SQUADCAL

TRA. 906 H.F.S.S.B. Transmitter-Receiver

Technical Manual

RACAL
THE ELECTRONICS GROUP

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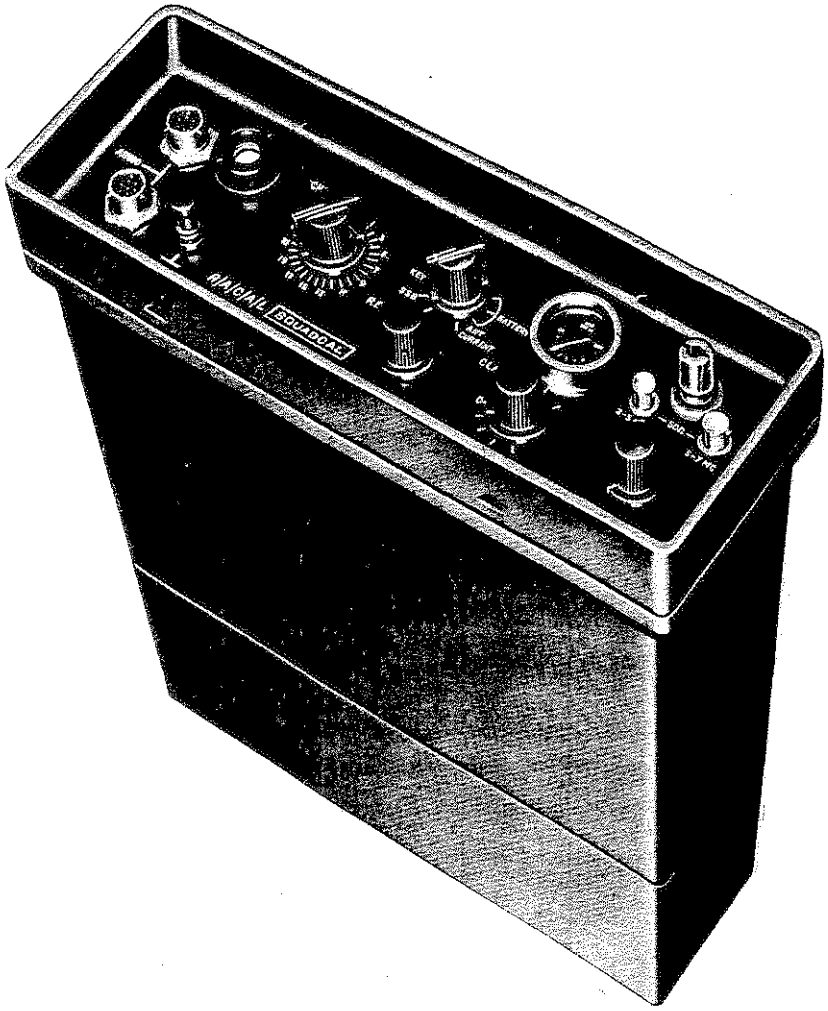

SQUADCAL

TRA. 906 H.F. S.S.B.
TRANSMITTER-RECEIVER

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TECHNICAL SPECIFICATION

GENERAL

Frequency Range:	2 to 7 MHz. 3 to 7.5 MHz (to special order).
Channels:	29 located anywhere within the frequency range.
Modes of Operation:	SSB Telephony. SSB Keyed Tone Telegraphy (1000 Hz nominal). Compatible AM (Carrier plus one sideband).
Radiated Sideband:	Upper or lower sideband. (To be specified on order).
Frequency Stability:	Over the temperature range 0°C to +40°C the frequency change will be less than 200 Hz relative to the frequency at 20°C.
Antennas:	8-foot (2.4m) Whip. Dipole. End fed Long wire.
Antenna Matching:	In built ATU designed to tune the above antennas. Single control tuning.
Dimensions:	312mm ($12\frac{5}{16}$ in.) wide x 110mm ($4\frac{3}{8}$ in.) high x 394mm ($15\frac{1}{2}$ in) deep.
Weight:	Basic TRA.906 unit only, 3.9kg ($8\frac{1}{2}$ lb.) Operational manpack with handset, whip antenna, batteries and haversack - less [illegible], 8.2kg (18 lb.).
Temperature Range:	Operating: -10°C to +55°C Storage: -40°C to +70°C
Sealing:	Transmitter-Receiver case sealed and fitted with desiccator. Battery container may be removed without breaking main seal.
Batteries	(a) Three 6-volt latern batteries, e.g. Ever Ready 996 or Burgess F4M. (b) Fourteen HP2 or 'D' type torch cells, using similar battery container to (a), but with internal adaptor unit, type MA.910.

(c) Nickel-Cadmium Battery Pack (3.5 ampere hour) MA.928.
(d) Nickel-Cadmium Battery Pack (3.5 ampere hour) MA.948.

Front Panel Controls and Facilities:

(a) Channel Selector Switch.
(b) Function Switch selecting
OFF
S.S.B.
Key
A.M.
Tune
(c) Antenna Tuning Control.
(d) R.F. Gain.
(e) Clarifier.
(f) Meter, monitoring battery voltage (on S.S.B., A.M. and Key) and antenna current (on Tune).
(g) Whip antenna socket (also used for slant wire antenna with adaptor).
(h) Two 50 ohm coaxial sockets for dipole connector
(i) 2-5 MHz.
(ii) 5-7 MHz.
(i) Ground terminal.
(k) Two accessory sockets for handset, headset or morse key, loudspeaker amplifier/power supply unit or battery charging unit.

TRANSMITTER

Power Output: 5 watts p.e.p. into 50 ohm load.
5 watts c.w. into 50 ohm load.

Overall A.F. Bandwidth: Within 6 dB from 400 Hz to 2500 Hz relative to peak response.

Harmonic Emissions: -40 dB relative to p.e.p. output in 50 ohm load.

Spurious Emissions: -36 dB relative to p.e.p. output in 50 ohm load.

Carrier Suppression: -35 dB minimum relative to p.e.p. output.

Unwanted Sideband Suppression: -40 dB relative to p.e.p. output at 1 KHz modulating frequency.

Intermodulation Distortion: -25 dB relative to 5 watts p.e.p. output.

Power Consumption: Typically 550 mA at 18 volts on s.s.b. speech.

RECEIVER

Sensitivity:	1 mW A.F. output for 1μV r.f. input.
Signal/Noise Ratio:	Under the condition given for sensitivity the signal/noise ratio is 15 dB minimum.
Selectivity:	-6 dB bandwidth -2.2 kHz minimum; -40 dB bandwidth -5.5 kHz maximum.
Image Rejection:	Better than 60 dB.
Spurious Responses:	All spurious response attenuated by at least 40 dB.
Overall A.F. Bandwidth:	Within 6 dB from 400 Hz to 2.5 kHz relative to peak response.
A.F. Power Output:	4 mW maximum.
Distortion:	5% maximum at 4 mW.
Clarifier Range:	Approximately 300 Hz.
Power Consumption:	70 mA at 18 volts.

NOTE: The above mentioned performance figures are measured with a battery power supply of 18 volts.

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AMENDMENT

TO

TRA.906 H.F. S.S.B. TRANSMITTER-RECEIVER

Crystals

All crystals change frequency over a period of time. The close-tolerence high-stability crystals used in the TRA.906 are pre-aged in manufacture but further ageing and consequent frequency drift will occur throughout the life of the crystal.

It is recommended, therefore, that all crystals in the TRA.906 (including the sideband crystal) are checked and if necessary re-trimmed to the correct frequency at least every two months during the first year's use of the equipment. The period between checks may then be increased to six months.

Components List Page 8-9

Add the following

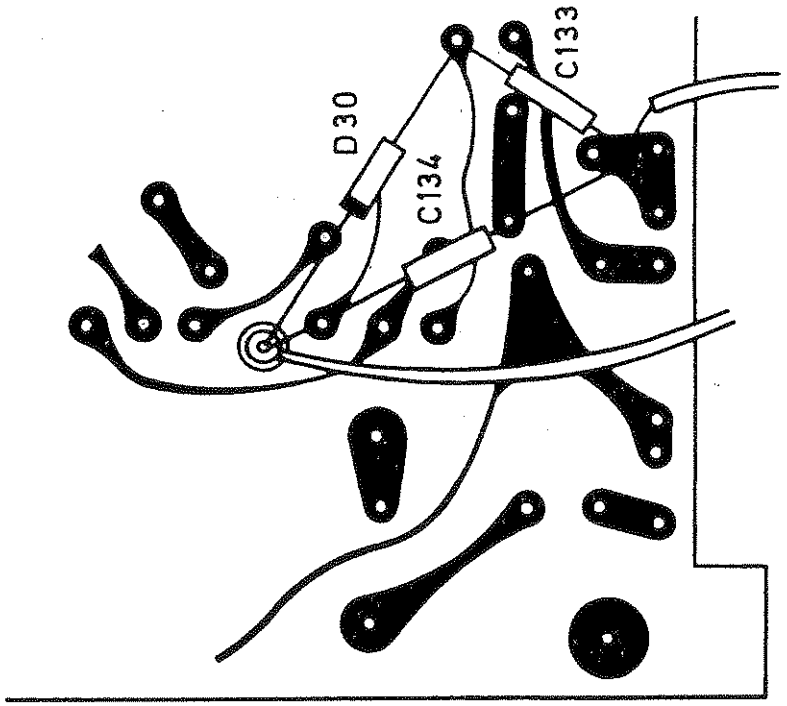
C133	0.1 µF	Ceramicon	30V	+50 -25	Erie 811/T/30V
C134	0.1 µF	Ceramicon	30V	+50 -25	Erie 811/T/30V

Circuit Fig.2

Add capacitor C134, 0.1µ, from the cathode of D30 to earth.

Component Layout Fig. 4

Add scrap view to this figure as on attached sheet.



Addendum to

COMPONENT LAYOUT: TRA. 906 Fig. 4.

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AMENDMENT TO TECHNICAL MANUAL

TRA.906 H.F. S.S.B. TRANSMITTER-RECEIVER

COMPONENTS LIST

Page 8-3 Amend resistor R78 to read as follows:-

1 ohm W.W. Vitreous $2\frac{1}{2}$W 10% 911767

November 1972

CHANGE No.1
Issue 13

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AMENDMENT TO
TRA.906 H.F. S.S.B. TRANSMITTER-RECEIVER

COMPONENTS LIST

Page 8-6 Amend capacitor C48 to read:

220µF	Electolytic	25V	-10 + 50%	921536

ILLUSTRATIONS

Fig. 2 Change value of C48 to 220.

CHAPTER 1

INTRODUCTION

1. The Racal "Squadcal" Type TRA. 906 has been developed to meet the world-wide military and civil requirements for a low cost, lightweight, high efficiency, rugged and reliable HF SSB packset. The Type TRA. 906 is a 5 watt p.e.p. single sideband transistorized transmitter/receiver providing 29 crystal controlled channels anywhere in the range 2-7 MHz (3-7.5 MHz as alternative on request) and weighing less than 18lb (8.2 kg) complete with carrying harness, standard accessories and batteries.

2. Designed primarily as an SSB equipment - either upper or lower sideband can be supplied - tone telegraphy and compatible AM telephony facilities are provided to allow use with existing systems.

3. A wide range of manpack accessories, including headsets, handset, morse key and whip aerial, are available and other ancillary items such as dipole and long wire antennas have been designed for use with the Type TRA. 906.

4. Extreme simplicity of operation is a main feature of "Squadcal" and an unskilled operator can be taught to use the equipment in a matter of minutes. Frequency changing can be accomplished in approximately 5-10 seconds by day or night.

5. The provision of 29 crystal controlled channels allows the operator the choice of a sufficient number of frequencies to cover large-net working and propagational changes without having to use more complex techniques such as frequency synthesis. The operator has only one control to select the required channel thus simplifying frequency changing. Any required frequency may be selected and channel crystals changed in the field without the use of test equipment.

6. A fine frequency control/clarifier is provided to enable the set to be "netted" on to any out-station which may not have been set up to exactly the same frequency. This control may also be used to vary the tone of the telegraphy note.

7. It is impossible to give the exact operating range of HF manpack but world wide trials have shown that the Type TRA. 906 with an 8' (2.4m) whip antenna will work manpack to manpack over distances of 4 to 10 miles (6-16 km) in primary jungle, 10 to greater than 25 miles (16-40 km) in open terrain, depending upon time of day and frequency of operation. These ranges are considerably extended by use of a longer whip, end-fed dipole antenna and where higher-powered base stations are employed. Ranges of many hundreds of miles are consistently being covered by the Racal Type TRA. 906 manpack.

8. The Type TRA. 906 has been made fully waterproof and can be totally immersed for an indefinite period. The front-panel-fitted desiccator with indicator can be changed without breaking the main front panel seal. The buoyancy of the set is approximately 7 lb, (3.2 kg) thus allowing the equipment to float. The low mass of carefully selected components, together with the use of "Cycolac" front panel, case and battery box allows the

equipment to withstand severe handling, both in use and transit and sets packed for airfreight have been dropped 15-20 ft (4.6 to 6m) and still been fully operational.

9. The electrical and mechanical design, together with careful choice of conservatively rated components, ensures long and trouble free service and the layout of the single printed circuit board allows easy access to all components for testing and repair, should this become necessary. Individual components are identified by circuit reference and "zoning" of circuitry allows rapid location of any fault condition. A specially designed field test set type CA.470B enables the equipment to be quickly checked before putting into operation and in addition to measuring transmitter output power, it provides a regulated d.c. supply from an a.c. mains source when required.

10. Designed basically for use from an 18V supply derived from three standard "Lantern" 6V batteries, the flexibility of the Type TRA. 906 is futher increased by the range of alternative power supplies available. A simple battery adaptor to fit the normal battery compartment enables fourteen U2 or "D" cells - probably the most common battery in the world to be used. A nickel cadmium battery pack is available with permanent connections between the cells and is assembled in a container which is interchangeable with the Lantern cells. The use of an 18V supply eliminates the need for a converter unit, thereby increasing efficiency and reliability and reducing weight, cost and complexity. All batteries can be changed without breaking the main equipment seal and nickel cadmium cells can be charged in the set via the front panel accessory socket.

11. "Squadcal" is normally supplied with a strong webbing harness assembly, and adequate stowage space is provided for accessories, antennas or spare batteries

12. The TRA. 906 is designed to operate into a normal 8 ft (2.4m) whip antenna but the built-in tuning unit allows dipole, end fed or base fed vertical antennas to be used when required.

13. Two accessory sockets on the front panel are provided for headset, handset, morse key etc. and full audio output is available to operate any combination of these items.

NOTE: Racal manpack accessories are interchangeable with a number of other army-type equipments but there are several accessories supplied by other manufacturers for use with their own equipment which will not operate with the Racal TRA.906. Care should, therefore, be taken to ensure that certain morse keys which look identical and have the same type of plug fitted are, in fact, suitable for use with the TRA.906. Some of these keys are wired differently and while no damage will result if the wrong key is used, telegraphy operation with the TRA.906 will not be possible.

14. For vehicle or shipborne installations specially designed mounting trays are available, together with 12V/24V d.c. supply unit, which also incorporates a loudspeaker and associated amplifier. This unit is compact enough for under-dash mounting and may be installed alongside or separately from the transmitter/receiver unit.

CHAPTER 2

GENERAL DESCRIPTION

1. The transmitter-receiver TRA. 906 is contained in a fully waterproof and dustproof case, the upper section containing the transmitter-receiver unit while the lower section comprises the battery power pack. De-humidifying of the transmitter-receiver unit is achieved by the inclusion of a desiccator unit, the element of which is easily re-conditioned by the application of a hot-air blower.

2. The upper section includes the control panel on which are mounted all the operating controls and external connector points. These latter points include the three antenna sockets, one for the whip antenna and two for the dipole antennas. The two dipole sockets are used to cover the frequency range in two steps of 2 - 5 and 5 - 7 MHz.

3. The transmitter-receiver circuit is formed, in the main, by a single fibreglass printed circuit board. As a consequence, easy access is provided to all components thus simplifying servicing problems. The printed circuit board is held in a 'U' shaped bracket whose open end is secured to the rear of the control panel.

4. Screening of the circuit against unwanted external pick-up is provided by the fitting of screening plates over the two faces of the printed circuit board. These together with the 'U' bracket and the plated rear of the control panel, provide complete screening of the circuit.

5. The battery power pack is attached to the upper section of the unit by two retaining screws, which, when screwed firmly home, ensure a watertight seal between the two sections. The battery complement may consist of three 6 volt Lantern type batteries, fourteen U2 type cells or a nickel cadmium re-chargeable battery of 3.5 ampere-hour capacity.

6. Metering of the battery supply is obtained by the use of the control panel meter, in conjunction with the system selector switch. When set to any one of the SSB, AM or KEY positions, the switch connects the meter across the battery output line. A reading of $\frac{3}{4}$ f.s.d. with the transmitter fully driven indicates serviceable batteries, whereas a $\frac{1}{2}$ f.s.d. under these conditions indicates discharged batteries.

7. The contact arrangement between the batteries and the main unit is so designed that provided the batteries are inserted with the terminals outward, incorrect connection is impossible. (see fig. 5)

8. The control panel contains two parallel connected AUDIO sockets which permit the connection of various combinations of handset, headset etc. Examples of these may be a loudspeaker amplifier and handset, handset (used by a second operator) and headset (used by first operator for monitoring), or headset (or handset) and morse key.

9. The control panel AUDIO sockets are also used to connect the various combined loudspeaker amplifiers and power units e.g. MA.909, MA.926 and MA.927. The nickel cadmium batteries can be charged in-situ by connecting the MA.911 Battery Charging Unit to the packset AUDIO socket.

10. The remaining items on the control panel are as follows:-

a)	CHANNEL switch.	A 29 position rotary switch which is used to select the required channel crystal.
b)	SYSTEM switch.	A five position rotary switch, used to select the mode of operation of the equipment. The positions of the switch are OFF, SSB, KEY, A.M. and TUNE. In the SSB, KEY, and AM positions the meter indicates battery voltage level while in the TUNE position the meter indicates the antenna current.
c)	R.F. GAIN.	This potentiometer controls the receiver gain.
d)	CLARIFIER	A potentiometer which provides adjustment of approximately 300 Hz of the channel frequency selected.
e)	TUNE	A variable inductor, used to tune the various antenna types

11. The total weight of the transmitter-receiver, including the haversack, dry batteries, whip antenna and handset, does not exceed 18 lb. (8.2 kg).

CHAPTER 3

PREPARATION

1. Unpack the equipment from the transit case and remove the transmitter-receiver from its haversack.

2. Carefully inspect the container for any transit damage.

3. Unscrew the two retaining screws in the base of the container and detach the battery power pack.

4. Check that the 2A fuse is serviceable and insert the batteries with the battery terminals pointing outwards from the case. Refit the battery pack and screw the retaining screws firmly home, to ensure a waterproof seal between the pack and the main case.

NOTE: Do not overtighten since this may damage the seal.

5. Set the system switch on the control panel to any one of the SSB, KEY or AM positions and read the level indicated. Fully charged batteries are indicated by a $\frac{3}{4}$f.s.d.

6. The transmitter-receiver may be supplied with the channel crystals installed. In such cases the trimmer capacitors of the crystals fitted will be correctly set by the manufacturer, and no internal adjustments to the equipment should be necessary.

7. Where crystals are to be fitted by the user, or where functional tests indicate that incorrect crystals are installed or that crystal trimmer capacitors require adjustment, then proceed as detailed in the following paragraphs. Do not remove the control panel unless it is necessary to do so.

8. Remove the 16 retaining screws around the edge of the control panel and carefully lift out the transmitter-receiver unit, to the extent of the connector cable. Remove the top and bottom screening plates. (see Chapter 4, para. 8)

9. Check that the correct channel and carrier crystals are fitted. The unit has a capacity of 29 channel crystals, the crystal holders being arranged in two groups of 14 and 15 each. One group is located at each side of the printed circuit board. The single carrier oscillator crystal position is located on the printed circuit board, adjacent to trimmer capacitor C87. (This crystal is soldered into the printed circuit board by the manufacturer to meet the requirement for l.s.d. or u.s.b. operation, as specified by the user). Replace the two screening plates.

10. Each crystal position is shunted by a trimmer capacitor, which may be used to adjust the channel oscillator frequency to its nominal value. The trimmer capacitor of each crystal requires to be adjusted whenever a new frequency crystal is inserted. The procedure to be followed and the test equipment recommended, is detailed in Chapter 6.

11. Where a new channel frequency has to be set up and where no test equipment is immediately available, the trimmer adjustment may be carried out as below. This procedure assumes that another station is available on the new channel:-

(1) Insert the new channel crystal into the required position.
(2) Set the CLARIFIER control to the mid-position.
(3) Set the system switch to SSB.
(4) Adjust the associated channel trimmer capacitor to obtain clear signals from the other station.

12. CRYSTAL FREQUENCY FORMULAE

The crystal frequencies required for the channels allocated and the sideband working in use, are calculated as follows:-

(a) Channel crystal frequency = for +8.9985 MHz for l.s.b. operation
or = for +9.0015 MHz for u.s.b. operation

(b) Carrier crystal frequency = 8.9985 MHz for l.s.b. operation
or = 9.0015 MHz for u.s.b. operation

Where for = allocated channel frequency in MHz.

13. Refit the transmitter-receiver unit into its container and replace the 16 retaining screws. These screws must be firmly tightened in order to prevent the ingress of moisture into the container, care being taken to ensure that no mechanical distortion occurs due to over tightening. The recommended maximum torque on the screws is 6 lb - ins. (2.72 kg-cm).

14. Replace the transmitter-receiver case in the haversack and tighten the haversack frame retaining screws into the threaded inserts which are located behind two of the eyelet holes in the bottom of the haversack. The remaining eyelet holes provide for haversack drainage.

15. When the indicator of the desiccator turns to a pink colour, the desiccator insert should be removed and dried out, or replaced with a new insert.

NOTE: In order to avoid corrosion damage to the battery pack, the batteries must be removed from the transmitter-receiver when the unit is taken out of service for long periods e.g. storage conditions.

CRYSTAL AGEING

16. All crystals change frequency over a period of time. The close-tolerance high-stability crystals used in the TRA.906 are pre-aged in manufacture but further ageing and consequent frequency drift will occur throught the life of the crystal.

17. It is recommended, therefore, that all crystals in the TRA.906 (including the side-band crystal) are checked and if necessary retrimmed to the correct frequency at least every two months during the first year's use of the equipment. The period between checks may then be increased to six months.

CHAPTER 4

OPERATION

1. Connect the required antenna. For man-portable working the whip antenna is used, while static operation permits the use of either a dipole or long wire antenna. Enhanced performance of the equipment is to be expected from the use of the latter antenna types.

2. Whip antenna

(1) Assemble the sectional whip antenna and insert the antenna plug into the WHIP antenna socket on the control panel.

(2) Where a flexible connector is provided, plug the flexible connector into the WHIP antenna socket, and the antenna plug into the free end of the flexible connector.

NOTE: The whip antenna is most easily assembled by laying the antenna along the ground in a straight line with the antenna plug away from the user. Holding the thinest section of the antenna, draw the centre wire tight, until the sections become interlocked.

3. Long wire antenna

(1) Erect the antenna, using a mast or tree etc.

(2) Connect the antenna plug into the WHIP antenna socket.

(3) Drive the earthing spike into the ground and connect the earth lead to the earth terminal on the control panel.

4. Dipole antenna

(1) Adjust the length of the antenna as required, by reference to the markings provided on the antenna.

(2) Erect the antenna horizontally with the line of the antenna running at right angles to the desired direction of the transmission/reception.

(3) Connect the coaxial feeder plug into the relevant 50Ω coaxial socket on the control panel. The two sockets are clearly marked for the two frequency ranges covered.

(4) Drive the earthing spike into the ground and connect the earthing lead to the earth terminal on the control panel.

5. SSB operation

(1) Connect the handset to either of the AUDIO sockets.

(2) Select the required channel on the CHANNEL switch.

(3) Set the system switch to TUNE.

(4) Adjust the TUNE control for a maximum reading on the meter.

(5) Set the system switch to SSB.

(6) On receive, set the RF GAIN control for the desired level and adjust the CLARIFIER for an undistorted output signal.

(7) To transmit, press the handset switch.

6. AM operation

(1) Connect the handset to either of the AUDIO sockets.

(2) Select the required channel on the CHANNEL switch.

(3) Set the system switch to TUNE.

(4) Adjust the TUNE control for a maximum reading on the meter.

(5) Set the system switch to AM.

(6) In the receive condition, set the RF GAIN control to maximum, adjust the CLARIFIER control for a zero beat and then adjust the RF GAIN control to the desired level.

(7) To transmit, press the handset switch.

7. Telegraphy operation

(1) Connect the headset into one AUDIO socket and the morse key into the other.

(2) Select the required channel on the CHANNEL switch.

(3) Set the system switch to TUNE.

(4) Adjust the TUNE control for a maximum reading on the meter.

(5) Set the system switch to KEY.

(6) In the receive condition, adjust the RF GAIN control for the desired level and adjust the CLARIFIER control for a satisfactory beat note.

(7) To transmit, operate the morse key. A half second delay occurs between the opening of the morse key and the change over to receive condition.

8. Battery Power Check

(1) Select a CHANNEL switch position known to be fitted with a crystal

(2) Set the system switch to TUNE.

(3) Adjust the TUNE control for a maximum reading on the meter.

(4) Set the system switch to KEY and operate the morse key, observing the meter. If the reading falls appreciably when the key is pressed, then the batteries are nearing an unserviceable condition. If the reading falls to 1/3 f.s.d. with the key depressed then if dry batteries are being used they should be replaced. If nickel cadmium cells are in use they should be re-charged.

CHAPTER 5

CIRCUIT DESCRIPTION

1. Certain stages of the transmitter-receiver are common to both send and receive circuits. These items are described under the heading of Common circuits in order to simplify the description.

2. COMMON CIRCUITS (fig. 2)

Channel Oscillator

The channel oscillator (VT 11) uses a modified Colpitts circuit and has a capacity for selection of any one of 29 crystals. Each crystal holder is shunted by a 6 pf trimmer capacitor.

3. The parallel capacitance of the crystal circuit is due, in part, to a 'varicap' diode D15, the bias of which is controlled by the CLARIFIER potentiometer (RV4). This latter control permits adjustment of up to approximately 300Hz, of the oscillator frequency.

4. The channel oscillator operates at a frequency of 8.9985 MHz above the signal frequency for l.s.b. working, or at 9.0015 MHz above signal frequency for u.s.b. working.

5. The output of the channel oscillator is applied to buffer amplifier VT 12, whose load consists of transformer T7. Two outputs are provided by T7, the first being the injection voltage to the receiver balanced mixer and the second being the injection voltage for the transmitter mixer circuit.

6. 9 Mc/s Filter (FL3)

This crystal filter is switched into the send and receive circuits, as appropriate, by the action of the T/R relay RLA and diodes D16 to D23. The filter characteristics are symmetrical about 9 MHz, over a bandwidth of 2400 Hz.

7. With the relay in the 'receive' condition, contacts A2 apply a forward bias to diodes D16, D17, D20 and D21 and a reverse bias to the send circuit diodes D18, D19, D22 and D23. This circuit action effectively connects the receive circuit to the filter and isolates the send circuit from the filter. The reverse action takes place when relay RLA is in the 'transmit' condition.

8. Carrier Oscillator

The carrier oscillator is used to provide carrier signals for the receiver detector and the transmitter balanced modulator. The circuit configuration is similar to that of the channel oscillator, the major difference being that only one crystal is employed.

9. The oscillator (VT 13) output is applied to buffer amplifiers VT 14 and VT 15, the former then providing the carrier signal for the receive circuit detector, while the latter provides the carrier for the transmit balanced modulator.

10. The oscillator operates at a frequency of 8.9985 MHz for l.s.b. working or at 9.0015 MHz for u.s.b. working. A preset trimmer capacitor C87 is connected across the crystal socket.

11. Voltage Regulator

This comprises a series regulator circuit of transistor VT 10 and zener diode D8. The battery power supply at 17.5 volts is applied via resistor R46 (1Kohm) to zener diode D8 which then holds the base voltage of VT 10 constant at a nominal 10 volts. The output voltage taken from the emitter of VT 10, will be the difference between this 10 volts reference and the base/emitter voltage drop, i.e. approximately 9.5 volts'.

12. The regulator circuit thus provides a constant level of voltage to the relevant circuits during the discharge cycle of the battery power supply.

13. Aerial tuning circuit

This circuit comprises a variable inductor L1, connected in series with the aerial. The inductor tunes with equivalent capacitance of the whip aerial, or, in the case of dipole aerials, with fixed capacitors C41 or C42. The selection of capacitance is dependent upon the frequency range in use, 2 to 5 or 5 to 7 MHz, this being a requirement in order that the loaded Q factor of the circuit is maintained. Tuning of the inductor is achieved by a ferrite and aluminium core whose position is set by the TUNE control.

14. RECEIVER

In the 'receive' condition of the T/R relay RLA, contacts A1 transfer the aerial from the transmitter output circuit to the r.f. amplifier stage VT1. The input circuit of this stage is shunted by diodes D1A and D1B, these functioning as limiters to protect the transistor against excessive input signals. The diodes provide protection up to approximately 20 volts of r.f. input.

15. The amplifier load comprises transformer T1 whose secondary is connected to the input of the 7 MHz filter FL1. This filter attenuates signals above 7 MHz. Gain of the amplifier is controlled by the RF GAIN potentiometer RV2 which sets the base bias of VT1. The h.t. line to VT1 is taken from the regulated output of the voltage regulator circuit.

16. Mixer

This comprises a balanced mixer circuit, using transistors VT2 and VT3. The differential input to the circuit is obtained from the output of filter FL1. The parallel input, at 8.9985 MHz (l.s.b.) or 9.0015 MHz (u.s.b.) above the signal input frequency, is derived from the channel oscillator circuit.

17. The desired intermediate frequency of the receiver is at nominally 9 MHz, this being the difference frequency between the parallel and differential input signals.

In order that a second harmonic of a 4.5 MHz input signal does not cause interference at the i.f., the input circuit includes potentiometer RV 1, which is adjusted to give a minimum response of the input circuit to 9 MHz (second harmonic of 4.5 MHz).

18. Diodes D1 and D2 in the mixer circuit are included to reduce the effects of cross-modulation in the mixer. The output signals from the mixer output transformer are applied to the 9 MHz crystal filter FL3.

19. I.F. Amplifier

This comprises a two-stage amplifier using transistors VT4 and VT6, fixed neutralisation of the transistors being achieved by capacitors C18 and C26 respectively.

20. The gain of VT4 is controlled by RV 2 which sets its base bias while the gain of VT6 is a result of negative feedback in its emitter circuit. The decoupling effect of series connected C27 and VT5 is dependent upon the conduction of VT5. Since the base current to this transistor is set by RV2, the level of negative feedback is also controlled by RV2.

21. The input signals to the first i.f. stage are obtained from the output of filter FL3. The amplified output signals from the i.f. amplifier are connected via transformer T5 to the receiver detector circuit.

22. Detector

This is a form of ring detector which obtains its carrier signal input at 8.9985 MHz or 9.0015 MHz from the carrier oscillator. This signal is applied between the junction of resistor R31 and R32 and earth. The products of the detector are applied via the low pass filter R33 - C32 to the input of the audio frequency amplifier.

23. A.F. Amplifier

The a.f. amplifier employs transistors VT 7, VT 8 and VT 9, transistors VT 7 and VT 8 being arranged as a feedback pair. The output of VT 8 is applied to the base of VT 9 which operates as an emitter follower. The low impedance output resulting from this circuit ensures that the power level in the telephone earpieces does not diminish when further headsets are parallel connected.

24. The output of VT 9, developed across R43, is connected via capacitor C40 and high frequency choke L2 to pin F of the AUDIO sockets. This output is also connected to pin 2 of plug PL5 and thence to the terminal block in the base of the main case. This output is available for use with an external loudspeaker amplifier.

25. TRANSMITTER (fig. 2)

The transmitter circuit of the TRA. 906 consists of an a.f. amplifier, balanced modulator, i.f. amplifier, mixer amd wideband amplifier stages. The r.f. signal requirements of the transmitter circuit are met by the carrier and channel oscillators.

26. A.F. Amplifier

This amplifier uses transistors VT24 and VT25 arranged as summing amplifiers which cater for multiple inputs.

27. Two identical input circuits are provided to transistor VT25, these being connected to sockets SK6 and SK7. (pin A in each case). This arrangement permits either socket to be used for an external microphone-telephone handset.

28. The output of VT25 is connected via capacitor C128 to the SET MOD LEVEL potentiometer RV8, whose wiper contact is connected to the input circuit of VT24. A connection is also made from the output of VT25 via C128 and C35 to the receiver a.f. amplifier, this circuit providing side-tone facilities.

29. The input circuit of transistor VT24 has, in addition to the signal from VT25, a connection to the output of the tone oscillator VT16 and VT17. This latter input is used during telegraphy (KEY) operation when the tone oscillator signal is used to produce a single sideband signal from the transmitter.

30. Tone Oscillator

The tone oscillator circuit uses transistors VT16 and VT17 arranged as a Wien oscillator. The oscillator is used on TUNE operation and when KEY operation is required, this being controlled by the action of the morse key. This latter action connects the emitter of VT16 to earth to complete the oscillatory circuit.

31. The oscillation starting condition of the circuit is controlled by the potentiometer RV5. The frequency of operation is approximately 1000Hz.

32. Balanced modulator

This circuit is made up of diodes D28a and D28b connected in a bridge circuit. The input signals are obtained from the secondary of transformer T11, across which appears the carrier oscillator output and into which is connected the audio signal output of V24.

33. The sum and difference frequency outputs of the modulator (carrier oscillator frequency ± audio frequency) are connected via diodes D22 and D23 to the 9 MHz crystal filter. The output of the filter is connected via diodes D18 and D19 to the input of the transmitter i.f. amplifier. It should be noted that diodes D18, D19, D22 and D23 are only forward biassed when the T/R relay is in the transmit condition.

34. Balancing of the modulator circuit is achieved by potentiometer RV6 and capacitors C122 and C123, the latter being variable.

35. I.F. Amplifier

The transmit i.f. amplifier is a single stage amplifier using transistor VT23. The input signal is obtained from the filter FL3 and comprises signals equal to the sum of the carrier oscillator frequency and the audio input frequencies. The amplifier stage is

fixed neutralised by capacitor C117 and develops its output across transformer T15.

36. Mixer

The mixer stage comprises of a series mixer using diodes D24 to D27. The input signals for the mixer stage are provided by the output of the i.f. amplifier, via T15 and the output of the channel oscillator.

37. The output signals of the mixer stage are applied to filter FL2, this being a low pass filter which attenuates all signals above 7 MHz. The filter output constitutes the drive to the succeeding wideband power amplifier.

38. Wideband Amplifier

This circuit comprises transistors VT20, VT21 and VT22, the former pair being connected as a feedback pair, while the output of VT20 provides the drive to the push pull power amplifier stage of VT18 and VT19. Diode D23A, connected in the base to earth circuits of the push-pull amplifier transistors VT18 and VT19, is included to provide correct base bias. The variation of forward voltage drop of the diode with temperature variations, is used to ensure the correct bias value over a wide range of ambient temperatures.

39. The power supply to the collector of the driver (VT20) and the final push pull stage is unregulated and is obtained from the battery power supply at the input to the voltage regulator circuit. The final amplifier uses the wideband transformer T12 as its load, the secondary of the transformer being connected via current transformer T6 (aerial monitoring) and the contacts A1 of the T/R relay to the aerial circuit.

40. Monitoring

Meter M1 is used, in conjunction with the system switch SB and the aerial current monitor circuit, to provide indication of battery power supply level and transmitter output level.

41. With SB set to SSB, KEY or AM positions, wafer SB2B connects the meter between the battery line and earth. In the TUNE position of SB, the meter is connected by wafer SB2B to the output of the aerial current monitor circuit T6, D7, R44, R45 and C43. Under these latter conditions the meter indicates the magnitude of the aerial current.

42. Telegraphy mode (KEY)

With the system switch set to the KEY position, the emitter of transistor VT16 in the tone oscillator is connected to pins E of both AUDIO sockets. With the morse key connected, operation of the key produces a circuit to earth for the emitter of VT1, via pin D of the AUDIO sockets.

43. This earth circuit, in addition to the operation of the tone oscillator also operates the T/R relay RLA to "transmit". A delay of approximately one second occurs between the lifting of the morse key and the changeover of the relay, back to the 'receive' condition.

44. A M Mode

The transmitter-receiver operates in the same manner as for s.s.b. with the exception that a re-inserted carrier signal is fed into the transmitter i.f. amplifier stage (VT23). This re-insertion of the carrier produces the compatible a.m. mode.

45. System Switch

This 2 wafer, 5 position rotary switch is used to select the required mode of operation of the transmitter receiver. The switch wafers are referenced as SB1 and SB2, numbered from the panel end of the spindle. Each wafer is further sub-divided into SB1B (back) and SB1F (front), and each side of each wafer has 12 contacts, as given on fig. 2. The functions of the switch contacts are given below:-

a) SSB position

Wafer	Tags	Function
SB1B	11 and 5	Completes power supply circuit.
SB1F		nil
SB2B	11 and 2	Connects meter across power supply.
SB2F	6 and 8	Connects PTT circuit between AUDIO sockets (SK6 and SK7) pins C and relay RLA.

b) KEY position

SB1B	11 and 5	Completes power supply circuit.
SB1F	9 and 6	Connects pins E of AUDIO sockets to tone oscillator.
SB2B	11 and 2	Connects meter across power supply.
SB2F	6 and 9	Connects AUDIO sockets, pins E via SB1B to relay RLA.
SB2F	12 and 3	Connects C.48 and R.48 across relay RLA coil.

c) A M position

SB1B	11 and 5	Completes power supply circuit.
SB1F	12 and 4	Connects collector of VT 15 via C20 to i.f. amplifier VT23 to provide re-inserted carrier.
SB2B	11 and 2	Connects meter across power supply.
SB2F	6 and 10	Connects PTT circuit between AUDIO sockets pins C and relay RLA.

d) TUNE position

Wafer	Tags	Function
SB1B SB1F	11 and 5 6 and 11	Completes power supply circuit. Earths the emitter of VT16 in tone oscillator. The oscillator then functions to provide an audio signal for the TUNE condition.
SB2F	6 and 11	Connects an 'earth' to operate relay RLA to 'transmit' condition.
SB2B	11 and 5	Connects the meter across the aerial current monitor circuit.

CHAPTER 6

MAINTENANCE

Introduction

1. The following details of tests on the various stages of the equipment, are intended for use on periodic maintenance and inspection. They should also be referred to in the case of fault conditions, when the performance of a stage (or stages) is suspect.

Test Equipment

2. The items of test equipment listed below are required in order that the tests detailed in this chapter may be carried out:

(a)	Multimeter e.g. AVO Model 8.	
(b)	Test Set. Racal CA.470B	
(c)	AF Power Output meter	Input Impedance - 300 Ω . Range - 5 mW. e.g. Marconi TF893A.
(d)	Oscilloscope	Frequency Range: 0-15 MHz minimum. Sensitivity: 100 mV/cm.
(e)	Frequency Counter	Frequency Range: 0-15 MHz minimum . e.g. Racal SA.535 plus SA.548.
(f)	Valve Voltmeter	Frequency Range: 200 Hz to 16 MHz minimum. Input Voltage: 100 mV minimum.
(g)	AF Signal Generator	Frequency Range: 100 Hz to 20 kHz minimum.
(h)	RF Signal Generator	Frequency Range: 2 to 25 MHz, minimum. e.g. Marconi TF 144H.
(j)	RF Power Meter (Not required if Test Set CA.470B is used).	Frequency Range: up to 7 MHz minimum. Input Impedance: 50 Ω . Power range: 1 to 10 watts.

Initial Procedure

3. (1) Ensure that the system switch is set to the OFF position.

(2) Remove the transmitter-receiver unit from its container and disconnect the power supply lead from PL5.

(3) Place a shorting link between terminals 3 and 4 of PL5.

(4) Insert the required channel crystals. Channel crystals to obtain channel frequencies of 2 MHz and 7 MHz should be included if possible, i.e. 10.9985 MHz and 15.9985 MHz for l.s.b. working or 11.0015 MHz and 16.0015 MHz for u.s.b. working.

(5) Connect the test set (item b) to one of the AUDIO sockets of the control panel.

(6) Set the test set TRANS/REC switch to REC.

(7) Set the system switch on the control panel to SSB and check that the control panel meter indicates approximately 80% of full scale deflection.

(8) Set the multimeter (item a) to the 10V d.c. range and measure the voltage between the emitter of VT10 (positive) and terminal 1 of plug PL5. A reading of between 9 volts and 10 volts should be obtained.

(9) Connect the AF power output meter (item c) across the AF OUT terminals of the test set.

CARRIER OSCILLATOR

4. (1) Set the system switch to SSB.

(2) Connect the frequency counter (item e) between test point TP3 and terminal 1 of PL5.

(3) Adjust trimmer capacitor C87 to obtain an indicated frequency on the frequency counter of 8.9985 MHz (or 9.0015 MHz if the carrier crystal has been so selected for u.s.b. operation).

(4) Disconnect and remove the frequency counter.

(5) Connect the valve voltmeter between TP3 and terminal 1 of PL5. The voltage indicated should be 0.8 volts minimum.

(6) Disconnect the valve voltmeter.

CHANNEL OSCILLATOR

5. (1) Connect the multimeter, set to the 2.5V d.c. range, between the wiper contact of potentiometer RV4 and terminal 1 of PL5.

(2) Adjust the CLARIFIER control to obtain a reading of 1.25 volts on the multimeter.

(3) The 'hairline' on the CLARIFIER knob should now be lined up with the raised zero mark on the control panel. If it does not, loosen the knob grubscrews and correctly position the knob. To facilitate this operation a shallow indentation is provided on the skirt of the knob. If the knob is pressed in, against the slight spring load of the potentiometer spindle, the indentation will lock on to the raised zero point and enable the grub-screws to be tightened without disturbing the spindle position.

(4) After tightening the grubscrews, re-check that the voltage indicated is still 1.25 volts.

(5) Disconnect the multimeter and connect the frequency counter between TP2 and earth.

(6) With the CLARIFIER set to the zero position, adjust the trimmer capacitor of each fitted crystal position of the CHANNEL switch to obtain the nominal frequency of each crystal, as shown on the counter.

(7) Adjust the CLARIFIER control over its complete range, on each position of the CHANNEL switch, checking that approximately 300 Hz variation of frequency of each crystal is obtained.

(8) Disconnect the frequency counter and connect the valve voltmeter in its place.

(9) Return the CLARIFIER control to zero and verify that at all positions of the CHANNEL switch, the voltage indicated is 0.2 volts minimum.

RECEIVER AF AMPLIFIER - RESPONSE

6. (1) Set the a.f. power output meter to the 300 ohms, 10 mW range.

(2) Connect the a.f. signal generator, set to 1 kHz, between TP4 and earth.

(3) Connect the valve voltmeter across the output terminals of the a.f. signal generator.

(4) Set the a.f. signal generator output level to obtain a 4 mW indication on the a.f. power output meter. This output power should be obtained with an a.f. signal generator output of 12 mV maximum as indicated on the valve voltmeter.

(5) Re-adjust the a.f. signal generator output level so as to obtain a 1 mW indication on the a.f. power meter. This power level should be obtained with an a.f. signal generator output of 6 mV maximum.

(6) Adjust the frequency of the a.f. signal generator above and below 1 kHz and note the frequencies at which the a.f. output falls by 3 dB relative to 1 mW. These frequencies should be 250 Hz minimum and 10 kHz maximum.

(7) Disconnect the signal generator and valve voltmeter.

RECEIVER IF AMPLIFIER

7. NOTE: Only the correct long-bladed trimming tool is to be used for the core adjustment of the i.f. transformers.

(1) Connect the r.f. signal generator, set to 9 MHz, to TP1.

(2) Set the RF GAIN control and potentiometer RV3, fully clockwise.

(3) Tune transformers T4 and T5 for a maximum indication on the a.f. power meter.

(4) Adjust the r.f. signal generator output to obtain a 1mW level on the a.f. power meter.

(5) Observe the output e.m.f. of the r.f. signal generator which should be not more than 15 μV.

(6) Check that the i.f. response is approximately symmetrical about 9 MHz.

(7) Disconnect the r.f. signal generator.

RECEIVER SENSITIVITY and SIGNAL/NOISE RATIO

8. (1) Connect the r.f. signal generator, set to 4.5 MHz, to socket SK3 (2 - 5 MHz).

(2) Connect the valve voltmeter across the terminals of the a.f. power meter.

(3) Set the CHANNEL switch to obtain a channel frequency of 2 MHz (channel crystal = 10.9985 MHz for l.s.b. or 11.0015 MHz for u.s.b.). If such crystals are not available, use the nearest channel frequency to 2 MHz that is available.

(4) Adjust potentiometer RV1 for a minimum indication on the a.f. power meter, increasing the r.f. signal generator output as necessary, to ensure that the absolute minimum is obtained.

(5) Set the r.f. signal generator to 2 MHz (or nearest, see operation (3)) and adjust the TUNE control for maximum a.f. output.

(6) Adjust the r.f. signal generator output to obtain a 1 mW a.f. output level. This should be obtained with an r.f. signal generator e.m.f. of 2 μV maximum. Note the valve voltmeter reading.

(7) Interrupt the r.f. signal generator output and note the residual reading on the valve voltmeter. The ratio of the valve voltmeter reading noted in operation (6) to this residual reading should be at least 15 dB.

(8) Repeat operations (5) to (7) inclusive at a frequency of 7 MHz (or nearest available).

(9) Disconnect the valve voltmeter.

RECEIVER SELECTIVITY

9. (1) Connect the frequency counter across the a.f. power meter.

(2) Adjust the frequency of the r.f. signal generator above and below the frequency used in para. 8 (8) above, until the a.f. output reduces by 6 dB.

(3) The frequencies at which the a.f. output falls by 6 dB should be 300 Hz to 350 Hz and 2.4 kHz to 2.6 kHz, as observed on the frequency counter.

(4) Disconnect the counter.

RF GAIN CONTROL

10. (1) Retune the r.f. signal generator to the frequency referred to in para. 8 (8) and adjust the output level to obtain an r.f. generator e.m.f. of 64 mV.

(2) Check that by rotating the RF GAIN control anti-clockwise, the a.f. output can be reduced to 1 mW.

(3) Connect the mic/tel. handset to the free AUDIO socket and reduce the r.f. signal generator e.m.f. to 2 μV.

(4) Slowly turn the RF GAIN control to maximum and, with the handset earpiece, check that the potentiometer track is noise free.

RECEIVER SPURIOUS RESPONSE CHECK

11. 4.5 MHz Check

(1) Set the r.f. signal generator to 2 MHz and the CHANNEL switch to obtain a 2 MHz (or nearest) channel frequency.

(2) Adjust the TUNE control for a maximum a.f. output.

(3) Retune the r.f. signal generator to 4.5 MHz and adjust RV1 for a minimum a.f. output.

(4) Adjust the r.f. signal generator output to obtain a 1 mW a.f. output level. The signal generator e.m.f. should be 680 μV minimum.

(5) Repeat the measurement of (4) with the receiver tuned to 7 MHz or the nearest channel frequency to 7 MHz available.

I.F. Breakthrough

(6) Set the CHANNEL switch to obtain a channel frequency of 2 MHz.

(7) Tune the r.f. signal generator to 9 MHz and adjust its output level to obtain a 1 mW a.f. output. The generator e.m.f. for this level of a.f. should be 680 μV minimum.

(8) Repeat operations (6) and (7) with the CHANNEL switch set to obtain a channel frequency of 7 MHz.

Image Check

(9) Reset the CHANNEL switch to obtain the 2 MHz channel frequency (or nearest).

(10) Tune the r.f. signal generator to approximately 20 MHz and adjust the generator output to obtain a 1 mW a.f. output level. The generator output e.m.f. required to obtain this a.f. level should be not less than 6 mV. If a frequency close to 2 MHz is used, the r.f. signal generator should be tuned to a frequency of twice the i.f. i.e., 18 MHz, plus the channel frequency to be used.

(11) Re-set the CHANNEL switch to obtain a channel frequency of 7 MHz (or nearest available).

(12) Retune the r.f. signal generator to 25 MHz (or to 18 MHz plus the channel frequency available in (11)) and adjust its output to obtain an a.f. output of 1 mW. This level should be obtained by a generator e.m.f. of not less than 6 mV.

Unwanted Sideband

(13) Connect the frequency counter across the terminals of the a.f. power meter.

(14) With the channel frequency of 7 MHz (or nearest available) still set, adjust the r.f. signal generator frequency to obtain a 1 mW a.f. output level at 1 kHz in the unwanted sideband. This 1 mW level should be obtained with an r.f. generator e.m.f. of not less than 100 μV.

TRANSMITTER AF AMPLIFIER

12. (1) Set the CHANNEL switch to a non-crystalled position.

(2) Connect the a.f. signal generator to the AF IN terminals of the test set.

(3) Connect the valve voltmeter across capacitor C121. Set RV8 fully clockwise.

(4) Set the test set switch to "TRANS".

(5) Set the output level of the a.f. signal generator to give a valve voltmeter reading of 200 mV at 1 kHz. The signal generator output level required to obtain this reading should be not more than 12 mV.

(6) Vary the frequency of the a.f. generator above and below 1 kHz until the voltmeter reads - 3 dB relative to 200 mV. The frequencies at which this occurs should be 200 Hz minimum and 10 kHz maximum.

SIDETONE (Telephony)

13. (1) Set the a.f. generator output to obtain a reading of 200 mV on the valve voltmeter.

(2) Transfer the valve voltmeter to measure the receiver a.f. output by connecting it accross the terminals of the a.f. power meter (still connected as in para. 3 (11) and set for 300 ohms).

(3) Measure the sidetone voltage level which should be at least 6 mV.

(4) Disconnect the a.f. signal generator.

TONE GENERATOR and TELEGRAPHY SIDETONE

14. (1) Connect the oscilloscope between TP5 and chassis.

(2) Set the system switch to TUNE.

(3) Adjust RV5 until oscillations commence.

(4) Continue to adjust RV5 until a sinusoidal display is obtained.

(5) Disconnect the oscilloscope.

(6) Measure the sidetone voltage as indicated on the valve voltmeter (still connected as in para. 13 (2)). This should be not less than 10 mV.

(7) Disconnect the valve voltmeter.

CARRIER BALANCE

15. (1) Connect the oscilloscope between the collector of VT23 and chassis.

(2) Set the system switch to SSB.

(3) Check that a clear display at 9 MHz is obtained on the oscilloscope.

(4) Adjust RV6 and C123 for the minumum amplitude of the displayed waveform.

(5) Disconnect the oscilloscope, and set the system switch to OFF.

TRANSMITTER POWER OUTPUT (CW)

16. (1) Connect the r.f. power meter (or the 50Ω socket of the Test Set CA.470B) to socket SK3 (2 - 5 MHz).

(2) Set the CHANNEL switch to obtain a channel frequency of 2 MHz (or nearest available).

(3) Connect the oscilloscope across socket SK3.

(4) Set the system switch to TUNE.

(5) Adjust the TUNE control for a maximum indication on the r.f. power meter. Set RV7 for an r.f. output of not less than 5W.

(6) Set the system switch to OFF.

(7) Transfer the oscilloscope and r.f. power meter to SK4 (5 - 7 MHz) and select a channel frequency of 7 MHz (or nearest available).

(8) Set the system switch to TUNE and adjust the TUNE control for a maximum r.f. output. This should be at least 5 watts.

ANSMITTER OUTPUT (AM)

(1) Set the system switch to OFF.

(2) Set the CHANNEL switch to obtain a 2 MHz (or nearest available) channel frequency.

(3) Connect the r.f. power meter across socket SK3.

(4) Set the system switch to TUNE and adjust the TUNE control for a maximum output.

(5) Set the system switch to AM. A power output of at least 1 watt should be obtained, without re-adjustment of the TUNE control and then return the system switch to OFF.

(6) Transfer the r.f. power meter to across socket SK4, set the CHANNEL switch to 7 MHz (or nearest available) channel frequency and repeat operations (4) and (5) to again obtain a 1 watt output.

CHAPTER 7

FAULT FINDING

1. The most common failing of this type of equipment is due to discharged battery power supplies. As a consequence, the power supplies should be checked first in the event of a deterioration in performance.

2. The next possible failure points to consider are due to poor external connections. These may occur due to the local conditions of use, e.g. whip antenna being damaged, handset leads strained. Faults of this nature can affect the performance to the extent of say, no transmission due to a press-to-transmit circuit breakage, etc.

3. The press-to-transmit circuit can be checked by setting the system switch to TUNE, or to KEY and operation of the morse key. Should the transmitter then function, the fault lies in either the handset switch or the connection to the AUDIO socket in use. This can be verified by changing the handset to the alternative AUDIO socket.

4. An antenna fault will be indicated by weak received signal levels and an inability of the antenna tuning circuit to respond to the adjustment of the TUNE control.

5. The following table is included as a guide to the elimination of certain stages as being faulty. If a malfunction has occurred and the fault cannot be diagnosed by using the table, the the unit must be opened up and normal fault finding procedure carried out. Reference to paragraph 6 of this chapter amd to Chapter 6 for details of performance will aid in further diagnosis.

SUSPECT CIRCUIT	COMMENT	ACTION
(a) CHANNEL OSCILLATOR	Serviceable if either receiver or transmitter functions.	Change to another channel to check if both receiver and transmitter fails.
(b) CARRIER OSCILLATOR	As above.	-
(c) TONE OSCILLATOR	Can cause failure of TUNE or KEY operations.	Check on headset for sidetone when on KEY Position with morse key pressed, or when the TUNE condition is used.
(d) ANTENNA	Weak received signals or failure of antenna tuning circuit.	Check physically.
(e) AUDIO SOCKETS	These are parallel connected.	Change external connection to alternative AUDIO socket

INJECT CIRCUIT	COMMENTS	ACTION
(f) PRESS-TO-TRANSMIT	The external circuit is formed by the handset connector and switch.	Set the system switch to TUNE, or to KEY and operate the morse key. If the transmitter functions, transfer the handset to the other AUDIO socket. If still not functioning, check that a d.c. path occurs between pins C and D of plug PL7 when the handset switch is operated.
(g) MORSE KEY	When operated, the key operates the T/R relay and the TONE OSCILLATOR.	Set the system switch to TUNE. If the transmitter functions, suspect the morse key connector. Check physically and change to the alternative AUDIO socket. Set the system switch to KEY and operate the morse key. If sidetone occurs with no transmit state, the morse key is serviceable and the T/R relay is suspect. Confirm this by setting the system switch to SSB and operating the handset switch.

6. Static voltage checks

The d.c. voltages quoted below are measured under no-signal conditions using an AVO model 8 multimeter. All readings are measured between the points quoted and earth and are therefore positive with respect to earth. Except where otherwise indicated, the system switch should be set to SSB.

Test point	Level	Test point	Level
VT1 base	1.7V	VT13 collector	9.5V
VT1 emitter	1.0V	VT14 base	2.5V
VT2 base	1.4V	VT14 collector	7.8V
VT3 base	1.4V	VT14 emitter	1.9V
VT2 emitter	0.7V	VT15 base	2.8V
VT3 emitter	0.7V	VT15 collector	9.5V
Junction C10-R12	5.0V	VT15 emitter	2.1V
VT4 base	1.7V	VT16 collector	* 1.5V
Junction R20-R21	1.0V	VT16 base	* 0.67V
VT6 base	2.3V	VT17 collector	* 6.0V

Test point	Level	Test point	Level
VT6 emitter	1.6V	Junction R79-D23A	0.7V
VT7 collector	3.5V	VT20 collector	17.5V
VT7 emitter	0.25V	VT20 emitter	2.1V
VT8 collector	6.2V	VT20 base	2.8V
VT8 emitter	2.8V	VT21 emitter	1.1V
VT9 emitter	5.5V	VT21 base	1.8V
VT9 collector	8.7V	VT22 collector	4.5V
VT10 emitter	9.5V	VT22 base	3.5V
Junction R46-R47	17.5V	VT22 emitter	2.8V
PL5, pin 5	18.0V	VT23 collector	8.5V
VT11 collector	8.5V	VT23 emitter	1.7V
VT11 emitter	7.0V	VT23 base	2.4V
VT12 base	5.2V	VT24 collector	0.5V
VT12 collector	7.8V	VT24 base	0.3V
VT12 emitter	4.5V	VT25 collector	0.7V
VT13 emitter	6.5V	VT25 base	0.58V

* System switch set to TUNE position

Extreme care must be taken to avoid a short-circuiting of emitter resistor R82 when measuring the emitter voltage of transistor VT20. This short-circuiting action will result in the destruction of VT20.

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Racal Part No.
Resistors					
R1	100	Composition	¼	10	919899
R2	10k	Composition	¼	10	919916
R3	3.9k	Composition	¼	10	919912
R4	1k	Composition	¼	10	919907
R5	1k	Composition	¼	10	919907
R6	270	Composition	¼	10	919902
R7	270	Composition	¼	10	919902
R8	3.3k	Composition	¼	10	919911
R9	3.3k	Composition	¼	10	919911
R10	3.3k	Composition	¼	10	919911
R11	Not Used				
R12	470	Composition	¼	10	919905
R13	100	Composition	¼	10	919899
R14	820	Composition	¼	10	919906
R15	820	Composition	¼	10	919906
R16	10k	Composition	¼	10	919916
R17	3.9k	Composition	¼	10	919912
R18	100	Composition	¼	10	919899
R19	100	Composition	¼	10	919899
R20	100	Composition	¼	10	919899
	or				
	47	Composition	¼	10	919896
R21	1k	Composition	¼	10	919907
R22	10k	Composition	¼	10	919916
R23	100	Composition	¼	10	919899
R24	10k	Composition	¼	10	919916
R24A	1.5k	Composition	¼	10	919908
R25	3.9k	Composition	¼	10	919912
R26	100	Composition	¼	10	919899
R27	100	Composition	¼	10	919899
R28	1k	Composition	¼	10	919907
R29	100	Composition	¼	10	919899

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Racal Part No.
Resistors (contd.)					
R30	100	Composition	$\frac{1}{4}$	10	919899
R31	470	Composition	$\frac{1}{4}$	10	919905
R32	470	Composition	$\frac{1}{4}$	10	919905
R33	1k	Composition	$\frac{1}{4}$	10	919907
R34	22k	Composition	$\frac{1}{4}$	10	919920
R35	47k	Composition	$\frac{1}{4}$	10	919923
R36	3.3k	Composition	$\frac{1}{4}$	10	919911
R37	68	Composition	$\frac{1}{4}$	10	919897
R38	68	Composition	$\frac{1}{4}$	10	919897
R39	18k	Composition	$\frac{1}{4}$	10	919919
R40	1k	Composition	$\frac{1}{4}$	10	919907
R41	470	Composition	$\frac{1}{4}$	10	919905
R42	68	Composition	$\frac{1}{4}$	10	919897
R43	470	Composition	$\frac{1}{2}$	10	902431
R44	100	Composition	$\frac{1}{4}$	10	919899
R45	12k	Composition	$\frac{1}{4}$	10	919917
R45A	22	Composition	$\frac{1}{4}$	10	919895
R46	1k	Composition	$\frac{1}{4}$	10	919907
R47	120k	Composition	$\frac{1}{4}$	10	919926
R48	220	Composition	$\frac{1}{4}$	10	919901
R49	47k	Composition	$\frac{1}{4}$	10	919923
R49A	47k	Composition	$\frac{1}{4}$	10	919923
R50	15k	Composition	$\frac{1}{4}$	10	919918
R51	1k	Composition	$\frac{1}{4}$	10	919907
R52	15k	Composition	$\frac{1}{4}$	10	919918
R53	27k	Composition	$\frac{1}{4}$	10	919921
R54	1.8k	Composition	$\frac{1}{4}$	10	919909
R55	10k	Composition	$\frac{1}{4}$	10	919916
R55A	47k	Composition	$\frac{1}{4}$	10	919923
R56	100	Composition	$\frac{1}{4}$	10	919899
R57	2.2k	Composition	$\frac{1}{4}$	10	919910
R58	10k	Composition	$\frac{1}{4}$	10	919916
R59	270	Composition	$\frac{1}{4}$	10	919902
R60	10k	Composition	$\frac{1}{4}$	10	919916
R61	100	Composition	$\frac{1}{4}$	10	919899

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Racal Part No.
Resistors (contd.)					
R62	22k	Composition	¼	10	919920
R62A	100	Composition	¼	10	919899
R63	4.7k	Composition	¼	10	919913
R63A	33k	Composition	¼	10	919922
R64	5.6k	Composition	¼	10	919914
R65	12k	Composition	¼	10	919917
R66	10k	Composition	¼	10	919916
R67	10k	Composition	¼	10	919916
R68	10k	Composition	¼	10	919916
R69	100	Composition	¼	10	919899
R70	470	Composition	¼	10	919905
R71	10k	Composition	¼	10	919916
R72	100	Composition	¼	10	919899
R73	470	Composition	¼	10	919905
R74	6.8k	Composition	¼	10	919915
R75	5.6k	Composition	¼	10	919914
R76	5.6k	Composition	¼	10	919914
R77	56k	Composition	¼	10	919924
R77A	1.5k	Composition	¼	10	919908
R78	1	W.W. Vitreous	2½ ~~1½~~	10	~~903630~~ 911767
R79	270	Composition	¼	10	919902
R80	Not Used				
R81	100	Composition	¼	10	919899
R82	47	Composition	½	10	902419
R83	100	Composition	¼	10	919899
R84	3.9k	Composition	¼	10	919912
R85	18k	Composition	¼	10	919919
R86	470	Composition	¼	10	919905
R87	47	Composition	¼	10	919896
R88	100	Composition	¼	10	919899
R89	100	Composition	¼	10	919899
R90	1k	Composition	¼	10	919907
R91	1k	Composition	¼	10	919907
R92	10k	Composition	¼	10	919916
R93	470	Composition	¼	10	919905

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Racal Part No.
Resistors (contd.)					
R94	10k	Composition	¼	10	919916
R95	100	Composition	¼	10	919899
R96	82	Composition	¼	10	919898
R97	100	Composition	¼	10	919899
R98	100	Composition	¼	10	919899
R99	1k	Composition	¼	10	919907
R99A	22	Composition	¼	10	919895
R100	10k	Composition	¼	10	919916
R101	3.9k	Composition	¼	10	919912
R102	820	Composition	¼	10	919906
R103	2.2k	Composition	¼	10	919910
R104	820	Composition	¼	10	919906
R105	120	Composition	¼	10	919900
R106	100	Composition	¼	10	919899
R107	100	Composition	¼	10	919899
R108	10k	Composition	¼	10	919916
R109	47k	Composition	¼	10	919923
R110	4.7k	Composition	¼	10	919913
R111	4.7k	Composition	¼	10	919913
R112	10k	Composition	¼	10	919916
R113	10k	Composition	¼	10	919916
R114	10k	Composition	¼	10	919916
R115	27k	Composition	¼	10	919921
R116	10k	Composition	¼	10	919916
R117	10k	Composition	¼	10	919916
R118	1k	Composition	¼	10	919907
R119	1k	Composition	¼	10	919907
Potentiometers					
RV1	1k	Linear			919516
RV2	25k	Linear (R.F. Gain)			909939
RV3	100k	Linear (I.F. Gain)			919512
RV4	25k	Linear (Clarifier)			909939
RV5	4.7k	Linear (Tone osc.)			919511

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Racal Part No.
Potentiometers (contd.)					
RV6	470	Linear (Balance Pot.)			919514
RV7	4.7k	Linear (Set tone level)			919511
RV8	4.7k	Linear (Set mod. level)			919511
RV9	22k	Linear			919517
Capacitors			V.		
C1	.01μF	Disc ceramic	250	-20 +40	916187
C1A	470pF	Polystyrene	125	2½	909893
C2	4.7μF	Tantalum	35	20	914026
C3	.01μF	Disc ceramic	250	-20 +40	916187
C4	.01μF	Disc ceramic	250	-20 +40	916187
C5	.01μF	Disc ceramic	250	-20 +40	916187
C6	.01μF	Disc ceramic	250	-20 +40	916187
C7	.01μF	Disc ceramic	250	-20 +40	916187
C8	.01μF	Disc ceramic	250	-20 +40	916187
C9	.01μF	Disc ceramic	250	-20 +40	916187
C10	.01μF	Disc ceramic	250	-20 +40	916187
C11	.01μF	Disc ceramic	250	-20 +40	916187
C11A	.01μF	Disc ceramic	250	-20 +40	916187
C12	.01μF	Disc ceramic	250	-20 +40	916187
C13	.01μF	Disc ceramic	250	-20 +40	916187
C14	.01μF	Disc ceramic	250	-20 +40	916187
C15	.01μF	Disc ceramic	250	-20 +40	916187
C16	.01μF	Disc ceramic	250	-20 +40	916187
C17	.01μF	Disc ceramic	250	-20 +40	916187
C18	2.2pF	Disc ceramic	500	±½pf	916834
C19	.01μF	Disc ceramic	250	-20 +40	916187
C20	82pF	Polystyrene	125	2½	910826
C21	4.7μF	Tantalum	35	20	914026
C22	.01μF	Disc ceramic	250	-20 +40	916187
C23	.01μF	Disc ceramic	250	-20 +40	916187

Cct. Ref.	Value	Description	Rat. V.	Tol. %	Racal Part No.
Capacitors (contd.)					
C24		Not Used			
C25	.01μF	Disc ceramic	250	-20 +40	916187
C26	2.7pF	Disc ceramic	500	$\pm\frac{1}{2}$pf	909889
C27	.01μF	Disc ceramic	250	-20 +40	916187
C28	100pF	Polystyrene	125	$2\frac{1}{2}$	913230
C29	4.7μF	Tantalum	35	20	914026
C30	.01μF	Disc ceramic	250	-20 +40	916187
C31	.01μF	Disc ceramic	250	-20 +40	916187
C32	.01μF	Disc ceramic	250	-20 +40	916187
C33	4.7μF	Tantalum	35	20	914026
C34	47μF	Tantalum	6	20	915100
C35	4.7μF	Tantalum	35	20	914026
C36	.01μF	Disc ceramic	250	-20 +40	916187
C37	1000pF	Polystyrene	125	10	900729
C38	47μF	Tantalum	6	20	915100
C39	Not used				
C40	4.7μF	Tantalum	35	20	914026
C41	68pF	Ceramic	-	5	909900
C42	30pF	Ceramic	-	5	912235
C43	.01μF	Disc ceramic	250	-20 +40	916187
C44	4.7μF	Tantalum	35	20	914026
C45	4.7μF	Tantalum	35	20	914026
C46	4.7μF	Tantalum	35	20	914026
C47	470μF	Electrolytic	25	-20 +40	919697
C48	~~250μF~~ 220μF	Electrolytic	25	-10 +50	~~910911~~ 921536
C48A	4.7μF	Tantalum	35	20	914026
C49 to C77	6pF	Variable	-	-	901987
C78	.01μF	Disc ceramic	250	-20 +40	916187
C79	330pF	Polystyrene	125	$\pm 2\frac{1}{2}$	910895
C80	.01μF	Disc ceramic	250	-20 +40	916187
C81	100pF	Polystyrene	125	$2\frac{1}{2}$	913230
C82	100pF	Polystyrene	125	$2\frac{1}{2}$	913230
C83	4.7μF	Tantalum	35	20	914026
C84	6.8pF	Ceramic		$\pm\frac{1}{2}$pF	919379

Cct. Ref.	Value	Description	Rat. V.	Tol. %	Racal Part No.
Capacitors (contd.)					
C85	4.7μF	Tantalum	35	20	914026
C86	.01μF	Disc ceramic	250	-20 +40	916187
C87	2-22pF	Variable			918757
C88	68pF	Polystyrene	125	2½	909892
C89	68pF	Polystyrene	125	2½	909892
C90	33pF	Polystyrene	125	±1pF	909894
C91	4.7μF	Tantalum	35	20	914026
C91A	4.7μF	Tantalum	35	20	914026
C92	.01μF	Disc ceramic	250	-20 +40	916187
C93	.01μF	Disc ceramic	250	-20 +40	916187
C94	4.7μF	Tantalum	35	20	914026
C95	4.7μF	Tantalum	35	20	914026
C96	.022μF	Polyester	250	10	911595
C97	.022μF	Polyester	250	10	911595
C98	4.7μF	Tantalum	35	20	914026
C99	470pF	Polystyrene	125	2½	909893
C100	Not used				
C101	.01μF	Disc ceramic	250	-20 +40	916187
C101A	.01μF	Disc ceramic	250	-20 +40	916187
C102	.01μF	Disc ceramic	250	-20 +40	916187
C103	4.7μF	Tantalum	35	20	914026
C104	4.7μF	Tantalum	35	20	914026
C105	.01μF	Disc ceramic	250	-20 +40	916187
C106	4.7μF	Tantalum	35	20	914026
C107	2000pF	Polystyrene	30	10	909895
C108	2000pF	Polystyrene	30	10	909895
C109	.01μF	Disc ceramic	250	-20 +40	916187
C110	.01μF	Disc ceramic	250	-20 +40	916187
C111	4.7μF	Tantalum	35	20	914026
C112	2000pF	Polystyrene	30	10	909895
C113	.01μF	Disc ceramic	250	-20 +40	916187
C114	.01μF	Disc ceramic	250	-20 +40	916187
C115	82pF	Polystyrene	125	2½	910826
C116	.01μF	Disc ceramic	250	-20 +40	916187
C117	2.2pF	Disc ceramic	500	±½pF	916834

Cct. Ref.	Value	Description	Rat. V.	Tol. %	Racal Part No.
Capacitors (contd.)					
C118	.01μF	Disc ceramic	250	-20 +40	916187
C119	Not used				
C120	.01μF	Disc ceramic	250	-20 +40	916187
C121	.01μF	Disc ceramic	250	-20 +40	916187
C122	2.7pF	Disc ceramic	500	±½pF	909889
C123	1.4-5.5pF	Variable			919109
C124	.01μF	Disc ceramic	250	-20 +40	916187
C125	.22μF	Polyester	100	20	909882
C126	470pF	Polystyrene	125	2½	909893
C127	4.7μF	Tantalum	35	20	914026
C128	4.7μF	Tantalum	35	20	914026
C129	470pF	Polystyrene	125	2½	909893
C130	4.7μF	Tantalum	35	20	914026
C131	.01μF	Disc ceramic	250	-20 +40	916187
C132	.01μF	Disc ceramic	250	-20 +40	916187
C133	0.1μF	Ceramicon	30	-25 +50	906675
C134	0.1μF	Ceramicon	30	-25 +50	906675
C135	.01μF	Disc ceramic	250	-20 +40	916187
Inductors					
L1		Aerial tuning coil assembly			CT 710000
L2	330μH	RF choke		10	911593
Transformers					
T1		RF. amp transformer			CT 710011
T2		Mixer input transformer			CT 710006
T3		Mixer output transformer			CT 710002
T4		1st I.F. transformer			CT 710064
T5		2nd I.F. transformer			CT 710064
T6		AE current transformer			CT 710008
T7		Buffer amp transformer			CT 710003
T8		9 Mc/s filter transformer			CT 710005
T9		9 Mc/s filter transformer			CT 710005
T10		Buffer amp transformer			CT 710007

Cct Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Transformers (contd.)					
T11		Buffer amp transformer			CT 710010
T12		P.P. output transformer			CT 710001
T13		P.P. input transformer			CT 710004
T14		Tx. mixer transformer			CT 710005
T15		Tx. I.F. transformer			CT 710064
T16		Bal. mod output transformer			CT 710005
Switches					
SA		Crystal selector- 29 position rotary			BR 711003
SB		System switch- 5 position rotary			BR 711116
Transistors					
VT1		Silicon transistor			909926
VT2		Silicon transistor			909926
VT3		Silicon transistor			909926
VT4		Silicon transistor			909926
VT5		Silicon transistor			909926
VT6		Silicon transistor			909926
VT7		Silicon transistor			909927
VT8		Silicon transistor			909927
VT9		Silicon transistor			910682
VT10		Silicon transistor			906004
VT11		Silicon transistor			909926
VT12		Silicon transistor			909926
VT13		Silicon transistor			909926
VT14		Silicon transistor			909926
VT15		Silicon transistor			909926
VT16		Silicon transistor			909927
VT17		Silicon transistor			909927
VT18		Silicon transistor			911586
VT19		Silicon transistor			911586
VT20		Silicon transistor			916632

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Transistors (contd.)					
VT21		Silicon transistor			909926
VT22		Silicon transistor			909926
VT23		Silicon transistor			909926
VT24		Silicon transistor			909927
VT25		Silicon transistor			909927
Diodes					
D1		Silicon diode			918130
D1A		Silicon diode			914898
D1B		Silicon diode			914898
D2		Silicon diode			918130
D3		Silicon diode			914898
D4		Silicon diode			914898
D5		Silicon diode			914898
D6		Silicon diode			914898
D7		Silicon diode			914898
D8		Zener			909902
D9		Zener			918084
D10		Not Used			
D11		Silicon diode			919099
D12		Silicon diode			914898
D13		Silicon diode			914898
D14		Not Used			
D15		Silicon diode			919099
D16		Silicon diode			914898
D17		Silicon diode			914898
D18		Silicon diode			914898
D19		Silicon diode			914898
D20		Silicon diode			914898
D21		Silicon diode			914898
D22		Silicon diode			914898
D23		Silicon diode			914898

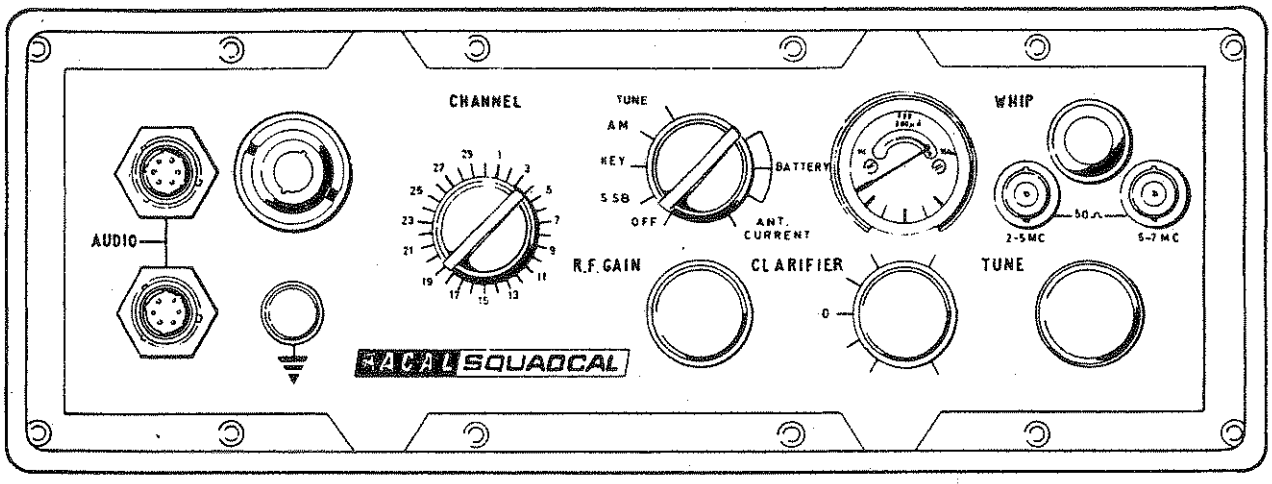
Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Diodes (contd.)					
D23A		Silicon diode			918130
D24		Silicon diode			914898
D25		Silicon diode			914898
D26		Silicon diode			914898
D27		Silicon diode			914898
D28A		Silicon diode			918130
D28B		Silicon diode			918130
D29		Not Used			
D30		Germanium diode			900071
Sockets					
SK1		Earth connector			901399
SK2		Whip antenna socket			AA 700674
SK3		Dipole antenna socket			905449
SK4		Dipole antenna socket			905449
SK6		Audio socket			909908
SK7		Audio socket			909908
Relays					
RLA		Transmit/receive relay 4 C/O-LD coil - 14V min. 18V max.			909880
Fuses					
FS1		Power supply fuse.	2A		901959
Filters					
FL1		7 MHz - Low-pass			AR 711002
FL2		7 MHz - Low-pass			AR 711002
FL3		Xtal filter - 9 MHz			BR 711039

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part No.
Miscellaneous					
-		Dessicator mounting (Whitworth thread) This item is supplied complete with a dessicator insert.			909909
-		Dessicator insert.			909910
M1		Meter sealed 200μA f.s.d.			AR 711005
XL1 to XL29		Channel Oscillator			AR 711016/Frequency
XL30		Carrier Oscillator			AR 711016/Frequency

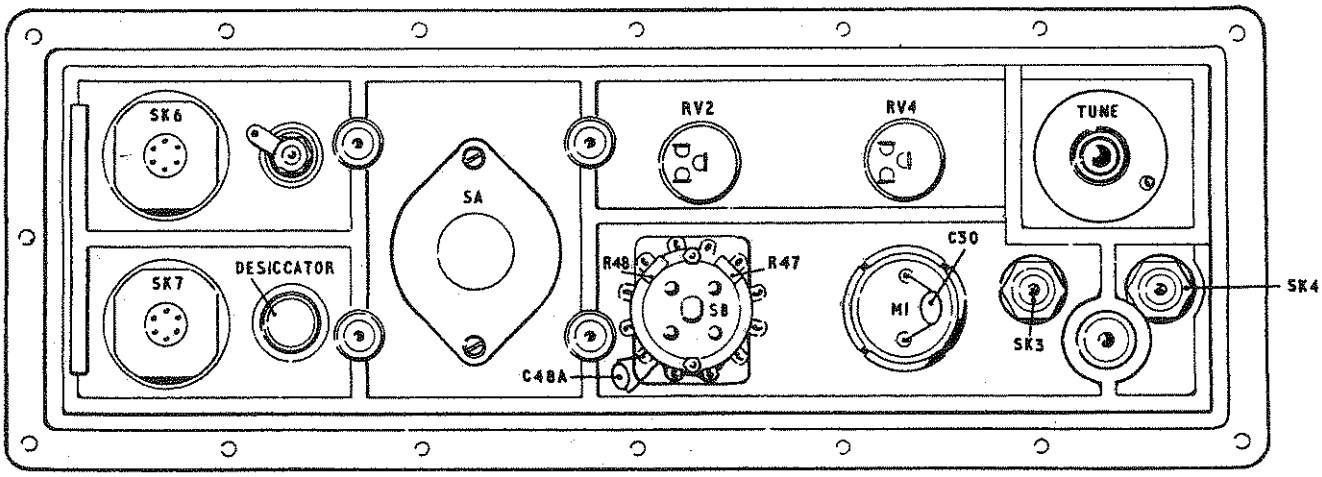
(For frequencies see Chapter 3 page 2, para. 12.)

	REFERENCE
Sideband crystal-Upper 9001.5 kHz/Lower 8998.5 kHz	A.R. 711016
8ft. (2.4m) sectional whip antenna	A.R. 711017
Flexible plug-in antenna mount	B.R. 711018
Unbreakable handset	B.R. 711013
Headset-single earpiece	B.R. 711015/A
Headset-noise excluding	B.R. 711014/A
Headset and boom microphone	B.R. 711024
Morse key with knee strap	B.R. 700059/A
Earth spike and lead	B.A. 700067
Instruction plate-English	B.R. 711012
Operators handbook-English	-
Maintenance handbook-English	-
Tool kit	A.A. 700066
Loudspeaker/amplifier unit type MA. 909	C.A. 700110
Dry batteries type 996 or F4M-3 per set	-
Battery adaptor type MA. 910 for U.2 cells	C.A. 700073
Dry batteries type U.2 14 per set (Requires MA. 910 adaptor)	-
Nickel cadmium re-chargeable battery pack (3·5a.h.) Type MA. 928	C.A. 700117
Universal battery charger Type MA.911 for nickel cadmium cells	C.A. 700103
Carrying harness and frame for TRA.906	D.A. 700049
Vehicle mounting tray Type MA.912A for TRA.906	C.A. 700075

Vehicle mounting for Type MA. 912B for MA. 926, MA. 927	C.A. 700151
Lightweight dipole antenna complete with feeder, support lines, throwing weights and spools	C.R. 711025
End fed antenna	C.R. 711026
Terminal adaptor (B.N.C./Terminal) for twin feeder operation	B.A. 700074
Terminal adaptor (Whip socket/Terminal for separate whip/end fed antenna)	A.A. 700118
Special flexible aerial mount for use in jungle	B.A. 700072
Test Set type CA.470	C.A. 700119
6/12V/24V D.C. Power Unit/Loudspeaker Amplifier for vehicle operation	C.A. 700140
100-125V 200-250V 45/60 Hz A.C. Power Unit/Loudspeaker Amplifier for static operation. Type MA.927	C.A. 700158
Hand Generator for charging nickel/cadmium cells. Type MA. 913	C.A. 700212
Tree clamp for hand generator (optional)	C.A. 700217



Front

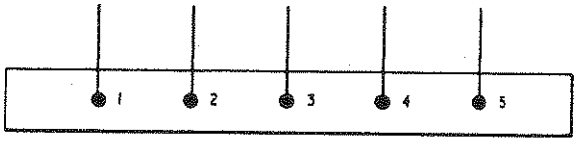


Rear

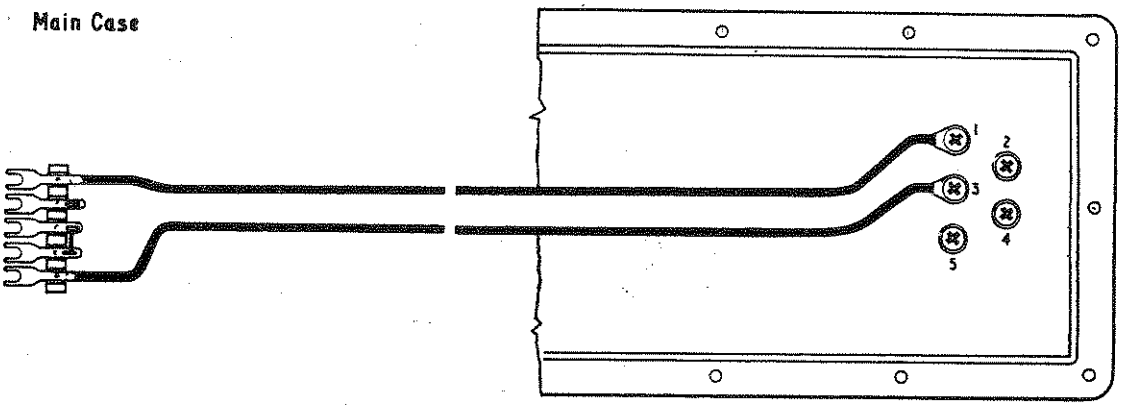
Control Panel–T.R.A.906

Fig.3

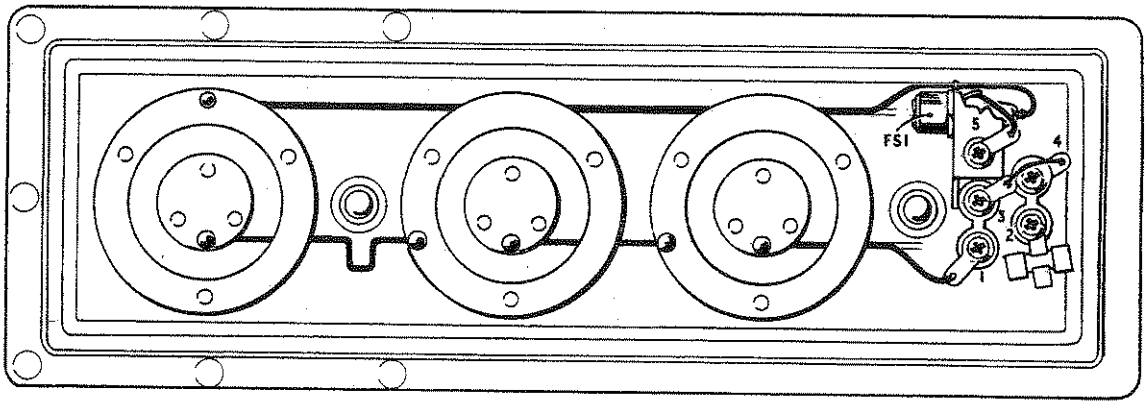
Transmitter Receiver Unit



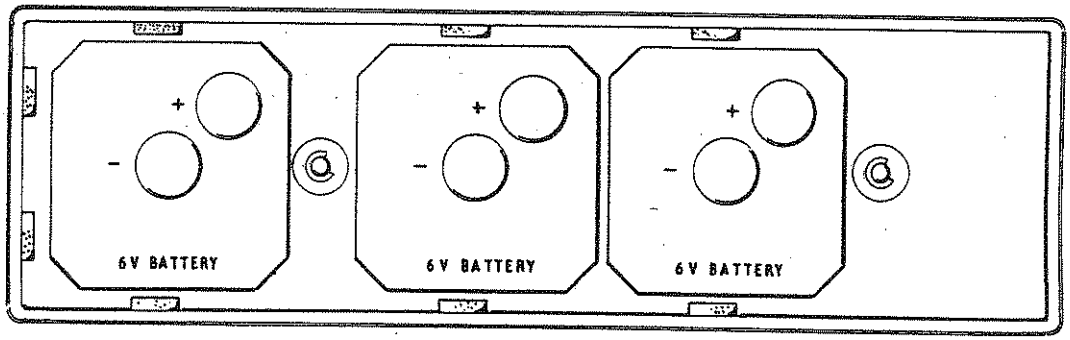
Main Case



Inside View



Base View



Top view of Battery Pack

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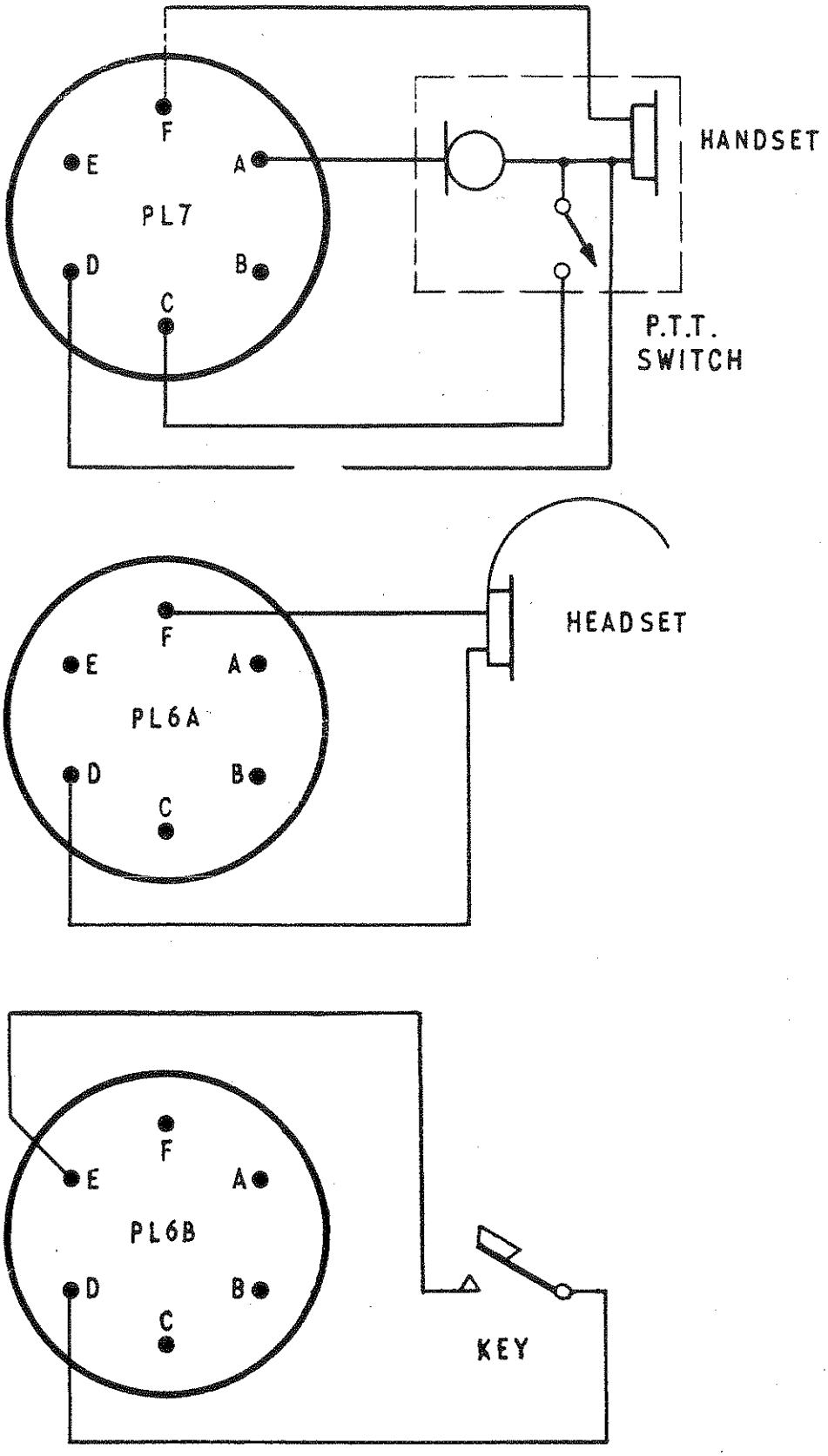
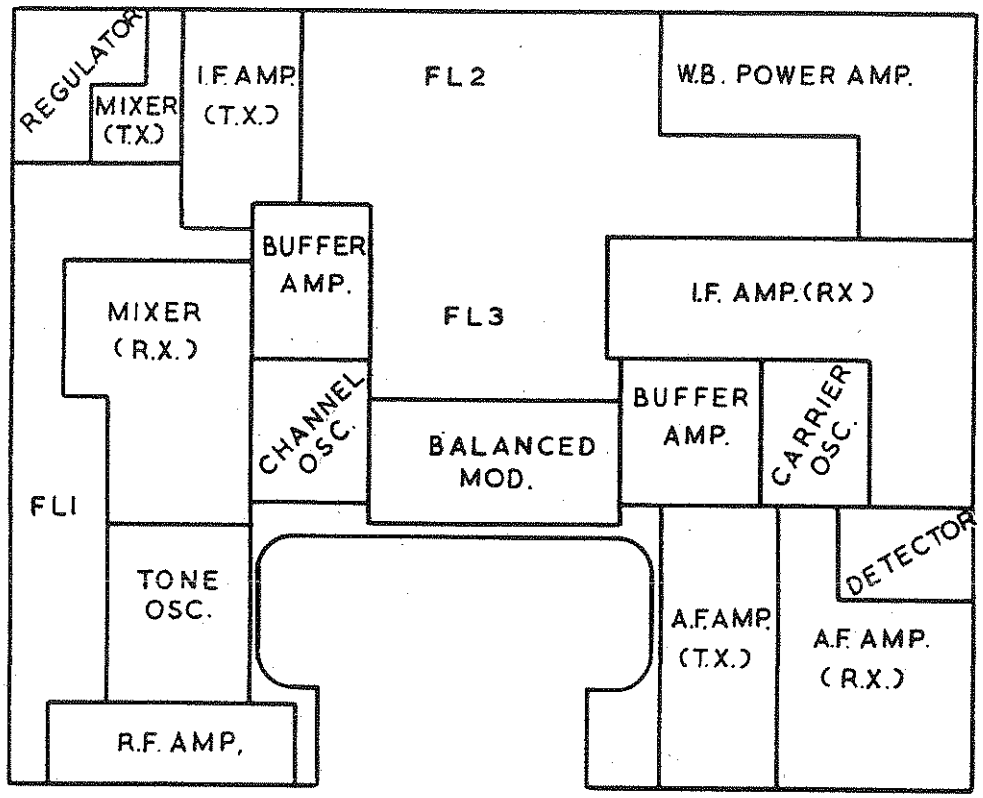
Power Supply Interconnections-TRA.906

Fig.5



229/6 Circuit : Mic./Tel./Morse Key-TRA.906 Fig.6



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Key to Stage Layouts

Fig.7

APPENDIX 1

LIST OF ANCILLARIES

ITEM	DESCRIPTION	REF. NUMBER	WEIGHT lb.	WEIGHT oz.	WEIGHT Kg.
1	8 ft (2.4m) Section Whip Antenna	AR.711017		10	.29
2	Flexible Plug-in Antenna Mount	BR.711018		7	.2
3	Shock Absorbing Antenna Mount	BA.700072		14	.39
4	Lightweight Dipole Antenna Complete with Feeder, Support Lines, Throwing Weight and Spools	CR.711025	3	14	1.75
5	End Fed Antenna	CR.711026		12	.34
6	Terminal Adaptor (Whip/Terminal) for separate Whip/End Fed Antenna	AA.700118		2	.05
7	Ground Spike and Lead	BA.700067		6	.17
8	Telephone Handset	BR.711013		14	.39
9	Headset and Boom Microphone	BR.711024	1	6	.63
10	Headset, Noise Excluding	BR.711014/A		12	.34
11	Headset, Single Earpiece	BR.711015/A		5	.15
12	Morse Key with Knee Strap	BR.700059/A		7.5	.21
13	Nickel - cadmium Rechargeable Battery Pack (3.5 a.h.) Type MA.948	CA.700515	5	12	2.6
14	Transit lid for MA.948 Battery	CA.700513		13	.37
15	Carrying harness and Frame	DA.700049	4	4	1.8
16	Terminal Adaptor (BNC/Terminal)	BA.700074		2	.06
17	Cover Assembly (in lieu of battery)	BA.700885			
18	Tool Kit	AA.700066		1.25	.03
19	User Handbook				
20	Mounting Tray Type MA.912A (included in this Handbook - Appendix 2)	CA.700075	2	2	.96
21	Mounting Tray Type MA.912B (included in this Handbook - Appendix 2)	CA.700075	1	12	.79
22	Mounting Brackets (included in this Handbook - Appendix 2)	BD.700167/8		4	.1
23	Static Mounting Assembly (included in this Handbook - Appendix 3)	CA.700288		12	.34
24	Heavy duty mounting frame Type MA.989A (included in this handbook - Appendix 2)	DA.700802	8	8	3.85
25	Heavy duty mounting frame Type MA.989D (included in this handbook - Appendix 2)	DA.700896	9	8	4.31

ITEM	DESCRIPTION	REF. NUMBER	WEIGHT lb.	oz.	Kg.
26	Torque Wrench	BA.700449			
27	Universal Battery Charger Type MA.945, for Nickel-cadmium Batteries (separate handbook available)	CA.700616	6	11	3.05
28	10-way Battery Charger, MA.914 for Nickel-cadmium batteries (separate handbook available)	CA.700475	88	12	40.3
29	Hand-operated Generator (18V) Type MA.913	CA.700212	8	0	3.62
30	Tree Clamp for MA.913	CA.700217	1	10	0.74
31	Unipad stand for MA.913	BA.700482	2	12	1.24
32	100-125V/200-250V, 45-60 Hz A.C. Power Unit/Loudspeaker Amplifier Type MA.927 for Static Operation (separate handbook available)	CA.700158	8	0	3.62
33	12V/24V D.C. Power Unit/ Loudspeaker Amplifier Type MA.926 for Vehicle Operation (separate handbook available)	CA.700140	7	10	3.46
34	Loudspeaker/Amplifier Unit Type MA.988	DA.700860	1	7	0.66
35	Test Set Type CA.470B (separate handbook available)	CA.700119B	7	8	3.4

APPENDIX 2

MOUNTING TRAYS

TYPES MA.912 and MA.989

Mounting Tray Type MA.912A

1. The Mounting Tray Type MA.912A is designed to allow simple installation of TRA.921 manpacks. Fitted with quick-release securing catches, the tray will accept a manpack with or without its battery compartment. It may be mounted horizontally or vertically according to individual requirements.

2. In cases where a permanent installation is not intended, the mounting tray can be permanently installed as a convenient stowage place for the manpack.

Mounting Tray Type MA.912B

3. The Mounting Tray Type MA.912B is designed to allow simple installation of the Vehicle Supply Unit Type MA.926, the Static Supply Unit Type MA.927, or the Universal Charger Type MA.945. The tray is fitted with quick-release catches and may be mounted horizontally or vertically. It can be installed alongside or separately from the manpack or assembled with the manpack mounting tray above, with the aid of brackets, to form a single unit.

Mounting Brackets BD.700167/8

4. The Brackets enable Mounting Tray Type MA.912B to be assembled with Mounting Tray Type MA.912A to form a single unit in different configurations to suit individual requirements.

Typical Installation (MA.912)

5. Typical installations are shown in Fig. APP.2-1. The mounting brackets can be fitted in alternative positions to enable the units to be surface mounted or suspended. Also, the position of the manpack and the supply unit may, in either case, be transposed to suit individual operational requirements. A suitable template for drilling the attachment holes is given in fig. APP.2-2.

Mounting Frame Type 989A

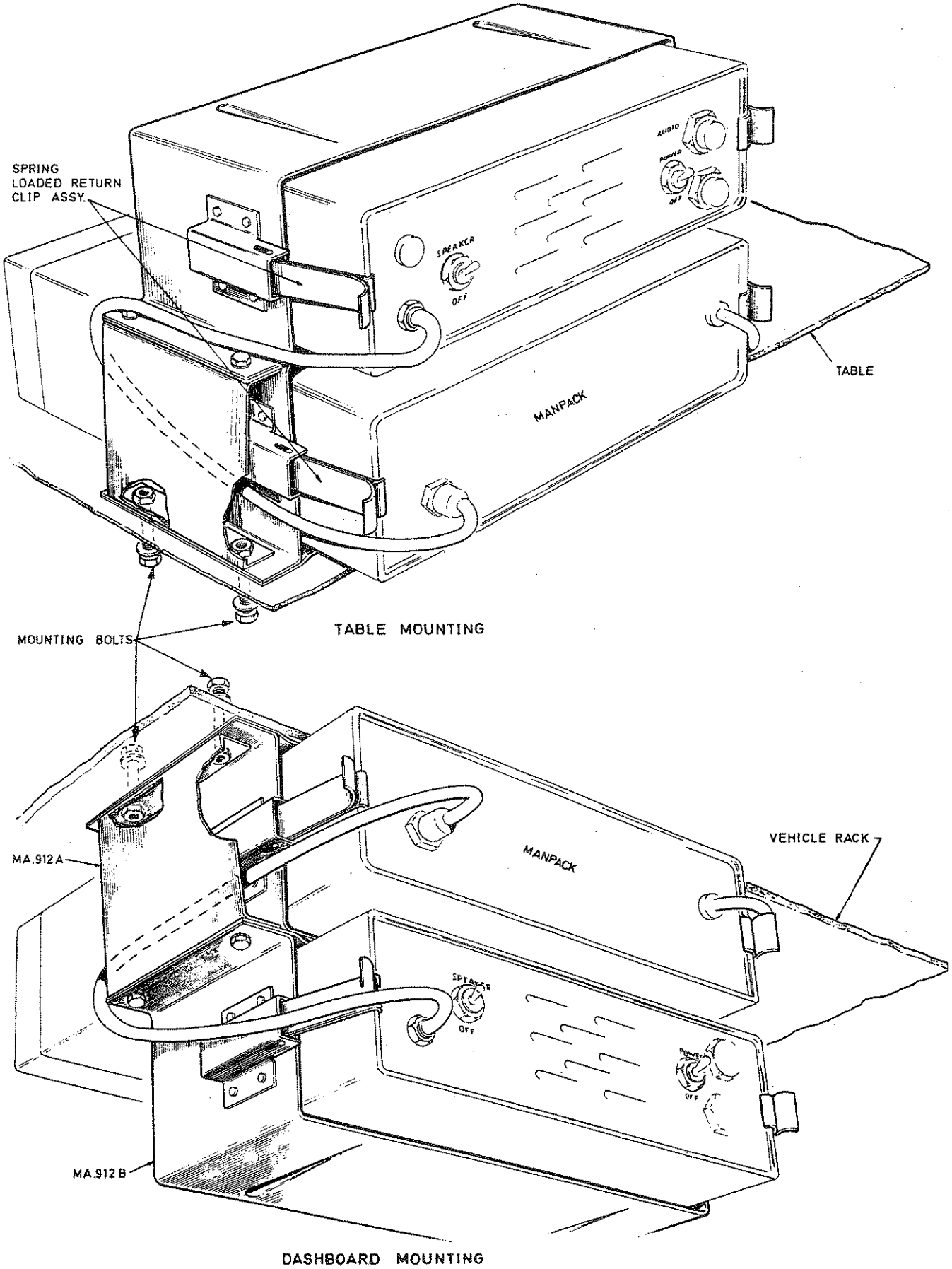
6. The mounting frame type 989A is a heavy duty frame designed for the TRA.906 manpack. It is built to withstand the severe environmental conditions encountered in fighting vehicles.

Mounting Frame Type 989D

7. Designed for Vehicle Supply Unit MA.926, Static Supply Unit 927 or Universal Charger Type MA.945, the Mounting Frame Type 989D is of similar construction to Type 989A.

Typical Installation (MA.989)

8. Typical installations are shown in Fig. APP.2-3. The mounting brackets may be fitted in alternative positions to enable the units to be surface mounted or suspended. Also the position of the manpack and the supply unit may, in either case, be transposed to suite individual requirements. A suitable template for drilling the attachment holes is given in Fig. APP.2-4.



Vehicle Mounting Trays Type MA.912A & B Fig.APP. 2-1

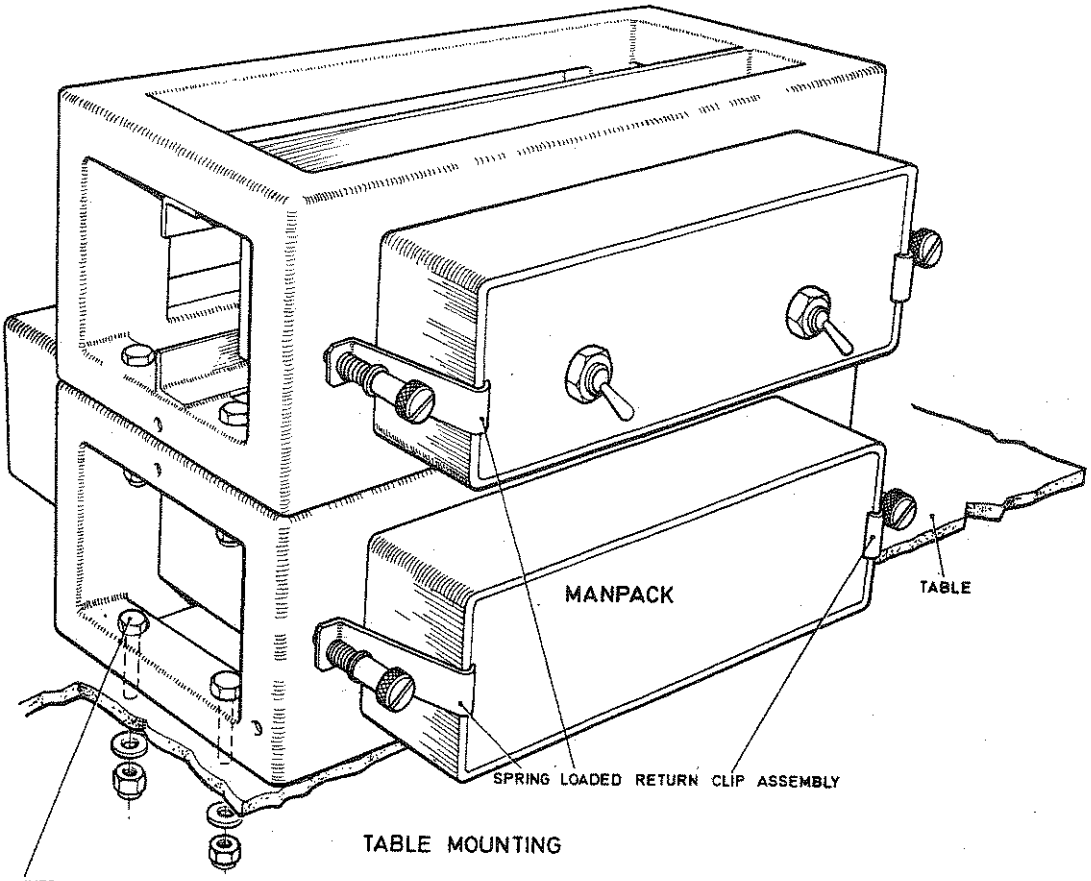
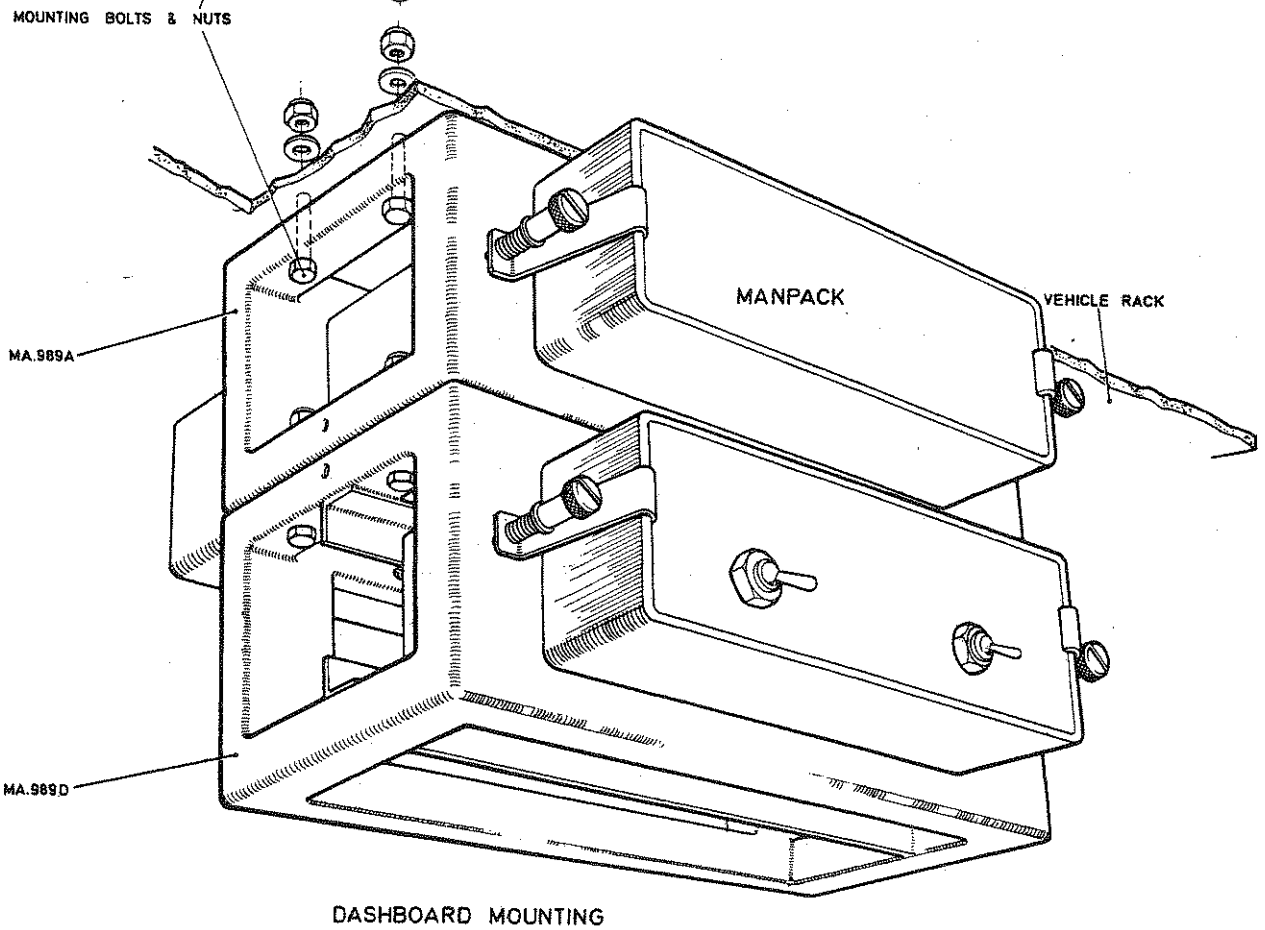


TABLE MOUNTING



DASHBOARD MOUNTING

Vehicle Mounting Trays Type MA.989A & D Fig.APP2-3

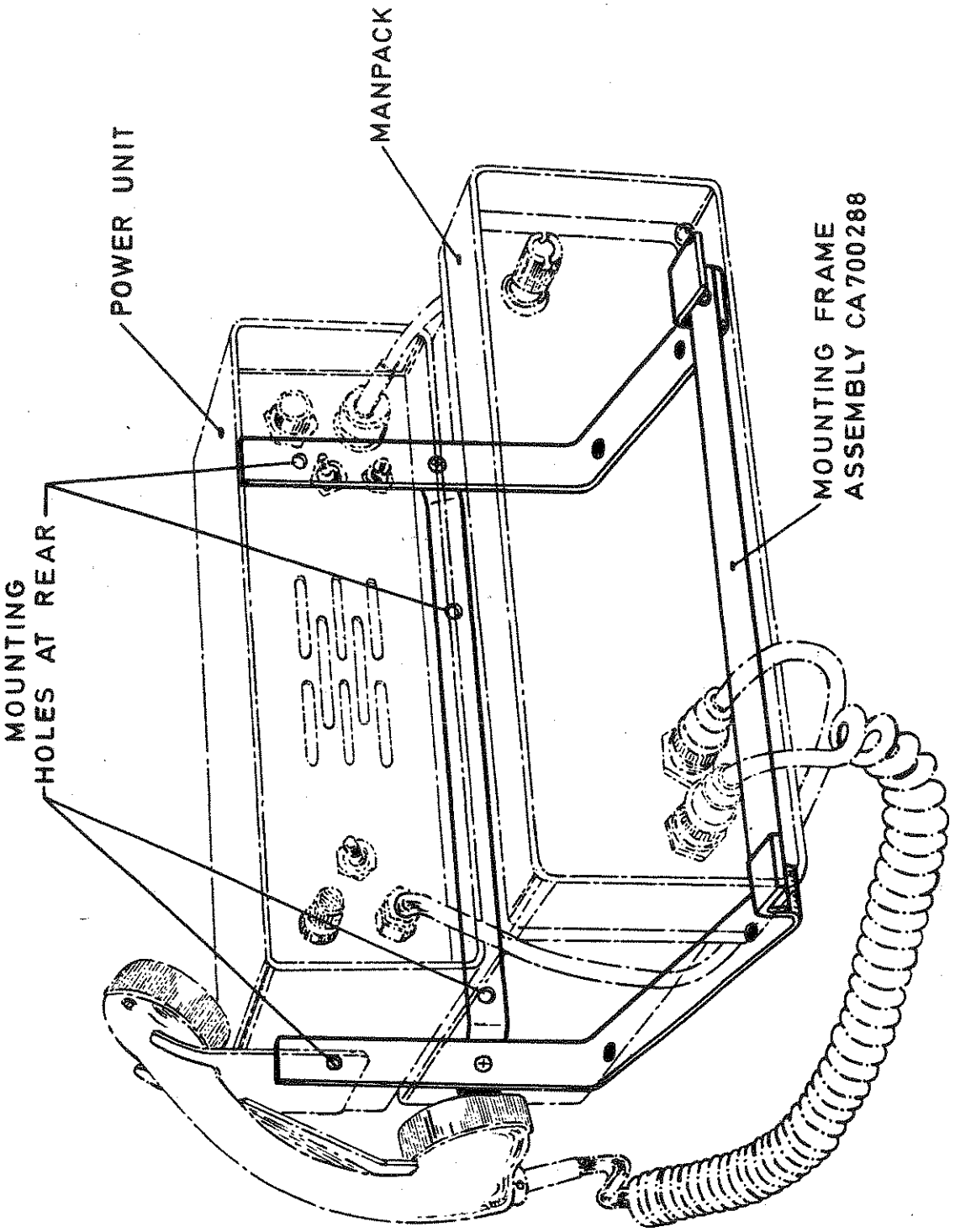
APPENDIX 3

STATIC MOUNTING ASSEMBLY (CA 700288)

1. The static mounting assembly is designed to accommodate a manpack and its associated power unit to form a compact unit suitable for bench mounting. A handset rest is also provided.

2. The manpack and power unit are mounted horizontally with the power unit installed above the manpack. Each unit is secured to the mounting frame assembly, at the rear, by two bolts provided with the mounting assembly.

3. A typical static installation is given in Fig. APP.3-1.



Typical Static Installation

Fig. APP. 3 - 1

APPENDIX 4

HAND OPERATED GENERATOR TYPE MA.913

INTRODUCTION

1. The Hand Operated Generator Type MA.913 is a self-contained unit used as a power source for the TRA.906 Manpacks. The generator provides a maximum output of 1.5A. The circuit of the generator is given in fig. APP.4-1.

2. A tree clamp ST 700217 is available allowing the generator to be fixed to a tree or post of approximately 12 in. diameter.

3. The weight and dimensions of the unit are as follows:

Weight:	9 lb. 10 oz. (4.36 kg) Generator complete with tree clamp and strap.		
Dimension: (Handles folded)	Length	Height	Depth
	11 in. (279 mm)	4¾ in. (121 mm)	7½ in. (191 mm)

USAGE

4. The generator is normally used as a means of charging the nickel-cadmium battery MA.948, and is capable of maintaining the battery in a fully charged condition during reception, by intermittent operation of the generator. It is advisable to limit the periods of transmission to the shortest times possible, or to operate the generator during the complete transmission period.

5. The generator can be used as the sole power source in an emergency, with continuous cranking during transmission and reception.

SETTING-UP FOR USE

7. The generator is set-up for use as follows:

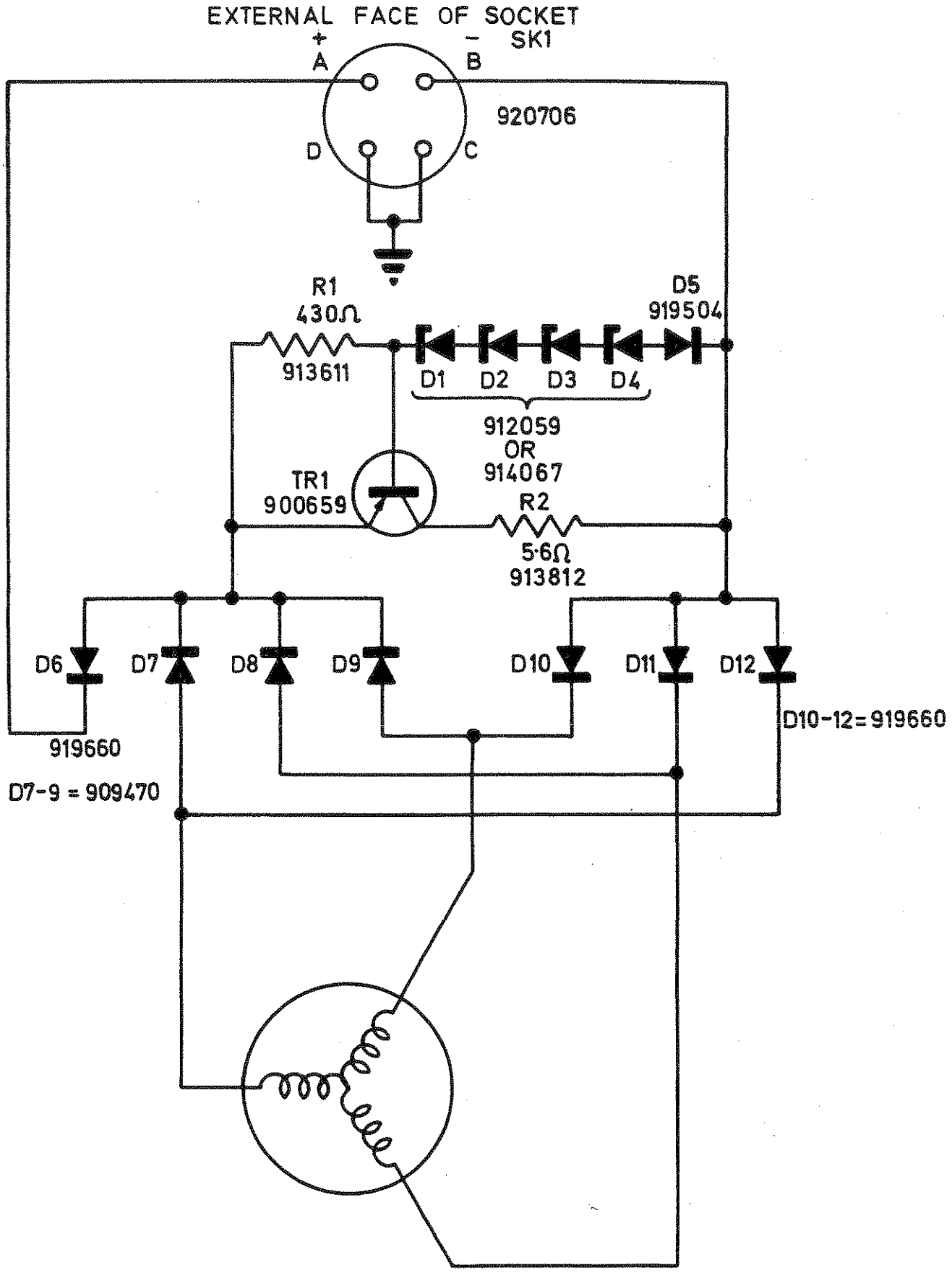
(1) Extend the clamp locking strap to its fullest extent. Fold one handle and affix generator to a firm support such as a tree or pole.

(2) Connect the socket on the generator to an audio socket on the front panel of the manpack, using the cable provided.

(3) Crank generator at approximately 70 r.p.m. to obtain power.

MAINTENANCE

8. The generator is a sealed unit, and does not require routine maintenance. The dessicator can, if necessary, be removed and re-activated by a hot-air blower.



Circuit: Hand Operated Generator Type MA.913 Fig. App. 4-1

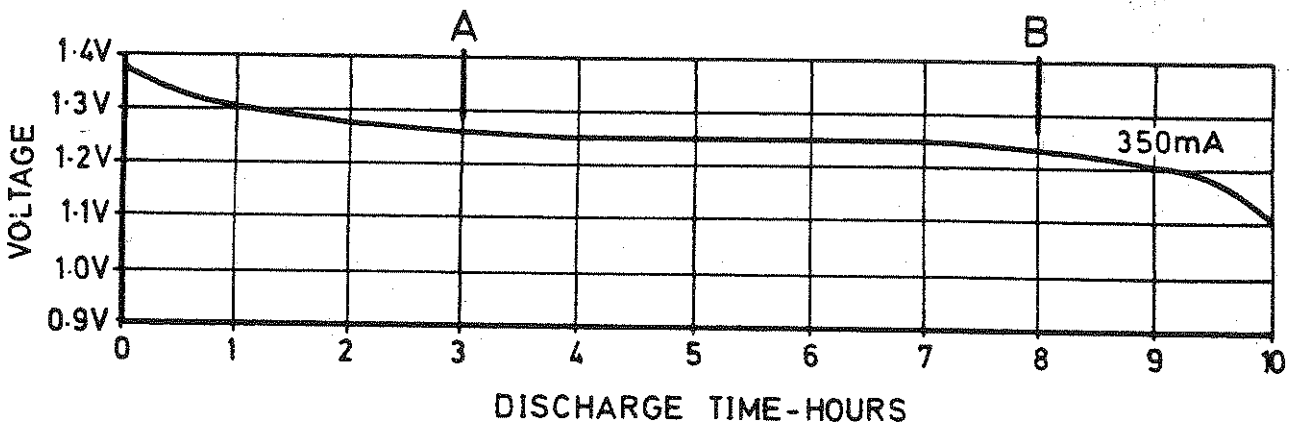
APPENDIX 5

THE CARE AND CHARGING OF NICKEL-CADMIUM BATTERIES

1. The modern sealed nickel-cadmium rechargeable cell will give many years of useful life if it is properly treated. Certain precautions must be taken during the charging and discharging of these cells and the following notes are intended to serve as a practical guide to the use of Battery Type MA.948 and the range of Racal battery chargers MA.913, MA.945 and MA.914.

State of Charge

2. During discharge the terminal voltage of Nickel-Cadmium cells remains sensibly constant. Fig. 1 shows a typical discharge curve of one of the cells in the MA.948 Battery. This curve shows the variation of terminal voltage with time as the cell discharges at a rate of 350mA. It is clear from this curve that it would be very difficult in practice to establish the state of charge over the middle position of the curve between A and B. To further complicate matters, the terminal voltage during discharge varies slightly with temperature.



TYPICAL DISCHARGE CURVE FIG. 1

3. Because of this diffculty in assessing the state of charge of the cells, the method used to charge the battery must be carefully controlled if it is not to be seriously overcharged with the consequent possibility of damaging the cells.

Storage

4. If batteries have been stored for a considerable time it is advisable to charge, discharge and recharge them at least once before use in order to obtain full capacity.

NOTE: A suggested load for battery discharge is a suitably rated vehicle headlamp(s). A multimeter should be placed in series with the headlamp(s) to ensure that discharge current does not exceed 3.5 Amps.

Battery Chargers Type MA.945 and MA.914

5. The charging method used in the Battery Chargers MA.945 and MA.914 removes to a great extent the necessity of accurately determining the state of charge of the battery. Both units are designed to provide a constant current output of approximately 350mA. At this rate, a discharged battery will be fully charged in about 14 hours. However, allowing the battery to remain on charge for periods considerably in excess of this will cause no serious damage.

Battery Charger Type MA.913

6. The MA.913 Hand Generator is a constant voltage source which provides a greatly increased rate of charge compared to the MA.945 and MA.914. It is theoretically possible to overcharge the battery when using the MA.913 and the following points should be noted when using this charger.

(a) A handle speed of 60-70 revolutions per minute should not be exceeded.

(b) A discharged battery will take about $2\frac{1}{2}$ hours to full charge.

(c) If in doubt regarding the state of charge of the battery, limit the charging time to 1 hour.

(d) It is possible in an emergency to charge the battery during operation of the manpack equipment, but this will result in increased noise output on both "receive" and "transmit". The heavy human effort required to charge the battery during "transmit" makes it difficult to maintain this operation for any length of time.

RECOMMENDED SPARES LIST FOR TRA 906 "MAINTENANCE SPARES"

FOR SERIAL Nos 008214 TO 006713 SHT 1 OF 2 Issue 1.

...m No.	PART No.	DESCRIPTION	QTY.	ITEM No.	PART No.	DESCRIPTION	QTY.
	RESISTORS				RESISTORS VARIABLE		
1.	902419	47 ohm 10% ½W	1	33.	909939	25 K ohm LIN.	1
2.	902431	470 ohm 10% ½W	1	34.	919511	4.7K ohm LIN.	1
3.	903630	1 ohm 10% 1½W	1	35.	919512	100 K ohm LIN.	1
4.	919895	22 ohm 10% ¼W	1	36.	919514	470 ohm LIN.	1
5.	919896	47 ohm 10% ¼W	1	37.	919516	1 K ohm LIN.	1
6.	919897	68 ohm 10% ¼W	1	38.	919517	22 K ohm LIN.	1
7.	919898	82 ohm 10% ¼W	1				
8.	919899	100 ohm 10% ¼W	4				
9.	919900	120 ohm 10% ¼W	1				
0.	919901	220 ohm 10% ¼W	1				
1.	919902	270 ohm 10% ¼W	1				
2.	919905	470 ohm 10% ¼W	2				
3.	919906	820 ohm 10% ¼W	1				
4.	919907	1 K ohm 10% ¼W	2				
5.	919908	1.5K ohm 10% ¼W	1				
6.	919909	1.8K ohm 10% ¼W	1				
7.	919910	2.2K ohm 10% ¼W	1				
8.	919911	3.3K ohm 10% ¼W	1				
9.	919912	3.9K ohm 10% ¼W	2				
0.	919913	4.7K ohm 10% ¼W	1				
.	919914	5.6K ohm 10% ¼W	1				
..	919915	6.8K ohm 10% ¼W	1				
3.	919916	10 K ohm 10% ¼W	4				
4.	919917	12 K ohm 10% ¼W	1				
5.	919918	15 K ohm 10% ¼W	1				
6.	919919	18 K ohm 10% ¼W	1				
7.	919920	22 K ohm 10% ¼W	1				
8.	919921	27 K ohm 10% ¼W	1	Per amendment.			
9.	919922	33 K ohm 10% ¼W	1				
0.	919923	47 K ohm 10% ¼W	1				
.	919924	56 K ohm 10% ¼W	1				
2.	919926	120 K ohm 10% ¼W	1				

RECOMMENDED SPARES LIST FOR TRA 906 "MAINTENANCE SPARES"

FOR SERIAL Nos 008214 TO 008713 SHT 2 OF 2 Issue 1.

ITEM No.	PART No.	DESCRIPTION	QTY.	ITEM No.	PART No.	DESCRIPTION	QTY.
	CAPACITORS:				MISCELLANEOUS:		
39	900729	1000pF 10% 160V	1	63	BA711007	KNOB CHANNEL SWITCH	1
10	901987	.8 - 6.8pF 400V.Var	4	64	BA711008/A	KNOB FUNCTION SWITCH	1
11	906675	0,1UF + 50% - 25% 30V	1	65	BA711009/A	KNOB TUNE	1
12	909882	0,22UF 20% 100V	1	66	909909	DESICCATOR	1
13	909889	2.7pF $\pm$ ½pF 500V	1	67	911593	CHOKE 330UH 10%	1
14	909892	68pF 2½% 160V	1				
15	909893	470pF 2½% 160V	1				
16	909894	33pF $\pm$ 1pF 160V	1				
17	909895	2000pF 10% 30V	1				
18	909900	68pF 5%	1				
19	910826	82pF 2½% 125V	1				
50	910895	330pF 2½% 160V	1				
51	911595	0,022 UF 10% 250V	1				
52	912235	30pF 5%	1				
53	913230	100pF 2½% 160V	1				
54	914026	4.7UF 20% 35V	6				
55	915100	47UF 20% 6V	1				
56	916187	0,01UF + 40% - 20% 100V	10				
57	916834	2.2pF $\pm$ ½pF 500V	1				
58	918757	2-22pF	1				
	919109	1.4 - 5.5pF	1				
60	919379	6.8pF $\pm$ ½pF. 750 V	1				
61	919697	470UF + 50%-20% 25V	1				
62	921536	220UF + 50%-10% 25V	1				

RECOMMENDED SPARES LIST FOR TRA 906 — SEMI-CONDUCTORS AND FUSES

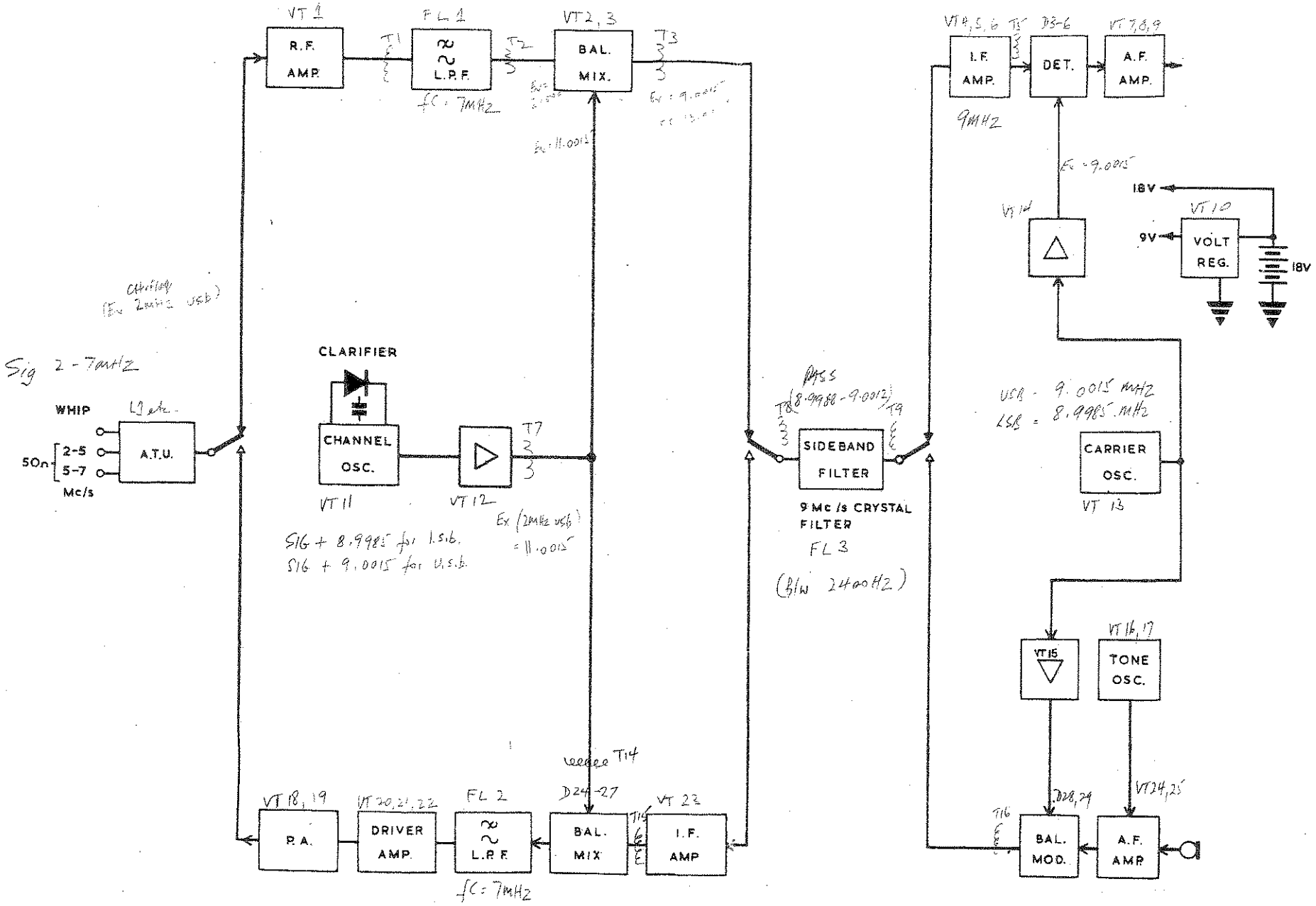
FOR SERIAL Nos 008214 TO 008713 — SHT 1 OF 1 — ISSUE 1

ITEM No.	PART No.	DESCRIPTION	QTY.	ITEM No.	PART No.	DESCRIPTION	QTY.
	SEMI-CONDUCTORS:						
1	900071	DIODE OA91	1				
2	906004	TRANSISTOR 2N 3053	1				
3	909902	DIODE 1S2100A	1				
4	909926	TRANSISTOR 2N3983	4				
5	909927	TRANSISTOR 2N3711	4				
6	910682	TRANSISTOR 2N3705	1				
7	911586	TRANSISTOR BDY.MC434	2				
8	914898	DIODE IN4149	5				
	916632	TRANSISTOR BSX61	1				
10	918084	DIODE BZY93-C27R	1				
11	918130	DIODE BAV 10	2				
12	919099	DIODE MV 1636	1				
	FUSES:						
13	901959	FUSE 2AMP	6				
	READY USE SPARES:						
14	909909	DESICCATOR	1				

RECOMMENDED SPARES LIST FOR TRA 906 "BASE SPARES" Issue 1.

FOR SERIAL Nos 008214 TO 008713 SHT 1 OF 1

ITEM No.	PART No.	DESCRIPTION	QTY.	ITEM No.	PART No.	DESCRIPTION	QTY.
1	DD700014	FRONT PANEL	1	39	909908	CONNECTOR FIXED	1
2	AD700028	SUPPORT BRACKET	2	40	909909	DESICCATOR	1
3	DA700045/A	BATTERY CASE ASSY	1	41	909916	SEAL "O" RING	1
4	DA700046/A	MAIN CASE CASSY	1	42	909924	CRYSTAL SOCKET	4
5	AA700063	MODIFIED ALLEN KEY	1	43	909928	TERMINAL STRIP	1
6	CD700507	FRONT PANEL EARTH STRIP	1	44	909929	SEAL "O" RING	1
7	CT710000	A.T.U. COIL ASSY	1	45	909932	SEAL "O" RING	1
8	CT710001	TRANSFORMER ASSY	1	46	909933	TRANSISTOR PAD	1
9	CT710002	TRANSFORMER ASSY	1	47	909934	TRIMMING TOOL TT1	1
10	CT710003	TRANSFORMER ASSY	1	48	909941	NUT $\frac{3}{8}$" x 32.T.P.I.	1
11	CT710004	TRANSFORMER ASSY	1	49	910300	SEAL "O" RING	1
12	CT710005	TRANSFORMER ASSY	1	50	911593	CHOKE 330 UH 10%	1
13	CT710006	TRANSFORMER ASSY	1	51	911600	CLIP	1
14	CT710007	TRANSFORMER ASSY	1	52	912236	STRIP FANNING 5 WAY	1
15	CT710008	TRANSFORMER ASSY	1	53	916174	KEY ALLEN	1
16	CT710010	TRANSFORMER ASSY	1	54	916175	KEY ALLEN	1
17	CT710011	TRANSFORMER ASSY	1	55	919107	CRYSTAL SOCKET	1
18	CT710064	TRANSFORMER ASSY	1				
19	AR711002	LOW PASS FILTER ASSY	1				
20	BR711003	CHANNEL SWITCH	1				
21	AR711005	SEALED METER	1				
22	BR711039	FILTER ASSY 9MHz	1				
23	BR711116	FUNCTION SWITCH	1				
24	BR711130	SEAL "O" RING	1				
25	900096	PLASKLIP NX 1A	1				
26	900404	INSULATOR LEAD-THRO	1				
27	900412	FUSEHOLDER	1				
28	901399	TERMINAL INSULATED	1				
29	901807	TRIMMING TOOL	1				
30	905449	CONNECTOR COAX	1				
31	909856 *1	CRYSTAL 8998.5KHz)	1	* 1. 909856 for LSB OR * 2 909857 FOR USB AS REQD: TO SPEC AR 711016			
32	909857 *2	CRYSTAL 9001.5KHz)					
33	909874	STOWAGE ANTI GRAV:	1				
34	909880	RELAY	1				
35	909881	SOCKET RELAY	1				
36	909883	CLIP RELAY	1				
37	909884	SINK HEAT	1				



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Block Diagram: TRA.906

Fig. 1

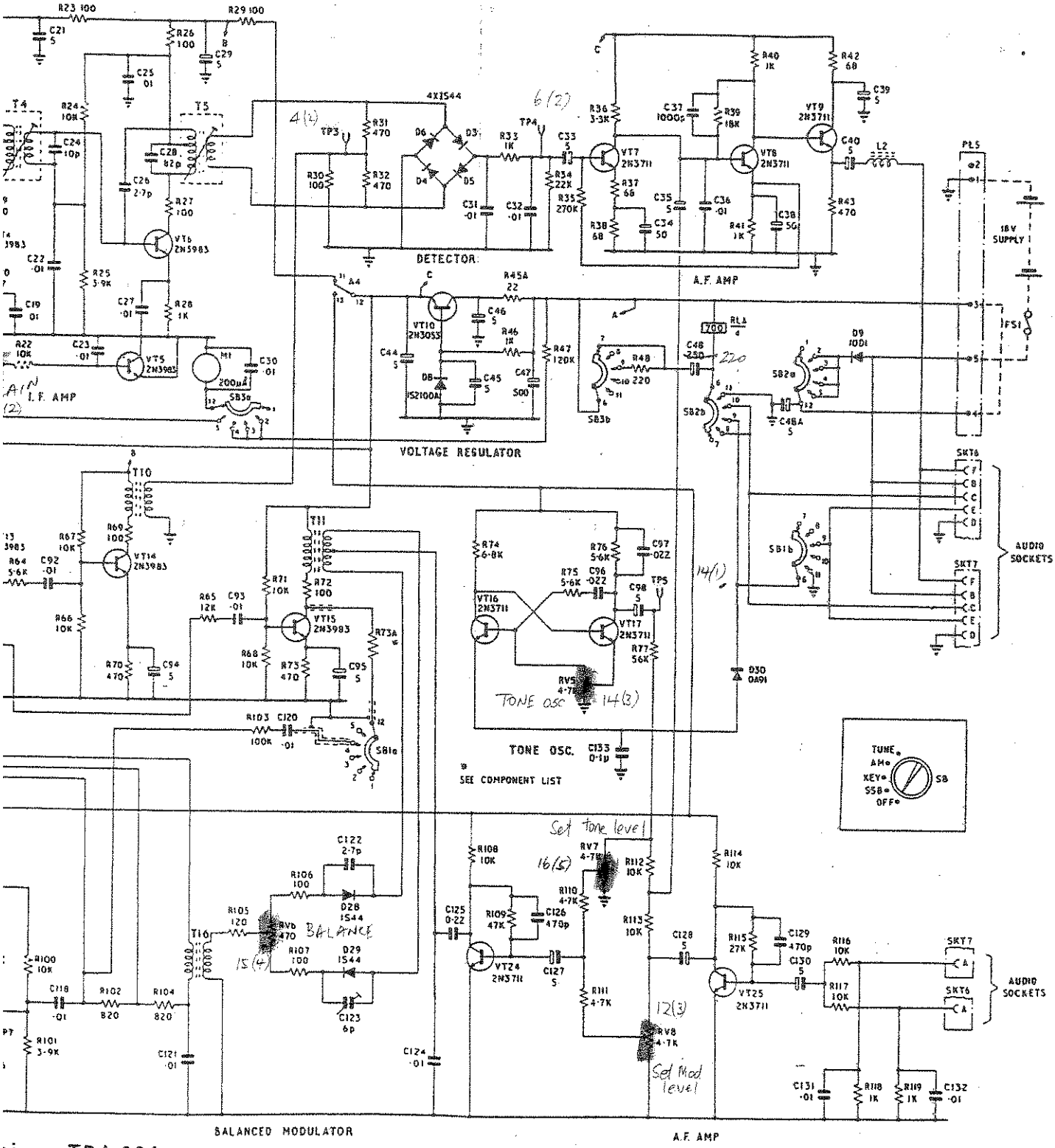

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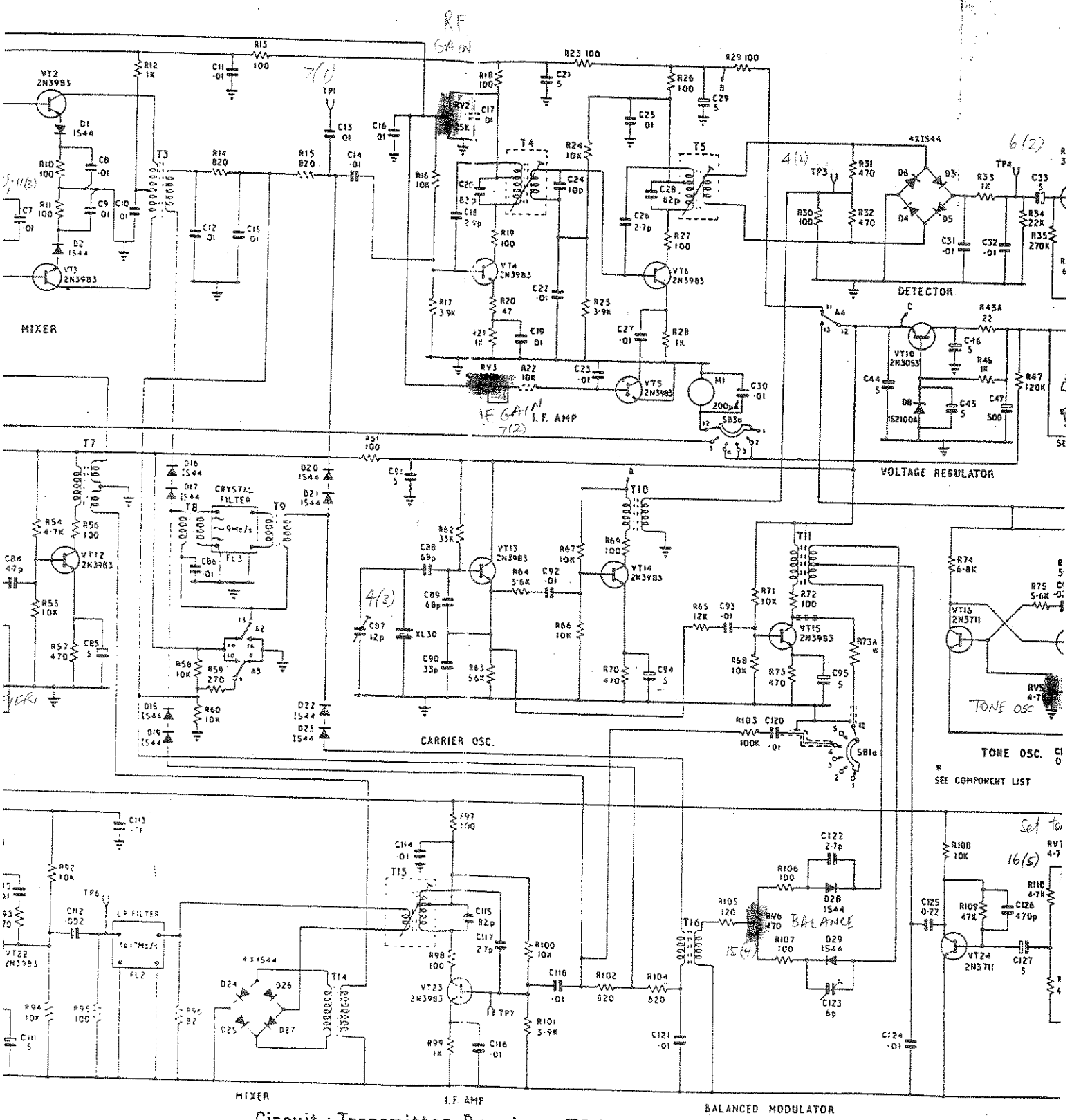
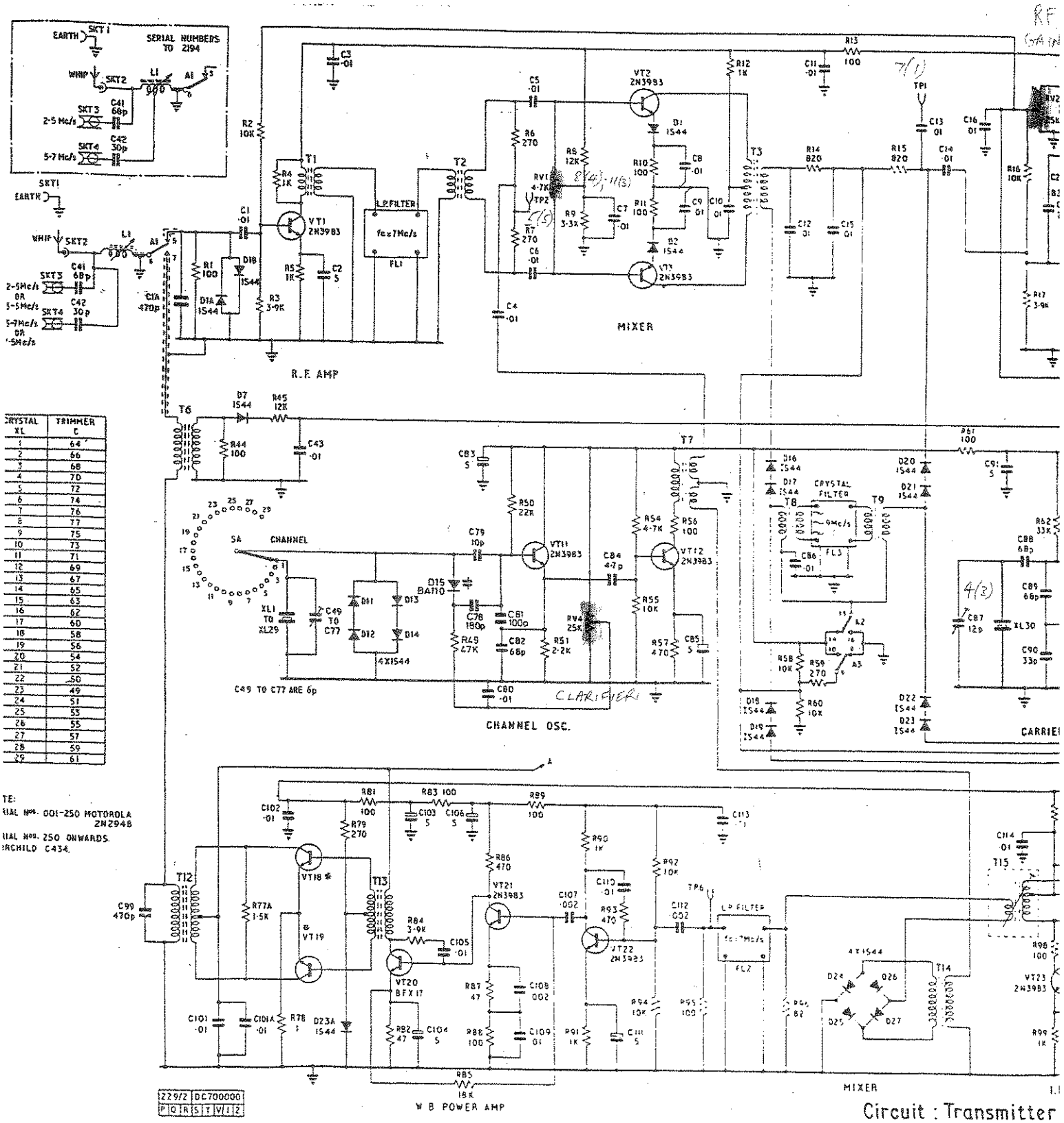
Fig.2



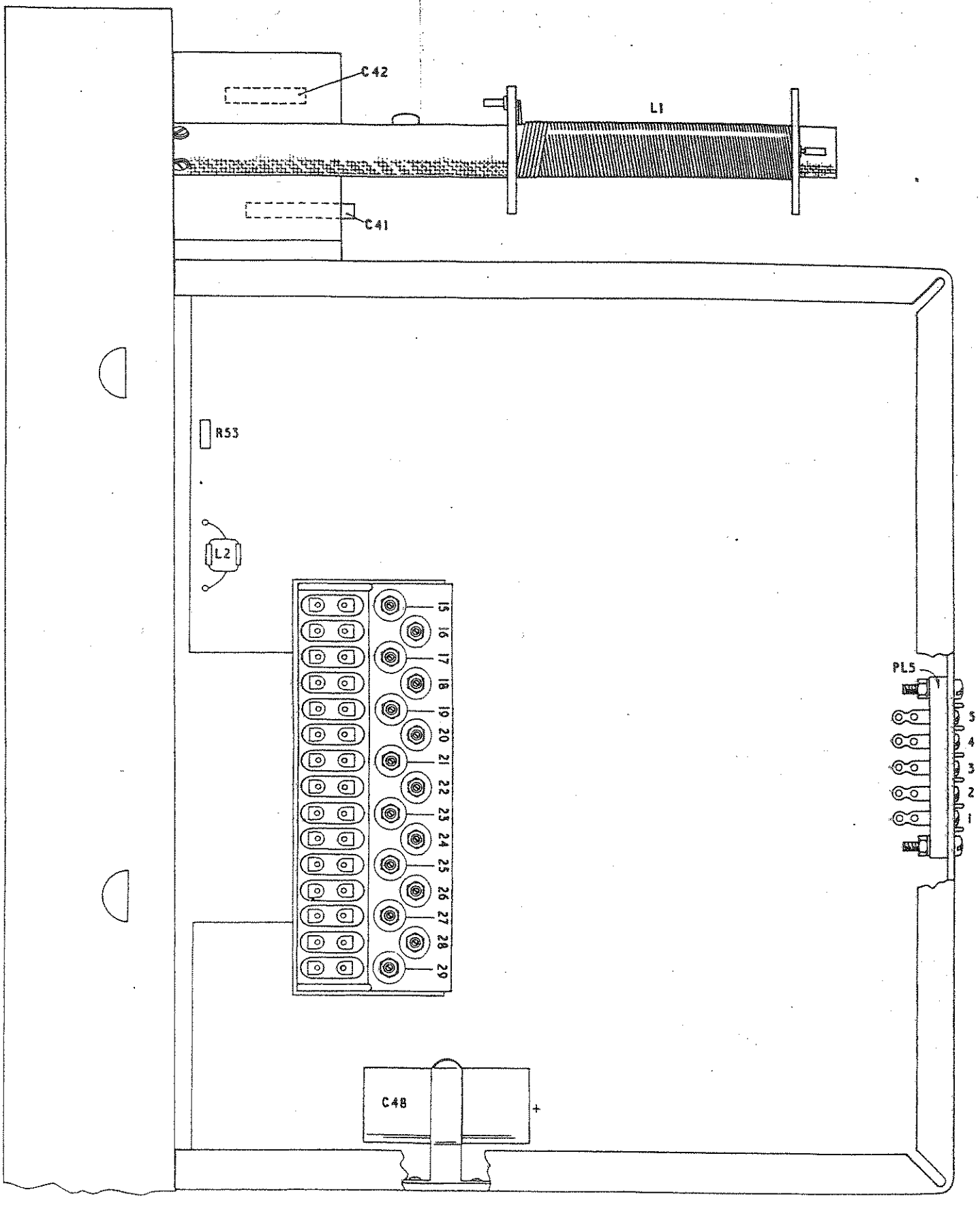
Circuit : Transmitter Receiver-TRA.906



CRYSTAL XL	TRIMMER C
1	64
2	66
3	68
4	70
5	72
6	74
7	76
8	77
9	75
10	73
11	71
12	69
13	67
14	65
15	63
16	62
17	60
18	58
19	56
20	54
21	52
22	50
23	49
24	51
25	53
26	55
27	57
28	59
29	61

TE:
RIAL Nos. 001-250 MOTOROLA 2N2948
RIAL Nos. 250 ONWARDS.
RCHILD C434.

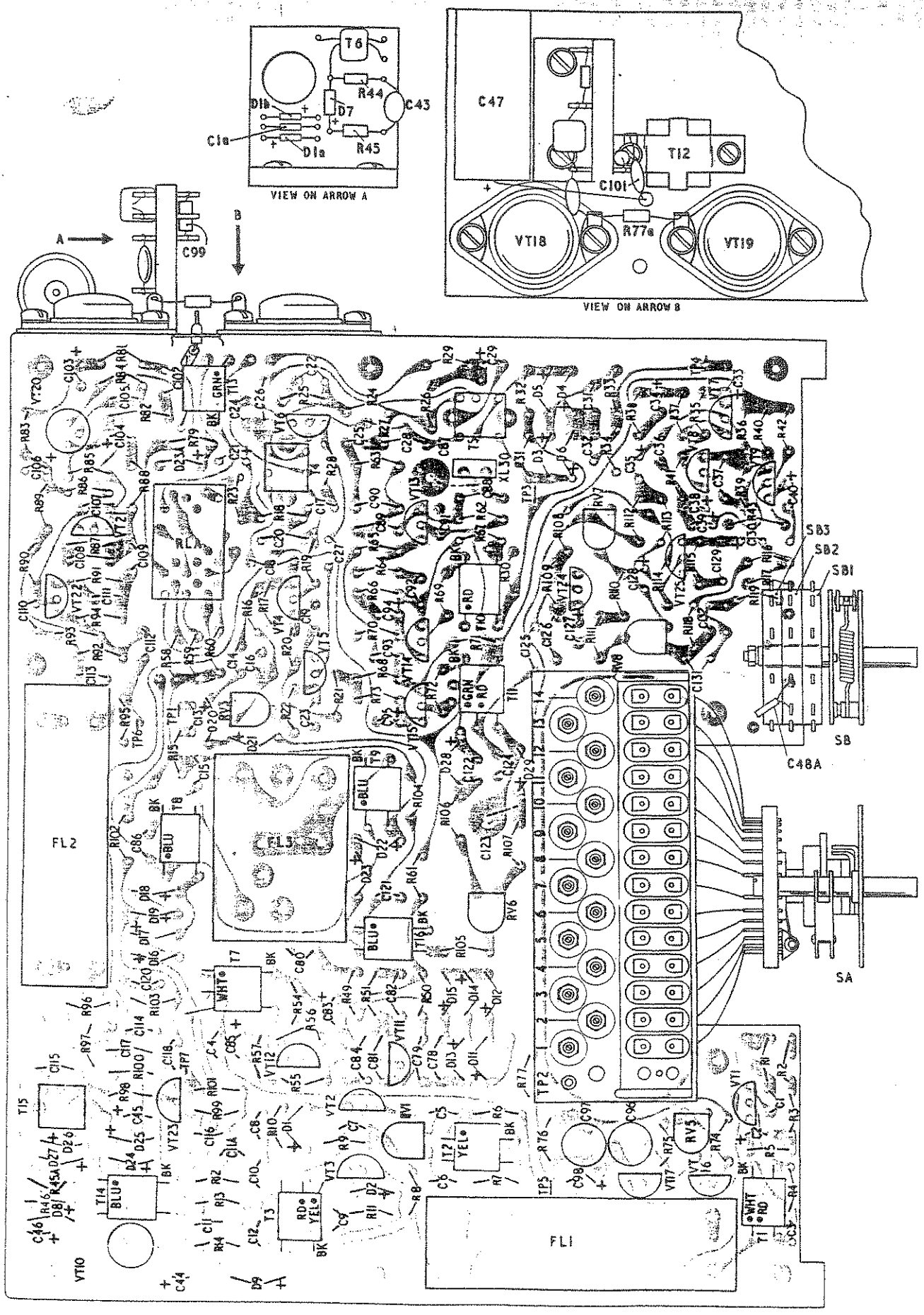
2292/2	DC700000
P	Q R S T V I 2



Underside View

it : TRA. 906

Fig. 4



Top View

Component