# Service Manual



Pye Telecommunications Ltd

# VHF FM MOBILE RADIOTELEPHONE Type M294E

Publication Ref. No. TP257

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.

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.

# VHF FM MOBILE RADIOTELEPHONE TYPE M294E

SERVICE MANUAL
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# AMENDMENT LIST

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

Reprints of the manual 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 manual reference number e.g. TP123/4 indicates that the page has been corrected by amendment number 4.

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

| Amend't No. | Date | Initials | Remarks |
|---|---|---|---|
| 1 | Sept 85 | – | Incorporated on reprint. |

# ERRORS & OMISSIONS

The usefulness of this Service Manual 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 manual
b) TP No. and Issue No.
c) Last amendment No. received
d) Page and/or Fig. No. in error

Please send to:

Pye Telecommunications Ltd.
Publications Dept.
P.O. Box 24
St. Andrews Rd.
Cambridge CB4 1DP
England

# CONTENTS


| | | Page |
|---|---|---|
| SECTION 1 | GENERAL INFORMATION | |
| | Summary of Data | 1.1 |
| | Introduction | 1.3 |
| | Options | 1.4 |
| SECTION 2 | INSTALLATION AND OPERATION | |
| | Pre-Installation Checks | 2.1 |
| | Netting Procedure | 2.2 |
| | Contents List | 2.2 |
| | Installation | 2.3 |
| | Connection of Ancillaries: | |
| | Voltage Converter VC290 | 2.8 |
| | Operation | 2.9 |
| SECTION 3 | TECHNICAL DESCRIPTION | |
| | General Description: | |
| | Receiver | 3.1 |
| | Transmitter | 3.2 |
| | Power Supplies and Switching | 3.2 |
| | Detailed Description: | |
| | Receiver | 3.3 |
| | Squelch | 3.3 |
| | Transmitter | 3.4 |
| | Automatic Level Control | 3.4 |
| SECTION 4 | SERVICING | |
| | Precautions and General Information | 4.1 |
| | Construction | 4.3 |
| | Equipment Access | 4.4 |
| | Crystal Information | 4.5 |
| | Test Equipment Required | 4.6 |
| | Alignment Procedures | |
| | Power Supply and Regulator | 4.8 |
| | Receiver Alignment | 4.8 |
| | Transmitter Alignment | 4.9 |
| | M294E Interface Data | 4.10 |
| SECTION 5 | PARTS LIST | |
| SECTION 6 | DIAGRAMS | |
| | See "List of Illustrations" | |

# LIST OF ILLUSTRATIONS


| | | Page |
|---|---|---|
| Fig. 2.1 | Typical Installation | 2.5 |
| Fig. 2.2 | Basic Installation | 2.7 |
| Fig. 3.1 | Block Schematic Diagram – Transmitter/Receiver | 3.1 |
| Fig. 3.2 | Power Supplies and Switching | 3.2 |
| Fig. 4.1 | Alignment Diagram | 4.6 |
| Fig. 4.2 | Diode Probe Circuit Diagram | 4.6 |
| Fig. 4.3 | Connection of Test Equipment – Receiver Testing | 4.8 |
| Fig. 4.4 | Connection of Test Equipment – Transmitter Testing | 4.9 |
| Fig. 6.1 | Transceiver PCB Assembly AT28948/– Layout Diagram | |
| Fig. 6.2 | M294E Transceiver Circuit Diagram | |

# SECTION 1
# GENERAL INFORMATION

## SUMMARY OF DATA

### General

| | |
|---|---|
| Operation | Single or two-frequency |
| Modulation | Phase (frequency) |
| Frequency band | A0 Band 148–174 MHz<br>E0 Band 68– 88MHz |
| Channel spacing | 12,5 kHz (S)<br>20 kHz (R)<br>25 kHz (V) |
| Number of channels | Single or 3 channel |
| Operational environment | This equipment is designed for operation from −25°C to +55°C and meets EIA recommendations or relevant national specifications. |
| Frequency stability | (i) ±5 ppm over the temperature range −10°C to +55°C<br>(ii) ±10 ppm over the temperature range −25°C to +55°C |
| Power supply | (i) 12V (nominal) DC, −ve ground<br>(ii) 12V (nominal) DC, +ve ground } Using add-on convertor<br>(iii) 24V (nominal) DC, +ve/−ve ground } unit VC290 |
| Current consumption | Receive (standby)–less than 400 mA<br>Transmit–less than 6A at 25W output power |
| Operator controls | On/off switch<br>Volume<br>Channel selector (3 channel only)<br>Option controls (when fitted) |
| Indicator lamps | (i) Power on–green. Light pipe edge lights on-off switch, volume control and channel selector.<br>(ii) Transmit–red<br>(iii) Various indicator lamps and displays depending on options. |
| Dimensions | Main unit: 175mm×52mm×175mm<br>Loudspeaker unit: 112mm×112mm×64mm |
| Weight | Main unit: 1,23 kg<br>Loudspeaker unit: 0,6 kg |
| Finish | Case: black textured acrylic paint<br>Front panel: grey |

### Receiver

| | |
|---|---|
| Input impedance | 50Ω (nominal) |
| Sensitivity | 12db SINAD for less than 0,31μVPD signal at 60% system deviation with 1kHz tone |
| Audio output | 3W into 3Ω with less than 5% distortion. |

| | |
|---|---|
| Audio response | +1db to −3db from 300Hz to 3kHz (2,5kHz on 12,5kHz channel spacing), relative to 1kHz and 6db/octave de-emphasis characteristic. |
| Spurious response attenuation | Better than 70 db |
| Adjacent channel selectivity | Better than 70db at 12,5kHz channel spacing<br>Better than 75db at 25kHz channel spacing (CEPT two signal method) |
| Squelch sensitivity | Factory preset to 10db SINAD |
| Intermodulation attenuation | Better than 70db at 25kHz channel spacing |
| Switching bandwidth | ±0,2% of mean operating frequency |

**Transmitter**

| | |
|---|---|
| Output impedance | 50Ω (nominal) |
| Power output | 10, 15 or 25W, Factory preset, (measured with 13,2V DC input)<br>6W − Available for 20 kHz A0 and E0 Bands only. |
| Spurious outputs | Conducted: less than 2,5μW |
| Hum and noise level | −55db relative to ±3kHz deviation |
| Modulation deviation | ±2,5kHz peak (12,5kHz channel spacing)<br>±4kHz peak (20kHz channel spacing)<br>±5kHz peak (25kHz channel spacing) |
| Modulation response | +1db to −3db from 300Hz to 3kHz (2,5kHz for 12,5kHz channel spacing) relative to 1kHz and 6db/octave pre-emphasis characteristic. |
| Modulation distortion | Less than 3% at 60% peak system deviation with 1kHz tone. |
| Modulation sensitivity | Less than 5mV for 60% peak system deviation with 1kHz tone. |
| Switching bandwidth | ±0,2% of mean operating frequency. |




## INTRODUCTION

The M294E is a front-mount VHF FM mobile radiotelephone designed to provide two-way communication between mobile installations or between a mobile installation and a base station. The equipment operates on fixed crystal-controlled frequencies in the ranges 68–88MHz and 148–174MHz using single or two frequency simplex working. Single and three channel versions of the radiotelephone are available.

The receiver has a sensitivity of 12db SINAD for less than 0,31$\mu$V PD and delivers 3W at less than 5% distortion into a 3$\Omega$ load.

The transmitter can generate a modulated carrier of 6, 10, 15 or 25W (factory preset) into a 50$\Omega$ load.

The equipment operates from a 12V DC negative ground supply. An add on voltage converter type VC290 enables the unit to be used with a 12/24V DC positive ground supply, or a 24V DC negative ground supply.

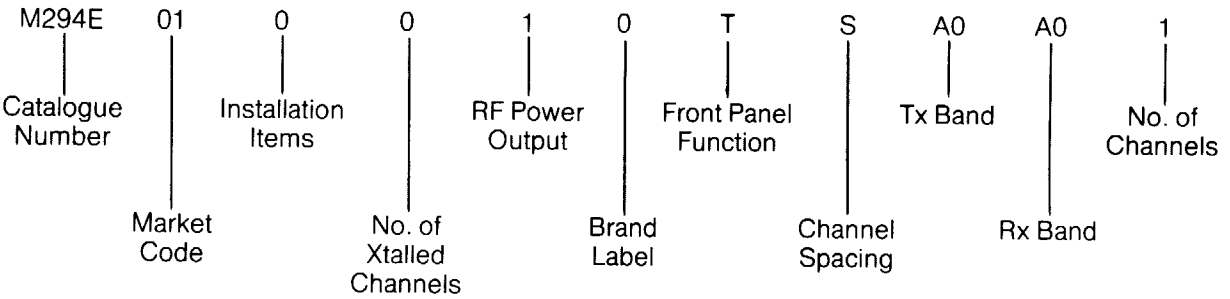
The complete installation comprises a compact transmitter/receiver, wired-in hand microphone, external loudspeaker and associated fixings. Space is available within the transmitter/receiver for optional signalling modules, whose status and related visual information is displayed on the front panel.

## OPTIONS

### Equipment Label

The catalogue and serial numbers together with the transmit and receive frequencies for each channel, when known, are shown on the equipment label attached to the transmitter/receiver rear panel assembly.

A typical equipment code is shown below:




### Frequency Label

The transmitter/receiver frequencies, when known, are shown on the frequency label attached to the unit.

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 02 France 03 West Germany

### Installation Items

0 Less installation items and loudspeaker–Mobile standard mounted
1 With installation items and loudspeaker–Mobile standard mounted

### Number of Crystalled Channels

0 Less Crystals
1 Crystalled on one channel
2 Crystalled on two channels
3 Crystalled on three channels

### RF Power Output

1 25 Watts
2 15 Watts
3 10 Watts
4 6 Watts – Available for 20 kHz A0 and E0 Bands only

### Brand Label

0 Less brand label
1 With Pye logo
2 With Philips logo

### Front Panel Function

T Transit panel fitted – Mobile non-operational
1 With front panel – less options
5 Less front panel – Mobile fitted with TE1 (TE1 must be ordered separately)
D Less front panel – Mobile fitted with TEDX (TEDX must be ordered separately)
F Less front panel – Mobile fitted with TED3 (TED3 must be ordered separately)
(For details of TE1, TED3 and TEDX see publication reference number TP216, TP221 and TP222 respectively)

Channel Spacing

S 12,5 kHz
R 20 kHz
V 25 kHz

Tx Band

A0 148 – 174 MHz
E0 68 – 88 MHz

Rx Band

A0 148 – 174 MHz
E0 68 – 88 MHz

Number of Channels

1 Single Channel
3 Three Channels

Primary Options

01 Less options

Secondary Options

ZZ Not Used

ANCILLARIES

12/24V DC Input Power Supply +ve or –ve ground.

A Voltage Convertor Unit type VC290 (see publication reference number TP214) can be used with 12/24V DC positive or negative ground power supplies.

# SECTION 2
# INSTALLATION AND OPERATION

## PRE-INSTALLATION CHECKS

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

### Equipment Required

| | |
|---|---|
| Power Supply | 8 – 16V, 6A |
| RF Output Meter | 50Ω, 50W |
| Marker Oscillator | 10,7 MHz |
| RF Signal Generator | FM |
| AF Output Meter | |
| Frequency Counter | |

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

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

2. Check the unit is switched off (On/Off button in outer position). Adjust the power supply for 13,2V DC output and connect to the equipment ensuring that the live lead is fused and that supply polarity is correct (–ve ground)

3. Check equipment serviceability as follows: –

   *Note: (i) 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 service manual*

   *(ii) Crystals are normally fitted before shipment, and the information Label (on equipment rear panel) 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 AF 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% peak system deviation. Set signal level to 1μV PD.

   c) Press the On/Off 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 AF output meter.

   e) Connect RF output meter to the antenna socket. With power supply set to 13,2V, operate the press-to-talk switch and check that power output is to specification.

## NETTING PROCEDURE

*Note: With the exception of the following procedures, oscillator coils should only be adjusted with reference to a frequency sub-standard.*

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) |
|---|---|---|---|---|---|
| A0 | Tx | 9,9125 | $\frac{fc}{16}$ | 158,6 | |
| A0 | Rx | 48,7 | $\frac{fc - 10,7}{3}$ | 156,8 | 146,1 |
| E0 | Tx | 4,875 | $\frac{fc}{16}$ | 78 | |
| E0 | Rx | 47,7 | $\frac{fc + 10,7}{2}$ | 84,7 | 95,4 |

## CONTENTS LIST (INSTALLATION ITEMS)

| Description | Part No. | Remarks |
|---|---|---|
| M294E transmitter/receiver | M294E | |
| Loudspeaker assembly | AT14637/01 | |
| Antenna and lead assembly | | Despatched separately when ordered |
| Radiotelephone Installation Items consisting of:– | AT36911/01 | |
| Cradle assembly | AT12405/01 | |
| Bagged items consisting of:– | AT36910 | |
| Clamp, cable | BT16043 | 1/Mic lead |
| Rest, microphone | BT25191 | |
| Support | BT26617 | 1/Mic lead |
| Tool, extractor | BT29007 | |
| Label, call sign | BT38143 | |
| Connector, self-stripping | FC15754 | 3 off |
| Fuse, 7,5A | FF06810 | |
| Fuseholder, self-stripping | FH02881 | |
| Plug BNC, free, str, 50Ω | FP99100 | For antenna lead |
| Terminal, insulated, female | FT16860 | |
| Terminal, insulated, male | FT16861 | |
| Ty-rap | QA04424 | |
| Scr, sl, pan, st, No. 10 x ½ in. | QQ41208/X | 4/cradle |
| Scr, sl, pan, st, No. 6 x ⅜ in. | QW41206/X | 2/support, 2/clamp |

## INSTALLATION

### Equipment Required

Medium size pliers
Circle cutter, holesaw, or socket punch
Drill bits (see sizes below)
Drill
Soldering Iron
¼ in. flat-blade screwdriver
Standard Crimping Tool
Bit sizes:–

Bit for No. 6 self-tapping screw – 2,8 mm
Bit for No. 10 self-tapping screw – 3,4 mm

*Note:* *(i)* *The item to be fitted can be used as a marking-out template*

*(ii)* *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.*

*(iii)* *Details of the screws required to secure the installation items are shown in the Contents List.*

*(iv)* *Refer to Basic Installation Diagram Fig. 2.2 throughout this procedure.*

> **CAUTION**
>
> **To prevent interference with any other electronic systems in the vehicle, e.g. ignition, anti-skid devices etc., the radiotelephone and antenna should be mounted as far away as possible from these units and their associated cables. Reference should be made to the vehicle manufacturers handbook for the location of these items.**

### Procedure

1. Check items against the Contents List.

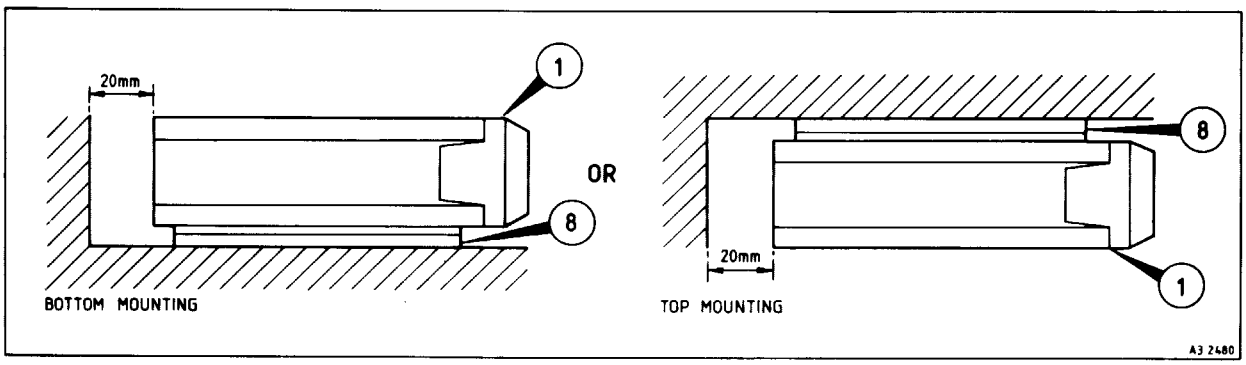
2. Determine location of installation.

   *Note:* *Ensure that the location of the cradle assembly is compatible with safety of the vehicle occupants, ease of equipment extraction and ease of equipment operation when seat belts (if fitted) are worn.*

   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.

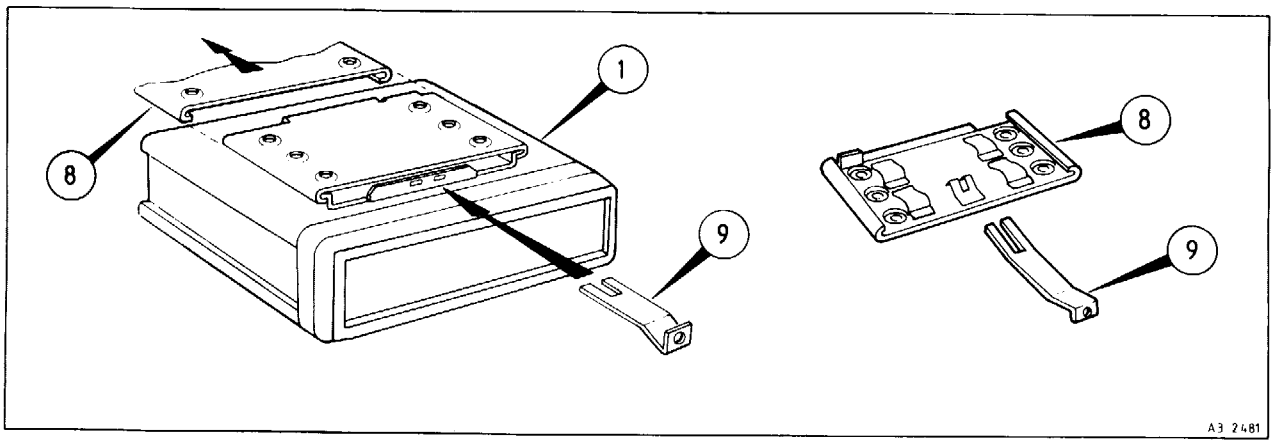


When finalising the locations of the items to be installed the lengths of the following cables should be noted:

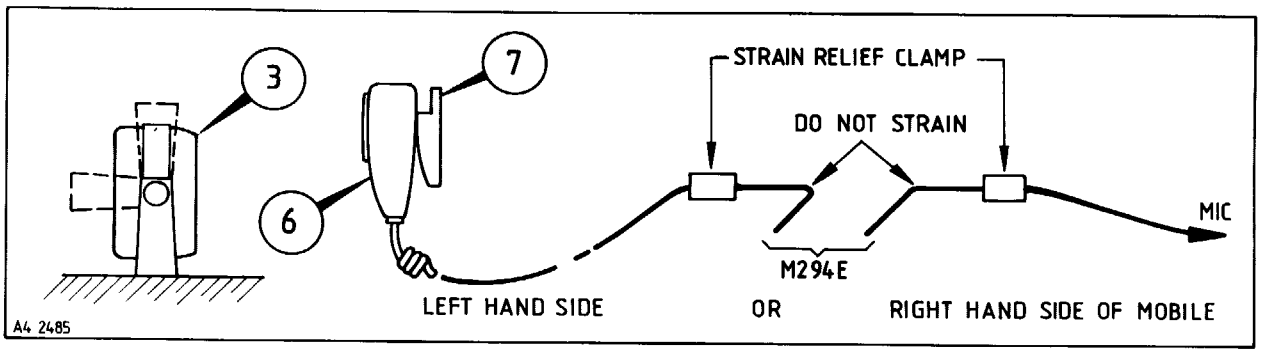
| | | |
|---|---|---|
| Power leads | – | 170 mm |
| Microphone and lead | – | 500 mm straight plus 340 mm coiled |
| Loudspeaker Lead (attached to radiotelephone) | – | 170 mm |
| Loudspeaker Lead (attached to loudspeaker) | – | 1000 mm |

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.

*Note: As an alternative to local manufacture the following Equipment Spacing Blocks are available from the Company:*

*Spacing Block 12 mm – Part Number SH30045*
*Spacing Block 18 mm – Part Number SH30046*

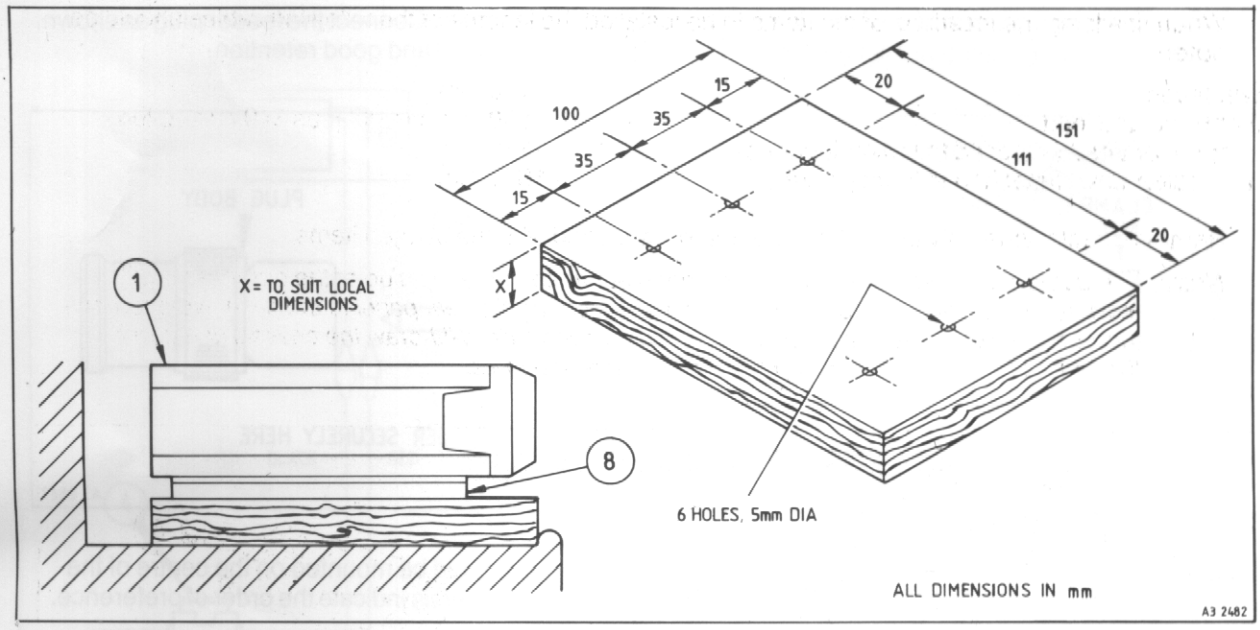
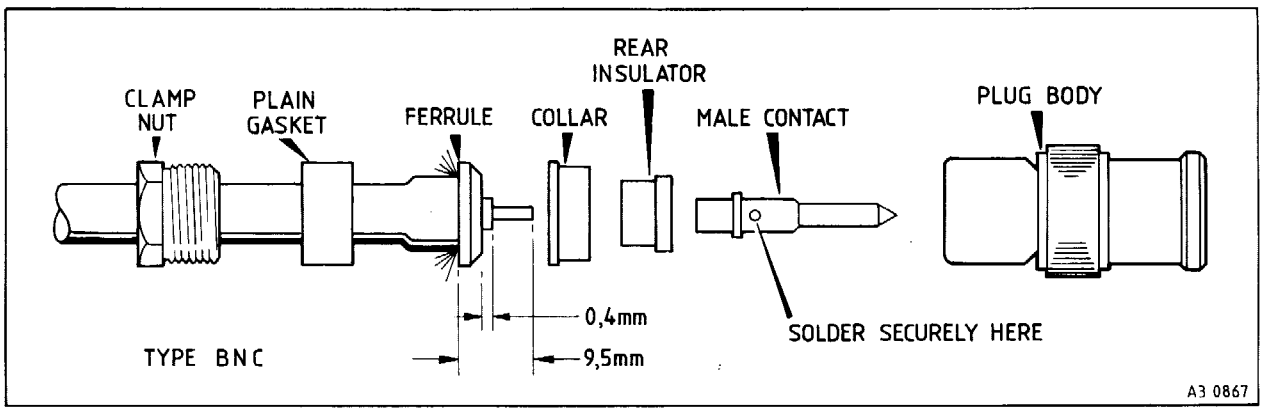


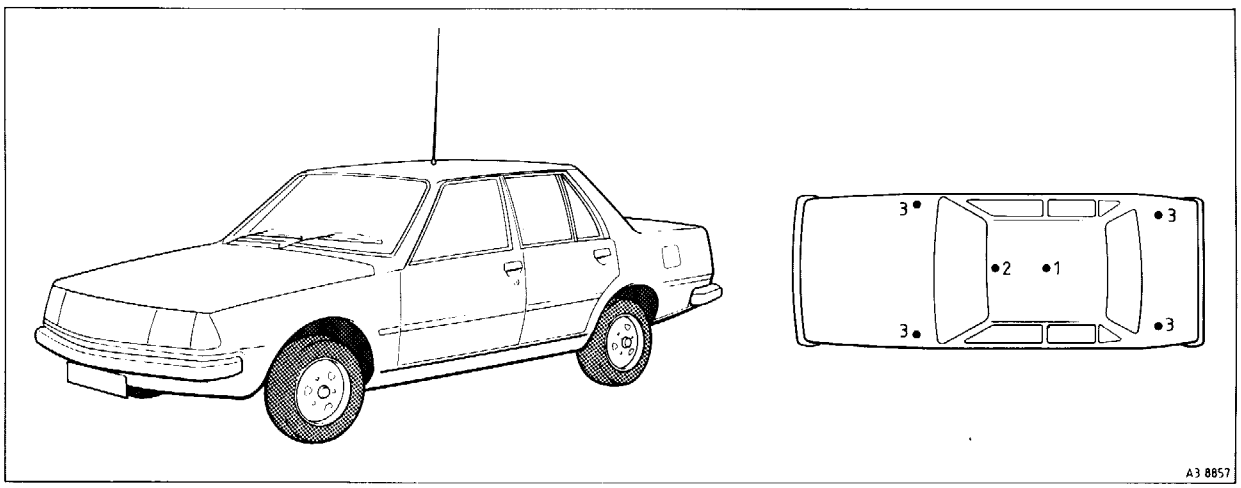



Fig. 2.1 Typical Installation

5. Mount the antenna, see Manufacturers Fixing Instructions for details. Connect the feeder plug as shown, ensuring that the clamp nut is tight enough to ensure both a good fit and good retention.




For best all round performance of the radiotelephone, the antenna should be mounted on the centre of the vehicle roof. Alternative positions give degraded performance, the numerals indicate the order of preference.




6. Connect vehicle battery to installation supply as follows:–

12V Supply

**CAUTION**

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

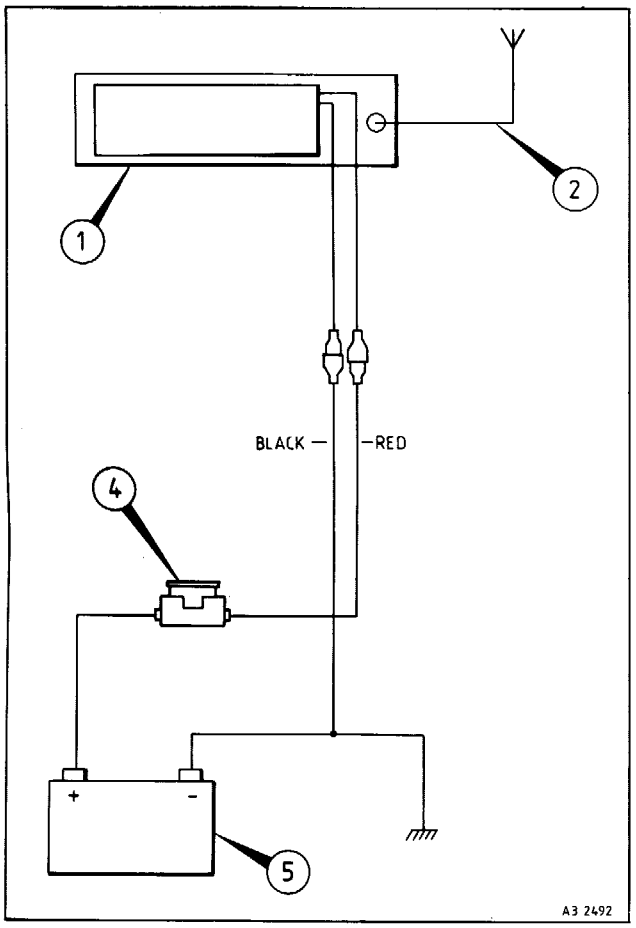
*Note:* *(i)* *Cable (not supplied), used between battery and connectors should be 63/0,2 mm*

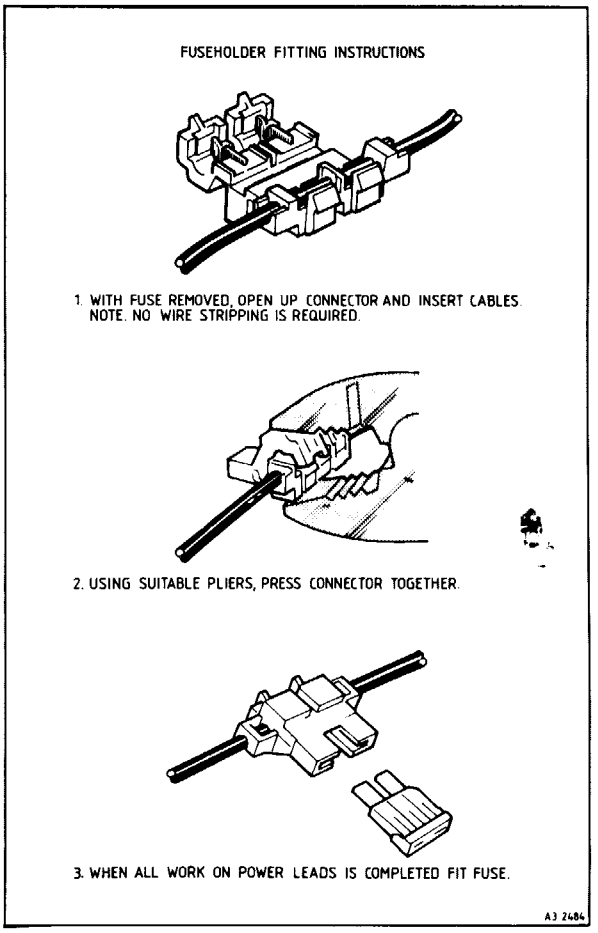
*(ii)* *Power leads are colour coded:*

*Red – positive*
*Black – negative*

*(iii)* *Fuseholder should be fitted as near to the battery as is practicable.*

a) Measure power leads to battery (5)




b) Cut positive power lead and fit fuseholder (4) as shown above.

c) Using the terminal crimping tool fit the female insulated terminal (Part No. FT16860) to the positive power lead and the male insulated terminal (Part No. FT16861) to the negative power lead.

d) Connect power leads to battery.

e) Connect the power leads to the power leads from the M294E.

*Note: 63/0,2 mm cable should be used whenever possible, where it is necessary to connect the positive power lead to thicker cable fit the fuseholder in a short length of 63/0,2 mm cable as described in (b). Fit one end of the 63/0,2 mm cable in to one end of the connector Part No. FC15754 supplied, fit the end of the thicker cable in to the opposite end of the connector and close the connector using suitable pliers. Use a similar method where it is necessary to connect the terminals type FT16860 and FT16861 to thicker cable.*

f) Connect the loudspeaker (3)

g) Connect the antenna feeder plug (2) to the antenna socket.

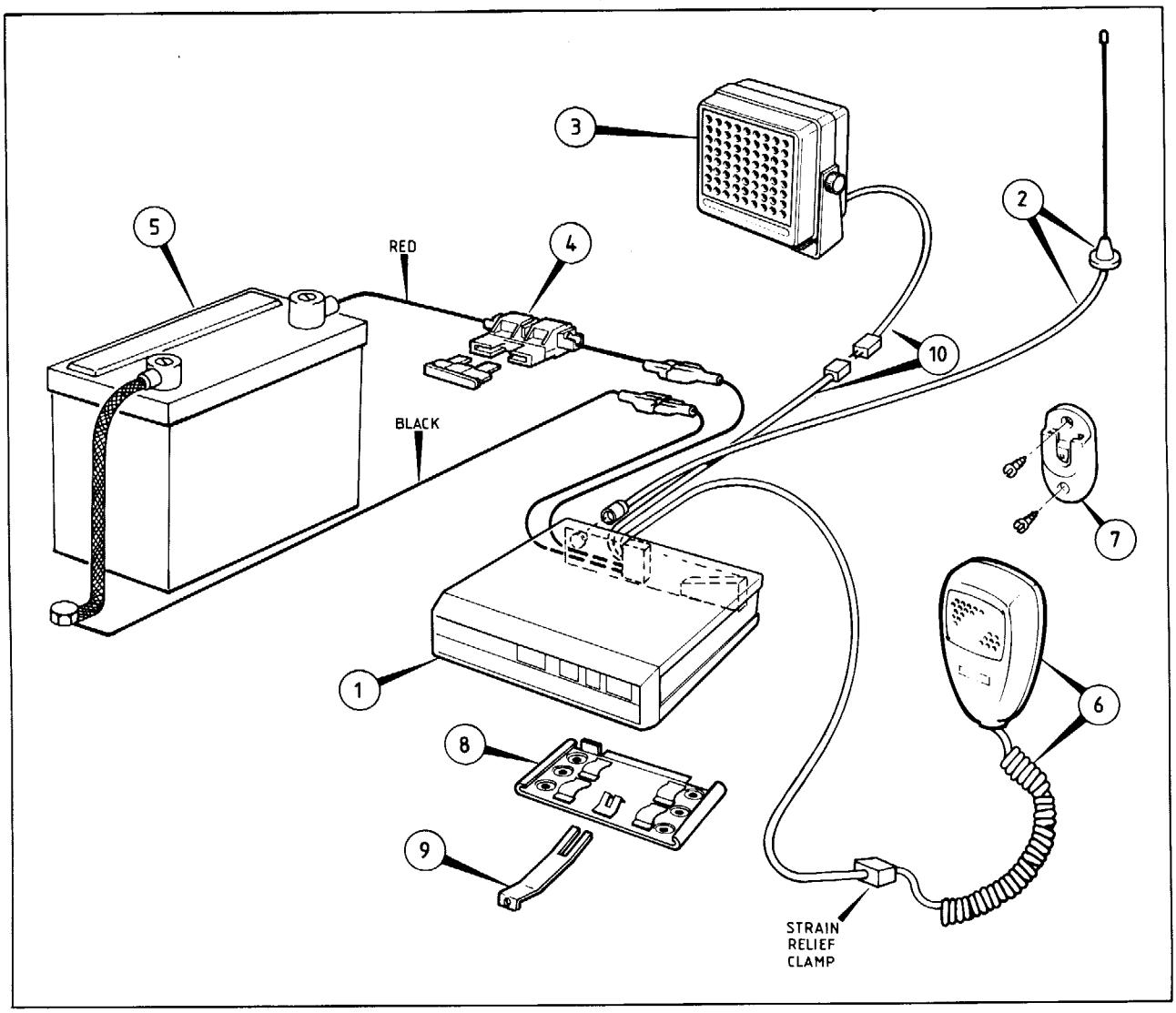
h) Use tyraps to secure leads and finalise installation.

**CAUTION**

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

## Air Check

Carry out a test call and check that the equipment is correctly netted in to the base station.




LEGEND

*Note: These indicator numbers only apply to drawings shown in this Installation Procedure.*

1. Transmitter/Receiver
2. Antenna and Feeder Cable
3. Loudspeaker
4. Fuseholder
5. Battery
6. Microphone and Lead Assy (showing strain relief clamp).
7. Microphone Rest
8. Cradle Assy.
9. Cradle Extractor Tool
10. Loudspeaker Lead

Fig. 2.2 Basic Installation

## RF Compatibility Checks

The following checks should be carried out if the vehicle is equipped with electronic anti-skid and/or electronic ignition systems.

*Note: (i) The transmitter should be keyed only for the time required to make an observation.*

*(ii) An assistant will be required for the following checks.*

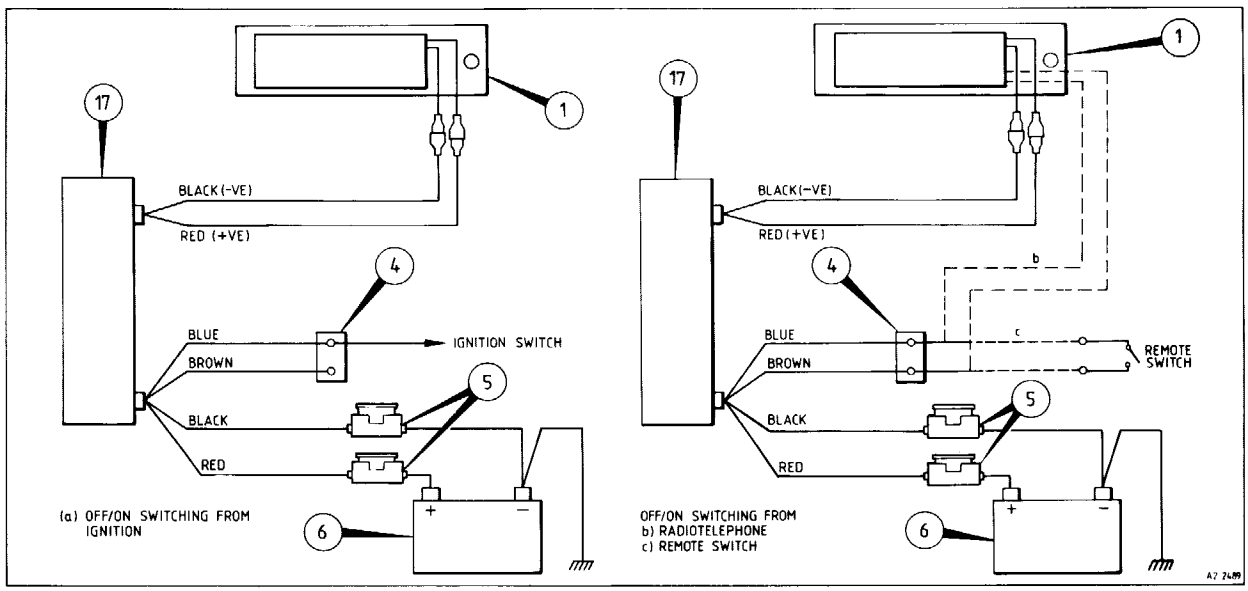
1. With vehicle stationary and the engine running at fast idle, key the transmitter and check that the brake lights do not illuminate, and the engine continues to run normally.

2. Operate brake pedal, key the transmitter and check that the brake lights do not extinguish.

3. Put the vehicle into motion at a moderate speed (10 – 15 mph), key the transmitter and operate the brake pedal simultaneously. Check that the braking action is normal, and that the engine does not surge or cut out.

> **CAUTION**
>
> **If the event of an apparent malfunction in the braking or ignition systems during the above checks, the radio installation should be rendered inoperative and the vehicle manufacturer should be contacted before any further use is made of the radio installation.**

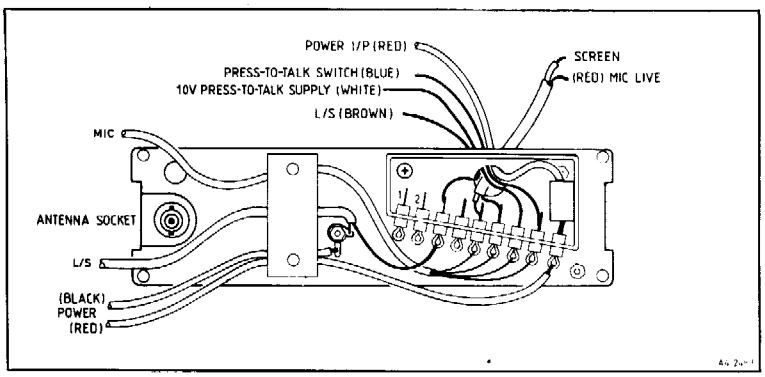
## CONNECTION OF ANCILLARIES
## VOLTAGE CONVERTER VC290 (17)

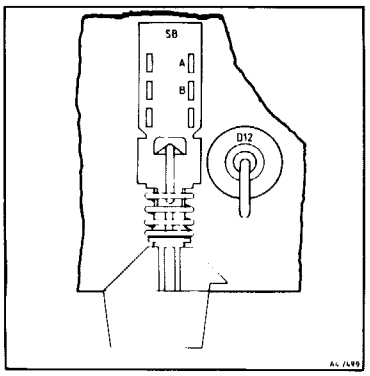



1. Locate and secure the Terminal Block (4) within 1 metre run of the VC290. Connect the switching leads (brown and blue) to the Terminal Block.

2a. On/Off Switching from Ignition – Connect blue lead of Terminal Block (4) to the auxiliary contact on the vehicle ignition switch. Leave brown lead of Terminal Block isolated.

2b. On/Off Switching from Radiotelephone – Remove the radiotelephone rear panel cover. Release the four 'pozidriv' screws securing the radiotelephone rear panel to its case and slide out the PWB and rear panel assembly. Locate unused feedthrough capacitors 1 and 2; also locate tags A and B of the On/Off switch. Connect a lead between the blue lead of the Terminal Block (4) and feedthrough capacitor 1. Connect a wire between feedthrough capacitor 1 and tag A. Connect a wire between tag B and feedthrough capacitor 2. Finally, connect a lead between feedthrough capacitor 2 and the brown lead of the Terminal Block (4). Refit the PWB and rear panel into the radiotelephone case and secure using the 'pozidriv' screws. Refit the rear panel cover.




2c. On/Off Remote Switching – Locate and secure switch. Connect blue lead of Terminal Block (4) to one contact of switch, and brown lead of Terminal Block (4) to the other contact of the switch.

3. Connect one VC290 input lead (one red, one black) to each Fuseholder (5).

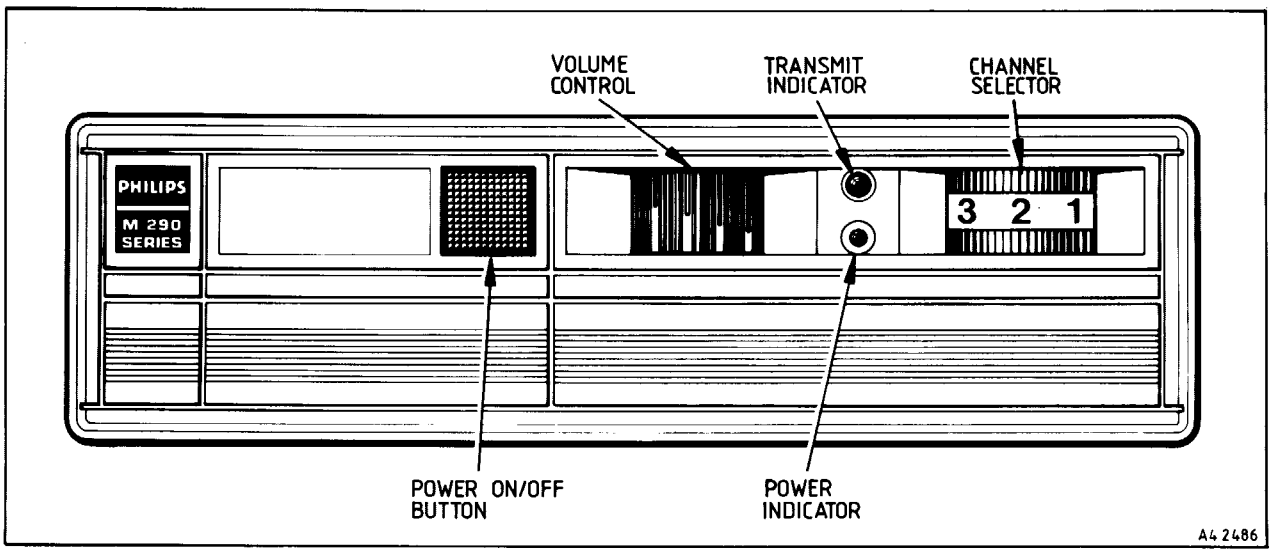
4. Observing polarity, connect each Fuseholder (5) to the vehicle battery using leads which are not common to any other circuit.

   *Note: The Fuseholders (5) should be fitted as near to the battery as is practicable.*

5. Check that the installation is correct and insert fuses into Fuseholders (5).

   *Note: Use 10A fuses for VC290/12 and 5A fuses for VC290/24.*

## OPERATION




### 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, these controls are:–

a) On/Off switch – this push-button switch makes or breaks the power supply to the radiotelephone.

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.

d) Option controls (when fitted) – refer to relevant publication.

### Indicators

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

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

## Reception

a) Press the On/Off button. Check that the green power on indicator is illuminated.

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 in to it 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 On/Off switch once and check that the On lamp is extinguished.

# SECTION 3
# TECHNICAL DESCRIPTION

## GENERAL DESCRIPTION

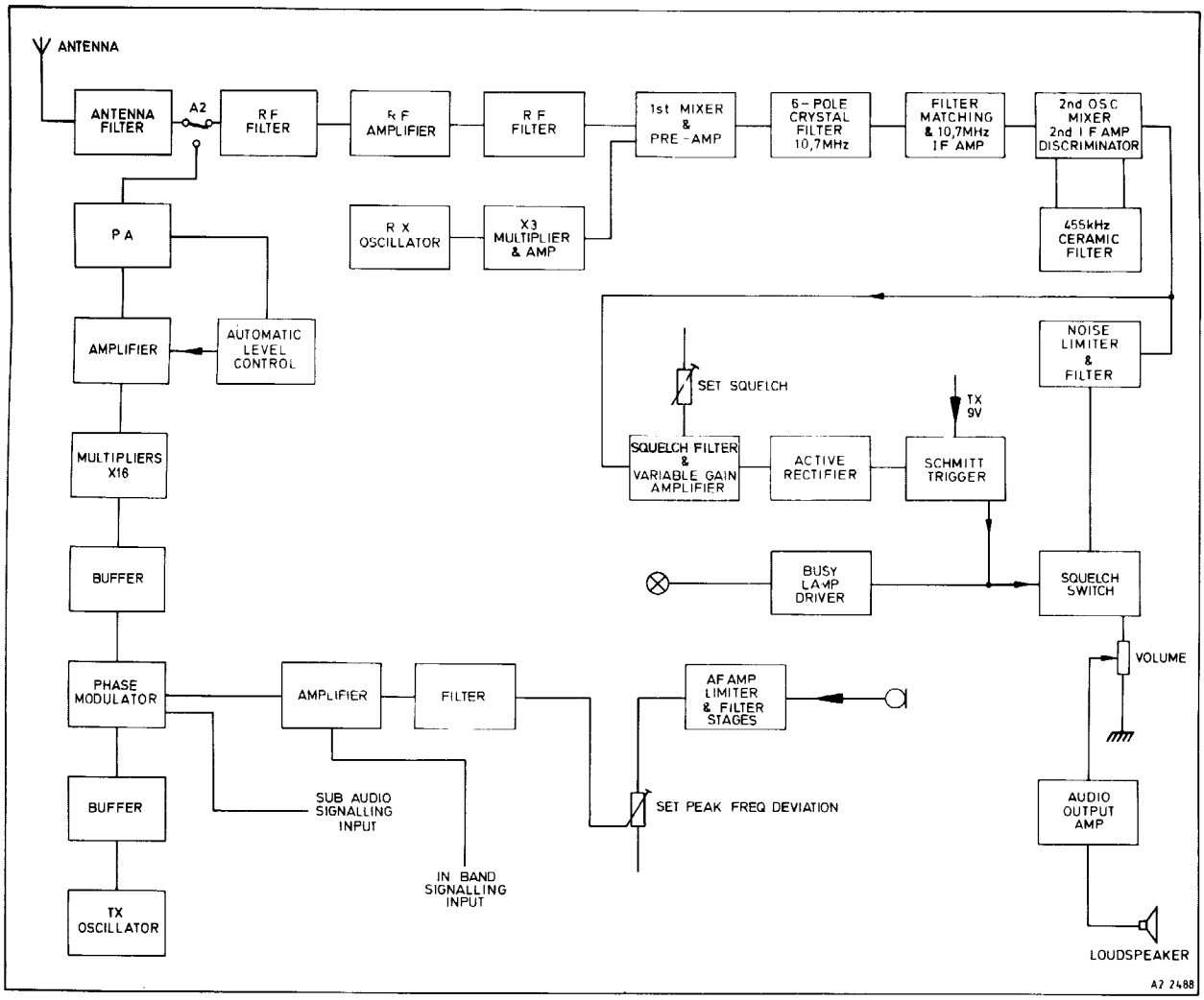



Fig. 3.1 Block Schematic Diagram – Transmitter/Receiver

### Receiver

Received signals are routed, via the antenna filter and relay contact A2, to a two-stage RF filter, and thence to a common-gate RF amplifier. A further 3-stage RF filter follows, which, together with the first RF filters, provides spurious response rejection.

The Rx oscillator frequency is multiplied, amplified 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 a 6-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 the squelch switch, to an IC audio output amplifier which delivers 3 watts into a 3Ω load.

## Transmitter

Audio signals from the microphone are fed via AF amplifier, limiter and filter stages to the deviation control. After further filtering and amplification the audio signal is fed to the phase modulator.

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 low modulation distortion.

After four stages of doubling to final frequency, the modulated RF is amplified and passed via the antenna filter and relay 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 continuously adjusted down to 6W by adjustment of RV4.

## POWER SUPPLIES AND SWITCHING

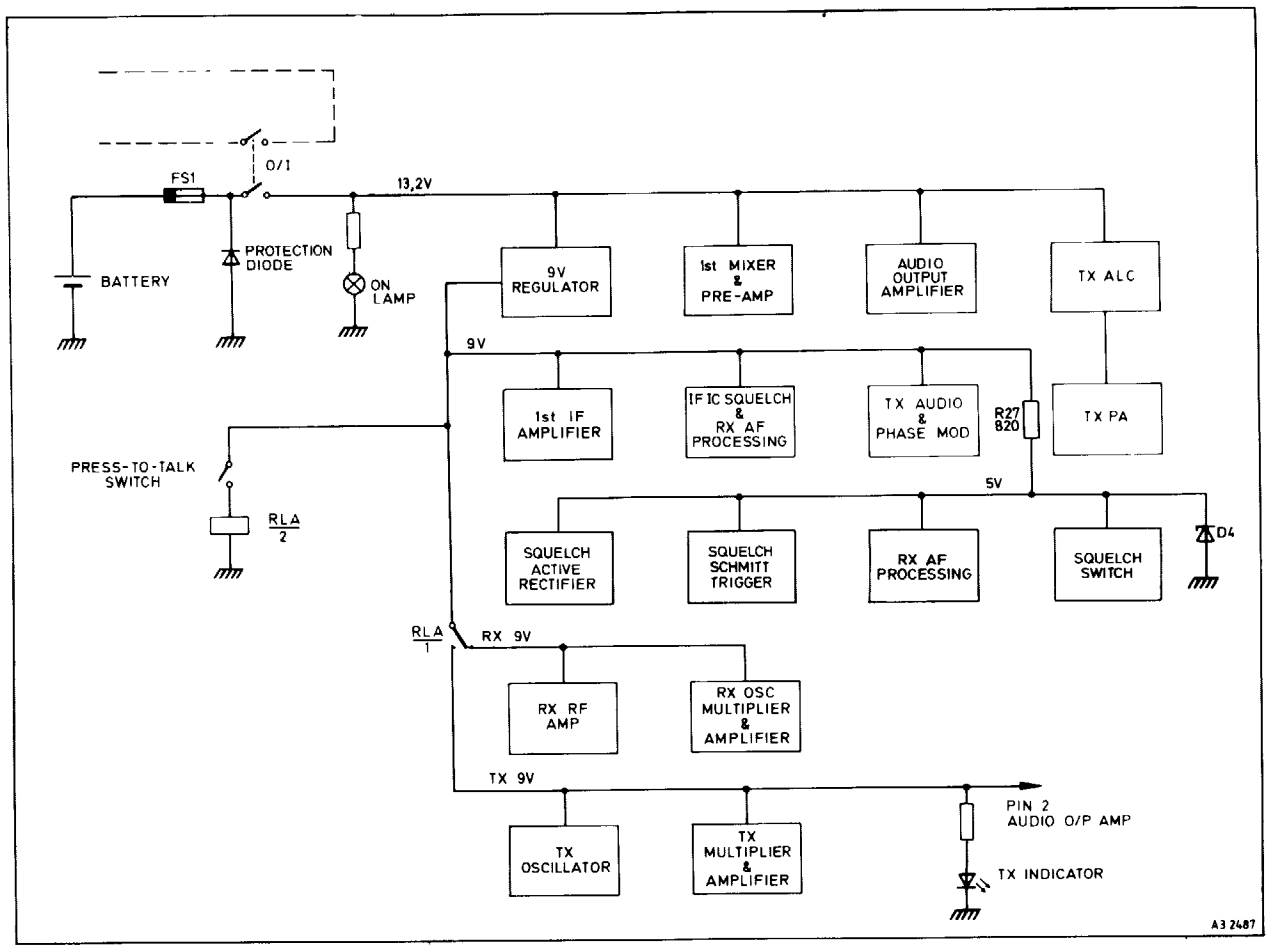



Fig. 3.2 Power Supplies and Switching

The battery 13,2V positive supply is fed, via a feedthrough capacitor, to the 8A fuse FS1 and one pole of the On/Off switch. A shunt diode is incorporated as protection against reverse polarity. The spare pole of the On/Off switch may be used for switching ancillaries such as the VC290.

Switched 13,2V is applied to the 9V regulator (IC7), 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 On/Off switch is closed and also gives illumination to transceiver controls and labels for night use.

Regulated 9V is applied to the 1st IF amplifier, IC1, squelch and AF processing, Tx audio and phase modulator, and the press-to-talk switch. Relay contact RLA1 routes 9V to the Rx RF amplifier, Rx oscillator, multiplier and amplifier.

Operation of the press-to-talk switch causes RLA/2 to be energised. RLA1 transfers regulated 9V to the Tx 9V line, supplying Tx oscillators, Tx multipliers, and the Tx indicator LED1, which provides a red point of light. RLA2 (shown on Fig. 3.1) transfers the antenna filter from the RF amplifier stage to the PA output.

Zener diode D4 is fed from the 9V regulated supply via R27 providing a 5V supply to the squelch active rectifier, squelch schmitt trigger, Rx AF processing and squelch switch.

## DETAILED DESCRIPTION

### Receiver

RF signals are routed, via the antenna filter and relay contact A2, to an RF filter L1, C1 – 6, L2, incorporating two high-Q inductors. A common-gate RF amplifier (TR1) is followed by a further stage of filtering comprising three tuned circuits L3/C9, L4/C14, L5/C15. These three, together with the initial two, provide spurious response rejection.

The modified Colpitts oscillator employs a series resonant overtone crystal operating at its third harmonic. Exact frequency is set by the trimmer L9 – 11, as appropriate (see also "Netting Procedure" in Section 2).

L12 is tuned to the third harmonic which is amplified by TR10 and filtered by L13, L14 to provide the injection frequency. Signal frequency is added to the injection frequency across L14 and applied to the gate of mixer TR2, with L6, L7, tuned to the 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. A 6-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, C38, tuned to the 2nd IF at 455 kHz.

Audio output from the discriminator takes two paths, one to the squelch circuit, the other to an audio noise limiter (which reduces the effect of impulsive interference on the audio signal), a buffer, an active low pass filter, an active high-pass filter (which reduces the low frequency components in the audio signal) and the squelch switch TR6.

Audio is gated to the audio output amplifier IC3 via TR6, itself gated on and off by TR7 and the action of the squelch circuit; RV1 is the volume control. IC3 is a short-circuit-proof thermally protected amplifier capable of delivering in excess of 3 watts into a 3Ω load. Pin 2 of IC3 is taken to the Tx 9V line, via D5 and R43, so that the amplifier is muted during transmissions. TR8 is provided as a busy lamp drive for use with tone options.

### Squelch

Under no signal conditions the discriminator output consists substantially of noise which is applied to the active filter TR11 where frequencies above 15 kHz are extracted. The filtered noise is applied, via TR11, to an amplifier TR12 the gain of which is set by RV2. D8 causes the negative half cycles of the signal to be amplified more than the positive thus, IC4b behaves as a rectifier with smoothing provided through R72, C87. The schmitt trigger IC4a provides a switched output to the squelch gate on the control board.

With a signal present the noise level falls causing IC4b output to fall and the schmitt trigger to change state.

## Transmitter

Microphone signals are fed via AF amplifier, limiter and filter stages comprising IC5a, b, d and associated components to the deviation control RV3. From RV3 the signal passes through three further stages of amplification and filtering comprising IC5b, IC6a, b and associated components before being fed to the phase modulator TR16.

An input to IC6b via C102 and R91 is provided for speech-band tone encoding.

A further input is provided via R85 to TR13 to enable microphone gating.

The oscillator TR14 is crystal controlled and operates in the fundamental, series resonant mode, the exact frequency of oscillation being set by the trimmer L15 – L17 as appropriate.

A buffer stage TR15 applies oscillator RF to the phase modulator TR16. The signal at TR16 collector is the phasor sum of the direct component, fed forward via C119, and a component amplified by TR16, the latter being amplitude modulated by the AF signal. The resultant phase modulated output is fed to a clipping buffer stage TR17 which removes the amplitude modulation. TR18 and TR19 are FET frequency doublers, each stage contributing some gain. The high output impedance of FET's allows untapped coils to be used in the drain tuned circuits of these stages. A further pair of doublers using bipolar transistors TR20, TR21 bring the RF up to final frequency; total multiplication being sixteen.

TR22, 23, 26 and 27 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 0,25$\mu$W.

## 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 TR26 and TR27.

R143 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 D9 and D10 determined by the setting of RV4. This voltage sum is applied to TR25 base, controlling the degree to which TR25 conducts, and thence the amount of current shunted from TR24 base. Hence, if the PA current tends to rise TR24 reduces the supply voltage to TR23 thus reducing the PA drive.

# SECTION 4
# SERVICING

## GENERAL

### Surface Mounted Devices (SMD's)

This equipment uses a large number of SMD's, sometimes referred to as Chip Components, because of their small size and lack of identification special care is recommended when replacing them.

The following is a list of suitable equipment to facilitate the efficient replacement of SMD's:–

| Description | Type |
|---|---|
| Magnifier (x2) bench flourescent | Radio Spares 548 – 704 |
| Soldering iron, standard, with PSU | Weller TCP3 and PU3D |
| Soldering iron, pencil, with PSU | Weller MP127 and MPU3D |
| Set SO Desoldering Blocks | Pye various |
| Tweezers, cross-over, self-gripping | Southerns 932 – SA, 951850 |
| Tweezers, curved end | Southerns 61 – 5A 951551 |
| Wick Solder (1/16 in.) | Pye ST00114 |
| Brush | Radio Spares 549 – 763 |
| Cutters, side, small | OK Industries PO2 |
| Glasses, safety | |
| Pad, bench, rubber | |
| Solder, 24 – 28 SWG | |

To change lead-less SMD's e.g. ceramic resistors or capacitors and small transistors the following procedure is recommended.

*Note:* *(i)* *As most SMD's have no markings to identify the type or value of component it is essential to replace one item at a time.*
*(ii)* *The replacement SMD should be fitted as soon as it is removed from the packet/container.*

a) Set up the magnifier, put the rubber pad on the bench and place the PCB on it.

> **WARNING**
> **Certain synthetic rubber compounds may produce toxic fumes when heated**

b) Identify the component to be changed, grip the sides with the cutters and shatter it, taking care not to cut the PCB beneath the SMD.

> **WARNING**
> **Safety glasses should be worn when shattering SMD's**

c) Brush the pieces of the component away from the PCB.

d) Using the pencil soldering iron remove the remnants of the end caps and clean the pads, if necessary use solder wick to remove excess solder.

e) With the aid of a pair of tweezers remove the replacement SMD from the pack and place it centrally on the pads.

f) Hold the component in position on the pads by exerting a light pressure on the centre of the component with the tips of the tweezers.

g) Using the pencil soldering iron tack one side of the SMD, remove the tweezers.

h) Solder the other end of the SMD using the 24 – 28 SWG solder.

i) Resolder the tacked end of the SMD using the 24 – 28 SWG solder.

j) Inspect both joints and clean away any foreign material.

To change larger SMD's fitted with connecting leads, cut or unsolder the leads as appropriate (using the SO Desoldering Blocks where suitable), the item may then be replaced similarly to a conventional component.

### Metal Oxide Silicon Devices

The field effect transistors and C-MOS integrated circuits used in this equipment are metal oxide silicon devices. Because they have an extremely high input impedance, they are susceptible to damage when subjected to high transient voltages or static electrical charges. To eliminate the possibility of damage the following precautions must be taken.

(i) Device leads must always be in contact with a conductive material to avoid the build-up of static charges.

(ii) Soldering iron tips, tools and metal parts of test equipment used during servicing must be grounded.

(iii) To avoid transient voltage spikes, devices must not be inserted nor removed with power connected.

(iv) Signals must not be applied to integrated circuits in the absence of power supplies to the devices.

### Transmitter Loading

Although the protection circuits ensure that the transceiver operates safely under a wide range of loading conditions, it is not advisable to operate the transmitter without a load connected to the antenna socket. During transmitter servicing, the Rf power meter and load provide a suitable termination.

### 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.

### 'Pozidriv' Screws

Special screwdrivers are required for use with 'Pozidriv' headed fixing screws. 'Pozidriv' screwdriver No. 1 is suitable for screws up to metric size M3, screws larger than this require a 'Pozidriv' screwdriver No. 2. The use of any other type of screwdriver can result in severe damage to the screwhead.

### Heatsink Components

Sufficient heatsink compound (Dow-Corning Type 340, Pye Part No. HM00405) must be applied between the component, insulating washers and heatsink surface to provide a good thermal path.

### Connector Pin Cleaning

Under no circumstances should connector pins be cleaned using any abrasive or corrosive agent. Grease or dust should be removed by use of a cleaning fluid such as RS Components Ltd. Catalogue No. 554/175.

### Soldering

Soldering operations on PWBs should be kept to a minimum and should preferably be carried out using a low voltage DC soldering iron with an earthed bit. This type of soldering iron MUST be used when replacing FETs or C-MOS integrated circuits. Always ensure that the holes in the printed circuit track are clear of solder before fitting components and check that tracks are clean before applying the soldering iron or solder. The amount of solder and the dwell time of the soldering iron should be kept to a minimum. To reduce the risk of damage to components heatshunts should be used wherever possible. Do not use a permanent magnet soldering iron in the vicinity of coils with ferrite cores.

### Routine Frequency Adjustment

Although the crystal oscillators used in this equipment are extremely accurate and reliable, it must be borne in mind that quartz crystals are subject to 'ageing' and circuits incorporating them therefore require periodic readjustment. This requirement is not affected by the amount of use given to the equipment, 'ageing' occurs even during careful storage. The effects are at a maximum with new crystals, becoming less significant over their life but, to ensure optimum performance the NETTING PROCEDURE in Section 2 must be carried out on installation and thereafter, as a matter of routine, at intervals of six months.

### Measuring Points (MP's)

Measuring points give an indication of equipment performance at these points when specified levels of RF or AF are injected at stated locations. The locations of MP's are shown on the circuit diagram. Test equipment required to measure the levels quoted is included in the list shown under "TEST EQUIPMENT REQUIRED".

### Replacement of Wire-ended Components

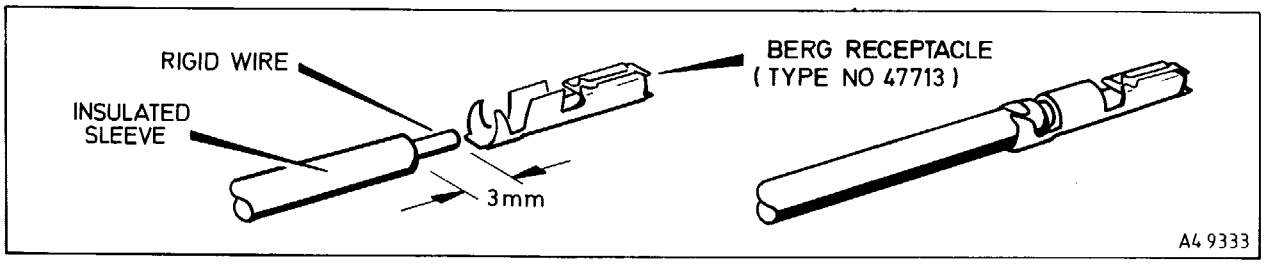
When replacing wire-ended components, ensure that the wires do not protrude more than 1 mm beyond the track surface. Failure to do this may result in short-circuiting the component to the casing.

### 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:–




## CONSTRUCTION

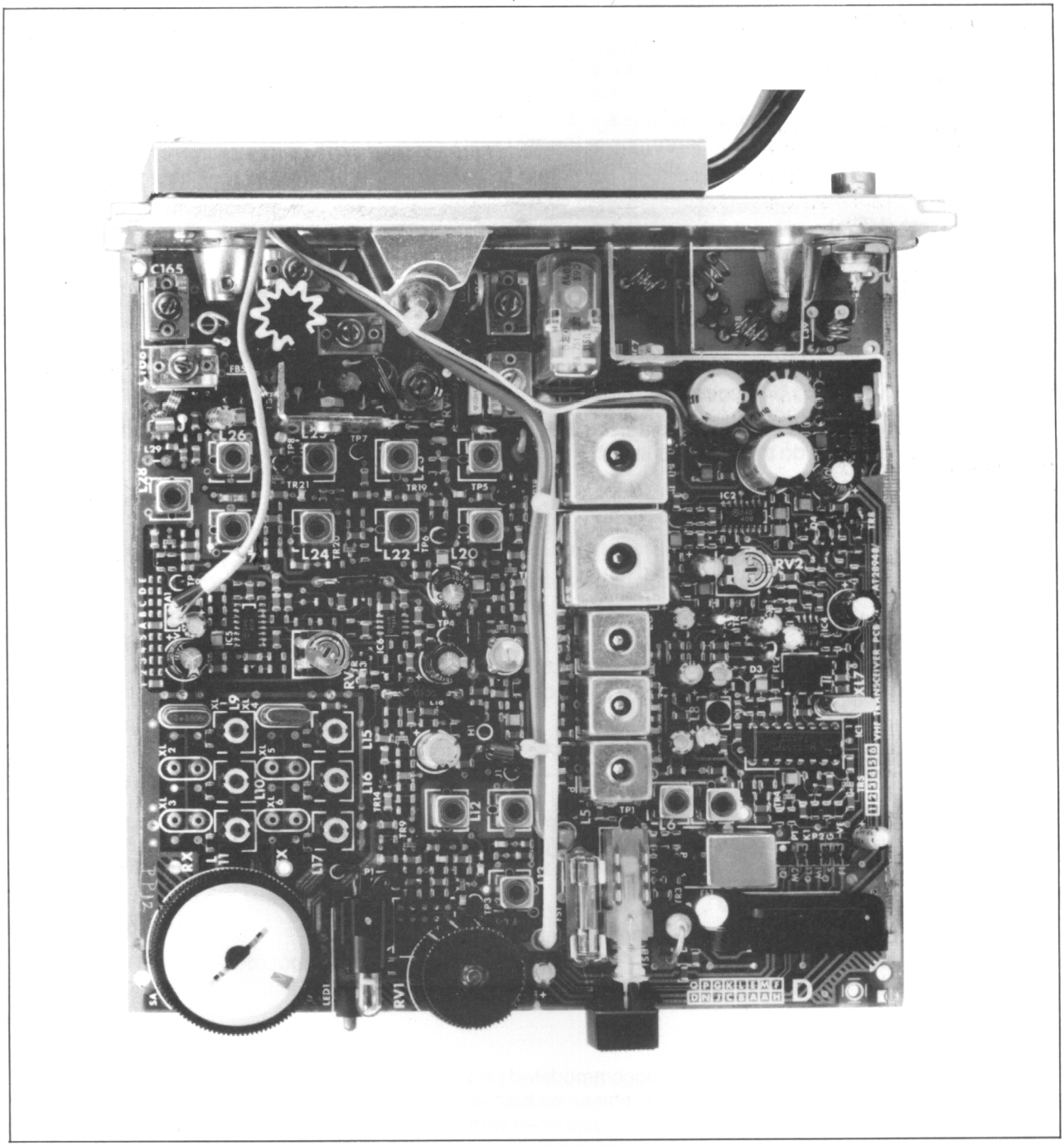
All transmitter and receiver circuitry is accommodated on a single printed wire board, secured by means of lugs and screws to an aluminium block, which serves both as a rear panel and as a heatsink for the transmitter PA transistor TR27. The rear panel is also fitted with a row of nine feed-through capacitors, which connect to the equipment by means of leads entering via the rear panel hole.

A tin-plated copper screen on the component side of the PWB accommodates the antenna filter. This screen suppresses unwanted interaction with adjacent circuitry; in addition the antenna filter screen acts as a heatsink for the 9V regulator and the Rx Audio Output IC. SMD components are extensively used throughout this equipment.

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. 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

Pozidriv Screwdriver

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

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

*Note: Should it prove necessary to replace the front panel do not over tighten the screws which secure it to the case or damage will result.*

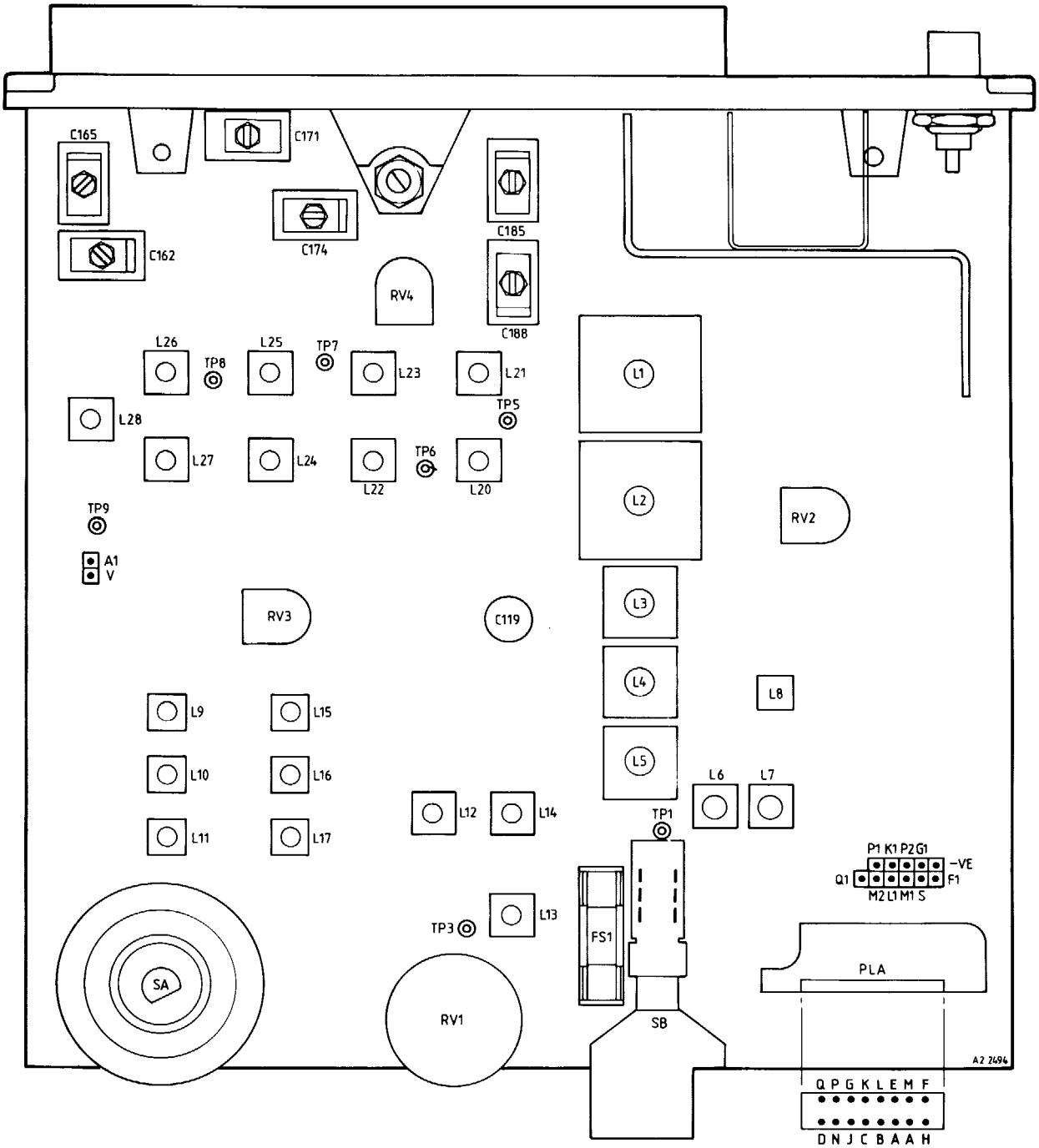



Fig. 4.1 Alignment Diagram

## CRYSTAL INFORMATION

### Crystal Specification

**Receiver 1st Oscillator**

| | | |
|---|---|---|
| ±10 PPM from −10°C to +55°C | : | T71 |
| ± 5 PPM from −10°C to +55°C | : | T84W |
| ±10 PPM from −25°C to +55°C | : | E71 |

**Transmitter**

| | | |
|---|---|---|
| ±10 PPM from −10°C to +55°C | : | T93RX or T93DQ |
| ± 5 PPM from −10°C to +55°C | : | T92RX or T92DQ |
| ±10 PPM from −25°C to +55°C | : | E93RX or E93DQ |

*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.*

### Receiver 1st Oscillator

| Band | Carrier Frequency (fc) MHz | Crystal Frequency (fx) MHz | Crystal Range (MHz) |
|---|---|---|---|
| AO | 148 – 174 | $\frac{fc - 10,7}{3}$ | 45,76 to 54,44 |
| EO | 68 – 88 | $\frac{fc + 10,7}{2}$ | 39,35 to 49,35 |

### Receiver 2nd Oscillator

Standard 11,155 MHz P52J. Alternative 10,245 MHz P52J. The alternative is used only when the carrier frequency is within 100 kHz of a multiple of the standard frequency.

### Transmitter

| Band | Carrier Frequency (fc) MHz | Crystal Frequency (fx) MHz | Crystal Range MHz |
|---|---|---|---|
| AO | 148 – 174 | $\frac{fc}{16}$ | 9,25 to 10,875 |
| EO | 68 – 88 | $\frac{fc}{16}$ | 4,25 to 5,5 |

## TEST EQUIPMENT REQUIRED

The following is a list of suitable test equipment for the alignment, fault location, and repair of the M294E. 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 – 15V, 6A | Kingshill 18VC10 |
| RF Output Meter | 50Ω, 50W | Bird Termaline 6154 |
| Multimeter | 20,000Ω/V | Avo 8 or Pye TM1A* |
| Diode probe | 10kΩ | Local manufacture, not required if Pye TM1A is used |
| Marker oscillator | 10,7 MHz | Pye SH10041 |
| RF Signal generator | FM | Racal 9082 |
| RF Fuse | | Marconi TM9884 |
| AF Signal generator | | Levell TG200 DMP |
| Modulation meter | | Racal 9009 |
| AF Power Meter | | Marconi TF893B |
| Distortion Analyser | | Hewlett Packard 334A |
| Hex Trimming Tool (for L1 – 5) | | ST01938 |
| Trimming Tool (for all coils exept L1 – 5) | | BT29042 |
| Metal Blade Trimming Tool (for potentiometers) | | ET16450 |
| White Trimming Tool (for variable capacitor) | | FT08053 |

*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)*

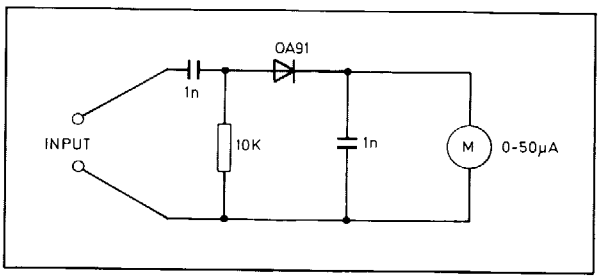



Fig. 4.2 Diode Probe Circuit Diagram

## 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.

**CAUTION**

**Always fit an RF fuse in series with the Signal Generator output.**

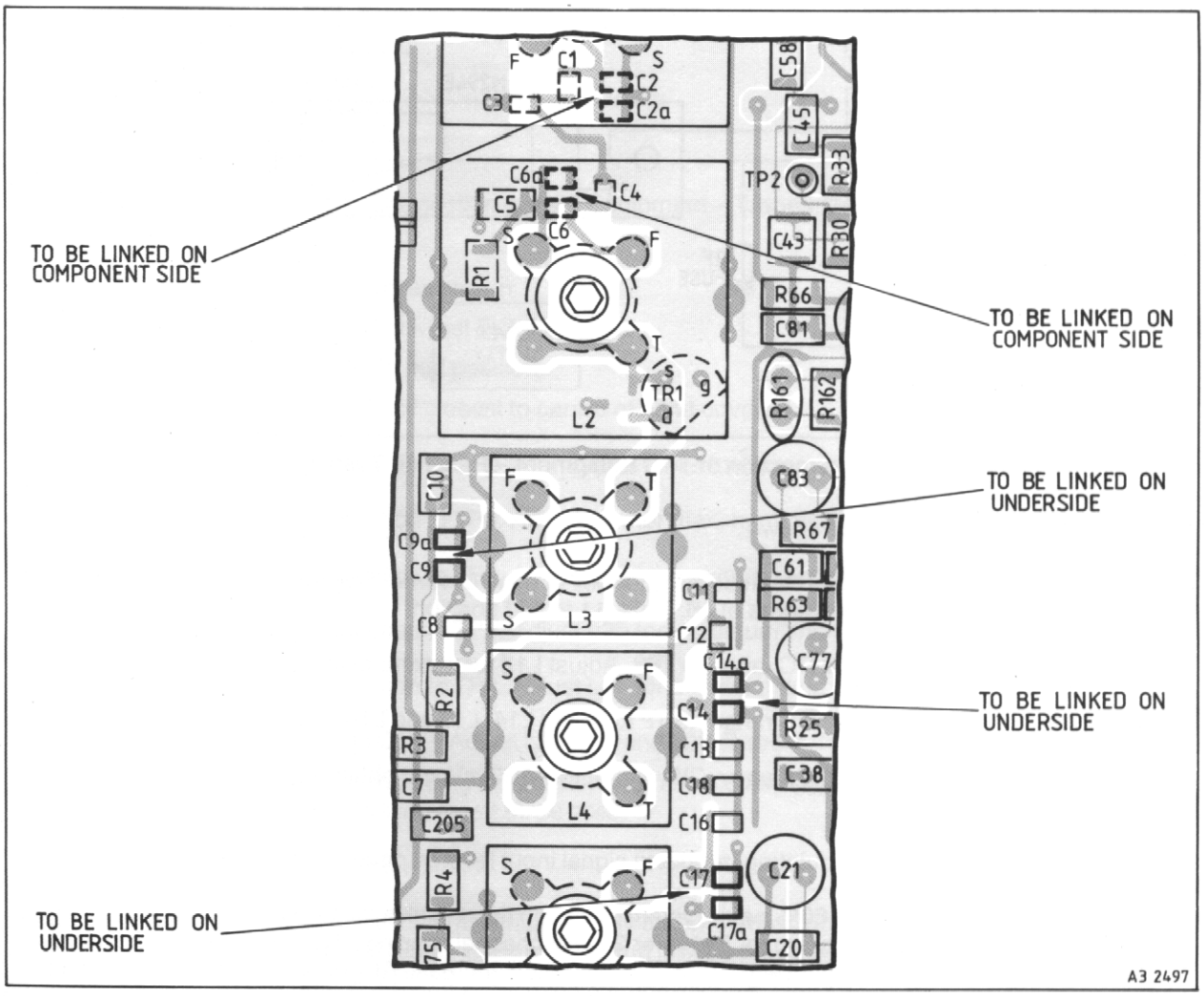
## Preliminaries

1. Obtain access to motherboard. Core-tuned coils L1 – 5 are to be tuned with the core away from PCB, all other core-tuned coils should be adjusted to the tuning point with the core near the PCB.

2. Keep transmit time to a minimum to avoid excessive heating and interference problems.

3. Connect AVO negative lead to rear panel.

4. On A0 Band equipment where the Rx frequency is below 160 MHz the additional parallel capacitors across L3 – 5 must be linked in (C9A, 14A, 17A).
   On E0 Band equipment where the Rx frequency is below 78 MHz the additional parallel capacitors across L1 – L5 must be linked in (C2A, 6A, 9A, 14A, 17A).




5. Ensure the following links are fitted:–

| | |
|---|---|
| Rx Audio | F1 – S |
| Tx Key | K1 – L1 |
| Sq. Defeat | M2 – Q1 |

6. Set the following controls as listed:–

| | |
|---|---|
| RV1 (Volume) | – fully counter-clockwise |
| RV2 (Squelch) | – fully counter-clockwise |
| RV3 (Deviation) | – mid position |
| RV4 (Tx Power) | – fully clockwise |

## POWER SUPPLY AND REGULATOR

1. Set the power supply to 13,2V DC and connect to the equipment, with the equipment switched off check that the supply current is less than 1$\mu$A.

2. Switch on the equipment, check that the POWER ON indicator lights and the quiescent current is less than 350 mA.

3. Using the multimeter check that the voltage on PLA pin H is between 8,7 and 9,3 V DC.

## RECEIVER ALIGNMENT

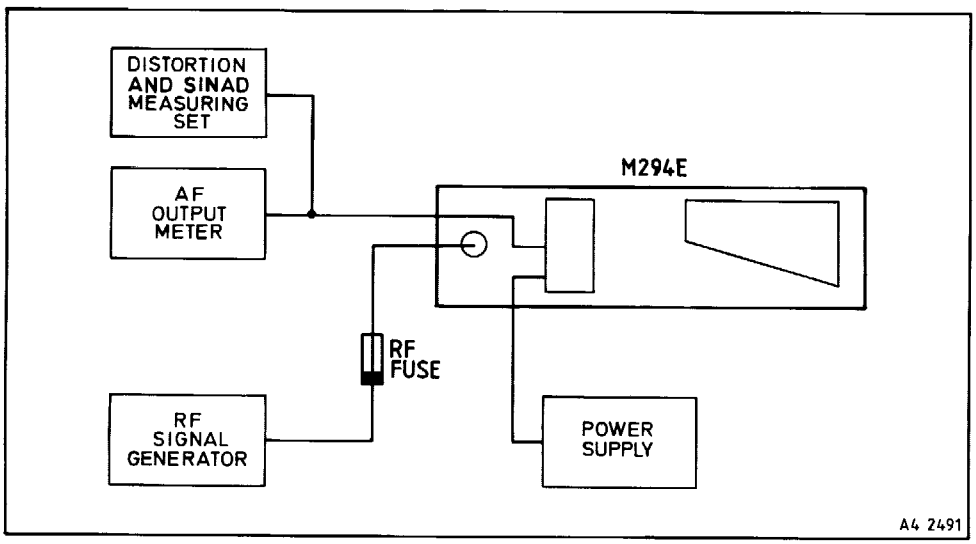



Fig. 4.3 Connection of Test Equipment – Receiver Testing

1. Connect the test equipment as shown.

2. Select channel frequency closest to middle frequency of band covered. Set cores of coils L1 – 5 flush with the top of their formers, set cores of L6, 7, 9 – 11 to mid position.

3. Connect multimeter set to 2,5V DC range to TP3. Adjust L12 for maximum and L13 for minimum.

4. Connect multimeter, set to 10V DC range, to TP1. Adjust L14, L13 and L14, in that order, for maximum.

5. Set signal generator to carrier frequency, CW with output 100 mV and obtain zero beat with the marker oscillator.

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

7. Modulate input signal 1 kHz at 60% peak system deviation (i.e. 1,5 kHz for 12,5 kHz channel spacing, 2,4 kHz for 20 kHz channel spacing, or 3 kHz for 25 kHz channel spacing). Set generator level to 3$\mu$V. Tune L8 for maximum audio output and L7 for least distortion. Increase RF generator output to 1 mV and check that distortion is less than 5% with 3W AF output.

8. Tune L1 – 5 in order for best SINAD, reducing signal input level as necessary; set the signal input level to 0,31 $\mu$V and check that SINAD is greater than 12 db.

   *Note: It may be necessary to re-adjust L14 slightly to achieve this figure.*

9. Remove channel crystal and check that the voltage at TP1 is reduced by greater than 250 mV, replace crystal.

10. Set RV2 such that squelch just opens at between 9 and 11 db SINAD.

11. Set signal generator output to 0,35 $\mu$V and check that 12 db SINAD is obtained on all other crystalled channels.

    *Note: Adjust relevant oscillator inductor to obtain zero beat using marker oscillator before carrying out this check.*

## TRANSMITTER ALIGNMENT

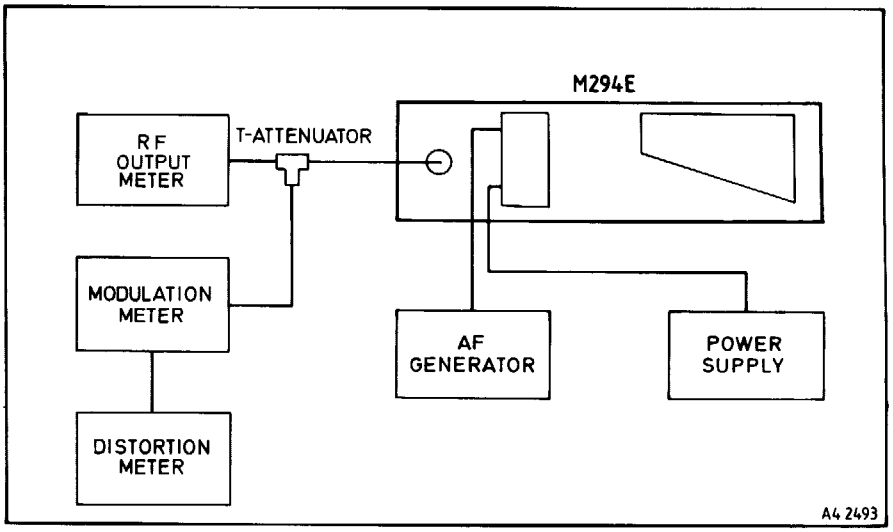



Fig. 4.4 Connection of Test Equipment – Transmitter Testing

1. a) Connect test equipment as shown.
   b) Key transmitter and check that Tx lamp lights.
   c) Set cores of L15 – 17 to mid position.
   d) Select channel frequency closest to centre of band covered.
2. Connect multimeter, set to 2,5V DC, to TP5. Adjust C119 for maximum and L20 for minimum.
3. Transfer multimeter connection to TP6. Adjust L21 for maximum and L22 for minimum.
4. Transfer multimeter connection to TP7. Adjust L23 for maximum and L24 for minimum.
5. Transfer multimeter connection to TP8. Adjust L25 for maximum and L26 for minimum.
6. Transfer multimeter connection to TP9. Adjust L27 for maximum and L28 for minimum.
7. Connect the diode probe to C162. Adjust L26, L27 and L28, in order, for maximum diode probe reading.
   *Note: To prevent this reading being masked by saturation it may be necessary to turn RV4 counter clockwise while adjusting these three coils.*
8. Adjust C188 for minimum capacitance.
9. Adjust C162 and C165 initially for maximum supply current. When power is registered on the RF output meter re-adjust C162 and C165 for maximum output power.

   Adjust C171 and C174 together for maximum power
   Adjust C185 and C188 together for maximum power
10. Repeat step 9 until absolute maximum power is obtained. Check that the power output is greater than 27 watts (6 watts, RF Power Output code 4) and that adjustment of RV4 will reduce the power to less than 6 watts (1 watt, RF Power Output code 4).
    Set RV4 to give the required power output and retune C188 for maximum power.
    Reset RV4 to give the required power output.
11. Apply a small amount of silicone locking compound such as Silcoset 151 (Ambersil Ltd., Basingstoke) between the nut and the top of the plate on C162,165,171,174,185 and 188 to prevent detuning caused through vibration.

    *Note: Ensure silicone compound does not run down on to PCB or other components*

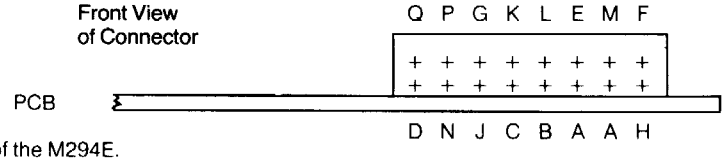
## Audio Alignment

1. Remove the Berg receptacles from pins A1 and V, set the AF oscillator to 1 kHz at 2 mV and connect the output to pins A1 and V. Adjust C119 for maximum deviation, adjust RV3 for 3 kHz deviation and then re-tune C119 slightly for minimum distortion consistent with maintaining at least 2,8 kHz deviation.
2. Increase input level to 40 mV and adjust RV3 for peak system deviation (see Transmitter Data in Section 1).
3. Link PLA pins A and B, check that deviation falls to less than 100 Hz, remove link.
4. Remove the AF oscillator output from pins A1 and V and reconnect the Berg receptacles, ensuring the braid/screen is connected to pin A1.

### M294E INTERFACE DATA
### (Internal and External)

*Note: Applicable to M294E Issue 1 PCB.*

Front View of Connector




PLA – Standard internal interface available on all versions of the M294E.

**Abbreviations**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dev. | – Deviation | O/C | – Open Circuit | w.r.t | – with respect to | ≤ | – equal to or less than |
| I/P | – Input | O/P | – Output | < | – less than | ≥ | – equal to or greater than |
| LS | – Loudspeaker | PTT | – Press to transmit | > | – greater than | // | – in parallel with |
| Mic. | – Microphone | | | | | | |

| Pin No. | Function | Interface Data | Comments |
|---|---|---|---|
| A | –ve | | 2 pins connected to Transceiver negative |
| B | Mic. AF Inhibit (Active Low) | 47k Impedance clamped to nominal 5V | Recommended interface O/C switch to –ve. Used with TED3, TEDX. |
| C | 'In Band' Tx AF Input. | 300 Hz – 2,8 kHz, 6 db/Octave Pre-emphasis +1, –3 db w.r.t 1 kHz. Input Impedance 82kΩ 225 mV at 1 kHz for 0,75 kHz – 2,25 kHz Dev. | Used with TEDX |
| D | 'Sub Audio' Tx AF Input | 67 – 255 Hz Pre-emphasised 6 db/Octave +1, –3 db w.r.t 255 Hz. Input Impedance 2KΩ//100 pf. I/P 500 mV at 67 Hz for 0,6 – 1,8kHz Dev. | Used with TED3, TE1 and some versions of TEDX. |
| E | Rx AF Output (Unsquelched) | 67 Hz – 300 Hz Flat ±3 db relative to 300 Hz 300 Hz – 3 kHz 6 db/Octave de-emphasis +1, –3 db w.r.t 1 kHz (300 Hz – 2,55 kHz, 12,5 kHz channel spacing) O/P load 10kΩ. O/P at 1 kHz AF, 1 mV RF I/P, 60% Dev. = 100mV ±2 db | Used with TED3 and TEDX at RF levels down to 0,3μV pd. Pin E level can fall by up to 2 db w.r.t level shown. |
| F | Rx AF Output (Squelched) | 300 Hz – 3 kHz 6db/Octave De-emphasised +1, –3 db w.r.t 1 kHz (200 Hz – 2,55 kHz, 12,5 kHz channel spacing). O/P load 5kΩ. O/P at 1 kHz AF, 1 mV RF I/P, 60% Dev. = 100 mV ±2 db | Used with TED3 and TEDX at RF levels down to 0,3μV pd. Pin F level can fall by up to 2 db w.r.t level shown. Connected to F1 on link field |
| G | Undedicated | | Used with TED3 and TEDX for gated AF to volume control. Connected to G1 on link field |
| H | 9V O/P | 9V (±0,2V) 300 mA max. | The total current from H and J should be max. current for Pin H. |
| J | 9V Tx O/P | 9V (+0,2 –0,4V) at 100 mA max. | See Note (i) |
| K | Tx Key O/P (From PTT) | 9V (±0,2V) at 10 mA (Tx) floating (Rx) | If key to –ve used Tx key O/P becomes active low for Tx. (See Note (ii)) Connected to K1 on link field |

# SECTION 5
# PARTS LIST

## NOTATION

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

**Capacitors** Values given in micro Farads unless otherwise stated

| | | | |
|---|---|---|---|
| 22 | = | 22 microFarad | ($F \times 10^{-6}$) |
| 22n | = | 22 nanoFarad | ($F \times 10^{-9}$) |
| 22p | = | 22 picoFarad | ($F \times 10^{-12}$) |

Fractional values shown thus:

| | | | |
|---|---|---|---|
| 2$\mu$2 | = | 2,2 microFarad | ($2,2 \times 10^{-6}$)F |
| 2n2 | = | 2,2 nanoFarad | ($2,2 \times 10^{-9}$)F |
| 2p2 | = | 2,2 picoFarad | ($2,2 \times 10^{-12}$)F |

**Resistors** Values given in Ohms unless otherwise stated

| | | | |
|---|---|---|---|
| 22 | = | 22 ohms | |
| 22k | = | 22 kilohms | (Ohms $\times 10^{3}$) |
| 22M | = | 22 Megohms | (Ohms $\times 10^{6}$) |

Fractional values are shown thus:

| | | | |
|---|---|---|---|
| 2$\Omega$2 | = | 2,2 ohms | |
| 2k2 | = | 2,2 kilohms | ($2,2 \times 10^{3}$) Ohms |
| 2M2 | = | 2,2 Megohms | ($2,2 \times 10^{6}$) Ohms |

## ORDERING OF SPARE PARTS

When ordering spares, please quote the description and Part No. of the item (or SMD Pack) 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.

### Surface Mounted Devices (SMD's)

SMD's are supplied in packs, each pack containing a number of identical components. The number of components per pack will depend on the component type.

A pack of components will have its own Part Number consisting of the Part Number of the component it contains with the pre-fix AT. For example the Part Number of a pack of ceramic resistors whose individual Part Number is CL99012 will be ATCL99012.

Thus if it were required to replace a 10k ±5% 0,25W h.c. resistor Part Number CL99048 the component pack Part Number ATCL99048 must be ordered.

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

## ABBREVIATIONS

| | | | |
|---|---|---|---|
| cadmium | cad | parts per million | ppm |
| carbon film | c. film | polyester | poly |
| ceramic | cer | printed wiring board | PWB |
| countersunk | csk | steel | st |
| electrolytic | elec | tubular | tub |
| hybrid circuit (SMD) | h.c. | wire wound | w.w. |

VHF FRONT MOUNT

MOBILE RADIOTELEPHONE TYPE M294E

| Cct. Ref | Description | Part No. | Remarks |
|---|---|---|---|
| **SUB-ASSEMBLIES** | | | |
| | PCB Assembly Tx/Rx | AT28948/– | See headed list |
| | Front Panel Assembly | AT14609/03 | See headed list |
| | Loudspeaker Assembly | AT14637/01 | |
| | Installation Items | AT36911/01 | See headed list |
| **MISCELLANEOUS** | | | |
| | Blank, channel | BT36211/01 | Single channel (except TE1) |
| | Blank, channel | BT20158 | Single channel (with TE1) |
| | Case and carrier assembly | AT13605 | |
| | Comprising: | | |
| | Case Assembly | AT13609/02 | |
| | Carrier | BT16826/02 | |
| | Scr, sdriv, pan, No 4 x 3/16 in | QJ08219/X | 4/Carrier case |
| | Washer, M2,5 | QA15004/X | 1/Carrier case |
| | Cover, rear | BT15822/06 | |
| | Front panel | BT23661 | |
| | Installation Instructions | TP845 | |
| | Knob assembly | AT25848/05 | Multi-channel only |
| | Knob, on/off | BT37460 | Except TE1 |
| | Knob, on/off | BT37493 | With TE1 |
| | Link Connector | FC99060 | |
| | Operating Instructions | TP960 | |
| | Scr, sdriv, pan, st, M2,5 x 5 mm | QJ11944/B | 2/Cover |
| | Scr, sdriv, pan, st, M2,5 x 10 mm | QJ11947/B | 4/Rear panel–case |
| | Scr, sdriv, csk, st, M3 x 6 mm | QJ11613/K | 2/Front panel–case |
| | Washer, M2,5 | QA15004/X | 1/Carrier–case |
| | Cover, rear | BT15822/07 | } |
| | Label, Made in England | BT38115 | } Market Code 02 |
| | Lead kit, in/out | AT70108 | } |

INSTALLATION ITEMS

AT36911/01

| | | |
|---|---|---|
| Bagged items | AT36910 | See headed list |
| Cradle assembly | AT12405/01 | |

BAGGED ITEMS

AT36910

| | | |
|---|---|---|
| Clamp, cable | BT16043 | 1/Mic. lead |
| Connector | FC15754 | |
| Fuse, 7,5A | FF06810 | |
| Fuseholder | FH02881 | |
| Label, call sign | BT38143 | |
| Plug, BNC, Free, str, 50Ω | FP99100 | 1/Antenna lead |
| Rest, microphone | BT25191 | |
| Support | BT26617 | 1/Mic. lead |
| Terminal, ins, female | FT16860 | |
| Terminal, ins, male | FT16861 | |
| Tool, extractor | BT29007 | |
| Ty-rap | QA04424 | |
| Scr, sl, pan, st, No. 1 x ½ in. | QQ41208/X | 4/Cradle |
| Scr, sl, pan, st, No. 6 x 3/8 in. | QW41206/X | 2/Support, 2/Clamp |

FRONT PANEL ASSEMBLY

AT14609/03

| | | |
|---|---|---|
| Fastener, push on | QA04144 | 3/Light pipe |
| Lens, green | BT37160/01 | |
| Light pipe | BT37276 | |
| Moulding assembly, Front | AT14579/03 | |
| Spigot, location | BT29958 | |

## PCB ASSEMBLY Tx/Rx

### AT28948/–

/01 12,5 kHz channel spacing, A0 Band
/02 20 & 25 kHz channel spacing, A0 Band
/03 20 kHz channel spacing A0 Band, 6W
/04 12,5 kHz channel spacing, E0 Band
/05 20 & 25 kHz channel spacing E0 Band
/06 20 kHz channel spacing E0 Band, 6W

| Cct. Ref | Description | Part No. | Remarks |
|---|---|---|---|
| **SUB-ASSEMBLIES** | | | |
| | Heatsink assembly | AT14717 | See headed list |
| | Lampholder assembly | AT14722 | |
| | Screen assembly | AT14706 | |
| | Rear panel assembly | AT14636/01 | |
| | Volume Potentiometer assembly | AT14605 | |
| **SEMICONDUCTORS & ICS** | | | |
| IC1 | IC IF Amp and Discriminator | FU07680 | |
| IC2 | IC Quad Op Amp 14-pin | FU99802/SM | |
| IC3 | IC Audio Amplifier | FU08027 | Part of AT14706 |
| IC4 | IC Dual Op Amp 8-pin | FU99803/SM | |
| IC5 | IC Quad Op Amp 14-pin | FU99802/SM | |
| IC6 | IC Dual Op Amp 8-pin | FU99803/SM | |
| IC7 | IC Voltage regulator MC7808CT | FU07734 | Part of AT14706 |
| TR1 | Transistor J309 | FV40828 | |
| TR2 | Transistor J310 | FV05901 | |
| TR3 | Transistor 2N5486 | FV09280 | |
| TR4,5 | Transistor MMBT918 | FV99122/SM | |
| TR6 | Transistor BFR30 | FV99151/SM | |
| TR7 | Transistor BCW72 | FV99101/SM | |
| TR8 | Transistor BCX19 | FV99102/SM | |
| TR9,10 | Transistor MMBT918 | FV99122/SM | |
| TR11,12 | Transistor BCW72 | FV99101/SM | |
| TR13 | Transistor BCW30 | FV99081/SM | |
| TR14 | Transistor BCW72 | FV99101/SM | |
| TR15–17 | Transistor MMBT918 | FV99122/SM | |
| TR18,19 | Transistor BFR30 | FV99151/SM | |
| TR20–22 | Transistor MMBT918 | FV99122/SM | |
| TR23 | Transistor PN-R04-831 | FV05830 | |
| TR24 | Transistor BD948 | FV99043 | Part of AT14717 |
| TR25 | Transistor BC327 | FV05975 | |
| TR26 | Transistor TP2314 BeO | FV41807 | |
| TR27 | Transistor TP2330 BeO | FV41841 | |
| D1,2 | Diode BAV99 | FV99063/SM | |
| D3 | Diode Zener BZX84C 6V8 | FV99011/SM | |
| D4 | Diode Zener BZX84C 5V1 | FV99008/SM | |
| D5 | Diode BAS16 | FV99064/SM | |
| D6,7 | Diode BAV99 | FV99063/SM | |
| D8 | Diode BAS16 | FV99064/SM | |
| D9, 10 | Diode 1N4001 | FV05840 | |
| D11 | Diode BAS16 | FV99064/SM | |
| D12 | Diode MR751 | FV08961 | |

**RESISTORS**

| | | | | | |
|---|---|---|---|---|---|
| R1 | * | | | | |
| R2 | * | | | | |
| R3 | 10 | ±5% | 0,125W | h.c. | CL99012 |
| R4 | * | | | | |
| R5 | 680 | ±5% | 0,125W | h.c. | CL99034 |
| R6 | 1k2 | ±5% | 0,125W | h.c. | CL99037 |
| R7 | 820 | ±5% | 0,125W | h.c. | CL99035 |
| R8 | 150 | ±5% | 0,125W | h.c. | CL99026 |
| R9 | 4k7 | ±5% | 0,125W | h.c. | CL99044 |
| R10 | 47k | ±5% | 0,125W | h.c. | CL99056 |
| R11 | 3k3 | ±5% | 0,125W | h.c. | CL99042 |
| R12 | 33k | ±5% | 0,125W | h.c. | CL99054 |
| R13 | 560 | ±5% | 0,125W | h.c. | CL99033 |
| R14 | 5k6 | ±5% | 0,125W | h.c. | CL99045 |
| R15 | 8k2 | ±5% | 0,125W | h.c. | CL99047 |
| R16 | 3k9 | ±5% | 0,125W | h.c. | CL99043 |
| R17 | 680 | ±5% | 0,125W | h.c. | CL99034 |
| R18 | 470 | ±5% | 0,125W | h.c. | CL99032 |

| Cct. Ref | Description | | | | Part No. | Remarks |
|---|---|---|---|---|---|---|
| Resistors (Contd.) | | | | | | |
| R19 | 150 | ±5% | 0,125W | h.c. | CL99026 | |
| R20 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R21,22 | 1k8 | ±5% | 0,125W | h.c. | CL99039 | |
| R23 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R24 | * | | | | | |
| R25 | 220 | ±5% | 0,125W | h.c. | CL99028 | |
| R26 | 10k | ±5% | 0,25W | c.film | PM01448 | /01,/04 |
| R26 | 18k | ±5% | 0,25W | c.film | PM01451 | /02,/05 |
| R26 | 15k | ±5% | 0,25W | c.film | PM01450 | /03,/06 |
| R27 | 820 | ±5% | 0,125W | h.c. | CL99035 | |
| R28 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R29 | 150k | ±5% | 0,125W | h.c. | CL99062 | |
| R30 | 22k | ±5% | 0,125W | h.c. | CL99052 | |
| R31 | 8k2 | ±5% | 0,125W | h.c. | CL99047 | |
| R32,33 | 22k | ±5% | 0,125W | h.c. | CL99052 | |
| R34 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R35 | 15k | ±5% | 0,125W | h.c. | CL99050 | |
| R36 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R37 | 5k6 | ±5% | 0,125W | h.c. | CL99045 | |
| R38 | 22k | ±5% | 0,125W | h.c. | CL99052 | |
| R39 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R40 | 33k | ±5% | 0,125W | h.c. | CL99054 | |
| R41 | 1k | ±5% | 0,125W | h.c. | CL99036 | |
| R42 | 3k3 | ±5% | 0,125W | h.c. | CL99042 | |
| R43 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R44 | 68 | ±5% | 0,125W | h.c. | CL99022 | |
| R45 | 220 | ±5% | 0,125W | h.c. | CL99028 | |
| R46 | 2Ω2 | ±5% | 0,125W | h.c. | CL99004 | |
| R47 | 1 | ±5% | 0,125W | h.c. | CL99000 | |
| R48 | 1k | ±5% | 0,125W | h.c. | CL99036 | |
| R49 | | | | | | Not fitted |
| R50,51 | 680 | ±5% | 0,125W | h.c. | CL99034 | |
| R52,53 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R54 | * | | | | | |
| R55 | * | | | | | |
| R56 | 560 | ±5% | 0,125W | h.c. | CL99033 | |
| R57 | 10 | ±5% | 0,125W | h.c. | CL99012 | |
| R58 | * | | | | | |
| R59 | 560 | ±5% | 0,125W | h.c. | CL99033 | |
| R60 | 15k | ±5% | 0,125W | h.c. | CL99050 | |
| R61 | 8k2 | ±5% | 0,125W | h.c. | CL99047 | |
| R62 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R63 | 1k2 | ±5% | 0,125W | h.c. | CL99037 | |
| R64 | 4k7 | ±5% | 0,25W | c.film | PM01444 | /01,/04 |
| R64 | 10k | ±5% | 0,25W | c.film | PM01448 | /02,/05 |
| R64 | 8k2 | ±5% | 0,25W | c.film | PM01447 | /03,/06 |
| R65 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R66 | 470 | ±5% | 0,125W | h.c. | CL99032 | |
| R67 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R68 | 22k | ±5% | 0,125W | h.c. | CL99052 | |
| R69 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R70 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R71 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R72 | 18k | ±5% | 0,125W | h.c. | CL99051 | |
| R73 | 2k7 | ±5% | 0,125W | h.c. | CL99041 | |
| R74 | 82k | ±5% | 0,125W | h.c. | CL99059 | |
| R75,76 | 1k | ±5% | 0,125W | h.c. | CL99036 | |
| R77 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R78 | 1k2 | ±5% | 0,125W | h.c. | CL99037 | |
| R79 | 470 | ±5% | 0,125W | h.c. | CL99032 | |
| R80 | 33k | ±5% | 0,125W | h.c. | CL99054 | |
| R81 | 270k | ±5% | 0,125W | h.c. | CL99065 | |
| R82 | 56k | ±5% | 0,125W | h.c. | CL99057 | |
| R83–85 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R86 | 56k | ±5% | 0,125W | h.c. | CL99057 | |
| R87 | 8k2 | ±5% | 0,125W | h.c. | CL99047 | |
| R88 | 68k | ±5% | 0,125W | h.c. | CL99058 | |
| R89 | 8k2 | ±5% | 0,125W | h.c. | CL99047 | |
| R90 | 82k | ±5% | 0,125W | h.c. | CL99059 | |

| Cct. Ref | Description | | | | Part No. | Remarks |
|---|---|---|---|---|---|---|
| Resistors (Contd.) | | | | | | |
| R91 | 82k | ±5% | 0,125W | h.c. | CL99059 | |
| R92 | 390k | ±5% | 0,125W | h.c. | CL99067 | |
| R93,94 | 56k | ±5% | 0,125W | h.c. | CL99057 | |
| R95 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R96 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R97 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R98,99 | 100k | ±5% | 0,125W | h.c. | CL99060 | |
| R100 | 470 | ±5% | 0,125W | h.c. | CL99032 | |
| R101 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R102 | 100k | ±5% | 0,125W | h.c. | CL99060 | |
| R103 | 18k | ±5% | 0,125W | h.c. | CL99051 | |
| R104 | 1k2 | ±5% | 0,125W | h.c. | CL99037 | |
| R105 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R106 | 15k | ±5% | 0,125W | h.c. | CL99050 | |
| R107 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R108 | 1k8 | ±5% | 0,125W | h.c. | CL99039 | |
| R109 | 3k9 | ±5% | 0,125W | h.c. | CL99043 | |
| R110 | 2k7 | ±5% | 0,125W | h.c. | CL99041 | |
| R111 | 8k2 | ±5% | 0,125W | h.c. | CL99047 | |
| R112 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R113 | 1k5 | ±5% | 0,125W | h.c. | CL99038 | |
| R114 | 470 | ±5% | 0,125W | h.c. | CL99032 | |
| R115 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R116 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R117 | 680 | ±5% | 0,125W | h.c. | CL99034 | |
| R118 | * | | | | | |
| R119 | 220 | ±5% | 0,125W | h.c. | CL99028 | |
| R120 | 680 | ±5% | 0,125W | h.c. | CL99034 | |
| R121 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R122 | 820 | ±5% | 0,125W | h.c. | CL99035 | |
| R123,124 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R125 | 10k | ±5% | 0,125W | h.c. | CL99048 | |
| R126 | 820 | ±5% | 0,125W | h.c. | CL99035 | |
| R127,128 | 47 | ±5% | 0,125W | h.c. | CL99020 | |
| R129 | 4k7 | ±5% | 0,125W | h.c. | CL99044 | |
| R130 | 820 | ±5% | 0,125W | h.c. | CL99035 | |
| R131 | 56 | ±5% | 0,125W | h.c. | CL99021 | |
| R132 | * | | | | | |
| R133 | * | | | | | |
| R134 | * | | | | | |
| R135 | 820 | ±5% | 0,25W | c.film | PM01435 | |
| R136 | 1 | ±5% | 0,125W | h.c. | CL99000 | |
| R137 | 820 | ±5% | 0,25W | c.film | PM01435 | |
| R138 | * | | | | | |
| R139 | * | | | | | |
| R140 | 820 | ±5% | 0,25W | c.film | PM01435 | |
| R141 | * | | | | | |
| R142 | 820 | ±5% | 0,25W | c.film | PM01435 | |
| R143 | * | | | | | |
| R144 | 3Ω3 | ±5% | 0,25W | c.film | PM01406 | |
| R145 | * | | | | | |
| R146 | * | | | | | |
| R147 | 22 | ±5% | 0,125W | h.c. | CL99016 | |
| R148 | 560 | ±5% | 0,125W | h.c. | CL99033 | |
| R149 | 100k | ±5% | 0,25W | c.film | PM01460 | |
| R150 | 68 | ±5% | 0,125W | h.c. | CL99022 | |
| R151 | 560 | ±5% | 0,125W | h.c. | CL99033 | |
| R152,154 | | | | | | Not used |
| R155 | 47k | ±5% | 0,125W | h.c. | CL99056 | |
| R156 | 100 | ±5% | 0,125W | h.c. | CL99024 | |
| R157 | | | | | | Not used |
| R158 | 2k2 | ±5% | 0,125W | h.c. | CL99040 | |
| R159 | 680 | ±5% | 0,125W | h.c. | CL99034 | |
| R160 | | | | | | Not used |
| R161 | 47k | Thermistor | | | PL23151 | |
| R162 | 150k | ±5% | 0,125W | h.c. | CL99062 | |
| R163 | * | | | | | |
| R164 | 1k5 | ±5% | 0,166W | | PL99771 | /01, /02 |

| Cct. Ref | Description | | | Part No. | Remarks |
|---|---|---|---|---|---|
| Resistors (Contd.) | | | | | |
| RV1 | Volume potentiometer assembly | | | AT14605 | |
| RV2,3 | 10k | ±20% | Lin, Pot, skel | PL03627 | |
| RV4 | 100 | ±20% | Lin Pot | PL06645 | |

* Band conscious resistors

BAND CONSCIOUS RESISTORS

| Cct Ref | A0 | E0 | GROUP |
|---|---|---|---|
| R1 | 33 | 33 | 2 |
| R2 | – | 10k | 2 |
| R4 | – | – | |
| R24 | 10k | 10k | 2 |
| R54 | 820 | 560 | 2 |
| R55 | 2k7 | 4k7 | 2 |
| R58 | 2k2 | 820 | 2 |
| R118 | 12k | 3k3 | 2 |
| R132 | 470 | 100 | 2 |
| R133 | 820 | 270 | 1 |
| R134 | – | 180 | 1 |
| R138 | 2k2 | 1k | 1 |
| R139 | 10 | 10 | 1 |
| R141 | 39 | 68 | 1 |
| R143 | 0Ω03 | 0Ω03 | 1 |
| | 0Ω33 /03 | 0Ω33 /06 | 1 |
| R145 | 10 | 6Ω8 | 1 |
| R146 | 470 | 330 | 1 |
| R163 | – | – | |

| GROUP 1 | | | | |
|---|---|---|---|---|
| 0Ω03 | ±20% | 2,5W | w.w. | PL41528 |
| 0Ω33 | ±10% | 2,5W | w.w. | PL50610 |
| 6Ω8 | ±5% | 0,25W | c.film | PM01410 |
| 10 | ±5% | 0,25W | c.film | PM01412 |
| 39 | ±5% | 0,25W | c.film | PM01419 |
| 68 | ±5% | 0,25W | c.film | PM01422 |
| 180 | ±5% | 0,25W | c.film | PM01427 |
| 270 | ±5% | 0,25W | c.film | PM01429 |
| 330 | ±5% | 0,25W | c.film | PM01430 |
| 470 | ±5% | 0,25W | c.film | PM01432 |
| 820 | ±5% | 0,25W | c.film | PM01435 |
| 1k | ±5% | 0,25W | c.film | PM01436 |
| 2k2 | ±5% | 0,25W | c.film | PM01440 |
| 10k | ±5% | 0,25W | c.film | PM01448 |

| GROUP 2 | | | | |
|---|---|---|---|---|
| 33 | ±5% | 0,125W | h.c. | CL99018 |
| 100 | ±5% | 0,125W | h.c. | CL99024 |
| 470 | ±5% | 0,125W | h.c. | CL99032 |
| 560 | ±5% | 0,125W | h.c. | CL99033 |
| 820 | ±5% | 0,125W | h.c. | CL99035 |
| 2k2 | ±5% | 0,125W | h.c. | CL99040 |
| 2k7 | ±5% | 0,125W | h.c. | CL99041 |
| 3k3 | ±5% | 0,125W | h.c. | CL99042 |
| 4k7 | ±5% | 0,125W | h.c. | CL99044 |
| 10k | ±5% | 0,125W | h.c. | CL99048 |
| 12k | ±5% | 0,125W | h.c. | CL99049 |

CAPACITORS

| | | | | | | |
|---|---|---|---|---|---|---|
| C1 | * | | | | | |
| C2 | * | | | | | |
| C2A | * | | | | | |
| C3 | * | | | | | |
| C4 | * | | | | | |
| C5 | * | | | | | |
| C6 | * | | | | | |
| C6A | * | | | | | |
| C7 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C8 | * | | | | | |
| C9 | * | | | | | |
| C9A | * | | | | | |
| C10 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C11 | * | | | | | |
| C12 | * | | | | | |
| C13 | * | | | | | |
| C14 | * | | | | | |
| C14A | * | | | | | |
| C15 | | | | | | Not used |
| C16 | * | | | | | |
| C17 | * | | | | | |
| C17A | * | | | | | |

| Cct. Ref | Description | | | | Part No. | Remarks |
|---|---|---|---|---|---|---|
| Capacitors (Contd.) | | | | | | |
| C97 | 270p | ±5% | 50V | h.c. | CN99048 | |
| C98 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C99 | 470p | ±5% | 50V | h.c. | CN99051 | |
| C100 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C101 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C102 | 470p | ±5% | 50V | h.c. | CN99051 | |
| C103 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C104 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C105 | 470p | ±5% | 50V | h.c. | CN99051 | |
| C106 | 100 | ±20% | 25V | elec | PS99424 | |
| C107 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C108 | 22 | ±20% | 63V | elec | PS99446 | |
| C109 | * | | | | | |
| C110 | * | | | | | |
| C111 | * | | | | | |
| C112 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C113 | * | | | | | |
| C114,115 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C116 | * | | | | | |
| C117 | * | | | | | |
| C118 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C119 | 7-35p | | 160V | variable | PV05118 | |
| C120 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C121 | * | | | | | |
| C122 | * | | | | | |
| C123 | * | | | | | |
| C124 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C125 | 100 | ±20% | 25V | elec | PS99424 | |
| C126 | * | | | | | |
| C127-129 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C130 | * | | | | | |
| C131 | * | | | | | |
| C132 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C133 | | | | | | Not used |
| C134 | * | | | | | |
| C135 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C136 | * | | | | | |
| C137 | * | | | | | |
| C138 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C139 | * | | | | | |
| C140 | * | | | | | |
| C141,142 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C143 | * | | | | | |
| C144 | * | | | | | |
| C145 | * | | | | | |
| C146 | * | | | | | |
| C147 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C148 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C149 | * | | | | | |
| C150 | * | | | | | |
| C151 | * | | | | | |
| C152 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C153 | * | | | | | |
| C154 | * | | | | | |
| C155 | * | | | | | |
| C156 | * | | | | | |
| C157 | * | | | | | |
| C158 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C159 | * | | | | | |
| C160 | 1 | ±20% | 100V | elec | PS99455 | |
| C161 | 10 | ±20% | 50V | elec | PS99436 | |
| C162 | * | | | | | |
| C163 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C164 | * | | | | | |
| C165 | * | | | | | |
| C166 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C167 | * | | | | | |
| C168,169 | 4n7 | ±20% | 50V | cer | PN99919 | |
| C170 | * | | | | | |

| Cct. Ref | Description | | | | Part No. | Remarks |
|---|---|---|---|---|---|---|
| Capacitors (Contd.) | | | | | | |
| C171 | * | | | | | |
| C172 | 1n | ±20% | 50V | cer | PN99915 | |
| C173 | * | | | | | |
| C174 | * | | | | | |
| C175 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C176,177 | 4n7 | ±20% | 50V | cer | PN99919 | |
| C178 | 100n | ±20% | 63V | pes | PQ99524 | |
| C179 | * | | | | | |
| C180 | * | | | | | |
| C181 | * | | | | | |
| C182 | 470 | ±20% | 25V | elec | PS99426 | |
| C183 | * | | | | | |
| C184 | * | | | | | |
| C185 | * | | | | | |
| C186 | * | | | | | |
| C187 | * | | | | | |
| C188 | * | | | | | |
| C189 | 470 | ±20% | 25V | elec | PS99426 | |
| C190 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C191 | * | | | | | |
| C192 | * | | | | | |
| C193 | * | | | | | |
| C194 | * | | | | | |
| C195 | * | | | | | |
| C196 | * | | | | | |
| C197 | * | | | | | |
| C198 | * | | | | | |
| C199 | * | | | | | |
| C200 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C201 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C202 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C203 | 4n7 | ±10% | 50V | h.c. | CN99110 | |
| C204 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C205 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C206 | | | | | | Not used |
| C207-213 | 1n | ±10% | 50V | h.c. | CN99102 | |
| C214 | 100n | ±10% | 50V | h.c. | CN99166 | |
| C215 | * | | | | | |
| C216 | * | | | | | |
| C217 | * | | | | | |
| C218–225 | | | | | | Not used |
| C226 | 100n | ±20% | 50V | cer | PN99927 | |

* Band conscious capacitors

## BAND CONSCIOUS CAPACITORS

| Cct. Ref. | A0 | E0 | GROUP |
|---|---|---|---|
| C1 | 3p9 | 8p2 | 1 |
| C2 | 12p | 27p | 1 |
| C2A | 1p | 10p | 1 |
| C3 | 27p | 27p | 1 |
| C4 | 3p9 | 8p2 | 1 |
| C5 | 150p | 4n7 | 1 |
| C6 | 12p | 27p | 1 |
| C6A | 1p | 10p | 1 |
| C8 | 2p7 | 8p2 | 1 |
| C9 | 10p | 27p | 1 |
| C9A | 2p2 | 10p | 1 |
| C11 | 22p | 27p | 1 |
| C12 | 1p8 | 1p8 | 1 |
| C13 | 2p2 | 1p8 | 1 |
| C14 | 12p | 33p † | 1 |
| C14A | 2p2 | 10p | 1 |
| C16 | 5p6 | 5p6 | 1 |
| C17 | 12p | 33p † | 1 |
| C17A | 2p2 | 10p | 1 |
| C18 | 27p | 10p | 1 |
| C63 | 4n7 | 100p | 1 |
| C65 | 33p | 47p | 1 |
| C67 | 8p2 | 18p | 1 |
| C68 | 3p9 | 6p8 | 1 |
| C70 | 10p | 22p | 1 |
| C72 | 1p2 | 1p8 | 1 |
| C73 | 1p2 | 1p8 | 1 |
| C74 | 12p | 27p | 1 |
| C109 | 1n | 68p | 1 |
| C110 | 270p | 470p | 1 |
| C111 | 100p | 150p | 1 |
| C113 | 150p | 100p | 1 |
| C116 | 27p | 56p † | 1 |
| C117 | 56p | 100p | 1 |
| C121 | 10p | 33p † | 1 |
| C122 | 2p2 | 3p3 | 1 |
| C123 | 10p | 33p † | 1 |
| C126 | 33p | – | 1 |
| C130 | 100p | 39p | 1 |
| C131 | 1p8 | 1p8 | 1 |
| C134 | 100p | 39p | 1 |
| C136 | 47p | 82p | 1 |
| C137 | 1p8 | 4p7 | 1 |
| C139 | 82p | 150p | 1 |
| C140 | 100p | 180p | 1 |

| Cct. Ref. | A0 | E0 | GROUP |
|---|---|---|---|
| C143 | 27p | 47p† | 1 |
| C144 | 1p | 1p | 1 |
| C145 | 33p | 100p | 1 |
| C146 | 100p | 100p | 1 |
| C149 | 1n | 4n7 | 1 |
| C150 | 10p | 22p | 1 |
| C151 | 1p2 | 1p8 | 1 |
| C153 | 1p2 | 1p8 | 1 |
| C154 | 10p | 33p † | 1 |
| C155 | 56p | 100p | 1 |
| C156 | 1n | 4n7 | 1 |
| C157 | 12p | 33p † | 1 |
| C159 | 22p | 22p | 1 |
| C162 | 30-140p | 10-180p | 3 |
| C164 | – | 47p | 2 |
| C165 | 30-140p | 10-80p | 3 |
| C167 | 180p | 100p | 2 |
| C170 | – | 82p | 2 |
| C171 | 60-80p | 120-350p | 3 |
| C173 | 33p | – | 2 |
| C174 | 10-80p | 60-180p | 3 |
| C179 | 150p | 120p | 1 |
| C180 | 100p | – | 2 |
| C181 | 150p | 120p | 1 |
| C183 | – | – | |
| C184 | – | – | |
| C185 | 60-180p | 120-350p | 3 |
| C186 | – | 33p | 2 |
| C187 | – | 68p | 2 |
| C188 | 10-80p | 60-180p | 3 |
| C191 | 2p2 | 6p8 | 2 |
| C192 | 3p3 | 5p6 | 2 |
| C193 | 12p | 27p | 2 |
| C194 | 8p2 | 22p | 2 |
| C195 | 15p | 39p | 2 |
| C196 | 3p9 | 10p | 2 |
| C197 | 18p | 39p | 2 |
| C198 | – | – | |
| C199 | 15p | 15p | 2 |
| C215 | – | 27p | 2 |
| C216 | – | 1n | 2 |
| C217 | – | 22p | 1 |

† Size 0805 (Small Case Size)

| GROUP 1 | | | | |
|---|---|---|---|---|
| 1p | ±0p25 | 50V | h.c. | CN99000 |
| 1p2 | ±0p25 | 50V | h.c. | CN99001 |
| 1p8 | ±0p25 | 50V | h.c. | CN99003 |
| 2p2 | ±0p25 | 50V | h.c. | CN99004 |
| 2p7 | ±0p25 | 50V | h.c. | CN99005 |
| 3p3 | ±0p25 | 50V | h.c. | CN99006 |
| 3p9 | ±0p25 | 50V | h.c. | CN99007 |
| 4p7 | ±0p25 | 50V | h.c. | CN99008 |
| 5p6 | ±0p5 | 50V | h.c. | CN99009 |
| 6p8 | ±0p5 | 50V | h.c. | CN99010 |
| 8p2 | ±0p5 | 50V | h.c. | CN99011 |
| 10p | ±5% | 50V | h.c. | CN99012 |
| 12p | ±5% | 50V | h.c. | CN99013 |
| 18p | ±5% | 50V | h.c. | CN99015 |
| 22p | ±5% | 50V | h.c. | CN99016 |
| 27p | ±5% | 50V | h.c. | CN99017 |
| 33p † | ±5% | 50V | h.c. | CN99018 |
| 33p | ±5% | 50V | h.c. | CN99037 |
| 39p | ±5% | 50V | h.c. | CN99038 |
| 47p † | ±5% | 50V | h.c. | CN99020 |
| 47p | ±5% | 50V | h.c. | CN99039 |
| 56p † | ±5% | 50V | h.c. | CN99021 |
| 56p | ±5% | 50V | h.c. | CN99040 |
| 68p | ±5% | 50V | h.c. | CN99041 |
| 82p | ±5% | 50V | h.c. | CN99042 |
| 100p | ±5% | 50V | h.c. | CN99043 |
| 120p | ±5% | 50V | h.c. | CN99044 |
| 150p | ±5% | 50V | h.c. | CN99045 |
| 180p | ±5% | 50V | h.c. | CN99046 |
| 270p | ±5% | 50V | h.c. | CN99048 |
| 470p | ±5% | 50V | h.c. | CN99051 |
| 1n | ±10% | 50V | h.c. | CN99102 |
| 4n7 | ±10% | 50V | h.c. | CN99110 |

| GROUP 2 | | | | |
|---|---|---|---|---|
| 2p2 | ±0p5 | 100V | cer | PN99858 |
| 3p3 | ±0p5 | 100V | cer | PN99860 |
| 3p9 | ±0p5 | 50V | cer | PN99861 |
| 5p6 | ±0p5 | 100V | cer | PN99863 |
| 6p8 | ±0p5 | 100V | cer | PN99864 |
| 8p2 | ±0p5 | 100V | cer | PN99865 |
| 10p | ±5% | 100V | cer | PN99866 |
| 12p | ±5% | 100V | cer | PN99867 |
| 15p | ±5% | 50V | cer | PN99868 |
| 18p | ±5% | 50V | cer | PN99869 |
| 22p | ±5% | 100V | cer | PN99870 |
| 27p | ±5% | 100V | cer | PN99871 |
| 33p | ±5% | 100V | cer | PN99872 |
| 39p | ±5% | 100V | cer | PN99873 |
| 47p | ±5% | 100V | cer | PN99874 |
| 68p | ±5% | 100V | cer | PN99876 |
| 82p | ±5% | 100V | cer | PN99877 |
| 100p | ±5% | 100V | cer | PN99878 |
| 180p | ±5% | 50V | cer | PN99881 |
| 1n | ±20% | 50V | cer | PN99915 |

| GROUP 3 | | | |
|---|---|---|---|
| 10-80p | 250V | variable | PV99021 |
| 30-140p | 250V | variable | PV99022 |
| 60-180p | 250V | variable | PV99023 |

| Cct. Ref | Description | Part No. | Remarks |
|---|---|---|---|

INDUCTORS

| | | A0 Band | E0 Band |
|---|---|---|---|
| L1 – 4 | Coil assembly, moulded | FT99209/03 | – |
| L1, 2 | Coil assembly, moulded | – | FT99210/01 |
| L3 – 5 | Coil assembly, moulded | – | FT99210/02 |
| L5 | Coil assembly, moulded | FT99209/02 | – |
| L6,7 | Coil assembly 10,7 MHz | FT99212/01 | FT99212/01 |
| L8 | Coil | FT06438 | FT06438 |
| L9–11 | Coil assembly | FT99207/01 | FT99207/02 |
| L12–14 | Coil assembly | FT99202/01 | FT99201/03 |
| L15–17 | Coil assembly | FT99206/01 | FT99206/02 |
| L18 | Choke 15$\mu$H ±10% | FT99004 | – |
| L18 | Choke 33$\mu$H ±10% | – | FT05618 |
| L19 | Choke 22$\mu$H ±10% | FT99011 | – |
| L19 | Choke 47$\mu$H ±10% | – | FT99005 |
| L20,21 | Coil assembly | FT99200/01 | FT99200/02 |
| L22,23 | Coil assembly | FT99201/01 | FT99200/03 |
| L24,25 | Coil assembly | FT99201/02 | FT99201/04 |
| L26–28 | Coil assembly | FT99202/01 | – |
| L26, 27 | Coil assembly | – | FT99201/03 |
| L28 | Coil assembly | – | FT99201/02 |
| L29 | | – | – |
| L30 | Coil assembly | AT31185 | – |
| L31 | Coil assembly | AT31188 | AT31221/04 |
| L32 | Coil assembly | AT31185 | – |
| L32 | Choke assembly | – | AT31975/01 |
| L33 | Coil assembly | AT31188 | AT31221/05 |
| L34 | Coil assembly | AT31187 | AT31187/01 |
| L35 | Coil assembly | AT31186 | AT31187 |
| L36–38 | Coil assembly | AT31233/04 | AT31224/01 |
| L39 | Coil | AT30544 | AT31047 |
| L40 | Choke 10$\mu$H ±10% | FT05708 | FT05708 |
| FB1, 2 | Choke assembly | AT31975/01 | AT31975/01 |
| FB8 | Choke assembly | AT31975/01 | AT31975/01 |
| FB11 | Choke assembly | AT31975/01 | AT31975/01 |

ELECTRICAL

| | | | |
|---|---|---|---|
| FB2 – 4,6,10 | Bead, 0,07 x 0,024 x 0,25 mm | FC36151 | 2, 10 A0 Band; 3,4,6 E0 Band |
| FB12, 13 | Core, Toroidal | FC02523 | E0 Band |
| FL2 | Ceramic Filter, 455 kHz nom/12,5 kHz | FC99022 | /01, /04 |
| FL2 | Ceramic Filter, 455 kHz nom/25 kHz | FC99020 | /02, /05 |
| FL2 | Ceramic Filter, 455 kHz nom/20 kHz | FC99021 | /03, /06 |
| XL7 | Crystal 11,155 MHz | FC03174/04 | |
| XL7 | Crystal 10,245 MHz | FC03174/03 | Alternative to FC03174/04 |
| FL1 | Crystal Filter 10,7 MHz 12,5 kHz | FC03550 | /01, /04 |
| FL1 | Crystal Filter 10,7 MHz 25 kHz | FC03552 | /02, /05 |
| FL1 | Crystal Filter 10,7 MHz 20 kHz | FC03551 | /03, /06 |
| FS1 | Fuse, 8A | FF99020 | |
| | Fuseholder, PWB mounting | FH99101 | 1/FS1 |
| TP1-9,H1,J1 | Header, str, male, 1 position | FC00837/01 | |
| | Header, str, male, 2 position | FC00837/02 | |
| | Header, str, male, 5 position | FC00837/05 | |
| | Header, str, male, 6 position | FC00837/06 | |
| PLA | Header, str, male, 16 position | FC00838/16 | |
| | Link connector | FC99060 | |
| RLA | Relay, c/o, 115Ω ±10%, 9V | FR21703 | |
| SB | Switch on/off | FS07344 | |
| SA | Switch, selector | FS07225 | |
| | Wire link assembly | AT14602/01 | 13V Link SA–PA |

| Cct. Ref | Description | Part No. | Remarks |
|---|---|---|---|
| **MISCELLANEOUS** | | | |
| | Can, modified | BJ34060 | 1/L1,2 |
| | Can, screening | FC00168 | 1/L3-5 |
| | Clip | QA04097 | 2/L1,2 |
| | Foam pad | BT37070 | 1/FB1,8,11; 1/L32 E0 Band |
| | Guide, connector | BT17574 | |
| | Heatsink | BT37586 | 1/TR23 |
| | Heatsink | QA05842 | 1/TR26 |
| | Heatsink | QA05849 | 1/TR25 |
| | Insulating bead | FJ00007 | 1/R143 |
| | Insulator | BT37679 | 6(/01–03); 4(/04–06) |
| | Insulator, mixer | BT37682 | |
| | Insulator, thermafilm | FJ00189 | 1/TR26 |
| | PCB standoff button | BT36480 | |
| | Screen, antenna filter | BT26391 | |
| | Screen, mixer | BT26389 | |
| | Screen, PA | BT26388 | |
| | Screen, PA driver | BT26310 | |
| | Spring, contact | BT26983 | |
| | Ty-rap | QA04424 | 3/Power lead |
| **FIXINGS** | | | |
| | Scr, s/t, st, No. 2 x ¼ in. | QJ08857/B | 2/PLA; 1/Lampholder – support moulding |
| | Scr, sdriv, tapt, pan, M3 x 6 mm | QJ11550/X1 | 2/R.panel |

**VOLUME POTENTIOMETER ASSEMBLY**
**AT14605**

| | | | |
|---|---|---|---|
| | Knob, volume | | BT37494 |
| | 5k ±20% | Log. Pot | PL64107 |

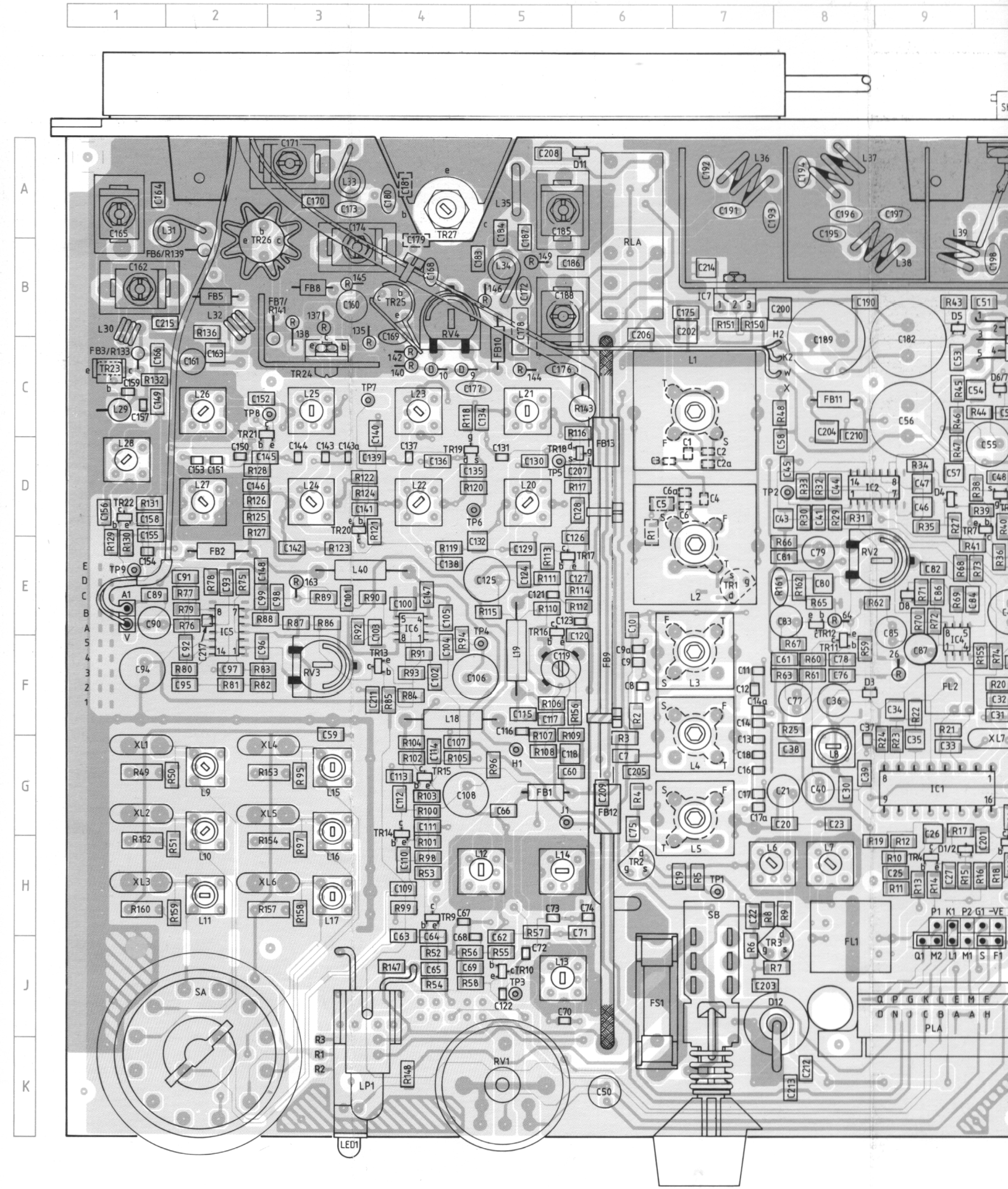
**REAR PANEL ASSEMBLY**
**AT14636/01**

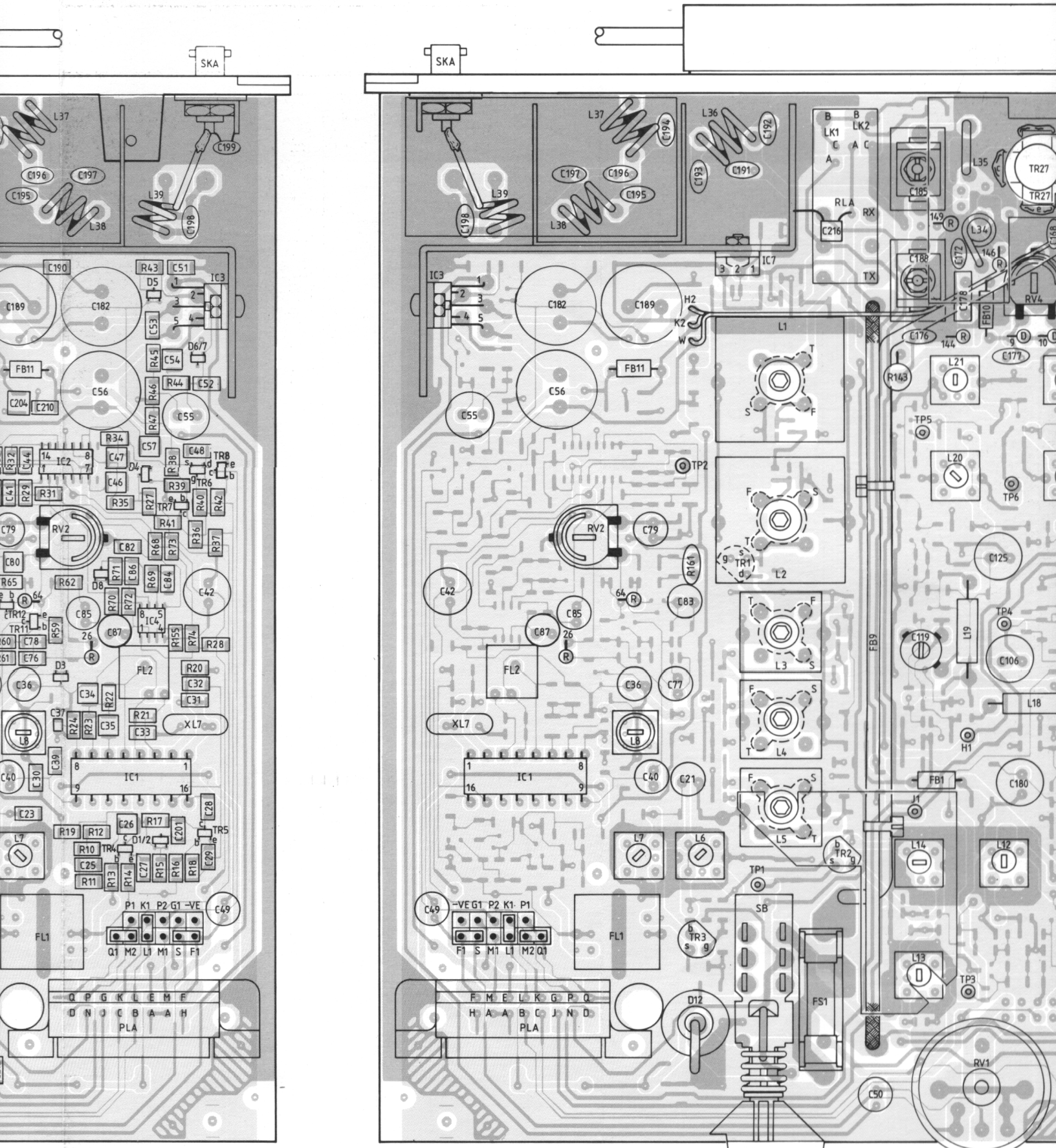
| | | | |
|---|---|---|---|
| | Lead assembly | AT10765/17 | 1/Loudspeaker |
| | Lead assembly | AT36580 | [0] C5,6 – A1 & V |
| | Microphone and lead assembly | AT29713/01 | |
| | Bracket assembly, mounting | AT13677 | See headed list |
| | Cable clamp | BT16054 | |
| | Casting, rear panel | BT36899/03 | |
| | Grommet, ⅜ in. | FG02221 | 1/Heatsink |
| | Lug | FT03706 | 2/PCB – heatsink |
| | Lug, copper | BT37179 | 1/PA heatsink |
| | Pillar, hexagon | BT04402 | 2/Heatsink |
| SKA | Socket | FS43779 | |
| | Tag | FT10006 | 1/SKA |
| SKC | Terminal, insulated, female | FT16860 | |
| PLB | Terminal, insulated, male | FT16861 | |
| | Scr, sdriv, pan, st, M2,5 x 10 mm | QJ11947/B | 2/Pillars – heatsink |
| | Scr, sdriv, tapt, pan, M3 x 6 mm | QJ11550/X1 | 1/Bracket – heatsink |
| | Scr, sdriv, tapt, pan, M3 x 10 mm | QJ11552/X1 | 2/Lug – heatsink |
| | Scr, sdriv, tapt, pan, M3 x 16 mm | QJ11554/X1 | 2/Clamp – heatsink |
| | Washer, M2,5 | QA15004/B | 1/Pillar |
| | Washer, M3 | QA15005/X | 2/Cable clamp |
| | Washer, M4 | QA15007/X | 2/Cable clamp |

**BRACKET ASSEMBLY MOUNTING**

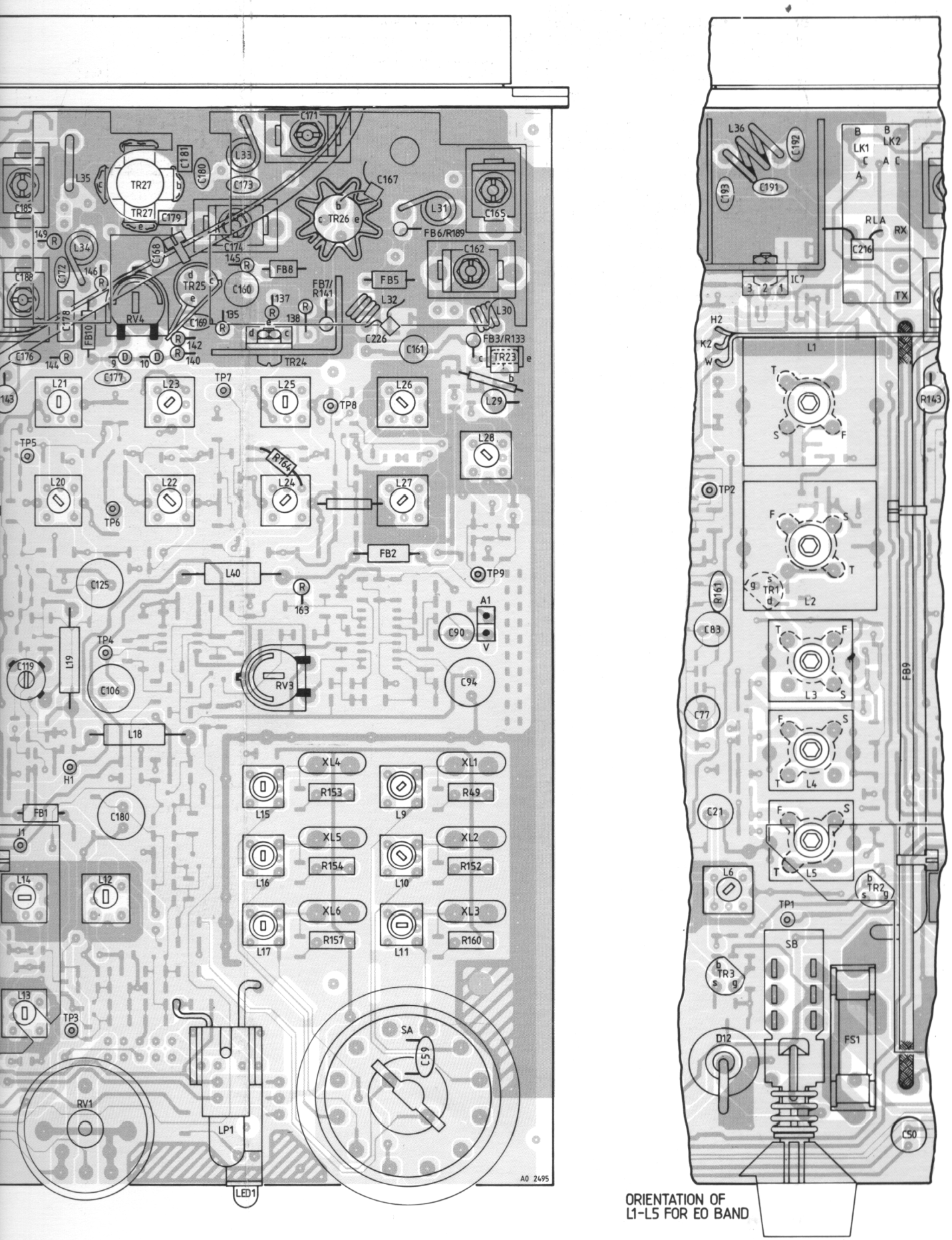
**AT13677**

| | | | |
|---|---|---|---|
| | Bracket, mounting | | BT11306 |
| [0] C1–9 | 1n + 100% – 0%, 50V, feedthrough | | PN26628 |


1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
J
K
RLA
SA
SB
PLA
FS1
RV1
RV2
RV3
RV4
LP1
LED1
IC1
IC2
IC4
IC5
IC6
IC7
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
TR13
TR14
TR15
TR16
TR17
TR18
TR19
TR20
TR21
TR22
TR23
TR24
TR25
TR26
TR27
P1 K1 P2 G1 -VE
Q1 M2 L1 M1 S F1
Q P G K L E M F
O N J C B A A H


SKA
L37
C199
C196
C197
C195
L39
L38
C198
C190
R43
C51
D5
IC3
C189
C182
C53
FB11
D6/7
R45
C54
C56
R44
C52
C204
C210
R46
C55
R47
C57
R34
C48
IC2
C47
TR8
D4
R38
C46
TR6
R39
R31
R35
R27
TR7
R40
R42
R41
C79
RV2
R68
R73
R36
R37
C80
C82
R71
C86
R69
C84
R65
R62
D8
C42
C85
R70
R72
C87
IC4
R155
R74
R28
TR12
TR11
R59
C78
C76
D3
FL2
R20
C36
C34
R22
C32
C31
C37
R24
R23
C35
R21
C33
XL7
L8
C39
IC1
C40
C30
C23
C28
R19
R12
C26
R17
C201
TR5
L7
R10
TR4
D1/2
C29
C25
R13
R14
C27
R15
R16
R18
R11
P1 K1 P2 G1 -VE
C49
FL1
Q1 M2 L1 M1 S F1
Q P G K L E M F
D N J C B A A H
PLA
SKA
L37
C194
L36
C192
C197
C196
C193
C191
C195
L39
C198
L38
IC7
3 2 1
IC3
C182
C189
H2
K2
W
L1
FB11
C56
C55
TP2
RV2
C79
R161
C42
64
C83
C85
C87
26
FL2
C36
C77
XL7
L8
IC1
C40
C21
L7
L6
TP1
C49
-VE G1 P2 K1 P1
F1 S M1 L1 M2 Q1
FL1
SB
TR3
F M E L K G P Q
H A A B C J N D
PLA
D12
FS1
C50
RV1
B B LK2
LK1
C A C
A
RLA
RX
C216
TX
C185
L35
TR27
TR27
149
R
L34
C188
C172
146
C178
FB10
RV4
C176
144
C177
R143
L21
TP5
L20
TP6
C125
L19
TP4
C119
C106
L18
H1
FB1
C180
J1
L14
L12
TR2
FB9
L2
L3
L4
L5
L13
TP3

AT28948/–







ORIENTATION OF
L1-L5 FOR E0 BAND

FIG. 6.1 TRANSCEIVER PCB ASSEMBLY
AT28948/– LAYOUT DIAGRAM

COMPONENT LOCATION – GRID REFERENCE

SEMICONDUCTORS & IC'S

| Code | Location |
|---|---|
| IC1 | 9G |
| IC2 | 9B |
| IC3 | 10C |
| IC4 | 9E |
| IC5 | 2E |
| IC6 | 4E |
| IC7 | 7B |
| TR1 | 7E |
| TR2 | 6H |
| TR3 | 8J |
| TR4 | 9H |
| TR5 | 10H |
| TR6-8 | 10D |
| TR9 | 4H |
| TR10 | 5J |
| TR11 | 8F |
| TR12 | 8E |
| TR13 | 4F |
| TR14,15 | 4G |
| TR16 | 5E |
| TR17 | 6E |
| TR18 | 6D |
| TR19 | 5D |
| TR20 | 3D |
| TR21 | 3C |
| TR22 | 1D |
| TR23 | 1C |
| TR24 | 3C |
| TR25 | 4B |
| TR26 | 2B |
| TR27 | 4A |
| D1,2 | 10H |
| D3 | 9F |
| D4 | 9D |
| D5 | 9B |
| D6,7 | 10C |
| D8 | 9E |
| D9 | 5C |
| D10 | 4C |
| D11 | 6A |
| D12 | 8J |

RESISTORS

| Code | Location |
|---|---|
| R1 | 6D |
| R2,3 | 6F |
| R4 | 6G |
| R5 | 7H |
| R6 | 7J |
| R7 | 8J |
| R8,9 | 8H |
| R10-14 | 9H |
| R15,16 | 10H |
| R17 | 10G |
| R18 | 10H |
| R19 | 9H |
| R20 | 10F |
| R21,22 | 9F |
| R23,24 | 9F/G |
| R25 | 8F |
| R26 | 9F |
| R27 | 9D |
| R28 | 10F |
| R29-33 | 8D |
| R34,35 | 9D |
| R36,37 | 10E |
| R38-40 | 10D |
| R41 | 10E |
| R42 | 10D |
| R43 | 9B |
| R44 | 10C |
| R45,46 | 9C |
| R47 | 9D |
| R48 | 8C |
| R49 | 1G |
| R50 | 2G |
| R51 | 2H |
| R52 | 4J |
| R53 | 4H |
| R54 | 4J |
| R55,56 | 5J |
| R57 | 5H |
| R58 | 5J |
| R59 | 9F |
| R60,61 | 8F |
| R62 | 9E |
| R63 | 8F |
| R64-66 | 8E |
| R67 | 8F |
| R68-72 | 9E |
| R73 | 10E |
| R74 | 10F |
| R75-79 | 2E |
| R80-83 | 2F |
| R84,85 | 4F |
| R86-89 | 3E |
| R90 | 4E |
| R91 | 4F |
| R92 | 3E |
| R93,94 | 4F |
| R95 | 3G |
| R96 | 5G |
| R97 | 3H |
| R98,99 | 4H |
| R100 | 4G |
| R101 | 4H |
| R102-105 | 4G |
| R106,107 | 5F |
| R108 | 5G |
| R109 | 6F |
| R110,111 | 5E |
| R112 | 6E |
| R113 | 5E |
| R114 | 6E |
| R115 | 5E |
| R116 | 6C |
| R117 | 6D |
| R118 | 5C |
| R119 | 4E |
| R120 | 5D |
| R121,122 | 4D |
| R123 | 3E |
| R124 | 4D |
| R125-128 | 2D |
| R129,130 | 1E |
| R131 | 1D |
| R132,133 | 1C |
| R134 | – |
| R135 | 4C |
| R136 | 2B |
| R137,138 | 3B |
| R139 | 2B |
| R140 | 4C |
| R141 | 3B |
| R142 | 4C |
| R143 | 6C |
| R144 | 5C |
| R145 | 3B |
| R146 | 5B |
| R147 | 4J |
| R148 | 4K |
| R149 | 5B |
| R150,151 | 7B |
| R152 | 1H |
| R153 | 3G |
| R154 | 3H |
| R155 | 10F |
| R156 | 6F |
| R157,158 | 3H |
| R159 | 2H |
| R160 | 1H |
| R161,162 | 8E |
| R163 | 3E |
| R164 | 3D |
| RV1 | 5K |
| RV2 | 9E |
| RV3 | 3F |
| RV4 | 4B |

CAPACITORS

| Code | Location |
|---|---|
| C1-6A | 7D |
| C7 | 6G |
| C8-9a | 6F |
| C10 | 6E |
| C11,12 | 7F |
| C13 | 7G |
| C14,14a | 7F |
| C15 | – |
| C16-18 | 7G |
| C19 | 7H |
| C20,21 | 8G |
| C22 | 7H |
| C23 | 8G |
| C24 | – |
| C25 | 9H |
| C26 | 9G |
| C27 | 9H |
| C28 | 10G |
| C29 | 10H |
| C30 | 8G |
| C31,32 | 10F |
| C33 | 9G |
| C34,35 | 9F |
| C36 | 8F |
| C37 | 9F |
| C38 | 8G |
| C39 | 9G |
| C40 | 8G |
| C41 | 8D |
| C42 | 10E |
| C43-45 | 8D |
| C46,47 | 9D |
| C48 | 10D |
| C49 | 10H |
| C50 | 6K |
| C51 | 10B |
| C52 | 10C |
| C53 | 9C |
| C54 | 10C |
| C55 | 10D |
| C56 | 9C |
| C57 | 9D |
| C58 | 8D |
| C59 | 3F |
| C60 | 6G |
| C61 | 8F |
| C62 | 5H |
| C63,64 | 4H |
| C65 | 4J |
| C66 | 5G |
| C67,68 | 5H |
| C69 | 5J |
| C70 | 6J |
| C71 | 6H |
| C72 | 5J |
| C73 | 5H |
| C74 | 6H |
| C75 | 6G |
| C76-78 | 8F |
| C79-81 | 8E |
| C82 | 9E |
| C83 | 8E |
| C84 | 10E |
| C85,86 | 9E |
| C87 | 9F |
| C88 | – |
| C89,90 | 1E |
| C91 | 2E |
| C92 | 2F |
| C93 | 2E |
| C94 | 1F |
| C95-97 | 2F |
| C98 | 3E |
| C99 | 2E |
| C100 | 4E |
| C101 | 3E |
| C102 | 4F |
| C103 | 4E |
| C104 | 4F |
| C105 | 4E |
| C106 | 5F |
| C107 | 4G |
| C108 | 5G |
| C109,110 | 4H |
| C111-114 | 4G |
| C115-117 | 5F |
| C118 | 6G |
| C119 | 5F |
| C120 | 6E |
| C121 | 5E |
| C122 | 5J |
| C123 | 6E |
| C124,125 | 5E |
| C126 | 6D |
| C127 | 6E |
| C128 | 6D |
| C129 | 5E |
| C130,131 | 5D |
| C132 | 5E |
| C133 | – |
| C134 | 5C |
| C135 | 5D |
| C136,137 | 4D |
| C138 | 4E |
| C139 | 4D |
| C140 | 4C |
| C141 | 4D |
| C142 | 3E |
| C143-145 | 3D |
| C146 | 2D |
| C147 | 4E |
| C148 | 2E |
| C149 | 1C |
| C150,151 | 2D |
| C152 | 2C |
| C153 | 2D |
| C154 | 1E |
| C155,156 | 1D |
| C157 | 1C |
| C158 | 1D |
| C159 | 1C |
| C160 | 3B |
| C161 | 2C |
| C162 | 1B |
| C163 | 2C |
| C164,165 | 1A |
| C166 | 1C |
| C167 | 2B |
| C168,169 | 4B |
| C170,171 | 3A |
| C172 | 5B |
| C173 | 3A |
| C174 | 3B |
| C175 | 7B |
| C176,177 | 5C |
| C178 | 5B |
| C179-181 | 4A |
| C182 | 9C |
| C183 | 5B |
| C184,185 | 5A |
| C186 | 6B |
| C187 | 5A |
| C188 | 6B |
| C189 | 8C |
| C190 | 9B |
| C191,192 | 7A |
| C193-196 | 8A |
| C197 | 9A |
| C198 | 10B |
| C199 | 10A |
| C200 | 8B |
| C201 | 10H |
| C202 | 7B |
| C203 | 8J |
| C204 | 8C |
| C205 | 6G |
| C206 | 6B |
| C207 | 6D |
| C208 | 5A |
| C209 | 6G |
| C210 | 8C |
| C211 | 4F |
| C212,213 | 8K |
| C214 | 7B |
| C215 | 1B |
| C216 | 6B |
| C217 | 2E |
| C218–225 | – |
| C226 | 2B |

INDUCTORS

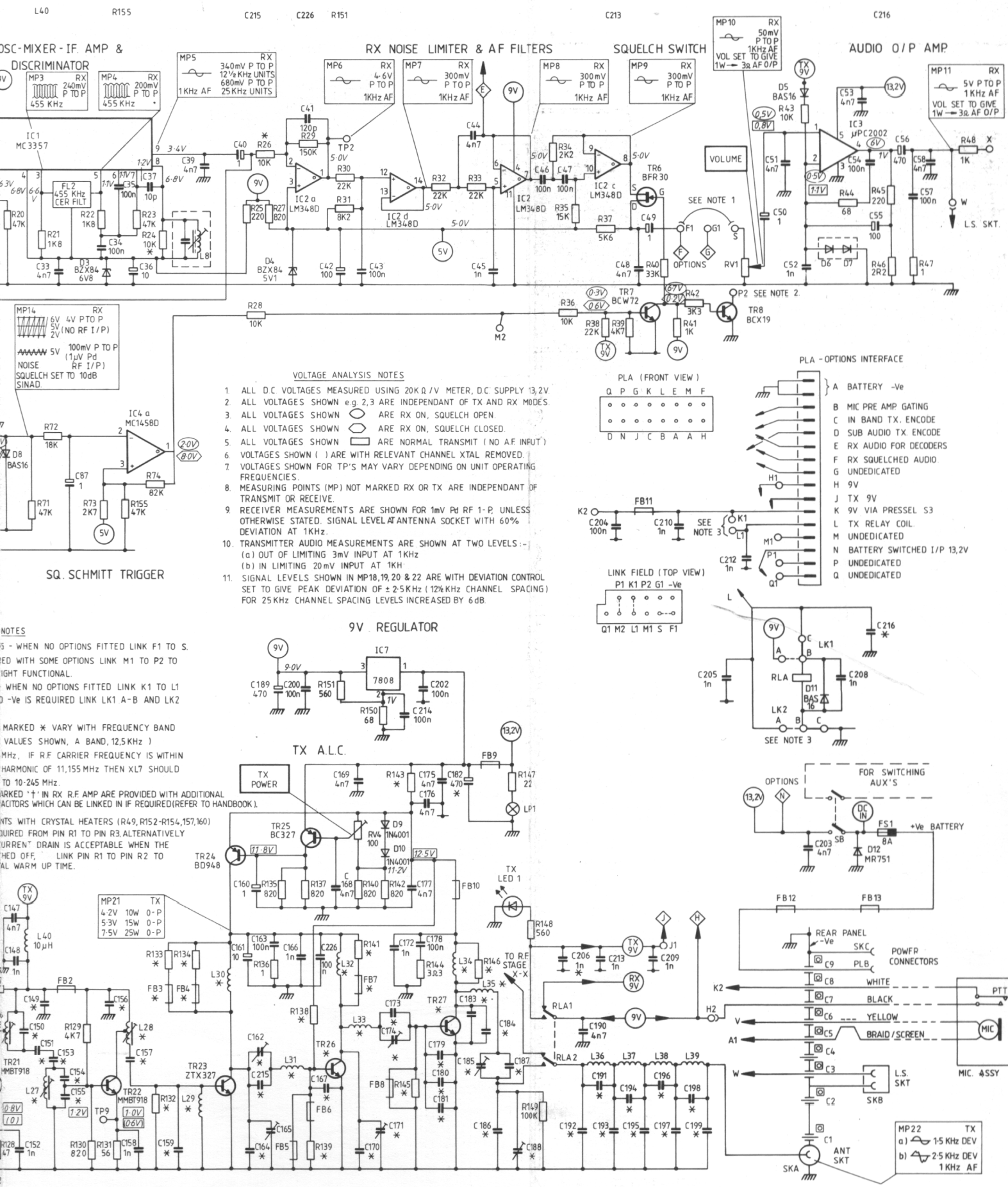
| Code | Location |
|---|---|
| L1 | 7C |
| L2 | 7E |
| L3,4 | 7F |
| L5 | 7G |
| L6,7 | 8H |
| L8 | 8G |
| L9,10 | 2G |
| L11 | 2H |
| L12 | 5H |
| L13 | 5J |
| L14 | 5H |
| L15,16 | 3G |
| L17 | 3H |
| L18 | 4F |
| L19 | 5F |
| L20 | 5D |
| L21 | 5C |
| L22 | 4D |
| L23 | 4C |
| L24 | 3D |
| L25 | 3C |
| L26 | 2C |
| L27 | 2D |
| L28 | 1D |
| L29 | 1C |
| L30 | 1B |
| L31 | 2A |
| L32 | 2B |
| L33 | 3A |
| L34 | 5B |
| L35 | 5A |
| L36 | 7A |
| L37 | 8A |
| L38 | 9B |
| L39 | 10B |
| L40 | 3E |

MISCELLANEOUS

| Code | Location |
|---|---|
| FB1 | 5G |
| FB2 | 2E |
| FB3 | 1C |
| FB4 | – |
| FB5,6 | 2B |
| FB7,8 | 3B |
| FB9 | 6F |
| FB10 | 5C |
| FB11 | 8C |
| FB12 | 6G |
| FB13 | 6C |
| FL1 | 8H |
| FL2 | 9F |
| FS1 | 6J |
| LED1 | 3K |
| LP1 | 3K |
| PLA | 9J |
| SA | 2K |
| SB | 7J |
| SKA | 10A |
| TP1 | 7H |
| TP2 | 8D |
| TP3 | 5J |
| TP4 | 5F |
| TP5,6 | 5D |
| TP7 | 4C |
| TP8 | 3C |
| TP9 | 1E |
| XL1,2 | 1G |
| XL3 | 1H |
| XL4,5 | 3G |
| XL6 | 3H |
| XL7 | 10F |
| A1 | 1E |
| H1 | 5G |
| H2 | 8C |
| J1 | 6G |
| K2 | 8C |
| R1,2 | 3K |
| R3 | 3J |
| V | 1E |
| W | 8C |
| X | 8C |

LINK FIELD

| | |
|---|---|
| F1 | 10J |
| G1 | 10H |
| K1 | 9H |
| L1 | 9J |
| M1 | 10J |
| M2 | 9J |
| P1 | 9H |
| P2 | 10H |
| Q1 | 9J |
| S | 10J |
| –ve | 10H |




VOLTAGE ANALYSIS NOTES

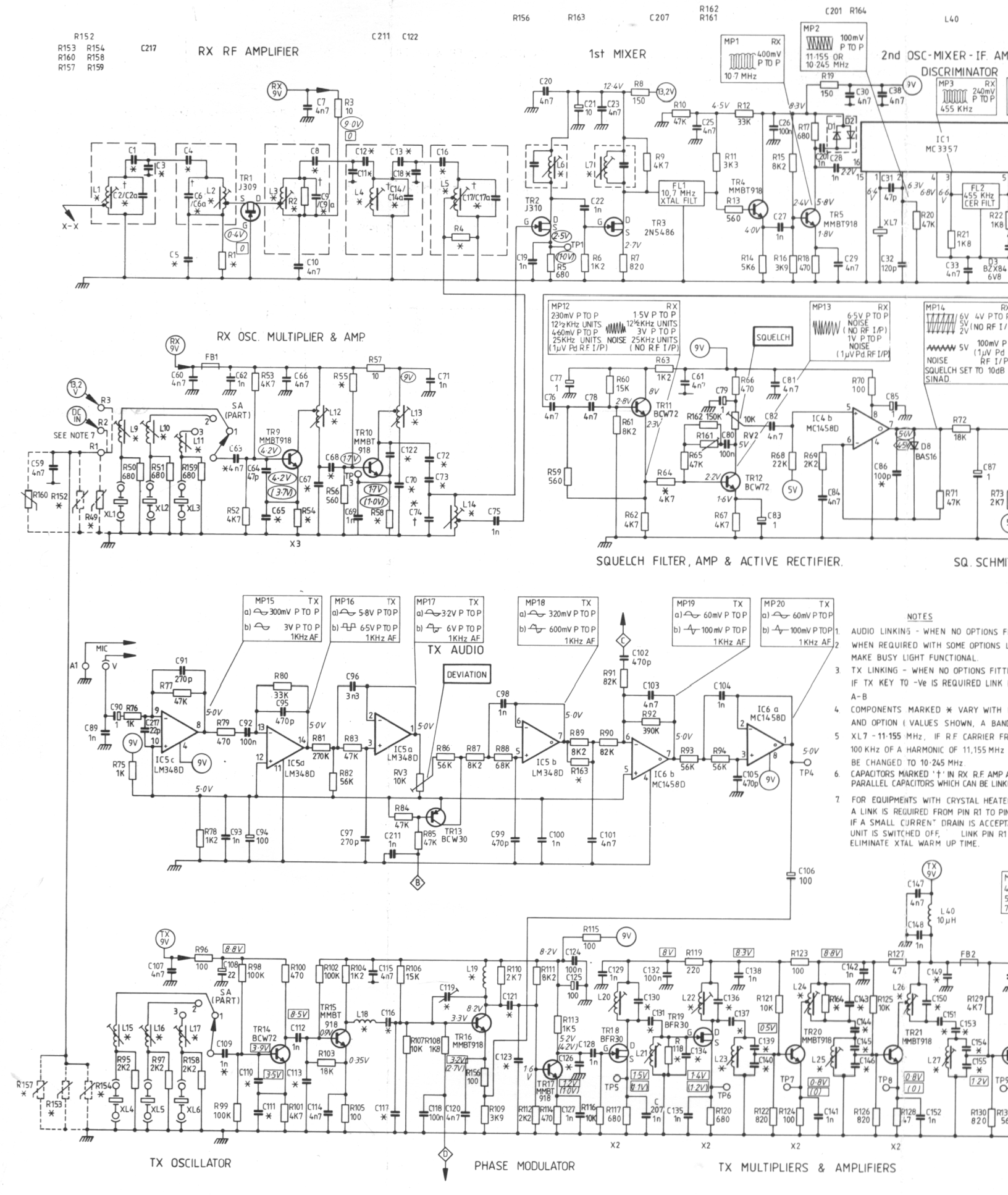
1. ALL D.C VOLTAGES MEASURED USING 20KΩ/V METER, D.C SUPPLY 13,2V.
2. ALL VOLTAGES SHOWN e.g. 2,3 ARE INDEPENDANT OF TX AND RX MODES.
3. ALL VOLTAGES SHOWN ⬭ ARE RX ON, SQUELCH OPEN.
4. ALL VOLTAGES SHOWN ⬡ ARE RX ON, SQUELCH CLOSED.
5. ALL VOLTAGES SHOWN ▭ ARE NORMAL TRANSMIT (NO A.F. INPUT)
6. VOLTAGES SHOWN ( ) ARE WITH RELEVANT CHANNEL XTAL REMOVED.
7. VOLTAGES SHOWN FOR TP'S MAY VARY DEPENDING ON UNIT OPERATING FREQUENCIES.
8. MEASURING POINTS (MP) NOT MARKED RX OR TX ARE INDEPENDANT OF TRANSMIT OR RECEIVE.
9. RECEIVER MEASUREMENTS ARE SHOWN FOR 1mV Pd RF 1-P, UNLESS OTHERWISE STATED. SIGNAL LEVEL AT ANTENNA SOCKET WITH 60% DEVIATION AT 1KHz.
10. TRANSMITTER AUDIO MEASUREMENTS ARE SHOWN AT TWO LEVELS :-
    (a) OUT OF LIMITING 3mV INPUT AT 1KHz
    (b) IN LIMITING 20mV INPUT AT 1KH
11. SIGNAL LEVELS SHOWN IN MP18,19,20 & 22 ARE WITH DEVIATION CONTROL SET TO GIVE PEAK DEVIATION OF ± 2·5KHz (12½KHz CHANNEL SPACING) FOR 25KHz CHANNEL SPACING LEVELS INCREASED BY 6dB.

NOTES

5 - WHEN NO OPTIONS FITTED LINK F1 TO S.
RED WITH SOME OPTIONS LINK M1 TO P2 TO
IGHT FUNCTIONAL.
WHEN NO OPTIONS FITTED LINK K1 TO L1
) -Ve IS REQUIRED LINK LK1 A-B AND LK2

MARKED * VARY WITH FREQUENCY BAND
VALUES SHOWN, A BAND, 12,5KHz )
MHz, IF R.F. CARRIER FREQUENCY IS WITHIN
HARMONIC OF 11,155MHz THEN XL7 SHOULD
TO 10·245 MHz.
ARKED '†' IN RX R.F. AMP ARE PROVIDED WITH ADDITIONAL
ACITORS WHICH CAN BE LINKED IN IF REQUIRED (REFER TO HANDBOOK).
NTS WITH CRYSTAL HEATERS (R49, R152-R154, 157, 160)
QUIRED FROM PIN R1 TO PIN R3. ALTERNATIVELY
URRENT DRAIN IS ACCEPTABLE WHEN THE
HED OFF, LINK PIN R1 TO PIN R2 TO
AL WARM UP TIME.

FIG. 6.2 M294E TRANSCEIVER CIRCUIT DIAGRAM


RX RF AMPLIFIER
1st MIXER
2nd OSC-MIXER - IF. AM
DISCRIMINATOR
RX OSC. MULTIPLIER & AMP.
SQUELCH FILTER, AMP & ACTIVE RECTIFIER.
SQ. SCHMI
TX AUDIO
TX OSCILLATOR
PHASE MODULATOR
TX MULTIPLIERS & AMPLIFIERS
SQUELCH
DEVIATION
SEE NOTE 7
NOTES



Pye Telecom

Pye Telecommunications Ltd
St Andrews Road Cambridge
England CB4 1DW
Tel: Cambridge (0223) 61222
Telex: 81166 (PYETEL G)

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