## Technical Manual

# TRA 7948A

# H.F. S.S.B. Transceiver

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# H.F. S.S.B. TRANSCEIVER

## TYPE TRA 7948A

## CONTENTS

# PART 1

## INSTALLATION AND OPERATING INSTRUCTIONS

## 1 BRIEF DESCRIPTION

The 100W H.F. Marine Transceiver Type TRA 7948A comprises silicon solid state circuitry and is of extremely rugged construction. In association with an approved aerial tuning unit, it fully complies with the Australian Post Office Specifications RB211B, C and D, RB239 and the third schedule of the Navigation Act 1912 - 1972.

The equipment operates in u.s.b. and a.m. modes, and eleven operating channels are available. With the exception of channel 1, these may be located anywhere within the frequency range 2-10 MHz. Channel 1 is allocated for distress and calling at 2182 kHz, and when selected a.m. mode is automatically switched in.

Both the transmitter and receiver are constructed as wideband systems, therefore individual channel alignment is unnecessary. Should there be the need to change a channel frequency, substitution of a crystal and accurate setting by the associated trimmer only is required. The temperature controlled oven, enclosing the frequency determining elements, ensures immunity to ambient temperature fluctuations and channel frequencies are accurately maintained.

A feature of the power amplifier is the ability to operate safely into any load. Hence, even with a severe mismatch, power is delivered for continued communications. For vessels requiring the facility, the distress signalling option may be fitted, which provides for alternate transmission of two tones for a predetermined period of time. This system is used to alert shore stations or other ships of an emergency situation.

## TECHNICAL SPECIFICATION

Complies with A.P.O. Specification RB211B, C & D, RB239 and the third Schedule of the Navigation Act 1912 - 1972.

### General

| | |
|---|---|
| Frequency Range: | 2 - 10 MHz |
| Modes of Operation: | SSB (A3J) upper sideband and a.m. (A3H transmitted) |
| Channel Mode: | Single frequency simplex (s.f.s.) or two frequency simplex (2 f.s.) |
| Channels: | Up to 11 s.f.s. channels.<br>Channel 1 is the distress channel at 2182 kHz, selection of which automatically defines a.m. mode. Where 2 f.s. channels are fitted the number of channels available reduces by 1 for each 2 f.s. channel. |
| Frequency Stability: | Stable to within ±50 Hz for a temperature range of 0 to 60°C and over the power supply range. |
| Power Supply: | 21V to 32V either polarity, nominally 25.2V |
| Power Consumption: | 9W approx. in receive 75W approx. in transmit (normal speech). |
| Ambient Temperature Range: | 0 - 60°C. Will operate satisfactorily down to -15°C. |
| Dimensions: | 9.4 cms ($3^{11}/16$ ins.) high<br>30.3 cms ($11^{15}/16$ ins.) wide<br>29.8 cms ($11^{3}/4$ ins.) deep |
| Weight: | 5.4 kg (12 lb) approx. |

### RECEIVER

| | |
|---|---|
| Sensitivity (s.s.b.) | 1μV at aerial input for 250 mW audio output. |
| (a.m.) | 10dB S+N/N for 4μV r.m.s. 30% modulated at aerial input. |
| Maximum Input: | 10V r.m.s. from 50 ohm source. |
| Image Rejection: | 50dB |
| Spurious Signal Rejection: | 60dB |
| I.F. Bandwidth (s.s.b.) | 2.4 kHz min. at -6dB<br>4.2 kHz max. at -50dB |
| (a.m.) | 6 kHz min. at -6dB<br>14 kHz max. at -50dB |
| Cross Modulation: | For a wanted signal giving 10dB S+N/N (s.s.b.) an unwanted signal of +70dB relative level (30% modulation) and separated from the carrier by at least 20 kHz, will cause less than 3dB increase in noise output from receiver. |

| | |
|---|---|
| Blocking: | For a wanted signal giving 10dB S + N/N (ssb) an unwanted signal of ±70dB separated by at least 20 kHz causes less than 3dB degradation of S + N/N or a.f. output level. |
| Intermodulation: | To produce a third order product equivalent to a wanted signal giving 10dB S + N/N, two unwanted signals greater than 20 kHz removed from the tuned frequency must be greater than +70dB relative to the wanted signal. |
| A.G.C. (for ssb) | Less than 6dB variation in output for 1µV to 100mV input signal. |
| (for a.m.) | Less than 6dB variation in output for 4µV to 100mW, 30% modulated, input signal. |
| A.F. Output: | 1W to loudspeaker |
| A.F. Distortion: | 5% maximum |

## TRANSMITTER

| | |
|---|---|
| Power Output: | 100W p.e.p. into 50 ohms at nominal supply voltage. |
| Intermodulation Products: | Better than 25dB below tone at rated output. |
| Aerial V.S.W.R. | Transmitter will operate into any impedance without cutting out or damage occuring. |
| I.F. Bandwidth: | 2.4 kHz at -6dB |
| Carrier Suppression: | 40dB below p.e.p. at rated output. |
| A.L.C. Control Range: | 30dB (a.f.)<br>20dB (r.f.) |

## DISTRESS SIGNALLING FACILITY (OPTION)

This facility is fitted where compliance to A.P.O. Specification RB239 and/or the third Schedule of the Navigation Act 1912 - 1972 is a requirement.

| | |
|---|---|
| Nature of Signal: | Alternately produced tones each 250mS duration ±50mS. Tone frequencies at 1300 and 2200 Hz ±1.5%. |
| Duration of Transmission: | When initiated, the distress signal will automatically be transmitted for 45 seconds ±15 seconds. |

## LOUD HAILER FACILITY (OPTION)

The microphone output is amplified to feed an external speaker for hailing purposes.

| | |
|---|---|
| Audio Output Power | 20W |
| Speaker Impedance | 8 ohms |

## OPTIONAL ITEMS AND AVAILABLE ANCILLARIES

| | |
|---|---|
| Distress Signalling Facility | 6708 (Internally fitted) |
| Loud Hailer Facility | 6726B (Internally fitted) |
| External Aerial Tuning Unit | LA 7727 |
| Mains Operated Power Supply Unit | PU 7723 |
| Microphone (Hand Held) | LA 7700 |
| Handset (Telephone Type) | LA 7910 B |
| Mobile Mounting Kit | 3039 B |
| Splashproof Cover Kit | 6852 |

### Additional Inclusive Items

With each transceiver the following items are supplied:-

| | No. OFF |
|---|---|
| Fuse, ½A Australux 3AG | 2 |
| Fuse, 15A Buss AGS | 2 |
| Connector, Coaxial B.N.C. Dage 30220-2 | 1 |
| Plug, 15 way Cannon DA-15P | 1 |
| Plug, Belling-Lee L1329/Ni | 1 |
| Cable Clamp, Amp. Part No. 2057301 | 1 |
| Terminal Strip with cover 2 pole Klippon Type KS2D | 1 |
| Marking strip, unmarked Klippon Type ELS02 | 1 |
| Terminal, ring tongue Amp 35110 | 2 |
| Connector, crimp pin Utilex H2280 | 4 |

# 3 INSTALLATION

## 3.1 General

Prior to despatch, the transceiver is completely aligned and tested to specifications therefore, on receipt, it is ready for immediate installation and operation. When received, it should be inspected to determine that there is no transportation damage.

Installation of the transceiver may best be considered as follows.

1) Mechanical fitment
2) Power supply connections
3) Aerial tuning unit installation and alignment
4) External speaker connections (if loud hailer option is fitted).

## 3.2 Mechanical Fitment

The TRA 7948 A transceiver may be bench mounted, but in order to secure it firmly against mechanical vibrations, a suitable mounting tray should be used. Racal mounting kit Type 3039 is available for this purpose and provides for mounting the equipment either above or beneath a suitable horizontal surface, such as a benchtop. Refer to figure 1 for mounting arrangement.

## 3.3 Power Supply Connections

A 24V d.c. source is required to power the transceiver and for this purpose heavy duty lead - acid batteries are very satisfactory. Where a battery charging unit is connected, it is most important that the connections are such that should the battery be accidentally disconnected, the charger is not supplying the transceiver directly as excessive voltage could be applied.

The transceiver is fitted with heavy duty leads 6 feet long for connection to the supply. Where a longer run is required, a terminal strip is supplied in the packing list for joining the transceiver supply leads to another pair of heavy duty leads which connect to the power source. All leads should be terminated with the crimp connectors also supplied before fitting to the terminal strip. The terminal strip itself is screwed or bolted to any convenient surface. It is recommended that any extension leads should be at least 70/.0076 or equivalent in order to prevent excessive line losses. If required, ring tongue connectors are supplied in the packing list for terminating the supply leads. Refer figure 2 for connection detail. Where a.c. supply of 115 or 240V is available, this may be utilised to power the transceiver by use of the A.C. Power Unit Type PU 7723.

## 3.4 Aerial Tuning Unit Installation and Alignment

### 3.4.1 Installation

The aerial tuning unit (A.T.U.) is an essential item for efficiently coupling the transceiver to the aerial. The A.T.U. should be positioned AS CLOSELY AS POSSIBLE to the aerial base, in order to prevent losses in the aerial feeder line. Also the A.T.U. should be earthed as directly as possible to the metal bulkhead of the boat.

Choice of aerial may be restricted, depending upon the particular vessel, but best results should be obtained at H.F. frequencies for a long wire aerial, either straight or in the form of an inverted "L". Either way, the aerial should be as long as practicable provided that the self resonant frequency is at least 15% higher than the highest transceiver operating frequency. For example at 8.2 MHz, aerial length should not exceed 25 feet.

A 12 ft whip antenna either straight or helically wound may be used again on condition that the self resonant frequency of the aerial is at least 15% higher than the highest operating frequency.

The signal path between the TRA 7948 transceiver and the A.T.U. must be via 50 ohm coaxial cable (e.g. RG-58 C/U). A B.N.C. connector is supplied in the packing list for terminating the cable at the transceiver end.

Control lines to the A.T.U. are connected to the 15 way plug (supplied) at the transceiver end. Screened 7/.0076 multi-core cable is recommended here, the number of cores required being 3 plus the number of channels fitted. Via the cable, the tranceiver extends d.c. supply to the A.T.U. as well as the p.t.t. line, plus logic lines for each channel. Each logic line is open circuit normally, but when the associated channel is selected, a connection to the negative supply rail is provided. Refer figure 3 for wiring details.

In the case of 2 f.s. channels, only one logic line is extended although the transmitter and receiver operate on different frequencies. The two frequencies however are quite close to each other on the 2 f.s. channels available and hence one A.T.U. channel only is required.

### 3.4.2 Alignment

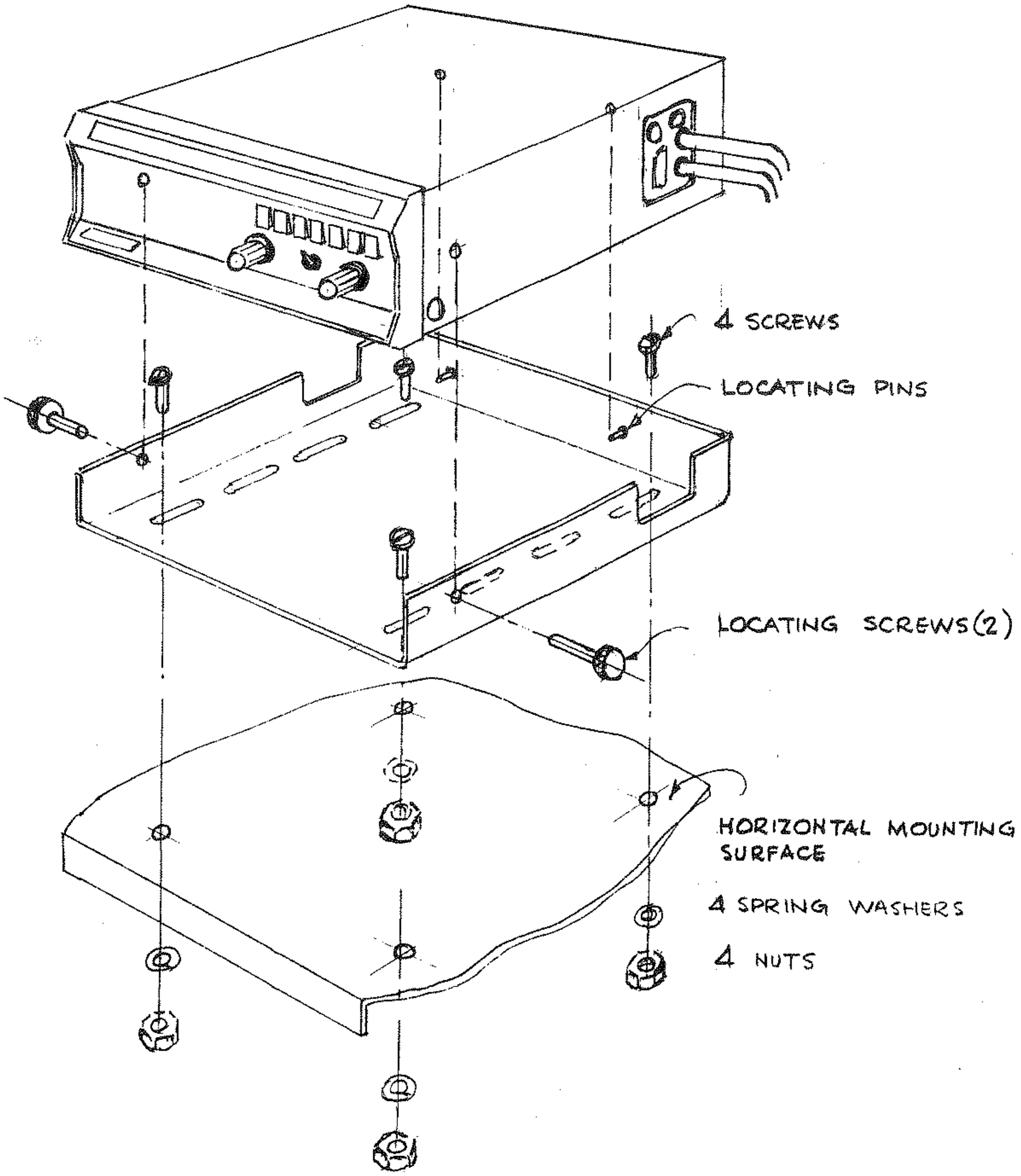
When aligning the A.T.U. the transceiver is normally left in the AM/TUNE MODE. The p.t.t. line which is extended to the A.T.U. enables transmission of the carrier signal for tuning purposes. The A.T.U. is then aligned for each channel as described in the associated A.T.U. handbook.

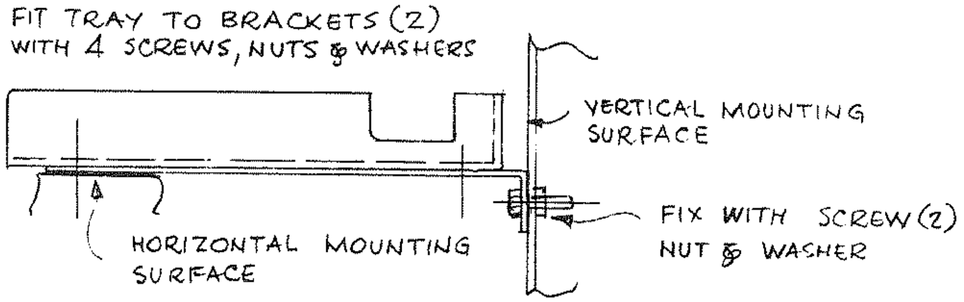
### 3.5 EXTERNAL SPEAKER CONNECTIONS

(for where the Loud Hailer option has been fitted)

The associated speaker must be 8 ohms impedance level. Single core screened cable is ideal for the speaker connection. Termination at the transceiver end is via the nylon plug supplied. Polarity of connection is unimportant as output to the speaker is transformer isolated.

# MOUNTING OF TRA7948 USING MOUNTING KIT TYPE 3039 B





ALTERNATIVE METHOD OF MOUNTING
TO HORIZONTAL/VERTICAL SURFACES
USING BRACKETS.

FIGURE 1

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# INSTALLATION INSTRUCTIONS

## A.T.U. LA7727 B FOR SS901A

1. Fit unit utilising the 4 holes in the mounting bars.
2. Remove cover.
3. Run aerial, earth, control leads and 50Ω transceiver aerial co-ax.
4. Connect earth and aerial leads. Aerials < ¼ λ at the highest operating frequency to the outermost of the two aerial connectors.

   NOTE: For a successful installation it is essential that the ATU be grounded, at the ATU, by heavy gauge copper strip, preferably 2" wide. The length should be kept as short and direct as possible.
5. Fit co-axial connector to transceiver aerial co-ax.
6. Bare back and prepare control leads. Do not fit heat shrink glands until step 17.
7. Terminate control cables, starting with the highest transceiver operating channel on ATU channel 12, the second highest to 11 and so on. Note that the values of the loading capacitors are approximately suitable for frequencies as follows:

| | |
|---|---|
| C1, 2, 3 & 4 | 2 to 3MHz |
| C5, 6, 7 & 8 | 3 to 5MHz |
| C9 & 10 | 5 to 8MHz |
| C11 & 12 | 8 to 10MHz |

8. Apply power to the system and ensure transceiver channel selector switch operates the ATU relays in proper sequence.
9. Selecting the highest operating channel solder a wander lead to the vernier coil (L1 to L12) corresponding to that channel.
10. Install a VSWR meter in the transceiver co-ax aerial line.
11. Set all slugs in the vernier coils so they flush with the top of the former.
12. With the transceiver set to A.M. and the appropriate channel selected, operate switch SA switching the transceiver to the transmit state.
13. With the VSWR meter set to read forward power select the tap on the main coil corresponding to maximum forward power.
14. Adjust the corresponding loading capacitor to further increase the forward power reading. Note that adjustment of the loading capacitor may cause the optimum coil tap to shift.
15. Set the VSWR meter to read reflected power and by fine adjustment of both the vernier coil and the loading capacitor adjust the tuning for best VSWR. The VSWR must be at least better than 1.5:1.
16. Repeat the above procedure for the remaining channels.
17. With the co-ax and control cables free of the ATU fit and shrink the glands into the cables.
18. Re-fit the tighten glands.
19. Confirm VSWR on all channels is < 1.5:1.
20. Seal vernier coils and trimmers with varnish.
21. Re-fit cover.

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## POWER SUPPLY CONNECTIONS, SHOWING FITMENT OF EXTENSION LEADS

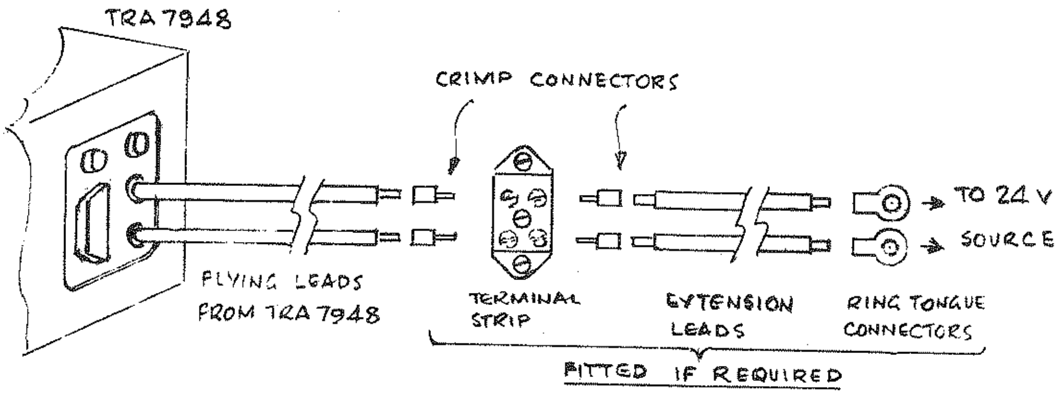

FIGURE 2

## AERIAL TUNING UNIT CONNECTIONS

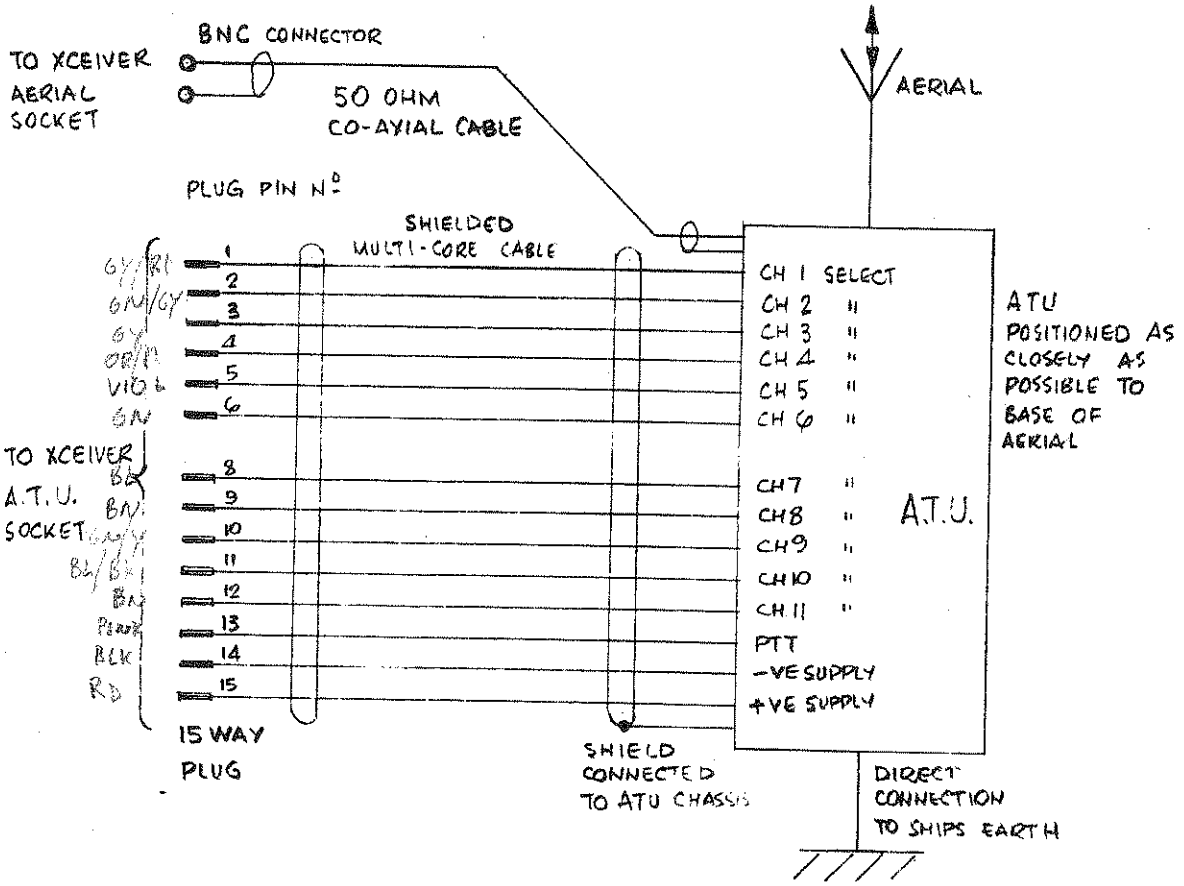

FIGURE 3

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# 4 OPERATION

## 4.1 Controls

The TRA 7948 A Transceiver is fitted with the following controls:-

| | |
|---|---|
| Volume / OFF | Adjusts receiver output level and turns the transceiver OFF in the fully anti-clockwise position. |
| Clarifier/Tune AM | The extreme anti-clockwise position selects a.m. mode. This mode is also used for tuning the A.T.U.<br>With the control turned clockwise out of the TUNE-AM position, s.s.b. mode is defined and reception is adjustable for frequency drift. |
| Channel Bank | |
| (a) Black Pushbuttons: (Total of 5) | Running from left to right, these will select channel 2 or 7, 3 or 8, 4 or 9, 5 or 10, 6 or 11 depending upon the state of the bank select switch. |
| (b) White Pushbutton: | This is the bank select switch which enables channels 2 to 6 in the OUT position, and channels 7 to 11 in the IN position. It is automatically disabled when a 2 f.s. channel is selected. |
| (c) Red Pushbutton: | This is the emergency channel which, when selected will cancel any other pushbutton selection and also define a.m. mode. |
| Power Switch | |
| (a) Down (HIGH) Position | Transmitter output power is set to 100W p.e.p. |
| (b) Central (LOW) Position | Transmitter output power is set at 10W p.e.p. approx. |
| (c) Up (EXT. SPEAKER) Position | If fitted, the loud hailer facility is activated |
| Alarm Switch (present only if distress signalling option is fitted) | |
| (a) Down ("TEST") Position | The distress signal appears at the speaker |
| (b) Central Position | No action |
| (c) Up ("ALARM") Position (momentary action) | The distress signal is transmitted and also appears at the speaker. |

### 4.2 Indicators

A solid state indicator lamp is fitted which is operative in transmit state only, providing a visual indication of output power. For load impedances within 2:1, the lamp will glow during peaks of modulation with the transceiver POWER switch in the "HIGH" position.

### 4.3 Operation

The functional state of the transceiver is in accordance with the control settings as described under section 4.1 above.

In order to transmit, ensure that the microphone is plugged into the equipment and depress the associated p.t.t. switch. Hold the microphone about 2 to 4 inches from the mouth and speak. Best clarity of communication will be achieved by holding the microphone in such a way as to talk ACROSS the front face rather than into it.

Check for output power transmission by the state of the front panel lamp. This lamp should flicker on and off during speech, when the POWER switch is set to "HIGH".

# PART 2

## TECHNICAL DESCRIPTION

SECTION

FIGURE

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# 1 PRINCIPLES OF OPERATION

## 1.1 INTRODUCTION (Refer Figure 1)

The S.S.B. Transceiver TRA 7948A essentially comprises three modules which are:-

Exciter/Receiver Board
Oven Oscillator Unit
Power Amplifier Board

The Oven Oscillator Unit is an electrically heated, temperature controlled assembly containing the channel oscillator and carrier insertion oscillator (c.i.o.) both of which are crystal controlled. The channel crystals are selected for the appropriate channel oscillator frequency, by d.c. controlled diode and transistor switches. The c.i.o. has a clarifier circuit for external line adjustment of this frequency.

At the Exciter/Receiver Board the transmit and receive circuits are built around a common mixing and i.f. stage. Input to the mixers, for transmission or reception, is a function of electronic switching. Two highly selective Xtal filters electronically selected provide for a.m. and S.S.B. operation.

The 100mW r.f. output from the Exciter/Receiver Board is fed to the Power Amplifier which is capable of delivering 100W p.e.p. into a 50 ohm load.

The basic transceiver can be fitted with up to two additional facilities: distress signalling and loud hailing. In each case an additional board is added.

The transceiver requires a d.c. supply of 24V which, in the transceiver transmit state, is directly switched to the power amplifier. Most of the other circuits require a regulated 9V supply which is taken from a regulator built on the Exciter/Receiver Board. This in turn is supplied by an intermediate regulator at 13V which is part of the power amplifier.

## 1.2 RECEPTION

### (a) U.S.B. Mode

Input signals in the 2 to 10MHz range are fed to a six pole filter to attenuate signals which are in the broadcast band and the image frequency of the required signal.

Channel oscillator output ($f_{ch.o}$), a.g.c. controlled and 10.7MHz higher than the operating channel frequency ($f_s$), is fed into double balanced mixer the tuned circuit of which selects the difference frequency ($f_{ch.0}-f_s$).

A highly selective sideband filter precedes the i.f. amplifiers the tuned circuits of which provide additional selectivity. The gain of one amplifier is automatically controlled.

At the second double balance action mixer, the $f_{ch.o}-f_s$ signal and input from the carrier insertion oscillator (c.i.o.) gives an audio output which is fed to an a.f. pre-amplifier. This amplifier also acts as a low pass filter with sharp roll off above 3kHz providing further receiver selectivity. Output from the amplifier is also used to drive the a.g.c. detector.

(b) A.M. Mode

The i.f. output of the 1st mixer is directed to the a.m. filter, to by-pass the sideband filter, and thence, via the amplifiers, to the 2nd mixer.

An audio output is obtained by feeding the 2nd mixer with a.m. carrier instead of the local carrier (c.i.o.) the a.m. carrier being recovered by a high gain limiting amplifier sampling the i.f.

During periods of no modulation and hence no audio output in the receive state, a secondary a.g.c. detector, sensing the i.f. level, clamps the a.g.c. to prevent i.f. overload.

## 1.3 TRANSMISSION

(a) U.S.B. Mode

Audio input from the microphone is fed to the mixer via an amplifier which incorporates a.g.c. to limit the audio drive to the rest of the transmitter. The 10.7MHz c.i.o. is also fed to the mixer and output consists of sidebands centred on 10.7MHz, the carrier being balanced out.

In the common i.f. amplification stage, for transmission, a.g.c. is switched out and pre-set gain components used.

The amplified i.f. is heterodyned with the channel oscillator output at the second mixer to produce the required $f_{ch.o}$-i.f. signal plus the image $f_{ch.o}$+i.f. Leakage of the product components is minimised by the mixer double balance action and further rejection occurs at the following seven pole filter.

The seven pole filter passes the required $f_{ch.o}$-i.f. signal only which is raised to a level of approximately 100mW by an r.f. amplifier operating in class B mode.

The power amplifier input from the exciter is fed, via an emitter coupled a.l.c. stage, to drive a series of linear wideband stages.

There are two class A amplifiers followed by two class B push pull stages which are individually biased by temperature compensated circuits. A wideband transformer serves to couple the output of the second class B push pull stage to the aerial changeover relay and to isolate the power amplifier from the transceiver chassis.

The a.l.c. circuitry sensing both the transmitter output and the operating conditions of the final amplification stage, ensures that maximum output, as allowed by the aerial impedance and power supply voltage, is maintained, also safe continued operation into any aerial impedance.

Both the magnitude and phase of output voltage and current is sensed by circuitry which is designed such that, for a matched aerial condition, there is maximum detector output and, therefore, maximum brilliance of the TUNE lamp. This circuitry is located on the reflectometer board which is separate from the three main modules.

(b) A.M. Mode

a.m. transmission is similar to ssb transmission even in so far as utilizing the sideband filter. The difference is that C.I.O. signal is re-inserted into the i.f. stage at a pre-set level. The output signal therefore comprises carrier plus one sideband.

## 1.4 OPTIONAL FACILITIES

### Distress Signalling

The additional module required for this facility has two tone oscillators, gating circuits and a timer. When triggered the timer turns on all circuits and grounds the p.t.t. line so that the transmission of the signal is automatic and for a duration of approximately 45 seconds. The gating circuits pass each tone alternately.

### Loud Hailer

When activated, the transmitter p.t.t. line is disabled and microphone output is passed to a 20W audio amplifier to feed an external speaker.

## 2. SUPPLY LINES AND SWITCHING CIRCUITS

### 2.1 Introduction

The transceiver front panel controls and the p.t.t. control of the microphone set up 'logic levels' for the operation of electronic switching within the modules.

Before entering into detailed description of the module circuits therefore the logic levels of these controls will be discussed.

Refer to Transceiver Chassis Wiring Diagram.

### 2.2 Receive and Transmit 9V Lines

The relay (RL/6), operated by the p.t.t. control, switches the regulator 9V output, via contacts RL1 to one of two lines, i.e. the RX 9V line and the TX 9V line. By the voltage on these lines the channel oscillator or carrier insertion oscillator is switched for input to the mixers as required; a.g.c. action is also disabled in the transmit condition.

### 2.3 Transmit Supply Line

Through contacts RL3-RL6 supply voltage is established in the transmit state which is applied to the power amplifier.

### 2.4 A.M. Line

Clarifier switch SB2 provides for a 9V line in SSB mode and OV in a.m. This line and/or the TX 9V line will power the carrier insertion oscillator on the 6710 board and select the s.s.b. crystal filter. Hence in receive a.m. mode only, the C.I.O. oscillator will be off and the a.m. crystal filter selected. A special a.m. detector is also activated.

The lines under the control of the clarifier switch are also wired to the Distress Channel switch (Channel 1), such that a.m. mode is automatically defined if this channel is selected.

### 2.5 Bank Select Line (Refer Figure 2)

Depression of any front panel channel switch (except the bank select switch) will normally enable two crystals within the oven oscillator. Selection between these is a function of the voltage on the bank select line (either 0 or 9V).

The bank select line may be controlled as follows:-

(a) By the front panel bank select switch, as with s.f.s. channels.

(b) By relay logic via the RX 9V line, as with 2fs channels.

(c) By the Distress Channel switch (Channel 1), which applies OV to this line in order to over-ride any other control function. Crystal 7 is therefore selected and crystal 1 position is not used.

## 3 EXCITER RECEIVER BOARD TYPE 6712B (Refer Figure 1)

This module comprises the full receiver and exciter, capable of operating in u.s.b. and a.m. modes.

U.S.B. operation is described first, which description covers the common circuitry of both operating modes. The additional circuitry required in a.m. is outlined later.

### 3.1 RECEIVER CIRCUIT (U.S.B. OPERATION)

### 3.1.1 Input Filter

This is a 2 to 10MHz bandpass filter in a six pole configuration comprising C13 to C19 and L1 to L6.

### 3.1.2 Diode Protection

The clamping diodes D1 and D2, protect the receiver input circuit against excessive (greater than 2V), input voltage.

### 3.1.3 Filter Switch

Q4 and Q5, with associated components, form a series shunt switch under the control of the RX 9V line. In the receive condition Q5 is on, hence Q4 is off, allowing receiver input signals to pass to the first mixer.

### 3.1.4 I.F. Trap

C22 and L8 are in series resonance at the intermediate frequency (10.7MHz) thereby attenuating signals of this frequency.

### 3.1.5 First Mixer

Since the first mixer has a constant current source, ML2-A, the input signal is equally amplified by the low noise amplifiers, Q6 and Q7, but phase opposed. R32 and R34, a.c. connected by C28 and C29, provide emitter degeneration thereby improving linearity and the dynamic range.

The channel oscillator output is applied to the switching transistors of ML2 which are connected for double balanced mixing action. Thus, any i.f. breakthrough may be balanced out by adjustment of R39 which is factory pre-set.

The mixer product $f_{ch.o}-f_s$ is selected by the parallel tuned circuit of T1 secondary and C33.

Gain control is effected by varying the channel oscillator level to the first mixer, the drive circuit of which has a.g.c. This circuit is discussed in more detail under the heading of Receive and Transmit Supporting Circuitry. (Section 3.3.1).

### 3.1.6 Sideband Filter

U.S.B. operation is provided by the crystal filter FL2 which is resistively terminated by R48 and R53; capacitors C42 and C43 provide reactive termination.

### 3.1.7 I.F. Amplifiers

The common base stage ML3-A serves as a summing amplifier accepting input from either FL2 or 3FL1 whichever is in circuit.

ML3-B is under the control of the RX 9V line and, in the receive condition, reduces the emitter degeneration of ML3-C to give the required increased i.f. gain.

ML4 is a tuned i.f. amplifier having a.g.c. applied to pin 4. The tuned circuit for frequency selective feedback around the amplifier is formed by L9 and C51.

Q10 is the second mixer drive amplifier.

### 3.1.8 Second Mixer

The second mixer, comprising ML5 and ML6-B, is of similar configuration and operation as the first mixer. The i.f. input mixed with the carrier insertion oscillator output produces audio across R92.

### 3.1.9 Audio Pre-amplifier

ML11 is an operational amplifier with feedback to restrict the audio bandwidth to 3kHz for improved selectivity.

### 3.1.10 A.G.C.

The a.g.c. detector Q19 takes drive from the audio pre-amplifier output via C103 and is biased, via the divider R158/159, from the RX 9V line. In the transmit condition therefore, this detector is inoperative.

With audio output above a predetermined level Q19, and hence ML10-A, are turned on. As a result, through D3 and the Darlington pair ML10-B and C, the voltage on the a.g.c. line is reduced.

Fast attack time is provided by C106 charging through R167, D3 and the "on" resistance of ML10-A. Relatively slow decay is defined by R106 discharging through R167, R166 when ML10-A is off.

### 3.1.11 A.F. Output Amplifier

The class B output amplifier, Q24 to Q28, has a very high open loop gain heavily restricted by negative feedback, R193 and R189, to minimise distortion.

The speaker is a functional part of the circuit in providing a d.c. earth return to bootstrapping resistor R192.

The output level at the speaker is determined by the transceiver VOLUME potentiometer which precedes this amplifier.

## 3.2 EXCITER CIRCUIT (U.S.B. OPERATION)

The mixers, filters and i.f. circuitry, used for both reception and transmission, have been discussed in the foregoing description of the receiver. When operating for transmissions however, following the gain controlled a.f. amplifier, the exciter gain is fixed. High stability components are used to ensure that gain variation, due to temperature changes and ageing, are minimal.

### 3.2.1 A.F. Amplifier

Q1 is turned on when the RX 9V line is active hence, when the transceiver is in the receive condition, any signals appearing at the amplifier input are heavily attenuated by R1 and Q1.

The amplifier is designed to accept a.f. inputs which may vary in level over a range of better than 30dB. The threshold for a.g.c. is set to approximately -45dBm, which is suitable for the recommended ancillary items.

Transistor Q3 and those at ML1-C, D and E form a feedback amplifier with a high input impedance.

The peak detector ML1-A and B, fed with the amplifier output, controls the impedance of Q2 which, combined with that of series resistor R3, determines the amplifier input level.

C4 and R8 allow for a long decay time whereas the discharge of C4, by ML1-A through R10, provides a fast attack.

### 3.2.2 First Mixer

The a.f. amplifier output is at a level to ensure optimum performance of the first mixer where, combined with the carrier insertion oscillator output, a double sideband i.f. signal is produced. The carrier signal is balanced out by means of pre-set potentiometer R33.

### 3.2.3 I.F. Strip

As already stated, this section including the sideband filter, behaves as described for reception except that pre-set gain is operative.

In transmit state ML3-B, biased by the Rx 9V line, is off. With increased emitter resistance the gain of ML3-C is reduced.

Under the control of the TX 9V line, ML3-D shorts out the a.g.c. line to amplifier ML4 whilst ML3-E switches in pre-set R67 to determine the i.f. gain.

### 3.2.4 Second Mixer

The combination of the i.f. input and that from the channel oscillator produces $f_{ch.o} \pm i.f.$ signals, the input components being balanced out by potentiometers R87 and R86 respectively. The r.f. output appears across pins 6 and 12 of ML5.

### 3.2.5. 10MHz Low Pass Filter

This filter is a 7 pole network the elements of which are C61 - C64, and L11 - L13. The second mixer output provides a high impedance source and termination is provided essentially by R94 in parallel with R96. The filter rejects any leakage of $f_{cho}$-i.f $f_{cho}$-i.f. signal.

### 3.2.6 Wideband Amplifier

This amplifier, comprising ML6-C, D, E, Q12 to Q16 and associated components, is driven in class B mode to conserve current. The inherently high gain of the amplifier is restricted by feedback resistor R103 for increased linearity. The amplifier is operated near to full output, therefore, any transients which may pass undetected by A.G.C. system, are clipped before entering the output power amplifier.

## 3.3 RECEIVE AND TRANSMIT SUPPORTING CIRCUITRY

### 3.3.1 First Mixer Drive

The first mixer drive circuit is essentially a switch which allows c.i.o. output in transmit and a.g.c. ch.o. drive in receive. In receive mode the RX 9V line turns on amplifier ML7-B, which is connected to the ch.o output. At the same time, ML7-E is switched on which, simultaneously, earths the bias on the c.i.o. amplifier ML7-C and, in order to minimise the c.i.o. leakage in the ch.o, attenuates the c.i.o. level to ML7-C.

The amplifier ch.o drive current path is split into the emitters of ML7-A and ML7-D but, depending upon the relative bias of these transistors (ML7-A has a.g.c.) anything between all and none of the ch.o current will pass through ML7-A. Thus, the drive level of the first mixer is gain controlled.

In transmit mode, the a.g.c. transistor is by-passed in order to give constant c.i.o. drive to the first mixer. Since the RX 9V line is off, ML7-B and E are turned off which turns on the c.i.o. amplifier ML7-C the output from which is fed directly to the first mixer.

### 3.3.2 Second Mixer Drive

In receive mode the c.i.o. amplifier ML8-B is turned on and amplified c.i.o. output is fed directly to the second mixer. In transmit mode the TX 9V line both biases the ch.o amplifier ML8-C and turns on ML8-A which turns off the c.i.o. amplifier ML8-B.

### 3.3.3 A.F. Oscillator

(fitted only where a.m. is not a feature) Unijunction transistor Q29 and associated components form an oscillator circuit, the frequency of which is determined, essentially, by R197 and C139. This oscillator provides a signal for tuning purpose and is rendered inoperative otherwise by OV on pin A.C.

### 3.3.4 9V Regulator

The regulator is designed to operate between 10.5 and 16 Volts and provides current limiting for protection against an accidental short. Over voltage protection is also a feature.

The differential amplifier ML10-D and E compares the output voltage against the reference, which is the voltage across Zener diode D5. The amplifier controls the output voltage via Q21 and Q20.

Should an accidental short occur across the 9V line, the voltage difference across R187 will turn on Q23 which will sufficiently remove drive from Q21 to limit output current to approximately 1.5A.

Should the supply current exceed 18V Q23 will be turned on by current through Zener diode D6 and R184 and the 9V regulator will be turned off.

If reverse polarity protection is required, the supply may be fed via pin W instead of pin AE.

## 3.4 A.M. OPERATION

Additional or alternative circuitry required for a.m. operation is described here.

### 3.4.1 A.M. Filter Switching

The line to board pin L carries 9V is s.s.b. mode and OV in a.m. mode. (See Transceiver Chassis Wiring Diagram).

Transistors ML8-D and E are turned on by 9V on this line and also by the TX OV line via 2R155, and hence are off only in a.m. receive mode. Under these conditions 2ML9 is biased (discussed later) and there will be no bias to the filter switching transistor 3Q9. Since the other filter switching transistor 3Q8 is permanently biased the signal will be fed via 3Q8 to the a.m. filter 3FL1.

Conversely, in a.m. transmit (and s.s.b. transmit and receive) ML8-D will be on to bias 3Q9 and since the value of biasing resistors are such that 3Q9 base is more negative than 3Q8 base, the signal path is via 3Q9 to the sideband filter FL2.

### 3.4.2 Limiting Amplifier

2ML9 and associated components comprise a very high gain amplifier which is driven by i.f. amplifier ML4. By virtue of the clipping action of 2ML9 the modulation information is removed from the a.m. signal to leave the carrier which is inserted into the second mixer instead of the c.i.o.

As ML8-E shorts out the bias to 2ML9 the amplifier is active only when ML8-E is turned off by the presence of OV on the line to pin L and on the TX 9V line (i.e. in a.m. receive state). Under the control of these lines the c.i.o. is also switched off in a.m. receive.

### 3.4.3 Secondary Detector

When an a.m. signal is being received, the phase relationship between the i.f. drive and the reinserted carrier to the second mixer is such that a d.c. shift results between the two outputs arms of the second mixer (i.e. between ML5, 11 and ML5, 12). In the absence of modulation information on the carrier, the receiver gain will increase as no audio will be produced to operate the primary a.g.c. detector.

Transistor 2Q11 will be turned on by the increasing d.c. difference of the two output arms of the second mixer, clamping a.g.c. line via ML10-A against further increase in receiver gain.  Hence, i.f. overload is prevented.

### 3.4.4 C.I.O. Re-insertion

A.M. transmissions are of one sideband and the carrier, the c.i.o. being re-inserted by the circuitry 2Q17, 2Q18 and associated components which is powered by the TX 9V line only.  The board pin K is held at 9V in the s.s.b. state, removing the bias from 2Q17 thus this c.i.o. re-insertion circuitry is also inavtive for s.s.b. transmissions.

With the 9V removed from pin K (a.m. transmit state) 2Q17 is turned on via 2R129 which action biases 2Q18, the c.i.o. amplifier and a pre-set level of the c.i.o. frequency is fed to the i.f. summing amplifier, Q10.  At the same time, through 2Q17, 2C81 and 2R134, the i.f. level is attenuated (approximately 6dB) such that the overall i.f. output (sideband plus re-inserted carrier) remains the same.

## 4. OVEN OSCILLATOR UNIT TYPE 6710 (Refer Figure 2)

The Oven Oscillator Unit Type 6710 for 12 channel use comprises a p.c. board fitted with an aluminium casting which forms an oven. Within this enclosure, which is electrically heated and maintained at a temperature of 70°C, the board accommodates the crystals and frequency determining elements of the oscillators.

### 4.1 Channel Oscillator

Q1 and Q2 form an amplifier circuit with positive feedback via C1.
The feedback is such that, without a crystal in circuit, the amplifier is stable, i.e. it will not oscillate. With a crystal across Q1 emitter to ground plane the amplifier gain is increased at a frequency associated with the series resonance of the crystal and the circuit oscillates. Clamping diodes D2 and D3 limit the output and the feedback so that Q1 and Q2 operate within their linear regions. Hence, the stability of the oscillator is mainly a function of the crystal and associated tuning components.

The crystals are arranged in two banks of six (1 to 6 and 7 to 12). The channel switching lines, via the board pins K, L, M, N, P and Q, diode select two crystals, one from each bank. The channel bank selection circuit comprises Q3 and Q4 the on/off state of which is dependent upon the voltage at board pin J. Where this voltage is 9V, Q3 is on and crystals 1 to 6 are enabled whereas with 0V at this pin the states of Q3 and Q4 are reversed and crystals 7 to 12 are enabled.

### 4.2 Carrier Insertion Oscillator

The operating principles of this oscillator are identical to those of the channel oscillator described above. However, the circuit is only complete if there is 9V on at least one of the terminals C, D and E.

Normally, the clarifier facility is not required when transmitting. To disable the clarifier in the transceiver transmit state, 9V is switched to board pin E and Q11 is turned on. In this condition the frequency of the oscillator is determined by the setting of C58 only.

In the receive state Q11 is off and the additional frequency determining circuitry L2, C59 and D16 is enabled. The capacitance of D16 is a function of the d.c. voltage supplied to pin H; adjustable inductor L2 compensates for the mean capacitance of C59 and D16 allowing centralization of the clarifier range about the nominal C.I.O. frequency.

### 4.3 Oven Control Circuit

ML1 is an amplifier with differential inputs (pins 2 and 3) comparing the voltage at R30, RB1 junction against a reference set by R29. RB1 is a thermistor located in the oven and adjacent to one of the heating transistors, Q6 and Q8.

The amplifier input differential at 'switch on' is such that the output of ML1, fed via Q5 and D12 tends to turn Q6 and Q8 hard on. Q7 limits the drive to deliver approx. 0.7V across the emitter resistors which determine the heating current through Q6 and Q8.

The heating transistors Q6 and Q8 may be fed from either a 12 or 24V supply and the current through them must be proportional accordingly. For 24V supply, LK1 and LK2 are not fitted such that there is one only emitter resistor per transistor (R35, R37). For 12V supply, the heating current is doubled by fitting these links, parallelling R45 and R50 across R35 and R37 respectively.

When the oven temperature reaches 70°C, the increased resistance of RB1 reduces the output voltage of ML1, and therefore the heating current, to a level whereby the temperature of 70°C is maintained.

## 5 100W POWER AMPLIFIER TYPE 4360

This amplifier accepts 40-125mW p.e.p. of r.f. input and raises the level to 100W p.e.p. across a 50 ohm load..

### 5.1 13V REGULATOR

All major circuits with the exception of the output stage are powered by 13V, comprising Q8, Q9, Q11 and associated components.

The regulator is powered continuously and provides continuous output irrespective of whether the associated transceiver is in the transmit or receive state. This feature reduces transmitter switch-on delays and provides a 13V output for use external to the amplifier.

D1 provides a voltage reference which is d.c. buffered by power Darlington transistor Q9. In the event of excessive current being drawn for any reason the voltage developed across R22 will turn on Q8, which turns on Q11 to bias Q9 off to the point where the output current is limited to about 4 amps maximum. In the event of over-voltage (greater than 34V), current will flow through Zener diode D5 and R26 to turn Q8 on, causing the regulator to turn off until the over-voltage is removed. In this way the amplifier and all external circuits powered by the regulator are protected for up to 50V supply voltage.

### 5.2 R.F. SIGNAL PATH

The r.f. input is fed via R1, R8 and C9 to emitter coupled Q3 and Q4, which are common base stages for r.f. signals. Any exciter i.f. present is trapped by L1 and C7, series tuned to 10.7mHz.

The proportion of the input signal amplified by Q3 is controlled by the bias on Q4 which in turn is governed by the a.l.c. circuitry described later.

Q12 is a shunt feedback class A amplifier, fed from Q3 via C14. This stage biases the following stages which are all d.c. coupled. The current drawn by Q12 also drives both class B biasing circuits (discussed later).

Q14 and Q15 form a differential pair, biased by Q12 emitter and fed a.c. wise by Q12 collector. Emitter degeneration resistors R38 to R42 are high stability components and provide for highly linear equal and anti-phase outputs at the two collectors, required to drive the class B stage which follows.

Q17, Q18 and associated components comprise the class B driver stage, d.c. connected via L8 and L11 to the bias circuitry. The output is summed and coupled to the class B output stage Q23, Q24 via auto-transformer T1, which also d.c. connects this last stage to its bias circuit. The driver employs series feedback (R58 - R69) and the output stage shunt feedback (R72 - R74, R86 - R88) to improve linearity and flatten the frequency response.

## 5.3 D.C. BIAS CIRCUITS FOR THE CLASS B AMPLIFIERS

### (a) Driver

The collector load of Q16 is the phase splitter stage Q14, Q15 (1 amp drawn) and base drive is the current drawn by class A stage Q12. The transistor is prevented from saturating by base to collector resistors R37 in parallel with S.O.T. resistor R36, which may be adjusted for a collector to emitter voltage anywhere between $V_{BE}$ and $V_{BE}$-.25V approx. In this way it is possible to bias the class B drivers Q17 and Q18 for optimum performance.

Q16 is located physically close to Q17, Q18 on the heat dissipation plate for thermal tracking purposes.

### (b) Output Stage

Q19, Q20, D6, Q21 and associated components comprise a high gain d.c. amplifier. By virtue of feedback from the output (Q21 collector) to the input (Q19 base) via R47, R48, R49 and R52, the output d.c. voltage is a function of these resistors and the base-to-emitter voltage of Q19 only. Thus Q19 is positioned physically close to Q23, Q24 on the heat dissipation plate for thermal tracking, and R47 is adjusted for optimum bias conditions of the output stage. R53 is normally not required, but serves to offset the adjustment range of R47 if correct bias cannot be otherwise achieved.

The bias circuit draws no additional current in its own right in order to function as it uses the existing current of the Q12 class A stage. Q21 sinks that surplus current from the class B driver stage which is not used to drive the output transistors. This is done with virtually no change in bias voltage due to the extremely low output impedance of the bias circuit.

## 5.4 A.L.C. SYSTEM

A winding of the output transformer T2 provides a voltage reference across R92 and R93, which via D13, can provide a d.c. reference across C52.

The output current is sensed by T3. The output of this transformer and the output from the winding on T2 are vector summed by R91, C56 and R94 to produce an a.c. output at the anode of D12, the magnitude of which is dependant upon the magnitude and relative phase of the output current. This a.c. output is additional to a d.c. term which is dependant upon the power supply voltage via D9, R89, T3 and R94. The a.c. and d.c. components may charge C52 through D12.

C52 is thus charged via either D13 or D12, whichever presents the greater voltage. The charge on this capacitor, therefore, is a complex function of output voltage, output current, relative phase of output current and voltage, and the d.c. supply voltage.

For s.s.b. operation, R96 and R97 attenuate the voltage across C52 and a reference is passed to the buffer stages via D14. The output voltage here carries "peak sensing" information.

For a.m. (or tuning) operations, zero volts is applied to pin P which turns Q25 off. C53 will then charge through R98 to a value which averages the voltage excursions across C52. The Output voltage via D15 carries average sensing information, and is in parallel with the peak sensing output.

Peak, or average sensing voltage, whichever is the greater, is passed to Q1 which charges C11 via R9. These components define a very fast attack time of less than 100 microseconds. In the absence of signal, C11 discharges slowly through R11.

The voltage across this time constant capacitor C11 is buffered by a high gain voltage follower stage Q6 and Q7 to feed the amplifier gain control circuit at Q4 base.

The output level defined by the a.l.c. system is dependant upon the d.c. voltage at Q3 base. This reference is defined by the bias chain R4, RB1, R6 and R7. The reference will vary under the following conditions:

(a) For supply voltages in excess of 25V, D2 will clamp the voltage at RB1/R4 to the 13V regulator output, and the reference will be fixed. For supply voltages below 25V, the reference will reduce in proportion to the supply voltage. In this way the amplifier output will reduce in order to preserve output quality down to about 15V supply voltage.

(b) When the temperature of the heat dissipation plate becomes excessive, thermistor RB1 located in close proximity to output transistors Q23 and Q24, increases in resistance and causes the reference to fall, reducing the work load of these output devices to within safe limits.

## 5.5 SWITCHING CIRCUITS

### 5.5.1 Amplifier On/Off Switching

The TX 9V line feeds resistor chain R27, R29 and R31 which biases Q5 (providing current drive for the gain control stage Q3, Q4) and Q12 (which also biases the remainder of the amplifier stages). Hence in receive state the amplifier is switched off.

### 5.5.2 Switch-on Delay

Switch-on of the amplifier via the TX 9V line requires a brief time interval for stabilisation of d.c. voltages throughout the whole transmitter, as otherwise an undesired pulse may be transmitted. Switch-on causes C12 to charge through R14 turning Q7 on briefly to clamp the amplifier in minimum gain condition.

### 5.5.3 Gain Kill Circuit

In order to prevent breaking heavy current with the relay contacts which switch power to the output stage via the TX + 24V line, it is desirable to ensure minimum current drain on amplifier switch-off.

This is achieved by connecting pin Q to the p.t.t. line, which switches the receive/transmit relay. On release of the p.t.t., a positive going voltage spike will switch Q1 via D10 and R3, increasing the voltage across C11. Hence the amplifier will be clamped to minimum gain before the relay contacts open.

## 5.6 PROTECTIVE CIRCUITRY

Some protective systems have already been described, namely:-

(a) Dissipation in the output transistor is kept within safe limits for any combination of output voltage, output current, relative phase of output current and voltage, d.c. supply voltage and heat dissipation plate temperature.

(b) Class B bias circuits track thermally.

(c) 13V regulator incorporates constant current limiting and over-voltage protection.

(d) Switch-on delay and output "kill" circuit.

Additional circuits are:

(a) Over-voltage Protection Output Stage

During over-voltage condition, collapse of the 13V regulator will turn off all circuitry with the exception of the output stage. Even so, turn-off resistors between base and emitter of the output transistors (R44, R46, R47, R48 and R49) will tend to turn these devices off and bleed out any leakage current. Under severe conditions of temperature and over-voltage, this bleed path may not be adequate.

Where the supply voltage is too high, the current through D5 and R26 which trips the over-voltage circuit also switches on Q21 to turn the output transistors hard off.

(b) Output Bias Circuit Failure

Failure of the output bias circuit could lead to catastrophic failure of the output transistors.

The output voltage from the bias circuit is sensed by Q13 via R44 and R46. Should this voltage rise too high for any reason, Q13 will turn on and remove the bias from the whole amplifier chain.

## 6 REFLECTOMETER BOARD TYPE 6718

This board provides an indication of aerial match by illuminating the front panel lamp during transmission, if the load impedance presented to the transceiver is within 2:1 V.S.W.R.

Output voltage information appears at R3, R4 junction, and output current information is applied across R3 and R4 by T1 as a voltage. These two voltages are vector summed in phase at D2 anode and antiphase at D1 anode (assuming a 50 ohm resistive load). The resultant a.c. voltages are detected by D2, C5, R7, R8 and D1, C4, R6 respectively and the d.c. voltages applied to the inputs of differential amplifier Q1, Q2. Q2 turns on Q3 which in turn switches on the solid state lamp connected across terminals D & E.

For correct load match, a.c. voltage at D1 anode will be close to zero due to cancellation of signal at this point, and the a.c. voltage at D2 anode will be maximum. Hence Q2, Q3 and the lamp will be turned ON.

For incorrect load match, only partial cancellation of the a.c. signals will occur at D1 anode, and a reduced level will appear at D2 anode. Q1 instead will turn on, leaving Q2, Q3 and the lamp turned OFF.

## 7 DISTRESS SIGNALLING BOARD TYPE 6723

The use of this board provides the distress signalling facility whereby two tones are alternately transmitted for a pre-set period of time.

When the equipment DISTRESS TEST control is activated, 9V is applied to 6723 board terminal G which activates the two oscillators and the gating circuits.

The two oscillators are similar in operation therefore only one, Q6 and associated components, will be described.

The collector load of Q6 is a parallel tuned circuit (L1,C6) providing positive feedback to the base of Q6 via R17, therefore the circuit oscillates at a frequency defined by the tuned circuit. Clamping diodes D2 and D3 limit the drive such that Q6 operates linearly.

Oscillator outputs are selected alternately by ML3 which functions as an analogue switch, under the control of logical inputs at terminals 5, 6 and 12, 13. There are two outputs; one from terminals 2,3 is directed to the transmitter input. The other from terminals 9,10 is amplified by ML4 to drive the equipment speaker amplifier.

Logical inputs to ML3 are anti-phase square wave signals, frequency 2Hz, derived from ML2 which is a dual type D flip-flop wired to provide a divide by four function. ML1, and associated components, form an oscillator circuit which drives ML2. S.O.T. capacitor C5 is chosen for correct switching frequency.

When the equipment DISTRESS ALARM control is activated, a momentary earth is applied to 6723 board terminal A, charging capacitor C1. Transistors Q1 to Q4 are switched on. Q3 activates all circuits so far described, whilst Q4 operates the p.t.t. line, enabling the distress signal to be transmitted. Transmission continues until C1 has discharged sufficiently through R1 for Q1 to turn off, which action disables all other circuits.

# 8 LOUD HAILER MODULE TYPE 6726B

## 8.1 General

When the transceiver HAILER facility is selected, supply voltage is applied to the module at 6965 board pin H, with the following results:-

a) The 20W audio amplifier is activated.

b) The transceiver press-to-talk facility is disabled, i.e. the transmitter cannot be turned on.

## 8.2 20W Audio Amplifier

ML1 and ML2 and associated components are amplifier stages which raise the level of the microphone output to a value suitable for driving the output amplifier.

The class B output amplifier, Q1 to Q5 has a very high open loop gain heavily restricted by negative feedback, R16 and R13 to minimise distortion. The transformer 3T1 is a functional part of the circuit in providing a d.c. earth return for bootstrapping resistor R18.

The entire amplifier is d.c. coupled and is biased by R6 and R7. This bias point is heavily decoupled by C3, R4 and C4 to prevent feedback.

## 8.3 Press to Talk Circuitry

Q6, Q7 and associated components form a non-inverting buffer circuit to control the TRANSMIT relay via pin G, under the control of p.t.t. logic at pin D. Action of this circuit is as follows:-

a) With the Loud Hailer facility NOT selected and the p.t.t. control NOT activated, Q6 is biased ON by R22 which in turn biases Q7 OFF. The transmit relay, therefore, is not turned on.

b) With the Loud Hailer facility NOT selected and the p.t.t. control activated, pin D is shorted to 0V, which action biases Q6 OFF via R19. Q7 therefore is turned ON by current flowing through R23, switching ON the transmit relay.

c) With the Loud Hailer facility selected, Q6 turns on via R21 irrespective of whether the p.t.t. control is operated or not. Q7 and hence the transmit relay therefore remain OFF.

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# PART 3

# MAINTENANCE

## CONTENTS

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## 1 RECOMMENDED TEST EQUIPMENT

| | | |
|---|---|---|
| a) | Power Source<br>24V d.c. (approx) at 15A | 24V lead - and battery<br>or<br>A.C. Power Unit Racal PU 7723 |
| b) | TRA7948 Test Jig | Racal JT197 |
| c) | Multimeter<br>20,000 ohms/volt | AVO 9 |
| d) | R.F. Power Meter<br>50 ohm, 100W | Marconi type TF 1020A/1 |
| e) | Oscilloscope<br>frequency response 25mHz or better with compensated 10:1 probe. | Solartron CD1740 |
| f) | R.F. Signal Generator with carrier modulation facility, calibrated output, 2µV to 2V r.m.s. e.m.f. output capability at 50 ohms impedance level. | Hewlett Packard 606A |
| g) | Two tone audio generator with flat frequency response, output capability down to -50dBm into 600 ohms | Marconi type TF2005R |
| h) | Frequency Counter, 25mHz capability, sensitivity better than 25mV r.m.s. Input capacity, including cable, less than 100pf. | Racal 9839 |
| j) | Electronic thermometer with probe, operable in the 60 - $80^{\circ}$C range. | Dependatherm MRC 3 with 50 - $100^{\circ}$C probe. |

## 2 DISMANTLING AND RE-ASSEMBLY

### 2.1 INTRODUCTION

The transceiver is constructed as an aluminium cast chassis with recessed compartments to locate the individual modules. There is a top and bottom aluminium cover plate giving complete access to all components. The chassis front panel, to which all controls and the loudspeaker are mounted is faced with a moulded A.B.S. escutcheon.

The arrangement of modules is such that any one module may be easily and separately removed.

The transceiver top cover plate is secured by four 4BA x ¼ inch and one 6BA x ¼ inch pan head screws, whilst the bottom cover plate is held by five 4BA x ¼ inch and two 6BA x ¼ inch pan head screws. With these covers off, the order in which the modules are removed or replaced, according to the groups of instructions below, is immaterial.

When the mechanical fixings of any boards are removed, the board may be lifted without removal of the loom leads to give access to the underside for tests and maintenance purpose.

Where replacement of a board is necessary, a note of the wire connections to appropriate board pins should be made for reference when reconnecting to the replacement board.

For all modules, re-assembly is the reverse of dis-assembly.

### 2.2 OSCILLATOR UNIT TYPE 6710

Remove the polyurethane cover surrounding the oven casting. Remove the screws securing the board which are 4 x 6BA x ¼ inch ch. head screws with plain and crinkle washers.

Lift board and remove the polyurethane pad from the underside of the board.

### 2.3 RECEIVER EXCITER BOARD TYPE 6712

Remove the fixing components to this board which are:-

8 x 6BA x ¼ inch ch. hd. screws with plain and crinkle washers.
1 x 6BA x 1 inch pillar and crinkle washer.

### 2.4 100W POWER AMPLIFIER MODULE TYPE 4360

#### 2.4.1 100W Power Amplifier Board Type 4361

The printed circuit board may be lifted with or without the connecting wires attached leaving the remainder of the module (heatsink and attached parts) still secured to the chassis.

Proceed thus for dis-assembly:-

a) Using a soldering iron and a pair of pliers, remove the eyelets which sleeve the base and emitter leads of Q9. Remove any solder between these leads and the printed circuit board, using a solder sucking device as required.

b) Remove the 4BA nut and crinkle washer which secure the 4BA solder tag to one of the two mounting screws to Q9.

c) Remove the twelve 6BA screws and crinkle washers which secure the six flange transistors to the heatsink.

d) Remove the 6BA x 1½ inch screw, plain crinkle and nylon washers from output transformer T2.

e) Remove the ten 6BA x ½ inch screws, plain and crinkle washers which secure the board to the heatsink assembly.

f) Lift the board carefully from the heatsink assembly, disconnecting the wiring first if complete removal is required.

Re-assembly is the reverse of dis-assembly with attention to the following:-

a) It is ESSENTIAL that a film of special thermal conducting compound be applied to the mating surfaces of the heatsink and output transistors Q23 and Q24, before re-assembly. It is also desirable, though not essential, that the mating surfaces of the heatsink and the other four flange transistors (Q14, Q15, Q17 and Q18) be similarly treated. Sufficient residual compound may exist on the heatsink for this purpose, and may be used PROVIDED IT IS FREE FROM GRIT OR OTHER IMPURITIES.
Otherwise fresh compound must be used.

Proprietory types of this compound are:-
Redpoint - "Thermpath 167"
Thermalloy - "Thermcote"

b) Ensure that no wires are trapped between the heatsink and flange transistors during re-assembly.

c) The screws securing the flange transistors should ideally be tightened to a torque of 45 to 55 inch-ounces (3½ to 4 kg-cms) in order to ensure good thermal contact between these transistors and the heatsink without over-straining the mounting screws. Where a torque screwdriver is unavailable secure screws tightly using a medium size screwdriver.

### 2.4.2 100W Power Amplifier Module Type 4360

Where complete removal of this module is necessary, proceed thus:-

a) Make a note of external wire connections and remove these wires from the board (Internal wiring or wiring from components on the heatsink need not be disconnected at this stage).

b) Remove mounting screws etc. from the receiver exciter board (refer section 2.3) and swing the board upwards with the wiring still connected in order to gain access to the amplifier mounting hardware underneath.

c) Remove the 8 4BA nuts and crinkle washers which secure the amplifier module to the chassis.

d) Carefully ease the amplifier module from the chassis e.g. by pushing through a hole in the chassis against the amplifier heatsink. DO NOT exert more than light force against the mounting screws, as these are soldered into the heatsink.

Replacement is the reverse of removal, except that it is ESSENTIAL that special thermal compound (specified under 2.4.1 above under Re-assembly) be applied liberally to the mating surfaces of heatsink and chassis before re-fitting the amplifier module.

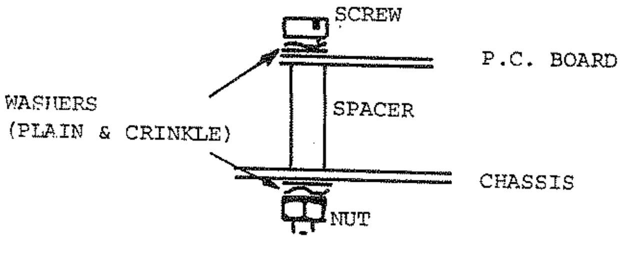
## 2.5 ITEMS MOUNTED ON THE FRONT PANEL

Remove and rotary control knobs (collet type fixing).

The escutcheon is secured to the chassis by four 4BA x $^3$/8 inch ch. head screws entered from the rear face of the chassis front panel whilst the indicator lamp is held to the escutcheon by adhesive. On removing the four 4BA screws, therefore, carefully ease the escutcheon away from the chassis to the extent of the indicator lamp leads. With the escutcheon thus separated from the chassis access is provided to the screws by which the controls and loudspeaker are mounted to the chassis.

## 2.6 REFLECTOMETER BOARD TYPE 6718

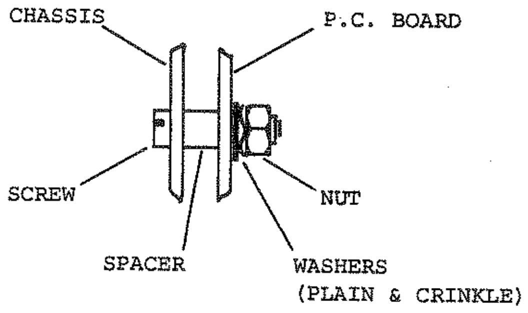
The board is secured to the transceiver chassis by four 6BA screws, spacers, nuts and eight plain and crinkle washers thus:-



## 2.7 DISTRESS SIGNALLING BOARD TYPE 6723

(OPTIONAL FITMENT)

The board is secured to the transceiver chassis by four 6BA screws, washers, spacers and nuts thus:-



On removing this hardware the board is free to be withdrawn with or without leads connected, but from the topside of the transceiver ONLY, as otherwise board components will foul with the speaker.

## 2.8 LOUD HAILER TYPE 6726

(OPTIONAL FITMENT)

### 2.8.1 Overall Assembly

The Loud Hailer Assembly

The Loud Hailer Assembly is secured to a platform of the casting by four 6BA screws, plain and crinkle washers and nuts.

### 2.8.2 A.F. Amplifier Board Type 6965

Disconnect wiring and remove the overall assembly (2.8.1 above).

With a solder sucking device, clear the solder from the base and emitter leads of TO-3 type transistors Q4 and Q5. Remove the four 4BA nuts and crinkle washers from the component side of the board and carefully lift away the board.

On re-assembly, it is important that the nuts be secured first before soldering the transistor leads to the board, as otherwise stress may be applied to the TO-3 transistors Q4 and Q5.

# 3 ALIGNMENT PROCEDURES

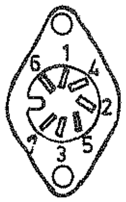
## 3.1 GENERAL

The procedures written in this section should be carried out by competent personnel only and the recommended test equipment, as listed under Section 1 of Part 3, should be used whenever possible.

The Racal Test Jig JT197, plugged into the transceiver A.F. INPUT socket (SKA) provides a convenient means for the connection of an audio generator and to monitor the receiver output. The jig also includes a p.t.t. line switch enabling the transceiver to be held in the transmit state.

If this item is unavailable the input/output connections and linking for p.t.t. action of SKA are:-

AF INPUT - PINS 1 & 2 (EARTH)
AF OUTPUT - PINS 6 & 5 (EARTH)
P.T.T. - PINS 3 & 4 (LINKED)



NOTE. Do not connect a microphone for p.t.t. control as the microphone acoustic pick-up will adversely affect alignment.

Test equipment earths must be connected to ground phase earth and not chassis, as the supply lines are both isolated from chassis.

## 3.2 CHANGE OF CHANNEL FREQUENCY OR FITMENT OF NEW CHANNELS.

Change of channel or addition of new channels normally requires fitment and alignment of new crystals only, as the transceiver is designed as a wideband system and does not require any additional individual channel adjustments.

However, where any of the channels fitted operate in 2 f.s. mode, special linking is required between the channel select switches.

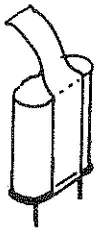
### 3.2.1 Fitment of Crystals.

Channel crystals are ground to a frequency 10,700 kHz higher than the required channel frequency.

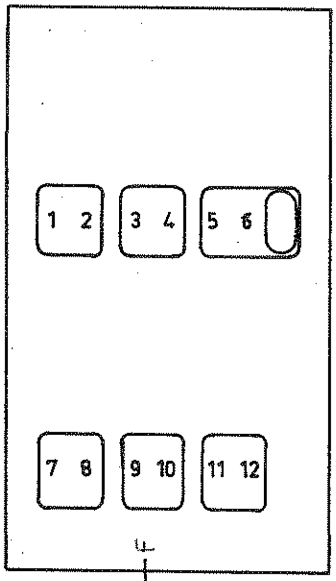
Each 2 f.s. channel fitted reduces the number of channels available by one. Inoperative channels will be in the second bank 7 to 11, as the bank select switch is disabled when a 2 f.s. channel (2 to 6) is selected.

Fitment of crystals is in accordance with the table shown below:-

| CHANNEL NUMBER | SFS CHANNELS | 2 FS CHANNELS | XTAL POSITION |
|---|---|---|---|
| 1 | Rx/Tx (2182kHz) | | 7 |
| 2 | Rx/Tx | Rx | 2 |
| (7) | Rx/Tx | Tx | 8 |
| 3 | Rx/Tx | Rx | 3 |
| (8) | Rx/Tx | Tx | 9 |
| 4 | Rx/Tx | Rx | 4 |
| (9) | Rx/Tx | Tx | 10 |
| 5 | Rx/Tx | Rx | 5 |
| (10) | Rx/Tx | Tx | 11 |
| 6 | Rx/Tx | Rx | 6 |
| (11) | Rx/Tx | Tx | 12 |



Tape to be attached to crystal as shown to facilitate removal.

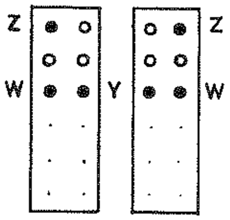


Showing Position of Crystals.

### 3.2.2 SFS/2FS Linking

A spare pole is available on each black channel select switch for s.f.s./2 f.s. linking. These are wired between terminals on the white bank select switch, referred to as W, Y and Z.

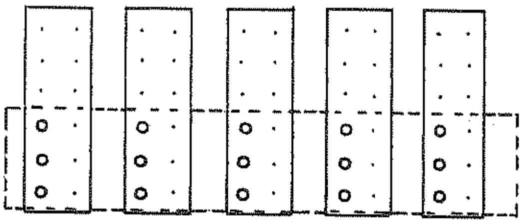
BANK SELECT PUSHBUTTON



Red pushbutton on left.

White push-button on left.

CHANNEL SELECT PUSHBUTTON



Only the first two Terminals of each pole are used.

Spare Pole per Switch available for SFS/2FS Linking.

a) Single Frequency Simplex.

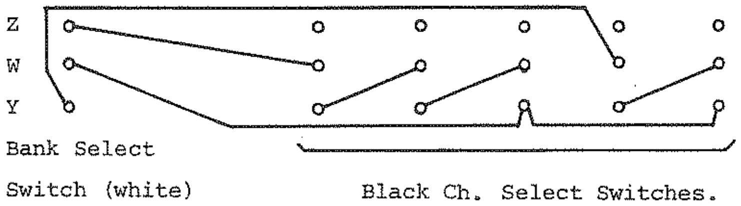
All switches that are used to select s.f.s. are to be wired in series between W and Z.

When all switches select s.f.s., W to Y only are linked.

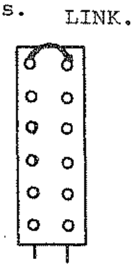
b) Two Frequency Simplex.

All switches that are used to select 2 f.s. are to be wired in series between W and Y.

EXAMPLE: 2 f.s. channels on 5 and 6 only.



In addition to the above linking the end terminals of each switch which selects a 2 f.s. channel must be linked. This allows for selection of a single A.T.U. channel for both receive and transmit channels.

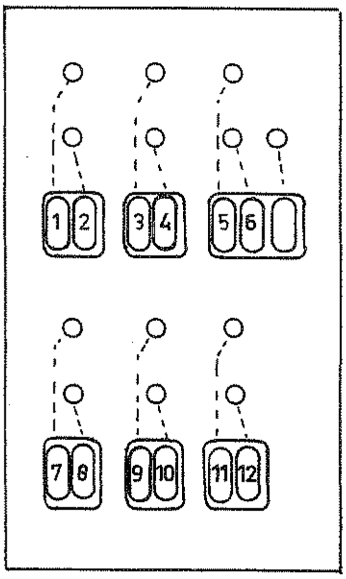


2.F.S. Channel Switch

3.2.3 Channel Frequency Alignment

Before carrying out oscillator frequency adjustments, allow at least half an hour of warm up time.

The trimmer capacitors which adjust channel frequency are accessible through slots in the oven casting. A small screwdriver or trimmer tool, preferably with an insulated shaft, is suitable for carrying out the adjustments. Each adjustment slot is associated with a particular crystal as shown below.



C.I.O. CRYSTAL at 10,700.0kHz.

Alignment itself may be carried out most accurately by monitoring the transmitted a.m. carrier signal with a counter, and trimming the associated crystal for the exact channel frequency ±5Hz. A suitable attenuator must be used to protect the counter or alternatively the output from the exciter may be monitored at the 6712 Board terminal P. Approximately 1 V r.m.s. of signal will be available at this point. 2 f.s. receive channels may be aligned in a similar manner by temporarily relocating the wire which connects to pin W of the white bank select switch onto pin Y (refer above).2 F.S. receive channels may then be enabled by releasing the bank select switch.

Alternatively oscillator output may be monitored at pin H of the 6712 Board or pin R of the 6710 Board. Approximately 100mV r.m.s. level is available at these points.

## 3.3 TWELVE CHANNEL OSCILLATOR TYPE 6710

Switch equipment power on and allow at least 10 minute warm-up time before taking oven temperature measurements, and at least half an hour before attempting oscillator frequency adjustments. Remove polyurethane cover from the oven.

### 3.3.1 Oven Temperature Adjustments.

The oven control potentiometer R29 is factory pre-set, and adjustment should only be necessary where this component, R30 or the thermistor RB1 has been replaced.

With reference to the Oven Oscillator Layout Diagram 6710 and using the Electronic Temperature Probe, monitor the oven temperature on top of the casting behind heating transistor Q8. Adjust R29 for a stable temperature of 70°C ±0.5°C, waiting about half a minute after each trial adjustment for stabilisation of temperature. Re-seal R29 with sealing varnish after adjustment.

### 3.3.2 Carrier Insertion Oscillator.

Monitor the output of the carrier insertion oscillator with the counter at 6710 Board pin G or 6712 Board pin F as convenient. Approximately 50 mV r.m.s. of signal is available at these points.

Set the equipment to U.S.B. TRANSMIT and check output frequency. If outside of 10,700,000Hz ±10Hz, set to within this range by adjusting C58, accessible via a slot in the casting. A small screwdriver or trimming tool preferably with an insulated shaft, may be used for this alignment.

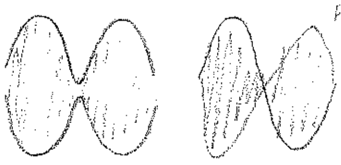
Set to U.S.B. RECEIVE and adjust L2 so that the equipment CLARIFIER control varies the frequency equally about 10,700,000Hz.

### 3.3.3 Channel Oscillator Refer Section 3.2.3.

## 3.4 RECEIVER EXCITER BOARD TYPE 6712B

### 3.4.1 Setting Up

| | REQUIRED FIGURE |
|---|---|
| Disconnect exciter output (i.e. remove cable core from pin P). Set to TRANSMIT condition and apply 30 to 300mV p-p of 1kHz audio signal. Check the level at TP1. | 130 - 250mV p-p |

|  |  | REQUIRED FIGURE |
|---|---|---|
| 3.4.2 | I.F. & U.S.B. Filter Alignment<br>Connect the C.R.O. probe to TP3. Tune C33, C42 and C43 for maximum output. Check level. | 0.4 to 1.0 V p-p |
| 3.4.3 | Carrier Balance<br>Link TP7 to ground plane earth and remove the audio input. Adjust R33 for minimum output level. | <.05V p-p |
| 3.4.4 | A.M. Filter Alignment<br>Reconnect audio input. A two tone envelope should be seen. Adjust 3C38 and 3C39 such that when the audio frequency is varied between 300 and 3000Hz, there is:<br>a) Minimum variation in amplitude<br>b) Minimum crossover amplitude.<br>Reset audio generator frequency to 1kHz, and remove link from TP7. | 0.7 to 2.1 V p-p |
| 3.4.5 | I.F. Alignment<br>Connect C.R.O. probe to pin P and select the lowest frequency channel of channels 2 to 11 (DO NOT select channel 1). Set for u.s.b. mode. Tune L9 for maximum output and set R67 for 5 V p-p. | 5V p-p |
| 3.4.6 | Second Mixer Balance (Ch.O)<br>Remove audio input. Adjust R86 to minimise the remaining signal. | <0.1V p-p |
| 3.4.7 | Second Mixer Balance (I.F.)<br>Reconnect the audio input. Select the highest frequency channel and adjust R87 to minimise the "fuzz" on the edges of the output signal. | Fuzz<br><.2V p-p |
| 3.4.8 | Exciter Gain<br>Check output on all channels. Select the highest level channel and adjust R67 for 5.5V p-p level. | >5.5V p-p |
| 3.4.9 | A.M. Carrier Level Adjustment<br>Select a.m. mode, any channel. A two tone waveform should be seen. Equalise tones using 2R132, and then adjust 2R132 clockwise such that amplitude at crossover is 10% of the peak to peak amplitude. Check overall level. | <br>FIG 2<br>4-6V p-p<br>THE POT IS CORRECTLY SET, IF FULL 90% MODULATION IS OBTAINED WITHOUT PASSING THROUGH FIG 2 CONFIGURATION AS AUDIO I/P LEVEL IS GRADUALLY INCREASED. |
| 3.4.10 | A.M. Level (Receiver)<br>Remove audio input. Set to RECEIVE A.M. and monitor the a.f. output with the oscilloscope (e.g. at pin U). Set the r.f. generator to deliver 2μV e.m.f. 80% modulated and connect to the AERIAL socket. Tune generator to the receiver and adjust 2L16 for maximum a.f. output. | 0.2Vp-p |

ONFUSION HERE
EPENDS ON
WHICH SIDE
POT IS VIEWED

REQUIRED FIGURE

3.4.11 A.G.C. Alignment

Set R114 fully clockwise. Increase generator output to 200mV e.m.f. and reduce modulation depth until the a.f. output starts to fall or "motorboating" occurs.

Adjust R114 SLOWLY anti-clockwise until the audio again starts to fall, and set about 10 degrees clockwise from this point. – –

3.4.12 I.F. Rejection.

Set generator for 200μV e.m.f. c.w. and switch the transceiver to s.s.b. at a frequency around 6MHz (midband). Tune generator around 10.7MHz for an a.f. response (increase generator level if necessary). Adjust L8 and R39 to null the output. Set generator to 2mV e.m.f. and re-adjust L8 and R39.

The output at best should be a noisy signal. Remove signal generator. – –

3.4.13 Reconnect cable core to pin P ONLY IF the power amplifier does not require alignment. Otherwise leave disconnected at this stage. – –

3.5 100W POWER AMPLIFIER BOARD TYPE 4360

3.5.1 Bias of Driver Stage

Check that exciter output is disconnected (e.g. cable core to pin P of 6712 Board is removed). Set to TRANSMIT U.S.B. and check AVERAGE d.c. voltage across resistor banks R58 - R63, and R64 - R69. If other than required, adjust S.O.T. resistor R36 for correct readings, using resistor values 0 - 1.8 ohms. (Resistance wire wound on a resistor would be suitable). 60 - 100mV

3.5.2 Bias of Output Stage.

Switch transceiver OFF and disconnect LK1. Connect an ammeter across LK1 terminals. Set to read 100mA full scale, and switch the equipment ON. If the current is other than required, adjust S.O.T. resistor R47 using resistor in the range 4.7 - 22 ohms. 30 - 60mA

Remove ammeter and replace LK1.

3.5.3 I.F. Trap Alignment.

Reconnect exciter output to the power amplifier. Connect the r.f. power meter to the Transceiver AERIAL socket. Set to A.M. TRANSMIT, on the lowest frequency channel, and monitor the r.f. output with an oscilloscope (e.g. across the link through T3). Some 100-140V p-p of signal should be seen.

| | | REQUIRED FIGURE |
|---|---|---|
| | With a screwsdriver short to ground plane the centre terminal of 6712 Board potentiometer R87. This action will unbalance the second mixer causing I.F. leakage. Minimise the "fuzz" seen on the oscilloscope by adjusting 4360 Board C7. | "fuzz" minimum |
| 3.5.4 | Output Power (U.S.B.)<br>Set to USB TRANSMIT on any channel except channel 1. Apply two tone audio input to the transmitter, using tone frequencies at 1 kHz and 1.6 kHz (approx). Set input level about 10dB above the point at which r.f. output ceases to increase. Adjust the level of one tone for zero crossover as seen on the oscilloscope. Ensure that the chassis is not unduly hot and set potentiometer R92 for correct output power on all channel except channel 1. | 50 - 60W |
| 3.5.5 | Remove audio input, and set to A.M. TRANSMIT. Ensure that the chassis is not unduly hot and if required adjust S.O.T. resistor R104 for correct output power on all channels. | 25 - 60W |

NOTE. S.O.T. components L7, C39 and C42 are fitted during manufacture and will not require re-alignment. Their purpose is to minimise second harmonic products across the frequency band.

## 3.6 LOW POWER ADJUSTMENT

When LOW POWER is selected exciter output is switched through R4 to attenuate the drive to the power amplifier. The resistor is a select on test component and is connected to terminals of the POWER switch.

Connect the power meter to the AERIAL socket and apply two tone audio input as in 3.5.4 above, set to U.S.B. TRANSMIT, and select LOW POWER. Check for 2.5 to 10.0W on all channels EXCEPT CHANNEL 1 (the a.m. channel). If otherwise re-select R4, using high stability r.f. resistors in the range 270 to 680 ohms.

## 3.7 DISTRESS SIGNALLING BOARD TYPE 6723 (Optionally Fitted).

In order to align, remove the board mounting parts with the wiring still connected, and lift the board out to make the components accessible. Insulate the board from the chassis as required.

Switch the transceiver on and set the ALARM switch to the TEST position. Monitor oscillator output frequencies at either end terminal of inductors L1 and L2 via a 1 Megohm resistor to prevent loading the associated circuit. As required adjust L1 for 1300Hz ±5Hz and L2 for 2200Hz ±5Hz.

Using a wristwatch, count the number of "hee haw" cycles from the speaker over a 15 second period. There should be 30 ± 4. If otherwise re-set S.O.T. capacitor C5, using values in the range 0.0068 to 0.068 microfarads.

## 3.8 LOUD HAILER TYPE 6726 B (OPTIONAL FITMENT)

The single variable control on the loud hailer board potentiometer R1, adjusts the drive level to the external speaker, and is normally factory pre-set to deliver rated output.

Under field operation a different level may be desired, which level may be set by operating the Transceiver Loud Hailer facility, and adjusting R1 as required.

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## 4. FAULT FINDING PROCEDURES

In the field overall transceiver checks may be carried out as under 4.1 using only a multimeter and soldering iron to locate the faulty module which may then be replaced. To locate the actual component at fault, more sophisticated equipment is required as under section 1 and procedure is detailed under section 4.2

## 4.1 OVERALL TRANSCEIVER CHECKS

### 4.1.1 Inspection

Disconnect the power and aerial leads. Remove top and bottom covers and inspect:-

a) Fuses (2 x 15A and 2 x 500mA). Check that these are intact.

b) Wiring. Check for good contact by the connections of leads to:-

All printed circuit boards

The relay $\frac{RL}{6}$

Switches and controls mounted to the front panel.

Sockets mounted on the side panel

### 4.1.2 D.C. Voltage Checks

NOTE: All d.c. voltages must be measured relative to the ground plane of any board and not chassis, as the transceiver chassis is isolated from the electrical earth of the equipment.

Connect the 24V d.c. supply and switch the transceiver ON.

Carry out voltage checks as given in the following table.

| TEST | POINT | SWITCHED STATE | REQUIRED VOLTAGE | ACTION WHERE VOLTAGE IS INCORRECT |
|---|---|---|---|---|
| BOARD | PIN | | | |
| 4360 | F | Any | 23.3V | Check supply, FS3, FS4, D1, SC and wiring |
| 4360 | D | Any | 13V | Check 13V regulator on 4360 board, or for a short circuit at pin D |
| 6712 | N | Any | 9V | Check 9V regulator on 6712 board, or for a short circuit at pin D. |
| 6710 | B | Any | 9V | |
| 6712 | D | RECEIVE | 9V | Check relay and associated wiring |
| 6712 | D | TRANSMIT | 0V | |
| 6712 | J | RECEIVE | 0V | |
| 6712 | J | TRANSMIT | 9V | |
| 4360 | C | TRANSMIT | 9V | |
| 4360 | H,J | RECEIVE | 22.8V | Check RL3 - RL6 and associated wiring, also D3 of 4360 board |
| 4360 | H,J | TRANSMIT | 24V | |
| 3028 | L | USB,CH.2 | 9V | Check SB2, SA - B4 and wiring |
| 3028 | L | AM,CH.2 | 0V | |
| 3028 | K | USB,CH.2 TRANSMIT | 9V | Check SB1, SA - B3 and wiring |
| 3028 | K | AM,CH.2 TRANSMIT | 8.3V | |

### 4.1.3 Location of a Faulty Module.

The performance of the transceiver will, to a large extent, indicate the probable area of malfunctioning as shown by the following table:-

| SYMPTOM | ACTION |
|---|---|
| Transmitter functional<br>Receiver non-functional | Receiver/Exciter Board 6712 faulty. |
| Receiver functional<br>Transmitter non-functional | Fault may be in Receiver/Exciter Board 6712 or Power Amplifier 4360. Perform check 4.1.3.1 below |
| Transceiver non-functional on one channel | Crystal of non-operative channel is prime suspect, otherwise Oscillator Board 6710. Perform checks 4.1.3.2 below |
| Transceiver non-functional on any channel and there is:-<br>a) Noise output from speaker<br>b) No noise output from speaker in s.s.b. mode | Channel oscillator suspect. Perform check 4.1.3.3 (a) below<br>Carrier insertion oscillator suspect. Perform checks 4.1.3.3 (b) below |
| Transceiver functional but front panel lamp non-functional | Reflectometer board 6718 or lamp faulty |

### 4.1.3.1 Receiver Functional, Transmitter Non-Functional.

To isolate the fault to either the Receiver/Exciter Board 6712 or Power Amplifier 4360 proceed as follows:-

Switch transceiver off.
At the Receiver/Exciter Board 6712 link:
TP1 (Tx a.f. amplifier output) to pin AB (speaker amplifier input).

Set both VOLUME AND CLARIFIER controls to mid point of travel.
Switch transceiver on.

Operate microphone P.T.T. control and speak.
If speech is not heard from the speaker the a.f. amplifier at the Receiver/Exciter Board is faulty.

Switch equipment off and disconnect the lead from TP1 to pin AB.

Return the power and with the P.T.T. control operated check for voltages at the Receiver/Exciter Board as under:-

| TEST POINT | VOLTAGE (V) |
|---|---|
| ML6 pin 11 | 5.0 |
| Q14 emitter | 5.2 |
| ML7 pin 9 | 1.5 |
| ML8 pin 9 | 1.9 |

The board is faulty if any of these voltages are found incorrect otherwise the Power Amplifier 4360 is suspect.

4.1.3.2 Transceiver Non-Functional On One Channel

Check crystal of non-operative channel as follows:-

Set transceiver for s.s.b. operation.
Select various channels including non-operative channel.
The noise output on non-operative channel will be noticeably higher than that on operative channels.

Lift off the polyurethane insulating cover from the oven and with reference to the table under section 3.2.1 identify the oscillator crystal for the faulty channel. Check the crystal of this channel by simply changing the position with one of another channel and observing, by the receiver noise output, whether the fault has followed the change of position.

If the crystal is found to be functional on other channels check that the switching line associated with the suspect channel is at 0V (board terminal K, L, M, N, P or Q). Should this be so, then the oven oscillator board is faulty.

4.1.3.3 Transceiver Non-Functional On Any Channel

a) Noise Output From Speaker - (Channel Oscillator Check)
Set transceiver for s.s.b. receive operation.
At Receiver/Exciter Board 6712 short pins G & H (Channel Oscillator input).
If the noise output does not increase, the fault lies with the oscillator unit.

b) No Noise Output From Speaker - (Carrier Insertion Oscillator Check).
Noise output in a.m. mode where there is no noise output in s.s.b. mode confirms that the carrier insertion oscillator is at fault.

A functional oscillator should provide approx. 5V at the collector of Q10. However, this check does not prove, conclusively, that the oscillator is not at fault. Crystal substitution is required to check whether the oscillator or crystal has failed.

## 4.2 INDIVIDUAL BOARD TESTS

Tests under 4.1 above will indicate the board at fault and perhaps also the fault area within the board itself. In some cases a multimeter may suffice to isolate the faulty component, in association with the voltages shown on the circuits. In general, however, more specialised equipment will be required.

### 4.2.1 TWELVE CHANNEL OSCILLATOR TYPE 6710

With the oven in situ within the transceiver, carry out the following tests as required depending upon the nature of the fault.

### 4.2.1.1 Oven Heating and Control

When the oven is cold the current drawn by the transceiver should be approximately 1 amp in the RECEIVE state, reducing to about 400 milli-amps, when the required temperature, 70°C, is reached.

For an ambient temperature of 20-25°C an oven temperature of 70°C should be reached in approximately five minutes from switch-on. Physically check (hand on oven) that the oven is being heated.

Where the oven operation is other than required, trace the faulty component by taking voltage measurements with reference to the values shown on the circuit diagram.

### 4.2.1.2 Channel Oscillator

If there is oscillator output on any of the channels used, check crystal(s) on non - operative channel(s) by substitution (refer Section 3.2.1 for position of crystals).

If the oscillator circuitry is at fault, carry out d.c. voltage measurements.

As an a.c. test using the oscilloscope, a functional oscillator should display approximately 700 millivolts p-p of clipped sine-wave signal at the junction of D2, D3 and C3.

### 4.2.1.3 Carrier Insertion Oscillator (C.I.O.)

The C.I.O. will only function where there is 9V on at least one of the board pin C, D and E, which should be the case in all modes except A.M. RECEIVE. Check that this is so.

Set the transceiver to S.S.B. RECEIVE and carry out d.c. voltages measurements with reference to the values shown on the circuit diagram.

If d.c. checks are satisfactory, replace the C.I.O. crystal and check for operation of this oscillator (e.g. by monitoring at D14, D15, C53 junction with an oscilloscope, where about 700 millivolts peak to peak of clipped sine-wave signal should be seen).

Where a replacement C.I.O. crystal is not readily available, remove the C.I.O. crystal and with the transceiver set to TRANSMIT, hold a channel oscillator crystal onto the C.I.O. crystal pads underneath the board. Check for signal at D14, D15, C53 junction as above. If present, the oscillator circuitry is proved to be functional.

## 4.2.2 TESTS ON RECEIVER/EXCITER BOARD 6712 B

### 4.2.2.1 D.C. Checks

The d.c. voltages which should be seen within the various circuits are shown on the circuit diagram.

In the light of observations made in performing the overall transceiver checks of section 2, carry out d.c. voltage checks in the suspect areas as tabulated below.

| SYMPTOM | SUSPECT CIRCUIT(S) |
|---|---|
| 9V at pin N not available | 9V regulator ML10D to Q23 |
| U.S.B. Transmission but no reception | a) RX Filter<br>b) Filter switch, Q4, Q5<br>c) RX A.F. Amplifier ML11<br>d) A.F. Power Amp. Q24 - Q28<br>e) A.G.C. Detector Q19 - ML10C (without signal input, TP6 to ground should show >3.5V).<br>f) First mixer drive ML7<br>g) Second mixer drive ML8A-C<br>h) I.F. switching ML3B, D & E |
| U.S.B. Reception but no transmission | a) TX A.F. Amp switch Q1<br>b) TX A.F. Amp Q2, ML1<br>c) TX R.F. Amp ML6C, D, E Q12 - 16<br>d) First mixer drive ML7C & E<br>e) Second mixer drive ML8A-C |
| No reception or Transmission | a) TX A.F. Amp Check TP1 Voltage<br>b) First Mixer Q6, Q7, ML2<br>c) Filter Switches (if fitted) ML8-D, 3Q8,3Q9<br>d) U.S.B. Filter FL2<br>e) I.F. Amplifiers ML3, 4 and Q10<br>f) Second Mixer ML6 A & B, ML5<br>g) First Mixer Drive ML7<br>h) Second Mixer Drive ML8 A - C |
| No Reception in A.M. | a) A.M. Switching ML8D, E & 3Q9<br>b) A.M. Limiting Amp 2ML9<br>c) Secondary A.G.C. Detector 2Q11 (Remove & Check)<br>d) A.M. Filter 3FL1 |
| No Transmission in A.M. | C.I.O. Re-Insertion 2Q17, 2Q18 |

### 4.2.2.2 A.C. Checks

Ensure transceiver power is switched off.
Disconnect the core of co-axial cable at pin P of Receiver/Exciter Board 6712B (Power Amplifier < disconnected).

If available connect the Test Jig JT 197 to the transceiver AUDIO socket. If not improvise as under section 3.1. Connect power and switch transceiver on.
Select any working channel and switch to RECEIVE U.S.B. operation.

Using the oscilloscope, earthed to a convenient point of the Receiver/Exciter Board earth plane (not transceiver chassis), perform the checks given in the following table.

| CONDITION | TEST POINT | SIGNAL | LEVEL | REMARKS |
|---|---|---|---|---|
| RECEIVE U.S.B. | PIN F | C.I.O. | 150mV p-p (approx.) | If not present C.I.O. is faulty. See separate tests on Oven Oscillator Unit. |
| RECEIVE U.S.B. | PIN H | CH.O | 300mV p-p (approx.) | If not present CH.O is faulty. See separate tests on Oven Oscillator Unit. |
| RECEIVE U.S.B.<br>TRANSMIT U.S.B. | TP 5<br>TP 5 | C.I.O. | 200mV p-p<br>300mV p-p | Proves 2nd mixer drive functional. |
| TRANSMIT U.S.B. | ML 7 PIN 1 OR TP 8 | C.I.O. | 300mV p-p | Proves part of first mixer drive circuit functional. |
| RECEIVE U.S.B. | ML 7 PIN 1 OR TP 8 | CH.O | 500mV p-p | Since Ch.O output is under a.g.c. control, where signal level is not obtained, check whether ML7 Pin 2 d.c. voltage is less than ML7 Pin 4. If this is the case, 1st mixer drive is at fault; if not the fault lies with the a.g.c. system. |

Connect a single tone generator (providing, preferably, a balanced output) to the input of the transmitter and set for a 1kHz output.

Switch the transceiver to TRANSMIT U.S.B. and with oscilloscope at pin C of the Receiver/Exciter Board, adjust the generator output level for an oscilloscope reading of 100mV p-p.

Perform checks as in following table:-

| CONDITIONS | TEST POINT | SIGNAL | LEVEL | REMARKS |
|---|---|---|---|---|
| TRANSMIT U.S.B. | TP1 | 1kHz | 120-250mV p-p | Obtained level should remain within ±20% when generator level is varied between 30mV and 1 V p-p. If not, a fault exists in either the TX AF Amp. switch Q1 or the TX AF Amp. |
| TRANSMIT U.S.B. | TP2 | 2 tone i.f. (10.7MHz) | 1.2-3.0V p-p | 1st Mixer functional. |
| TRANSMIT U.S.B. | TP3 | 2 tone i.f. (10.7MHz) | 0.4 - 1.0V p-p | U.S.B. filter and two i.f. amplifiers functional. |
| TRANSMIT U.S.B. | TP4 | 2 tone i.f. (10.7MHz) | 120 - 350mV p-p | Remaining i.f. amplifier functional. |
| TRANSMIT U.S.B. | PIN P | Exciter Output at channel frequency | 4.5.5V p-p | If level is close but outside limits realignment may be necessary (R67). Otherwise 2nd mixer, TX Filter or TX RF Amplifier is at fault. |
| TRANSMIT A.M. No audio input. | PIN P | Exciter Output | | C.I.O. re-insertion oscillator is faulty if output is not approx. half that seen in s.s.b. state. |

The exciter section of the board and the receiver circuits which are shared with the exciter have now been fully checked.

Continue with checks on the receiver section as follows:-

Disconnect the audio generator.

Connect the r.f. signal generator to the transceiver AERIAL input.

Carry out the checks tabulated overleaf, measuring the signals, unless stated otherwise, with an oscilloscope earthed to the exciter/receiver board earth plane.

| CONDITION | TEST POINT | SIGNAL | LEVEL | REMARKS |
|---|---|---|---|---|
| RECEIVE U.S.B. generator signal at 200mV (100mV pd) c.w. in 2-10MHz range | TP1 | R.F. | 150-300mV p-p | If this voltage is not present, wiring to the board, RX Filter switch Q4, Q5 or the RX Filter is faulty. |
| RECEIVE U.S.B. No input signal. | TP6 | A.G.C. | >4V d.c. | A.G.C. Detector faulty if this voltage not seen. |
| RECEIVER U.S.B. Generator re-connected and set for 2mV e.m.f. output. Tune generator to receiver, for an audio response. | PIN U | A.F. Output (Low level) | 1.4-2.2V p-p sinusoidal | Correct |
| | | | <1.4 p-p | RX AF Pre-amp (ML11 and associated components) OR Switching Circuits ML3B, D, F faulty. |
| | | | >2.2V p-p (possibly square wave) | Perform a.g.c. checks as follows:- |
| | TP6 (using voltmeter) | A.G.C. | >3V d.c. | A.G.C. detector faulty. |
| | | | <3V d.c. | 1st mixer drive ML7 is suspect. |
| RECEIVE U.S.B. | PIN U | A.F. Output (Low level) | >½ level obtained for 2mV input signal | If satisfactory level not obtained re-alignment may be necessary (see alignment procedures) otherwise switching circuits ML3B, D, F or I.F. Amp (ML4) is faulty. |
| RECEIVE U.S.B. Generator signal increased to 2mV e.m.f. | AA | Amplified AF Output | >8V | By adjustment of VOLUME control if this control and AF Amplifier is functional. |
| RECEIVE A.M. Generator output at 220mV e.m.f. 1kHz 30-50% modulated. | PIN U | AF Output (Low Level Level) | 1.4-2.2 p-p sinusoidal | AF Limiting Amp. 2ML9 or switch ML8C is suspect if this output is not obtained. |
| | TP6 | A.G.C. | | Note d.c. level |
| Re-adjust generator output for 200mV e.m.f. c.w. | TP6 | A.G.C. | | If increase in a.g.c. level is more than o.25V, secondary detector 2Q11 is suspect. |

### 4.2.3 100W POWER AMPLIFIER TYPE 4360

CAUTION When servicing this module, extreme care must be taken to ensure that board pins and tracks are not shorted to the earth plane by test equipment leads and probes, which could result in destruction of board components.

Unless the area of fault is known initially, it is strongly recommended that checks be carried out in the order given below.

Where there is a need to replace a component, reference should be made to the dismantling instructions (section 2.4). If a flange type transistor is replaced or the board removed, special compound must be applied between the transistor(s) and heatsink and the mounting screws properly tightened.

Should one or both output transistors require replacement, biasing resistor R47 will need to be re-set (refer section 3.5.2).

#### 4.2.3.1 Preparation

Remove input connection to the amplifier, e.g. by lifting the coaxial core from receiver exciter board pin B.

With the transceiver switched off, connect the 24V/15 amp power source with provision for monitoring supply current, either by using the power supply current indicator if one is fitted, or by using an ammeter in the supply line set to read 10A full scale.

Connect to earth plane the board pin designated "Q21C", to which a grey lead is terminated. This action shorts out the bias to the output transistors.

#### 4.2.3.2 D.C. Tests

With the transceiver set to S.S.B. RECEIVE, switch ON. If supply current drawn exceeds 2.0 amps, IMMEDIATELY SWITCH OFF, and remove LK1. Switch on again. If the current now drawn is less than 2 amps a fault exists in the output stage and is probably one or both of output transistors Q23 or Q24. If the supply current is unchanged a fault exists elsewhere in the transceiver, not necessarily in the power amplifier.

Remove LK1 if still in circuit.

Check d.c. voltage at pin D. This should be 13V ±2V, otherwise the 13V regulator (Q8, Q9, Q11 and associated circuitry) is faulty, or there is a short circuit across pin D.

Check voltage at pin C. In RECEIVE mode this should be 0V, otherwise the amplifier will be biased ON.

Check for 0V at the base terminals of Q5, Q12, Q14 and Q15. If otherwise a fault exists in this area of circuitry (assuming that there is 0V at pin C).

If tests so far have proved satisfactory, switch briefly to TRANSMIT and note the supply current. This should INCREASE by no more than 1.5A when switching from RECEIVE to TRANSMIT (typically 1.1A), otherwise there is a fault in amplifier stages Q3 to Q5 or Q12 to Q18. Check d.c. voltages at the terminals of these transistors in order to isolate the fault.

If there is no increase in current when switching to TRANSMIT, check for 9V at pin C, then 3.2V at Q12 base. 0V at this last point suggests failure of Q13.

If the tests so far show no fault, remove the short to earth plane from Q21C and again switch to TRANSMIT. Check voltage at Q21C. This should be 0.6V ±0.12V (depending upon temperature). If otherwise there is fault in the bias circuitry Q19 to Q21.

Switch the transceiver OFF and replace LK1. Switch ON again. Briefly key the transmitter, and note INCREASE in current relative to the value in RECEIVE state. If this is greater than 100 milliamps more than the value measured above with LK1 disconnected, R47, which defines the biasing of the output transistors, may need re-setting. Otherwise there is a fault in the bias circuit Q19 to Q21.

### 4.2.3.3 A.C. Tests

CAUTION During these tests, do not allow the chassis to become too hot (uncomfortable to touch), as under fault conditions the amplifier may not be able to protect itself.

Although d.c. tests will reveal most faults, an a.c. check is necessary to show that the amplifier is functioning as designed.

Connect the r.f. 50 ohm dummy load to the transceiver AERIAL socket, and monitor this output with the oscilloscope (e.g. within the transceiver across the B.N.C. terminals). Connect an r.f. signal generator to the input of the amplifier (core to pin B, screen to pin A). Set the generator to deliver 10mV r.m.s., 80 to 100% modulated at a frequency of about 3mHz.

Switch the transceiver ON in the TRANSMIT state and note supply current. Increase generator drive slowly until one of three limits is reached:-

(1) Output voltage reaches 150V p-p (correct operation).
(2) The INCREASE in current reaches 7 amps.
(3) Input level to the power amplifier reaches 1V r.m.s. (approximately 5V p-p) for modulated input.

If results 2 or 3 are obtained, carry out successive a.c. level checks to identify the area of fault, connecting the oscilloscope probe to ground plane reference:-

| TEST POINT | REQUIRED LEVEL | SUSPECT CIRCUITS IF LEVEL INCORRECT |
|---|---|---|
| Pin B (Input | <5V p-p (Note Level) | |
| Q5 collector | 0V p-p | Q2 to Q5 and associated components |
| Q12 collector | 1.4 x Input | Q2 to Q5 stage, Q12 stage and a.l.c. circuitry Q1, Q6 and Q7 |
| Q14 base | 1.4 x Input | C23 |
| Q14 collector | 1.7 x Input | Q14, Q15 stage and Q17 |
| Q15 collector | 1.7 x Input | Q14, Q15 stage and Q18 |
| Q17 emitter | 0.85 x Input (½ sine wave) | Q17 or Q16 |
| Q18 emitter | 0.85 x Input (½ sine wave) | Q18 or Q16 |
| Q17 collector )<br>Q18 collector ) | 1.7 x Input approx. )<br>(not sine wave) ) | T1, output stage |
| Q23 base )<br>Q24 base ) | 1 x Input approx. )<br>(not sine wave) ) | T1, output stage |
| Q23 collector )<br>Q24 collector ) | 12 x Input )<br>(sine wave) ) | Output stage (Q23, Q24 or T2 prime suspects) or short circuit after T2 |
| link through T3 | 70 x Input | T2 or open circuit from T2 |

Where all tests so far are satisfactory, or any fault has been repaired, increase the generator level until the output ceases to increase or until the peaks of modulation are clipped without indication of limiting occurring.

In the event of no indication of limiting, turn R92 fully clockwise (minimum output setting). If the output reduces, this control requires re-alignment (section 3.5.4), otherwise there is a fault in the a.l.c. circuitry.

Short Q1 collector and base. If the output drops, the detector circuitry (D13 and associated components) is faulty. Otherwise the fault lies with buffer circuits Q1, Q6 and Q7.

If limiting has been observed, switch transceiver to A.M. TRANSMIT, remove the modulation from the input signal and further increase the input level. Limiting should again be observed to occur but at a lower level than before (not greater than 75% of the previous level as seen on the oscilloscope). If otherwise, check for 0V d.c. at pin P, which voltage indicates either that R104 needs re-setting (section 3.5.5), or that there is a fault in the a.m. detector circuitry R98 to R104, C53 to Q25.

On completion of servicing, replace coaxial core onto pin P of the receiver exciter board and check overall transmitter operation.

### 4.2.4 REFLECTOMETER BOARD TYPE 6718

#### 4.2.4.1 Preparation

Meaningful tests on this board can only be made when r.f. power is being monitored. Hence connect the 50 ohm dummy load to the AERIAL socket and switch to A.M. TRANSMIT for testing purposes.

#### 4.2.4.2 D.C. Checks

With the a.m. carrier of any channel being transmitted, check d.c. voltages relative to ground plane at the base terminals of Q1 and Q2. Interpret results thus:-

a) If Q2 base is at a higher d.c. voltage than Q1 base, the detector circuitry R1 to R8, C1 to C5, D1, D2 and T1 is functional. Check for 9V at pin D and less than 6V at Q3 emitter. If these checks are positive, the board itself is functional and the fault lies with the front panel lamp or wiring to same.

b) If Q1 base is at a higher or equal d.c. voltage to Q2 base, the same detector circuitry or wiring to same is faulty. Carry out a.c. checks to identify the faulty component.

#### 4.2.4.3 A.C. Checks

Connect the oscilloscope probe to the link through T1. 100 to 150V p-p of signal on A.M. TRANSMIT should be seen otherwise there is a wiring fault external to the board or lack of continuity between board terminals C and G.

Monitor R1/R2 junction. The level at this point should be 10V p-p approximately if C1, R1, R2 and C2 are operational.

Check levels at the anodes of D2, D1. Approximately 20V p-p and 4V p-p or less should be seen at these points respectively if T1, R3 and R4 are functional.

Using the oscilloscope as a voltmeter, check d.c. levels at D2 and D1 cathodes, where approximately 10V d.c. and 2V d.c. or less respectively should be seen if D2 and D1 are operational.

If the fault remains check R7 and R8.

## 4.2.5 DISTRESS SIGNALLING BOARD TYPE 6723

### 4.2.5.1 Initial Checks.

The area of a fault may quickly be established with reference to the following table:-

| SYMPTOM | PROBABLE FAULT AREA |
|---|---|
| No action in either TEST or ALARM state | External wiring |
| Distress TEST functional (i.e. "hee haw" sound from speaker), but transmitter not keyed on distress ALARM. | External wiring |
| ALARM functional, TEST non-functional Transmitter keyed in ALARM state but no "hee haw" sound in either TEST or ALARM states. | ML3 or ML4 |
| Continuous tone in either TEST or ALARM states. | ML1 or ML2 |
| One tone only switched in half the time | One of the two oscillators Q6 or Q7 |

### 4.2.5.2 Functional Checks.

Lift out the board with wiring still attached (refer section 2.6). Ensure that board tracks will not short to chassis, e.g. by laying the board on a piece of cardboard. Switch the transceiver ON and select Distress TEST. With an oscilloscope earthed at board terminal F, carry out the following tests as required to isolate the fault:-

a) Monitor either end terminal of L1. Approximately 5V p-p of sine wave signal should be seen, otherwise oscillator Q6 is faulty.

b) Monitor either end terminal of L2. Approximately 5V p-p of sine wave signal should be seen, otherwise oscillator Q7 is faulty.

c) Monitor ML1 pin 6. Approximately 6V of square wave signal (frequency 8Hz) should be seen if this stage is functional.

d) Monitor pins 12 and 13 of ML2. Approximately 8V of square wave signal at 2Hz should be seen at both these test points, otherwise ML2 has failed.

e) If tests (a) to (d) above are positive, check for less than 0.5V p-p of sine wave signal at ML3 pin 2 and 9. This signal should be switched from 1300 to 2200Hz twice a second, otherwise ML3 is non-functional.

f) Check for a similar signal to (e) above at pin J to prove out the ML4 stage.

Briefly switch to ALARM. The transmitter should be keyed for 45 seconds ±15 seconds, otherwise there is a fault in stages Q1 to Q4.

4.2.6 LOUD HAILER TYPE 6726B

Carry out tests as indicated below depending upon whether the fault lies with the amplifier or p.t.t. circuitry.

4.2.6.1 Audio Amplifier

4.2.6.1.1 D.C. Tests

Carry out successive checks as follows, measuring relative to board pins B or C:-

| TEST POINT | REQUIRED D.C. LEVEL | CIRCUITRY CHECKED |
|---|---|---|
| R6/R7 junction<br>(use 25V or higher range) | 9V | R6, R7, C3, C4, ML1 |
| ML1 pin 6 | 9V | ML1 and associated components |
| ML2 pin 6 | 9V | ML2 and associated components |
| Board pin A | 0V | 2T1 |
| Q4 or Q5 emitter | 12V | Q1 to Q5 and associated components |

4.2.6.1.2 A.C. Tests

Set R2 fully clockwise (max. gain position). Switch in the transceiver Hailer facility, operate the microphone and carry out the following a.c. checks:-

| TEST POINT | REQUIRED A.C. LEVEL | CIRCUITRY CHECKED |
|---|---|---|
| Board pin E | 15mV p-p (approx) | External wiring |
| ML1 pin 6 | 300mV p-p (approx) | ML1 and associated components |
| ML2 pin 6 | 2.5V p-p (approx) | ML2 and associated components |
| Board pin A | 20V p-p (approx) | Q1 to Q5 stage |
| Across 2T1 secondary | 35V p-p (approx) | 2T1 |

4.2.6.2 P.T.T. Circuitry

Any fault in this area will be in switching stages Q6 and Q7, or external wiring to pins D and G.

To check external wiring, set the transceiver to RECEIVE condition (i.e. HAILER facility NOT selected), apply a link between pins B and G and check that the relay is activated. Reconnect the link between pins B and D. If the relay is not turned ON the switching stages are proven to be faulty.

## 5. DIAGRAMS AND PARTS LISTS

These are arranged in the order given below.

## 5.1 PARTS LISTS

## 5.2 CIRCUIT DIAGRAMS AND COMPONENT LAYOUTS

## CHASSIS ASSEMBLY

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| RESISTOR | S.O.T. 5% ½W METAL OXIDE CORNING TR5 | 1 | R4 |
| RESISTOR | IM 5% ½W CARBON IRH BTS | 1 | R3 |
| POTENTIOMETER | 10K±20% ROTARY D.P.S.T. 3/4" PLAIN ENDED SHAFT CURVE C (VOL) IRC CTS-45 | 1 | R1, SC |
| POTENTIOMETER | 10K ±20% ROTARY D.P.S.T. 3/4" PLAIN ENDED SHAFT CURVE A (CLAR) IRC CTS-45 | 1 | R2, SB |
| KNOB | BLACK ELMA 73-14-¼ | 2 | PART OF SB, SC |
| COVER PLATE | BLACK ELMA 1450-14 | 2 | PART OF SB, SC |
| NUT COVER | BLACK ELMA 1454-14 | 2 | PART OF SB, SC |
| CAPACITOR | 39p ±10% 630V CERAMIC DUCON CDS-N750 | 1 | C1 |
| CAPACITOR | 0.1 ±20% 100V METALLISED POLYESTER AEE PHE240D | 1 | C2 |
| DIODE | FAIRCHILD IN4148 OR AN 2003 | 1 | D3 |
| DIODE | LIGHT EMITTING HEWLETT PACKARD 5082-440 | 1 | D2 |
| DIODE | RCA40109 OR PHILIPS BYX50-200 | 1 | D1 |
| FUSE | 15A BUSS AGS | 2 | FS3, FS4 |
| FUSEHOLDER | FOR 9/32" x ¼" FUSE BUSS 4413 | 2 | FOR FS3, FS4 |
| FUSE | ½A AUSTRALUX 3AG | 2 | FS1, FS2 |
| FUSEHOLDER | 10A/240V AC MCMURDO PFH125 | 2 | FOR FS1, FS2 |
| RELAY | 9V HD CONTACTS VARLEY VP6-5A-CAB-9M | 1 | RL |
| RETAINER | RELAY VARLEY VP6 | 1 | FOR RL |
| BASE | RELAY VARLEY VP6 | 1 | FOR RL |
| SWITCH | TOGGLE ON-OFF N.K.K. S333 | 1 | 5D |
| SOCKET | MICROPHONE 7 WAY PREA 8-9052/C79-02 | 1 | SKA |
| CONNECTOR | CHASSIS MTG BNC UG625/B-U | 1 | SKB |
| SOCKET | CANNON DAC-155 | 1 | SKC |
| SCREWLOCK | FEMALE CANNON D20418-2 | 2 | PART OF SKC |
| CONTACT | SOCKET CANNON 030/1953/000 | 15 | PART OF SKC |
| CONNECTOR | FIXED SOCKET BLACK BELLING LEE L603A | 1 | SKD |
| KNOB | (RED) MCMURDO 4094 | 1 | CHANNEL 1 KNOB |
| COMPOUND | HEATSINK THERMPATH REDPOINT TYPE 167 | A/R | FOR FITTING POWER AMP |

12 CHANNEL OSCILLATOR BOARD TYPE 6710

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| BOARD | PRINTED CIRCUIT RACAL ABD6711 | 1 | |
| INSULATOR | AAD3108 | 1 | |
| INSULATOR | AAD3082 | 1 | |
| OVEN | SUB ASSY RACAL ABA4867 | 1 | SEE LIST BELOW |
| RESISTOR | 1.5 20% ½W CARBON MORGANITE A5 | 4 | R35, R37, R45, R50 |
| RESISTOR | 22 5% ¼W METAL GLAZE IRH RG¼ | 1 | R34 |
| RESISTOR | 56 5% ¼W METAL GLAZE IRH RG¼ | 2 | R4, R43 |
| RESISTOR | 68 5% ¼W METAL GLAZE IRH RG¼ | 2 | R7, R46 |
| RESISTOR | 100 5% ¼W METAL GLAZE IRH RG¼ | 5 | R3, R33, R36, R40, R41 |
| RESISTOR | 150 5% ¼W METAL GLAZE IRH RG¼ | 1 | R8 |
| RESISTOR | 270 5% ¼W METAL GLAZE IRH RG¼ | 2 | R6, R44 |
| RESISTOR | 180 5% ¼W METAL GLAZE IRH RG¼ | 1 | R47 |
| RESISTOR | 470 5% ¼W METAL GLAZE IRH RG¼ | 2 | R32, R42 |
| RESISTOR | 560 5% ¼W METAL GLAZE IRH RG¼ | 1 | R11 |
| RESISTOR | 680 5% ¼W METAL GLAZE IRH RG¼ | 1 | R13 |
| RESISTOR | 1.2K 5% ¼W METAL GLAZE IRH RG¼ | 1 | R31 |
| RESISTOR | 2.2K 5% ¼W METAL GLAZE IRH RG¼ | 7 | R16, R18, R21, R23, R26, R28, R48, |
| RESISTOR | 2.2K 5% ¼W METAL OXIDE CORNING TR5 | 1 | R30 |
| RESISTOR | 2.7K 5% ¼W METAL GLAZE IRH RG¼ | 4 | R1, R10, R12, R38 |
| RESISTOR | 3.9K 5% ¼W METAL GLAZE IRH RG¼ | 3 | R2, R9, R39 |
| RESISTOR | 10K VARIABLE WIREWOUND BOURNS 3007P-1-103 | 1 | R29 |
| RESISTOR | 27K 5% ¼W METAL GLAZE IRH RG¼ | 1 | R49 |
| RESISTOR | 100K 5% ¼W METAL GLAZE IRH RG¼ | 8 | R14, R17, R19, R22, R24, R27, R51, R52 |
| CAPACITOR | 220P 2% 100V CERAMIC N750 PHILIPS 2222-638-58221 | 1 | C59 |
| CAPACITOR | 33P 2% 63V CERAMIC N750 PHILIPS 2222-638-58339 | 12 | C8, C11, C14, C17, C21, C23, C27, C29, C33, C36, C39, C42 |
| CAPACITOR | 33P 2% 63V CERAMIC N.P.O. PHILIPS 2222-638-10339 | 1 | C57 |
| CAPACITOR | 4.5-29P 160V CERAMIC DISC TRIMMER 7-5 TRIKO-02 STETTNER 4.5-20N | 13 | C9, C12, C16, C18, C22, C24, C28, C31, C34, C37, C41, C43, C58 |
| CAPACITOR | 0.01 $^{-20}_{+80}$% 50V DISC CERAMIC MSK BM | 14 | C1, C2, C3, C4, C6, C7, C45, C48, C49, C52, C53, C55, C61, C47 |
| CAPACITOR | 0.1 20% 100V METALLISED POLYESTER AEE PHE240 | 13 | C13, C19, C26, C32, C38, C44, C51, C56, C62, C64, C67, C69, C71 |
| CAPACITOR | 1.0 $^{-20}_{+50}$% 35V TANTALUM SIEMENS B45134 | 1 | C50 |
| CAPACITOR | 10 $^{-20}_{+50}$% 16V TANTALUM SIEMENS B45134 | 1 | C46 |
| TRANSISTOR | FAIRCHILD 2N3563 | 4 | Q1, Q3, Q4, Q9 |
| TRANSISTOR | FAIRCHILD 2N3640 | 2 | Q2, Q10 |
| TRANSISTOR | I.T.T. TT3642 OR 2N3642 | 1 | Q11 |
| TRANSISTOR | PHILIPS BC107 | 2 | Q5, Q7 |
| DIODE | FAIRCHILD AN2003 OR 1N4148 | 4 | D1, D13, D17, D18 |
| DIODE | HEWLETT PACKARD HP5082-2800 | 4 | D2, D3, D14, D15 |
| DIODE | PHILIPS BA182 | 6 | D4, D5, D6, D7, D8, D9 |
| DIODE | PHILIPS BZX79/C3V3 | 1 | D12 |
| DIODE | GENERAL ELECTRIC A15A | 1 | D11 |
| DIODE | I.T.T. BA163 | 1 | D16 |

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| PIN | MIS. TERMINAL VERO 2141 | 19 | |
| MICRO LOGIC | FAIRCHILD U9T7101392 | 1 | ML1 |
| INDUCTOR | 33µH 10% CAMBION 3640-57-2 | 1 | L1 |
| INDUCTOR | RACAL ACT3037 | 1 | L2 |
| CRYSTAL | RACAL SPEC. ARA1038 DEF.K HC25/U | 12 | XTL 1-12 |
| CRYSTAL | RACAL SPEC. ARA1037 DEF.J HC18/U | 1 | XTL 13 |
| CAGE JACK | CAMBION 450-3704-01-03-00 | 24 | XTAL HOLDERS |
| TAPE | PRESSURE SENSITIVE $^{1}/8$" FIBRE REINFORCED "SCOTCH" | A/R | FOR XTALS |

OVEN SUB-ASSEMBLY TYPE 4867 (PART OF 6710 BOARD)

| | | | |
|---|---|---|---|
| OVEN | RACAL ACD4240 | 1 | |
| TRANSISTOR | MOTOROLA 2N5191 | 2 | Q6, Q8 |
| THERMISTOR | PHILIPS 2322/660/91007 | 1 | RB1 |
| COMPOUND | HEATSINK THERMPATH REDPOINT LTD TYPE 167 | A/R | OR EQUIVALENT |
| ADHESIVE | EPOXY INSTANT RESIWELD | A/R | |
| INSERT | 6BA SELF LOCKING BANC-LOK MV3/B/6BA | 2 | |

RECEIVER EXCITER BOARD TYPE 6712B

| COMPONENT | DESCRIPTION & MANUFACTURER | | | | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|---|---|---|
| BOARD | PRINTED CIRCUIT | | TYPE 6713 | | 1 | |
| RESISTOR | 10 OHMS | 5% ½W CARBON | IRH | BTS | 5 | R104, R106, R107, R108, R119 |
| RESISTOR | 22 OHMS | 5% ½W CARBON | IRH | BTS | 2 | R41, R156 |
| RESISTOR | 27 OHMS | 5% ½W CARBON | IRH | BTS | 1 | R117 |
| RESISTOR | 56 OHMS | 5% ½W CARBON | IRH | BTS | 3 | R144, R145, R148 |
| RESISTOR | 68 OHMS | 5% ½W CARBON | IRH | BTS | 3 | R28, R29, R61 |
| RESISTOR | 82 OHMS | 5% ½W CARBON | IRH | BTS | 3 | R118, R189, 2R154 |
| RESISTOR | 100 OHMS | 5% ½W CARBON | IRH | BTS | 9 | R26, R36, R68, R81, R88, R91, R109, R164, 2R130 |
| RESISTOR | 120 OHMS | 5% ½W CARBON | IRH | BTS | 1 | R146 |
| RESISTOR | 180 OHMS | 5% ½W CARBON | IRH | BTS | 3 | R126, R141, R161 |
| RESISTOR | 220 OHMS | 5% ½W CARBON | IRH | BTS | 2 | R183, 3R47 |
| RESISTOR | 270 OHMS | 5% ½W CARBON | IRH | BTS | 1 | R116 |
| RESISTOR | 330 OHMS | 5% ½W CARBON | IRH | BTS | 6 | R16, R73, R97, R147, 3R42, 2R128 |
| RESISTOR | 390 OHMS | 5% ½W CARBON | IRH | BTS | 1 | R171 |
| RESISTOR | 470 OHMS | 5% ½W CARBON | IRH | BTS | 6 | R48, R53, R192, R193, 3R46, 3R52 |
| RESISTOR | 680 OHMS | 5% ½W CARBON | IRH | BTS | 4 | R10, R74, R179, R167 |
| RESISTOR | 1K OHMS | 5% ½W CARBON | IRH | BTS | 6 | R1, R112, R124, R168, R184, R191 |
| RESISTOR | 1.2K OHMS | 5% ½W CARBON | IRH | BTS | 2 | R178, 2R152 |
| RESISTOR | 1.8K OHMS | 5% ½W CARBON | IRH | BTS | 5 | R56, R143, R151, R163, 2R133 |
| RESISTOR | 2.2K OHMS | 5% ½W CARBON | IRH | BTS | 5 | R5, R9, R21, R122, R150 |
| RESISTOR | 2.7K OHMS | 5% ½W CARBON | IRH | BTS | 1 | 2R157 |
| RESISTOR | 3.3K OHMS | 5% ½W CARBON | IRH | BTS | 2 | R127, R139 |
| RESISTOR | 3.9K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R2 |
| RESISTOR | 4.7K OHMS | 5% ½W CARBON | IRH | BTS | 13 | R11, R22, R38, R66, R89, R111, R121, R123, R172, R188, 2R131, 2R155, 3R153 |
| RESISTOR | 6.8K OHMS | 5% ½W CARBON | IRH | BTS | 4 | R54, R142, R149, R182 |
| RESISTOR | 10K OHMS | 5% ½W CARBON | IRH | BTS | 5 | R13, R113, R170, 2R93, 2R129 |
| RESISTOR | 22K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R14 |
| RESISTOR | 27K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R169 |
| RESISTOR | 39K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R3 |
| RESISTOR | 47K OHMS | 5% ½W CARBON | IRH | BTS | 2 | 2R162 |
| RESISTOR | 150K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R12 |
| RESISTOR | 220K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R166 |
| RESISTOR | 470K OHMS | 5% ½W CARBON | IRH | BTS | 1 | R8 |
| RESISTOR | 1.5M OHMS | 5% ½W CARBON | IRH | BTS | 1 | R4 |
| RESISTOR | 68 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R82 |
| RESISTOR | 10 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 4 | R32, R34, R83, R84 |
| RESISTOR | 47 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R98 |
| RESISTOR | 82 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R27 |
| RESISTOR | 100 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R102, 2R134 |
| RESISTOR | 150 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 5 | R69, R71, R79, R96, 2R136 |
| RESISTOR | 180 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R18 |
| RESISTOR | 220 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R99, 2R137 |
| RESISTOR | 270 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R78 |
| RESISTOR | 330 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 3 | R19, R59, R94 |
| RESISTOR | 390 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 3 | R24, R92, R101 |
| RESISTOR | 470 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 3 | R31, R77, R186 |
| RESISTOR | 820 OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R76, R173 |
| RESISTOR | 1K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R23 |
| RESISTOR | 1.5K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R57, R103 |
| RESISTOR | 1.8K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R62, R72 |
| RESISTOR | 2.2K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R17, R58 |
| RESISTOR | 3.9K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 2 | R176, 3R43 |
| RESISTOR | 4.7K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 3 | 3R44, 3R51, 2R138 |
| RESISTOR | 5.6K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | 3R49 |
| RESISTOR | 18K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R159 |
| RESISTOR | 150K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R158 |
| RESISTOR | 180K OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R7 |
| RESISTOR | 1M OHMS | 5% ½W METAL OXIDE | CORNING | TR5 | 1 | R6 |

SHEET 1 OF 3

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| RESISTOR | 0.47 OHMS ±5% 2W WIREWOUND ASW 2 | 1 | R187 |
| RESISTOR | VARIABLE 100 OHMS PLESSEY V10K8 | 2 | R86, R132 |
| RESISTOR | VARIABLE 1K OHMS PLESSEY V10K8 | 2 | R33, R174 |
| RESISTOR | VARIABLE 2K2 OHMS PLESSEY V10K8 | 3 | R39, R67, R87 |
| RESISTOR | VARIABLE 47K OHMS PLESSEY V10K8 | 1 | R114 |
| CAPACITOR | 30pF ±2% 125V POLYSTYRENE ALLIED TCS125 | 1 | C22 |
| CAPACITOR | 115pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C61 |
| CAPACITOR | 236pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C64 |
| CAPACITOR | 293pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C63 |
| CAPACITOR | 270pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C62 |
| CAPACITOR | 354pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C19 |
| CAPACITOR | 390pF ±5% 100V POLYSTYRENE DUCON DFB114 | 1 | 2C99 |
| CAPACITOR | 532pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C14 |
| CAPACITOR | 566pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C17 |
| CAPACITOR | 640pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C16 |
| CAPACITOR | 725pF ±2% 100V POLYSTYRENE DUCON DFB SPECIAL | 1 | C18 |
| CAPACITOR | 1066pF ±2% 50V POLYSTYRENE DUCON DFB SPECIAL | 1 | C13 |
| CAPACITOR | 2200pF ±10% 50V POLYSTYRENE DUCON DFB SPECIAL | 2 | C109, C133 |
| CAPACITOR | 22pF ±2% 100V CERAMIC PHILIPS 63210229 | 2 | C56, C90 |
| CAPACITOR | 100pF ±2% 63V CERAMIC PHILIPS 63210101 | 1 | C51 |
| CAPACITOR | 1000pF ±10% 630V CERAMIC DUCON CDS-Y | 1 | C2 |
| CAPACITOR | .01 $^{+80}_{-20}\%$ 50V CERAMIC MSK BM | 57 | C11, C12, C32, C21, C23, C27, C31, C44, C46, C47, C48, C52, C54, C58, C59, C60, C65, C66, C69, C71, C73, C75, C76, C78, C79, C82, C85, C86, C87, C88, C89, C98, C114, C116, C117, C118, C119, C121, C129, C135, 3C34, 3C36, 3C37, 3C46, 2C53, 2C96, 2C97, 2C101, 4C138 |
| CAPACITOR | 0.22 ±20% 50V METAL. LACQ. SHIZUKI PML 224M50 | | C108 |
| CAPACITOR | .047µF ±20% 250V AEE PHE 240H | 1 | C1 |
| CAPACITOR | .01µF ±20% 250V AEE PHE 240H | 1 | C3 |
| CAPACITOR | .022µF ±20% 250V AEE PHE 240H | 1 | C7 |
| CAPACITOR | .1 ±20% 100V AEE PHE 240D | 14 | C29, C57, C67, C68, C70, C103, C122, C124, C126, C127, C128, C131, C132, C137 |
| CAPACITOR | 1.0 ±20% 100V AEE PHE 240D | 1 | C4 |
| CAPACITOR | .47µF $^{+50}_{-20}\%$ 35V TANTALUM SIEMENS B45134 | 1 | C49 |
| CAPACITOR | 2.2µF $^{+50}_{-20}\%$ 35V TANTALUM SIEMENS B45134 | 2 | C72, C111 |
| CAPACITOR | 4.7µF $^{+50}_{-20}\%$ 25V TANTALUM SIEMENS B45134 | 3 | C24, C74, C115 |
| CAPACITOR | 22µF $^{+50}_{-20}\%$ 6.3V TANTALUM SIEMENS B45134 | 3 | C9, C134, C120 |
| CAPACITOR | 22µF $^{+50}_{-20}\%$ 16V TANTALUM SIEMENS B45134 | 2 | C102, C123 |
| CAPACITOR | 47µF $^{+50}_{-20}\%$ 6.3V TANTALUM SIEMENS B45134 | 1 | C5 |
| CAPACITOR | 100µF ±20% 10V TANTALUM UNION CARBIDE K100J10S | 1 | C106 |
| CAPACITOR | 1.0µF $^{+50}_{-20}\%$ 35V TANTALUM SIEMENS B45134 | 1 | C107 |

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| CAPACITOR | 47μF $^{+50}_{-10}$% 10V ELECTROLYTIC PHILIPS 2222-015-14479 | 3 | C8, C26, C113 |
| CAPACITOR | 150μF $^{+50}_{-10}$% 6.3V ELECTROLYTIC PHILIPS 2222-015-13151 | 2 | C6, C28 |
| CAPACITOR | 470μF $^{+50}_{-10}$% 10V ELECTROLYTIC PHILIPS 2222-017-14471 | 1 | C136 |
| CAPACITOR | VARIABLE 10-40pF $^{+70}_{-10}$% 250V STETTNER 10S TRICO 06 10/40N750 | 5 | C33, C42, C43, 3C38, 3C39 |
| TRANSISTOR | FAIRCHILD AX1192 | 1 | Q2 |
| TRANSISTOR | FAIRCHILD AX1272 OR 2N3646 | 7 | Q4, Q10, Q12, Q13, Q15, Q19, 2Q18 |
| TRANSISTOR | FAIRCHILD AY1114 OR 2N3906 | 4 | 3Q8, 3Q9, 2Q11, 2Q17 |
| TRANSISTOR | PHILIPS BC177 | 4 | Q3, Q23, Q25, Q26 |
| TRANSISTOR | FAIRCHILD AY8140 | 1 | Q27 |
| TRANSISTOR | FAIRCHILD AY9140 | 1 | Q28 |
| TRANSISTOR | FAIRCHILD AY9171 OR 2N3740 | 1 | Q20 |
| TRANSISTOR | FAIRCHILD PN4249 | 1 | Q21 |
| TRANSISTOR | I.T.T. TT1010 | 2 | Q6, Q7 |
| TRANSISTOR | PHILIPS BC107 | 1 | Q24 |
| TRANSISTOR | FAIRCHILD 2N3563 | 1 | Q5 |
| TRANSISTOR | FAIRCHILD 2N3640 | 2 | Q14, Q16 |
| TRANSISTOR | FAIRCHILD 2N 3641 | 1 | Q1 |
| DIODE | FAIRCHILD AN2003 OR 1N4148 | 6 | D1, D2, D3, D7, D8, D4, |
| DIODE | G.E. A15A | 1 | D9 |
| DIODE | PHILIPS BZX79 C6V8 | 1 | D5 |
| DIODE | PHILIPS BZX79 C16 | 1 | D6 |
| R.F. CHOKE | 1.2μH ±5% CAMBION 2960-29-1 | 1 | L1 |
| R.F. CHOKE | 1.8μH ±5% CAMBION 2960-31-1 | 1 | L5 |
| R.F. CHOKE | 2.2μH ±5% CAMBION 2960-32-1 | 4 | L2, L3, L4, L13 |
| R.F. CHOKE | 2.7μH ±5% CAMBION 2960-33-1 | 2 | L11, L12 |
| R.F. CHOKE | 3.9μH ±5% CAMBION 2960-35-1 | 1 | L6 |
| R.F. CHOKE | 10μH ±5% CAMBION 2960-40-1 | 1 | L10 |
| R.F. CHOKE | 10μH ±10% CAMBION 3640-45-2 | 2 | L15, L17 |
| R.F. CHOKE | 33μH ±10% CAMBION 3640-57-2 | 1 | L14 |
| R.F. CHOKE | 100μH AEGIS VPC 100 | 1 | L7 |
| R.F. CHOKE | RACAL ACT2744 | 1 | L9 |
| R.F. CHOKE | RACAL ACT2824 | 1 | L8 |
| R.F. CHOKE | RACAL ACT2827 | 1 | 2L16 |
| TRANSFORMER | RACAL ABT2748 | 1 | T1 |
| INTEGRATED CIRCUIT | FAIRCHILD CA3046 | 7 | ML1, ML2, ML3, ML6, ML7, ML8, ML10 |
| INTEGRATED CIRCUIT | RCA CA3023 | 1 | ML4 |
| INTEGRATED CIRCUIT | RCA CA3026 | 1 | ML5 |
| INTEGRATED CIRCUIT | FAIRCHILD U9T7741393 | 1 | ML11 |
| INTEGRATED CIRCUIT | RCA CA3043 | 1 | 2ML9 |
| FILTER | RACAL AAS2408 | 1 | FL2 |
| FILTER | RACAL AAS2406 | 1 | 3FL1 |
| HEAT SINK ASSY | REDPOINT 665A | 1 | FOR Q20 |
| HEAT SINK TO5 | THERMALLOY 1115C | 1 | FOR Q27 |
| MTG. PAD | JERMYN TO5-005<br>MCMURDO 9150-05-19 | 1 | FOR Q27 |

100W 24V POWER AMPLIFIER TYPE 4360

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| ASSEMBLY | P.C. BOARD ABA 4361 | 1 | SEE LIST BELOW |
| SUB-ASSEMBLY | POWER AMPLIFIER ABA 6962 (HEATSINK & ATTACHED PARTS) | 1 | SEE LIST BELOW |
| TRANSISTOR | MOTOROLA 2N6367 OR TRW PT5776 | 2 | Q14, Q15 |
| TRANSISTOR | MOTOROLA OR TRW 2N6095 | 2 | Q17, Q18 |
| TRANSISTOR | MOTOROLA 2N5942 OR TRW PT5783 | 2 | Q23, Q24 PT 9780, CTC 580-28 |
| WASHER | MICA DISC 1" O.D. ¼" I.D. PART OF DIODE MOUNTING HARDWARE | 2 | FOR MOUNTING T2 |
| COMPOUND | THERMPATH REDPOINT TYPE 167 | A/R | FOR MOUNTING Q14, Q15, Q17, Q18, Q23, Q24 |
| EYELETS | TUCKER EO69/090 | 2 | ) FOR CONNECTING |
| TAG | 4BA SHORT TUCKER LS 312 | 1 | ) Q9 |
| WIRE | 7/0076 TYPE 1 DEF3008/B INSULATION RED | A/R | ) |
| WINDING ASSEMBLY | TRANSFORMER RACAL ACT4367 | 1 | ) |
| X CORE | 30mm PHILIPS K5.352.55 | 2 | ) PARTS OF T2 |
| WASHER | NYLON INSULATOR FOR TO-66 TRANSISTOR | 1 | ) |
| SLEEVING | ¼" ±1/32" HELLERMANN TYPE H30 | 1 | ) |
| SCREW | 6BA x 1½ CH.HD M.S. MTS 163 & 165 | 1 | ) |

P.C. BOARD ASSEMBLY 4361

| | | | |
|---|---|---|---|
| BOARD | PRINTED CIRCUIT RACAL ADD4362 | 1 | |
| RESISTOR | 1.0 10% ½W METAL OXIDE WELWYN MR5 | 1 | R37 |
| RESISTOR | 3.3 5% ½W METAL OXIDE WELWYN MR5 | 1 | R51 |
| RESISTOR | 4.7 5% ½W METAL OXIDE WELWYN MR5 | 1 | R43 |
| RESISTOR | 10 2% 1W METAL OXIDE CORNING TR6 | 4 | R38, R39, R41, R42 |
| RESISTOR | 10 2% ½W METAL OXIDE CORNING TR5 | 11 | R58, R59, R61, R62, R63, R64, R66, R67, R68, R69, R48 |
| RESISTOR | 12 2% ½W METAL OXIDE CORNING TR5 | 1 | R16 |
| RESISTOR | 15 2% 1W METAL OXIDE CORNING TR6 | 2 | R54, R56 |
| RESISTOR | 33 2% ½W METAL OXIDE CORNING TR5 | 2 | R1, R8 |
| RESISTOR | 39 5% ½W METAL OXIDE CORNING TR5 | 3 | R29, R31, R49 |
| RESISTOR | 100 2% ½W METAL OXIDE CORNING TR5 | 1 | R28 |
| RESISTOR | 100 5% 2W METAL OXIDE CORNING TR8 | 6 | R72, R73, R74, R86, R87, R88 |
| RESISTOR | 120 5% ½W METAL OXIDE CORNING TR5 | 1 | R27 |
| RESISTOR | 220 5% ½W METAL OXIDE CORNING TR5 | 1 | R93 |
| RESISTOR | 390 2% ½W METAL OXIDE CORNING TR5 | 1 | R91 |
| RESISTOR | 820 2% ½W METAL OXIDE CORNING TR5 | 1 | R94 |
| RESISTOR | 2.2K 2% ½W METAL OXIDE CORNING TR5 | 1 | R6 |
| RESISTOR | 2.7K 2% ½W METAL OXIDE CORNING TR5 | 1 | R7 |
| RESISTOR | 3.9K 2% ½W METAL OXIDE CORNING TR5 | 1 | R4 |
| RESISTOR | 10K 2% ½W METAL OXIDE CORNING TR5 | 2 | R96, R97 |
| RESISTOR | S.O.T. 5% ½W METAL OXIDE CORNING TR5 | 1 | R47 |
| RESISTOR | 1.2 10% ½W CARBON MORGANITE AS | 6 | R82, R83, R84, R76, R77, R78 |
| RESISTOR | 2.2 10% ½W CARBON MORGANITE AS | 1 | R32 |
| RESISTOR | 10 5% ½W CARBON IRH BTS | 3 | R12, R52, R89 |
| RESISTOR | 15 5% ½W CARBON IRH BTS | 2 | R79, R81 |
| RESISTOR | 22 5% ½W CARBON IRH BTS | 1 | R44 |
| RESISTOR | 33 5% ½W CARBON IRH BTS | 1 | R33 |
| RESISTOR | 39 5% ½W CARBON IRH BTS | 1 | R18 |
| RESISTOR | 56 5% ½W CARBON IRH BTS | 1 | R9 |
| RESISTOR | 100 5% ½W CARBON IRH BTS | 4 | R21, R46, R57, R71 |
| RESISTOR | 330 5% ½W CARBON IRH BTS | 1 | R24 |
| RESISTOR | 560 5% 1W CARBON IRH BTA | 1 | R26 |
| RESISTOR | 1K 5% ½W CARBON IRH BTS | 2 | R23, R34 |
| RESISTOR | 10K 5% ½W CARBON IRH BTS | 1 | R101 |
| RESISTOR | 15K 5% ½W CARBON IRH BTS | 2 | R19, R102 |

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| RESISTOR | 47K 5% ½W CARBON IRH BTS | 1 | R17 |
| RESISTOR | 39K 5% ½W CARBON IRH BTS | 1 | R103 |
| RESISTOR | 100K 5% ½W CARBON IRH BTS | 2 | R3, R14 |
| RESISTOR | 150K 5% ½W CARBON IRH BTS | 1 | R98 |
| RESISTOR | 4.7M 5% ½W CARBON IRH BTS | 1 | R11 |
| RESISTOR | S.O.T.10% ½W CARBON MORGANITE AS | 1 | R36 |
| RESISTOR | S.O.T. 5% ½W CARBON IRH BTS | 1 | R104 |
| RESISTOR | .15 5% 5W WIREWOUND IRH ASW5 | 1 | R22 |
| RESISTOR | 1K 5% 2W WIREWOUND IRH ASW2 | 1 | R13 |
| POTENTIOMETER | 100 BOURNS 3389P-1-101 | 1 | R92 |
| CAPACITOR | 10-40p VARIABLE STETTNER 105-TRIKO 06 N750 | 1 | C7 |
| CAPACITOR | 1000p 10% 630V DISC CERAMIC DUCON CDS-Y | 1 | C52 |
| CAPACITOR | .01 +80 -20 % 50V DISC CERAMIC MSK BM | 2 | C54, C56 |
| CAPACITOR | .1 20% 100V METALLISED POLYESTER AEE PHE240D | 23 | C1, C3, C4, C9, C13, C14, C16, C19, C21, C23, C24, C25, C26, C27, C28, C29, C31, C33, C36, C38, C43, C49, C51 |
| CAPACITOR | .47 10% 50V CERAMIC CHIP VITRAMON VJ2321x474KF | 6 | C34, C41, C44, C46, C47, C48 |
| CAPACITOR | 1 +50 -20 % 35V TANTALUM SIEMENS B45134 | 1 | C12 |
| CAPACITOR | 4.7 -20 +50 % 25V TANTALUM SIEMENS B45134 | 1 | C22 |
| CAPACITOR | 10 -20 +50 % 25V TANTALUM SIEMENS B45134 | 2 | C8, C17 |
| CAPACITOR | 22 -20 +50 % 6.3V TANTALUM SIEMENS B45134 | 1 | C32 |
| CAPACITOR | 100 -20 +50 % 3V TANTALUM SIEMENS B45134 | 1 | C37 |
| CAPACITOR | S.O.T. 10% 630V DISC CERAMIC DUCON CDS | 2 | C39, C42 |
| CAPACITOR | 100 -10 +100 16V ELECTROLYTIC ELNA RA | 1 | C6 |
| CAPACITOR | 0.47 -20 +50 % 35V TANTALUM SIEMENS B45134 | 1 | C53 |
| TRANSISTOR | PHILIPS BC107 | 4 | Q1, Q2, Q6, Q25 |
| TRANSISTOR | PHILIPS OC958 OR 2N4427 | 2 | Q3, Q4 |
| TRANSISTOR | FAIRCHILD 2N4250 | 2 | Q7, Q8 |
| TRANSISTOR | FAIRCHILD 2N3641 | 2 | Q11, Q13 |
| TRANSISTOR | PHILIPS OR 2N2904<br>FAIRCHILD AY9140 | 1 | Q20 |
| TRANSISTOR | FAIRCHILD AY8140 | 1 | Q5 |
| TRANSISTOR | MOTOROLA/TRW 2N3553 OR<br>PHILIPS BFS23A | 1 | Q12 |
| DIODE | FAIRCHILD AN2003 OR 1N4148 | 8 | D2, D4, D12, D13, D14, D15, D16, D10 |
| DIODE | ITT IN4002 | 2 | D3, D6 |
| DIODE | PHILIPS BZX70/C15 | 1 | D1 |
| DIODE | PHILIPS BZX70/C18 | 1 | D9 |
| DIODE | PHILIPS BZX70/C33 | 1 | D5 |
| DIODE | PHILIPS BZX70/C62 | 2 | D7, D8 |
| INDUCTOR | .15 20% CAMBION 2960-21-3 | 1 | L14 |
| INDUCTOR | .22 10% CAMBION 3640-5-2 | 2 | L12, L13 |
| INDUCTOR | 4.7 10% CAMBION 2960-36-2 | 2 | L5, L6 |
| INDUCTOR | 5.6 10% CAMBION 2960-37-2 | 2 | L8, L11 |
| INDUCTOR | 10 10% CAMBION 3640-45-2 | 3 | L1, L2, L3, L4 |
| TRANSFORMER | RACAL AAT 6730 | 1 | T1 |
| TRANSFORMER | RACAL AAT 1399 | 1 | T3 |
| SOLDER | TYPE Sn62 (62% Sn, 36% Pb, 2% Ag) | | FOR C34, C41, C44 TO C48 |
| HEATSINK | IERC LP5A1B | 1 | FOR Q12 |
| HEATSINK | THERMALLOY 1115C | 3 | FOR Q3, Q4, Q5 |
| PAD TRANSISTOR | MCMURDO (JERMYN TO5-005) 9150-05-19 | 4 | FOR Q3, Q4, Q5, Q20 |
| ADHESIVE | DOW CORNING SILASTIC 732 RTV | | FOR T3 |

POWER AMPLIFIER SUB-ASSEMBLY TYPE 6962

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| HEATSINK | ASSEMBLY, RACAL ABA 6747 | 1 | |
| TRANSISTOR | PHILIPS BD438 | 1 | Q16 |
| TRANSISTOR | PHILIPS BD437 | 1 | Q21 |
| TRANSISTOR | MOTOROLA MJ3000 OR MJ3001 | 1 | Q9 |
| TRANSISTOR | PHILIPS BD437 | 1 | Q19 |
| THERMISTOR | P.T.C. PHILIPS 2322-660-91007 | 1 | RB1 |
| ADHESIVE | EPOXY RESIN INSTANT RESIWELD | A/R | FOR RD1 |
| INSULATOR | WASHER NYLON FOR TO-3 TRANSISTOR | 2 | FOR Q9 |
| INSULATOR | WASHER MICA FOR TO-3 TRANSISTOR | 1 | Q9 |
| THERMPATH | REDPOINT TYPE 167 | A/R | FOR MOUNTING Q9, Q16, Q19, Q21 |

REFLECTOMETER BOARD TYPE 6718

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| BOARD, | PRINTED CIRCUIT RACAL AAD6719 | 1 | |
| RESISTOR | 1.2K OHM 5% ¼W CARBON IRH BTS | 1 | R2 |
| RESISTOR | 15K OHM 5% ¼W CARBON IRH BTS | 1 | R1 |
| RESISTOR | 120K OHM 5% ¼W CARBON IRH BTS | 1 | R6 |
| RESISTOR | 120 OHM 5% ¼W METAL OXIDE CORNING TR5 | 2 | R3, R4 |
| RESISTOR | 150 OHM 5% ¼W METAL OXIDE CORNING TR5 | 1 | R9 |
| RESISTOR | 330 OHM 5% ¼W METAL OXIDE CORNING TR5 | 1 | R12 |
| RESISTOR | 2.7K OHM 5% ¼W METAL OXIDE CORNING TR5 | 1 | R11 |
| RESISTOR | 27K OHM 5% ¼W METAL OXIDE CORNING TR5 | 1 | R8 |
| RESISTOR | 82K OHM 5% ¼W METAL OXIDE CORNING TR5 | 1 | R7 |
| CAPACITOR | 10p ±10% 630V DISC CERAMIC DUCON CDS N750 | 1 | C2 |
| CAPACITOR | .01 +100% -0 50V DISC CERAMIC MSK BM | 3 | C1, C4, C5 |
| CAPACITOR | .1 ±20% 100V METALLISED POLYESTER AEE PHE240 | 1 | C3 |
| TRANSISTOR | PHILIPS BC107 | 2 | Q1, Q2 |
| TRANSISTOR | PHILIPS 2N2906 | 1 | Q3 |
| DIODE | FAIRCHILD IN4148 OR AN2003 | 2 | D1, D2 |
| TRANSFORMER | RACAL AAT1399 | 1 | T1 |
| ADHESIVE | DOW CORNING SILASTIC 732 RTV | A/R | |
| PIN | TERMINAL HARWIN H2072Z | 2 | |
| PIN | CN4737 | 9 | |
| SPACER | HARWIN R6081 | 4 | |

SWITCH ASSEMBLY TYPE 6854

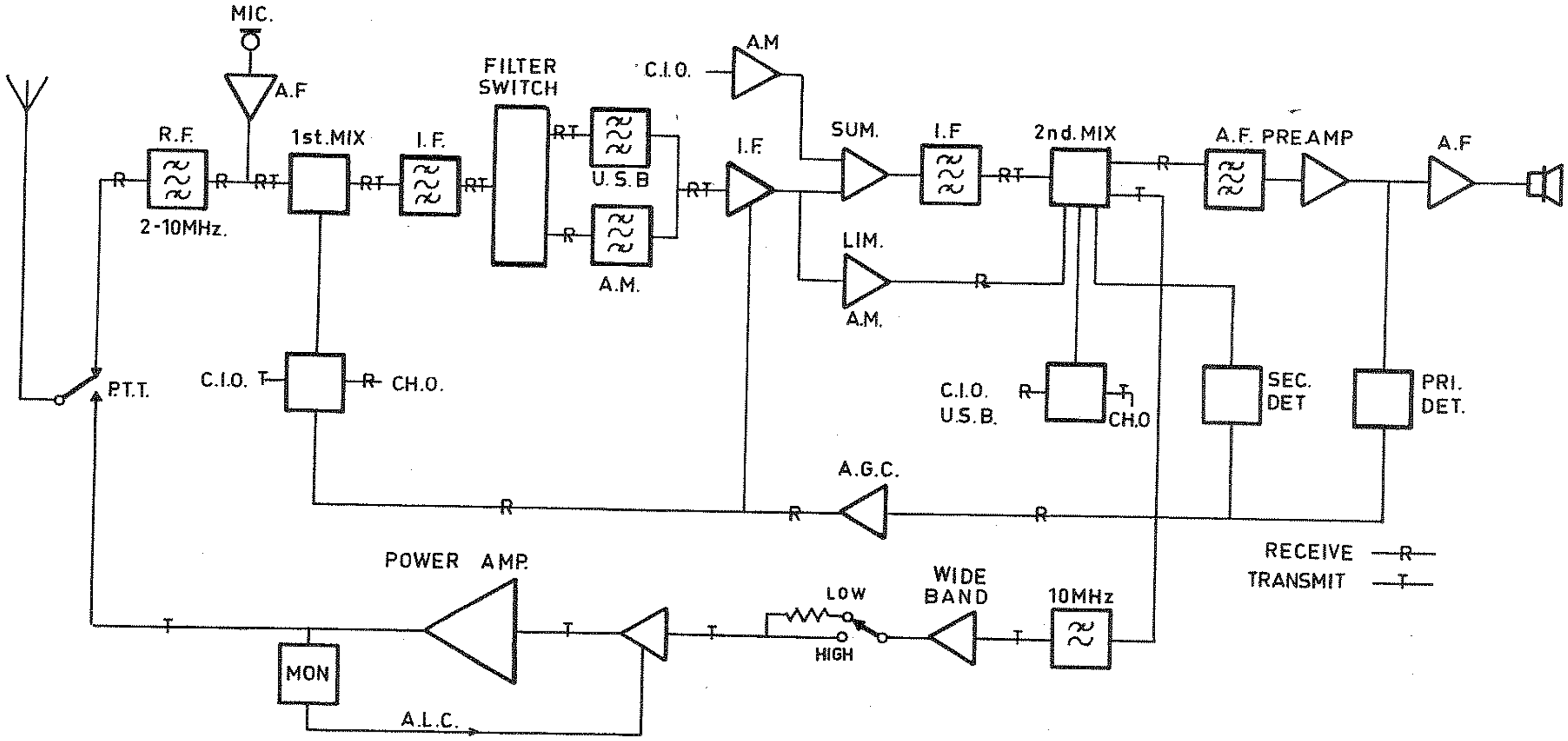
| COMPONENT | DESCRIPTION & MANUFACTURER | | | | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|---|---|---|
| BOARD | PRINTED CIRCUIT | | | ABD6853 | 1 | |
| SWITCH | | | | ABSW 6720 | 1 | |
| RESISTOR | 1K | ±5% ¼W CARBON | IRH | BTS | 2 | R5, R6 |

## DISTRESS SIGNALLING BOARD TYPE 6723

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| BOARD, | PRINTED CIRCUIT RACAL ABD 6724 | 1 | MOD |
| RESISTOR | 270 OHMS 5% ½W CARBON IRH BTS | 1 | R39 |
| RESISTOR | 100K 5% ½W METAL OXIDE CORNING TR5 | 2 | R13, R14 |
| RESISTOR | 2.2K 5% ½W CARBON IRH BTS | 1 | R8 |
| RESISTOR | 1.8K 5% ½W CARBON IRH BTS | 1 | R22 |
| RESISTOR | 10K 5% ½W CARBON IRH BTS | 1 | R6 |
| RESISTOR | 27K 5% ½W CARBON IRH BTS | 2 | R7, R38 |
| RESISTOR | 15K 5% ½W CARBON IRH BTS | 4 | R16, R19, R17, R21 |
| RESISTOR | 47K 5% ½W CARBON IRH BTS | 2 | R28, R26 |
| RESISTOR | 33K 5% ½W CARBON IRH BTS | 3 | R29, R27, R33 |
| RESISTOR | 100K 5% ½W CARBON IRH BTS | 3 | R3, R34, R36 |
| RESISTOR | 120K 5% ½W CARBON IRH BTS | 1 | R2 |
| RESISTOR | 680K 5% ½W CARBON IRH BTS | 2 | R4, R37 |
| RESISTOR | 820K 5% ½W CARBON IRH BTS | 2 | R23, R31 |
| RESISTOR | 1M 5% ½W METAL OXIDE CORNING TR5 | 3 | R11, R9, R12 |
| RESISTOR | 3.3M 5% ½W CARBON IRH BTS | 1 | R1 |
| RESISTOR | 1.2M 5% ½W CARBON IRH BTS | 2 | R24, R32 |
| RESISTOR | 1.5K 5% ½W CARBON IRH BTS | 1 | R18 |
| CAPACITOR | 1.0 +50% -20 35V TANTALUM SIEMENS B45134 | 1 | C10 |
| CAPACITOR | S.O.T.±20% 250V METALLISED POLYESTER AEE PHE240H | 1 | C5 |
| CAPACITOR | 6.8 ±10% 50V METALLISED LACQUER SHIZUKI PML586K50 | 1 | C1 |
| CAPACITOR | 0.1 +8 -20 % 50V DISC CERAMIC MSK BM | 2 | C7, C4 |
| CAPACITOR | .068 ±2% 50V POLYSTYRENE DUCON DFB0532 | 1 | C6 |
| CAPACITOR | .024 ±2% 50V POLYSTYRENE DUCON DFB SPEC | 1 | C8 |
| CAPACITOR | .15 ±10% 100V MET POLYESTER AEE PHE240 | 1 | C3 |
| CAPACITOR | 2.2 +5 -20 % 35V TANTALUM SIEMENS B45134 | 1 | C2 |
| CAPACITOR | 4.7 +50 -20 % 25V TANTALUM SIEMENS B45134 | 1 | C9 |
| CAPACITOR | 0.1 ±10% 100V MET POLYESTER AEE PHE240 | 1 | C11 |
| TRANSISTOR | FAIRCHILD 2N4250 | 1 | Q1 |
| TRANSISTOR | PHILIPS BC108 | 1 | Q2 |
| TRANSISTOR | FAIRCHILD AY1114 OR 2N3906 | 3 | Q3, Q6, Q7 |
| TRANSISTOR | I.T.T. TT3642 OR 2N3642 | 1 | Q4 |
| I.C. | FAIRCHILD U9T7741391 | 2 | ML1, ML4 |
| I.C. | MOTOROLA MC14013CL | 1 | ML2 |
| I.C. | MOTOROLA MC14016CL | 1 | ML3 |
| DIODE | FAIRCHILD AN2003 OR 1N4148 | 5 | D1, D2, D3, D4, D6 |
| INDUCTOR | RACAL ABT6791 | 2 | L1, L2 |
| PINS | MCMURDO CN4737-01-08 | 9 | |

LOUD HAILER TYPE 6726B

| COMPONENT | DESCRIPTION & MANUFACTURER | QTY. | CIRCUIT REFERENCES |
|---|---|---|---|
| BOARD | PRINTED CIRCUIT RACAL AAD6966 | 1 | |
| RESISTOR | 56 5% ½W CARBON IRH GBT ½ | 2 | R13, R17 |
| RESISTOR | 270 5% ½W CARBON IRH GBT ½ | 1 | R19 |
| RESISTOR | 470 5% ½W CARBON IRH GBT ½ | 2 | R16, R18 |
| RESISTOR | 820 5% ½W CARBON IRH GBT ½ | 2 | R12, R23 |
| RESISTOR | 1.2K 5% ½W CARBON IRH GBT ½ | 2 | R8, R14 |
| RESISTOR | 2.2K 5% ½W CARBON IRH GBT ½ | 3 | R2, R4, R9 |
| RESISTOR | 3.9K 5% ½W CARBON IRH GBT ½ | 1 | R21 |
| RESISTOR | 12K 5% ½W CARBON IRH GBT ½ | 1 | R22 |
| RESISTOR | 18K 5% ½W CARBON IRH GBT ½ | 1 | R11 |
| POTENTIOMETER | 22K CARBON LINEAR PLESSEY V10K8 | 1 | R1 |
| RESISTOR | 39K 5% ½W CARBON IRH GBT ½ | 1 | R3 |
| RESISTOR | 68K 5% ½W CARBON IRH GBT ½ | 1 | R7 |
| RESISTOR | 100K 5% ½W CARBON IRH GBT ½ | 1 | R6 |
| CAPACITOR | 330pf ±20% 500V CERAMIC DISC PLESSEY CDS-Y | 1 | C2 |
| CAPACITOR | .01 ±20% 250V MET POLY AEE PHE 240H510 | 1 | C7 |
| CAPACITOR | 0.1 ±20% 100V MET POLY AEE PHE 240D610 | 1 | C9 |
| CAPACITOR | 1.0 $^{+50}_{-20}$% 35V TANTALUM SIEMENS B45134 | 1 | C1 |
| CAPACITOR | 10 $^{+50}_{-20}$% 16V TANTALUM SIEMENS B45134 | 1 | C6 |
| CAPACITOR | 22 $^{+50}_{-20}$% 16V TANTALUM SIEMENS B45134 | 2 | C3, C4 |
| CAPACITOR | 470 $^{+50}_{-10}$% 40V ELECTROLYTIC PHILIPS 2222/017/17471 | 1 | C8 |
| TRANSISTOR | PHILIPS BC107 | 2 | Q1, Q6 |
| TRANSISTOR | PHILIPS 2N2904 | 2 | Q2, Q3 |
| TRANSISTOR | PHILIPS 2N2221 | 1 | Q7 |
| TRANSISTOR | FAIRCHILD 2N3055 | 2 | 2Q4, 2Q5 |
| EYELETS | TUCKER E069/090 | 4 | FOR 2Q4, 2Q5 |
| DIODE | ITT IN4002 | 2 | D2, D3 |
| DIODE | ZENER PHILIPS BZX70/C18 | 1 | D1 |
| MICROLOGIC | NATIONAL LM741 | 2 | ML1, ML2 |
| HEATSINK | ABD 8839 | 1 | |
| TRANSFORMER | ABT 6952 | 1 | 2T1 |

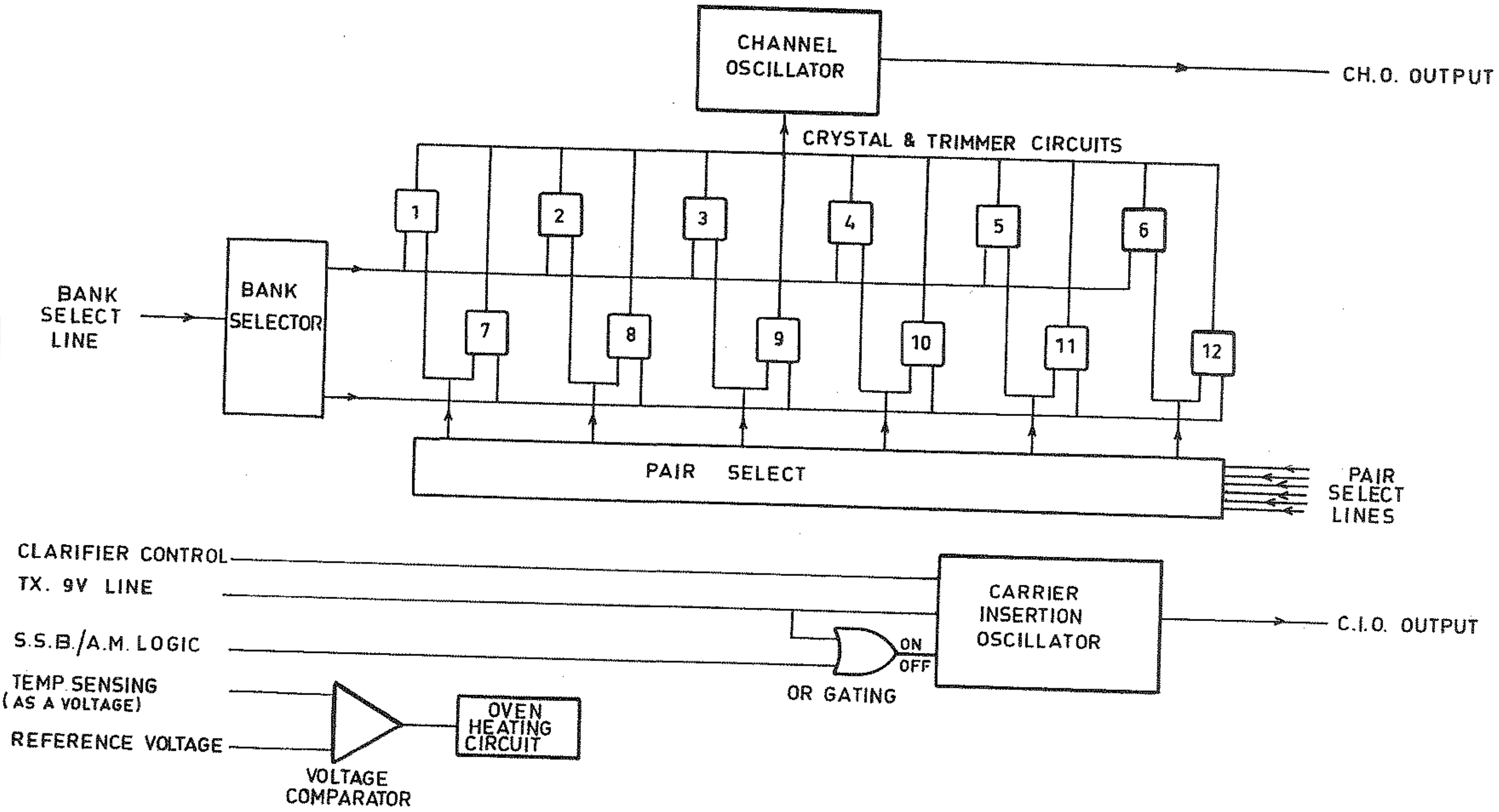


TRANSCEIVER BLOCK DIAGRAM

FIG. 1

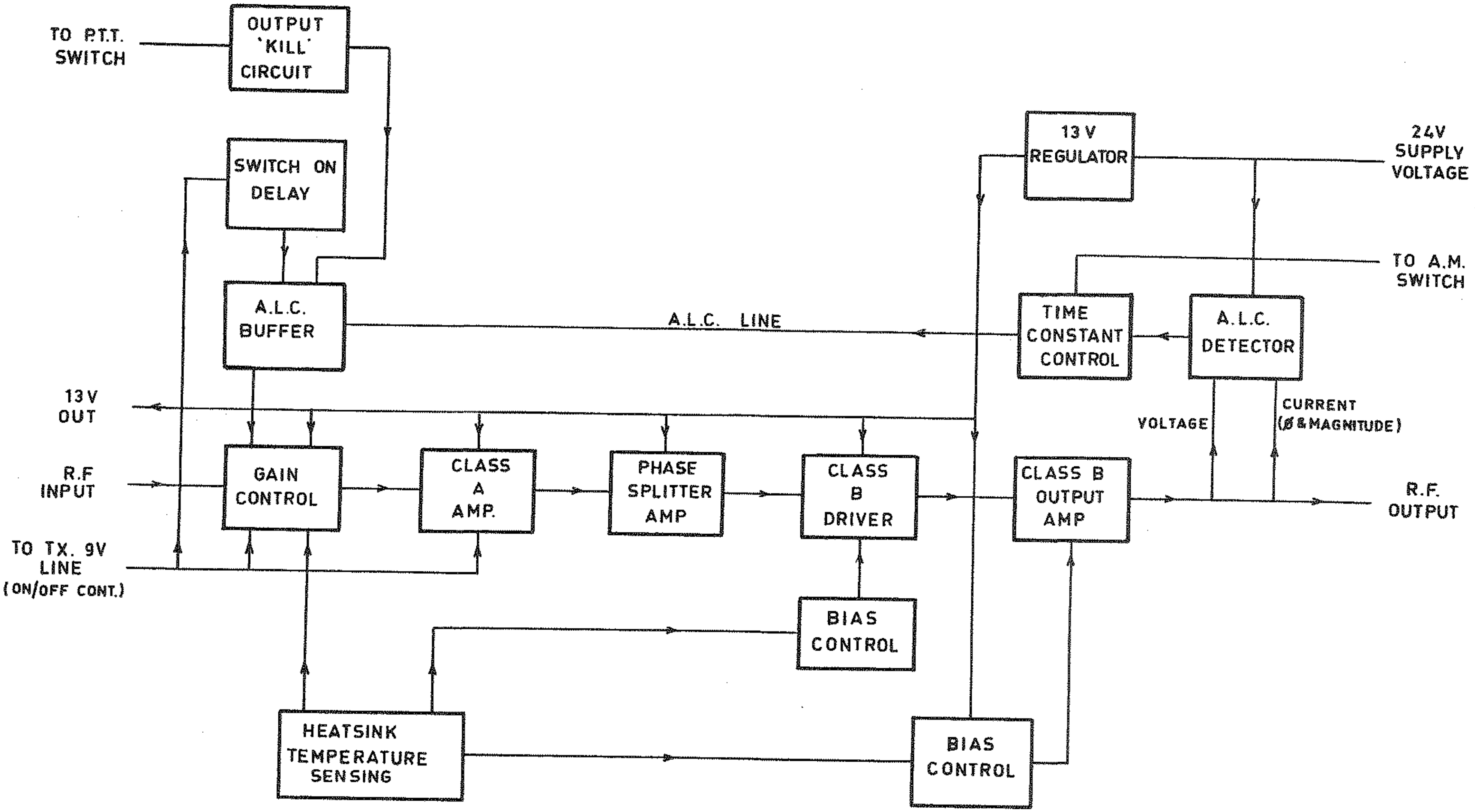
TRA 7948 A

RACAL
The Electronics Group



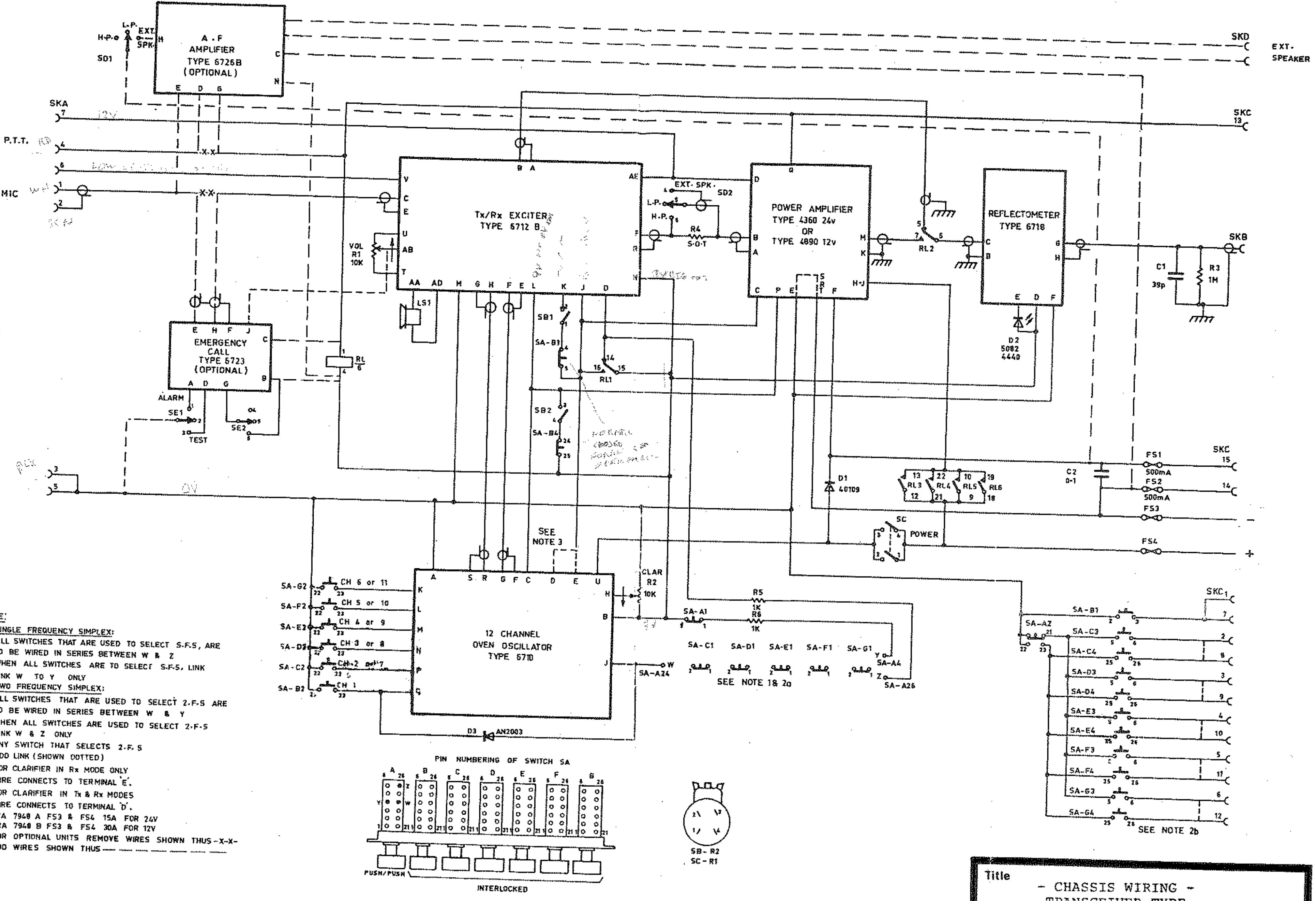
OSCILLATOR TYPE 6712 BLOCK DIAGRAM FIG. 2

RACAL
The Electronics Group



100W AMPLIFIER TYPE 4360 BLOCK DIAGRAM FIG. 3

RACAL
The Electronics Group



NOTE;

1. SINGLE FREQUENCY SIMPLEX:
ALL SWITCHES THAT ARE USED TO SELECT S.F.S, ARE
TO BE WIRED IN SERIES BETWEEN W & Z
WHEN ALL SWITCHES ARE TO SELECT S.F.S, LINK
LINK W TO Y ONLY

2.a. TWO FREQUENCY SIMPLEX:
ALL SWITCHES THAT ARE USED TO SELECT 2.F.S ARE
TO BE WIRED IN SERIES BETWEEN W & Y
WHEN ALL SWITCHES ARE USED TO SELECT 2.F.S
LINK W & Z ONLY

b. ANY SWITCH THAT SELECTS 2.F.S
ADD LINK (SHOWN DOTTED)

3. FOR CLARIFIER IN Rx MODE ONLY
WIRE CONNECTS TO TERMINAL 'E'.
FOR CLARIFIER IN Tx & Rx MODES
WIRE CONNECTS TO TERMINAL 'D'.

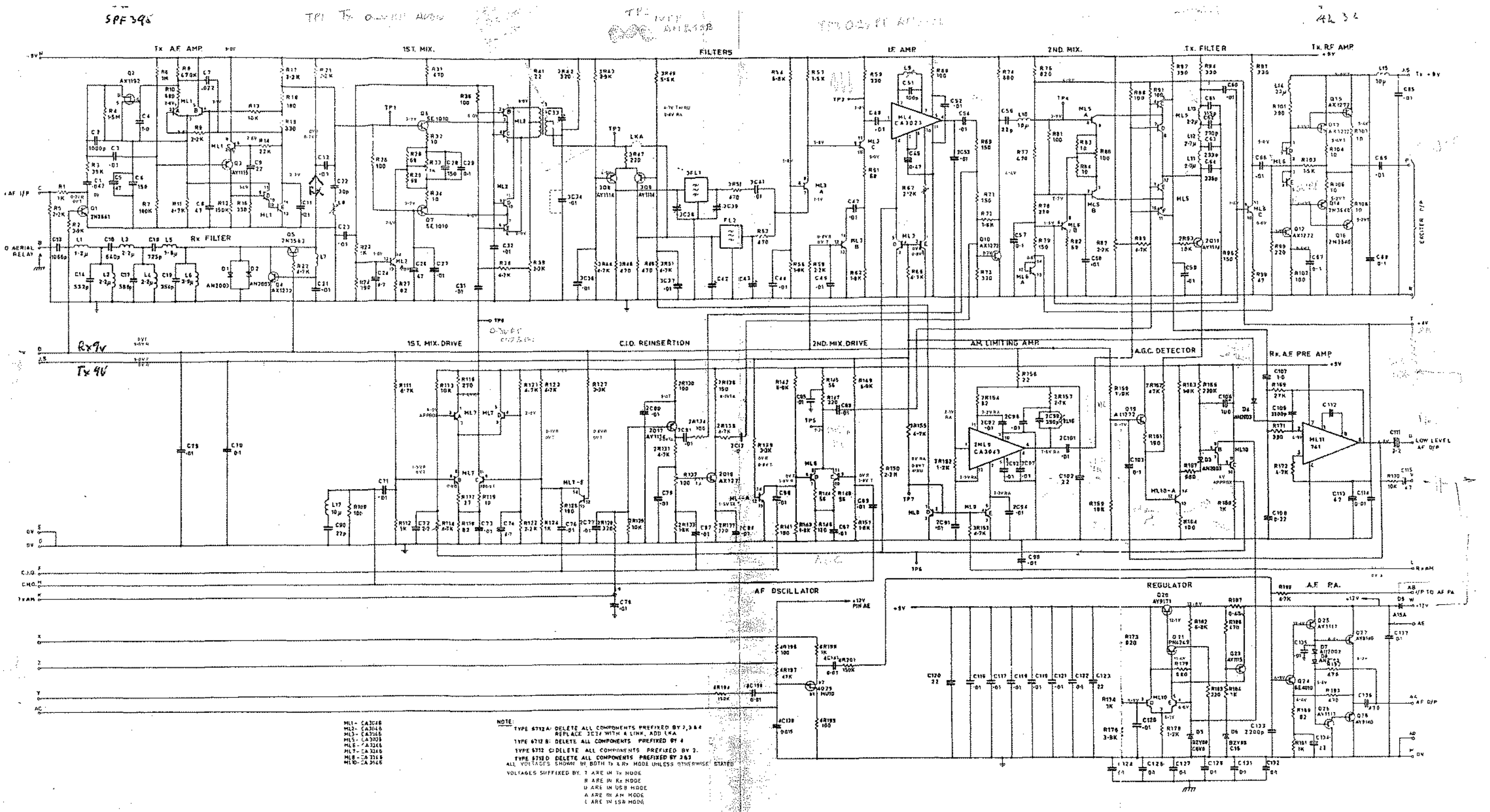
4. TRA 7948 A FS3 & FS4 15A FOR 24V
TRA 7948 B FS3 & FS4 30A FOR 12V

5 FOR OPTIONAL UNITS REMOVE WIRES SHOWN THUS -X-X-
ADD WIRES SHOWN THUS — — — — — — —

Title
- CHASSIS WIRING -
TRANSCEIVER TYPE
TRA 7948

Drawing No: ACC 674 Date: 24-9-74

RACAL
The Electronics Group



**NOTE:**

TYPE 6712 A: DELETE ALL COMPONENTS PREFIXED BY 2,3 & 4
REPLACE 3C34 WITH A LINK, ADD LKA

TYPE 6712 B: DELETE ALL COMPONENTS PREFIXED BY 4

TYPE 6712 C: DELETE ALL COMPONENTS PREFIXED BY 2.

TYPE 6712 D DELETE ALL COMPONENTS PREFIXED BY 2&3

ALL VOLTAGES SHOWN IN BOTH Tx & Rx MODE UNLESS OTHERWISE STATED

VOLTAGES SUFFIXED BY. T ARE IN Tx MODE
R ARE IN Rx MODE
U ARE IN USB MODE
A ARE IN AM MODE
L ARE IN LSB MODE

For 1V R.F. audio o/p at [illegible] V SSB Rx Mode

(2 Mc/s) 300V Read on Scope via capacitor on TP3

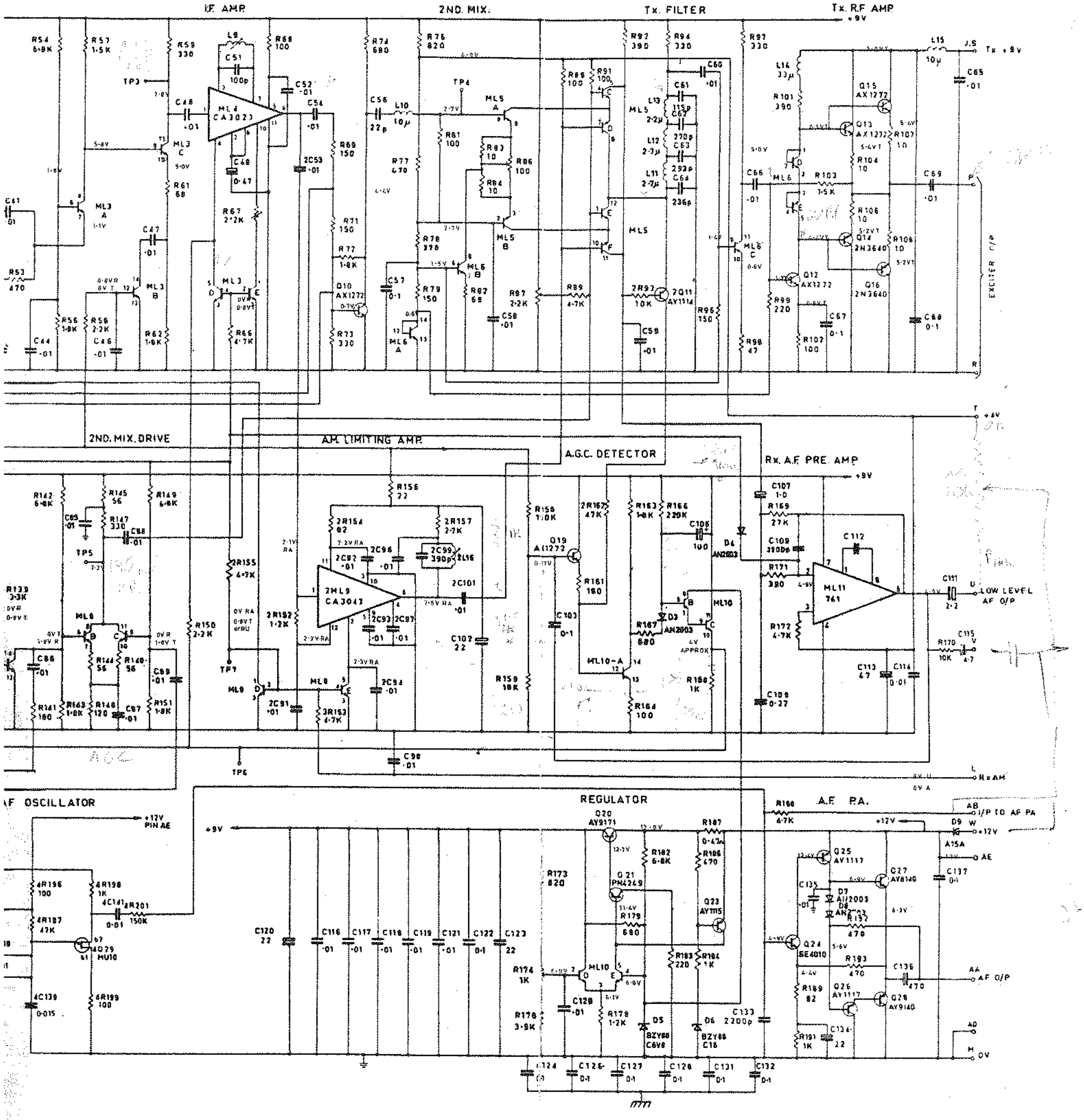
(10 Mc/s) 600V

Title

- CIRCUIT DIAGRAM -
RECEIVER EXCITER BOARD
TYPE 6712

Drawing No: ADC 6712
Date: 24-9-74

RACAL
The Electronics Group



ON A GOOD SET

FOR 1V P.P. AUDIO O/P AT Pin U SSB Rx MODE

) 30µV READ ON SIG GEN VIA CAPACITOR ON TP3

4) 6µV

TP2

Title

- CIRCUIT DIAGRAM -
RECEIVER EXCITER BOARD
TYPE 6712

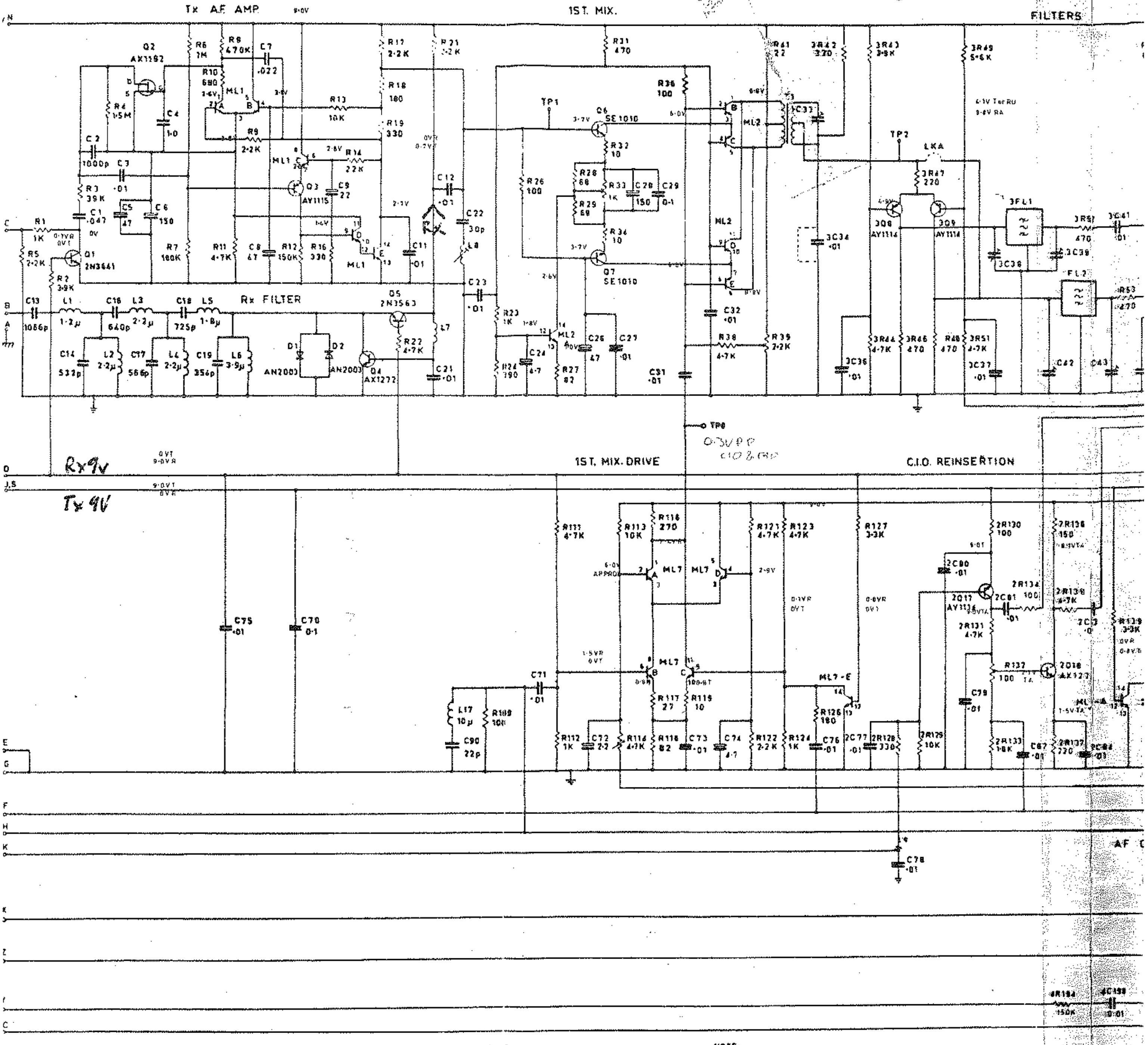
Drawing No: ADC 6712 Date: 24-9-74

**RACAL**
The Electronics Group

AM114A
or
SPF395

TP1 Tx 0.2VPP Audio

TP2 1VPP AM&SSB



ML1 – CA3046
ML2 – CA3046
ML3 – CA3046
ML5 – CA3026
ML6 – CA3046
ML7 – CA3046
ML8 – CA3046
ML10 – CA3046

**NOTE:**

TYPE 6712 A: DELETE ALL COMPONENTS PREFIXED BY 2,3 & 4
REPLACE 3C34 WITH A LINK, ADD LKA

TYPE 6712 B: DELETE ALL COMPONENTS PREFIXED BY 4

TYPE 6712 C: DELETE ALL COMPONENTS PREFIXED BY 2.

TYPE 6712 D DELETE ALL COMPONENTS PREFIXED BY 2 & 3

ALL VOLTAGES SHOWN IN BOTH Tx & Rx MODE UNLESS OTHERWISE STATED

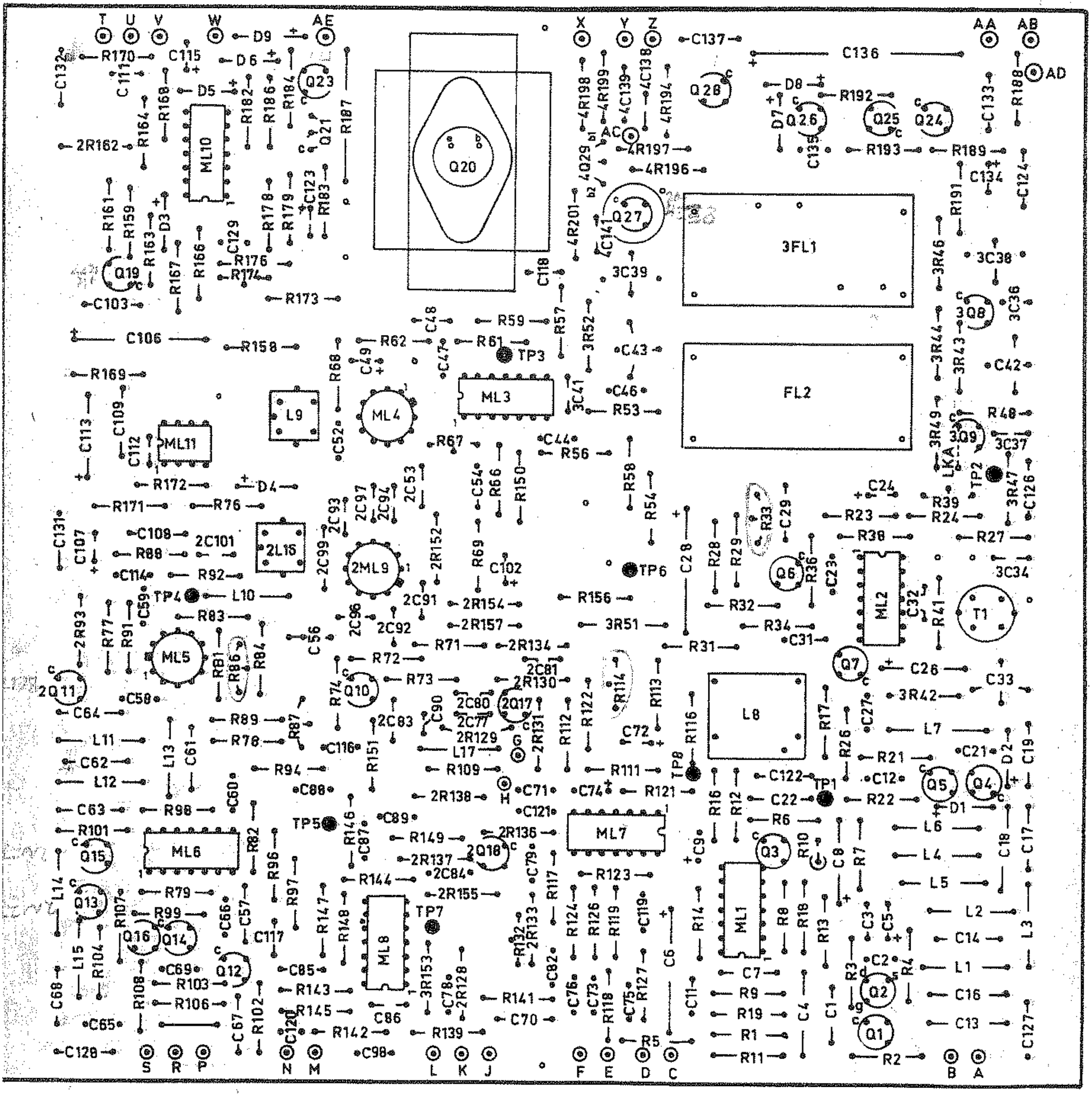
VOLTAGES SUFFIXED BY T ARE IN Tx MODE
R ARE IN Rx MODE
U ARE IN USB MODE
A ARE IN AM MODE
L ARE IN LSB MODE

AGC TP6
AP. TP 2V – 3.6V TP6 1V – 5.5V

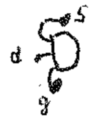
Rx Filter
in B 100mV P.P in, T.P.1 90mV P.P

(10.7 Mc/s)

(10.1 Mc/s)



R33

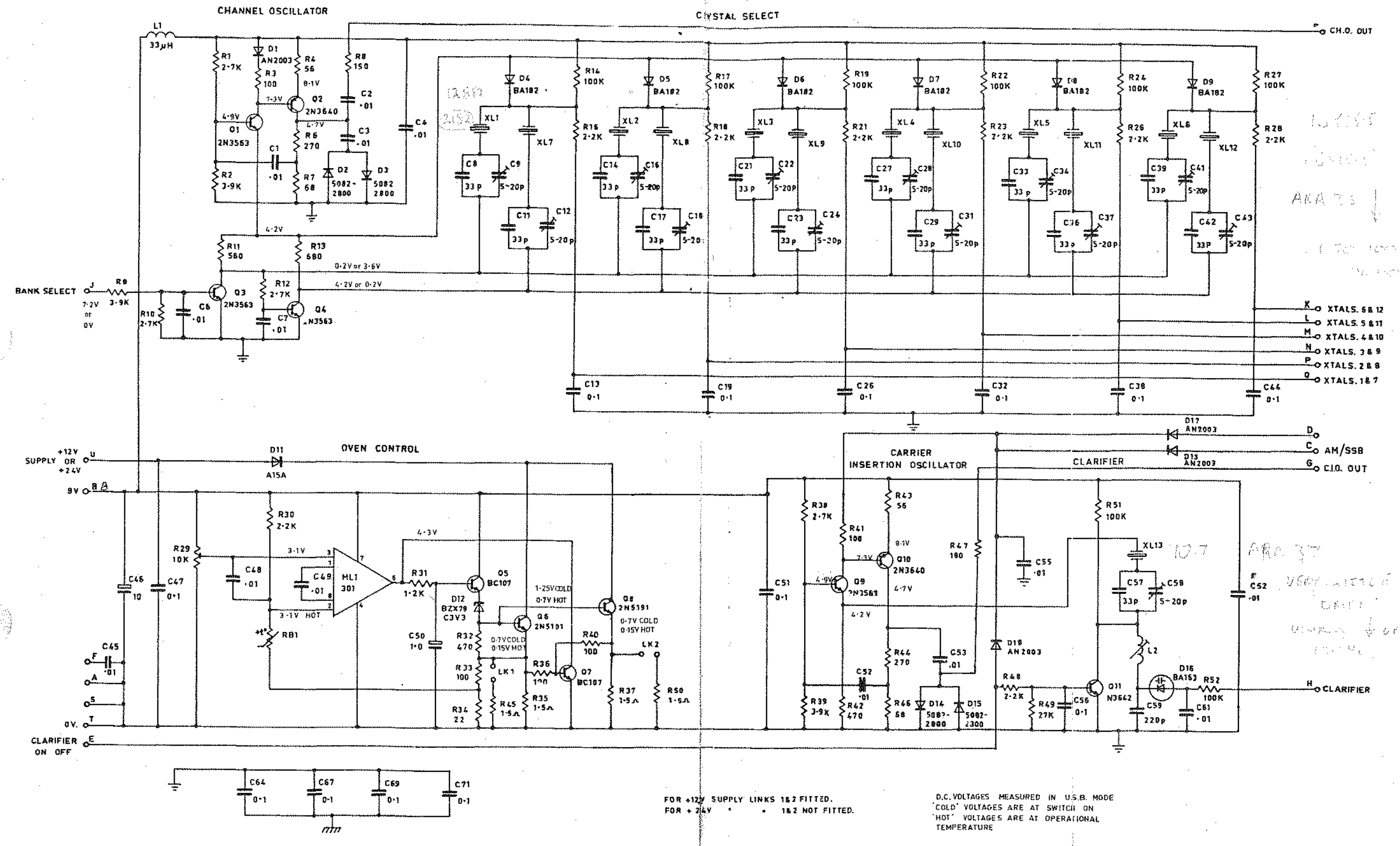


Title

- BOARD LAYOUT -
RECEIVER EXCITER BOARD
TYPE 6712

Drawing No: *ACH 6712* Date: *24-9-74*

RACAL
The Electronics Group



FOR +12V SUPPLY LINKS 1&2 FITTED.
FOR + 24V " " 1&2 NOT FITTED.

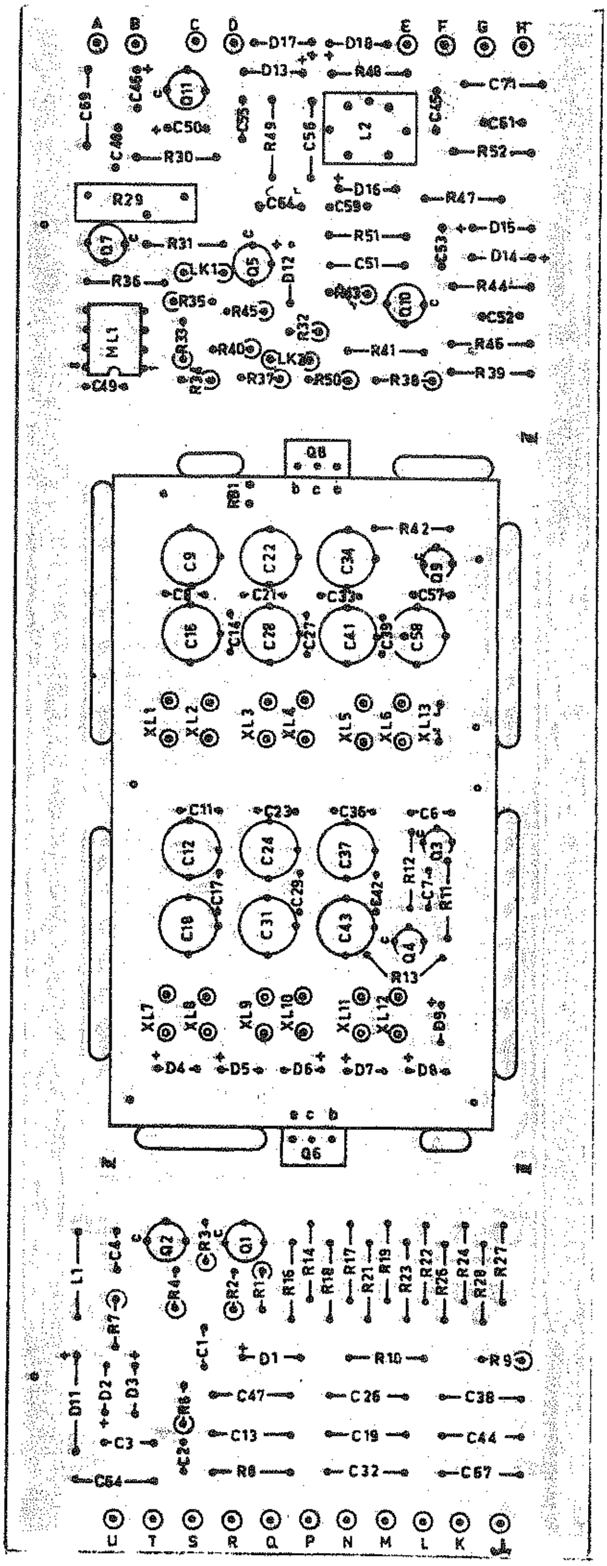
D.C. VOLTAGES MEASURED IN U.S.B. MODE
'COLD' VOLTAGES ARE AT SWITCH ON
'HOT' VOLTAGES ARE AT OPERATIONAL TEMPERATURE

Title

- CIRCUIT DIAGRAM -
12 CHANNEL OSCILLATOR BOARD
TYPE 6710

Drawing No: ACC 6710 Date: 24-9-74

RACAL
The Electronics Group



Title

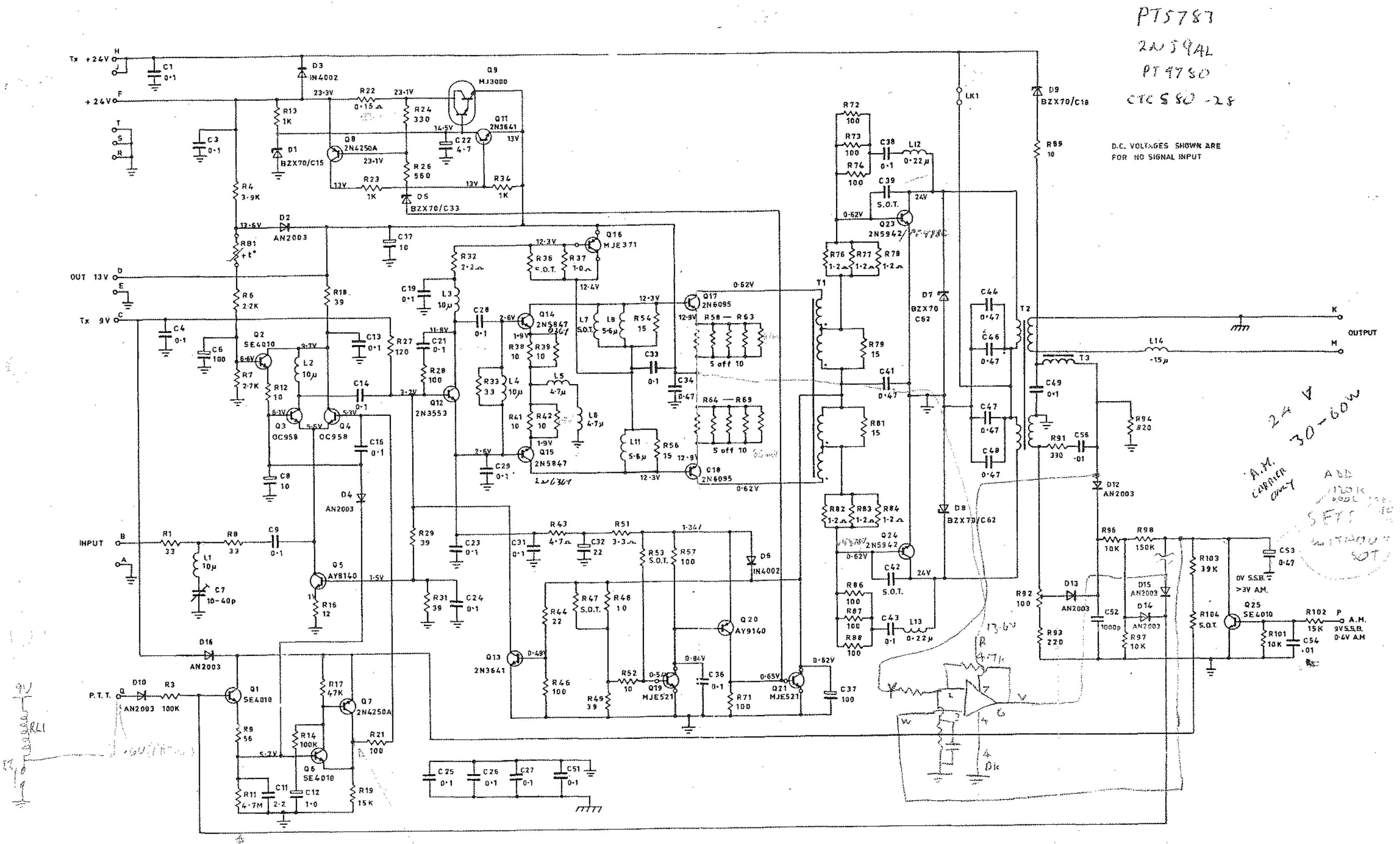
- BOARD LAYOUT -
OVEN OSCILLATOR UNIT
TYPE 6710

Drawing No: ABH 6710

Date: 24.9.74

RACAL
The Electronics Group

METAL
SIDE
down

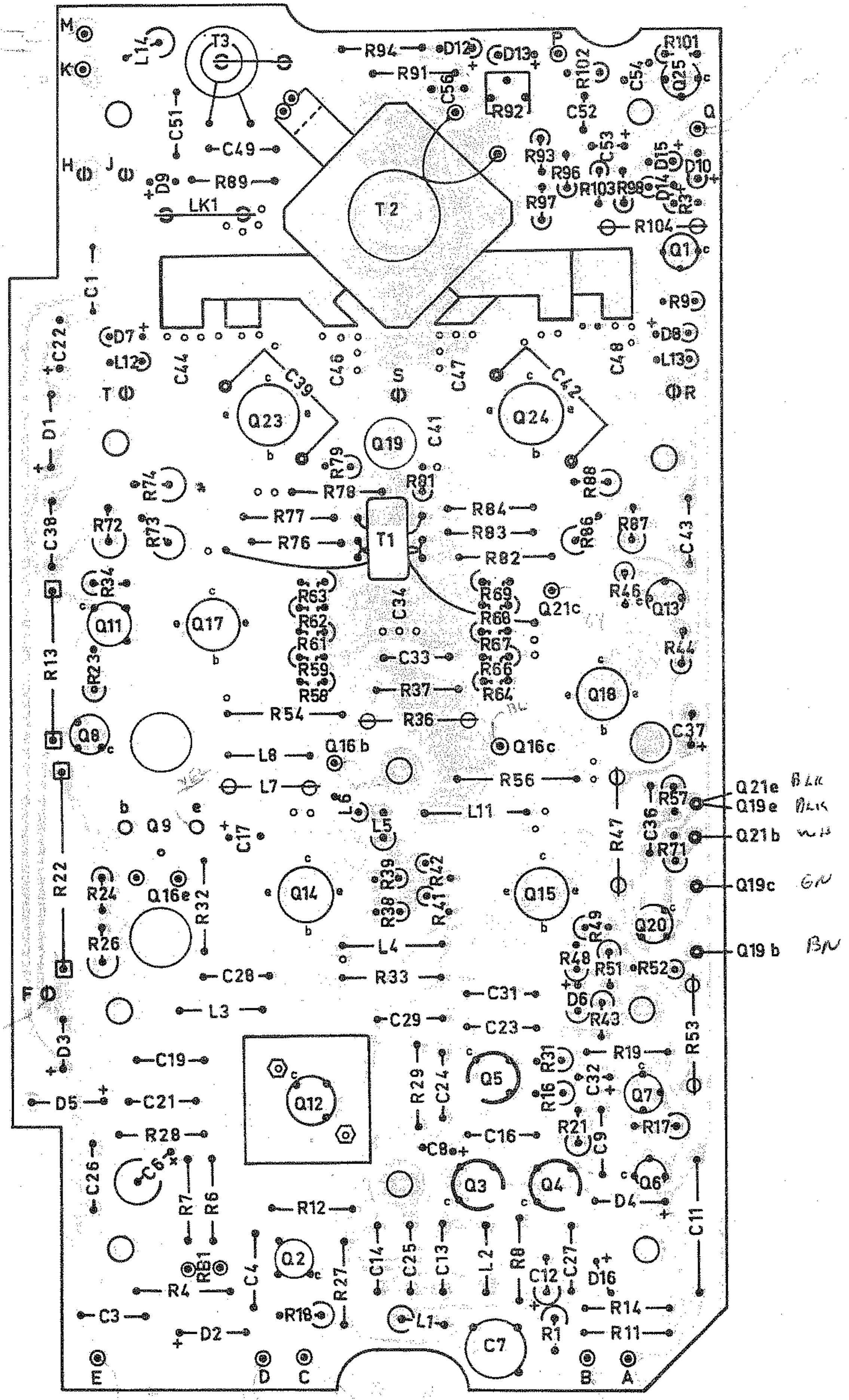


P.T.T. OFF
P.T.T. ON

**Title** - CIRCUIT DIAGRAM -
100W 24V POWER AMPLIFIER
TYPE 4360

**Drawing No:** ACC 4360 **Date:** 24-9-74

**RACAL**
The Electronics Group



Title

- BOARD LAYOUT -

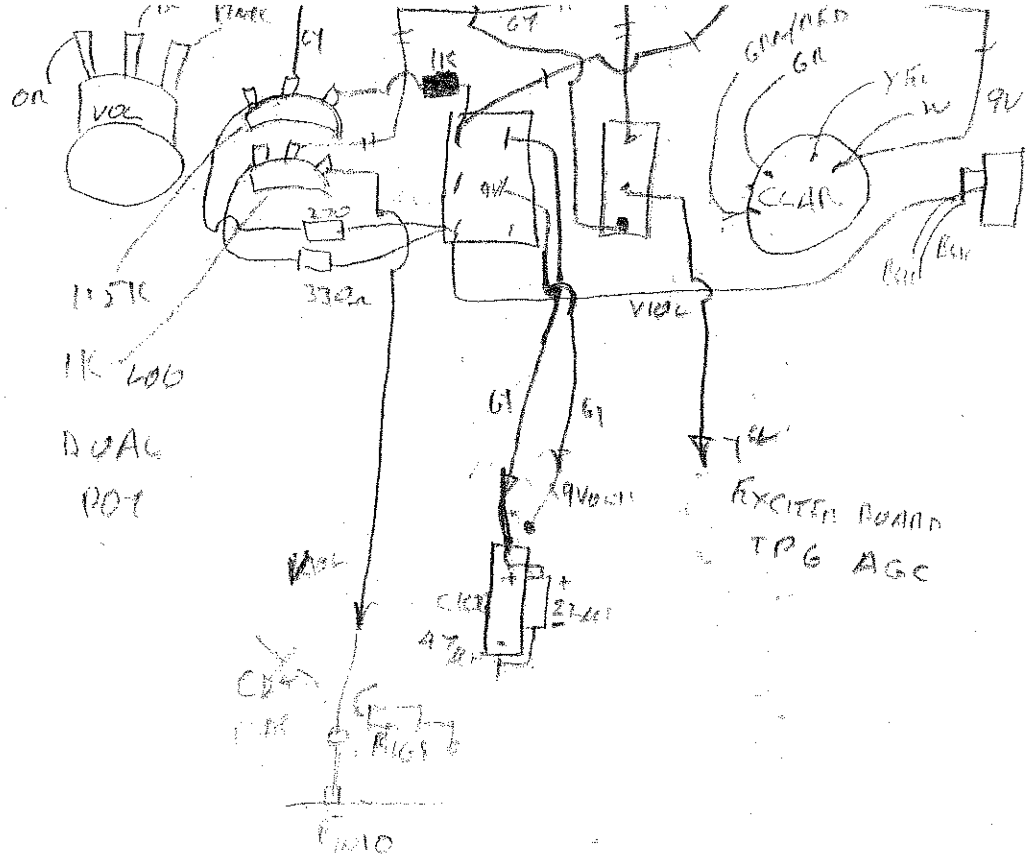
100W 24V POWER AMPLIFIER

TYPE 4360

Drawing No: ACH 4360 Date: 24-9-74

RACAL

The Electronics Group



CAAP 49

MELCH 84

[illegible] 64

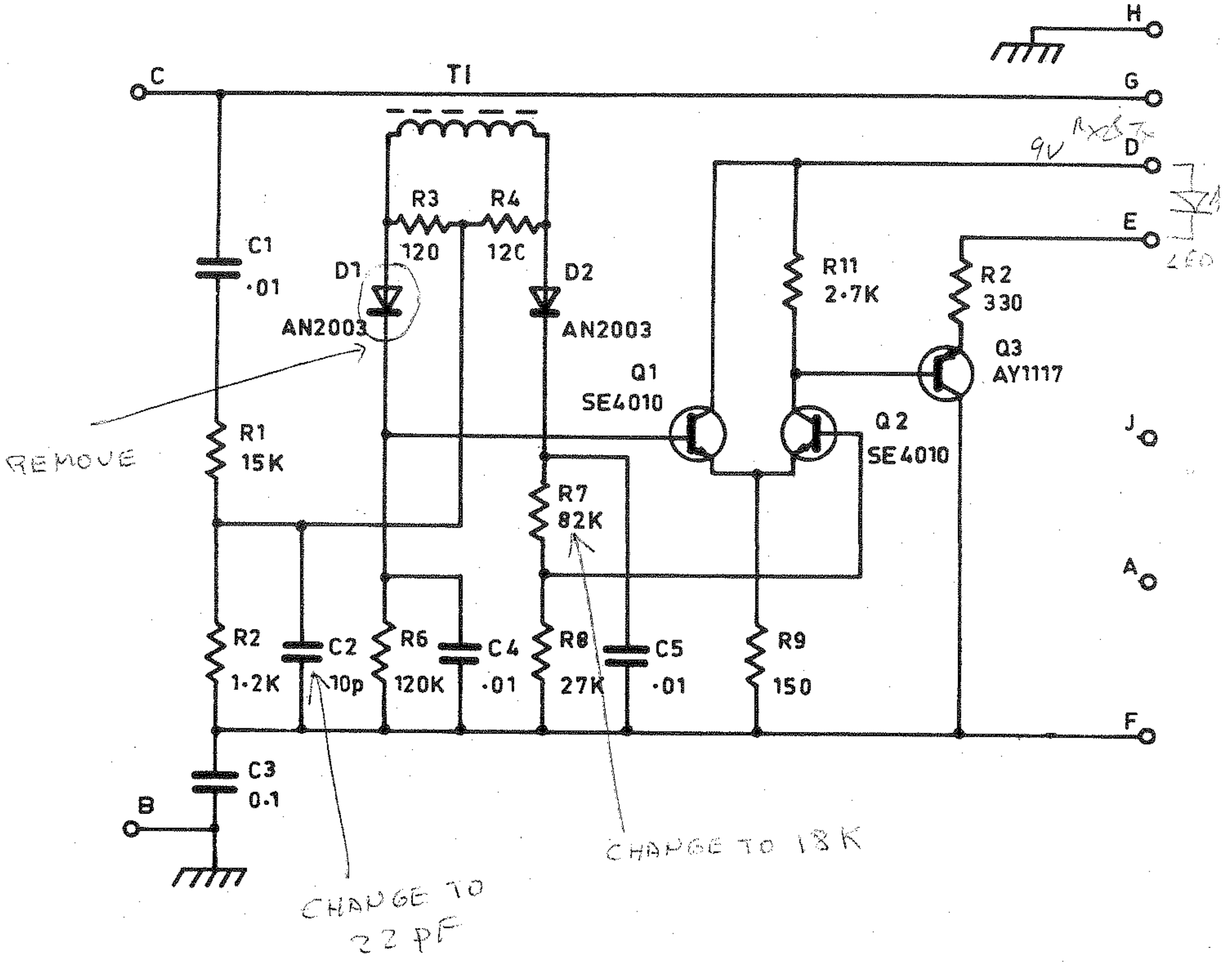
[illegible] 1.00

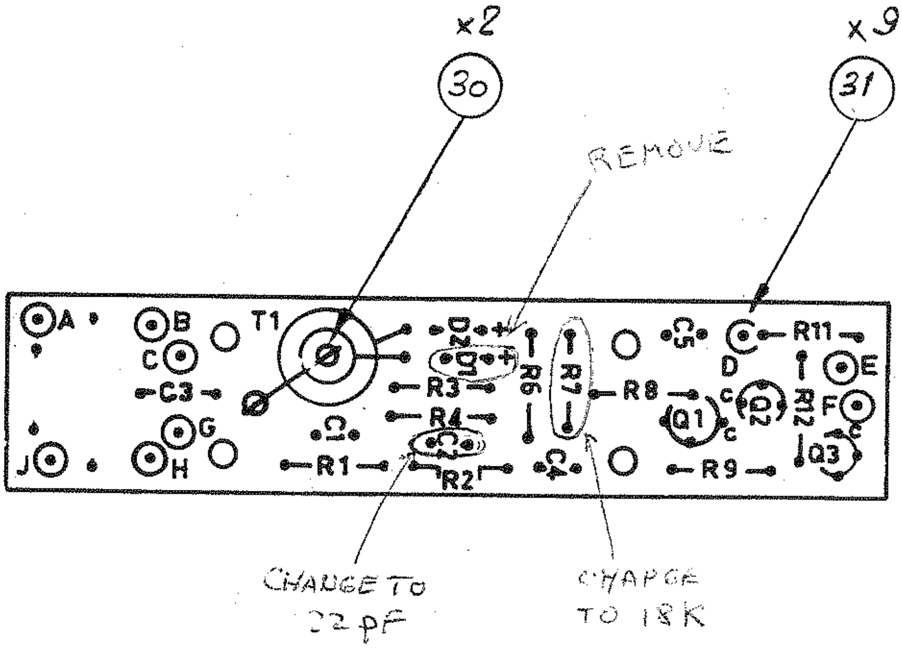
MTA 1 [illegible]

[illegible]

| | | | | | | |
|---|---|---|---|---|---|---|
| 2182 | 2524 | 4125 | 4134.3 | 2760 | 4075.4 | 94 |
| | 2201 | 6215.5 | 4428.7 | 2056 | 4369.8 | |

2

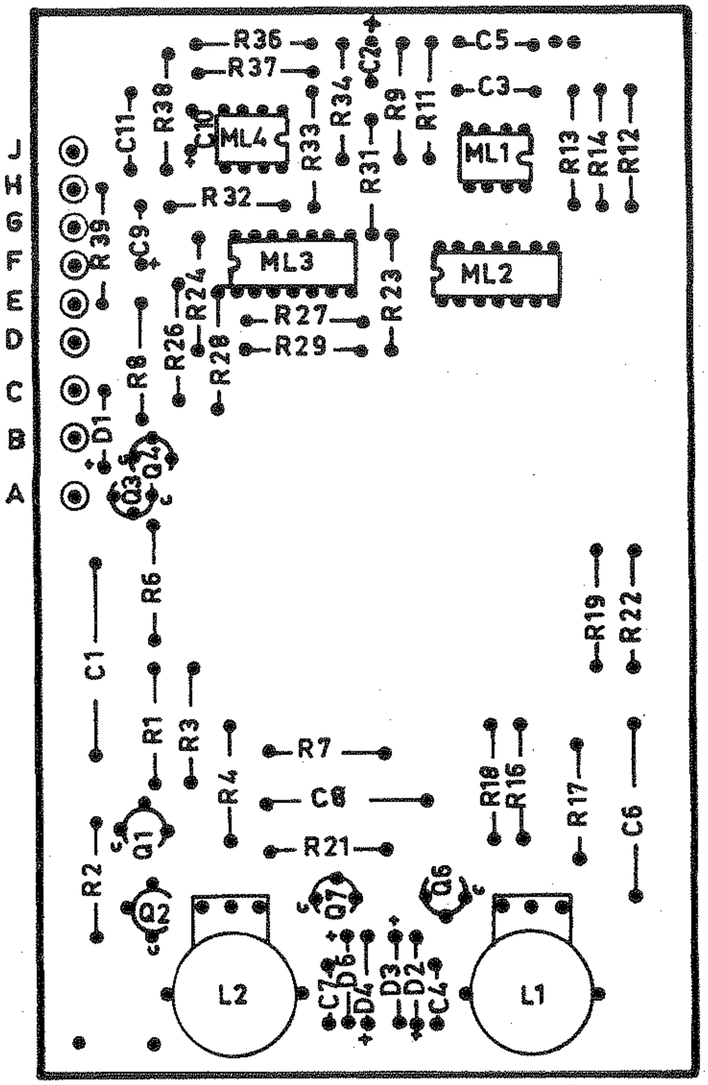




**Title** - CIRCUIT DIAGRAM &
BOARD LAYOUT
REFLECTOMETER BOARD TYPE 6718

**Drawing No:** AAC 6718 **Date:** 24-9-74

RACAL
The Electronics Group

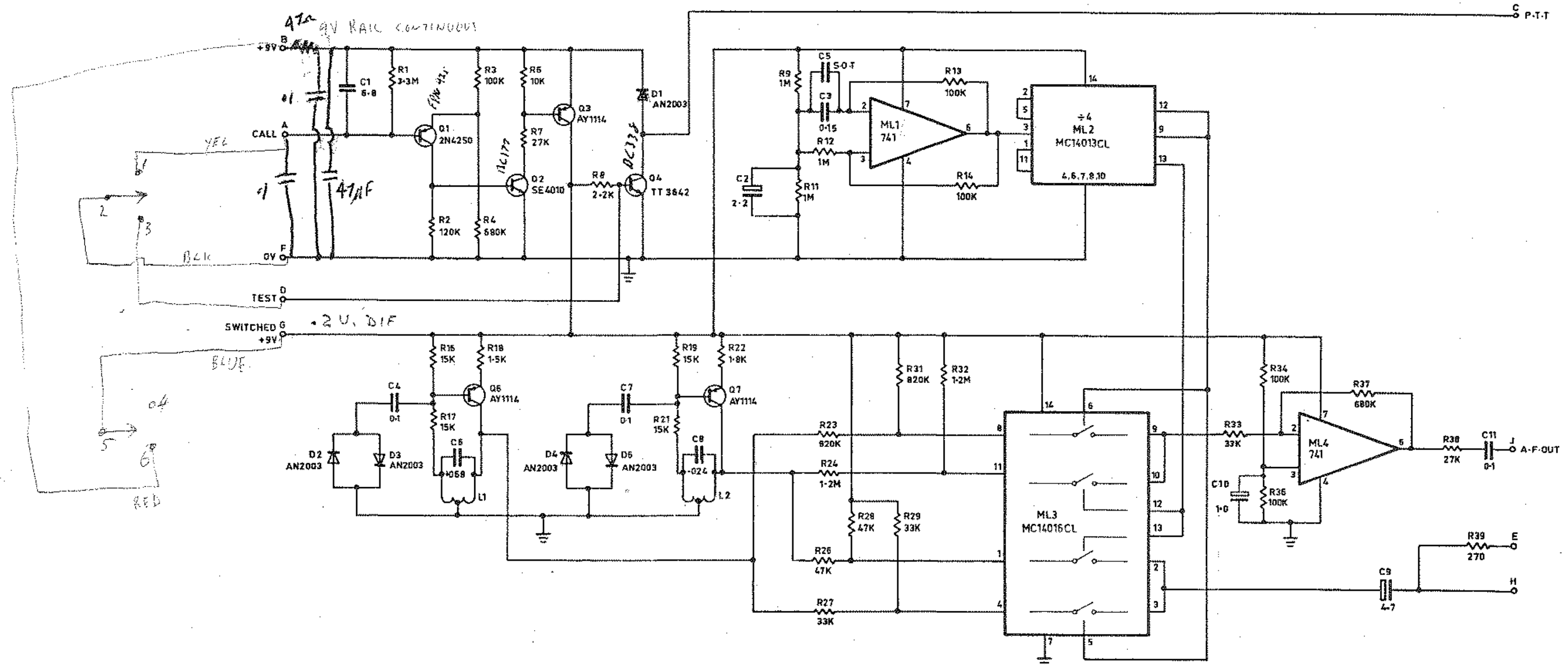


**Title**

- BOARD LAYOUT -
DISTRESS SIGNALLING BOARD
TYPE 6723

**Drawing No:** AAA 6723
**Date:** 24-9-74

RACAL
The Electronics Group



RACAL MOD

TO ENSURE THAT OSCILLATION OF THE TIMER CIRCUIT
CANNOT TAKE PLACE, RESULTING IN UNDESIRED TRANSMISSION.
Q2 CHANGED FROM PHILIPS TYPE BC107 TO FAIRCHILD TYPE SFA010 ON AY1112

THIS MOD DOES NOT ALWAYS WORK.

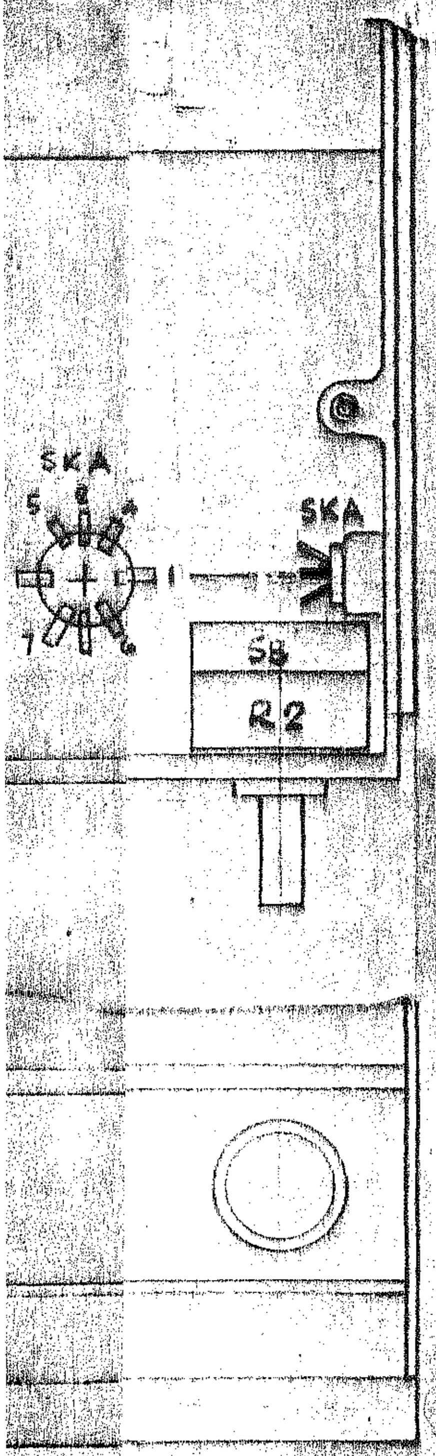
(1) Pin 'B' is UNBYPASSED. A 47Ω RESISTOR & 47μF CAP HELPED STOP FALSE TRIGGERING

(2) A ·1μF ACROSS PINS A & F ALSO STOPPED FALSE TRIGGERING BY KILLING THE OSCILLATION IN Q1,Q2,

Title
- CIRCUIT DIAGRAM -
DISTRESS SIGNALLING BOARD
TYPE 6723

Drawing No: ACC 6723
Date: 24-9-74

RACAL
The Electronics Group



## TRA 7948

## INSTRUCTIONS FOR FITTING DISTRESS SIGNALLING OPTION

**NOTE:** Steps 1, 2, 3, 9 & 10 would not apply for normal factory assembly using new equipment.

1. Remove top and bottom covers.
2. Remove knobs (2) by lifting out end caps, and releasing collet nut with screw driver.
3. Remove escutcheon by releasing screws in corners (4) slide out L.E.D. from the escutcheon.
4. Modify escutcheon by drilling hole as detailed on drawing AAD6723.
5. Remove protective backing from label, item 3 and fit to escutcheon as shown on drawing.
6. Fit switch SB, item 8 in hole provided in chassis with momentary position to top of chassis.
7. Mount DISTRESS SIGNALLING Bd6723 item 1 in holes provided in chassis as indicated, using parts supplied, items 11, 15, 16, 17, 18.
8. Connect according to wiring instructions:

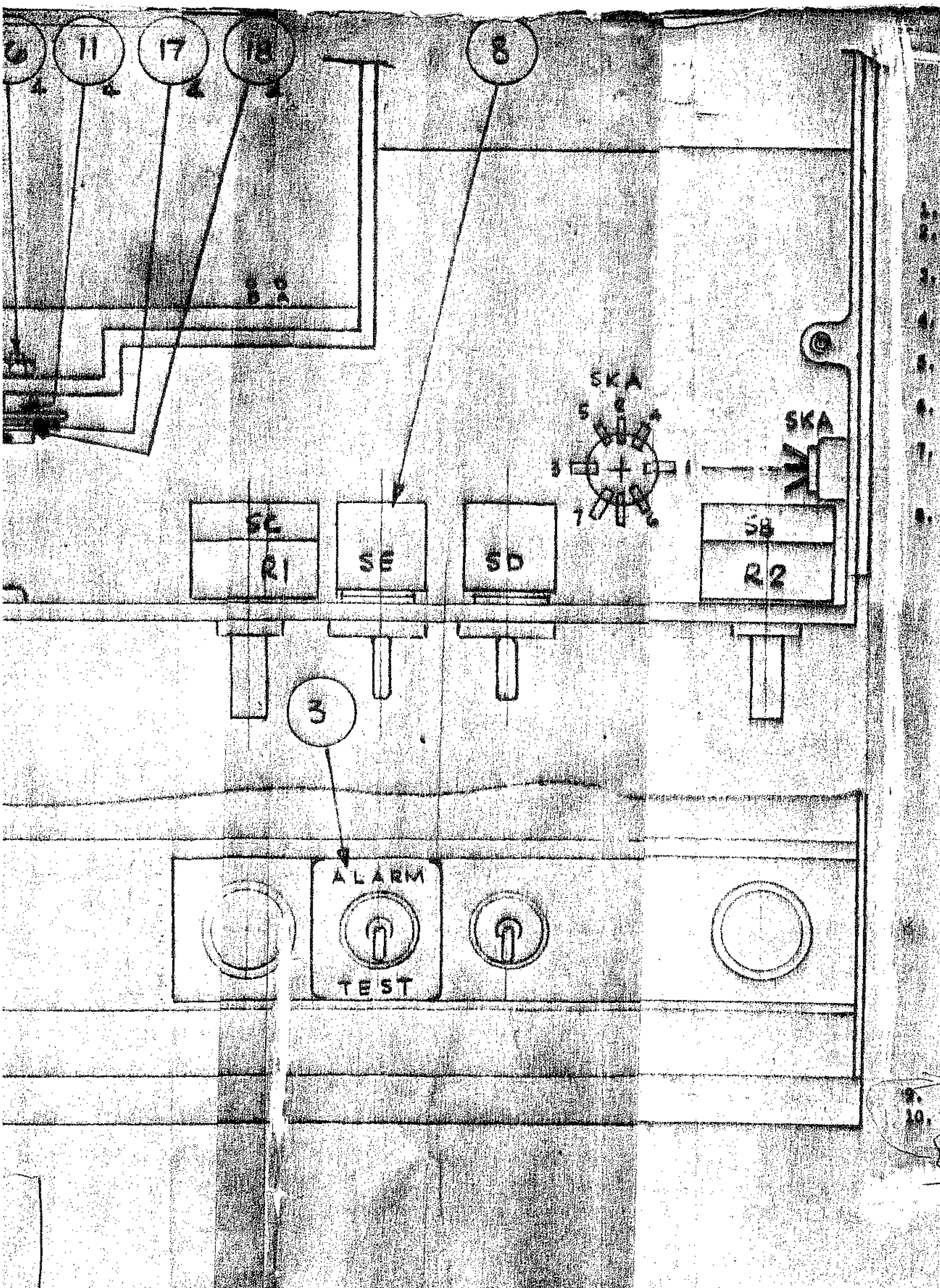
| From | To | Wire Colour | Wire Type | Notes |
|---|---|---|---|---|
| EM Call Bd.6723 | | | | |
| Pin A | SK1 | Y | 7/.0076 | |
| Pin B | 6712 Bd. Pin M | R/BN | " | |
| " B | SK6 | R/BN | " | |
| " C | SKA4 | O | " | |
| " D | SK3 | W | " | |
| " E | SKA1 | Core | Screened Cable | Remove existing Connections to SKA1 & 2 |
| " F | SKA2 | Screen | | |
| " G | SK5 | B lue | 7/.0076 | |
| " H | 6712 Bd. Pin C | Core | Screened Cable | Use Cable previously connected to SKA1 & 2 |
| " E | 6712 Bd. Pin E | Screen | | |
| " J | Volume (R1) Centre Tap | G/B | 7/.0076 | |
| SKA3 or 5 | SK2<br>SK4 | BK red<br>NOT USED | 7/.0076 | |

Lace wires to existing cable form.

9. Re-fit L.E.D. escutcheon and knobs.
10. Re-fit top and bottom covers.

{Fit R7 – 1KΩ resistor across switch SA–A1 and SA–A2 (see diagram)

| ALL DIMENSIONS IN INCHES | | | THIRD ANGLE PROJECTION |
|---|---|---|---|
| LIMITS | SPECIAL LIMITS ARE STATED ON DRAWING<br>DECIMAL ± .005<br>FRACTIONAL ± 1/64<br>ANGLES ± 1° | LIMITS ON DECIMAL DIA. HOLES<br>UP TO .200 DIA. INCL. + .004 − .001<br>.200 DIA. TO .750 DIA. + .0075 − .0015<br>ABOVE .750 DIA. + .010 − .002 | TITLE TRA 7948 A & B INSTALLATION INSTRUCTIONS FOR DISTRESS SIGNALLING OPTION. |
| PLATING | STANDARD—NO ALLOWANCE TO BE MADE FOR PLATING THICKNESS<br>SPECIAL—THIS PART MUST CONFORM TO DIMS. & LIMITS AFTER PLATING | | DRG. No. ABD 6957 |
| FINISH | | DRN./DATE 30.4.74 | MATL. — |
| RACAL ELECTRONICS PTY. LTD.<br>NORTH RYDE N.S.W. AUSTRALIA | | CHKD./DATE 30-4-74 | SPEC. — |
| | | APPD./ | SCALE — |



INSTRUCTIONS F

NOTE: Steps 1, 2
Factory

1. Remove top and b
2. Remove knobs (2)
collet nut with
3. Remove escutcheon
out L.H.D. from
4. Modify escutcheon
AAD6733.
5. Remove protective
escutcheon as sh
6. Fit switch SN, 1
momentary positi
7. Mount DISTRESS S
in chassis as in
15, 16, 17, 18,
8. Connect according

| From | To |
|---|---|
| SN Call<br>Bd.6723 | |
| Pin A | SN1 |
| Pin B | 6712 Bd,<br>Pin N ✓ |
| " B | SN6 ✓ |
| " C | SKA4 ✓ |
| " D | SN3 ✓ |
| " E | SKA1 |
| " F | SKA2 |
| " G | SN5 |
| " H | 6712 Bd,<br>Pin C ✓ |
| " K | 6712 Bd,<br>Pin E |
| " J | Volume<br>Centre |
| SKA3 or 5 | SN2<br>SN4 |

Lace wires to ex
9. Re-fit L.H.D. esc
10. Re-fit top and b

FTL 87-14
SA-A1 Qu

ALL DIMENSIONS IN INCHES

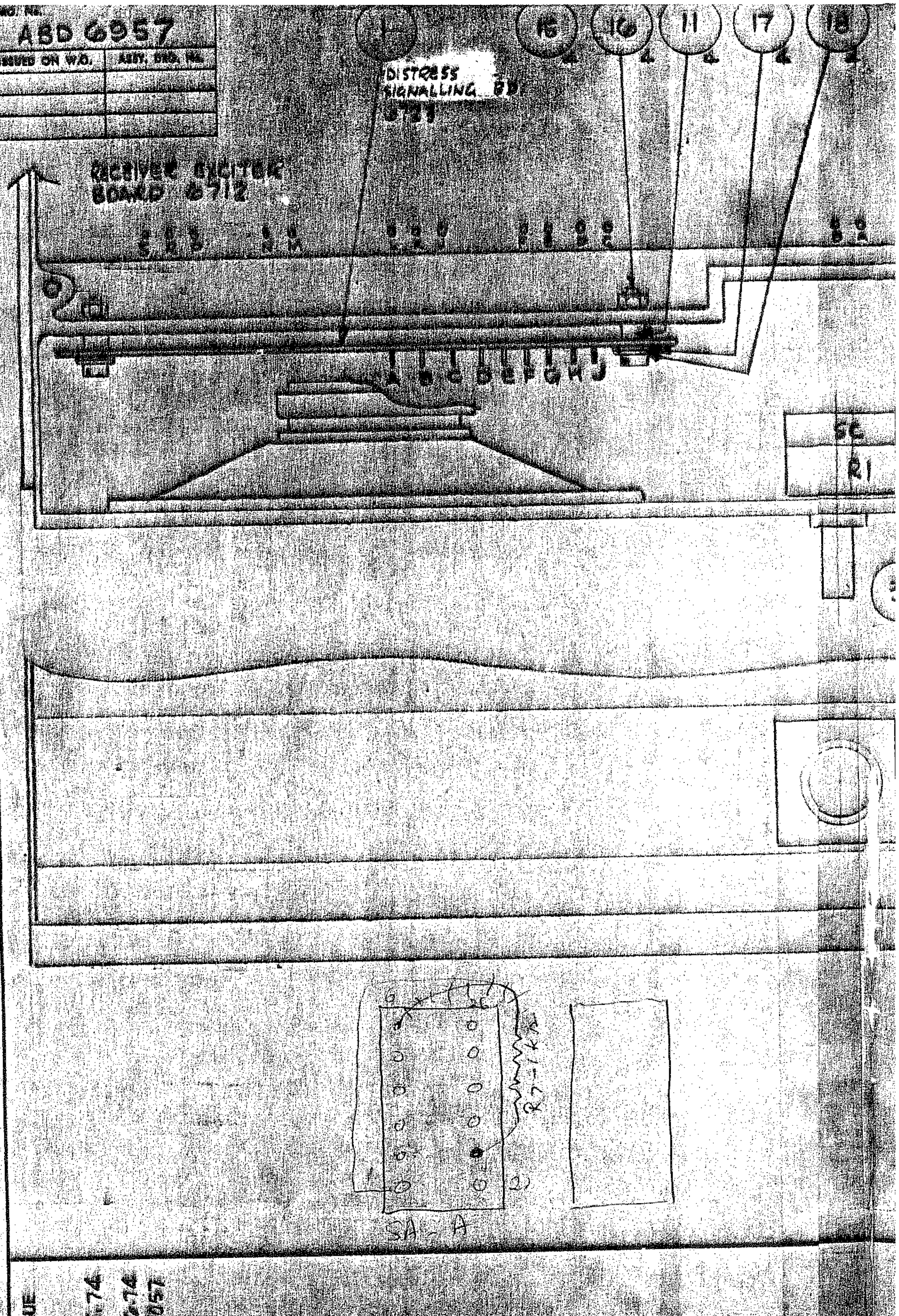
| | |
|---|---|
| LIMITS | SPECIAL LIMITS ARE STATED ON DRAWING<br>DECIMAL ± .005<br>FRACTIONAL ± 1/64<br>ANGLES ± 1° |
| | LIMITS ON D<br>UP TO .200<br>.200 DIA. TO<br>ABOVE .750 |
| PLATING | STANDARD—NO ALLOWANCE TO BE MADE FOR PLA<br>SPECIAL—THIS PART MUST CONFORM TO DIMS. & LIM |
| FINISH | |

DRN.
CHKD.
APPD.

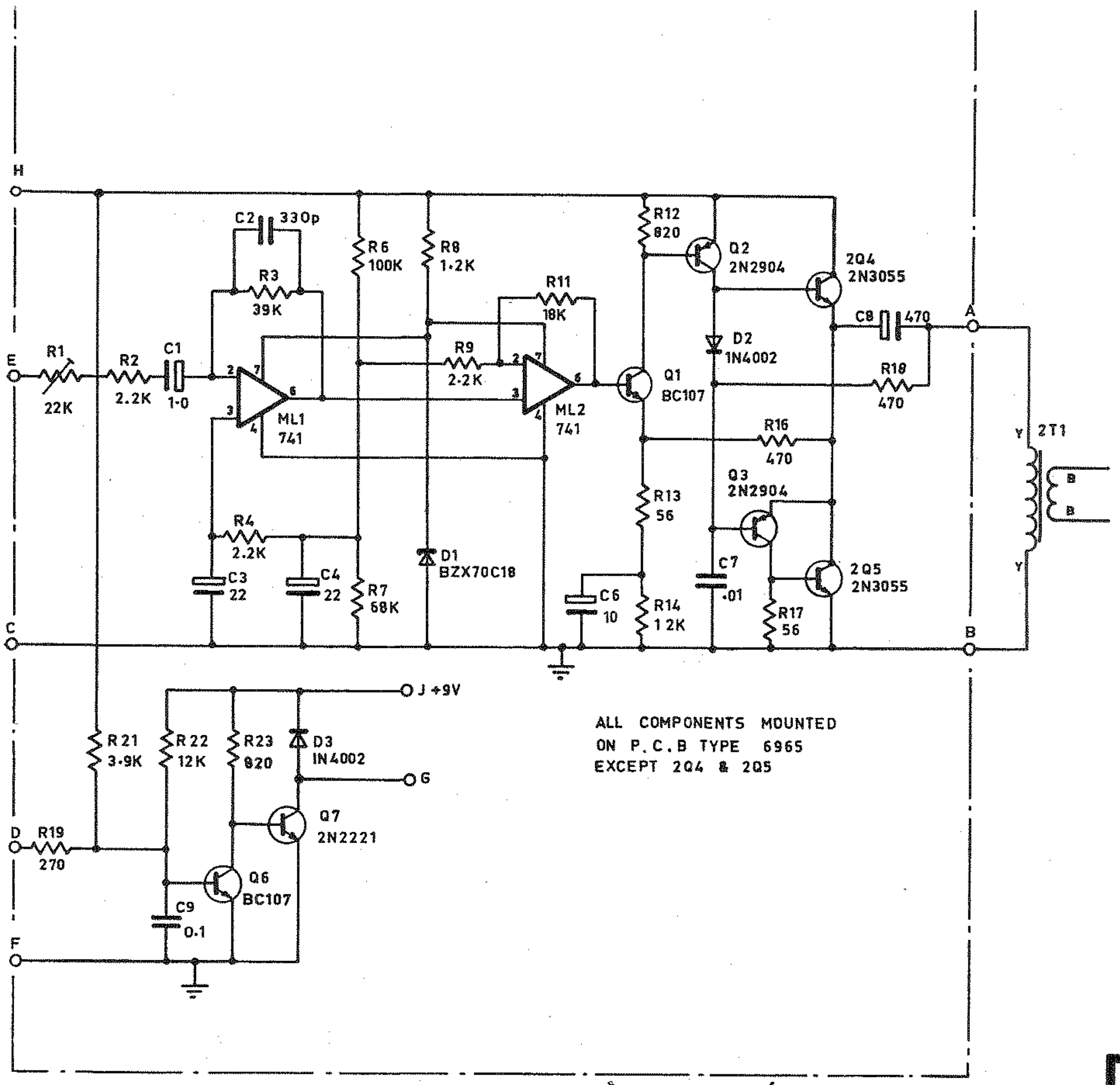
RACAL ELECTRONICS PTY. LTD.
NORTH RYDE, N.S.W., AUSTRALIA

DRG. No.
ABD 6957

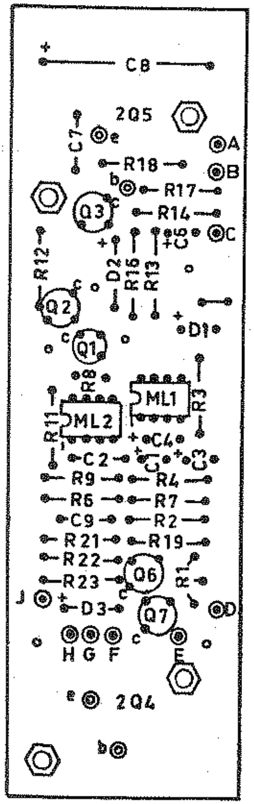
| ISSUED ON W.O. | ASSY. DRG. No. |
|---|---|
| | |
| | |
| | |



ISSUE
2.5.74
17.6.74
WA 7057



ALL COMPONENTS MOUNTED
ON P.C.B TYPE 6965
EXCEPT 2Q4 & 2Q5



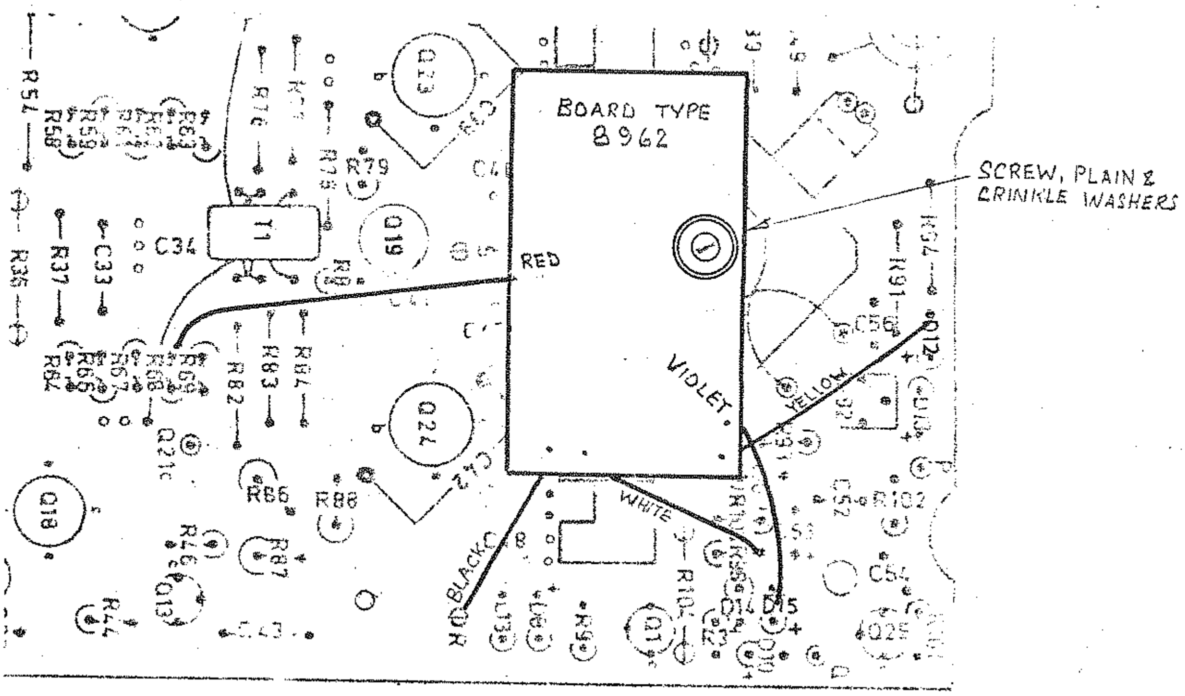
Title – CIRCUIT DIAGRAM & BOARD LAYOUT –
LOUD HAILER AMPLIFIER TYPE 6726 B

Drawing No: ABH 6726B Date: 24-9-74

RACAL
The Electronics Group

# MODIFICATION INSTRUCTIONS

**PURPOSE.** To reduce severity of power roll off in a.m. mode due to temperature under conditions of sustained transmission.



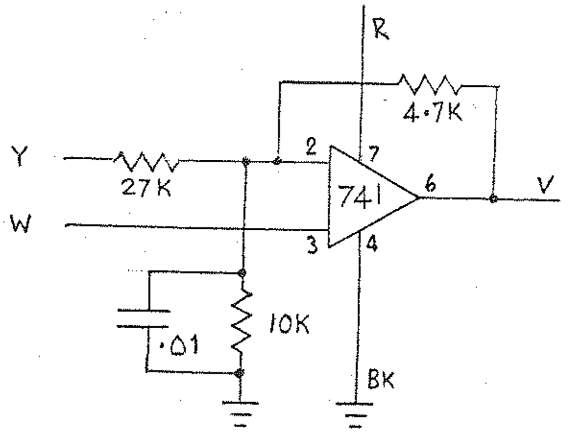
**PARTS REQUIRED.** Board assembly type 8962.

**PROCEDURE**

Modifications carried out on 4360 Power Amplifier.

1) Remove R104
2) Cut D15 anode lead, leaving sufficient lead on D15 to connect a wire.
3) Remove screw and washers securing T2 and fit 8962 board upside down, flat against the transformer as shown. Refit screw using the metal washers ONLY.
4) Connect wires from the 8962 board as shown.
    a) Red wire to R68 lead
    b) Black wire to earth pin R
    c) White wire to R98 lead
    d) Purple wire to D15 anode
    e) Yellow wire to D12 anode

*CIRCUIT*



# Guarantee

We, Racal Electronics Pty. Ltd., 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 Pty. Ltd. or an authorised vendor at the appropriate prices and terms.
4. Components such as electric bulbs, semiconductors 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 Pty. Ltd.

*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 PTY. LTD., SYDNEY, N.S.W., AUSTRALIA.

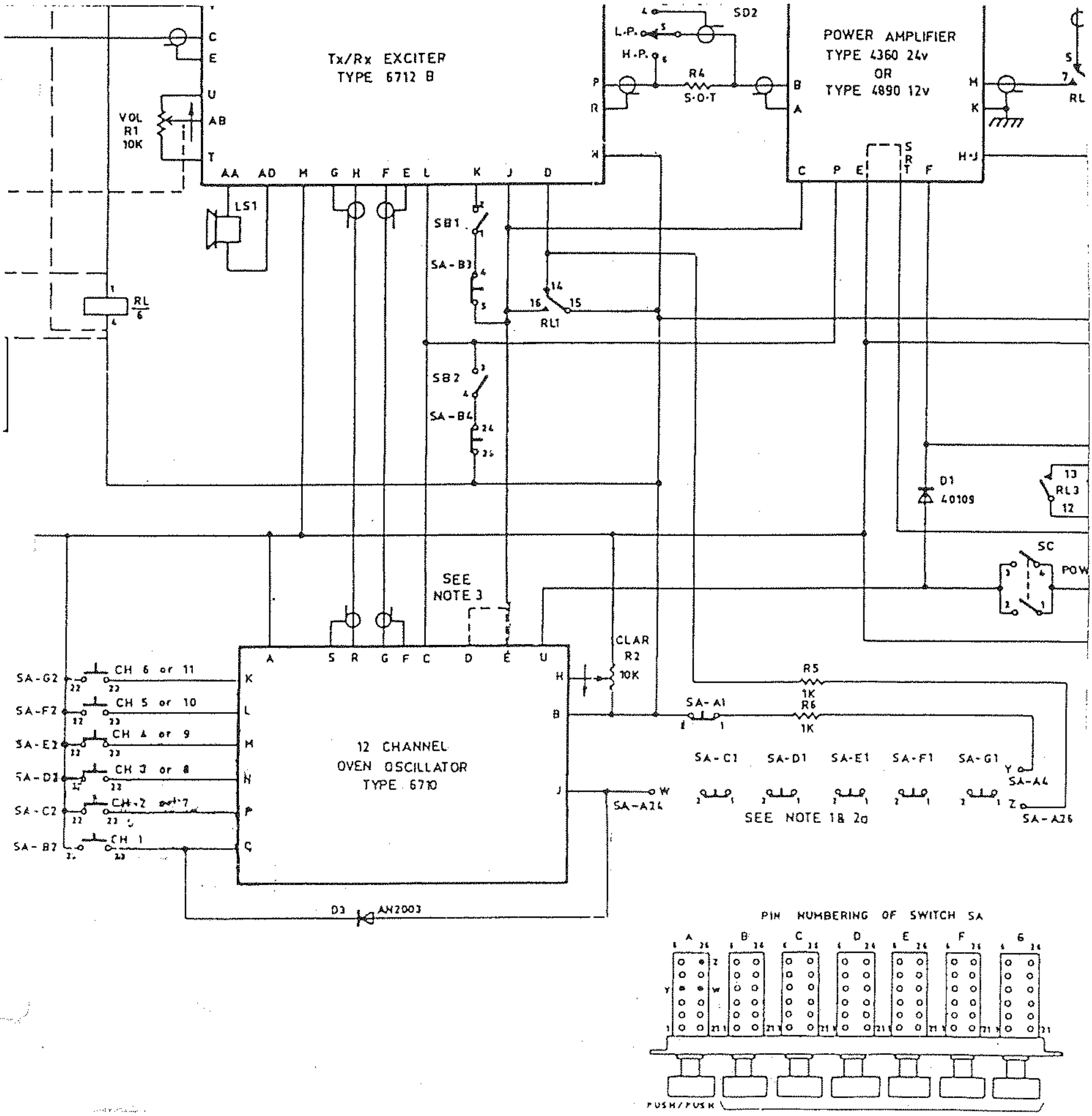
EQUIPMENT : TELERADIO SS90/SS901A

To allow use of H3E or J3E on 2182 kHz

1. Locate channel select switch SA-B.

2. Unsolder wire from pin 4 of switch SA-B2 and resolder to pin 5.

3. Unsolder wire from pin 24 of switch SA-B4 and resolder to pin 25.



EQUIPMENT : TELERADIO SS120A

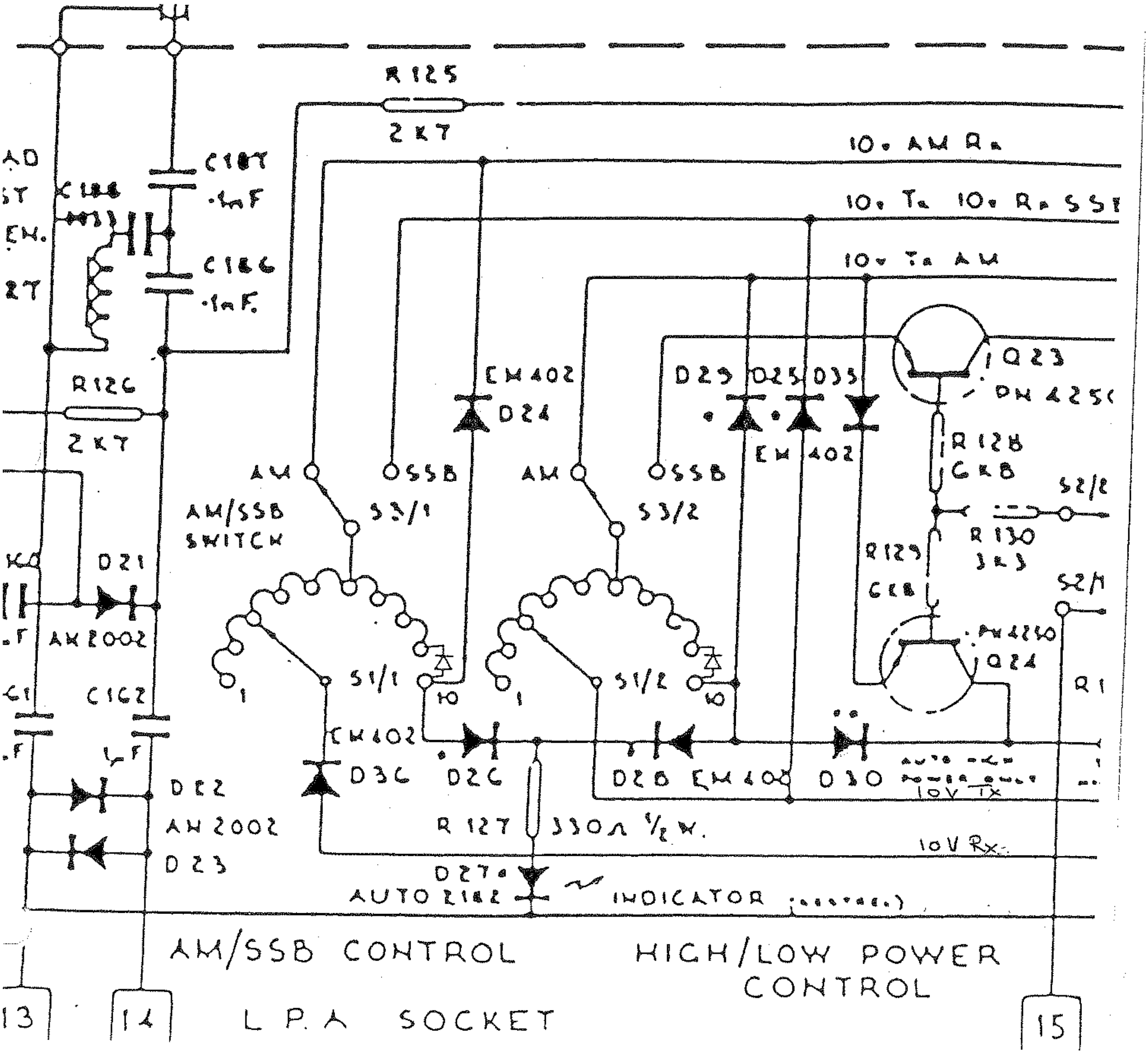
To allow use of H3E or J3E on 2182 kHz

1. a) Locate diodes D24, D29 and D30 on main baseboard.

   b) Remove and discard above diodes.

2. a) Locate channel select switches S1/1 and S1/2.

   b) Fit diodes (EM402 or equivalent) between contacts 9 and 10 on switch wafer S1/1 and S1/2. (Cathode on contact 9)

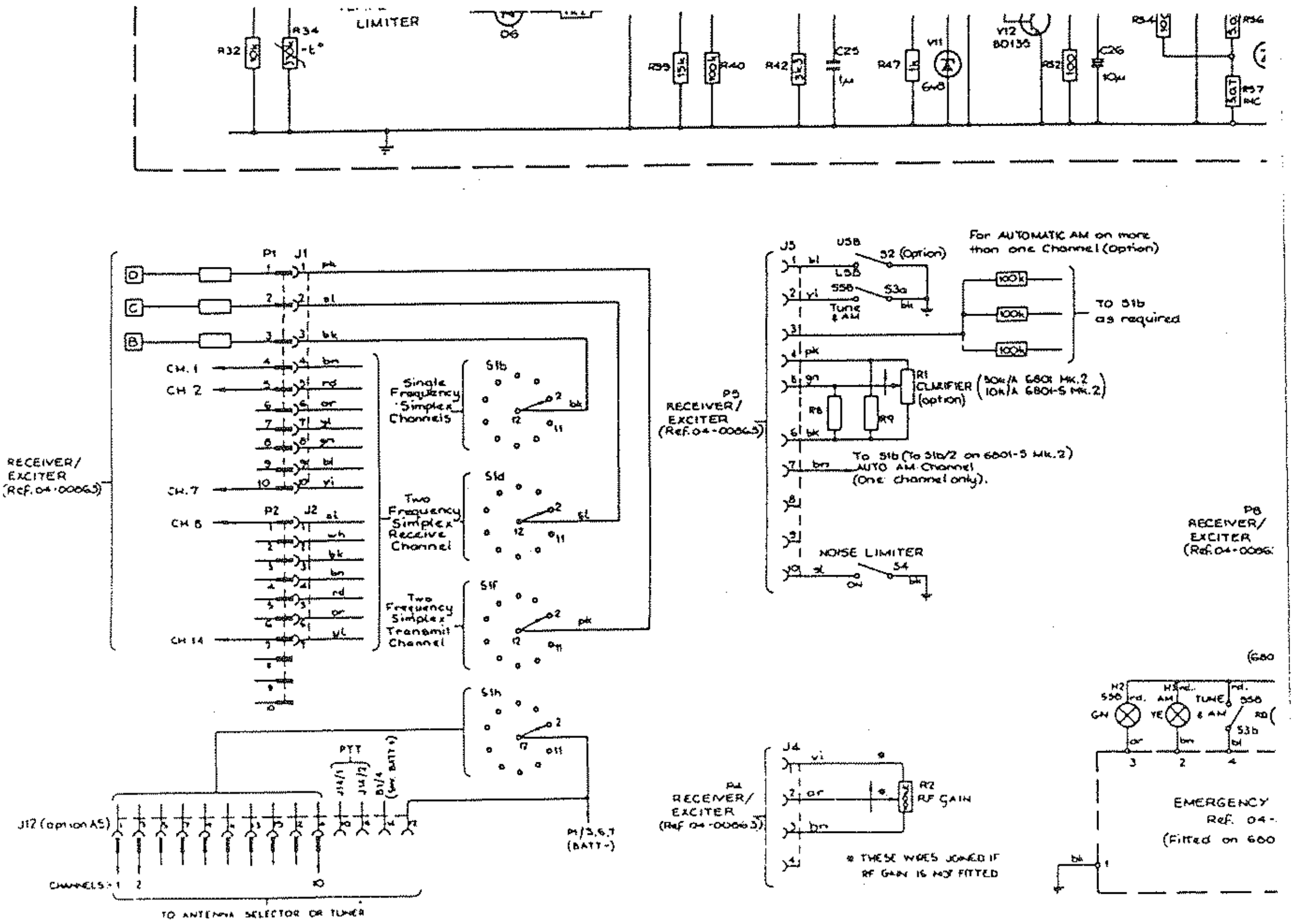


EQUIPMENT : CODAN 6801

To allow use of H3E or J3E on 2182 kHz

1. Locate channel select switch S1b (S1b2 on 6801-SMk2). Trace brown wire going from S1b to Pin 7 of plug P5 and isolate wire. (Note: S1b is the first wafer, counting from front of set)

2. Locate Flasher board. Remove and discard diode D1.



PCM electronics Pty.Ltd. Made in AUSTRALIA Pt/No 13802

| CHANNEL | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| TX FREQ. | | | | | | | | | | |
| RX FREQ. | | | | | | | | | | |
| TUNE | | | | | | | | | | |
| MATCH | | | | | | | | | | |
| USE | | | | | | | | | | |

electronics Pty.Ltd. Made in AUSTRALIA Pt/No 13802

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CHANNEL | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| TX FREQ. | | | | | | | | | | |
| RX FREQ. | | | | | | | | | | |
| TUNE | | | | | | | | | | |
| MATCH | | | | | | | | | | |
| USE | | | | | | | | | | |

EQUIPMENT : TELERADIO SS75A

To allow use of either H3E or J3E on 2182 kHz

1. Locate channel select switch wafers 2 and 3. (Count switch wafer sections from front of set)
2. Locate switch wafer segment as indicated on diagram below.
3. Cut indicated wires and reconnect switch wafer segment as shown. (Note: Components and wires found on SWA-2F should be connected together and left floating)