SQUADCAL

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

TECHNICAL MANUAL

RACAL

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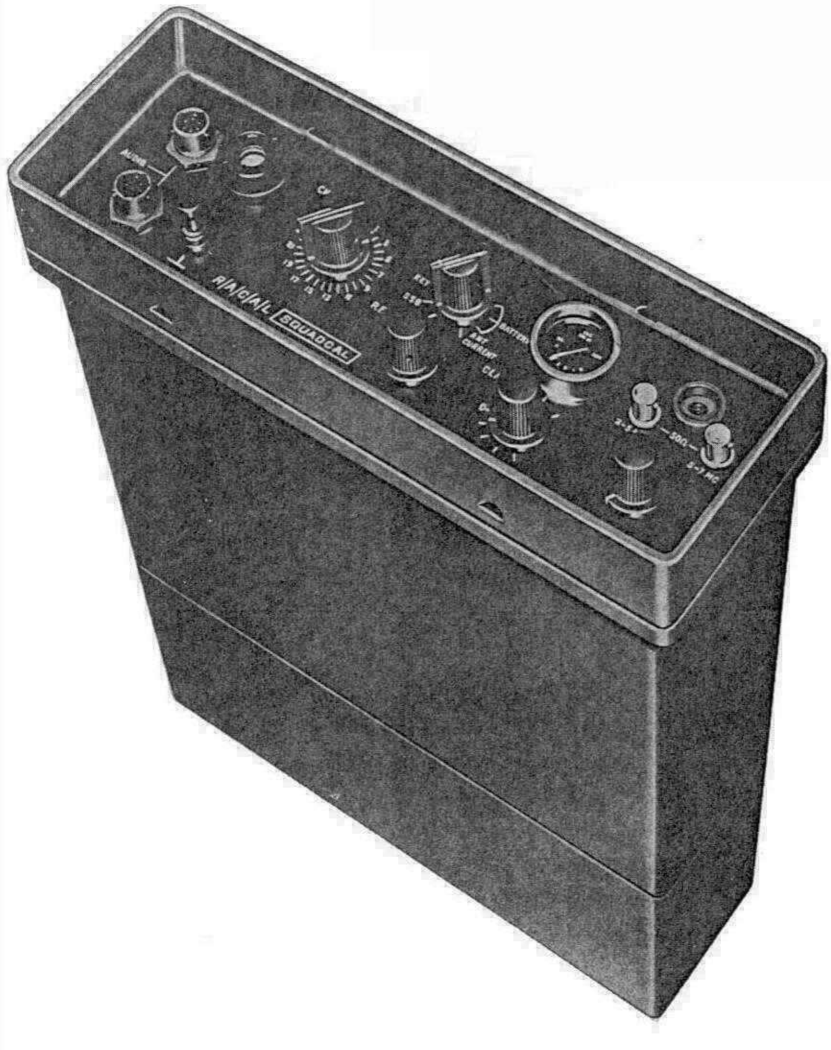

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HANDBOOK CHANGE INFORMATION

At RACAL, we continually strive to keep up with the latest electronic developments by adding circuit and component improvements to our equipments.

Sometimes, due to printing and despatch requirements, we are unable to incorporate these changes immediately into printed handbooks. Hence, your handbook may contain new change information on following pages.

The user is recommended to hand-amend this handbook, as soon as possible, in accordance with the corrections, if any, which follow this sheet.

NOTES

CONTENTS

ILLUSTRATIONS

TECHNICAL SPECIFICATION

GENERAL.

Frequency Range	2 to 7 Mc/s
Channels	29 located anywhere within the frequency range.
Modes of Operation	SSB Telephony SSB Keyed Tone Telegraphy Compatible AM (Carrier plus one sideband).
Radiated Sideband	Lower (Upper sideband available alternatively).
Frequency Stability	Over the temperature range 0°C to +40° the frequency change will be less than 200 c/s.
Antennas	8-foot Whip Dipole Slant Wire
Antenna Matching	Inbuilt ATU designed to match the above antennas. Single control tuning.
Dimensions	12 5/16 in. (31.2cm) wide x 4 3/8 in. (11 cm) high x 15 1/2 in. (39.4 cm) deep.
Weight	Less than 18 lb (8.2 kg) including haversack, handset, batteries and whip antenna. Weight of T/R unit only, with batteries - 11 lb. 8 oz (5.2 kg).
Temperature Range	Operating: -10°C to +55°C. Storage: -40°C to +70°C.
Sealing	Transmitter-Receiver case sealed and fitted with dessicator. Battery container may be removed without breaking main seal.
Batteries	(a) Three 6-volt lantern batteries, e.g. Ever Ready 996 or Burgess F4M. (b) ~~Twelve~~ Fourteen U2 torch cells, using similar battery container to (a), but with internal adaptor unit. (c) 3.5 Ampere-hour Nickel Cadmium rechargeable battery.
Standard Accessories	Haversack Handset 8-foot whip antenna.

Optional Accessories	Dipole antenna Slant wire antenna Ground spike Single-sided headset Noise-excluding headset Morse key with knee strap Self-contained loudspeaker amplifier Self-contained loudspeaker amplifier complete with power supply unit for vehicle use.
Storage of Accessories	Storage is provided in the standard haversack for all accessories listed above except the vehicle loudspeaker amplifier and power supply unit.
Front Panel Controls and Facilities.	(a) Channel Selector Switch (b) Function Switch selecting 'Off' 'SSB' 'Key' 'AM' 'Tune' (c) Antenna Tuning Control (d) R.F. Gain (e) Clarifier (f) Meter, monitoring battery voltage (on 'SSB', 'AM' and 'Key') and antenna current (on 'Tune'). (g) Whip antenna socket (h) Two 50 ohm coaxial sockets for dipole connector: (i) 2-5 Mc/s (ii) 5-7 Mc/s (i)) Ground connector. (k) Two accessory sockets for handset, headset or morse key or loudspeaker amplifier.

TRANSMITTER

Power Output	5 watts PEP into 50 ohm load
Overall AF Bandwidth	-6 dB at 400 c/s and 2·5 kc/s relative to response at 1 kc/s.
Harmonic Emissions	-40 dB relative to PEP output in 50 ohm load.
Spurious Emissions	-36 dB relative to PEP output in 50 ohm load.
Carrier Suppression	-35 dB minimum relative to 5 watts PEP output.

Unwanted Sideband Suppression.	-40 dB relative to PEP output at 1 kc/s modulating frequenc
Intermodulation Distortion	-25 dB relative to 5 watts PEP output.
Power Consumption	550 mA at 18 volts on speech peaks.

RECEIVER

Sensitivity	1 mW AF output for 1 microvolt p.d. RF input, 50 ohm sour
Signal/Noise Ratio	Under the conditions given for sensitivity the signal/noise ratio is 15 dB minimum.
Selectivity	-6 dB bandwidth - 2.4 kc/s minimum -40 dB bandwidth - 5.5. kc/s maximum
Image Rejection	70 dB
Spurious Responses	All spurious response attenuated by at least 50 dB.
Blocking	The blocking ratio for 3 dB change in wanted output is great than 50 dB for wanted signal levels up to 100 microvolts (50 source) and interfering signals greater than 20 kc/s off-tune.
Overall AF Bandwidth	-6 dB at 400 c/s and 2.5 kc/s relative to response at 1 kc/s.
AF Power Output	4 mW maximum
Distortion	5% maximum at 4 mW
Clarifier Range	± 200 c/s continuously variable
Power Consumption	70 mA at 18 volts.

N.B. The above mentioned performance figures are measured with a battery power supply of not less than 18 volts.

CHAPTER 1

INTRODUCTION

1. The RACAL TRA. 906 is a compact, lightweight transmitter-receiver which operates in the frequency range 2 to 7 megacycles. A maximum of 29 crystal controlled channels is provided, channel changing being facilitated by a selector switch. The r.f. output power is 5 watts p.e.p. minimum, the input power under these conditions being approximately 10 watts. The battery supply is sufficient for a continuous operation of 15 hours, using a transmit/receive ratio of 1:9. The r.f. output power at the end of this period will be not more than 3 dB down on the nominal level.

2. The unit offers three modes of operation, single sideband telephony, compatible amplitude modulation telephony and keyed tone telegraphy.

3. The primary role of the unit is man-portable or field application and to this end the operating procedure has been minimised. The inclusion of a CLARIFIER control, which provides an adjustment of at least ±200 c/s of channel frequency, allows the unit to be 'netted' with other equipments whose channel frequency accuracy may be less reliable. The power supply requirements are met by a battery pack which forms the lower part of the unit.

4. For man-portable operation the unit uses a standard eight foot sectional whip antenna. The performance of the unit is enhanced on static operation by the employment of a slant wire antenna or a dipole antenna. The unit incorporates built-in matching facilities for all these types of antenna.

6. A variety of optional accessories can be supplied with the unit. The whip aerial and the microphone-telephone handset however are standard to the equipment. The unit is provided in a stout canvas haversack which frame mounts on the operator's back. The haversack has sufficient storage compartments to cater for all the optional accessories.

7. The accessories referred to are as shown below:-

(a) Dipole antenna
(b) Slant wire antenna
(c) Earthing spike
(d) Single earpiece headset
(e) Noise excluding headset
(f) Morse key with kneestrap
(g) Self contained loudspeaker amplifier.

CHAPTER 2

GENERAL DESCRIPTION

1. The transmitter-receiver TRA. 906 is contained in a fully waterproof 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 dessicator 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 megacycles.

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 ~~twelve~~ U2 type torch cells, or one 3.5AH nickel cadmium re-chargeable battery, whichever complement meets the user's requirement.

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. indicates fully serviceable batteries whereas a reading of $\frac{1}{3}$ f.s.d. or less in the transmit state, indicates discharged batteries.

7. The contact arrangement, by which the battery terminals are connected to the internal transmitter-receiver supply socket, consists of a concentric ring layout such that, provided the batteries are inserted terminals uppermost, precludes incorrect positioning of the terminals. (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 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, AM 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 at least $\pm$200 c/s of the channel frequency selected.
(e)	TUNE	A variable inductor, used to obtain optimum performance of the various antenna types.

10. The total weight of the transmitter-receiver, including the haversack, 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 1A 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.

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. Remove the 16 retaining screws from the flange adjacent to 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.

7. 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 capacitator C87. (This crystal is soldered into the printed circuit board by the manufacturer to meet the requirement for l.s.b. or u.s.b. operation, as specified by the user). Replace the two screening plates.

8. 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.

9. The transmitter-receiver may be supplied with the channel crystals installed, if the customer requires this. In such cases the trimmer capacitors of the crystals fitted will be correctly set by the manufacturer.

10. Where a new channel frequency has to be set up and where no test equipment is immediately available, the trimmer adjustment is 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.

11. 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 = fcr + 8.9985 Mc/s for l.s.b. operation
or = fcr + 9.0015 Mc/s for u.s.b. operation
b) Carrier crystal frequency = 8.9985 Mc/s for l.s.b. operation
or = 9.0015 Mc/s for u.s.b. operation

Where fcr = allocated channel frequency in Mc/s.

12. 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 as the two flanges are fastened together.

13. Replace the transmitter-receiver case in the haversack and firmly tighten the haversack frame retaining screws.

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 slant wire antenna. Enhanced performance of the equipment is to be expected from the use of the latter antenna types.

2. Whip antenna

(1) Plug the flexible connector into the WHIP antenna socket on the control panel.

(2) Assemble the sectional whip antenna and insert the antenna plug into the free end of the flexible connector.

3. Slant 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. (It should be remembered that moist ground provides a more effective earth than dry ground).

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 transmission/reception. (Where omni-directional transmission or reception is required, the orientation of the antenna can be as convenient, provided it is horizontally erected).

(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 one second delay occurs between the opening of the morse key and the changeover to receive condition.

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 at least $\pm$200 c/s of the oscillator frequency.

4. The channel oscillator operates at a frequency of 8.9985 Mc/s above the signal frequency for l.s.b. working, or at 9.0015 Mc/s 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 Mc/s, over a bandwidth of 2400 c/s.

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 Mc/s for l.s.b. working or at 9.0015 Mc/s 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 (1K) 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. This output resolves itself as 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 Mc/s, 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 Mc/s filter FL1. This filter attenuates signals above 7 Mc/s. 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 Mc/s (l.s.b.) or 9.0015 Mc/s (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 Mc/s, this being the difference frequency between the parallel and differential input signals.

In order that a second harmonic of a 4.5 Mc/s 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 Mc/s (second harmonic of 4.5 Mc/s).

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 Mc/s 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. This feedback is also under the indirect control of RV3 which, when adjusted, varies the base current to transistor VT5. This transistor is series connected with emitter decoupler C27. The effectiveness of C27 as a decoupler is varied by the conduction rate of VT5, and thus the negative feedback level of VT4 is controlled.

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 Mc/s or 9.0015 Mc/s 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 if the TRA. 906 consists of an a.f. amplifier, balanced modulator, i.f. amplifier, mixer and 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 circuit makes the emitter earth circuit of VT16 when the key is pressed.

31. The oscillation starting condition of the circuit is controlled by the potentiometer RV5. The frequency of operation is approximately 670 c/s.

32. Balanced modulator

This circuit is made up of diodes D28 and D29 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 VT24.

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 Mc/s 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. L.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 a 4 diode series mixer using diodes D24 and 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 Mc/s. 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 [redacted] 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 ramge 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 SB3a connects the meter between the battery line and earth. In the TUNE position of SB, the meter is connected by wafer SB3a 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 VT16 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 3 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, SB2 and SB3, numbered from the panel end of the spindle. Each wafer is further sub-divided into parts 'a' and 'b' containing contacts 12 (wiper) 1,2,3,4,5 and 6 (wiper) 7,8,9,10,11 respectively. The mechanical details of the switch are illustrated in fig. 4 while the circuit functions of the various positions are described below:-

a) SSB position

Wafer	Tags	Function
SB1a		nil
SB1b		nil
SB2a	12 and 2	Completes power supply circuit.
SB2b	6 and 8	Connects PTT circuit between AUDIO sockets (SK6 and SK7) pins C and relay RLA.
SB3a	12 and 2	Connects meter across power supply.
SB3b		nil

b) KEY position

Wafer	Tags	Function
SB1a		nil
SB1b	6 and 9	Connects pins E of AUDIO sockets to tone oscillator.
SB2a	12 and 3	Completes power supply circuit.
SB2b	6 and 9	Connects AUDIO sockets, pins E via SB1b to relay RLA.
SB3a	12 and 3	Connects meter across power supply.
SB3b	6 and 9	Connects CR circuit of C48 and R48 across relay RLA coil.

c) A M position

Wafer	Tags	Function
SB1a	12 and 4	Connects collector of VT 15 via C20 to i.f. amplifier VT23 to provide re-inserted carrier.
SB1b		nil
SB2a	12 and 4	Completes power supply circuit.
SB2b	6 and 10	Connects PTT circuit between AUDIO sockets pins C and relay RLA.
SB3a	12 and 4	Connects meter across power supply.
SB3b		nil

d) TUNE position

Wafer	Tags	Function
SB1a		nil
SB1b	6 and 11	Earths the emitter of VT16 in tone oscillator. The oscillator then functions to provide an audio signal for the TUNE condition.
SB2a	12 and 5	Completes power supply circuit.
SB2b	6 and 11	Connects an 'earth' to operate relay RLA to 'transmit' condition.
SB3a	12 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 CA470	
(c)	AF Power Output meter	Input Impedance - 300 Ω. Range - 5 mW. e.g. Marconi TF893A.
(d)	Oscilloscope	Frequency Range: 0-15 Mc/s minimum. Sensitivity: 100 mV/cm.
(e)	Frequency Counter	Frequency Range: 0-15 Mc/s minimum. e.g. Racal SA.535 plus SA.548.
(f)	Valve Voltmeter	Frequency Range: 200 c/s to 16 Mc/s minimum. Input Voltage: 100 mV minimum.
(g)	AF Signal Generator	Frequency Range: 100 c/s to 20 kc/s minimum.
(h)	RF Signal Generator	Frequency Range: 2 to 25 Mc/s minimum. e.g. Marconi TF 144H.
(j)	RF Power Meter	Frequency Range: up to 7 Mc/s 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 Mc/s and 7 Mc/s should be included if possible, i.e. 10.9985 Mc/s and 15.9985 Mc/s for l.s.b. working or 11.0015 Mc/s and 18.0015 Mc/s 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 T/R switch to the 'R' position.

(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 Mc/s (or 9.0015 Mc/s 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 grubscrews 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 at least ±200 c/s 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 kc/s, 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 kc/s and note the frequencies at which the a.f. output falls by 3 dB relative to 1 mW. These frequencies should be 250 c/s minimum and 10 kc/s maximum.

(7) Disconnect the signal generator and valve voltmeter.

RECEIVER IF AMPLIFIER

7. (1) Connect the r.f. signal generator (item h), set to 9 Mc/s, to test point TP1.

   (2) Check that the RF GAIN control (RV2) is set to maximum.

   (3) Set potentiometer RV3 fully clockwise.

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

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

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

   (7) Check that the i.f. response is approximately symmetrical about 9 Mc/s.

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

RECEIVER SENSITIVITY and SIGNAL/NOISE RATIO

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

   (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 Mc/s (channel crystal = 10.9985 Mc/s for l.s.b. or 11.0015 Mc/s for u.s.b.). If such crystals are not available, use the nearest channel frequency to 2 Mc/s that is available.

   (4) Adjust potentiometer RV1 for 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 Mc/s (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 Mc/s (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 c/s to 350 c/s and 2.4 kc/s to 2.6 kc/s, 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 Mc/s Check

(1) Set the r.f. signal generator to 2 Mc/s and the CHANNEL switch to obtain a 2 Mc/s (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 Mc/s 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 Mc/s or the nearest channel frequency to 7 Mc/s available.

I.F. Breakthrough

(6) Set the CHANNEL switch to obtain a channel frequency of 2 Mc/s.

(7) Tune the r.f. signal generator to 9 Mc/s 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 Mc/s.

Image Check

(9) Reset the CHANNEL switch to obtain the 2 Mc/s channel frequency (or nearest).

(10) Tune the r.f. signal generator to approximately 20 Mc/s 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 Mc/s is used, the r.f. signal generator should be tuned to a frequency of twice the i.f. i.e., 18 Mc/s, plus the channel frequency to be used.

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

(12) Retune the r.f. signal generator to 25 Mc/s (or to 18 Mc/s 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 Mc/s (or nearest available) still set, adjust the r.f. signal generator frequency to obtain a 1 mW a.f. output level at 1 kc/s 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 'TX' .

(5) Set the output level of the a.f. signal generator to give a valve voltmeter reading of 200 mV at 1 kc/s. 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 kc/s until the voltmeter reads - 3 dB relative to 200 mV. The frequencies at which this occurs should be 200 c/s minimum and 10 kc/s 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 Mc/s 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 to socket SK3 (2 - 5 Mc/s).

(2) Set the CHANNEL switch to obtain a channel frequency of 2 Mc/s (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 Mc/s) and select a channel frequency of 7 Mc/s (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.

TRANSMITTER OUTPUT (AM)

17. (1) Set the system switch to OFF.

(2) Set the CHANNEL switch to obtain a 2 Mc/s (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-adjustement of the TUNE control.

(6) Repeat operations (2), (4) and (5) and 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.

SUSPECT CIRCUIT	COMMENT	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	VT2 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

Orders for Spare Parts

In order to expedite handling of spare part orders, please quote:-

(1) Type and serial number of equipment.

(2) Circuit reference, description and manufacturer of part required.

(3) Quantity required.

Joint-Service Numbers

(also known as CCA or NATO Stock Numbers)

Commercial and private users will note that the above numbers have been included in this section; these are for assisting Service users in the provision of spare components.

NOTES ON COMPONENT CHANGES AND ADDITIONS

Cct. Ref.	Value	Description	Rat.	Tol. %	N. A. T. O. No.	Manufacturer

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Manufacturer.
Resistors					
R1	100	Composition	1/10	10	Erie 15
R2	10k	Composition	1/10	10	Erie 15
R3	3.9k	Composition	1/10	10	Erie 15
R4	1k	Composition	1/10	10	Erie 15
R5	1k	Composition	1/10	10	Erie 15
R6	270	Composition	1/10	10	Erie 15
R7	270	Composition	1/10	10	Erie 15
R8	12k	Composition	1/10	10	Erie 15
R9	3.3k	Composition	1/10	10	Erie 15
R10	100	Composition	1/10	10	Erie 15
R11	100	Composition	1/10	10	Erie 15
R12	1k	Composition	1/10	10	Erie 15
R13	100	Composition	1/10	10	Erie 15
R14	820	Composition	1/10	10	Erie 15
R15	820	Composition	1/10	10	Erie 15
R16	10k	Composition	1/10	10	Erie 15
R17	3.9k	Composition	1/10	10	Erie 15
R18	100	Composition	1/10	10	Erie 15
R19	100	Composition	1/10	10	Erie 15
R20	47	Composition	1/10	10	Erie 15
R21	1k	Composition	1/10	10	Erie 15
R22	10k	Composition	1/10	10	Erie 15
R23	100	Composition	1/10	10	Erie 15
R24	10k	Composition	1/10	10	Erie 15
R25	3.9k	Composition	1/10	10	Erie 15
R26	100	Composition	1/10	10	Erie 15
R27	100	Composition	1/10	10	Erie 15
R28	1k	Composition	1/10	10	Erie 15
R29	100	Composition	1/10	10	Erie 15
R30	100	Composition	1/10	10	Erie 15
R31	470	Composition	1/10	10	Erie 15
R32	470	Composition	1/10	10	Erie 15
R33	1k	Composition	1/10	10	Erie 15
R34	22k	Composition	1/10	10	Erie 15
R35	270k	Composition	1/10	10	Erie 15

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Manufacturer
Resistors (contd.)					
R36	3.3k	Composition	1/10	10	Erie 15
R37	68	Composition	1/10	10	Erie 15
R38	68	Composition	1/10	10	Erie 15
R39	18k	Composition	1/10	10	Erie 15
R40	1k	Composition	1/10	10	Erie 15
R41	1k	Composition	1/10	10	Erie 15
R42	68	Composition	1/10	10	Erie 15
R43	470	Composition	$\frac{1}{4}$	10	Morganite Type S
R44	100	Composition	1/10	10	Erie 15
R45	12k	Composition	1/10	10	Erie 15
R45A	22	Composition	1/10	10	Erie 15
R46	1k	Composition	1/10	10	Erie 15
R47	120k	Composition	1/10	10	Erie 15
R48	220	Composition	1/10	10	Erie 15
R49	47k	Composition	1/10	10	Erie 15
R50	22k	Composition	1/10	10	Erie 15
R51	2.2k	Composition	1/10	10	Erie 15
R52	1.5k	Composition	1/10	10	Erie 15
R53	470	Composition	1/10	10	Erie 15
R54	4.7k	Composition	1/10	10	Erie 15
R55	10k	Composition	1/10	10	Erie 15
R56	100	Composition	1/10	10	Erie 15
R57	470	Composition	1/10	10	Erie 15
R58	10k	Composition	1/10	10	Erie 15
R59	270	Composition	1/10	10	Erie 15
R60	10k	Composition	1/10	10	Erie 15
R61	100	Composition	1/10	10	Erie 15
R62	33k	Composition	1/10	10	Erie 15
R63	5.6k	Composition	1/10	10	Erie 15
R64	3.3k	Composition	1/10	10	Erie 15
R65	12k	Composition	1/10	10	Erie 15
R66	10k	Composition	1/10	10	Erie 15
R67	10k	Composition	1/10	10	Erie 15
R68	10k	Composition	1/10	10	Erie 15
R69	100	Composition	1/10	10	Erie 15

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Manufacture.
Resistors (contd.)					
R70	470	Composition	1/10	10	Erie 15
R71	10k	Composition	1/10	10	Erie 15
R72	100	Composition	1/10	10	Erie 15
R73	470	Composition	1/10	10	Erie 15
R74	2.2k	Composition	1/10	10	Erie 15
R73A	-	see under MISCELLANEOUS			
R75	5.6k	Composition	1/10	10	Erie 15
R76	5.6k	Composition	1/10	10	Erie 15
R77	5.6k	Composition	1/10	10	Erie 15
R77A	1.5k	Composition	1/10	10	Erie 15
R78	1	W.W. Vitreous	1.5	10	Painton MVIA
R79	270	Compositions	1/10	10	Erie 15
R80	Deleted				
R81	100	Composition	1/10	10	Erie 15
R82	47	Composition	½	10	Morganite Type S
R83	100	Composition	1/10	10	Erie 15
R84	3.9k	Composition	1/10	10	Erie 15
R85	18k	Compositions	1/10	10	Erie 15
R86	470	Composition	1/10	10	Erie 15
R87	47	Composition	1/10	10	Erie 15
R88	100	Composition	1/10	10	Erie 15
R89	100	Composition	1/10	10	Erie 15
R90	1k	Composition	1/10	10	Erie 15
R91	1k	Composition	1/10	10	Erie 15
R92	10k	Composition	1/10	10	Erie 15
R93	1k	Composition	1/10	10	Erie 15
R94	10k	Composition	1/10	10	Erie 15
R95	100	Composition	1/10	10	Erie 15
R96	82	Composition	1/10	10	Erie 15
R97	100	Composition	1/10	10	Erie 15
R98	100	Composition	1/10	10	Erie 15
R99	1k	Composition	1/10	10	Erie 15
R100	10k	Composition	1/10	10	Erie 15
R101	3.9k	Composition	1/10	10	Erie 15
R102	820	Composition	1/10	10	Erie 15
R103	2.2k	Composition	1/10	10	Erie 15

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Manufacture.
Resistors (contd.)					
R104	820	Composition	1/10	10	Erie 15
R105	220	Composition	1/10	10	Erie 15
R106	100	Composition	1/10	10	Erie 15
R107	100	Composition	1/10	10	Erie 15
R108	10k	Composition	1/10	10	Erie 15
R109	47k	Composition	1/10	10	Erie 15
R110	4.7k	Composition	1/10	10	Erie 15
R111	4.7k	Composition	1/10	10	Erie 15
R112	47k	Composition	1/10	10	Erie 15
R113	47k	Composition	1/10	10	Erie 15
R114	10k	Composition	1/10	10	Erie 15
R115	27k	Composition	1/10	10	Erie 15
R116	10k	Composition	1/10	10	Erie 15
R117	10k	Composition	1/10	10	Erie 15
R118	1k	Composition	1/10	10	Erie 15
R119	1k	Composition	1/10	10	Erie 15
Potentiometers					
RV1	4.7k	Linear			Morganite 62H
RV2	25k	Linear (R.F. Gain)			Plessey MH1
RV3	100k	Linear (I.F. Gain)			Plessey MH1
RV4	25k	Log. (Clarifier)			Plessey MH1
RV5	4.7k	Linear (Tone osc.)			Morganite 62H
RV6	100	Linear (Balance Pot.)			Morganite 62H
RV7	4.7k	Linear (Set tone level)			Morganite 62H
RV8	4.7k	Linear (Set mod level)			Morganite 62H
Capacitors			V.		
C1	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C2	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C3	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C4	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C5	.01µF	Disc ceramic	100	-20 +80	Erie CD 801

Cct. Ref.	Value ohms	Description	Rat. W.	Tol. %	Manufacture
Capacitors (contd.)					
C6	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C7	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C8	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C9	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C10	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C11	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C11A	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C12	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C13	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C14	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C15	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C16	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C17	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C18	2.7pF	Disc ceramic	500	± .5pF	Erie 861/NPO
C19	.01µF	Disc ceramic	100	-20 +80	Erie CD 801

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
Capacitors (contd.)					
C20	100pF	Polystyrene	125	2½	Suflex HS7/D
C21	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C22	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C23	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C24	10pF	Polystyrene	125	±1pF	Suflex HS7/D
C25	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C26	2.7pF	Disc ceramic	500	±.5pF	Erie 861/NPO
C27	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C28	100pF	Polystyrene	125	2½	Suflex HS7/D
C29	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C30	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C31	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C32	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C33	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C34	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C35	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C36	01µF	Disc ceramic	100	-20 +80	Erie CD 801
C37	1000pF	Polystyrene	125	10	Suflex HF 10/F
C38	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C39	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C40	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C41	68pF	Ceramic	-	5	TCC LPS 6640
C42	27pF	Ceramic	-	5	TCC LPS 6625
C43	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C44	5µF	Tantalum	25	-20 +50	STC TAAG 5/25

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
<u>Capacitors (contd.)</u>					
C45	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C46	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C47	500μF	Electrolytic	25	-20 +50	Hunts MEF 37T L37/1
C48	500μF	Electrolytic	25	-20 +50	Hunts MEF 37T L37/1
C49 to C77	6pF	Variable	-	-	Mullard C004EA/6E
C78	22pF	Polystyrene	125	±1pF	Suflex HS7/D
C79	10pF	Polystyrene	125	±1pF	Suflex HS7/D
C80	Deleted				
C81	180pF	Polystyrene	125	2½	Suflex HS7/D
C82	68pF	Polystyrene	125	2½	Suflex HS7/D
C83	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C84	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C85	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C86	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C87	12pF	Tubular Ceramic trimmer.			Mullard C004EA/12E
C88	68pF	Polystyrene	125	2½	Suflex HS7/D
C89	68pF	Polystyrene	125	2½	Suflex HS7/D
C90	33pF	Polystyrene	125	±1pF	Suflex HS7/D
C91	.5μF	Disc ceramic	100	-20 +80	Erie CD 801
C92	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C93	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C94	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C95	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C96	.047μF	Polycap	400	10	Suflex
C97	.047μF	Polycap	400	10	Suflex

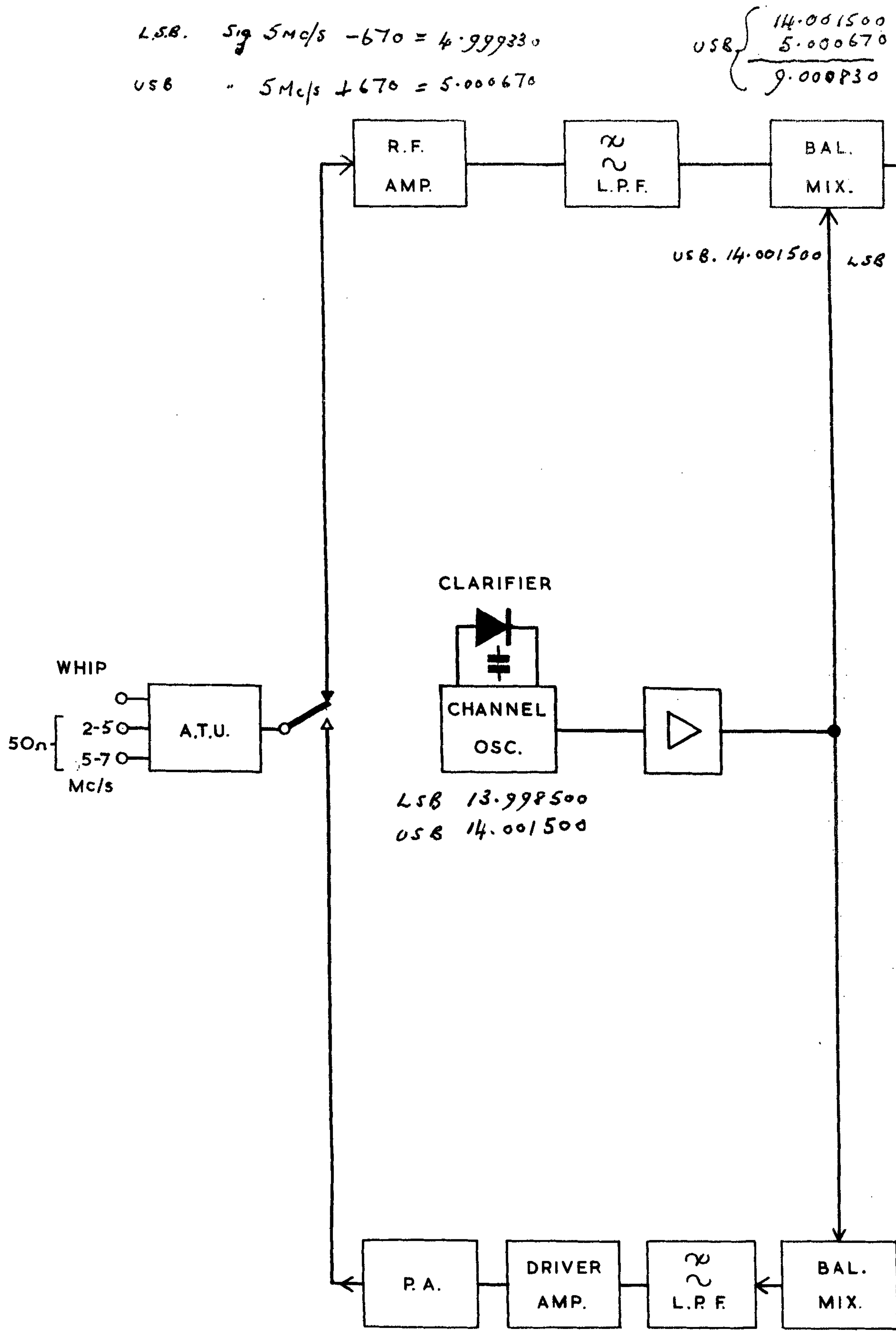
Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
Capacitors (contd.)					
C98	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C99	470pF	Polystyrene	125	2½	Suflex HS7/F
C100	Deleted				
C101	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C102	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C103	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C104	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C105	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C106	5µF	Tantalum	25	-20 +50	STC TAAG 5/25
C107	2000pF	Disc ceramic	100	-20 +80	Erie CD 801
C108	2000pF	Polystyrene	30	10	Suflex HS7/B
C109	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C110	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C111	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C112	2000pF	Disc ceramic	100	-20 +80	Erie CD 801
C113	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C114	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C115	100pF	Polystyrene	125	2½	Suflex HS7/D
C116	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C117	2.7pF	Disc ceramic	500	±.5pF	Erie 861/NPO
C118	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C119	Deleted				
C120	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C121	.01µF	Disc ceramic	100	-20 +80	Erie CD 801
C122	2.7pF	Disc ceramic	500	±.5pF	Erie 861/NPO

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
Capacitors (contd.)					
C123	6p	Tubular ceramic trimmer			Mullard C004EA/6E
C124	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C125	.22μF	Polyester	100	20	Wima Type MK5
C126	470pF	Polystyrene	125	2½	Suflex HS7/F
C127	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C128	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C129	470pF	Polystyrene	125	2½	Suflex HS7/F
C130	5μF	Tantalum	25	-20 +50	STC TAAG 5/25
C131	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
C132	.01μF	Disc ceramic	100	-20 +80	Erie CD 801
Inductors					
L1		Aerial tuning coil assembly			Racal CT 710000
L2		AF choke			Racal CT 710009
Transformers					
T1		RF. amp transformer			Racal CT 710011
T2		Mixer input transformer			Racal CT 710006
T3		Mixer output transformer			Racal CT 710002
T4		1st I.F. transformer			Racal CT 710012
T5		2nd I.F. transformer			Racal CT 710012
T6		AE current transformer			Racal CT 710008
T7		Buffer amp transformer			Racal CT 710003
T8		9 Mc/s filter transformer			Racal CT 710005
T9		9 Mc/s filter transformer			Racal CT 710005
T10		Buffer amp transformer			Racal CT 710007
T11		Buffer amp transformer			Racal CT 710010
T12		P.P. output transformer			Racal CT 710001
T13		P.P. input transformer			Racal CT 710004
T14		Tx. mixer transformer			Racal CT 710005
T15		Tx. I.F. transformer			Racal CT 710012
T16		Bal. mod output transformer			Racal CT 710005

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
Switches					
SA		Crystal selector- 29 position rotary.			Racal AR 711003
SB		System switch- 5 position rotary.			Racal AR 711004
Transistors					
VT1		Silicon transistor			Texas TI 407
VT2		Silicon transistor			Texas TI 407
VT3		Silicon transistor			Texas TI 407
VT4		Silicon transistor			Texas TI 407
VT5		Silicon transistor			Texas TI 407
VT6		Silicon transistor			Texas TI 407
VT7		Silicon transistor			Texas 2N 3711
VT8		Silicon transistor			Texas 2N 3711
VT9		Silicon transistor			Texas 2N 3711
VT10		Silicon transistor			RCA 2N 3053
VT11		Silicon transistor			Texas TI 407
VT12		Silicon transistor			Texas TI 407
VT13		Silicon transistor			Texas TI 407
VT14		Silicon transistor			Texas TI 407
VT15		Silicon transistor			Texas TI 407
VT16		Silicon transistor			Texas 2N 3711
VT17		Silicon transistor			Texas 2N 3711
VT18		Silicon transistor			Motorola 2N 2948
VT19		Silicon transistor			Motorola 2N 2948
VT20		Silicon transistor			Motorola 2N 2951
VT21		Silicon transistor			Texas TI 407
VT22		Silicon transistor			Texas TI 407
VT23		Silicon transistor			Texas TI 407
VT24		Silicon transistor			Texas TN 3711
VT25		Silicon transistor			Texas TN 3711
Diodes					
D1		Silicon diode			Texas IS 44
D2		Silicon diode			Texas IS 44
D3		Silicon diode			Texas IS 44
D4		Silicon diode			Texas IS 44
D5		Silicon diode			Texas IS 44

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
<u>Diodes (contd.)</u>					
D6		Silicon diode			Texas IS 44
D7		Silicon diode			Texas IS 44
D8		Silicon diode			Texas IS2 100A
D9		Silicon diode			I.R.C. 10 DI
D10	Deleted				
D11		Silicon diode			Texas IS 44
D12		Silicon diode			Texas IS 44
D13		Silicon diode			Texas IS 44
D14		Silicon diode			Texas IS 44
D15		Silicon diode			STC BA 110
D16		Silicon diode			Texas IS 44
D17		Silicon diode			Texas IS 44
D18		Silicon diode			Texas IS 44
D19		Silicon diode			Texas IS 44
D20		Silicon diode			Texas IS 44
D21		Silicon diode			Texas IS 44
D22		Silicon diode			Texas IS 44
D23		Silicon diode			Texas IS 44
D23A		Silicon diode			Texas IS 44
D24		Silicon diode			Texas IS 44
D25		Silicon diode			Texas IS 44
D26		Silicon diode			Texas IS 44
D27		Silicon diode			Texas IS 44
D28		Silicon diode			Texas IS 44
D29		Silicon diode			Texas IS 44
<u>Sockets</u>					
SK1		Earth connector			Belling Lee L1301
SK2		Whip aerial socket. Integral with chassis.			
SK3		Dipole aerial socket.			UG 657U (Transradio BN5/5B)
SK4		Dipole aerial socket.			UG 657U (Transradio BN5/5B)
SK6		Audio socket.			Thorn Pygmy PT 67A-10-6-5.
SK7		Audio socket.			Thorn Pygmy PT 67A-10-6-5.

Cct. Ref.	Value ohms	Description	Rat. V.	Tol. %	Manufacturer
Relays					
RLA		Transmit/receive relay. 4 C/O-LD coil - 14 min. 18V max. - 700Ω			Siemens-08141-007
Fuses					
FS1		Power supply fuse. 0.5A			
Filters					
FL1		7 Mc/s - Low-pass			Racal AR 71002
FL2		7 Mc/s - Low-pass			Racal AR 71002
FL3		Xtal filter - 9 mc/s			McCoy Silver Sentinel - 9 Mc/s.
Miscellaneous					
		Dessicator mounting (Whitworth thread) This item is supplied complete with a dessicator insert.			Silica Gel Ltd. Type IDA1
		Dessicator insert.			Silica Gel Ltd. Type IDA1-80
R73 A		This component value is selected on test and may vary with different equipments. The specific value used in each equipment is marked on the inside of the 'U' shaped chassis adjacent to meter M1. The component used will in all cases be a 1/10 watt, 5%, ERIE 15.			



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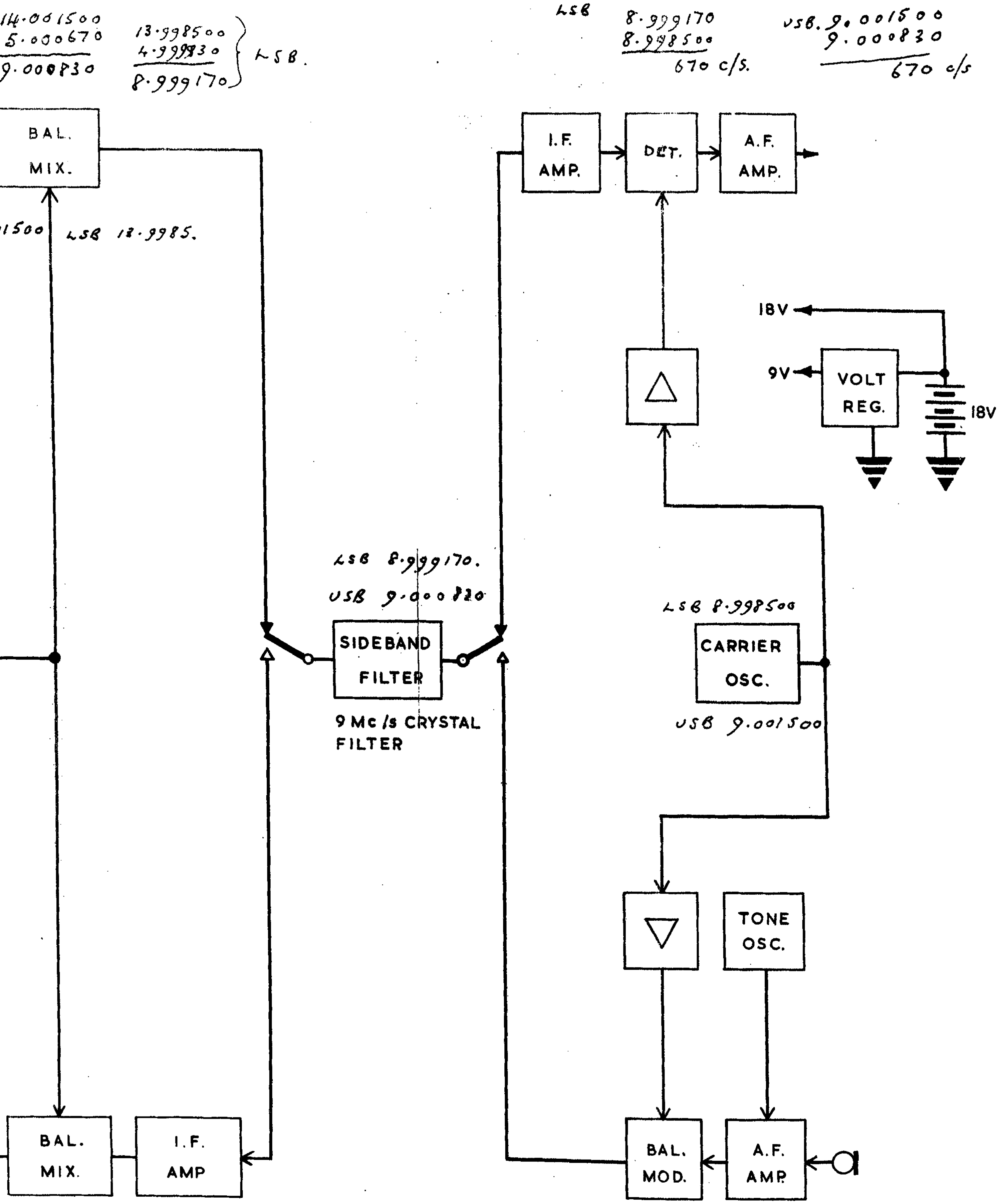
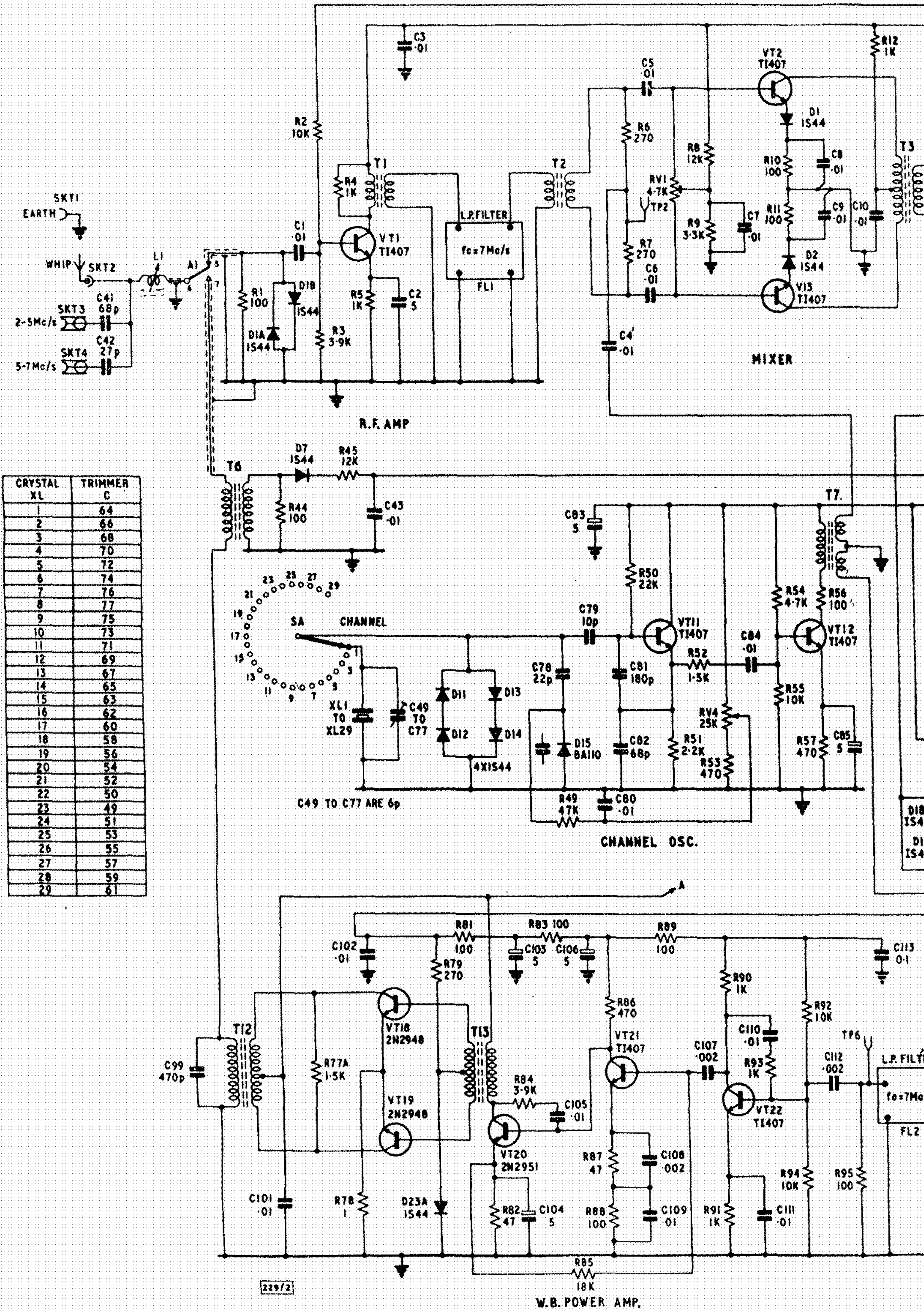
Block Di

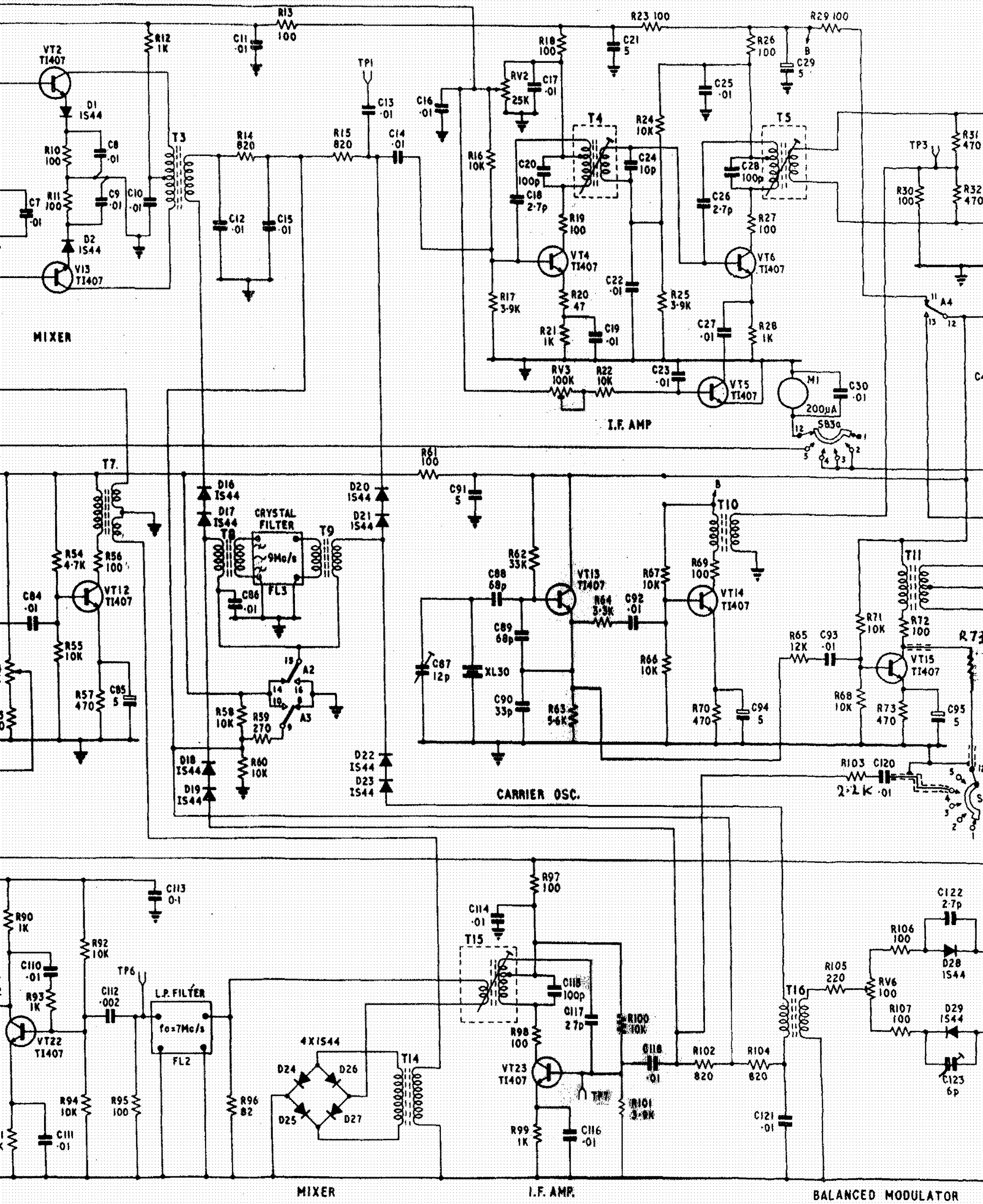


lock Diagram: TRA.906

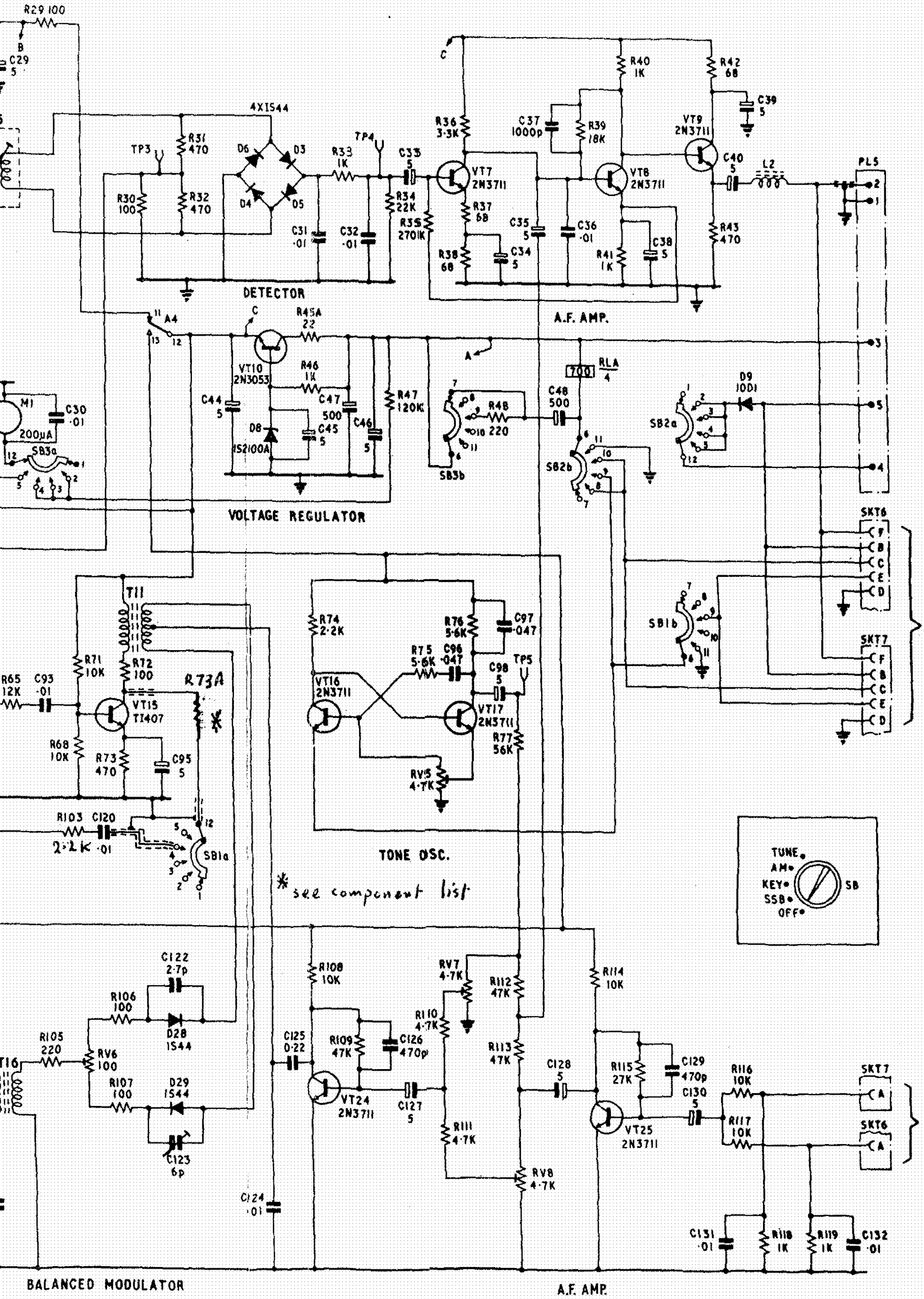
Fig. 1



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

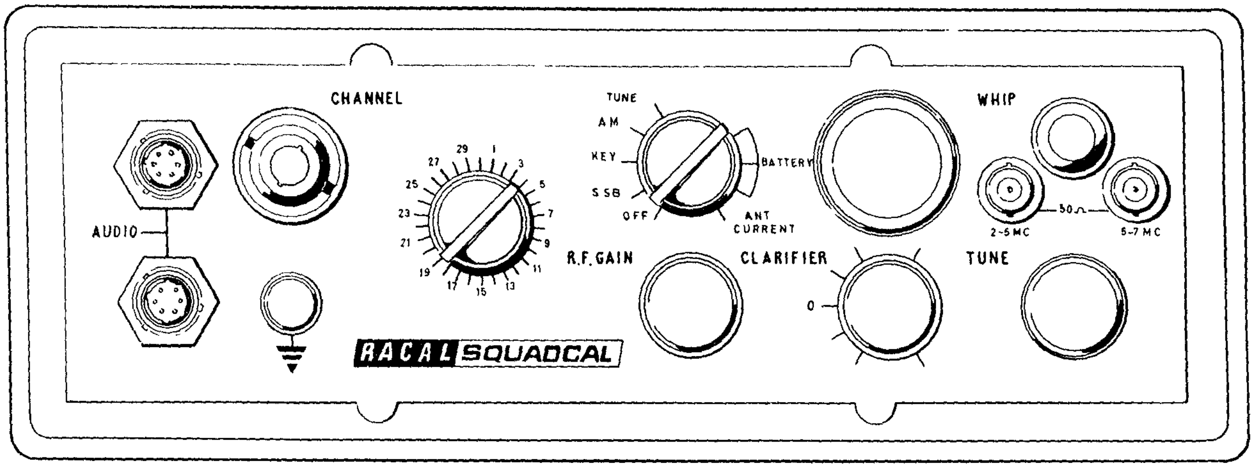


Circuit : Transmitter Receiver-TRA.906

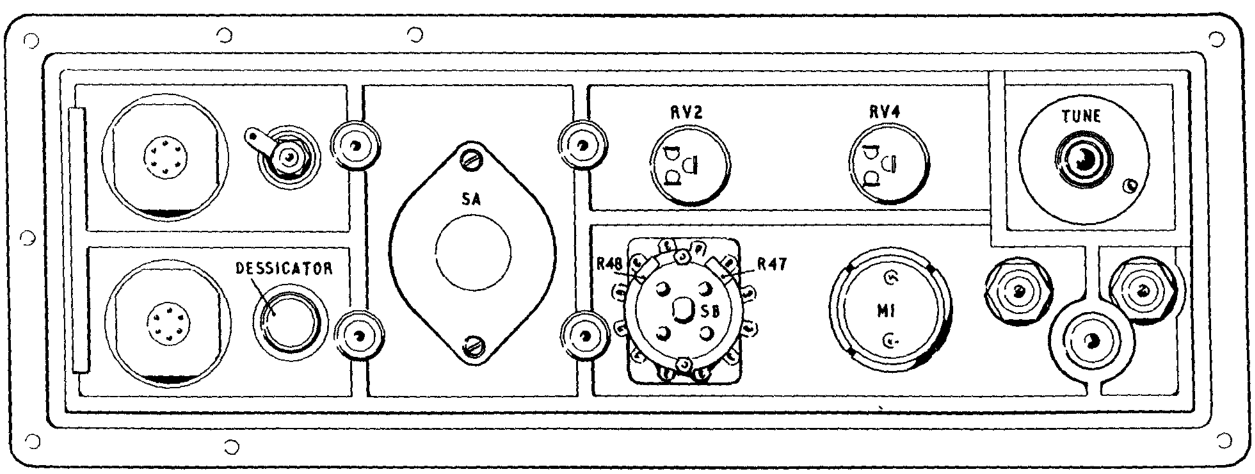


R29 100
C29 5
4X1S44
TP3
R31 470
R32 470
R30 100
D6
D3
D4
D5
R33 1K
TP4
C33 5
C31 ·01
C32 ·01
R34 22K
R35 270K
DETECTOR
C
R36 3·3K
VT7 2N3711
R37 68
R38 68
C34 5
C37 1000p
R39 18K
R40 1K
C35 5
C36 ·01
VT8 2N3711
R41 1K
C38 5
R42 68
C39 5
VT9 2N3711
C40 5
L2
R43 470
PL5
A.F. AMP.
A4
R45A 22
VT10 2N3053
R46 1K
C44 5
C47 500
C46 5
R47 120K
D8
1S2100A
C45 5
VOLTAGE REGULATOR
M1
200μA
C30 ·01
SB3a
A
SB3b
R48 220
C48 500
RLA 4
700
SB2b
SB2a
D9
1001
SKT6
SKT7
SB1b
AUDIO SOCKETS
T11
R71 10K
R72 100
R73A
R65 12K
C93 ·01
VT15 TI407
R68 10K
R73 470
C95 5
R103 2·2K
C120 ·01
SB1a
R74 2·2K
R76 5·6K
C97 ·047
R75 5·6K
C96 ·047
C98 5
TP5
VT16 2N3711
VT17 2N3711
R77 56K
RV5 4·7K
TONE OSC.
*see component list
TUNE
AM
KEY
SSB
OFF
SB
C122 2·7p
R106 100
D28 1S44
R105 220
T16
RV6 100
R107 100
D29 1S44
C123 6p
C124 ·01
R108 10K
C125 0·22
R109 47K
C126 470p
VT24 2N3711
C127 5
RV7 4·7K
R110 4·7K
R111 4·7K
R112 47K
R113 47K
RV8 4·7K
C128 5
R114 10K
R115 27K
C129 470p
C130 5
VT25 2N3711
R116 10K
R117 10K
C131 ·01
R118 1K
R119 1K
C132 ·01
BALANCED MODULATOR
A.F. AMP.

Fig.2



Front



Rear

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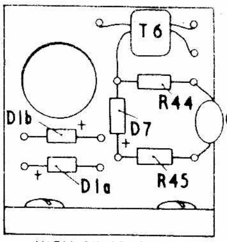
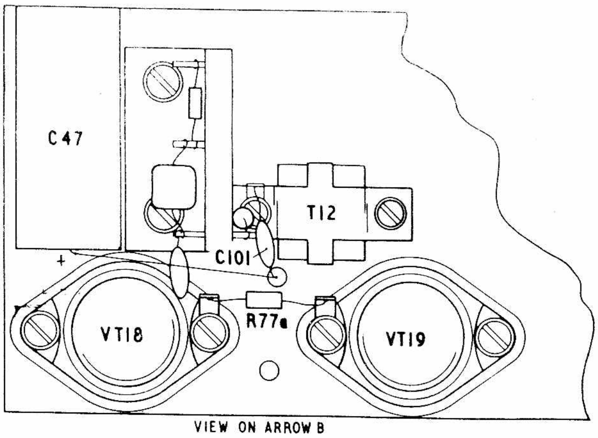
Control Panel–TRA.906

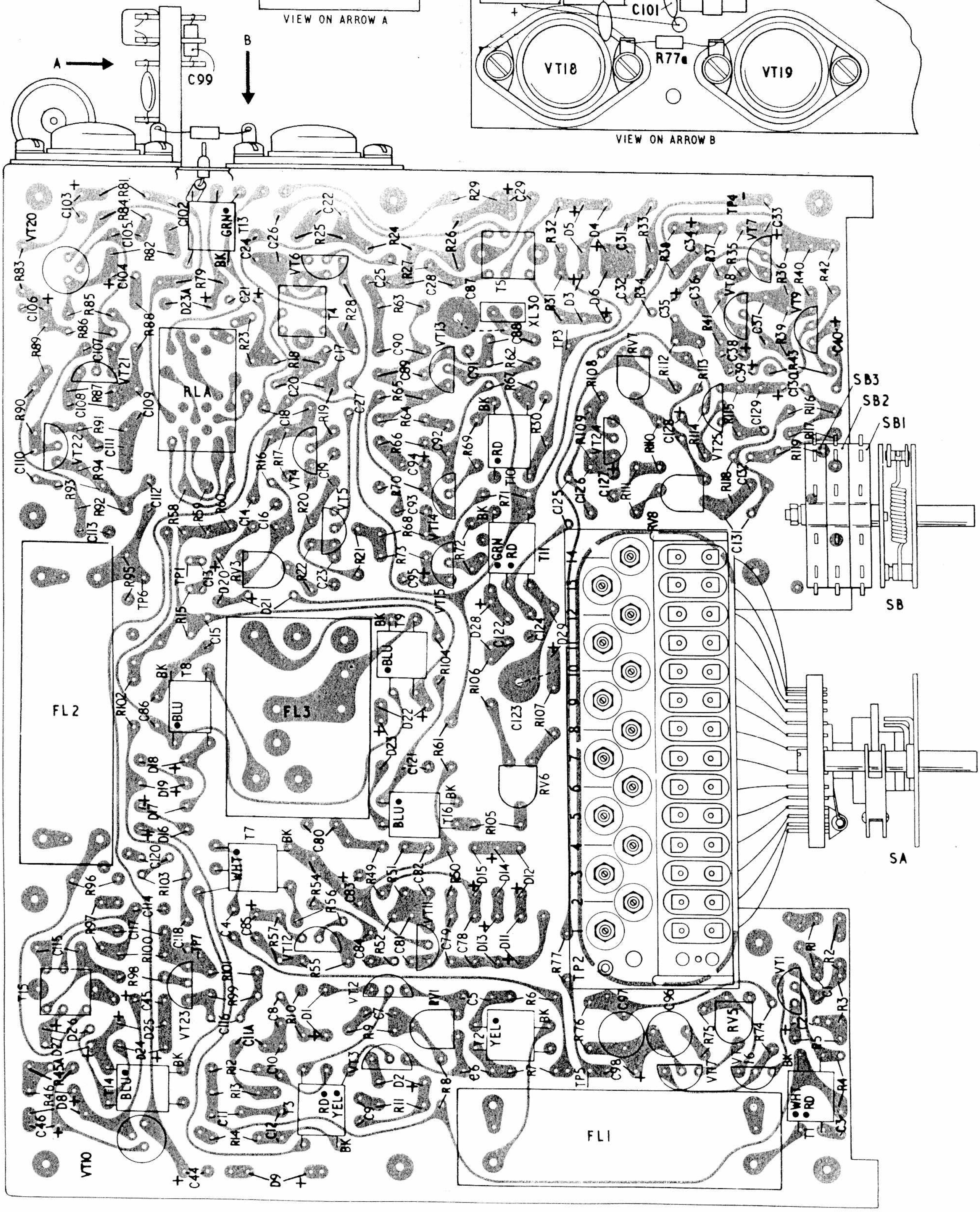
Fig.3



VIEW ON ARROW A



VIEW ON ARROW B



Top View

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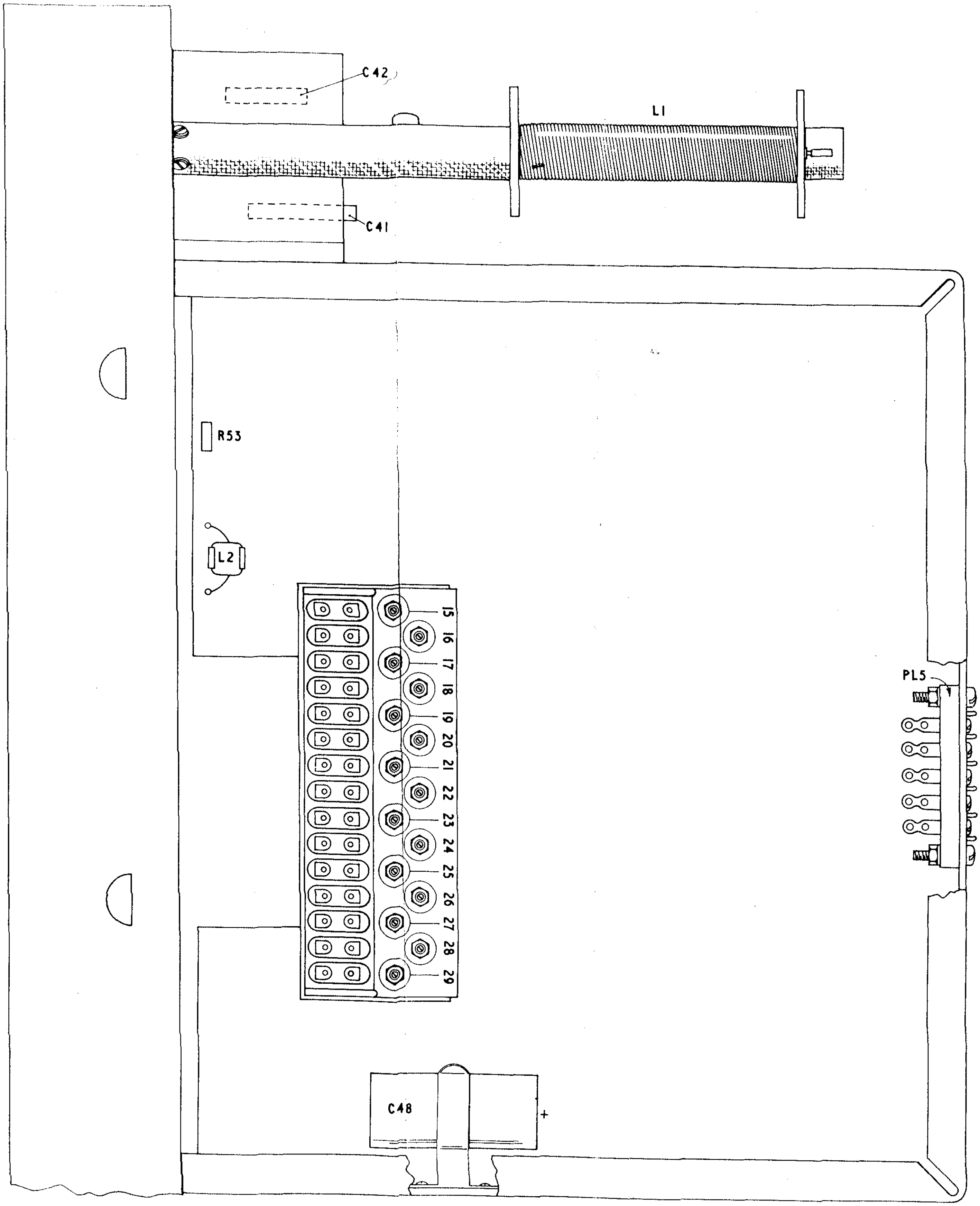
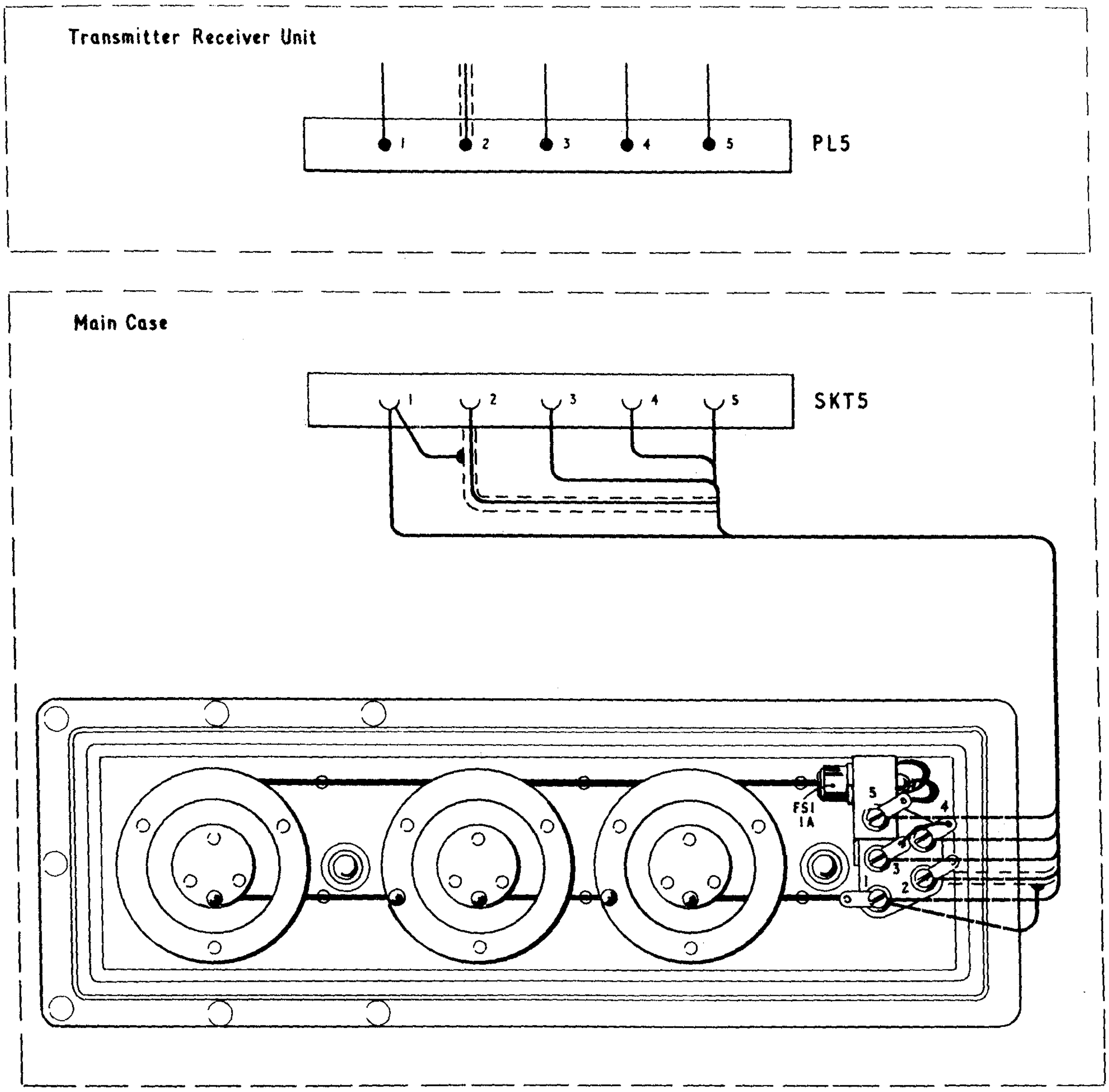
Component Layo

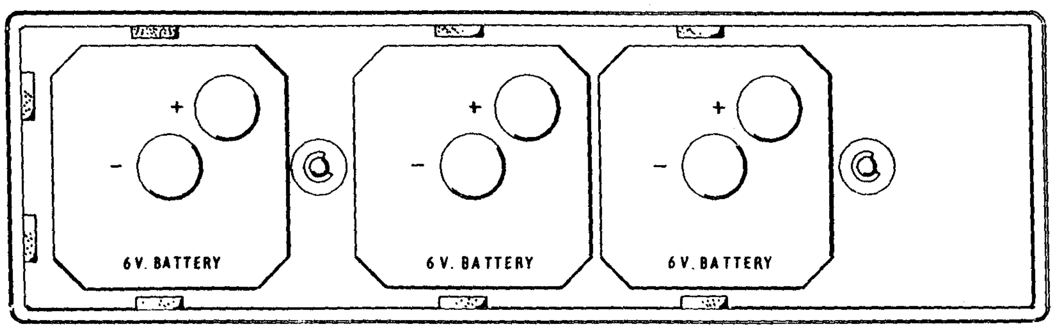


Underside View

ent Layout : TRA. 906

Fig. 4





Top view of Battery Pack

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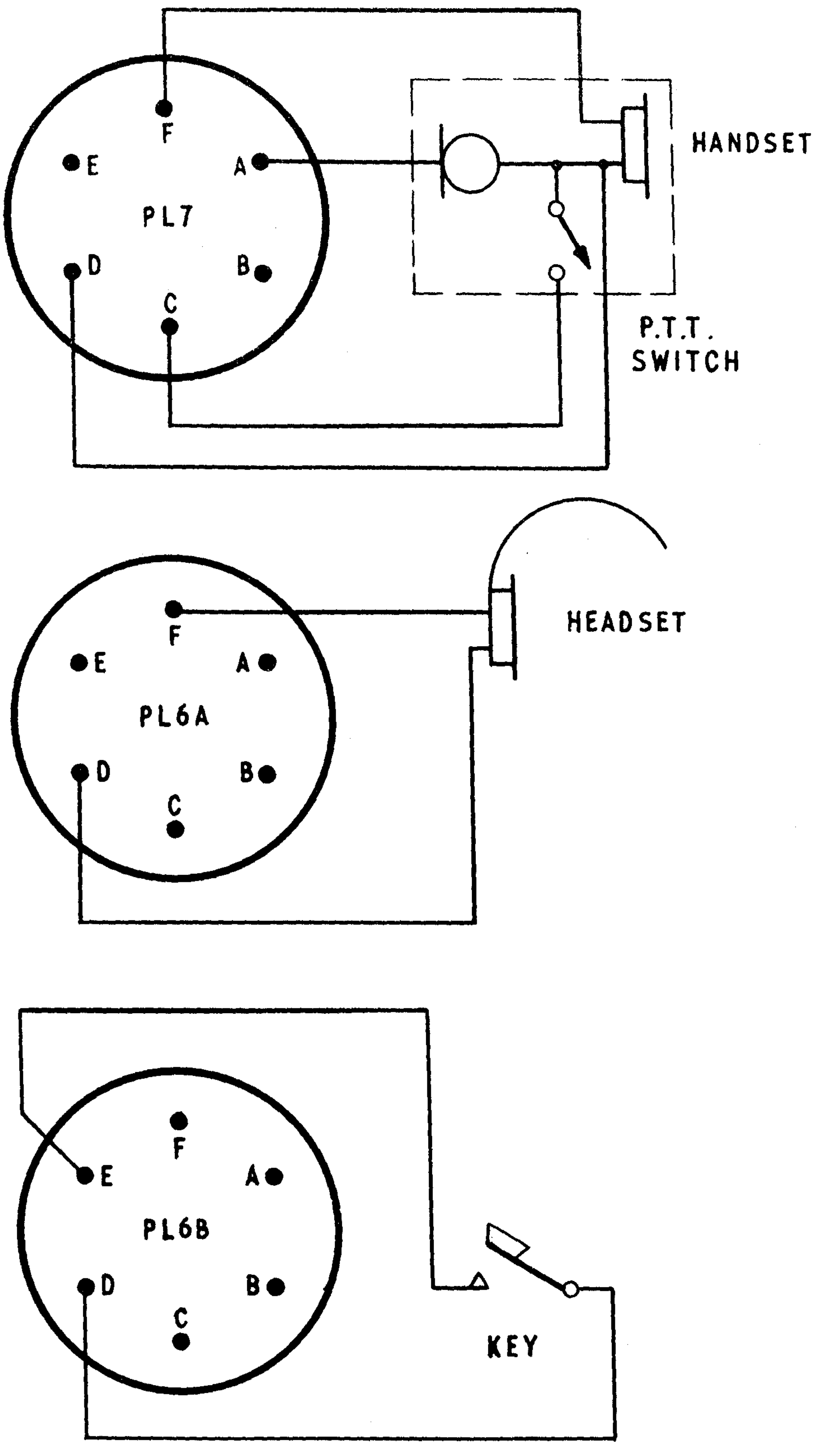
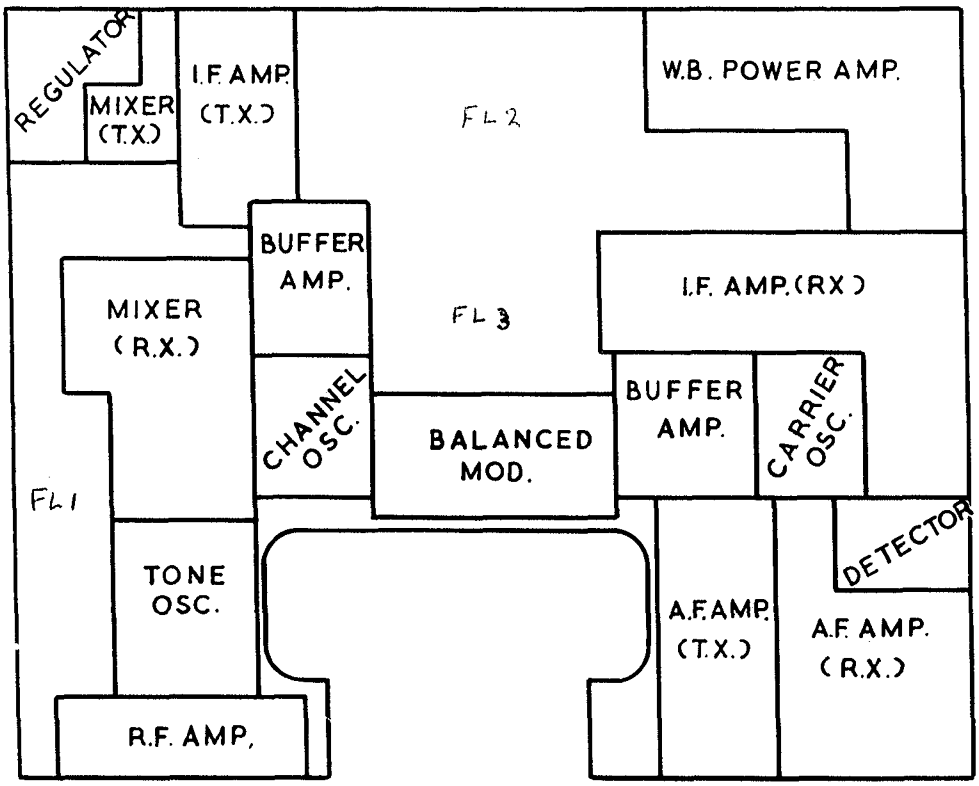
Power Supply Interconnections-TRA.906

Fig.5



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



229/7 **Key to Stage Layouts** **Fig. 7**

SC.146

Guarantee

We, Racal Electronics Limited, guarantee, subject to the following terms, to replace or, at our option, repair, free of charge, any components or parts of any goods supplied which fail within 12 months of the date of despatch solely as a result of faulty materials or bad workmanship.

1. Defective components or parts must be returned to our factory carriage paid, and any labour costs involved in refitting into an equipment will be chargeable to the customer.
2. Damage caused by unauthorised alteration or substitution of non-standard parts by incorrect installation or any third party or consequential damage or loss is not covered by this guarantee.
3. This guarantee will apply only if the equipment is bought from Racal Electronics Limited or an authorised vendor at the appropriate prices and terms.
4. Components such as electric bulbs and valves are covered by such guarantee as is given by the manufacturers of those components.
5. This guarantee cannot be altered by any person or Company other than Racal Electronics Limited.

PLEASE COMPLETE FORM BELOW AND RETURN TO SUPPLIER

TEAR OFF HERE

REGISTRATION FORM

Name of Purchaser..

Address of Purchaser..

Equipment Type..

Equipment Serial Number..

Date of Purchase..

Name of Supplier..

Address of Supplier..

The guarantee for this equipment will not be effective unless this form is returned duly completed.

RACAL ELECTRONICS Ltd., WESTERN ROAD, BRACKNELL, BERKS.