849	1/LP1
Lamp 14V, 0.09A, type CM37	FL17850	LP1
Transistor ON751	FV05572	TR36
Clip	QA04097	2/L1, 2/L2
Full nut, st, M2,5	QA11604/B	2/Housing interconnection
Scr. st. pan pozi, M3 x 8 mm	QJ11551/X1	2/Rear panel to PWB
Scr. st. pan pozi, M2,5 mm	QJ11944/B	2/Housing interconnection
Scr. st. S/T, No. 2 x ¼	QJ08871/X1	1/lampholder, 2/support moulding

REAR PANEL ASSEMBLY AT13675/01

Lead assembly	AT10765/17	1/loudspeaker
Lead assembly	AT36552/01	Power lead
Lead assembly	AT36553/01	Microphone
Lead assembly	AT36584/01	Aerial
Rear panel assembly	AT13674/01	**Item 4**
Cover,	AT13676	Fitted on rear panel **Item 7**
Mounting bracket assembly	AT13677	**Item 6**
Hexagonal pillar	BT04451	4 off
Cable clamp	BT16054	**Item 5**
Core, ferrox cube	FC02103	6 off
Ferrite bead, 8 x 3 x 10	FC34450	
Scr. st. pan pozi, M2,5 x 5 mm	QJ11944/B	1/Mounting bracket, 4/cover assembly
Scr. st. pan pozi, M2,5 x 12 mm	QJ11948/B	2/Cable clamp

PWB ASSEMBLY AT28569/--

Description				Part No.	Remarks/Code/Band
AT28569/01 – used on AT13660/01					
AT28569/02 – used on AT13660/02					
AT28569/03 – used on AT13660/03					
AT28569/04 – used on AT13660/04					
AT28569/05 – used on AT13660/05					
consisting of:–					
Resistors					
0Ω03	±20%	2,5W	w/w	PL41528	R168
1	±10%	0,25W	c. film	PM01400	R40,163
2Ω2	±10%	0,25W	c. film	PM01404	R39
3Ω3	±10%	0,25W	c. film	PM01406	R171
10	±5%	0,25W	c. film	PM01412	R1,59,170
22	±5%	0,25W	c. film	PM01416	R164,169,175
39	±5%	0,25W	c. film	PM01419	R161
47	±5%	0,25W	c. film	PM01420	R114,155
56	±5%	0,25W	c. film	PM01421	R159
68	±5%	0,25W	c. film	PM01422	R37,186
82	±5%	0,125W	c. film	PL99798	R185
100	±5%	0,25W	c. film	PM01424	R5,13,71,76,77,92,99,127,135,151, 152,156
120	±5%	0,25W	c. film	PM01425	R90
150	±5%	0,25W	c. film	PM01426	R60,100,142,177,180
220	±5%	0,25W	c. film	PM01428	R23,38,94
270	±5%	0,25W	c. film	PM01429	R147
390	±5%	0,25W	c. film	PM01431	R98
470	±5%	0,25W	c. film	PM01432	R15,69,160,172,179,181,130,144
560	±5%	0,25W	c. film	PM01433	R57,61,174
680	±5%	0,25W	c. film	PM01434	R2,14,48,89,146,148. All variants R48–53 –/02, /04, /05
820	±5%	0,25W	c. film	PM01435	R4,56,150,154,162,165,166,183
1k	±5%	0,25W	c. film	PM01436	R41,72,73,75,78, All variants R81,84, –/01, /02, /05
1k2	±5%	0,25W	c. film	PM01437	R20,67,86,158,134
1k5	±5%	0,25W	c. film	PM01438	R109,143 R81,84 –/03, /04
1k8	±5%	0,25W	c. film	PM01439	R16,R17
2k2	±5%	0,25W	c. film	PM01440	R83,97,113,121,141,167,182, All variants R121–126 –/02, /04, /05 R65 –/03, /04
2k7	±5%	0,25W	c. film	PM01441	R58,80,138, All variants R85 – /01, /02, /05
3k3	±5%	0,25W	c. film	PM01442	R8,157,107,136
3k9	±5%	0,25W	c. film	PM01443	R10,12,139 – All variants R85 – /03, /04
4k7	±5%	0,25W	c. film	PM01444	R6,31,34,54,55,64,70,82,103,104, 110,131. All variants R65 – /01, /02, /05
5k6	±5%	0,25W	c. film	PM01445	R137,111
6k8	±5%	0,25W	c. film	PM01446	R101,136
8k2	±5%	0,25W	c. film	PM01447	R11,63,102,140
10k	±5%	0,25W	c. film	PM01448	R19,35,36,88,93,105,145,149,153, 178
12k	±5%	0,25W	c. film	PM01449	R96
15k	±5%	0,25W	c. film	PM01450	R33,62
15k	±5%	0,125W	c. film	PL99782	R189
18k	±5%	0,25W	c. film	PM01451	R79,106,108,112,133
33k	±5%	0,25W	c. film	PM01404	R21
47k	±5%	0,25W	c. film	PM01456	R18,24
56k	±5%	0,25W	c. film	PM01457	R28
68k	±5%	0,25W	c. film	PM01458	R26
100k	±5%	0,25W	c. film	PM01460	R7,9,27,32,66,74,87,91,128,129, 132,173
150k	±5%	0,25W	c. film	PM01462	R25
680k	±5%	0,25W	c. film	PM01470	R30
820k	±5%	0,25W	c. film	PM01471	R29
1M	±5%	0,25W	c. film	PM01472	R22

Resistors Contd.

Description				Part No.	Remarks/Code/Band
33	±5%	0,25W	c. film	PM01418	R95 – Select-on-test
39				PM01419	
47				PM01420	
56				PM01421	
68				PM01422	
82				PM01423	
100				PM01424	
120				PM01425	
150				PM01426	
180				PM01427	
220				PM01428	
270				PM01429	
100	±5%	0,25W	c. film	PM01424	R176, Select-on-test
120				PM01425	
150				PM01426	
180				PM01427	
220				PM01428	
270				PM01429	
330				PM01430	
390				PM01431	
470				PM01432	
Thermistor				PL23088	R68
Potentiometer, 470Ω lin.				PL06730	RV6
Potentiometer, 4k7, lin.				PL03370	RV2,5,1
Potentiometer, 5kΩ, log with knob				PL09217	RV3 – volume control
Potentiometer, 10k, lin.				PL03647	RV4
Potentiometer, 100Ω				PL03323	RV7
Posistor, 2k2, ±20%				PL23133	R42-47,115–120, /05

Capacitors

0p33	±10%		cer. tub.	PN00115	C141
0p56	±10%		cer. tub.	PN00123	C2,67,147
1p8	±0p25	63V	cer. plate	PW99560	C130,135
2p2				PN99751	C187
3p3				PN99753	C188
3p9				PN99563	C63,191
8p2				PN99567	C62,189
10p	±2%	63V	cer. plate	PN99568	C33,121,122
12p				PN99760	C190
12p				PN99569	C1,3,68
15p				PN99570	C65,192,195
18p				PN99571	C146,194
22p				PN99572	C151
27p				PN99573	C117,140,155
33p				PN99574	C61,143,176
47p				PN99576	C28,60,133
56p				PN99577	C37,116,152
82p				PN99579	C17,20,137
100p				PN99580	C112,128,132,138,144,178–181
120p				PN99806	C29,36
150p				PN99582	C113
270p				PN99776	C111
1n	±10%	63V	cer. plate	PN99600	C14,27,35,39,57,64,80,82,84,87,110, 114,118,123,126,127,131,134,136, 139,142,145,148,150,153,154,166, 173,201
2n2	±10%	100V	cer. plate	PN99602	C59,66,92,94,97,103,104,106
2n2	±2,5%	100V	poly.	PQ99617	C98,101
4n7	±10%	63V	cer. plate	PN99813	C4,6,7,15,18,19,21,22,24,26,30,42-45, 49,51,55,56,58,69,70,74,76,86,89,100, 108,109,115,120,149,164,165,168-170, 186,198,200
10n	±2,5%	100V	poly.	PQ99621	C102,99

Capacitors Contd.

Description				Part No.	Remarks/Code/Band
100n	±10%	63V	poly.	PQ99511	C23,31,32,38,41,52,54,73,96,125, 129,161,175,197
1μ	±20%	35V	elect.	PS99502	C75
2μ2	63V		Al elect.	PS99821	C16,40,46-48,77,78,83,85,93,95,107, 159,160
2μ2	±20%	35V	elect.	PS99503	C71,72
4μ7	±20%	25V	elect.	PS99504	C90
6μ8		35V	tant.	PS99512	C79
10μ		25V	elect.	PS99513	C34
33μ		16V	All elect.	PS99807	C81,88,105,124,202
100μ	±20%	3V	elect.	PS99510	C50,91
470μ		16V	All elect.	PS99809	C53,174,196,199
Trimmer capacitor				PV09368	C172,183,
Variable, 7–35p		100V		PV05118	C119
Variable 10–80p				PV09369	C177,185,
Variable 30–140p				PV09370	C158,163,

Inductors

Coil Assembly	AL03156	L8
Coil Assembly	AT31185	L37,39
Coil Assembly	AT31186	L42
Coil Assembly	AT31187	L41
Coil Assembly	AT31188	L38,40
Coil Assembly	AT31233/04	L43–46
Coil Assembly	AT32052/02	L34
Coil Assembly	AT32052/03	L32,35
Coil Assembly	AT32060/01	L31
Coil Assembly	AT32060/02	L30
Coil Assembly	AT32068/01	L28,29
Coil Assembly	AT32078/03	L17
Coil Assembly	AT32078/04	L16
Coil Assembly	AT32078/05	L15
Coil Assembly	AT32122/01	L6,7
Coil Assembly	AT32126/06	L1,2
Coil Assembly	AT32171/23	L18, /01, /03 L18-23, /02, /04, /05
Coil Assembly	AT32172/09	L9, /01, /03 L9-14, /02, /04, /05
Coil Assembly	AT32700/01	L4
Coil Assembly	AT32700/09	L3
Coil Assembly	AT32700/10	L5
Coil Assembly	AT32171/23	L18–23 One per channel
Coil Assembly	AT32172/09	L10-14
Choke 15μH	FT99004	L24
Choke 22μH	FT99011	L25
Choke 470μH	FT99007	L47
Coil Assembly	AT32071/03	L26,27

Semiconductors

IC – IF Amp and discriminator MC3357	FU07680	IC1
IC – Audio TDA2002	FU09725	IC2
IC 741	FU99073	IC3
Transistor PBC108	FV05800	TR17–19,21,22,37,38
Transistor PBC108B	FV05802	TR6,9,14-16,23
Transistor BF244B	FV05827	TR27,28
Transistor 2N5447	FV05828	TR8,20,34
Transistor ZTX327	FV05830	TR32
Transistor MPS918-18	FV05893	TR4,5,11,12,29-31,24-26
Transistor TIS 88A	FV08241	TR3
Transistor MPS-A13	FV08935	TR7,10,13
Transistor TIP32, with fitting kit	FV08940	TR33,39
Transistor J309	FV40828	TR1
Transistor WN1003	FV40829	TR2
Transistor*	FV41807 TP3314	TR35 5918L
Diode 1N4148	FV05808	D1-6,8-10,14
Diode 1N4001	FV05840	D11,12

Semiconductors Contd.

Description	Part No.	Remarks/Code/Band
Diode MR751	FV08961	D15
Diode ZF8,2	FV08030	D13
Led, Red	FV05858	Led 1
Transistor 0N751	FV05572	TR36

*Observe Beryllium Oxide warning

Miscellaneous Items

Crystal Filter 25 kHz	FC99004	FL1 – /01, /02, /05
Crystal Filter 12,5 kHz	FC03293	FL1 – /03, /04
Ceramic filter 455 kHz	FC99020	LF2 – /01, /02, /05, 25 kHz spacing
Ceramic filter 455 kHz	FC99022	FL2 – /03, /04, 12,5 kHz spacing
Channel switch SA	FS07199	Six channel equipment
Channel knob	BT37459	
Heatsink	QA05839	
Heatsink	BT37520	
Screen, antenna assembly	AT13654	
Ferrite Bead 0,07 x 0,24 x 0,25	FC36151	FB1,2,3,5,6
Crystal, 11,155 MHz	FC03013	XL13, to spec YE00687/01
16-way right-angle header	FC00838/16	Options
Switch, push-button	FS07191	SB, On/Off
Knob, on/off	BT37460	
Relay	FR04000	RLA
Fuse, 8A	FF99020	FSI
Fuseholder	FH99101	
Can	FT03516	L6,7
Can	FT03520	L3-5
Can	FT03521	L15-17, 26-32, 34,35
Regulator Screen	BT26304	
Oscillator Screen	BT26305	

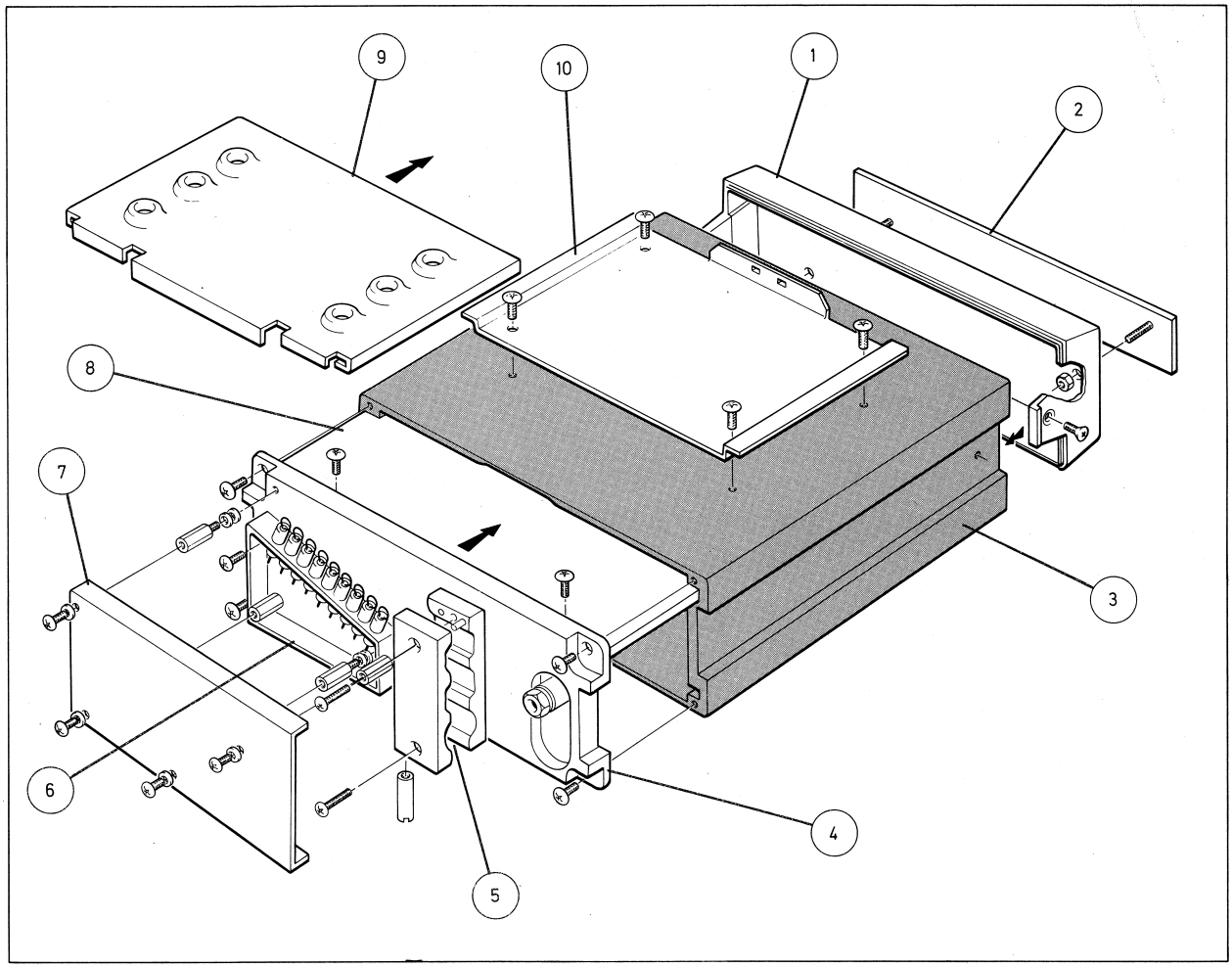
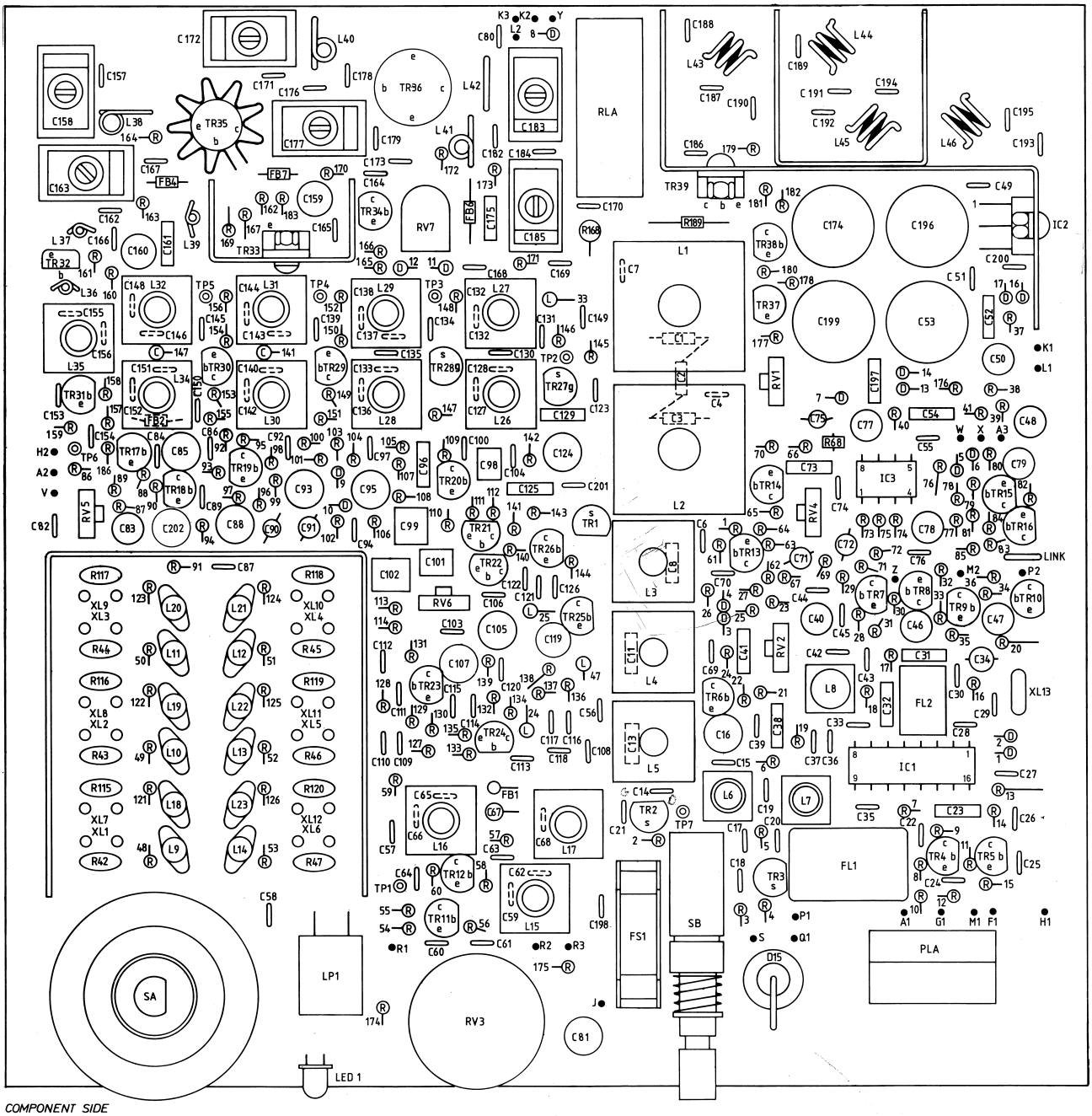


Fig 5.1 : Exploded View

Note: The identification numbers shown above appear against the relevant items in the Parts List.



COMPONENT SIDE

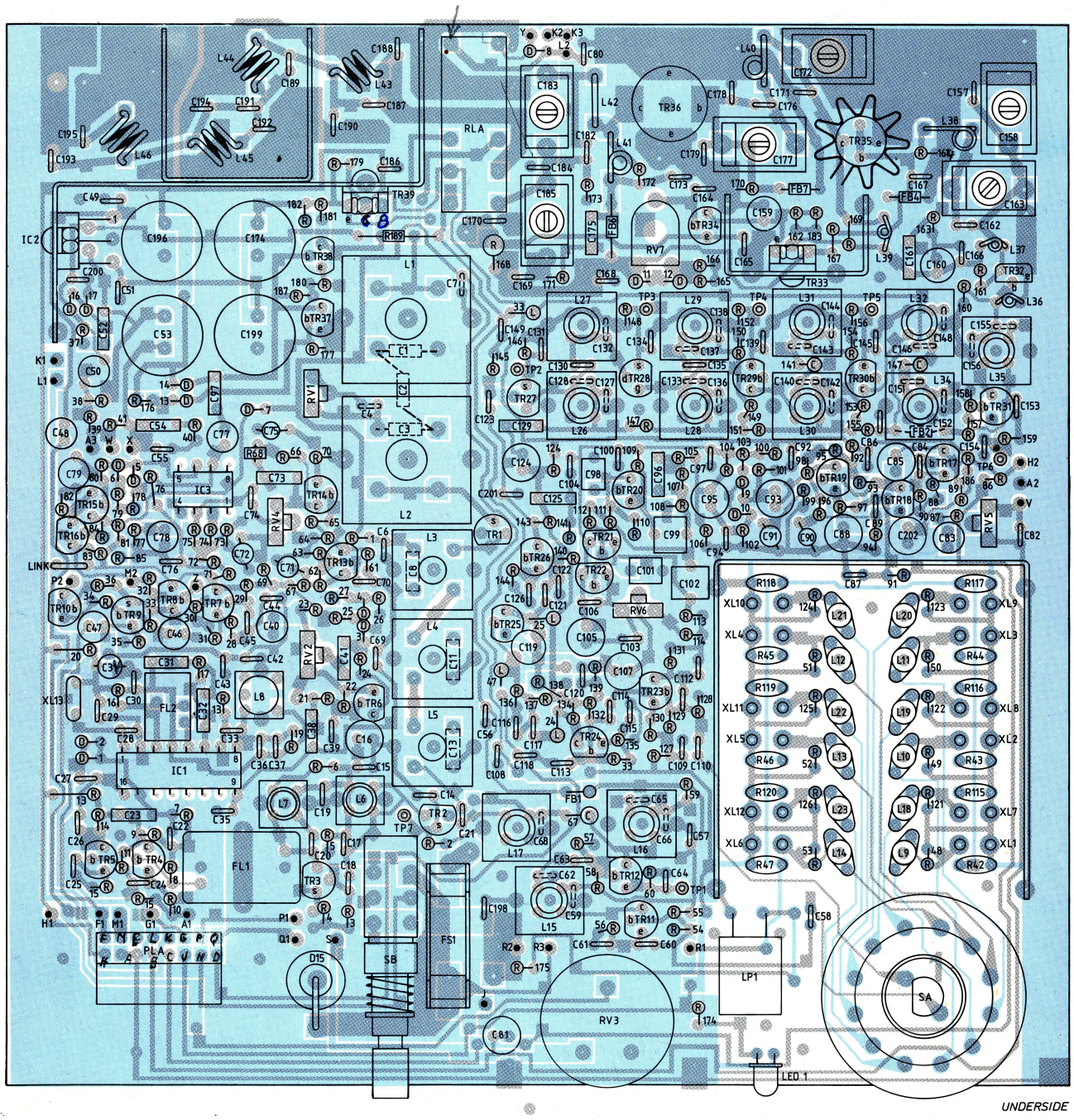
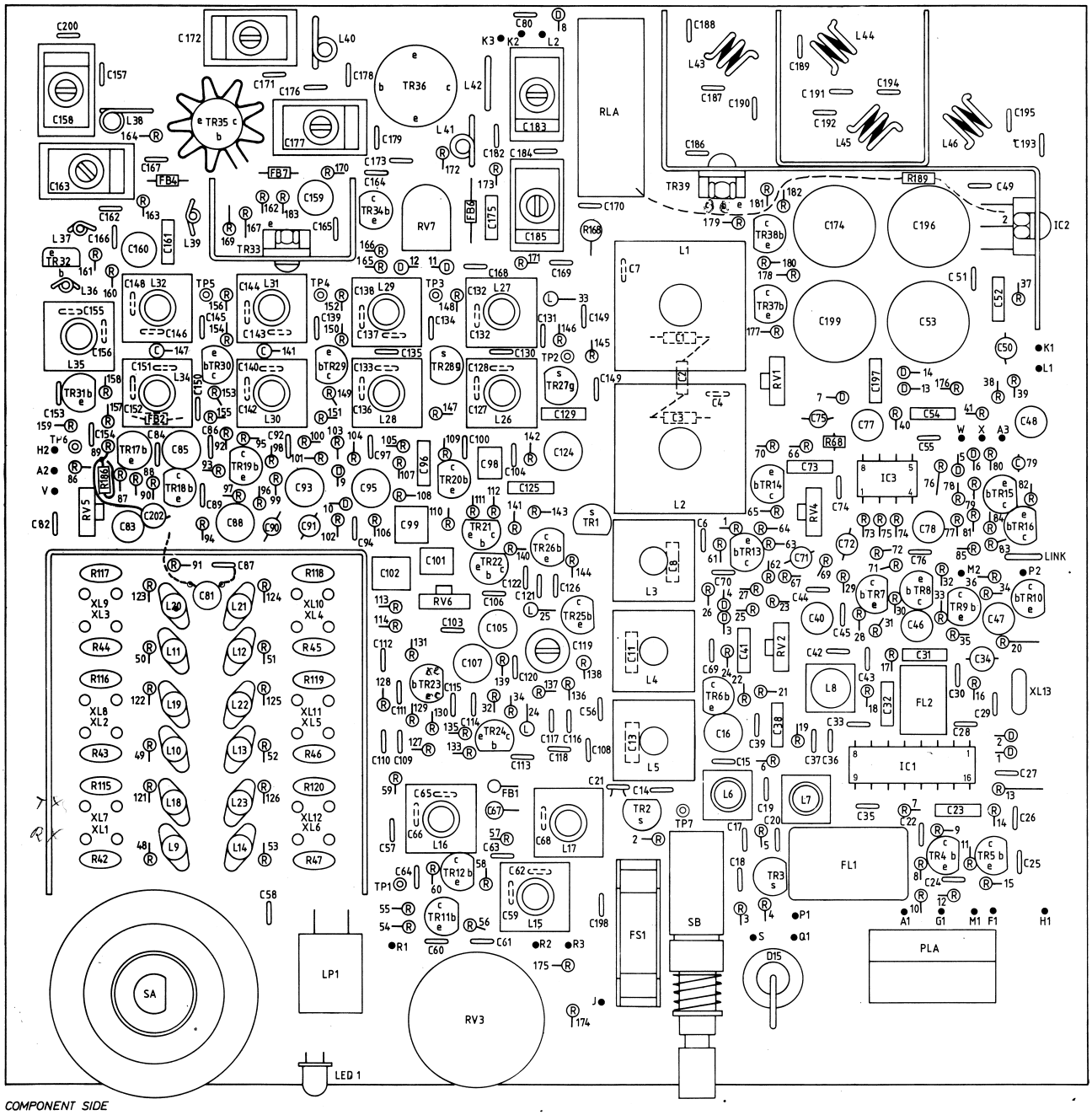


FIG 6:1 COMPONENT LOCATION AND LAYOUT DIAGRAM MOTHERBOARD AT28569 Issue 1.

TP267



COMPONENT SIDE

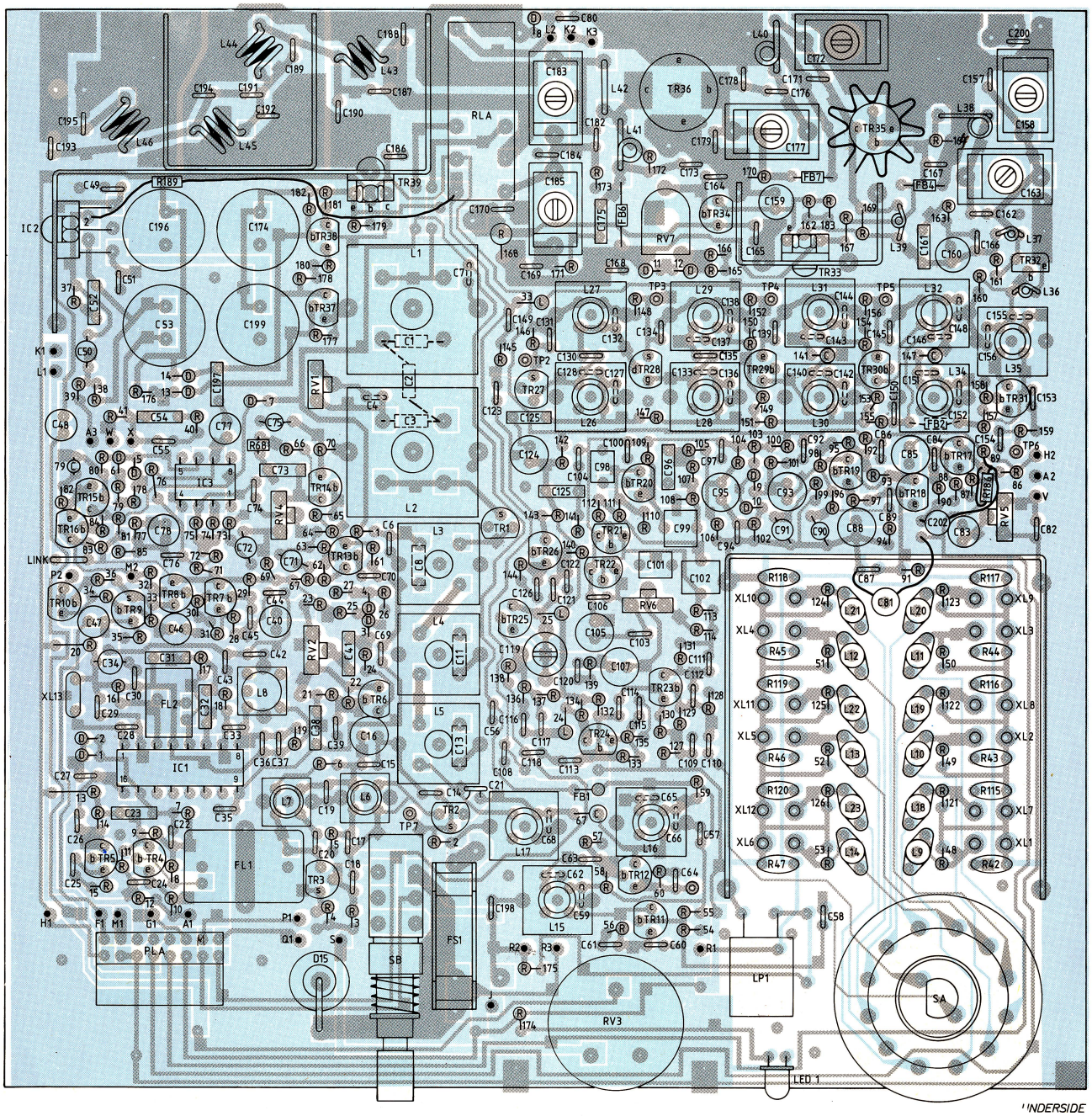


FIG 6:2 EARLIER VARIANT :
MOTHERBOARD AT28569
Issue C

TP267

s = Squelched
u = Unsquelched

Rx. R.F. AMPLIFIER

1st MIXER & PRE AMP.

2nd OSC.- MIXER - IF. AMP. & DISCRIMINATOR.

Rx. NOISE LIMITER & FILTER.

AUDIO O/P AMP.

Rx. OSC. MULTIPLIER & AMP.

SQUELCH FILTER AMP. & ACTIVE RECTIFIER.

SQ. SCHMITT TRIGGER

Tx. AUDIO

MIC. PRE AMP.

Tx. OSCILLATOR.

PHASE MODULATOR.

Tx. MULTIPLIERS & AMPLIFIERS.

Tx. PA.

C/O RELAY.

ANTENNA FILTER.

NOTES

1. R176 IS SELECTED FROM **THE** VALUES IN THE RANGE 100Ω TO 470Ω TO GIVE 10v ± 0,2v FROM THE REGULATOR FOR AN INPUT OF 13,2 VOLTS.
2. R95 IS SELECTED FROM **THE** VALUES IN THE RANGE 33Ω TO 270Ω TO GIVE SYMMETRICAL PEAK TRANSMIT DEVIATION.
3. LINK PIN F1 TO PIN S IS REQUIRED WHEN NO OPTIONS ARE FITTED. WHEN OPTIONS ARE FITTED THE LINK IS TO BE FROM PIN G1 TO PIN S.
4. WHEN OPTIONS ARE FITTED A LINK FROM PIN M1 TO PIN P2 IS NEEDED TO MAKE THE BUSY LAMP FUNCTIONAL.
5. FOR OPTIONS WHICH PROVIDE TRANSMIT LOCK OUT AND / OR TRANSPOND THE LEAD FROM THE MIC. SKT. PIN 3 (WHICH USUALLY GOES TO PIN L2) IS FITTED TO PIN K3 AND LINKS ARE REQUIRED FROM PIN K1 TO PIN K2 AND FROM PIN L1 TO PIN L2.
6. FOR EQUIPMENTS WITH CRYSTAL HEATERS R42-47, R115-120 A LINK IS NEEDED FROM PIN R1 TO PIN R3. ALTERNATIVELY IF A SMALL CURRENT DRAIN IS ACCEPTABLE WHEN THE SET IS SWITCHED OFF THE LINK MAY BE MADE FROM PIN R1 TO PIN R2 ELIMINATING THE CRYSTAL WARM UP TIME.
7. PIN Y IS PROVIDED SO THAT THE TRANSMITTER MAY BE KEYED BY GROUNDING THE RELAY. IF THIS ARRANGEMENT IS REQUIRED LINK PIN H2 TO L2 & CUT THE THIN TRACK WHICH CONNECTS TO RELAY GROUND.
8. D.C. VOLTAGES WITH AN AVO. 8 (10v RANGE)

PLA

A	BATTERY – Ve.
B	MIC. PRE AMP. GATING.
C	IN BAND Tx. ENCODE.
D	SUB AUDIO Tx. ENCODE.
E	Rx. AUDIO FOR DECODERS.
F	Rx. SQUELCHED AUDIO.
G	UNDEDICATED.
H	10V
J	Tx. 10V
K	10V VIA PRESSEL S3
L	Tx. RELAY COIL
M	UNDEDICATED
N	BATTERY SWITCHED I/P 13,2V
P	UNDEDICATED
Q	UNDEDICATED

FIG 6:3 OVERALL CIRCUIT DIAGRAM M294 TRANSMITTER/RECEIVER

APPENDIX

MOBILE MICROPHONE

AT29692/--

AT29692/02 — FM microphone fitted with PREH plug

General Information

This microphone is issued as a replacement for the FM fist microphone originally used on Pye mobile radiotelephones. It differs from the original microphone in that its insert incorporates an integrated circuit, while a printed wire board accommodates response shaping circuitry.

Circuit Diagram

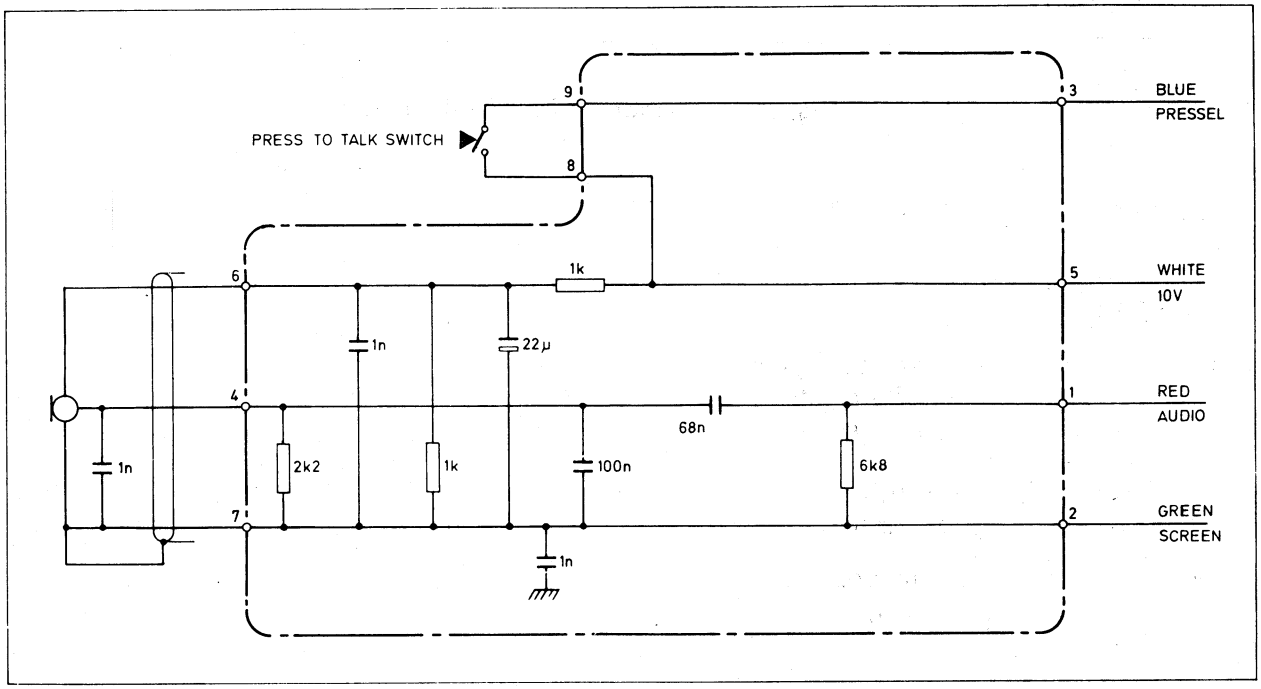


Fig. 1 Circuit Diagram

TESTING

Test Equipment Required

Audio millivoltmeter	Radiometer RV36
Multimeter	AVO 8
AF Generator	Marconi TF2021M
Oscilloscope	General Purpose

Note: The insert used in this microphone incorporates an integrated circuit. Consequently, the 10V energising supply must be connected before any tests are carried out.

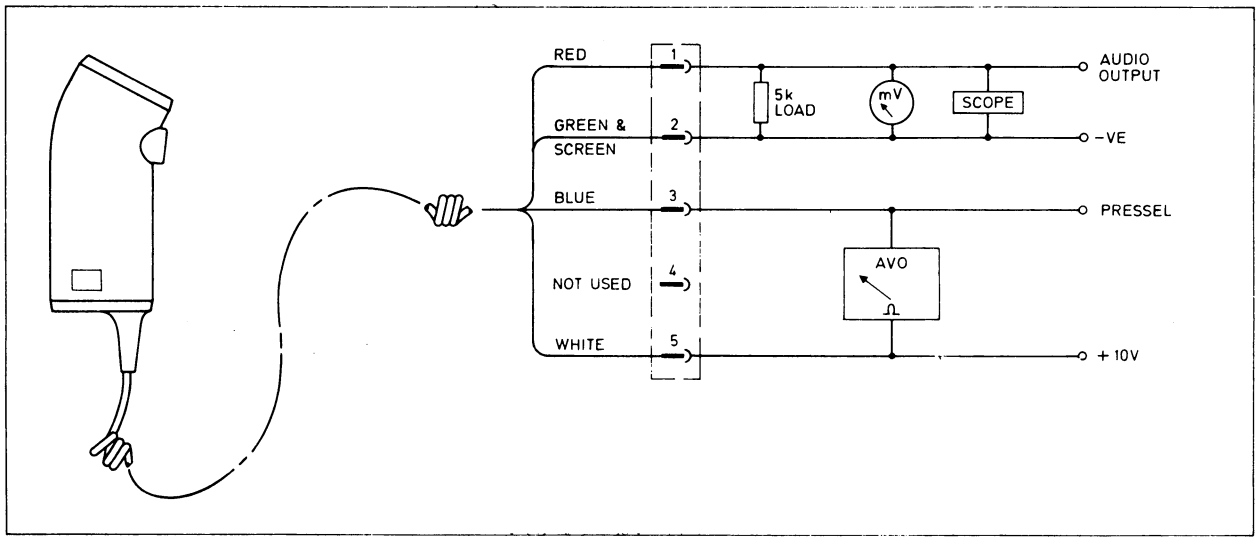


Fig. 2 Connection of Test Equipment

1. Connect to the microphone as shown in fig. 2.

Resistance Checks

1. With equipment switched off and AVO set to 'Ω x 100' range, check that the resistance between pins 3 and 5 is greater than 1MΩ. Set AVO to 'Ω ÷ 100' range and actuate the press-to-talk switch. Check that the resistance falls to less than 10Ω.

Reset AVO to 'Ω x 100'. Check that a resistance of greater than 10MΩ is available between all microphone output connections and:—

a) Silver base of microphone housing.

b) Outer shell of PREH connection

Supply Decoupling Test

1. Set AF generator to 1 kHz, at 1VRMS. Switch on equipment and superimpose this audio signal on the 10V line. With no sound fed into the microphone, measure the audio output at pin 1. Check that this is less than 1mV RMS. Disconnect AF generator

Sensitivity Checks

1. Speak into the microphone in a normal conversational tone. Observe waveform on oscilloscope and millivoltmeter reading. Check that audio output level is approximately 5mV average.

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