Professionals in communication

MAINTENANCE HANDBOOK

for

KESTREL & HAWK SSB TRANSCEIVERS

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CONTENTS

1. SPECIFICATION

1.1 TRANSCEIVER

SYSTEM:	Single Frequency Simplex Two Frequency Simplex Capability (Up to 20 Frequencies)
FREQUENCY RANGE:	2 - 12 MHz
FREQUENCY ACCURACY:	Within 50 Hz, 0^{o} to 60^{o}C
MODES:	<u>KESTREL</u>: A3H, A2J and A3J (Automatic A3H only on 2182 KHz) <u>HAWK</u>: A3J and optional A3H
POWER INPUT:	Nominal 24V DC (25.2V ± 10%) or " 12V DC (13.2V ± 10%)
POWER CONSUMPTION:	180 - 250mA (Receive) either on 12V or 24V 9A Average, 12A Peak (Speech - 130W) 24V 18A Average, 23A Peak (Speech - 130W) 12V
SIZE:	Width 270mm Height 105mm Depth 356mm
LOAD IMPEDANCE:	50 ohms
WEIGHT:	5.68kg

1.2 RECEIVER

SENSITIVITY:	0.5uV (Typical 0.14uV) in 50 for 10dB (S & N)/N (SSB) 2uV (Typical 0.6uV) in 50 for 10dB (S & N)/N (AM) at 30% Modulation Input fully protected
CLARIFIER:	<u>KESTREL</u>: ± 150Hz (NOM) <u>HAWK</u>: ± 25Hz
SELECTIVITY:	2.5KHz at 6dB, 6KHz at 70dB (SSB) 6 KHz at 6dB, 30 KHz at 65dB (AM)
IF FREQUENCY:	1650 KHz
A.G.C.:	Audio increase 3dB for 70dB increase in signal from 2uV
AUTOMATIC NOISE LIMITER:	Rejects noise spikes in excess of 3dB of average audio.
AUDIO OUTPUT:	5W at better than 5% THD in 3Ω (12V) 5W at better than 5% THD in 15Ω (24V)

1.3 TRANSMITTER

POWER OUTPUT:	<u>SSB</u>:	<u>AM</u>:
	50W	35W
	100W	70W
	130W	85W

MODULATION CONTROL:	Derived from the output of speech amplifier. An increase in input level of 20dB will not cause output level to vary by more than 1dB.
CARRIER SUPPRESSION:	-45dB below PEP
INTERMODULATION PRODUCTS:	-30dB at 130W (3rd order)
UNWANTED SIDE-BAND SUPPRESSION:	-45dB below PEP
SPURIOUS OUTPUT:	-55dB below PEP
MICROPHONE:	Dynamic microphone designed for mobile communication use.
KEYED MODULATOR: (if fitted)	2 KHz
PROTECTION:	The transmitter is capable of operating into an infinite VSWR load at full rated power for at least 2 min.

1.4 ANTENNA TUNING UNITS

AK 100 (AUTOMATIC):	Designed to match any physically realisable antenna.
NUMBER OF CHANNELS:	10, selected automatically when changing channels on set. Pre-tuned at installation.
ATU (MANUAL):	Tunes any antenna under quarter wave, and suitable capacitors may be fitted to extend the tuning range.
	Meter indication of tuning.

1.5 ACCESSORIES

Universal Mounting Assembly
Hand held Microphone with Clip

1.6 OPTIONAL ACCESSORIES

Low Profile Mounting Bracket

Morse Key

Headset

AC Power Supply Unit 24V or 12V from 240V or 115V

Ext. Microphone

Ext. Loudspeakers (Horn or Boxed)

Whip Antenna

RFDS 2 Tone Encoder

Tone Call

20 Freq. Module

Muting

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2. GENERAL DESCRIPTION

2.1 MANUAL

This manual contains the necessary information for maintaining the Kestrel and Hawk HFSSB communications equipment. The manual includes a general description of the equipment, theory of operation, installation information and maintenance procedure.

2.2 EQUIPMENT

The SSB range of transceivers covers applications in the land mobile/land base and marine mobile/marine base communications in the frequency range of 2 to 12 MHz in up to 20 crystal controlled channels specified by the user.

The units are capable of transmitting and receiving in both SSB (A3J), Compatible AM (A3H) and Keyed Audio (A2J) modes.

2.3 MODEL TYPES

The current model numbers are as follows:-

<u>KESTREL</u>

1. 12V 50W Marine Transceiver SSB061M/12
2. 12V 130W Marine Transceiver SSB131M/12
3. 24V 50W Marine Transceiver SSB061M/24
4. 24V 130W Marine Transceiver SSB131M/24

<u>HAWK</u>

5. 12V 50W Land Transceiver SSB061L-12
6. 12V 100W Land Transceiver SSB101L-12
7. 24V 50W Land Transceiver SSB061L-24
8. 24V 100W Land Transceiver SSB101L-24

NOTE: All marine models are supplied with automatic AM on emergency frequency 2182 KHz and with two frequency simplex capability.

All models are supplied with 10 frequency channelling, but may be extended to 20 channels either on initial order or at a later date.

2.4 PHYSICAL DESCRIPTION

All models are housed in an anodised extruded aluminium case. The front panel has shock absorbing facia and recessed controls. Dimensions and weights are shown in the specifications. Each unit is divided into two basic sections, i.e. the main circuit base board and the rear linear power amplifier panel. These two sections are interconnected by a plug and socket arrangement which ensures reliable connections, ease of testing, maintenance and replacement of either section, if required. The main circuit board is supported on two 'H' section diecast rails. Small physical size and low overall weight have been achieved by using solid state techniquest throughout the entire unit.

2.5 OPTIONAL EQUIPMENT

2.5.1 Morse Key

An enclosed Morse Key can be provided to operate a tone generator and transmit-receive control module which is encased within the transceiver (special order only).

2.5.2 Headset (Earphones)

These can be provided to fit a standard phone jack socket which should be specified when ordering a transceiver (or may be fitted later at a small extra charge) in place of the extension speaker-socket.

2.5.3 AC Power Supply Units

These are available for both 12V and 24V transceivers, and full details can be found in separate manuals.

2.5.4 Extension Microphone and/or Loudspeaker

These are both available ready to plug in on marine sets, and to special order on land models. Lead lengths should not exceed 100 feet without obtaining advice from the factory. Special shielded cables are required.

2.5.5 Antennas

A large variety of antennas is available, and further guidance on suitable types may be found in the section on installation in this manual.

2.5 OPTIONAL EQUIPMENT (Continued)

2.5.6 RFDS Alarm

This self-contained accessory is an invaluable aid in securing help in an emergency in outback areas of Australia. It is recommended to be fitted to all sets intended for use with Royal Flying Doctor Service base stations. For details see Section 12.

2.5.7 Tone Call

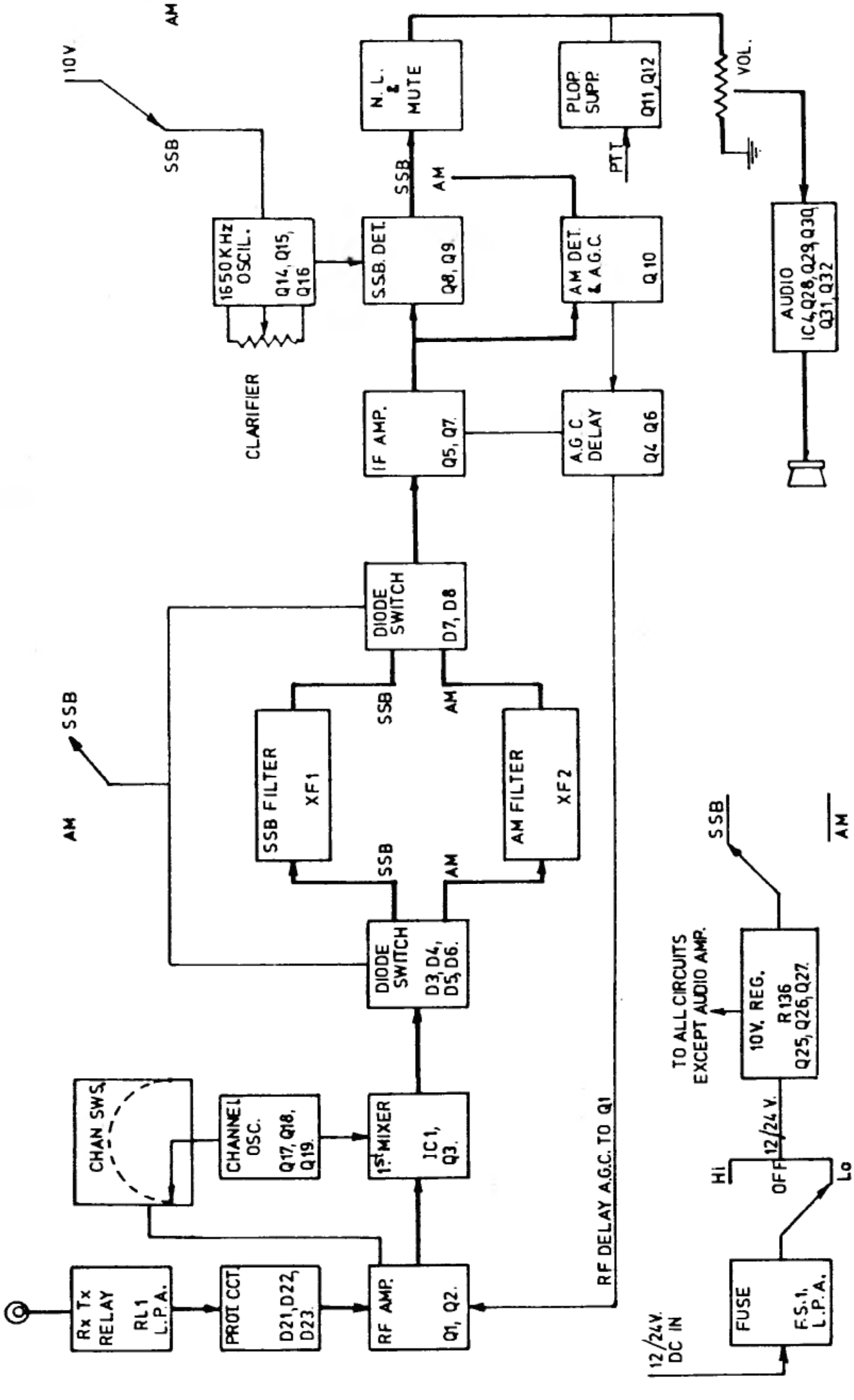
This may be added to existing sets or ordered as an extra facility with new equipment. It allows the receiver to be left in a noiseless condition until an incoming signal from another similarly equipped set turns it on. For full details see Section 11.

2.5.8 20 Frequency Module

This addition to our range has been developed to enable a large number of dual frequencies now in use by marine coast stations to be accommodated in one transceiver. Additional switching may be used to enable two simplex frequencies to be fitted to each channel on an existing set. For details see Section 9.

2.5.9 Muting

This may be fitted to any Hawk or Kestrel model and enables the set to be left running silently. Reception of speech or speech like signals switch-es on the receiver.



PCM Drg. No. 13889

FIGURE 3.2 RECEIVER BLOCK DIAGRAM

3. THEORY OF OPERATION

3.1 GENERAL

The operating frequency is selected from the installed channels by the channel knob as required. This simultaneously selects the local oscillator crystal and the correct tuned circuits in the RF amplifier and RF filter.

When an auto antenna tuner is being used the correct antenna matching network is also selected.

When the operating mode, as selected by the mode switch, is SSB the SSB crystal filter is switched into the circuit and the audio output is taken from the product detector. If the operating mode is AM, the AM crystal filter is switched into the circuit and the audio output is then taken from the AM envelope detector.

The crystal locked carrier oscillator (1650 KHz) is used to transmit and receive for SSB but only on transmit for AM.

The antenna system is connected to the RF filter only on transmit. This serves as a low pass filter to attenuate harmonics of the signal frequency which appear at the output of the linear power amplifier (LPA).

A different network may be used in the filter for each channel and is optimised in performance for that channel.

3.2 RECEIVE MODE

Refer to Block Diagram opposite

During Receive operation, the antenna is connected via the antenna change-over relay (RL1) to the RF amplifier.

Signals, on the selected channel, received by the antenna are amplified by the RF amplifier and fed to the first mixer via relays RL2 and RL3. Also fed to the first mixer, via RL5, is the output of the crystal locked channel oscillator.

The first mixer produces an output comprising the sum and difference of the local oscillator and the input frequencies. The channel oscillator is always 1650 KHz above the selected input channel frequency and therefore only the difference output from the mixer is required. THis is selected by a tuned circuit on 1650 KHz and fed into the 1650 KHz SSB or AM filter.

The output signal from the crystal filter is amplified by the two stage intermediate frequency amplifier.

Primary RF AGC is supplied from the AM detector and controls the overall gain of the first IF amplifier Q5. Delayed AGC is also fed to the receiver RF amplifier.

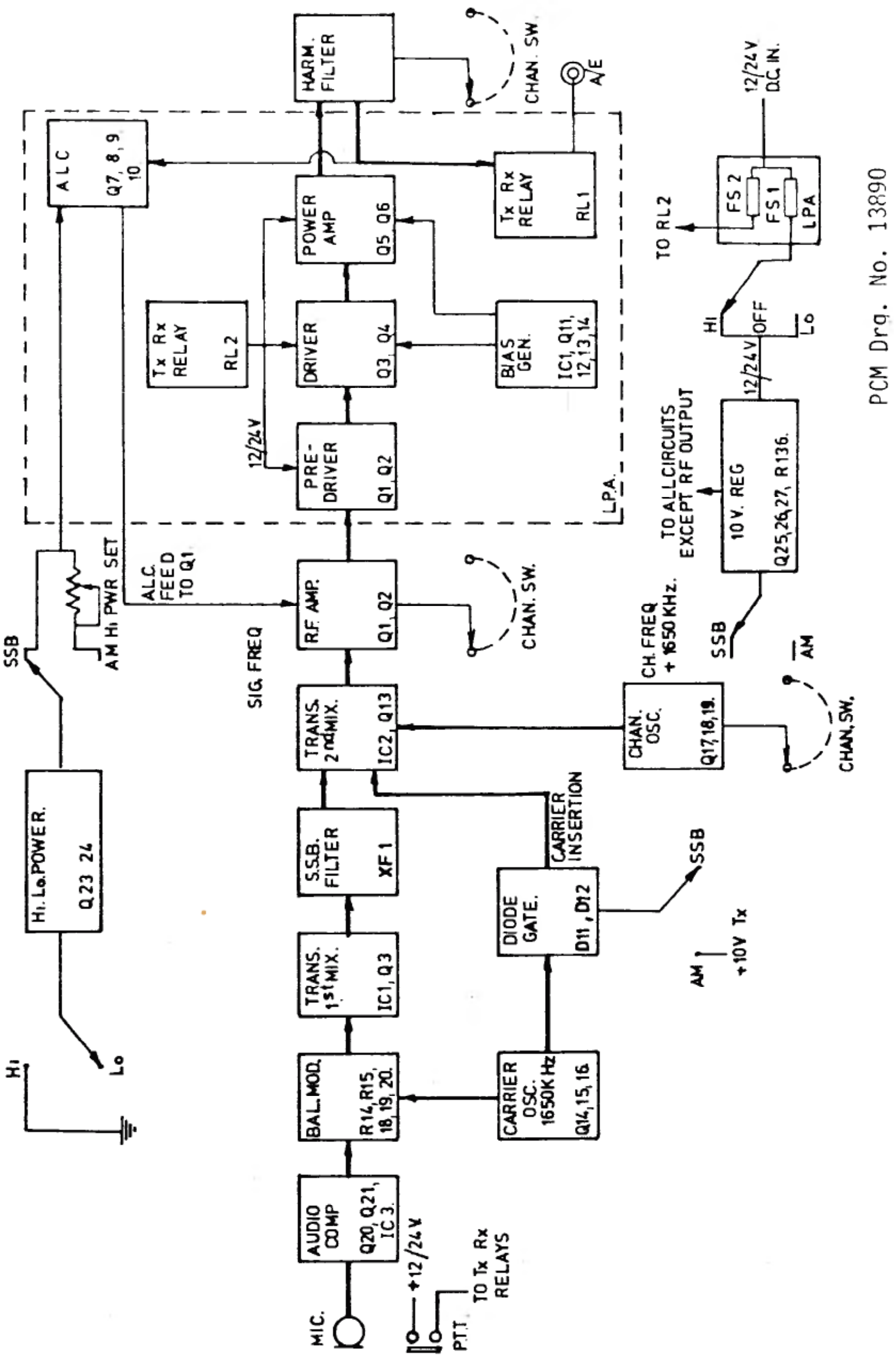


FIGURE 3.3 TRANSMITTER BLOCK DIAGRAM

3.2 RECEIVE MODE (Continued)

The audio output from the product detector (on SSB) or envelope detector (on AM) is fed to the audio amplifier via the mute circuit (if fitted) and the volume control. On earlier sets to approximately S.No.3500, a noise limiter was fitted in conjunction with the mute.

3.3 TRANSMIT MODE

Signals from the microphone are amplified by the audio compressor amplifier and fed to the transmitter first mixer via RL3. Also feeding the first mixer, via RL5, is the 1650 KHz carrier oscillator. The transmitter first mixed now functions as a double sideband suppressed carrier (DSBSC) modulator with an output of 1650 KHz which is fed to the SSB crystal filter. The SSB crystal filter has only sufficient bandwidth to pass one sideband, thus the DSBSC signal becomes a single sideband suppressed carrier (SSBSC) signal.

The signal appearing at the output of the crystal filter is fed to the transmitter second mixer where it is mixed with the signal from the channel oscillator. The resultant output signal is fed to the input of the RF amplifier via RL1.

The tuned circuits at the inputs of the RF amplifier select the difference signal which is then amplified and fed to the LPA.

Automatic load control (ALC) is developed in the LPA assembly to provide a constant RF output level. The ALC control voltage is fed to the RF amplifier Q1 control gate via a common AGC-ALC line as the RF amplifier is common to receive and transmit.

3.4 POWER DISTRIBUTION

A 10V regulated supply is used throughout the transceiver, exceptions being the audio amplifier, linear power amplifier, microphone press-to-talk (PTT) facility and the remote antenna tuning unit which use the main supply. The power amplifier biasing circuitry, however, utilizes the regulated supply.

3.5 FUSES: RATING AND ACCESS

Remove the 4 heatsink retaining screws and unplug the power amplifier assembly, or remove two screws and the cover leaving the LPA assembly on the set.

The fuse holders are located on the upper edge of the LPA assembly above the in-line PC socket.
Fuse rating are as follows:-

1. Receiver Fuse (FS1) 2A Type 3AC or 3AG
2. Transmitter Fuse (FS2)

50W	12V	15A Type 3AC or 3AG
100W/130W	12V	20A Type 3AC or 3AG
130W	24V	15A Type 3AC or 3AG

NOTE: Do not replace fuses with types other than specified.

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4. CIRCUIT ANALYSIS

4.1 RECEIVE MODE

Channel switch S1/5 connects the antenna input from the LPA through RL1 to the RF amplifier input tuned circuit. The split capacitor network across the coil assembly provides the necessary 50 ohm antenna matching impedance and thus correct loading and bandwidth of the tuned circuit.

Output from L1 is selected by S1/6 and is fed to gate 1 of Q1 via a 0.01uF (C22) coupling capacitor.

During the receive mode the voltage on gate 2 of Q1 is derived from the RF delayed AGC and can be measured at test point 22 (TP22). The source of Q1 is held slightly positive by the divider network R2 and R4, ensuring the gate 2 to source voltage is negative when AGC voltage is reduced to zero, thus extending the control range of the AGC.

Channel switch S1/7 selects Q1 output tuned circuit (L11-L20). Bandwidth and constant gain with frequency is achieved by the use of a single 680pF (C25-C35) capacitor together with the parallel resistors R7 and R9.

Buffer amplifier Q2 provides an output impedance of 100ohm and a voltage gain of -1.5. The output signal of Q2 can be monitored at TP2.

4.2 RECEIVER FIRST MIXER

The integrated circuit used is a double balanced mixer. Signal frequency is fed between pins 1 and 4 and is mixed with the channel oscillator signal fed to pins 7 and 8. Because the channel oscillator is 1650 KHz higher than the signal frequency a resultant IF output signal of 1650 KHz is produced.

Signal frequency level to the mixer can be monitored at TP3 and the channel frequency injection level can be monitored at TP4. Overall gain of the mixer is determined by the ratio of R24 added to the internal resistance of IC1, to the divider network R29 and R30 and the dynamic impedance of L22.

On receive, L22 serves as a low impedance load to the input signal frequencies and provides additional rejection of the input signals to the mixer.

Q3 buffer gives the necessary low impedance drive for the crystal filter matching network.

Output level of Q3 can be monitored at TP5.

4.3 NOISE BLANKER

When fitted, the noise blanker is interposed between the first mixer and the crystal filters.

Its operation is basically to detect pulses of noise of greater than about twice average signal voltage and use the derived pulses to blank the incomming signal ahead of the crystal filters.

By using a high Q signal path, the incomming IF signal is delayed in its passage through the unit for long enough that the blanking pulses (derived from a low Q circuit) reach the output signal gates soon enough to prevent the passage of the signal to the crystal filter for the duration of the interfering pulse.

Certain types of receiver interference such as ignition pulses in mobile receivers are thus greatly reduced or eliminated.

4.4 FILTERS

On receive, the 8 pole crystal lattice filter provides adjacent channel rejection at the correct bandwidth. Nominal bandwidths for the filters are SSB - 3 KHz and AM - 6 KHz. The correct filter for SSB or AM is selected by the diode switching matrix D3 to D8.

The operation of the diode switching is as follows:-

On SSB, 10V DC is applied to R33 and R37 causing current to flow through D3, R32, D4 and R34 and the internal input transformer of the filter. D3, D4 and D7 are therefore in a low resistance state or 'ON'. Since no voltage is applied to R35 and R38, D5, D6 and D8 are 'OFF'. Thus the AM filter is isolated from the signal path.

When the AM function is selected, the 10V Rx AM line is switched to R35 and R38 resulting in D5, D6 and D8 being swithced 'ON' and D3, D4 and D7 'OFF'. The diode matrix circuitry also provides the correct matching networks at the input and output of the filter.

Although the filter selects the lower sideband (LSB) the receiver tunes to the upper sideband (USB) due to the channel oscillator being higher in frequency than the signal frequency.

Input signal level at the filter can be monitored at TP20 and the output at TP6.

4.5 IF AMPLIFIER AND DELAYED AGC

Dual gate mosfets Q5 and Q7 are utilized as intermediate amplifiers on 1650 KHz. The tuned circuit load of each stage provides maximum gain together with some selectivity. The first stage (Q5) is AGC controlled on gate 2. The source of Q5 is held above ground to allow a negative gate 2 to source voltage to be established at high signal levels thus increasing the AGC range. Q4 acts as an AGC amplifer and responds to an increase in voltage on its base to provide the control voltage for gate 2 of Q5. As the gain is reduced, the drain current of Q5 is reduced to almost zero. This current change is sensed by Q6 which turns 'OFF' when the drain current is almost zero and provides the required RF AGC voltage. D9 provides compensation for the base emitter voltage of Q6 with variations in temperature.

The delay in RF AGC operation is necessary to prevent RF gain being reduced when the signal is comparatively weak. RF gain is kept as high as possible on weak signals to ensure good signal to noise performance, but is reduced on strong signals to prevent overloading occurring. IF output can be monitored at TP7.

4.6 SIGNAL AND AGC DETECTORS

The signal detectors comprise Q8 and Q9 in a balanced pair configuration. The IF signal is converted to a current source by R55 feeding the two emitters of Q8 and Q9. In the SSB mode, the carrier oscillator injection is fed to Q8 base and alternatively switches Q8 and Q9 'ON'. The function of the transistor pair is therefore a product detector, the output being an audio signal corresponding to the received SSB signal.

Filtering of the carrier oscillator IF frequencies from the audio signal is achieved by C75 and the capacity of the shielded audio cables. Detected audio is then passed via RL4 to the noise limiter and mute circuit (if fitted) and subsequently to the volume control and the main audio amplifier.

Transistor Q10 serves as the detector during the AM mode of reception. Under no signal condition Q10 is biased just beyond cutoff. D10 provides temperature compensation for the base emitter voltage of Q10. The divider network R57 and R59 ensures that the transistor is biased at the correct point and therefore sets the detector gain.

Output signal of Q10 is a current proportional to the negative half of the waveform as seen at TP7 and hence when averaged out with C77 becomes proportional to the average signal at the audio rate. The detected audio from the collector is directed via RL4 to the noise limiter and following circuitry in the same way as SSB derived audio.

Further filtering of Q10 collector current by C78 produces an average at a much slower rate and the result is proportional to the average signal level. This voltage is used for the AGC circuitry.

4.7 RECEIVER AUDIO AMP.

The receiver audio amplifier comprises IC4 and Q28 through Q32 and is powered from the 24 or 12V unregulated supply rail.

The audio input is coupled via C165 to the non-inverting input of IC4 (pin 3). DC bias is set by the by-passed divider chain R139, R140 and R141 at half the supply voltage. The output of IC4 drives the complementary drivers Q29 and Q30 which, in turn, provides a current drive to the complementary output pair Q31 and Q32.

Overall feedback is applied via R142. Because of the presence of C167, DC gain is unity, so that the DC output voltage at TP18 follows the reference voltage on pin 3 of IC4. The AC gain is set by the ratio R142 to R150 and is 100 times.

Q28 with R143, R144 and R145 ensure that both driver and output pairs are slightly forward biased for Class B operation.

4.8 TRANSMITTER AUDIO COMPRESSOR

Audio input from the microphone is fed via RL6 to pin 3 of IC3, the microphone amplifier. RL6 is utilized for local and remote microphone facilities when this feature is fitted. The local microphone will always override the remote installation.

Q20 detects the audio signal and feeds the resultant output to Q21 which acts as a variable resistor controlling the overall gain of IC3. Thus, a constant audio output level is achieved which may be monitored at TP13. Shaping of the audio bandwidth is performed by C119 and C120 while C118 and R114 control the variable feedback coupling.

4.9 TRANSMITTER FIRST MIXER

IC1 has a dual function. As well as being the receiver first mixer, it is also utilized as the transmitter first mixer (balanced modulator).

The transmitter audio is fed via RL3 to pin 1 of IC1 while the carrier oscillator signal of 1650 KHz is injected into pin 7 via RL5. To achieve the required carrier rejection, overall balance of the mixer is important. This fine balance is accomplished by R20. Due to the signal applied to pin 1 being much lower in frequency in the transmit mode, the gain is now determined by R25 rather than R24. The resultant DSBSC signal can be monitored at TP5 at the buffer Q3 emitter. This DSBSC signal is then directed through the SSB filter in both SSB and AM modes of transmission.

The SSB filter is used in both modes of transmission but in the receive mode the SSB or AM filters are used as appropriate.

On AM transmit, the A3H mode is used. This signal comprises carrier plus one side band and is therefore compatible AM, and is able to be received on DSB transceivers.

4.10 TRANSMITTER SECOND MIXER

From the filter, the 1650 KHz SSB signal is directed to pin 4 of the transmitter second mixer IC2. This signal level can be monitored at TP10. Also injected into pin 7 of IC2 is the channel oscillator frequency. The sum and difference frequencies of the channel oscillator and the 1650 KHz signal are fed to the base of the buffer amplifier Q13.

When the AM mode of transmit is used, 10V Tx AM is applied to the junction of D11 and D12, forward biasing them. The carrier oscillator on 1650 KHz is fed to D11 and D12 through the voltage divider R82 and R83. When D11 and D12 are switched 'ON' the 1650 KHz signal is coupled to the signal input of IC2 (pin 4) via R78, the AM carrier insertion level control.

Output is taken from the emitter of Q13 and fed to Q1 RF amplifier via RL1. The output level at this point can be measured at TP9. It is at this point that the difference frequency is selected from the two signals which were fed into the transmitter second mixer.

As in the receive mode, Q1 acts as a controlled linear amplifier at the desired signal frequency. The output from buffer Q2 is fed to the LPA via RL2, R155 and T1.

4.11 REC. AND TRANS. CHANNEL OSCILLATOR

The channel oscillator Q19 operates in a Colpitts configuration. Transistor Q16 acts as a buffer before the signal is fed to IC1 on receive or IC2 on transmit. Q18 is utilized in a feedback mode to produce a constant output at TP12. When the AC voltage on the base of Q18 increases, Q18 conducts, increasing the current through R108 and reducing bias voltage on Q19 thus reducing the oscillator amplitude.

4.12 CARRIER OSCILLATOR

Operation of the carrier oscillator is identical with that of the channel oscillator with the exception of the clarifier circuitry.

The main element of the clarifier circuit is D13. This diode is a variable capacitor type and is connected in series with the carrier oscillator crystal X1.

On receive, the 10V Rx line is connected to R95 and forward baises D14, thus applying a positive voltage through R96 to the cathode of D13. This variable DC voltage alters the bias on D13 and therefore the series capacitance of the carrier crystal. This enables the oscillator to be changed in frequency by approximately ±100Hz in Kestrel, and ±25Hz in Hawke models.

In the transmit condition, the 10V Tx supply is connected to R98 and forward biases D15, which applies the voltage to the varactor circuitry. As it is desired to hold the transmitter frequency constant, a voltage divider network consisting of R97, R99 and R100 provides a preset DC voltage whilst on transmit.

4.13 10v. REGULATOR

The 10V regulator supply is used throughout the transceiver with the exception of the audio amplifier, LPA, microphone PTT facility and the remote antenna tuning unit. The 10V regulator, however, is used on the LPA bias circuitry.

Regulator reference is set by D31, a 5.1V zener diode, which sets the emitter voltage of Q27. The output voltage is sensed by the divider network consisting of R135, R136 and R137. Temperature compensation is provided by D33 and D34.

Variable resistor R136 is the regulator output voltage trimmer. A sample of the output voltage is fed to the base of Q27, the output of which drives the base of Q26 providing a current source to the base of Q25, the main series regulator.

The LED D32 will indicate when sufficient voltage exists across the regulator for normal transceiver operation.

4.13 10v. REGULATOR (Continued)

The function of SCR1 (fitted in 24V sets only) is to act as a fuse blower (FS1 in LPA) should a regulator defect arise and allow the 10V rail to rise above a safe level (approx 15V). It is controlled by D40 and R160.

4.14 'PLOP' SUPPRESSOR

Because the receiver audio amplifier is powered both in the receive and in the transmit modes, small differences in operating time of the relays in the set can cause an audible 'plop' in the loudspeaker when changing from receive to transmit or transmit to receive.

The FET Q11 is connected across the volume control R138. In the receive mode, Q12 is 'OFF' and C80 is charged to +10V turning Q11 'OFF'. When the push-to-talk button is operated, Q12 receives bias via R65 and turns 'ON', pulling the gate of Q11 down to 1V or less. Q11 is then 'ON' and its drain-source channel appears as a low resistance, shunting the audio and blanking the receiver. This occurs before any relays operate. When the push-to-talk button is released, Q12 turns 'OFF' and C80 charges towards +10V, the time constant being determined by R63 and C80. Q11 turns 'OFF' after about 100mS, i.e. after transmit-receive relays have released.

4.15 HARMONIC FILTER

L25 and L26 and C124 to C133, C135 to C144 and C145 to C154 comprise the harmonic filter. The filter is a 5 pole Chebyshev type and on any fitted channel comprises two series inductors and three shunt capacitors. The filter is designed to provide correct matching of the power amplifier to the 50 ohm antenna outlet and, at the same time, provide large attenuation of harmonic frequencies, particularly the second and third harmonics. The 2 to 12 MHz band is divided into 10 bands, each with a ratio of highest to lowest frequency of about 1.2:1. Depending upon which band the assigned frequency falls, the appropriate inductor taps are selected by links installed under the main board between the tap and the appropriate switch contact. The correct capacitors must be installed on the filter sub-board between the switch contacts and filter ground. (See Section 10).

4.16 OPERATION OF AUTOMATIC HIGH POWER AND AUTOMATIC AM FUNCTIONS

Automatic high power and automatic AM functions are fitted as standard on the Kestrel units to fulfil marine specifications.

The output PEP is controlled by the reference voltage appearing on pin 5 of the LPA connector. When the voltage supplied from the main board to pin 5 is high, the full PEP, as set by the 'HI' trimpot on the LPA, is available. When pin 5 is allowed to float, the power output is reduced to that set by the 'LOW' trimpot on the LPA. When pin 5 is supplied from a high voltage via R131 the power output is reduced below the maximum PEP set by the 'HI' trimpot.

Four lines control all the AM/SSB and high/low power functions. These are as follows:-

1st The receive AM filter and detector are selected by the 10V Rx AM line, which is supplied from the main 10V Rx line via D36 and either A1/1 and S3/1 position 10 and D24. A control voltage is therefore present on the 10V AM Rx line in the receive mode either when S1/1 is in position 10 or when S1/1 is in positions 1 through 9 and S3/1 is in the AM position.

2nd The SSB filter is selected by the 10V Tx, 10V Rx SSB line, which is supplied from the 10V Tx line via D25, or from the 10V Rx line via D36, S1/1 (positions 1 through 9) and S3/1 when in the SSB position. A control voltage is therefore present either in the transmit mode, or in the receive mode channles 1 through 9 when the SSB mode is selected.

3rd Carrier insertion for the Tx AM mode is controlled by the 10V Tx AM line, which is supplied from the 10V Tx line either via S1/2 (positions 1 through 9) and S3/2 (AM position) or through S1/2 (Position 10) and D29. A control voltage is therefore present in the Tx mode when either S1/2 is in positions 1 to 9 and the AM mode is selected, or when S1/2 is in position 10 irrespective of the mode selection.

4th Control of PEP is carried out by the ALC REF line, which is supplied in one of three ways as follows:-

i) If S1/2 is in any position 1 through 9, and S3/2 is in the SSB position, Q23 emitter is supplied with voltage from the 10V Tx line and, since no voltage will be present on the 10V Tx AM line, then no voltage is present either on Q24 emitter or the anode of D30. If S2/2 is in the 'HI' position, Q23 will be turned 'ON' hard and +10V will appear on the ALC REF line, producing the full PEP output for SSB. If S2/2 is in the 'LO' position Q23 will be 'OFF' and the ALC REF line will be connected only via the very high impedance of the 'OFF' Q23, resulting in the low PEP output set on the LPA. Hence for Channels 1 to 9, in the SSB mode, high/low power selection is achieved.

4.16 OPERATION OF AUTOMATIC HIGH POWER AND AUTOMATIC AM FUNCTIONS (Continued)

ii) If S3/2 is now in the AM position, an identical arrangement applies via D35, Q24 and R131, except that R131 permits adjustment of the resistance between the ALC REF and 10V Tx lines. Hence on Channels 1 to 9 in the AM mode, a high power output adjustable by R131 or a low power output with the same PEP as for low power SSB are obtained.

iii) When S1/2 is in Position 10, 10V Tx is applied to the ALC REF line via D30 and R131, so that irrespective of the setting of S2/2, high power AM is obtained.

D26, D28 with R127 and the LED D27 provide indication of selection of the auto function.

4.17 TWO FREQUENCY SIMPLEX OPERATION

The following text describes the operation of a 10 frequency transceiver. When a 20 frequency module has been fitted, read in conjunction with Section 9.

For two frequency simplex operation, the transceiver is required to transmit and receive on different frequencies without utilizing the channel select switch. To accomplish this requirement, various frequency selective components must be switched between transmit and receive due to the 'FULL TRANSCEIVE' operation of many sections of the transceiver.

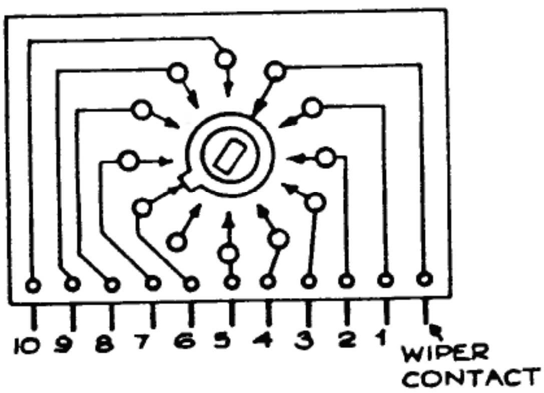

FIGURE 4.17.1 WAFER SWITCH (Copper Side)

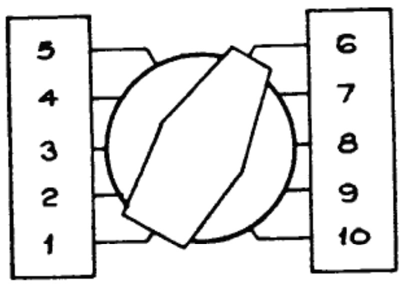

FIGURE 4.17.2 FRONT PANEL CHANNEL SELECTOR

The single frequency simplex operates on 10 channels, each being selected by a bank of single pole - 11 position wafer switches. Positions 1 to 5 correspond to Channels 1 to 5, position 7 to 11 to Channels 6 to 10, with position 6 being a blank contact.

4.17 TWO FREQUENCY SIMPLEX OPERATION (Continued)

In the two frequency simplex operation, a 2 pole - 5 position wafer switch is utilized in the positions with common transmit plus receive frequency elements. RL7 through RL11 ('A-B' relays) are then used to switch the poles of the wafer thus allowing the transceiver to transmit and receive on independent frequencies. (See Figures 4.17.3 and 4.17.4).

The various 'A-B' relay functions are as follows:-

1.	RL7 and 8	RF Amplifier Input (Q1)
2.	RL9	RF Amplifier Output (Q2)
3.	RL10	Channel Oscillator Crystal Select
4.	RL11	Auto ATU Relay Select

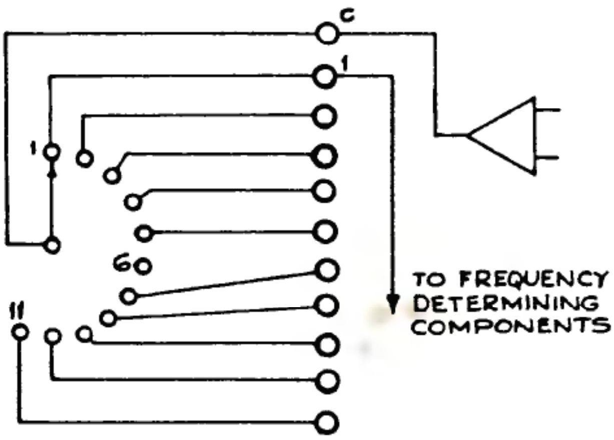

FIGURE 4.17.3 SINGLE FREQUENCY CHANNEL OPERATION

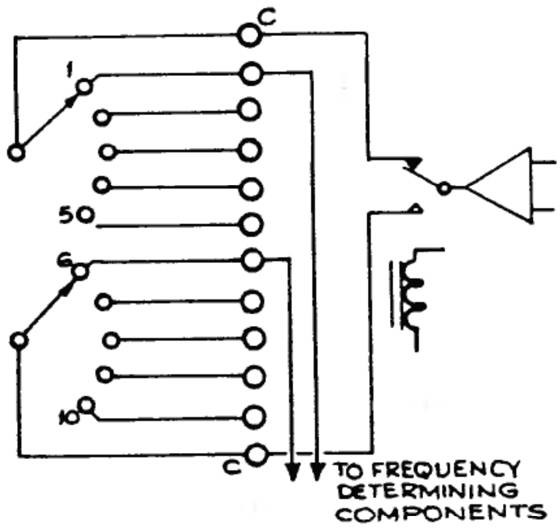

FIGURE 4.17.4 TWO FREQUENCY CHANNEL OPERATION

The control voltage for the 'A-B' relays (10V TR line) is provided from a single pole switch, bank 3 on the channel select switch S2. This provides the control over which channels are single frequency and those that are two frequency simplex. By using this method 10 frequencies in various combinations of single and two frequency simplex are available.

Table 4.17.1 provides an example where Channels 1 and 6 and Channels 2 and 7 are used for two frequency, the remaining channels for single frequency operation.

4.17 TWO FREQUENCY SIMPLEX OPERATION (Continued)

CHAN	RECEIVE	TRANSMIT	'A-B' RELAY STATES
1 2	Two Freq. Chan. 1 Two Freq. Chan. 2	Two Freq. Chan. 6 Two Freq. Chan. 7	Energised on Transmit
3 4 5	Single Freq. Chan. 3 Single Freq. Chan. 4 Single Freq. Chan. 5	Single Freq. Chan. 3 Single Freq. Chan. 4 Single Freq. Chan. 5	Not Energised
6 7	Two Freq. Chan. 1 Two Freq. Chan. 2	Two Freq. Chan. 6 Two Freq. Chan. 7	Energised on transmit
8 9 10	Single Freq. Chan. 8 Single Freq. Chan. 9 Single Freq. Chan. 10	Single Freq. Chan. 8 Single Freq. Chan. 9 Single Freq. Chan. 10	Energised at all times

TABLE 4.17.1

Channels 1 and 6 and Channels 2 and 7 are connected in parallel in the LPA filter and S1/3. This enables the transmitter to operate on either Channel 1 or 6, or Channels 2 or 7.

During two frequency simplex operations, if Channel 1 is a receive channel, then the transmit channel is 5 positions further on, i.e. Channel 6, subsequently it follows that:-

2 Rec. - 7 Trans.

3 Rec. - 8 Trans.

4 Rec. - 9 Trans.

5 Rec. - 10 Trans.

Note that with all the single channels (i.e. 6 and above) the 'A-B' relays are energised.

When the requirement is that an option be provided for receiving on both frequencies of a two frequency operation, this can be accomplished by a minor reconnection of S1 bank 3 as illustrated in Figures 4.17.5 and 4.17.6.

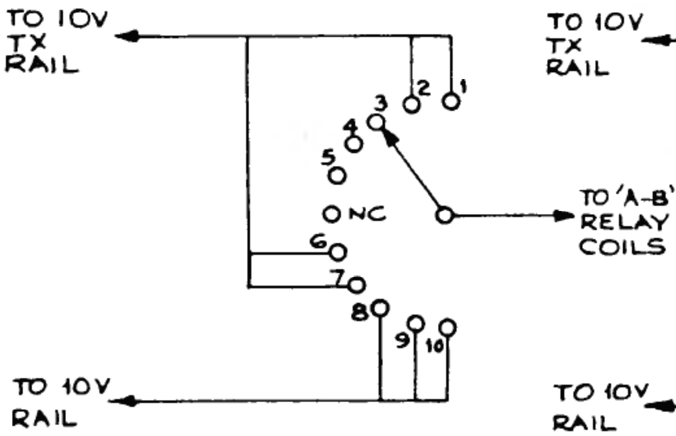

FIGURE 4.17.5

NORMAL TWO FREQ. SIMPLEX CHANNELS 1-6 AND 2-7 AS TWO CHANNEL SIMPLEX

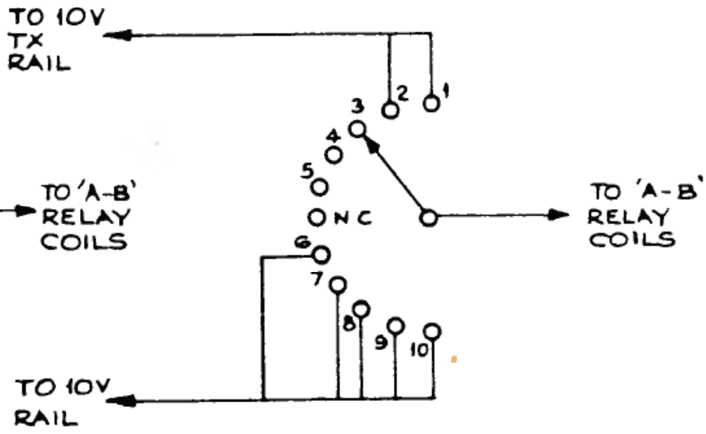

FIGURE 4.17.6

MODIFIED TWO FREQ. SIMPLEX CHANNELS 3,4,5,8,9 & 10 AS SINGLE CHANNEL SIMPLEX

During the normal two frequency simplex operation (see Figure 4.17.5) the 'A-B' relays are energised with the operation of the PTT facility when the channel switch is in the two frequency simplex position.

With modified connections (see Figure 4.17.6) the transceiver operates in an identical manner with the channel switch in the Chan 1 or Chan 2 position, but in the corresponding Chan 6 and Chan 7 position, it operates in a normal simplex, i.e. receives on the transmit frequency.

CHAN	RECEIVE	TRANSMIT	'A-B' RELAY STATE
1 2	Two Freq. Chan. 1 Two Freq. Chan. 2	Chan. 6 Chan. 7	Energised on Transmit
3 4 5	Single Freq. Chan. 3 Single Freq. Chan. 4 Single Freq. Chan. 5	Chan. 3 Chan. 4 Chan. 5	Not Energised
6 7	Single Freq. Chan. 6 Single Freq. Chan. 7	Chan. 6 Chan. 7	Energised on Transmit
8 9 10	Single Freq. Chan. 8 Single Freq. Chan. 9 Single Freq. Chan. 10	Chan. 8 Chan. 9 Chan. 10	Energised at all times

TABLE 4.17.2

4.18 LINEAR POWER AMPLIFIER ASSEMBLY, 12v.

4.18.1 BUFFER AMPLIFIER

The input buffer stage provides a small amount of gain and a large degree of electrical isolation from the frequency and mode determining circuits of the main board. Base bias is set by R1 and R2 and the bias current by R3 and R4. R3 is by-passed to set the correct gain level. The input feed is DC isolated by C12.

4.18.2 PRE-DRIVER

The pre-driver Q2 is operated as a single ended Class A stage. It is fed via choke L2 and the output is coupled by C18 to the primary of T1. C16,R7,R8 and L1 provide frequency selective negative feedback for linear gain. Base bias and drive are both direct coupled and are generated across R5 by the input buffer stage.

4.18.3 DRIVER AMPLIFIER

The driver stage, comprising matched transistors Q3 and Q4, is operated in Class 'A-B' for good linearity and low dissipation. Collector feed is via chokes L4 and L5 and collector current is monitored at TP1. Base bias and RF drive are applied via tapped hybrid choke in T1 and the bias source is RF isolated by L3. C5 and C6 (part of T2 assembly) and C2 and C3 (part of T1 assembly) compensate the respective transformers at high frequencies.

4.18.4 POWER AMPLIFIER

The output stage, comprising matched transistors Q5 and Q6, is operated in push-pull Class B. To ensure linear operation, a standing collector current of between 50mA and 450mA (no signal) is used to eliminate crossover distortion. DC power is applied via the tapped hybrid choke which forms part of the T3 assembly and is coupled to (but DC isolated from) the 50 ohm output via the conventional transformer windings of T3. C8 compensates T3 at high frequencies. The DC feed is RF isolated by L7. Collector current is monitored at TP2. T2 is of similar construction to T3. Base drive is applied via the tapped hybrid choke and step-down transformer windings of T2. Base bias is applied via L6. R13,C25 and R16,C26 form a negative feedback loop from collector to base of each transistor.

4.18.5 BIAS GENERATOR

Transistor Q12, base controlled by the voltage divider R37,R38 and R39, provides a controlled constant current source to bias the driver pair Q3 and Q4. Q11, a diode connected transistor, mounted in the heatsink compensates the entire bias circuitry for changes in operating temperature on the Linear Power Amplifier.

Bias current for the output stage is provided by Q14 directly from the 12 volt main rail. Q14 is controlled by a DC amplifier chain comprising IC1 and Q13 with associated components, the operation of which is as follows:-

Potentiometer R42 and resistor R43 provide a controllable current source draining through R44 and Q11, and connected to the positive input of IC1. The negative input of IC1 is supplied by a voltage divider formed by R45 and R46, the latter being connected to the bias output. Thus the effect of a rise in the output voltage is to cut back the output from the IC and restore the output to its original level. Conversely, any fall in output voltage will reflect back on the IC and produce an increase in output.

A13 and the voltage divider R47, R48 provide a suitable matching and drive network between IC1 and the output control transistor Q14. R49 is a bleed resistor to ensure that sufficient current flows in the bias circuit to obviate the possibility of a voltage build up when bias current is not being drawn, and C42 is a large enough capacitor to ensure voltage stability despite the surges of current which are required in biassing a Class B linear amplifier.

4.18.6 THERMAL COMPENSATION

The compensating diode Q11 is mounted on the heatsink under T2 and as close to Q5 and Q6 (the heat source) as possible. The fact of Q11 being part of the positive input circuit of the IC ensures that as the heatsink temperature rises, and voltage across Q11 falls, the output voltage of the bias amplifier will also fall. This tends to prevent a current runaway from occurring in the output stage.

4.18.7 AUTOMATIC LOAD CONTROL (ALC)

Q8 emitter is biased to +5V by R31 and R32. In the absence of an RF output, Q8 base is biased between 5 and 10V depending on the setting of R25 and/or R26. Hence Q8 is off and Q9 receives no base drive and is also off. The divider R34 and R36 therefore sets the base voltage of Q9 and an ALC output voltage to the main board of about 6.4V. This is sufficient to ensure the main board RF amplifier operates at full gain.

In operation, antenna current is sensed by the current transformer L9. The secondary current develops a voltage across R23 and R24. The resulting voltage is stepped down by the compensated attenuator R21,R22 and C35 and is rectified by D1 to produce a negative DC voltage across C34, proportional to the peak antenna current.

Antenna voltage is sensed by the frequency compensated attenuator R18,R19 and C32 and is rectified by D4 to produce a negative DC voltage across C33, proportional to the peak antenna voltage.

The circuit is designed so that for a load impedance of 50 ohm, the voltages across C33 and C34 will be approximately equal in magnitude. The larger magnitude voltage will control the ALC system. Either D2 or D3 will be forward biased, driving the base of Q8 less positive. When the base voltage of Q8 falls below about 4.4V, Q8 turns on, providing base drive to Q9, which also turns on. The collector voltage falls with a time constant (ALC attack time) set by C38 and R35 of about 1.5mS. The base voltage of Q9 falls, reducing the voltage on the ALC output line. The ALC delay time is set by R34, R36 and C38 and is about 500mS.

Trimmers R25 and R26 provide means of setting the power levels at which the ALC operates by providing a voltage divider with R20 to Q8 base. R26 sets the low power setting and <u>must</u> be set first.

Q7 and associated components back off the ALC and hence output power, at supply voltages below nominal to ensure linearity of transmitter output and freedom from spurii. C37 and C44 remove audio signal from the supply line. Since Q7 emitter is connected to the regulated 10V rail, it follows that as the supply voltage falls, Q7 starts to turn on, effectively partly shunting R31 and increasing the ALC reference voltage on Q8 emitter. This means that a smaller negative voltage is required on capacitors C33 and C34 to operate the ALC - i.e. lower RF power. The component values are arranged so that linearity and spurii will actually improve with decreasing supply voltage. This is done by reducing RF power a little faster than is essential to prevent bottoming of the power transistors.

4.18 LINEAR POWER AMPLIFIER ASSEMBLY, 12v. (Continued)

4.18.8 POWER SUPPLY

Power to the three main amplifier stages and Q14 is supplied directly from the 12V rail via FS2 (15 or 20A) and RL2 contacts. D6 is a crowbar reverse polarity protection diode. It prevents excessive reverse voltages from damaging the transceiver and will blow FS1 in the event of application of enough reverse voltage to cause potential damage.

All bias in the LPA is derived from the +10V Tx regulated line, so that when the set is off or in the receive mode, no bias is applied and even small leakage currents are prevented by RL2 which operates with the PTT function.

4.19 LINEAR POWER AMPLIFIER, 24v.

4.19.1 BUFFER AMPLIFIER

The input buffer stage provides a small amount of gain and a large degree of electrical isolation from the frequency and mode determining circuits of the main board. Base bias is set by R1 and R2 and the bias current by R3 and R4. R3 is by-passed to set the correct gain level. The input feed is DC isolated by C12.

4.19.2 PRE-DRIVER

The pre-driver Q2 is operated as a single ended Class A stage. It is fed via choke L2 and the output is coupled by C18 to the primary of T1. C16, R7, R8 and L1 provide frequency selective negative feedback for linear gain. Base bias and drive are both direct coupled and are generated across R5 by the input buffer stage.

4.19.3 DRIVER AMPLIFIER

The driver stage, comprising matched transistors Q3 and Q4, is operated in Class 'A-B' for good linearity and low dissipation. Collector feed is via choke L4 and L5 and collector current is monitored at TP1. Base bias and RF drive are applied via tapped hybrid choke in T1 and the bias source is RF isolated by L3. C5 (part of T2 assembly) and C2 and C3 (part of T1 assembly) compensate the respective transformers at high frequencies. R59 and R60 are emitter ballast resistors for thermal and bias stabilization and are by-passed by C61 and C62 to prevent reduction of signal gain.

4.19.4 POWER AMPLIFIER

The output stage, comprising matched transistors Q5 and Q6 is operated in push-pull Class B. To ensure linear operation, a standing collector current of 150mA (no signal) is used to eliminate crossover distortion. DC power is applied via the tapped hybrid choke which forms part of the T3 assembly and is coupled to (but DC isolated from) the 50 ohm output via the conventional transformer windings of T3. C8 compensates T3 at high frequencies. The DC feed is RF isolated by L7. Collector current is monitored at TP2. T2 is of similar construction to T3. Base drive is applied via the tapped hybrid choke and step-down transformer windings of T2. Base bias is applied via L6. Heat sensing diodes D10 and D11 are cemented directly to the tops of Q5 and Q6 and are connected in parallel. They form part of the biassing circuit described below.

4.19.5 BIAS GENERATOR

Transistor Q12, with R37 and potentiometer R38 provides a controllable constant current source through R40 and R41 to provide bias for the driver pair Q3 and Q4. Bias current for the output stage is provided through Q14 directly from the 24V supply line. Q14 is controlled by a DC amplifier chain, IC1, Q13 and associated components, the operation of which is as follows:-

Bias adjustment is made by potentiometer R42 and resistors R43 and R58 supplying an adjustable current source to R44, D10, D11 and Q11 (a diode connected transistor mounted on the heatsink). The positive input of IC1 is connected to the junction of R43 and R44. The negative input of IC1 is supplied by a voltage divider formed of R45 (from the 10V Tx rail) and R46 (from the bias output). A rise in the bias voltage will thus cause a cutback in the output from the IC and restore the bias voltage to approximately its previous level. Conversely, any fall in bias voltage will reflect back on the IC and produce an increase in output.

Q13 and the voltage divider R47,R48 provide a suitable matching and drive network between IC1 and Q14, the bias output transistor. R49 is a bleed resistor to ensure that sufficient current flows in the bias circuit to obviate the possibility of a voltage build up occurring when bias current is not being drawn. C42 is the "tank" capacitor for the Class B output stage bias and consequently needs to have a large enough capacity to ensure voltage stability with SSB modulation.

4.19.6 THERMAL COMPENSATION

The diode connected transistor Q11 and two small diodes D10 and D11 (which are connected in a series - parallel configuration) together provide temperature compensation for the final P.A. bias. The small diodes are cemented directly to the output transistors and Q11 is mounted underneath T2, adjacent to the P.A. transistors.

As the temperature rises, the voltage across the diodes falls, and so consequently does the positive input voltage to IC1 and utlimately, the final bias voltage.

The rate at which the bias tapers off allows the output transistors to continue delivering high output up to a temperature of about 100^{o}C.

4.19.7 AUTOMATIC LOAD CONTROL (ALC)

Q8 emitter is biased to +5V by R31 and R32. In the absence of an RF output, Q8 base is baised between 5 and 10V depending on the setting of R25 and/or R26. Hence Q8 is off and Q9 receives no base drive and is also off. The divider R34 and R36 therefore sets the base voltage of Q9 and an ALC output voltage to the main board of about 6.4V. This is sufficient to ensure the main board RF amplifier operates at full gain.

In operation, antenna current is sensed by the current transformer L9. The secondary current develops a voltage across R23 and R24. The resulting voltage is stepped down by the compensated attenuator R21,R22 and C35 and is rectified by D1 to produce a negative DC voltage across C34, proportional to the peak antenna current.

Antenna voltage is sensed by the frequency compensated attenuator R18, R19 and C32 and is rectified by D4 to produce a negative DC voltage across C33, proportional to the peak antenna voltage.

The circuit is designed so that for a load impedance of 50 ohm, the voltages across C33 and C34 will be approximately equal in magnitude. The larger magnitude voltage will control the ALC system. Either D2 or D3 will be forward biased, driving the base of Q8 less positive. When the base voltage of Q8 falls below about 4.4V, Q8 turns on, providing base drive to Q9, which also turns on. The collector voltage falls with a time constant (ALC attack time) set by C38 and R35 of about 1.5mS. The base voltage of Q9 falls, reducing the voltage on the ALC output line. The ALC delay time is set by R34, R36 and C38 and is about 500mS.

Trimmers R25 and R26 provide means of setting the power levels at which the ALC operates by providing a voltage divider with R20 to Q8 base. R26 sets the low power setting and must be set first.

Q7 and associated components back off the ALC and hence output power, at supply voltages below nominal to ensure linearity of transmitter output and freedom from spurii. C37 and C44 remove audio signal from the supply line. Since Q7 emitter is connected to the regulated 10V rail, it follows that as the supply voltage falls, Q7 starts to turn on, effectively partly shunting R31 and increasing the ALC reference voltage on Q8 emitter. This means that a smaller negative voltage is required on capacitors C33 and C34 to operate the ALC - i.e.lower RF power. The component values are arranged so that linearity and spurii will actually improve with decreasing supply voltage. This is done by reducing RF power a little faster than is essential to prevent bottoming of the power transistors.

4.19.8 POWER SUPPLY

Power to the three main amplifier stages and the bias output transistor is taken directly from the 24V input line following FS2 and RL2. In order to prevent discharge of C28, the tank capacitor on the 24V rail, and consequent destruction of RL2 contacts with PTT operation, R57 is connected across RL2 and keeps C28 charged at all times while power is connected to the transceiver.

D6 is a crowbar reverse polarity protection diode, which will pass sufficient current to blow FS1 in the event of the set being connected to the power in reverse polarity.

4.19.9 MAXIMUM TEMPERATURE CONTROLLER

Q15, Q16, Q17, potentiometer R54 and associated resistors provide thermal protection of the LPA. When the base emitter bias voltage of the final transistors falls to a preset level (indicating a preset maximum heatsink temperature) the power output automatically reduces. Ultimately, the high power ALC level can be reduced right down to the low power level if needed. If the transmitter cools, the power will rise automatically.

Q15 (normally off) has its emitter voltage preset by R54 so that it starts to come on only when its base voltage has dropped to a value corresponding to a critical high temperature. When Q15 comes on, its collector voltage rises, turning on Q16 and progressively turning off Q17 which is in series with R25, the high power ALC adjuster. As Q17 turns off (increasing its collector to emitter resistance) the ALC reverts to the power set by R26, the low power adjuster.

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5. ALIGNMENT

5.1 TEST EQUIPMENT

The following test equipment is the recommended minimum for servicing and channel installation:-

1.	Power Supply	Nom. 13.2V 18A Steady 30A peak Nom. 25.2V 10A Steady 20A peak
2.	Frequency Counter	Accurate to 1 part in 1 million or better.
3.	High Frequency Oscilloscope	Complete with high impedance probe capable of measuring 50mV/cm to 20mV/cm accurately at frequencies up to 12 MHz.
4.	Signal Generator	Capable of CW and AM modulation at frequencies between 1.6 MHz and 12 MHz, with an output variable from 0.5uV to 0.5V.
5.	Multimeter	Current range to 1A, 5% accuracy
6.	Dummy Load	50 ohm, 50W (resistive, intermittent).

5.2 BASIC RECEIVER CHECKS

1. Set bench supply at 25V or 13.2V and plug in transceiver. Remove FS2 (15A or 20A). Set R136 fully anti-clockwise. On 24V series 01 boards ONLY lift one end of 100 ohm resistor R57 in LPA alongside FS2.

2. Switch on transceiver.

3. Check 10V regulated supply line at TP17 (see board layout at rear of handbook). Adjust R136 for 10V.

4. Check AM/SSB switch operates RL4. On Kestrel units, RL4 will remain energised on channel 10.

5. Connect oscilloscope to TP11 and with mode switch on SSB, check that approximately 1.2V p-p of 1650 KHz signal is present.

6. Connect frequency counter to TP11. Note that the frequency setting depends on the type of clarifier used.

   a. Without clarifier control:

      Adjust R100 to 1650KHz (± 1Hz)

   b. Where clarifier controls receive only:

      First set high frequency with clarifier control fully clockwise, by adjusting C97. Note that Hawk range is 25Hz each way from 1650KHz, and Kestrel range is 120Hz each way from 1650KHz.
      Low range may then be set by adjusting R100 with clarifier control fully anticlockwise.

5.2 BASIC RECEIVER CHECKS (Continued)

c. Where clarifier control is used to net transmitter: (Hawk only). Ensure that mid-range produces 1650KHz.

7. Connect oscilloscope to TP12. Check that approximately 1.2V p-p on selected channel crystal frequency is present.

   Repeat above on TP4 (channel oscillator), whilst in receive mode.

8. Repeat Item 7 above for all channels in use.

9. Connect frequency counter to TP12. Check each channel fitted and adjust appropriate crystal trimmer until frequency is within 2 Hz of required crystal frequency.

10. Check voltage at TP18 or 19. This should be approximately 13V (24V sets) or 6.5V (12V sets). (DC Voltages)

11. Inject 35mV at 1KHz into input of volume control. This should give 10V p-p across speaker (TP18 and 19) on 12V sets and 15V p-p on 24V sets. This represents approximately 4W.

NOTE: The overall gain of the amplifier is approximately 100.

5.3 RECEIVER ALIGNMENT

1. Set mode switch to AM. Connect generator (set to 1650 KHz modulated approx. 30%) to TP20. Set level for audible signal. Connect 0-10V meter to TP22 (delayed AGC line). Tune IF transformers L22, L23 and L24 for maximum audio and minimum voltage at TP22. Reduce generator level if necessary. (200uV in at TP20 gives about 1:1 S/N in audio output.)

2. Transfer generator (set to 1650 KHz, 30%) to antenna input socket and select lowest freq. channel. Adjust L21 (IF trap) for minimum audio output, reducing or increasing generator output as required.

3. Set generator to channel frequency and still monitoring TP22, adjust appropriate RF amplifier coils (L1-L10, and L11-L20), for minimum voltage. Repeat for each operational channel. Recheck IF amplifier coils L22, L23 and L24.

5.4 RECEIVER PERFORMANCE CHECKS

5.4.1 RECEIVER SENSITIVITY - AM

Set generator on channel frequency and modulated 30% with a 1 KHz signal. Connect voltmeter across speaker terminals or between TP18 and 19. Sensitivity should be better than 1uV for 10dB.

$$\frac{\text{MODULATED SIGNAL AND NOISE}}{\text{UNMODULATED SIGNAL AND NOISE}}$$

5.4.2 RECEIVER SENSITIVITY - SSB

Set signal generator 1 KHz above channel frequency. Connect voltmeter across speaker terminals or between TP18 and 19. Sensitivity should be better than 0.5uV for 10dB.

$$\frac{\text{SIGNAL AND NOISE}}{\text{NOISE}}$$

5.5 RECEIVER FAULT FINDING

If the overall receiver performance is down or the tune-up procedure proves unsuccessful, systematically check circuit stage gains and AGC operation as described below.

For all checks from 1 to 5 inclusive below, short TP24 to ground to disable the AGC circuitry.

5.5.1 RF AMPLIFIER GAIN

Connect oscilloscope to TP2 and signal generator (on channel frequency) to antenna. Increase generator output until 100mV p-p is obtained on oscilloscope. Generator output should be between 1 and 2.1mV, corresponding to a voltage gain of between 17 and 35.

5.5.2 FIRST MIXER CONVERSION GAIN

With 100mV p-p on TP2 (as in 5.5.1), transfer oscilloscope to TP20. The voltage on TP20 should be between 1.5 and 2V p-p, corresponding to a conversion voltage gain of between 15 and 20.

5.5.3 CRYSTAL FILTER AND SWITCH LOSS

With oscilloscope still connected to TP20, adjust generator output to 1V p-p.

Transfer oscilloscope to TP6 and adjust signal generator frequency for maximum voltage. The voltage at TP6 should be greater than 300mV on both SSB and AM models, corresponding to a filter plus filter switch loss of less than 10dB.

5.5.4 FIRST IF AMPLIFIER GAIN

Transfer generator to TP6 and adjust output to 50mV p-p. Measure voltage at Q5 drain (or Q7 gate 1). The voltage should be between 2 and 4V p-p, corresponding to a voltage gain of between 40 and 80.

NOTE: It will be necessary to tune L23 for maximum volts on the oscilloscope to compensate for probe capacitance. It will therefore be required to re-align L23 as in Section 5.3 above.

5.5.5 SECOND IF AMPLIFIER GAIN

With generator still on TP6, reduce output until Q5 drain voltage is 100mV p-p. Connect oscilloscope to TP7 (IF output) and peak L23 and L24. The voltage at TP7 should be between 3 and 6V p-p, corresponding to a voltage gain of between 30 and 60. See NOTE in 5.5.4

5.5 RECEIVER FAULT FINDING (Continued)

5.5.6 NORMAL AGC

Remove short on Tp24.

Set mode switch to AM and connect voltmeter to TP 24.

Transfer generator (set to channel frequency, 30% modulated at 1 KHz) to antenna and increase output until voltmeter indication begins to rise. Check Q4 collector for simultaneous fall in voltage.

NOTE: This voltage fall indicates normal AGC.

5.5.7 DELAYED AGC

With generator output set at last level in 5.5.6, transfer voltmeter to TP22 (delayed AGC) increase generator output until voltmeter indication begins to fall.

NOTE: This voltage indicates delayed AGC.

5.5.8 AM DETECTOR

With generator still connected to antenna, check output is 1mV modulated 30%. Tune L22 and L23 for minimum voltage at TP22. See NOTE in 5.5.4

The AF voltage at TP8 should be between 120 and 180mV p-p.

The RF carrier voltage at TP7 should be between 1.8 and 2.6V p-p.

5.5.9 SSB DETECTOR

Set mode switch to SSB, and set generator (still connected to antenna) to CW and at 1 KHz above channel frequency. The generator audio level voltage at TP8 should be between 300 and 400mV p-p. The RF voltage at TP7 should be between 1.8 and 2.6V p-p.

5.5.10 AUDIO AMPLIFIER

With generator still connected to antenna, adjust output for a 50mV p-p voltage on wiper contact of volume control. (This can be measured with an oscilloscope or millivoltmeter).

The AF output across TP18 and 19 (across speaker terminals) should be between 4.5 and 5.5V p-p for 12V transceivers and 10 to 15V p-p for 24V transceivers.

5.6 TRANSMITTER BASIC CHECKS

1. Align receiver as described in 5.3 above.

2. Connect a 50 ohm dummy load to the antenna connector.

   Remove FS2 (15A or 20A) in LPA. Check carrier oscillator and channel oscillator frequencies as described in 5.2 above. Operate microphone PTT switch and either whistle into microphone or use the call tone for each of the following tests unless otherwise indicated.

5.7 TRANSMITTER ALIGNMENT

i) Connect oscilloscope to TP13 (compressor output). Check that audio level is between 1 and 1.5V p-p and that it does not increase beyond 1.5V p-p with large increases is applied modulation.

ii) Transfer oscilloscope to TP3 (first mixer input) and check that audio level is between 1 and 1.5V p-p.

iii) Transfer oscilloscope to TP20 (first mixer output) with oscilloscope on maximum sensitivity and no audio input, adjust R20 (carrier balance) for minimum voltage at TP20. This voltage should be less than 40mV p-p.

iv) Transfer oscilloscope to TP4. Check carrier oscillator level (1650 KHz) is between 350 and 450mV p-p.

5.7.1 IF AMPLIFIER

Transfer oscilloscope to TP6 (IF amplifier input) and apply a single audio tone of approximately 150mV p-p to microphone and check that RF level at TP6 has no visible modulation on SSB and small ripple on AM.

5.7.2 TRANSMITTER MIXER

Transfer oscilloscope to TP10 (transmitter mixer) and check that RF level on SSB is approximately 15mV.

5.7.3 AM CARRIER LEVEL

i) Set mode switch to AM, with single tone audio input, and with oscilloscope still on TP10, adjust carrier insertion potentiometer R78 to full anti-clockwise position, then turn slowly until the audio envelope shows 90% modulation.

   NOTE: On some sets, reverse operating pots have been used.

ii) Transfer oscilloscope to TP1 or 9, and check that a fuzzy waveform of approximately 200mV p-p is present.

   NOTE: If the levels in these tests are too low for available test equipment, R78 adjustment may be completed when the LPA is tested by monitoring the antenna output.

5.7 TRANSMITTER ALIGNMENT (Continued)

iii) Transfer oscilloscope to TP2 and check that approximately 2.5V p-p (on SSB) and 3V p-p of clipped waveform (on AM) is present.

NOTE: Because the LPA is not yet operating, this stage is more heavily loaded than in normal operation - hence the clipped AM waveform.

iv) Insert FS2. Resolder 100 ohm resistor on LPA (24V 01 boards only). Transfer oscilloscope to TP14 and set at 20V/cm. Operate PTT and power output should be observed.

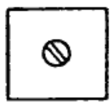
NOTE: There should be a slight variation in voltage between TP15 (LPA filter input) and TP14 (LPA filter output).

5.8 SETTING UP LINEAR POWER AMPLIFIER

Requirements:
- Ampmeter reading 0 - 1A
- CRO calibrated to make RF envelope measurements from 50 to 250V p-p
- 50 ohm dummy load
- Power supply capable of delivering 25A without falling below 12V (or 12A without falling below 24V for 24V model sets).
- Two tone audio oscillator. (Approx. 1300 & 2200 Hz)

NOTE: Two different potentiometers have been used in the manufacture of our Linear Power Amplifiers. The following was written for Cermet pots (illustrated)

Where Helitrim pots (illustrated) are in use, read (para 2) "leave both pots fully anticlockwise" and (ALC setting) "R26 and R25 both turned fully anticlockwise".



1. Turn Channel Selector to blank position between 5 and 6. Remove links at TP1 and TP2. Connect dummy load to coaxial lead (output voltage measurements may be made with CRO connected across dummy load or at TP15 on top board of harmonic filter). Attach LPA to main board and connect to power supply.

2. Switch on set and operate PTT button and check that driver and PA bias supplies are operating correctly. (This need only be done after replacing transistors which have failed). The voltages should be measured at the bases of the driver and PA transistors. R38 (set driver current) and R42 (set PA current) are the two potentiometers. R38 should vary driver base voltage between 0.4V and 0.7V. These readings are not critical. Leave both pots fully clockwise (lowest voltage).

5.8 SETTING UP LINEAR POWER AMPLIFIER (Continued)

3. Insert ampmeter across TP1 pins, and adjust R38 to obtain correct current readings:-

0.9A	All 12V sets
0.3A	All 24V sets.

   Seal the pot and switch off power supply. Replace link at TP1.

4. Insert ampmeter across TP2 pins, switch on and adjust R42 to obtain correct current readings:-

0.1A	12V 50W set
0.45A	12V 100W and 130W
0.15A	24V 50W, 100W and 130W

   When adjusting 24V sets, it is recommended to meter the base voltage while performing the PA adjustment above, as a current runaway can occur if the pot is advanced too rapidly. Conduction commences shortly after voltage exceeds 0.6 and onset is very rapid.

5. Make sure that HI-LOW power switch is on LO, and set is in SSB mode, with 2 tone osc. to mike or direct coupled to remote socket. Channel Selector to operational channel. Replace link at TP2.

   R26 (LO ALC) and R25 (HI ALC) both turned fully clockwise.

   Operate PTT and adjust R26 for 80V p-p output (15W).

6. Change to HI power and adjust R25:-

   150V p/p for 50W models
   200V p/p for 100W models
   230V p/o for 130W models

7. Change to AM, still on HI Power and adjust R131 located behind loudspeaker for 140V p/p output for 50W models or 190V p/p output for 100W and 130W models.

8. Although the quiescent current given above in para. 4 is quite a safe level, it may be reduced further, resulting in better efficiency and linearity if the following procedure is followed:-

   Use HI PWR SSB with 2 tone modulation, and observe output into a 50 ohm load with CRO. Very carefully move R42 to REDUCE the bias. If the bias is reduced too much, cross-over distortion near the zero crossing will appear. (See Figures 5.9.1 and 5.9.2).

   Avoid unbalanced audio tones because the crossover points will be hard to distinguish. Re-adjust the input tone levels if necessary to get clean crossovers.

   When satisfied with this adjustment, seal pot R42.

   <u>NOTE</u>: Do NOT adjust driver transistor bias on signal

5.8 SETTING UP LINEAR POWER AMPLIFIER (Continued)

FUNCTION			P-P VOLTAGE C.R.O.	POWER METER			
				BIRD 4311 (P.P.)	BIRD 43 (AVE.)	MARCONI TF1020A (AVE.)	MARCONI TF 2503 (AVE.)
SSB	Lo Power		80V	16W	8W	8W	8W
TWO	Hi Power	50W	160V	56W	24W	28W	28W
TONE		100W	200V	100W	43W	50W	50W
		130W	230V	130W	56W	65W	65W
AM	Lo Power		80V	16W	8W	8W	8W
ONE	Hi Power	40W	126V	40W	17W	20W	20W
TONE		80W	180V	80W	35W	40W	40W
		90W	190V	90W	39W	45W	45W

The basis of a two tone test is that two audio signals are injected into the transmitter audio amplifier, and two RF signals should be obtained out of the power amplifier.

However, no amplifiers are perfectly linear and some mixing of the two tones will occur, but all of the new signals produced should be so weak in comparison to the main transmitter output that they will be virtually undetectable in an oscilloscope pattern. What will be seen is a pattern of the two sine wave signals as they add and subtract, forming peaks and valleys.

A two tone test's main advantage is that it will produce a stationary pattern that may be examined for major defects. Figures 5.9.1 to 5.9.6 show various scope patterns of two tone test patterns.

To make the test, apply the output of a two tone generator to the microphone input, set the oscilloscope for about 200 Hz, and check the pattern to see that both tones are of equal level. If the tones are not equal in level, the valleys of the waveform will not meet at a single point on the zero line.

Figure 5.9.2 shows mild flattening of the peaks and figure 5.9.3 severe flattening. These patterns indicate an amplifier stage being overdriven or underloaded. Decreasing the drive level or increasing the loading should result in the Figure 5.9.1. pattern.

Incorrect bias adjustment can also cause non-linearity. This defect will show up as a rounding of the crossover points, as in Figure 5.9.4.

Figures 5.9.5 indicates what happens when an external two tone generator is used and carrier leak-through is also present. The carrier causes the peaks of the two tone pattern to have different height.

5.9 TWO TONE TESTS

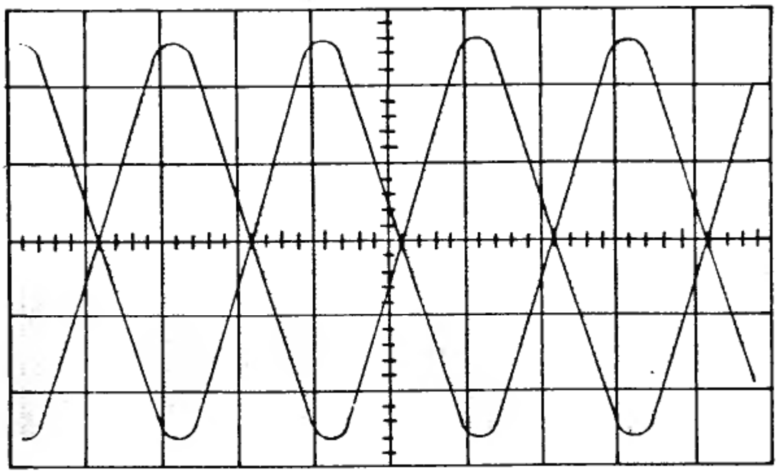


FIGURE 5.9.1 CORRECT PATTERN

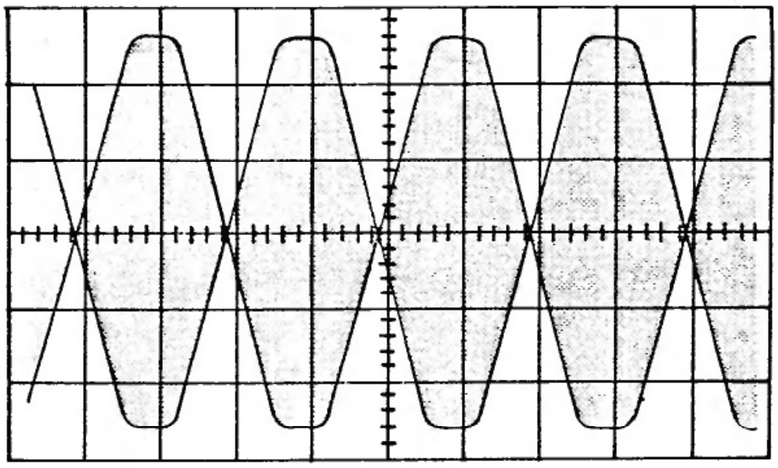


FIGURE 5.9.2 MILD FLATTENING OF PEAKS

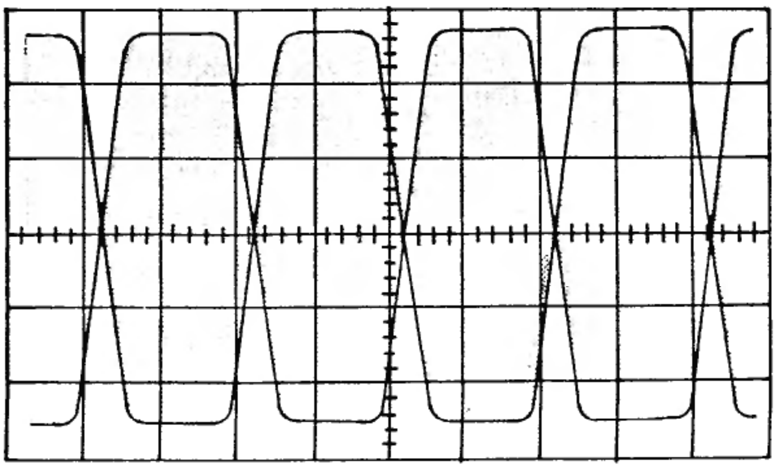


FIGURE 5.9.3 SEVERE FLATTENING OF PEAKS

5.9 TWO TONE TESTS (Continued)

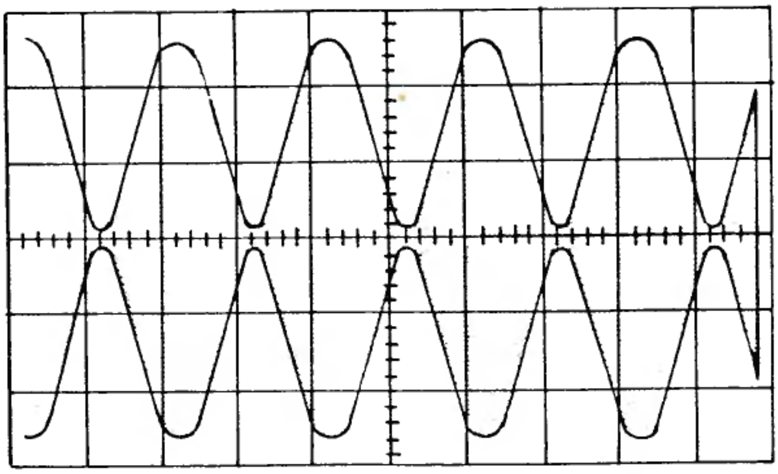


FIGURE 5.9.4 NON-LINEARITY OF CROSS-OVER POINTS

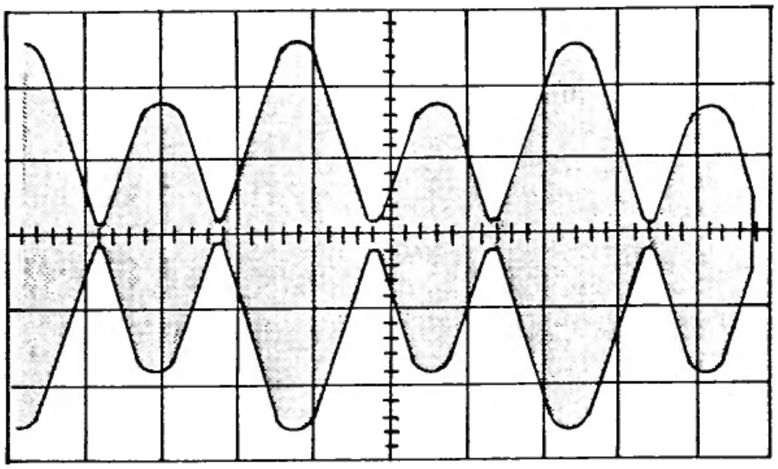


FIGURE 5.9.5 CARRIER PEAKS NOT LEVEL

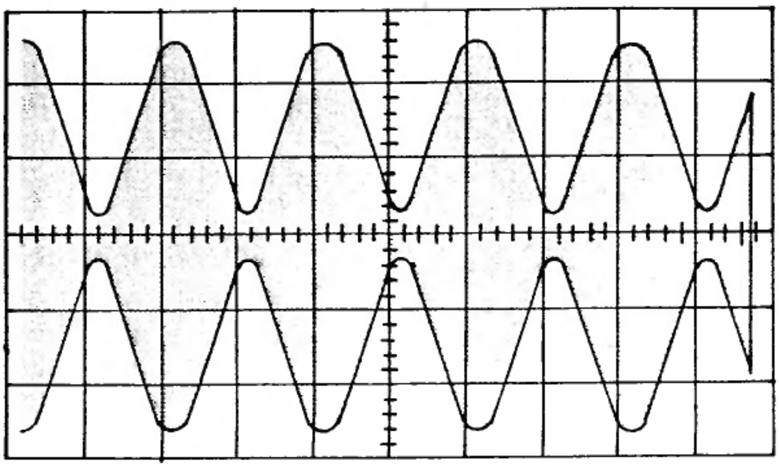


FIGURE 5.9.6 90% AM MODULATION

6. SERVICING LPA

WARNING: The necessity of making thermal contact between Q5, Q6 and the heatsink as near perfect as possible cannot be overstressed. It is no exaggeration to say that one grain of sand could destroy a power output transistor by holding its case lightly off the heatsink. Other devices mounted on the heatsink (such as Q3, Q4, Q11 and Q14) must also be in good thermal contact.

6.1 SERVICE PROCEDURES

6.1.1 PROCEDURE IN CHANGING POWER DEVICES

i) Remove old or faulty transistor.

ii) Clean off ALL old compound from heatsink (not just most of it).

iii) If any evidence of bulging around threaded holes, grind the heatsink flat again, or countersink holes.

iv) Ensure that the case of the transistor to be fitted is flat, by rubbing it on a piece of emery or carborundum cloth on a flat surface. Any hollows MUST be thoroughly ground out.

v) Apply silicone paste evenly to transistor mounting face, and screw down immediately so that no particles of dirt can be stuck between heatsink and transistors.

6.1.2 RECEIVER WORKS NORMALLY, NO OUTPUT FROM TRANSMITTER, NO FUSES BLOWN

LPA draws noticeable current, but no RF output. Check position of drain by removing links at TP1 and TP2. Should Q2 have failed, replace C16, R9 and Q1 and, as a matter of course, check R5. Replace transistors as necessary. Before reconnecting links, check that bias voltages on Q3, Q4, Q5 and Q6 will set up correctly. If not, IC1, Q12 and Q14 may need replacing.

A short at C46 may occur rarely and can result in failure of pot R42. Check voltages around IC1 before trying replacement.

Q12 can be checked individually by noticing that driver bias voltage is correctly adjustable, both with and without TP1 link (see Setting Up LPA, Section 5.8)

LPA draws no current on FS2 line. Key transmitter and check that voltage appears at both Q5,Q6 and Q3,Q4 collectors. If not at Q3,Q4, track under board will be burnt through adjacent to TP2 indicating faulty Q3 or Q4. If voltages normal, but no output, check RF drive with CRO. Table of LPA voltages will give a clear indication of fault area by comparing actual measurements.

6.1 SERVICE PROCEDURES (Continued)

6. 1 .3 FUSES BLOW WHEN TRANSMITTER IS KEYED

Turn channel selector to blank channel.

FS1 (2A) blows on keying transmitter, but main board does not draw excessive current when connected to power without LPA. 10V Tx line drawing excessive power; IC1, C11, C36 and C39 (in conjunction with Q10) are the only components that can pass sufficient current to rupture FS1 without burning and thus showing up.

FS 2 (15/20A) blows on keying transmitter. Remove link at TP2; if fault cleared, Q5, Q6 are faulty. If not, remove link at TP1. If fault cleared, Q3, Q4 are faulty. (On rare occasions T2 or T3 can cause these effects due to internal shorts. Transistors will almost certainly be damaged as well). If fault persists, Q14 and C42 are the only individual components left to investigate. Failing this, trouble will be found to be a physical fault in wiring or P.C. tracks, or a long wire through board contacting heatsink, or piercing the insulation of a wire running under the board. Should R49 be found to be burnt, Q14 will have shorted or been driven fully on, and Q5, Q6, R49 and C42 will need replacing.

6. 1 .4 FRONT END FAULTS

It is necessary to remove links at TP1 and TP2 if signal tracing is to be done in the low level stages Q1 and Q2, otherwise regeneration sets in, and Q3, Q4, Q5 and Q6 may be damaged. Do not operate with drive signal applied for lengthy periods as Q2 is likely to be overheated.

6. 1 .5 INTER-STAGE COUPLING TRANSFORMERS

Faults in the interstage coupling transformers T1, T2 and T3 are often very hard to diagnose, but must be suspected when DC voltages are correct and transistor replacement does not remedy the defect.

6. 1 .6 AUTOMATIC LOAD CONTROL

Where power transisters have had to be replaced, and no obvious reason has shown why they failed, it is adviseable to check the operation of the ALC sensing and amplifier. The voltage sensing can readily be checked by operating at high power into a dummy load, noting the voltage developed at the junction of D2 and D3, and simply removing the dummy load and measuring the same point again.

To check current sensing, first lift one end of D3 or D4 to disable the voltage sensing, measure at D2,D3 junction as before with 50 ohm load, and then again with 20 ohm load.

Whilst making these measurements, check that the ALC amplifier is also working by measuring the voltage either side of D8. If no variation, trace fault in the area of Q7,Q8,Q9,Q10 by following the circuit description in Section 4.18.7 or 4.19.7.

6.2 THERMAL PROTECTION

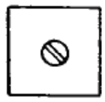
6.2.1. MAXIMUM TEMPERATURE CONTROLLER (after Ser. No. 3040)
(fitted to all 24V and optional on 12V LPA's).

Equipment Required

Dummy Load 50 ohm (resistive)
C.R.O.
Power Supply or Battery 24V
0-15 amp Ampmeter
Temperature Probe (SANWA Type K30TH DII).

NOTE: Two types of potentiometer have been used in the manufacture of the LPA. The following is written for Cermet pots (illustrated)

Where a Helitrim pot has been used, read R54 fully anticlockwise as fully clockwise.



Setting Up - for serial numbers 3040 and above

Key transmitter to AM Hi-Power and note when R54 is fully clockwise. AM full power is produced, but when fully anticlockwise, power is reduced to AM low power. Reset R54 fully clockwise. Unkey transmitter and allow to cool.

Connect the temperature probe to the flange of Q5 or Q6 via the hole in the heatsink ensuring that it has a good contact (Use heatsink thermal compound).

Note the time, and switch to Hi-Power AM Carrier Unmodulated. After about 1 minute, note the DC current drawn by the set, typically 8-9 amps. Watch the temperature rise on the PA transistors. When it reaches approx. 90 - 95°C (after approx. 10-12 minutes), adjust R54 CCW until the current and RF power output just begin to drop (a drop in current of 0.25 to 0.5A is satisfactory.) Allow the unit to run into full thermal shutdown. Whilst doing this, a check should be kept on the temperature and ampmeter.

The LPA should go into full thermal shutdown after approx. 18-20 mins. "I" should be 4-5 amp, O/P 20-30 watts PEP and temperature on Q5,Q6 100 - 110°C.

Unkey transmitter, allow to cool for approx. 5 mins, then key transmitter and check that the set has reached full output (unmodulated 70W 8-9 amp.)

When completed, seal R54 against vibration.

6.2 THERMAL PROTECTION (Continued)

NOTE:

1. Should a current runaway occur, allow set to cool, then try again. If this still occurs, replace T3 and try again. Should this still occur, then Q3/4 5/6 could be suspect.

2) For ALL LPA's pre 3040 with thermal runaway, it would be adviseable to return the unit to the factory for modification, or modify as per Section 6.3.

3) Transformer ferrites may be permanently damaged if subjected to large DC flux or stored close to large magnetic fields, e.g. loudspeaker magnets. Such damage will result in rapid current increase.

Fault Finding

If R54 is fully CCW and there is no Hi-Power ALC adj., check Q15 for S/C, D9 for O/C.

Should R54 be varied and has no effect on Hi-Power setting, check Q15,Q16,Q17 for O/C.

6.2.2 24V LPA's BEFORE SET NO. 3040

Switch the transceiver to transmit AM hi-power and note when R54 is fully CW full power is produced, but when fully CCW, low power ALC operation comes in. Reset R54 to fully CW, unkey transmitter and allow the heatsink to cool.

Note the time and switch to AM hi-power carrier transmit. After about a minute, note "I", the current (DC) drawn by the set - typically about 8-9 amps.

After about 2-4 mins. from switch on, the current will slowly start to increase and the heatsink should be too hot to touch. When the current has risen to "I"+1 amp, quickly rotate R54 CCW to set the current to "I"-2 amps. The current and RF power O/P should continue to decrease towards the low power values.

As a check, cool the transmitter for 20 mins., and run the AM transmit. Note after a few minutes (3-4) the current and RF power correctly reduce when the heatsink gets very hot. If necessary, reset R54 as described above (or even to slightly lower current than "I"-2 amp). When completed, seal the potentiometer against vibration.

Should either a thermal, RF or a current runaway occur, allow the unit to cool and try again.

6.2 THERMAL PROTECTION (Continued)

NOTE: It is recommended that the pre-3040 24V LPA be modified as per the modification procedure at the end of the chapter. The reason for this is that it gives better thermal protection, independent bias control and better liearity. It also improves reliability under severe thermal conditions particularly on long periods of AM transmissions.

All parts are available from the factory or can be modified as per the Mod.Note (see 6.3 below).

To check current sensing, first lift one end of D3 or D4 to disable the voltage sensing, measuring at D2,D3 junction as before with 50 ohm load, and then again with 20 ohm load.

Whilst making these measurements, check that the ALC amplifier is also working by measuring the voltage either side of D8. If no variation,trace fault in the area of Q7,Q8,Q9 and Q10 by following the circuit description as in Section 4.18.7 .

6.3 UPDATING OF THERMAL PROTECTION, 24v. LPA

To allow independent bias control on Q3/4 and Q5/6, better thermal protection and better linearity. Improves reliability under severe thermal conditions, particularly on long periods of AM transmission.

6.3.1. ITEMS REQUIRED

L4/5	COIL	PL 13001 (Alternatively modify existing L4/5 as below)	
R58	RES. 2K2	RES-302-6222	
R59/60	RES 3.3Ω	RES-302-6339	
C61/62	CAP. 4.7uF Tant. 35V	CAP-501-2475	
D10/11	Diode IN2002	DSG-00001	
T2	Transformer	PL 13619 (Alternatively modify existing T2 as below)	
R155 (on main board)	RES. 150ohm RES. 330ohm	RES-302-6151 RES-302-6331	130W 50W

6.3.2 PROCEDURE

Remove T2, Q5, Q6, lift both emitters of Q3/4, drill two holes (1mm - 1.2mm) either side of Q5/6 inner emitters (see diagram). Remove LPA board from heatsink. Replace L4 and L5. Remove insulated link from Q11 and R41. Cut track between R41 and R44. Run a wire from R44 to anodes of D10/11 through hole, and a wire from Q11 anode through hole to cathodes of D10/11 (see diagram). For LPA's with diode fitted in series with R44, remove the diode, replace LPA board on heatsink.

6.3 UPDATING OF THERMAL PROTECTION, 24v. LPA (Continued)

Fit R58 2K2 between R43 and R40 (see diagram). Fit R59/60 on outer emitter of Q3/4 (making lead as short as possible) and to earth. Fit C61/62 to inner emitter of Q3/4 with positive to emitter. Cement D10/11 to Q5/6 with cathode facing the base (use 5 min. araldite or thermal bond cement). When cement is dry, replace Q5/6; join cathode of D10/11 and solder wire from Q11 to cathode. Replace T2 with new one (PL 13619) or modify as below. Replace R155 on mainbase board as per above list.

6.3.3 SETTING UP PROCEDURE

See Section 5.8 in Handbook.

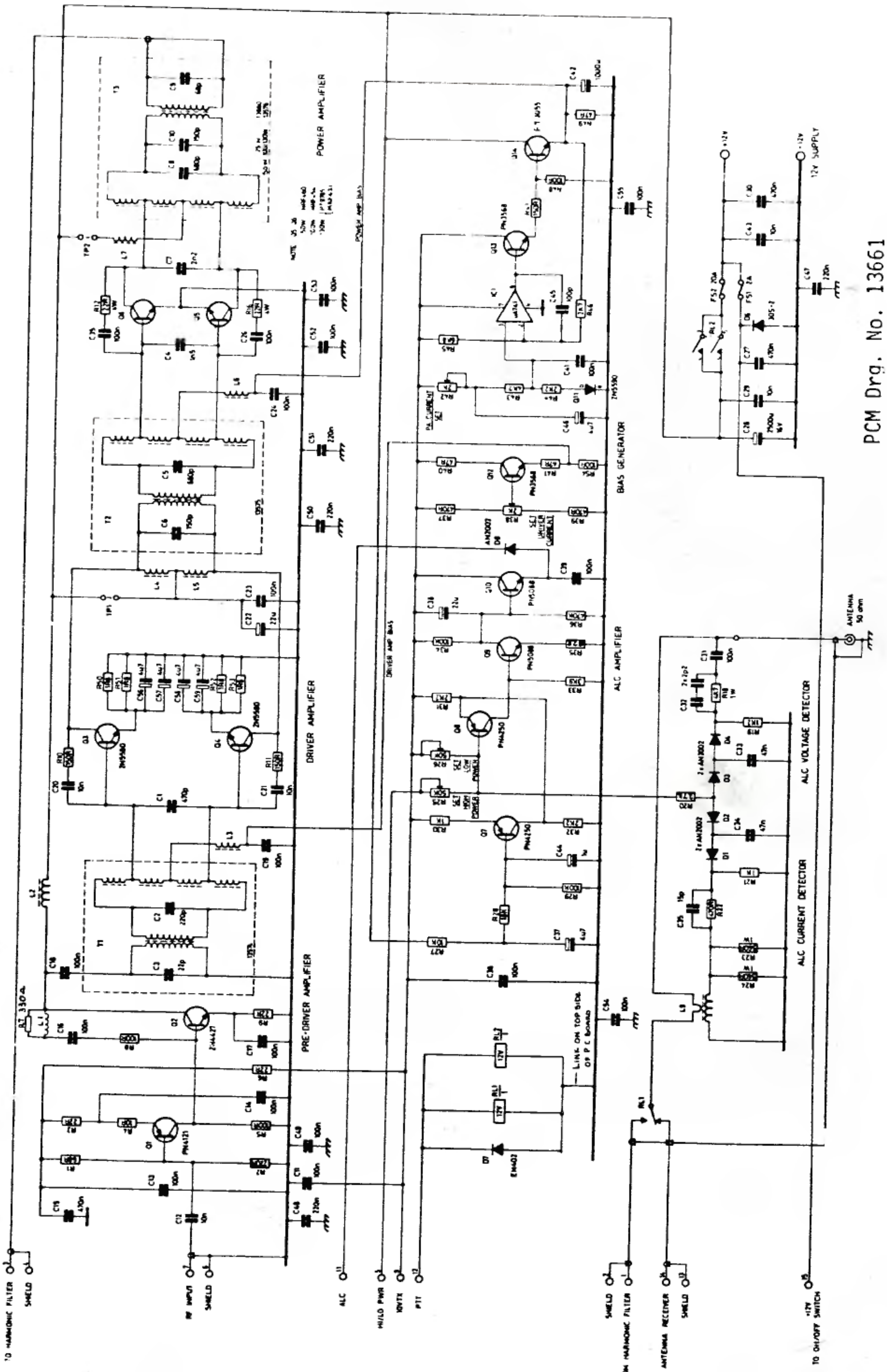
6.3.4 MODIFYING T2

Remove C6 150pF and primary turns (4). Using 30 AWG PTFE wire, increase primary turns to 10 turns and terminate as original.

6.3.5 MODIFYING L4/L5

Remove existing winding and rewind with 20 turns 26 AWG enamel wire.

It must be noted that when fitting new Q3/4 or Q5/6, all hollows MUST be ground out and all old heatsink compound MUST be removed from the heatsink and fresh applied. (See Section 6.1.1 (iv & v)



12V LPA CIRCUIT DIAGRAM

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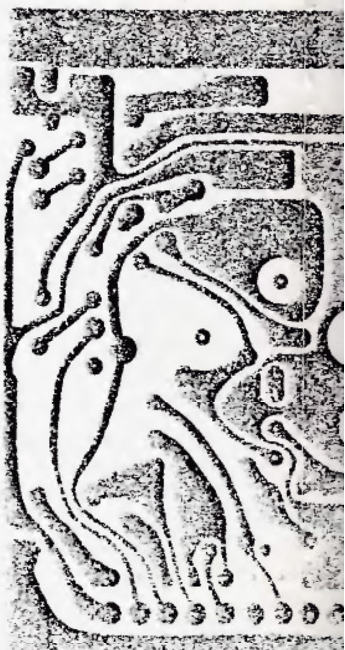
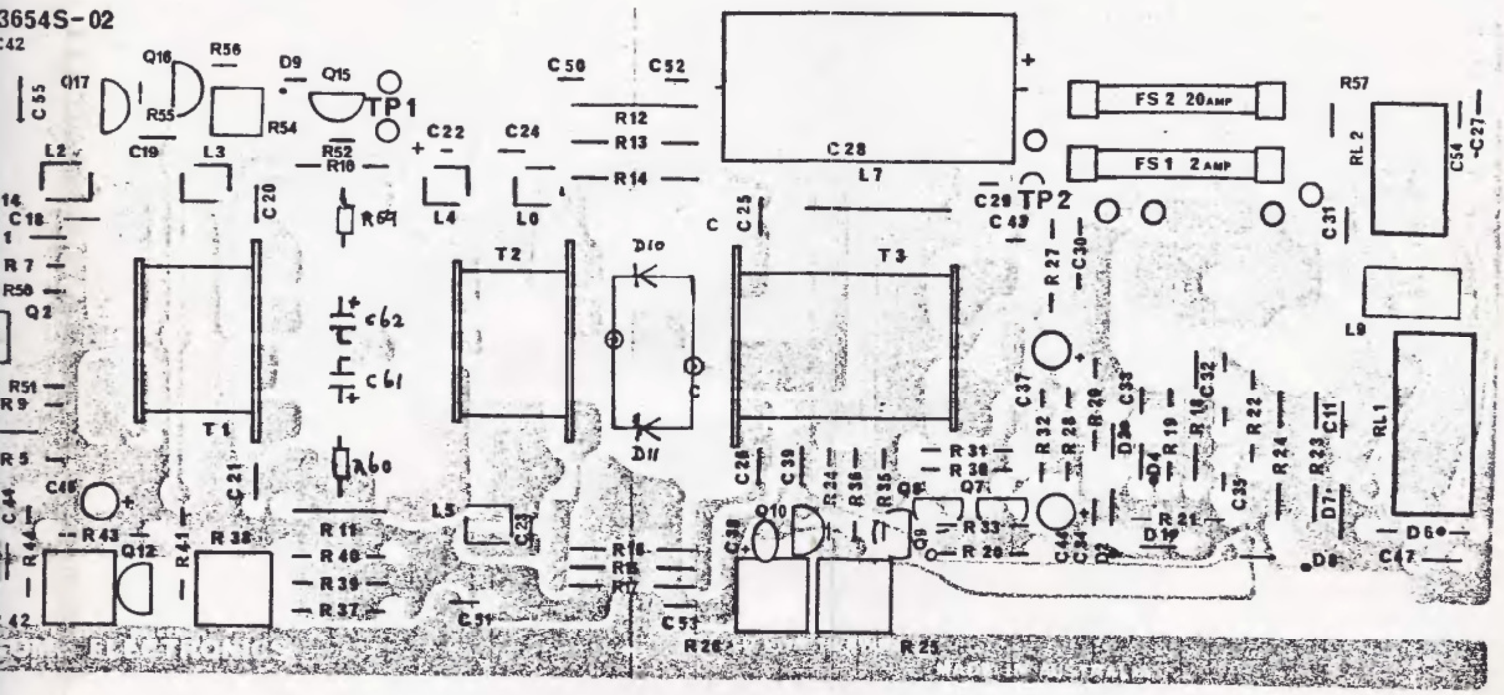
PC 13654S-0


C42
Q14
C55
Q17
R 49
R 48
L2
C14
C18
L 1
R 47
R 46
R 3
R 4
C16
R 7
R50
C15
Q1
R 8
Q2
R51
R 9
R 6
R 1
R 2
C12
C17
C13
C36
R 5
C46
Q13
C44
IC 1
C48
C49
R46
R44
C45
R 42

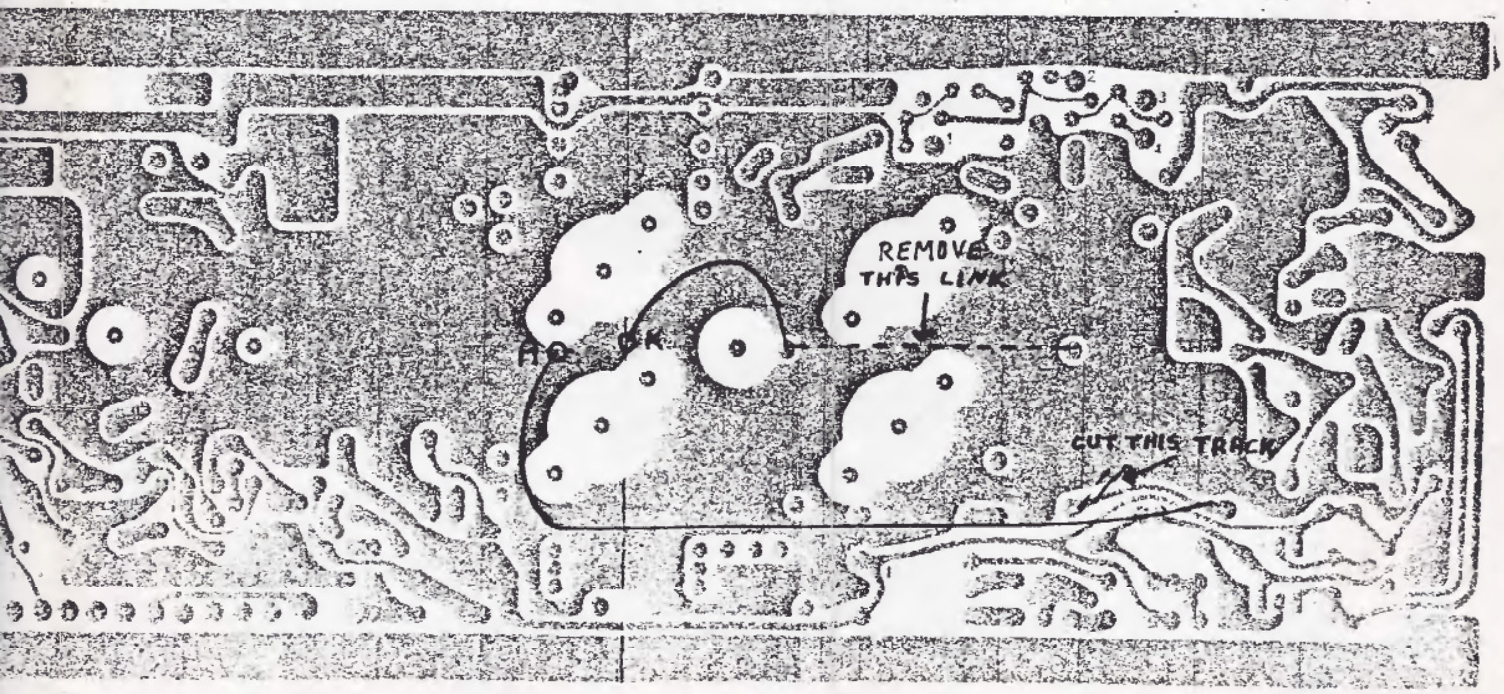


LINEAR POWER AMPLIFIER

PRINTED CIRCUIT BOARD

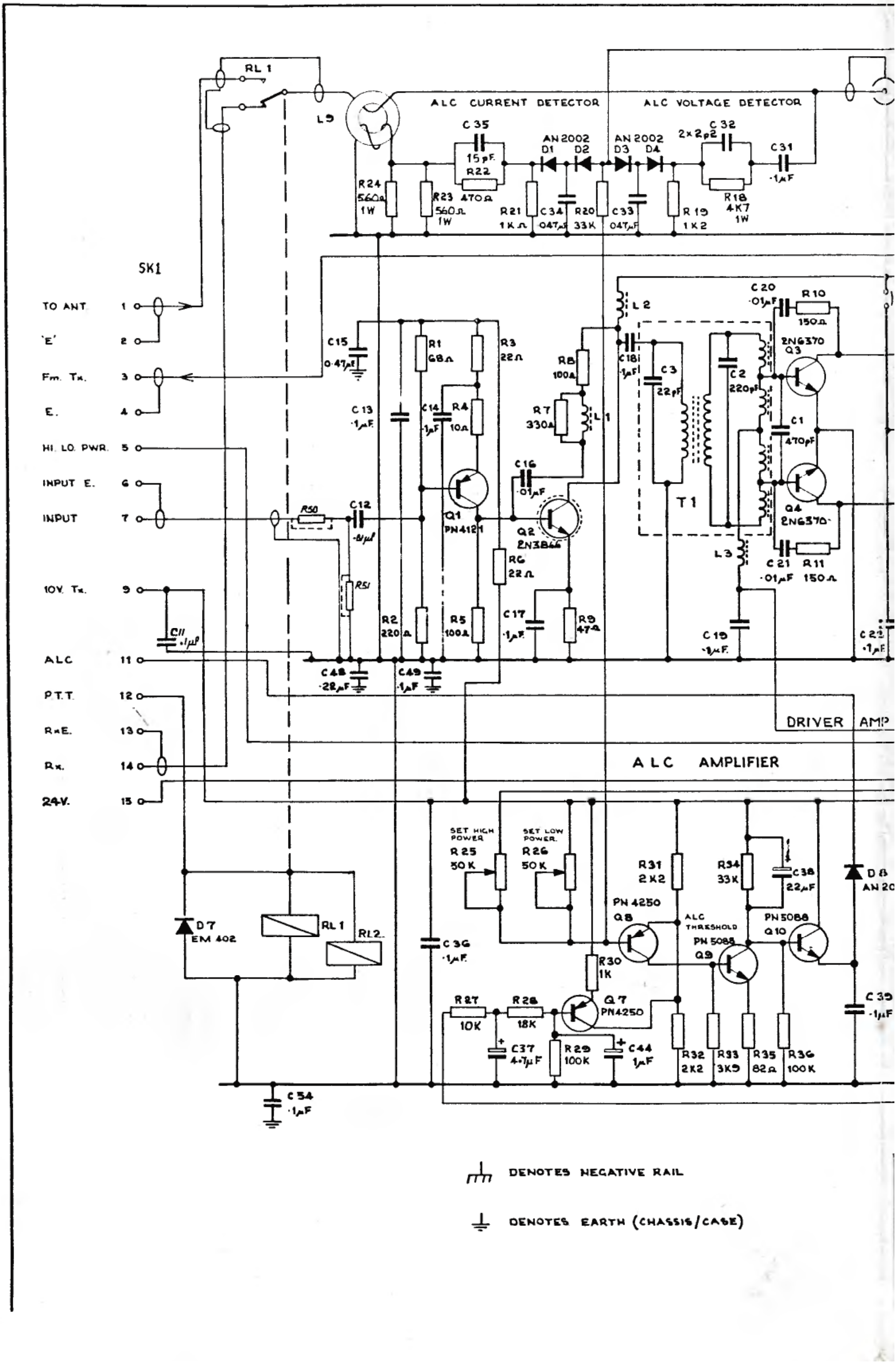


TOP VIEW

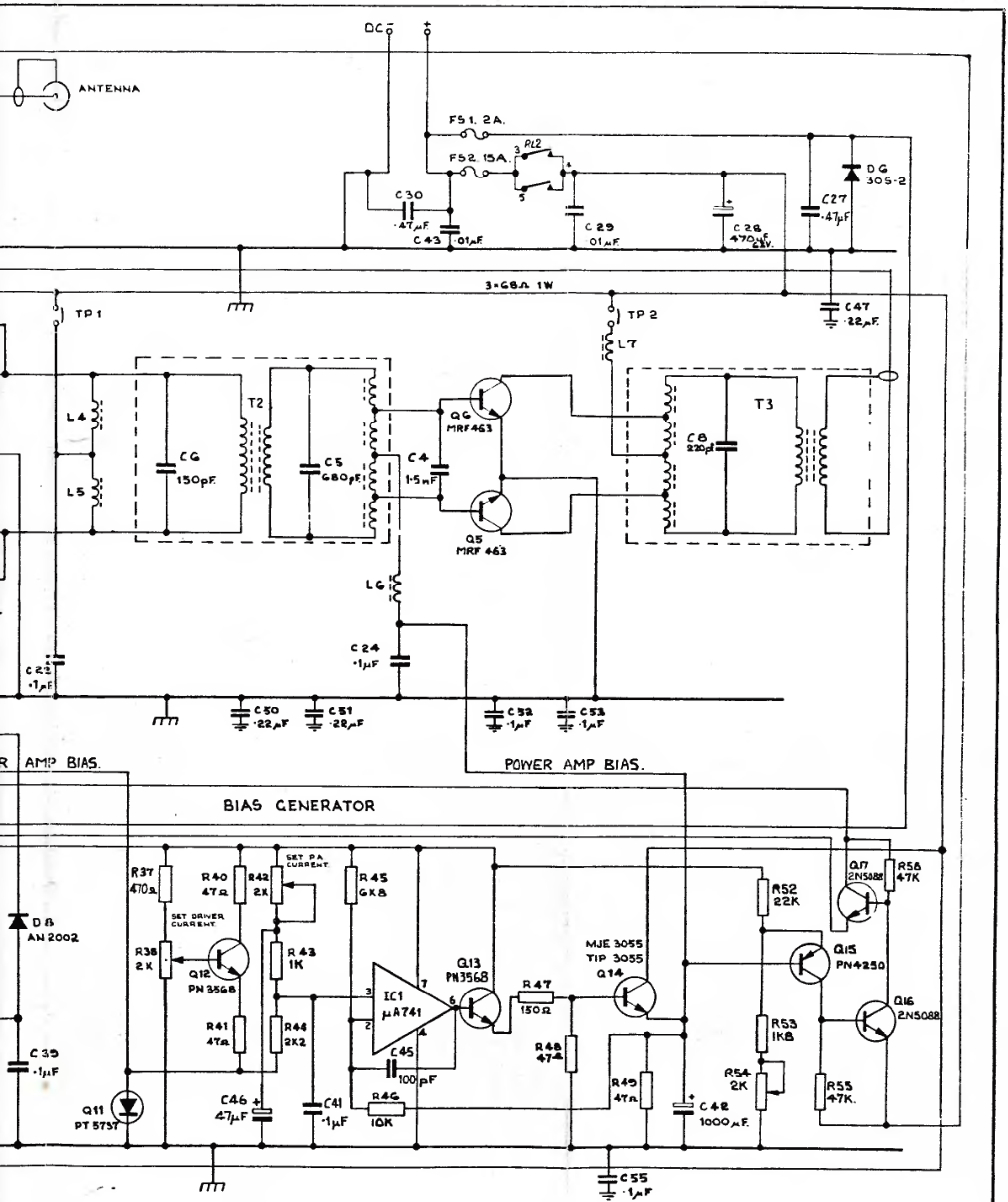


BOTTOM VIEW

Alterations for 24v Shown in Blue



RL 1
L 9
ALC CURRENT DETECTOR
ALC VOLTAGE DETECTOR
C 35
15 pF
R22
470Ω
AN 2002
D1
D2
AN 2002
D3
D4
2×2p2
C 32
C 31
·1μF
R24
560Ω
1W
R23
560Ω
1W
R 21
1K Ω
C34
047μF
R20
33K
C33
047μF
R 19
1K2
R18
4K7
1W
SK1
TO ANT
1
'E'
2
Fm. Tx.
3
E.
4
HI. LO. PWR.
5
INPUT E.
6
INPUT
7
10V. Tx.
9
ALC
11
P.T.T.
12
Rx E.
13
Rx.
14
24V.
15
C15
0·47μF
R1
68Ω
R3
22Ω
C 13
·1μF
C14
·1μF
R4
10Ω
R50
C12
·1μF
R51
C11
·1μF
Q1
PN4121
Q2
2N3866
R6
22Ω
R2
220Ω
R5
100Ω
C 17
·1μF
R9
47Ω
C48
·22μF
C49
·1μF
L 2
R8
100Ω
R 7
330Ω
L 1
C 16
·01μF
C18
·1μF
C 3
22pF
C 2
220pF
T 1
L3
C 19
·1μF
C 20
·01μF
R 10
150Ω
2N6370
Q3
C 1
470pF
Q4
2N6370
C 21
·01μF
R 11
150Ω
C 22
·1μF
DRIVER AMP
ALC AMPLIFIER
SET HIGH POWER
R 25
50 K
SET LOW POWER
R 26
50 K
R31
2K2
R34
33K
C38
22μF
D 8
AN 20
PN 4250
Q8
ALC THRESHOLD
PN 5088
Q9
PN 5088
Q 10
D7
EM 402
RL 1
RL2
C 36
·1μF
R30
1K
Q 7
PN4250
R 27
10K
R 28
18K
C37
4·7μF
R29
100K
C44
1μF
R32
2K2
R33
3K9
R35
82Ω
R36
100K
C 39
·1μF
C 54
·1μF
DENOTES NEGATIVE RAIL
DENOTES EARTH (CHASSIS/CASE)



03					
02					
01	FIRST ISSUE	MC	13/12/6		
REV. No	DESCRIPTION	BY	DATE		

MACHINING

Tolerance unless otherwise specified

Fractional ± 1/64"

Decimal .01. ±.005

Decimal .001. ±.0005

TREATMENT

DRAWN	MC 13/12/6	CHECKED	
TRACED		CHECKED	
APP'D			

DO NOT SCALE WORK TO FIGURES

SCALE

MATERIAL	
ROUGH SIZE	

CIRCUIT DIAGRAM 24V. L.P.A.

DRAWING No. A2/13715

7. NOISE BLANKER

7.1 PRINCIPLES OF OPERATION - See Figure 7.1

The Noise Blanker removes short pulses of signal (noise) to prevent them from passing on to the following stages of the receiver. It is fitted in the receiver immediately before the filter assembly.

Signals pass through the Blanker via two circuits. The main circuit comprises a Signal Delay Buffer, a Noise Gate and a Buffer, the output of which is then passed on through the receiver.

The second circuit comprises a Noise Amplifier, a Pulse or Noise Detector and an Amplifier. This second circuit derives pulses which are then used to switch the Noise Gate of the main circuit thus removing the noise spikes imposed on the wanted signal.

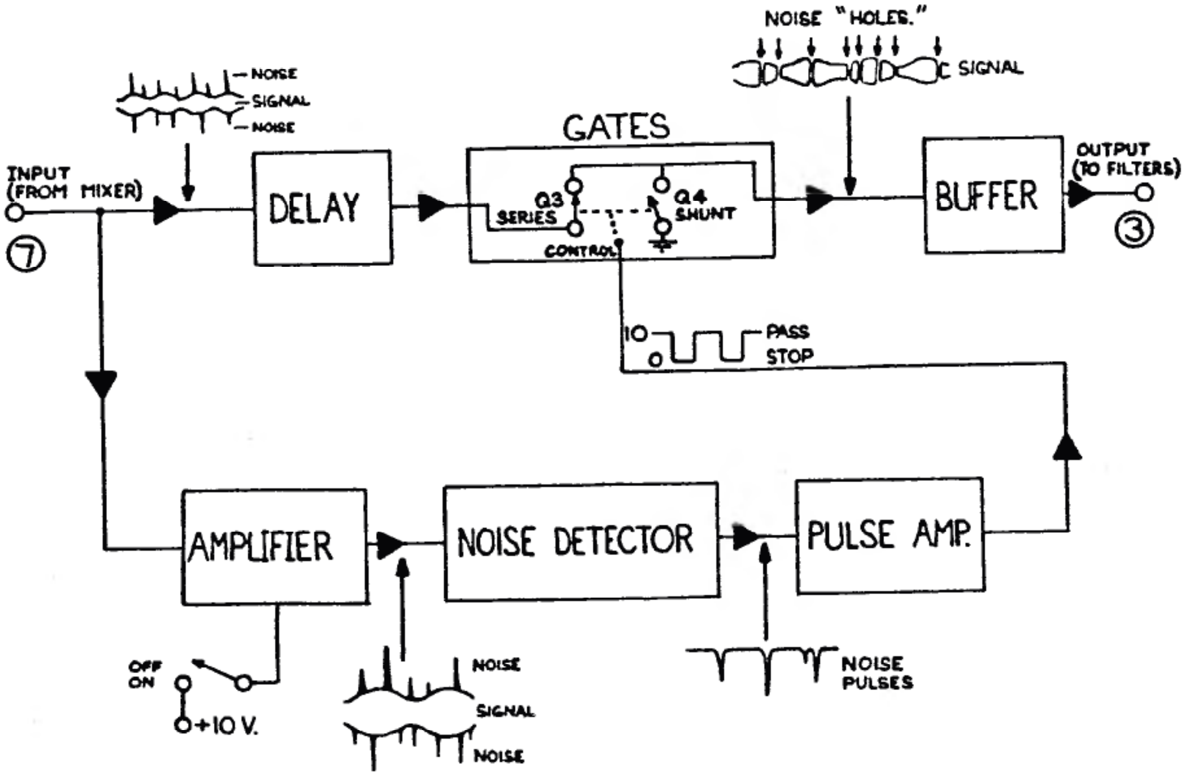


FIGURE 7.1 NOISE BLANKER BLOCK DIAGRAM

7.2 DETAILED DESCRIPTION - See Figure 7.2

Signals are delayed by L1 and L2 being 'High Q' tuned circuits. Q1 isolates the two coils and Q2 isolates L2 from, and provides a low impedance drive for, the Noise Gate. There is little or no gain between Pin 7 input and Q2 emitter.

Q3 is a series gate and Q4 is a shunt gate. During normal signal conditions Q3 is on, Q4 is off. The control voltage on the gates of the two FETS being high (+10V via R34 and R35). Q5 is an emitter follower buffer output to pin 3.

Signals are also amplified by Q6 and Q7. The first stage having a gain of approximately 8-12 and the second stage 17-25. Overall voltage gain from Pin 7 to Q7 drain is therefore 135 to 300. Local AGC is applied around this amplifier, being derived from Q8 and Q9. Q8 is biased from R22 and R23 just below conduction and detects positive half cycle of RF when signal is present. R25, R26 and C20 form an averaging filter, the average voltage appearing across C20. When this voltage is above 0.6V, Q9 conducts and pulls down Gate 2 of Q6 which reduces Q6 gain. Hence AGC action.

Amplified signals are passed to the pulse detector D1 and D2. D1 conducts on positive RF cycles and produces a positive voltage across C24, and follows all but very fast changes of inputs. D2 conducts on <u>negative</u> RF cycles only when the negative cycle is larger than the positive offset due to the D1 circuit. Hence only fast negative pulses are detected by D2.

These pulses are amplified be Q10 and again by Q11. R35 controls the attack time of the pulses (negative going edge) and R34 controls the pulse width or decay time (positive going edge). These pulses drive the gate FETS Q3 and Q4, and during noise pulses Q3 is turned off, Q4 is turned on, thereby gating the receiver signal path off.

Q12 is an audio gate. Its control is available on TP2 on the copper side of the PCB. Q12 circuitry has nothing to do with the Noise Blanker but is added so the PCB assembly is compatable with earlier audio processing noise limiters.

7.2.1 TUNING

1. With Noise Blanker fitted to transceiver and signal applied, tune L1 and L2 (nearest centre of Noise Blanker PCB) for maximum receiver gain. Measure minimum AGC volts on transceiver TP22.

2. With Noise Blanker on, tune L3 and L4 (nearest side and top of PCB) for <u>minimum</u> volts on TP1(centre edge of PCB). Adjust signal input as necessary.

7.2.2 QUICK CHECKS

1. No signal level change between Pin 7 and Pin 3 - transceiver RX, TX Noise Blanker on or off.

2. Signal and noise observable with CRO on Q7 drain (lead nearest corner of PCB) when Noise Blanker turned on. DC at this point +10V when Noise Blanker on.

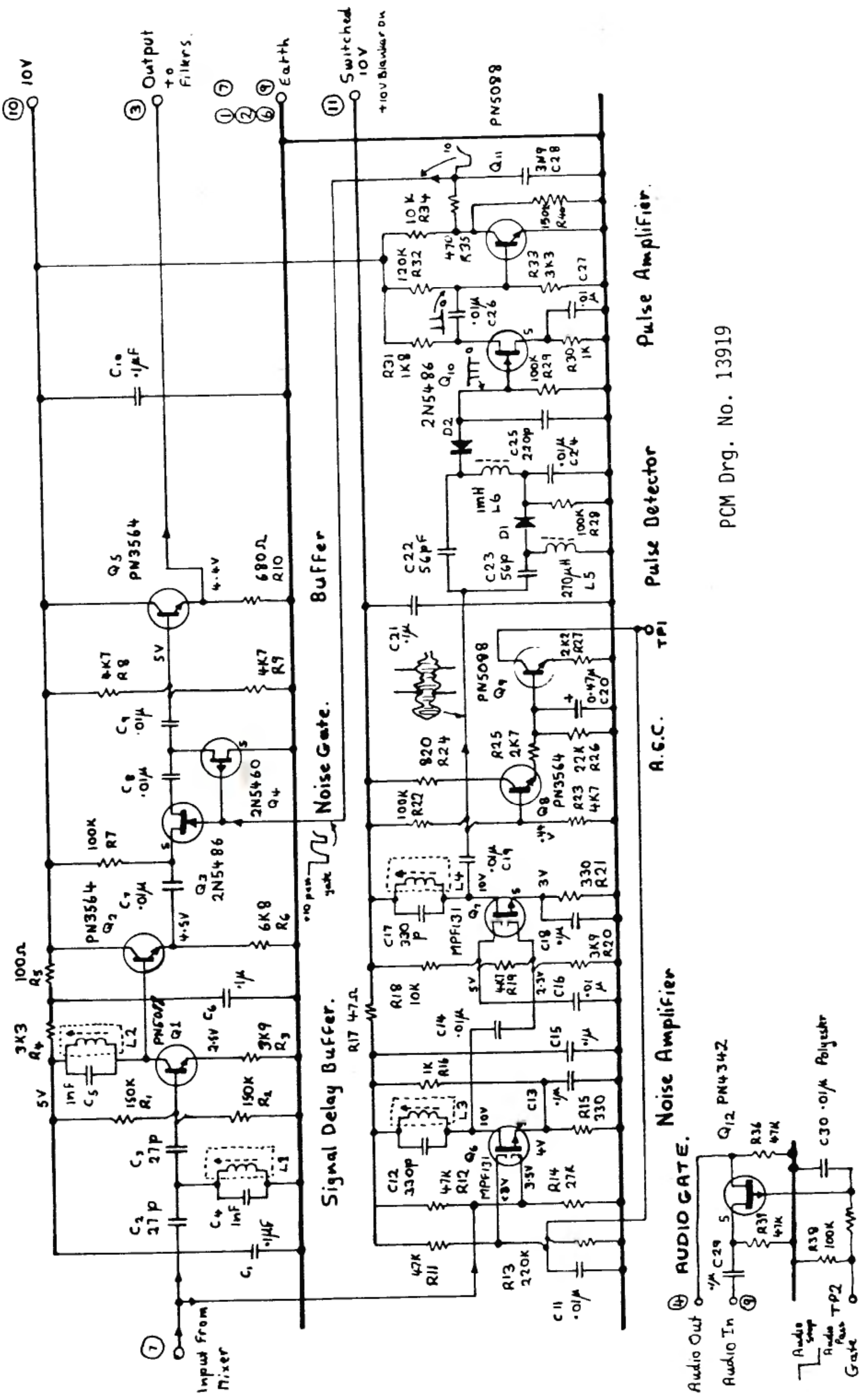


FIGURE 7.2 NOISE BLANKER CIRCUIT DIAGRAM

7.3 FITTING INSTRUCTIONS

NOTE: This unit has been fitted as standard equipment from S. No. 3700 approximately.

Remove existing ANL/MUTE PCB by desoldering pads under main base PCB. If Mute is fitted, cut wires from back of PCB and re-use on new Mute if this is being fitted, otherwise tie back in loom.

Make sure there is no link fitted on main base PCB between Pins 3 and 7.

Insert new PCB on main base PCB, component side towards front of set.

Prior to soldering, remove audio coax. leads from under PCB unless the audio gate is required for tone-call operation. Where this is used, wire control lead from tone decoder to TP2 on Blanker PCB.

If neither Mute or Tone Calling is used, the audio circuit on the main base PCB can be completed with a link on the underside of the PCB where coax. wires originate near TP8.

7.3.1 SERVICE PROCEDURE

If If signal does not pass through Blanker:

1. Check that DC voltage (8V to 9V) appears on Q3 and Q4 gates.

   If low or no voltage, check Q11 which should measure 0.2V to 0.3V positive on base (top of R32 or R33) and be non-conductive. If collector voltage is low (less than 8V) Q11, C28 or FET Q4 is probably leaky or shorted.

2. The operation of Q3 and Q4 may be checked in circuit with a DC ohm-meter by shorting the gates to ground, when Q3 should go open circuit and Q4 become a low resistance. (Source to to drain in both cases).

3. Trace IF signal (1650 KHZ at about 10mV) from Pin 7 through to Pin 3. If signal disappears, a check with multimeter around fault area should quickly show up faulty component. (Note voltages shown on diagram).

4. To check operation of Noise Amplifier connect 10V at Pin 11 and feed 1650 KHZ at about 5mV PP to Pin 7 and check that between 0.7V and 1.5V appears at drain of Q7 (top of C17 or R22) with AGC line disabled by lifting Q9 collector.

7.3 FITTING INSTRUCTIONS (Continued)

5. AGC action can be checked by reconnecting Q9 collector when the following conditions are regarded as typical (+/- 20%).

INPUT SIGNAL	OUTPUT SIGNAL	AGC VOLTS (TPI)
15mV PP	2.5V PP	7.8V dc
18mV PP	3.0V PP	6.5V dc
20mV PP	3.2V PP	6.3V dc
22mV PP	3.3V PP	5.0V dc
45mV PP	3.5V PP	4.6V dc

Q8 is DC biassed just below conduction point so that Q9 is also shut off until triggered by Q8. The function of Q9 is to act as a variable resistor to drain voltage from Gate 2 of Q6.

6. Operation of the Pulse Detector and Amplifier can best be checked in a receiver with incoming noisy signal. Rectified pulses should be seen at top of R32 and R33.

7. Audio Gate may be checked by applying 8-10V DC to TP2 when audio should not pass. With TP2 disconnected 1 or 2V PP should pass with little attenuation.

7.4 PARTS LIST - See Figure 7.3

REFERENCE	DESCRIPTION	PART NO.
	PCB	13920
	Connecting Pin Strip	TML-00001
	Test Pins	PCH-00001
	Ferrite Bead	FER-00001
	Sleeving, PTFE, 1.5mm	INS-00001
C1,6,10,13,15, 18,21,29	Capacitor, Ceramic, 100nF	CAP-015-4101
C2,3	Capacitor, Ceramic, NPO, 27pF	CAP-014-7270
C4,5	Capacitor, Styro, 1nF	CAP-203-6102
C7.8.9.11.14.16, 19,26,27	Capacitor, Ceramic, 10nF	CAP-012-4103
C12,17	Capacitor, Styro, 330pF	CAP-201-7331 or CAP-203-7331
C20	Capacitor, Tag, 0.47uF, 16VW	CAP-501-3474
C22,23	Capacitor, Ceramic, NPO, 56pF	CAP-014-4560 or CAP-006-5560
C24,30	Capacitor, Greencap, 10nF	CAP-101-5103
C25	Capacitor, Ceramic, Hi-K, 220pF	CAP-008-5221
C28	Capacitor, Greencap, 3.9nF	CAP-101-3392

7.4 PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
D1,2	Diode, IN4148	DSG-00001
L1,2	Coil Assembly	13922
L3,4	Coil Assembly	13923
L5	Choke, 270uH	Col-00014
L6	Choke, 1mH	Col-00023
Q1,9,11	Transistor, PN5088	TGN-00002
Q2,5,8	Transistor, PN3564	TGN-00001
Q3,10	Transistor, 2N5486	TFN-00001
Q4	Transistor, 22N5460	TFP-00002
Q6,7	Transistor, MPF131	TFN-00002
Q12	Transistor, 2N4342	TFP-00001
R1,2,40	Resistor, 150K, 5%, 1/4W	RES-302-6154
R3,20	Resistor, 3K9, 5%, 1/4W	RES-302-6392
R4,33	Resistor, 3K3, 5%, 1/4W	RES-302-6332
R5	Resistor, 100ohm, 5%, 1/4W	RES-302-6101
R6	Resistor, 6K8, 5%, 1/4W	RES-302-6682
R7,22,28,29,38	Resistor, 100K, 5%, 1/4W	RES-302-6104
R8,9,19,23	Resistor, 4K7, 5%, 1/4W	RES-302-6472
R10	Resistor, 680ohm, 5%, 1/4W	RES-302-6681
R11,12,36,37,39	Resistor, 47K, 5%, 1/4W	RES-302-6473
R13	Resistor, 220K, 5%, 1/4W	RES-302-6224
R14	Resistor, 27K, 5%, 1/4W	RES-302-6273
R15,21	Resistor, 330ohm, 5%, 1/4W	RES-302-6331
R16,30	Resistor, 1K, 5%, 1/4W	RES-302-6102
R17	Resistor, 47ohm, 5%, 1/4W	RES-302-6470
R18,34	Resistor, 10K, 5%, 1/4W	RES-302-6103
R24	Resistor, 820ohm, 5%, 1/4W	RES-302-6821
R25	Resistor, 2K7, 5%, 1/4W	RES-302-6272
R26	Resistor, 22K, 5%, 1/4W	RES-302-6223
R27	Resistor, 2K2, 5%, 1/4W	RES-302-6222
R31	Resistor, 1K8, 5%, 1/4W	RES-302-6182
R32	Resistor, 120K, 5%, 1/4W	RES-302-6124
R35	Resistor, 470ohm, 5%, 1/4W	RES-302-6471

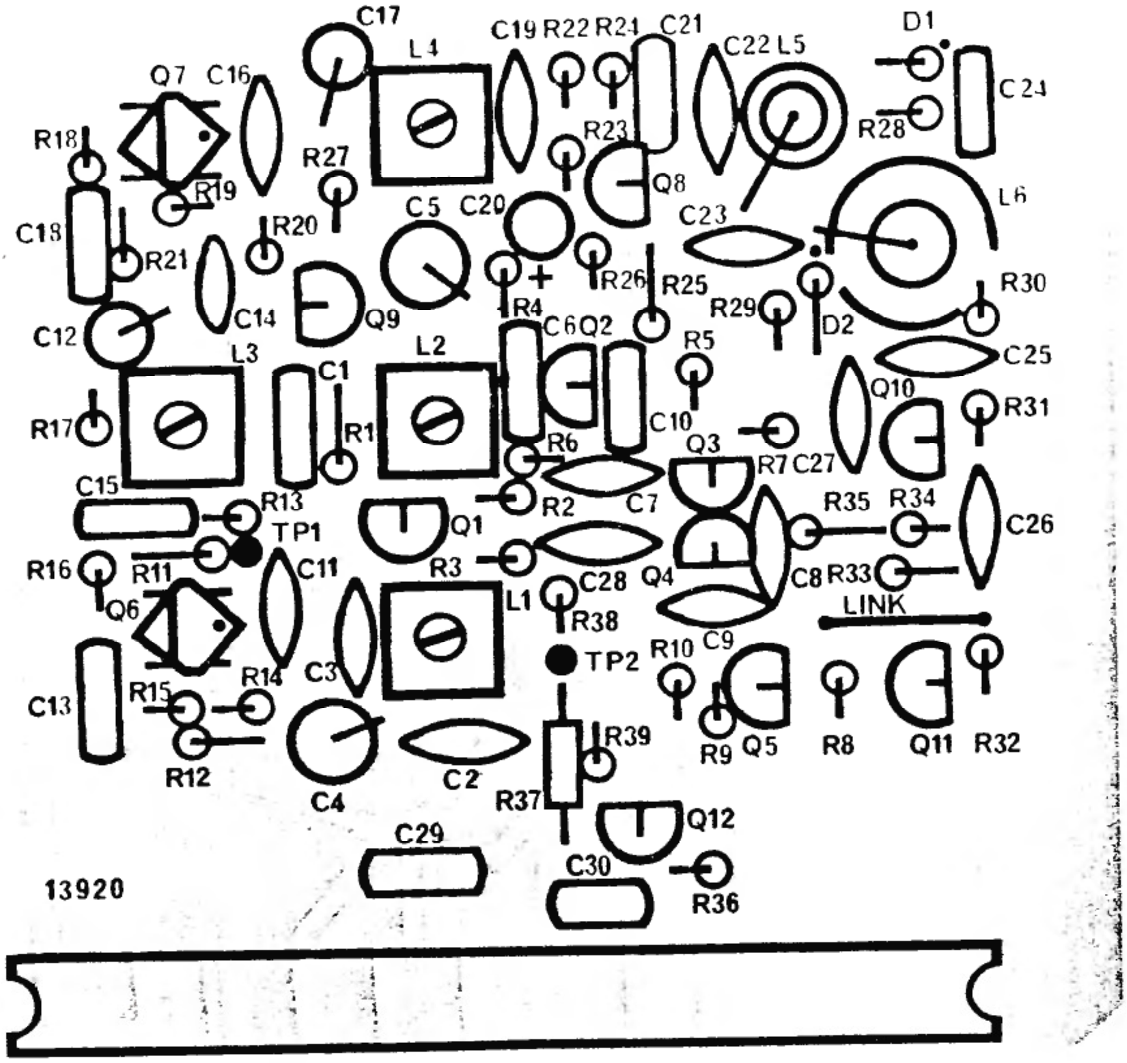


FIGURE 7.4 NOISE BLANKER PCB LAYOUT DIAGRAM

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8. INSTALLATION AND NOISE SUPPRESSION

8.1 MARINE INSTALLATION, GENERAL

As most vessels differ in the construction material used and in antenna types, no attempt will be made to describe specialised fitment techniques. However, the following points should be observed to obtain best results from the equipment.

It should be borne in mind when selecting a site for the radio equipment that the cable from ATU to antennas is part of the radiating antenna and, therefore, only the smallest possible amount should be inside the vessel, particularly if it is inside metal or a metal re-inforced material.

On a ship (or elsewhere), the antenna suitability for the frequencies in use will have a much more dramatic effect on results than the power output of the transmitter. Where good results are required on 2 MHz frequencies, use the longest possible antenna up to about 100 feet, or 30 metres. A long-wire antenna of 25 to 30 feet is to be preferred to a whip antenna where rigging makes it possible to erect it reasonably clear of other metal. On sailing vessels the backstay of a high mast can often be insulated top and bottom and makes an almost ideal antenna.

Whip antennas can give quite good results where the lead is either short or well out in the open, so that it becomes a useful radiating part of the antenna.

Where a long earth lead is unavoidable, it is best to use as long an antenna as possible, otherwise it becomes very difficult to avoid metal on the radio and ATU becoming "hot", that is, there is sufficient RF voltage at the frame of the units to cause burnt fingers, etc.

A remote controlled preset tuning unit (AATU) can be used to avoid many of these problems, by placing it at a point where the antenna lead can be brought in close to a good earth point. The tuning unit is then coupled to the transceiver with a 50 ohm coaxial cable and a multi-wire control cable. The worst feature of this system is that, in the event of the ship losing its antenna in rough weather, there is very little chance of being able to transmit effectively, unless a manual ATU is also provided as a safety measure.

One way to overcome many difficulties brought about by having to place the radio and Manual Antenna Tuning Unit in a safe dry location and the antenna some distance away, is the use of shielded feeder cable. Naturally, it does cause noticeable radiation loss but, to give an example, if the antenna is forty feet long and the screened lead ten feet, the losses on 2 MHz will only amount to about 25%. The lead may then be bundled up with other cables or whatever is convenient (even inside a metal hull) without any interaction taking place.

Where specific problems arise, the manufacturers will always be pleased to advise on methods of overcoming the trouble.

8.2 INSTALLATION INSTRUCTIONS, RADIO

Mount cradle assembly using bolts or screws in a suitable location ensuring that there will be adequate ventilation at the rear of the transceiver.

Attach the transceiver to the cradle using the four knurled head case retaining screws. Ensure that the extension and control sockets on the right hand side of the case are accessible through the cradle cutout.

NOTE: Earth connection is required for antenna tuning unit only, NOT the transceiver.

Connect the primary battery power to the transceiver using the recommended size of cable according to length of run involved. The mating socket for the power connector is included in the transceiver shipping carton.

The following table indicates the minimum cable size for maximum allowable voltage drop. Observe correct polarity to wiring.

LENGTH OF CABLE	24V SETS	12V SETS
Up to 3m	3mm 1/1.38 or 7/0.50	6mm 7/1.04
Up to 6m	4mm 7/.084	7mm 7/1.53
Up to 9m	6mm 7/1.04	Light starter 7/1.70
Up to 15m	7mm 7/1.53	Heavy starter 19.1.35

TABLE 8.2.1

8.3 INSTALLATION INSTRUCTIONS, ANTENNA TUNING UNIT

Do not place the Antenna Tuning Unit on a lower deck than the transceiver. In selecting a position for the antenna tuner in wooden or other non-metal hulled vessels, a position reasonably close to the hull earth plate connection point should be chosen. This position should be a compromise with the antenna location. Use high voltage insulated cable from the antenna terminal of the ATU to the antenna.

A minimum hull earth plate area of half a square metre or 6 square feet is recommended. A dynaplate is better than not having an earth connection.

8.3 INSTALLATION INSTRUCTIONS, ANTENNA TUNING UNIT (Continued)

In metal hulled vessels, the ATU should be mounted close to the nearest effective earth point to the antenna feed point.

Mount the unit in the chosen location, utilising bracket provided.

Connect the ATU earth post to earth point using heavy power cable or a heavy duty strap (similar to vehicle battery earth strap).

8.4 VEHICLE INSTALLATION

Each vehicle presents its own special problems but the following points will assist in achieving the best results from the equipment.

Do not mount rear of cabinet in an enclosed space. Ensure that there is adequate room for air to circulate behind the cabinet and hence through the heatsink.

Most vehicle installations will require battery lead lengths of under 3m. Refer to the Table in Section 6.1 for the grade of cable to use for a given length.

Mount universal cradle assembly and transceiver to avoid excessive vibration against other parts of the vehicle.

Use only good quality coaxial cable and connectors between the transceiver and antennas. Suitable cable is RG58 C/U (50 ohm) and connector type ACME C54-01. Seal exposed antenna connector with Telco tape or equivalent.

Tune antenna for minimum VSWR using a VSWR bridge at the antenna end of coaxial cable.

There are many types of whip antenna available for vehicle use, but at all except the highest HF frequencies in use their radiation efficiency is low. This is because a quarter wavelength at any frequency is the shortest naturally resonant antenna, and any loading to make a shorter antenna electrically equivalent to a quarter wave must result in loss of RF power.

Basically, where more than one frequency is to be used, only three methods can be followed:-

i) A separate tuned whip for each frequency. Usually one base is used and the appropriate whip screwed on as needed.

ii) A tapped tuned whip, which needs to be specifically constructed for each frequency to be used and have the tapping changed each time the frequency is changed.

8.4 VEHICLE INSTALLATION (Continued)

iii) A loaded whip with a 50 ohm resonance somewhat higher in frequency than the highest frequency to be used. A tuning unit is then mounted as close to the base of the whip as practicable and connected to the whip antenna with open wire and to the transceiver with 50 ohm coaxial cable. The earth terminal is connected as directly as possible to the vehicle bodywork.

Either manual or pretuned automatic tuning units may be used. The position of antenna mounting on a vehicle is often difficult to decide, but a few guidelines can be given:-

i) Mount the antenna as high as possible, bearing in mind that the top must not exceed 4 metres at any time the vehicle is travelling.

ii) Do not mount it parallel to metal over any large proportion of its length (such as against a van body).

iii) Avoid mounting close to the engine if it is petrol driven because of spark noise pickup.

iv) On a vehicle with separate cab and bodywork, always mount the antenna on the cab and away from the other metal to avoid receiver noise pickup due to differences in "ground" voltage.

v) When an antenna tuning unit is used, choose a position for mounting where the antenna lead is as short as possible. The length of coaxial lead between radio and ATU is of no consequence in a mobile installation.

8.5 NOISE SUPPRESSION, VEHICLE

This information is designed to assist an installation technician to locate and correct various forms of electrical interference. However, it can only be considered as a guide and cannot be taken as a means to solve all interference problems.

The most likely source of interference in a petrol engined installation is the ignition system. Other items of electrical equipment responsible for causing appreciable interference fields are the generator/alternator, the windscreen wiper and fan motors, the vibrating contacts of current and voltage regulators, fuel pumps, etc. Resistive suppressors fitted in spark plug leads (where these are wire, not carbon) and capacitors fitted to most low voltage equipment will usually reduce interference below signal levels. A further source of interference is the discharge of electrostatic energy built up on the wheels of vehicles.

Spring contacts can be fitted in the wheel bearings to conduct this to the vehicle without sharp discharges.

8.5 NOISE SUPPRESSION, VEHICLE (Continued)

The degree of interference caused depends on the following factors:-

i) The installation layout of the electrical equipment concerned and the length of routing and the associated wiring.

ii) The screening properties inherent in the construction of the vehicle which, in turn, depends on the quality of contact between various panels.

The amount of interference picked up on the antenna can be determined by removing the coax feeder from the antenna base. When the feeder is only accessible at the equipment end, it may be detached at this point. However, this will not differentiate between the interference picked up by the feeder and that picked up by the antenna itself.

The magnitude of interference from any, or all, of the above sources may not cause serious trouble in areas of high signal strength but may assume considerable nuisance value in areas of low signal strength.

Figure 8.6.1 at the end of this chapter shows typical methods of noise suppression.

In many vehicles, it is of great advantage to bond the framework of engines, alternators, and other metalwork to each other by the shortest possible means with heavy braid. Even the bonnet or exhaust pipe of some vehicles may radiate spark plug noise.

8.6 NOISE SUPPRESSION, MARINE

1. Make sure that low resistnace leads are used to the battery. This is the number one noise suppressor in any system.

2. Identify the cause of the noise by switching off items of equipment one at a time.

3. Where the noise is caused by such things as miniature fluorescent lights, it is frequently better to scrap them than to attempt to cure the interference.

4. Noise from generators and alternators can be minimised by fitting suppressor capacitors at the offending machines or their regulators. If this does not cure the trouble, it then becomes necessary to use suppressor units and shielded cables between alternator or generator and the suppressor box which should also contain the regulator.

   This type of suppressor box is supplied as standard equipment with some marine electrical installations but, in many cases, it is found to be wired without shielding on the power cables and is therefore not working correctly.

5. In cases where alternator interference is extreme, and does not respond to the fitting of suppressor capacitors, we can supply a power suppressor unit which can handle current to 60 amps on circuits up to 110 volts. Other voltages to special order. This suppressor unit will reduce the interference from most generators, alternators and regulators to the point where it is difficult to tell from the radio whether they are working or not.

   A few types of 240 volt alternators have regulators which are not economically suppressible.

6. A fairly common cause of interference on wooden or other non-metallic hulls is "propeller-static" which can be identified by always being in synchronization with the shaft speed. It can usually be completely eliminated by connecting a spring strip, in good rubbing contact with the shaft, back to the metal of the shaft gland, and also to the earthing point of the radio.

7. Depending on the type of generator(s) or alternator(s) mounted on engines, it can be a help to either

   a) Bond all frames of engines and other machinery together and then back to the earthing point OR

   b) Isolate selected pieces of equipment.

   It is usually a trial and error job to find which is the best treatment.

8. Small DC electric motors can usually be adequately suppressed by fitting capacitors to the brushgear, either across it or from it to ground, or in stubborn cases both across the brushgear and from series fields to ground on both sides of the circuit.

9. Other electronic devices such as sounders, radar, etc. occasionally cause radio interference, and this is usually because of insufficient attention being given to grounding and shielding when they are installed.

10. In a few cases, where receiver interference is extreme, it has been necessary to mount a whip antenna on the ship's masthead with a remote controlled ATU at its base especially for receiving. This is usually only effective in large vessels where the masthead is a reasonable distance away from the source of the noise. Coaxial cable which must be used to connect ATU to set will not pick up either signals or interference.

11. Regrettably, there is quite a number of small (and a few not so small) ships in the writer's experience where the entire wiring of the vessel is in such a condition that nothing short of completely rewiring the ship would allow the radio to operate satisfactorily. Where any problem of this magnitude is suspected, it is best to inform the owner or captain before proceeding with the job.

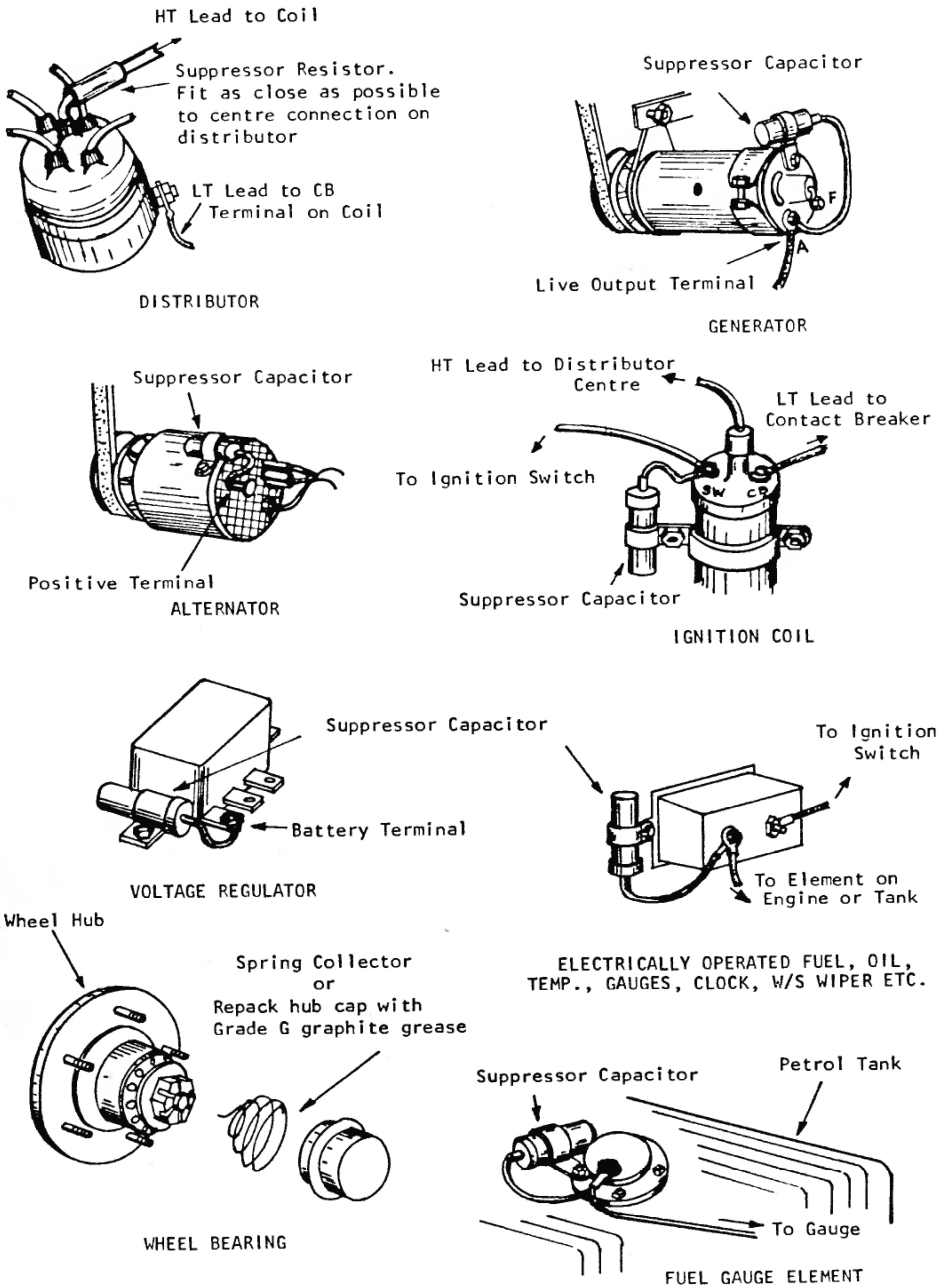

FIGURE 6.3 TYPICAL METHODS OF NOISE SUPPRESSION

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9. TWENTY FREQUENCY MODULE

GENERAL:

In order to accommodate the extra frequencies needed for Radphone and OTC dual frequency channels, we have developed this assembly which may be added to our SSB transceivers to allow the fitting of up to twenty frequencies.

This option may be fitted to any set after Serial No. 645 .

CONSTRUCTIONAL DETAILS:

The frequency determining components for the additional frequencies are fitted on a small circuit board mounted above the channel switch wafers. This board plugs onto pins mounted on the switch wafers.

Two frequency operation is achieved in the standard 10 channel set by switching with 'A-B' relays between 2 poles of the appropriate 2 pole 5 position Switch Wafer Assemblies.

In the twenty frequency option the same relays switch between separate single pole 10 position wafers.

In order to accommodate the additional wafers required, special thin switch wafers have been developed, and there are now eight wafers in place of the former four in the oscillator and RF sections.

In addition to two-frequency switching, the 'A-B' relays may be controlled from a switch on the front panel to allow additional simplex channels to be fitted.

As no alteration has been made in the transmitter harmonic filter, it becomes necessary to make sure when extra simplex channels are fitted that they are within the same filter range. For example, in a Kestrel with 4620 KHz and 2112 KHz fitted, 4535 KHz and 2164 KHz would also be fitted without needing vacant channels.

Conversion details are shown on the accompanying sheet, and the parts list is overleaf.

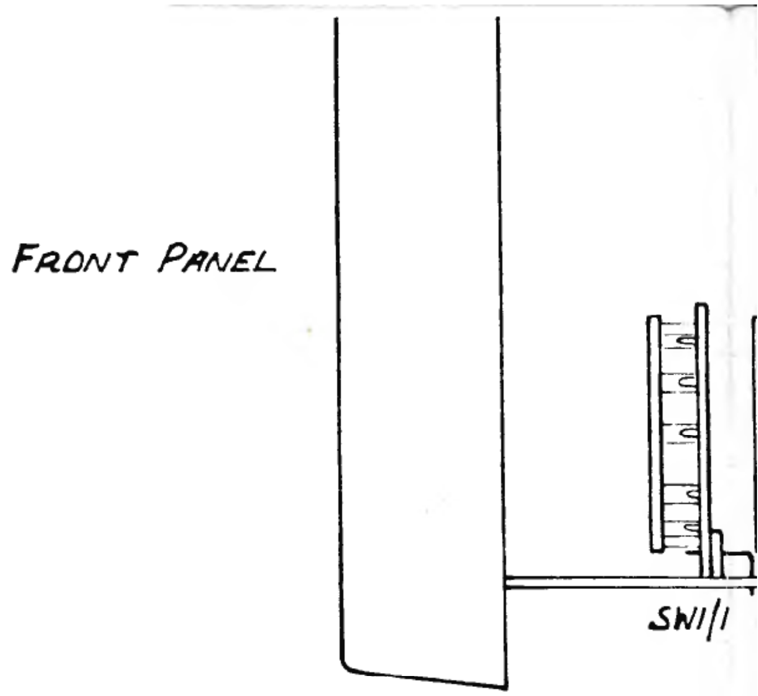
9 TWENTY FREQUENCY MODULE (Continued)

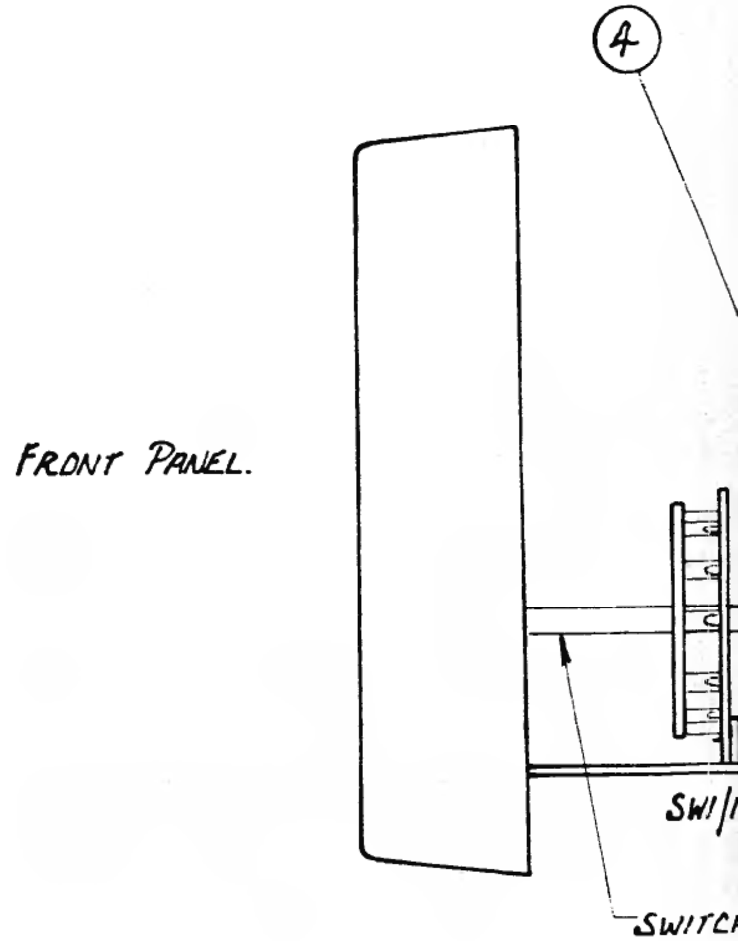
PARTS LIST

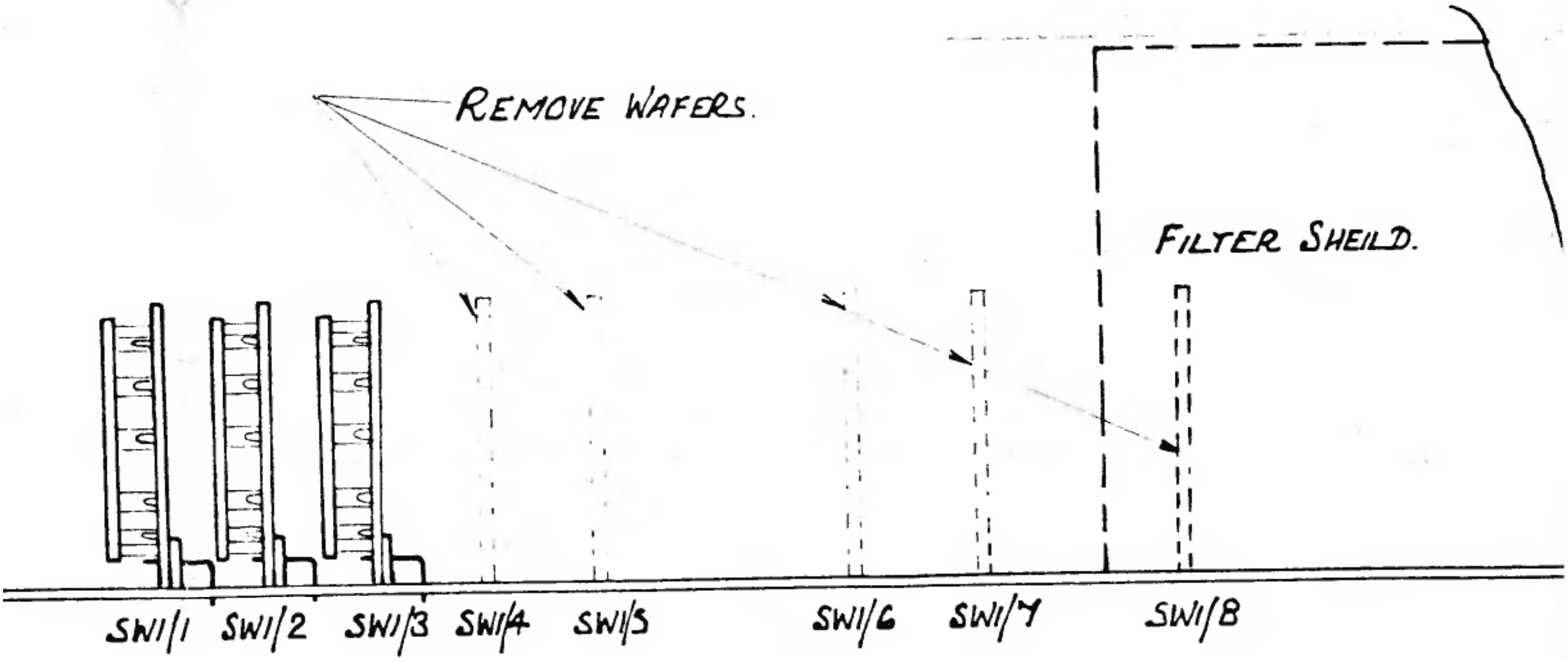
REFERENCE	DESCRIPTION	PART NO.
1	SW1/4a,5a,6a,7a Wafer Assy.	13767
2	SW1/4, 6 Wafer Assy.	13768
3	SW1/5, 7 Wafer Assy.	13769
4	20 Frequency Board Assy. (less channel components)	13770
5	Spacer Insulated Fibre (qty. 8)	13772
6	SW1/8 Wafer Assy.	13013
7	Socket PCB Qty.48	CON-00061
C21,22	Capacitor, Disc Ceramic 0.1uF 63V	CAP-015-4104
	PCB Stake	PCH-00001

HARMONIC FILTER RANGE CHART

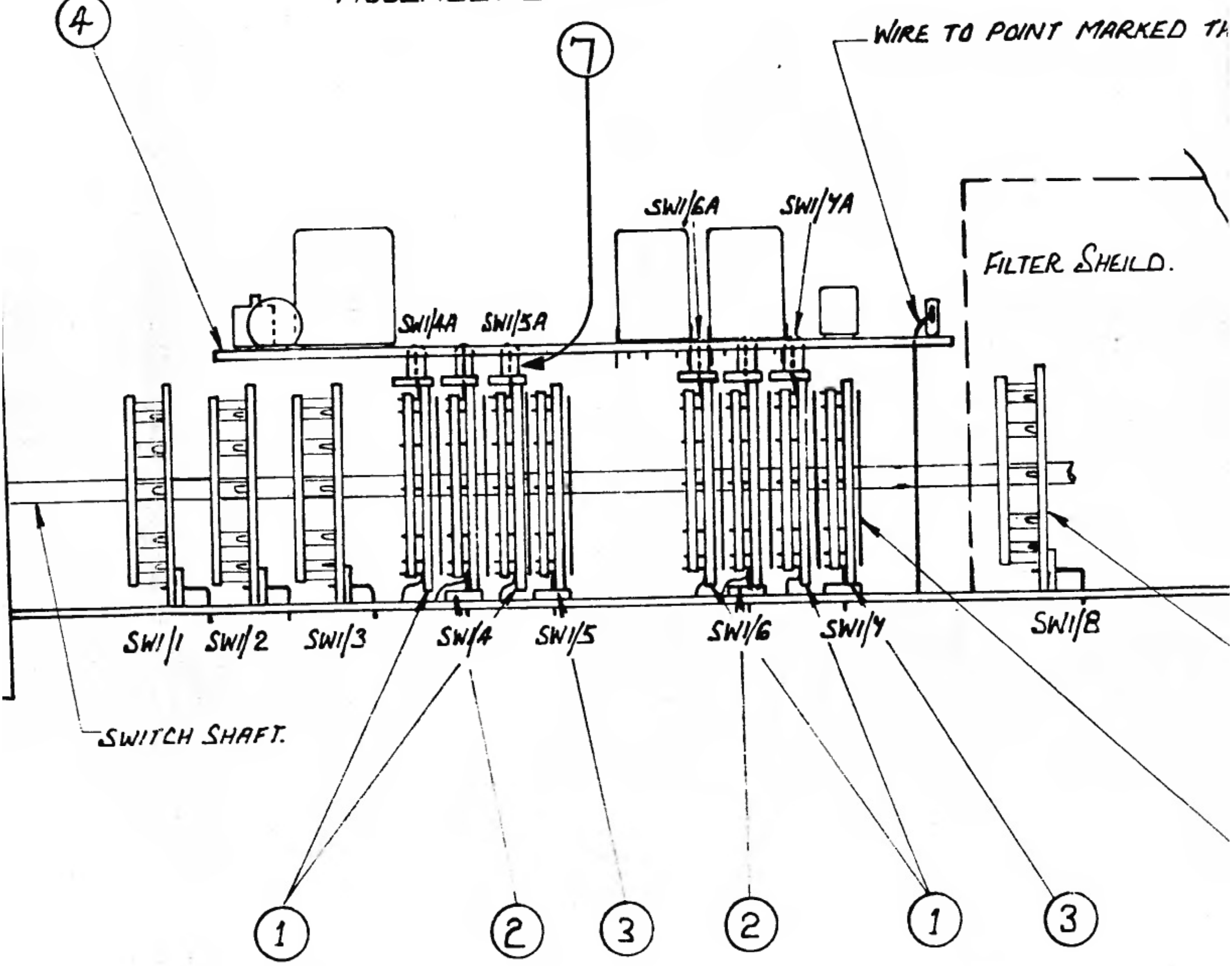
RANGE NO.	FREQUENCY LIMITS
1	2.0 - 2.4 MHz
2	2.4 - 2.9 MHz
3	2.9 - 3.5 MHz
4	3.5 - 4.2 MHz
5	4.2 - 5.0 MHz
6	5.0 - 6.0 MHz
7	6.0 - 7.2 MHz
8	7.2 - 8.6 MHz
9	8.6 - 10.3 MHz
10	10.3 - 12.0 MHz

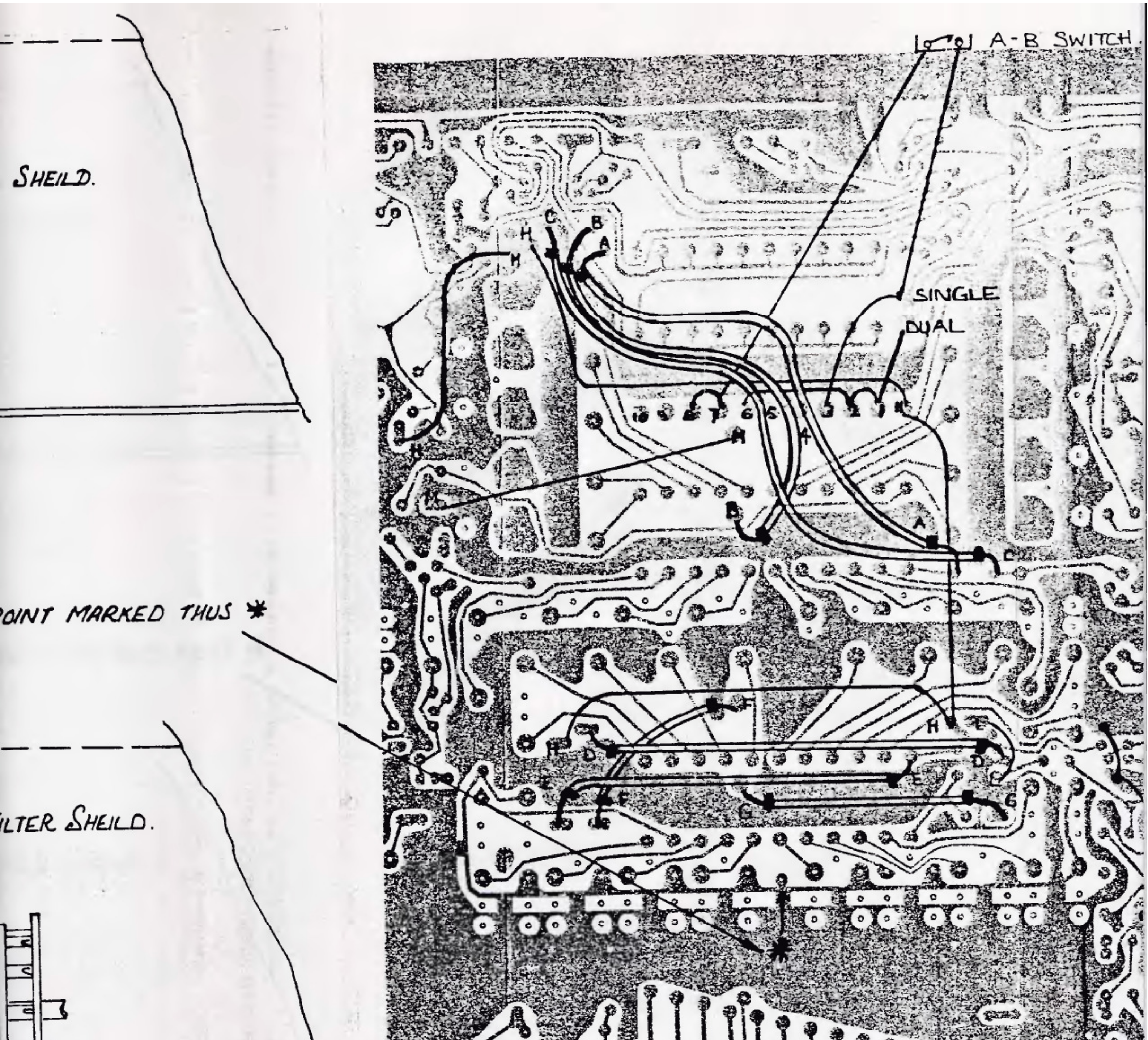

FRONT PANEL
SW1/1


4
FRONT PANEL.
SW1/1

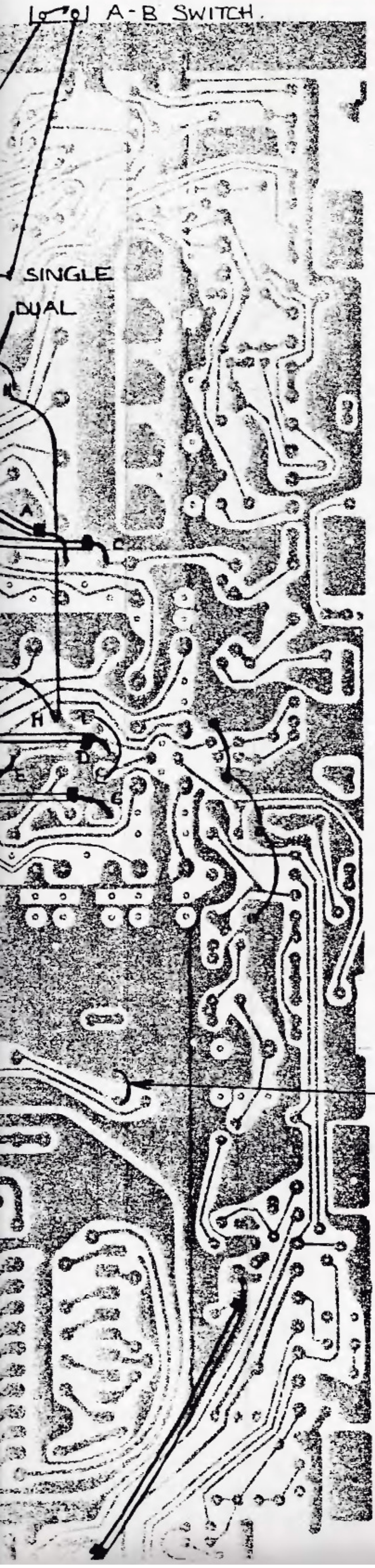


ASSEMBLY DETAIL





SHEILD.
OINT MARKED THUS *
ILTER SHEILD.
SW1/8
6
3
5
A-B SWITCH.
SINGLE
DUAL



DUAL FREQ. - Wire from dual to any required dual channel; Tx channel components on top PCB, Rx channel components on bottom PCB.

SHOWN: Channels 1,2 & 6 are dual freq. channels, Tx channels on top, Rx channel on bottom.

SINGLE FREQ. - Normal. No connections. Rx, Tx on bottom PCB.

SHOWN: Simplex channels on 4,5,9 & 10

SINGLE FREQ. SPECIAL - Wire from single to required channel. Rx, Tx on top PCB

SHOWN: Simplex channel on Channel 3.

TWO SIMPLEX FREQUENCIES - PER CHANNEL Wire "A-B" switch on front panel to "single" (+10V RxTx)

SHOWN: Channels 7 and 8 both have two simplex channels each, which may be selected by operating "A-B" switch.

NOTES:

1. Wire tail on wafers SW1/4A,5A,6A and 7A are to be connected to dual freq. ("A-B" relays) at points M,B,F and G respectively.
2. Wire tails on wafers SW1/4 and SW1/6 are to be connected to earth.
3. All other components not noted are the same as standard 10 freq. SSB
4. RL11 is not fitted on 20 freq. Link as per single frequency.
5. S1/3 is wired differently from 10 channel set. Detailed explanation above at head of page.

LINK AS PER SINGLE FREQ.

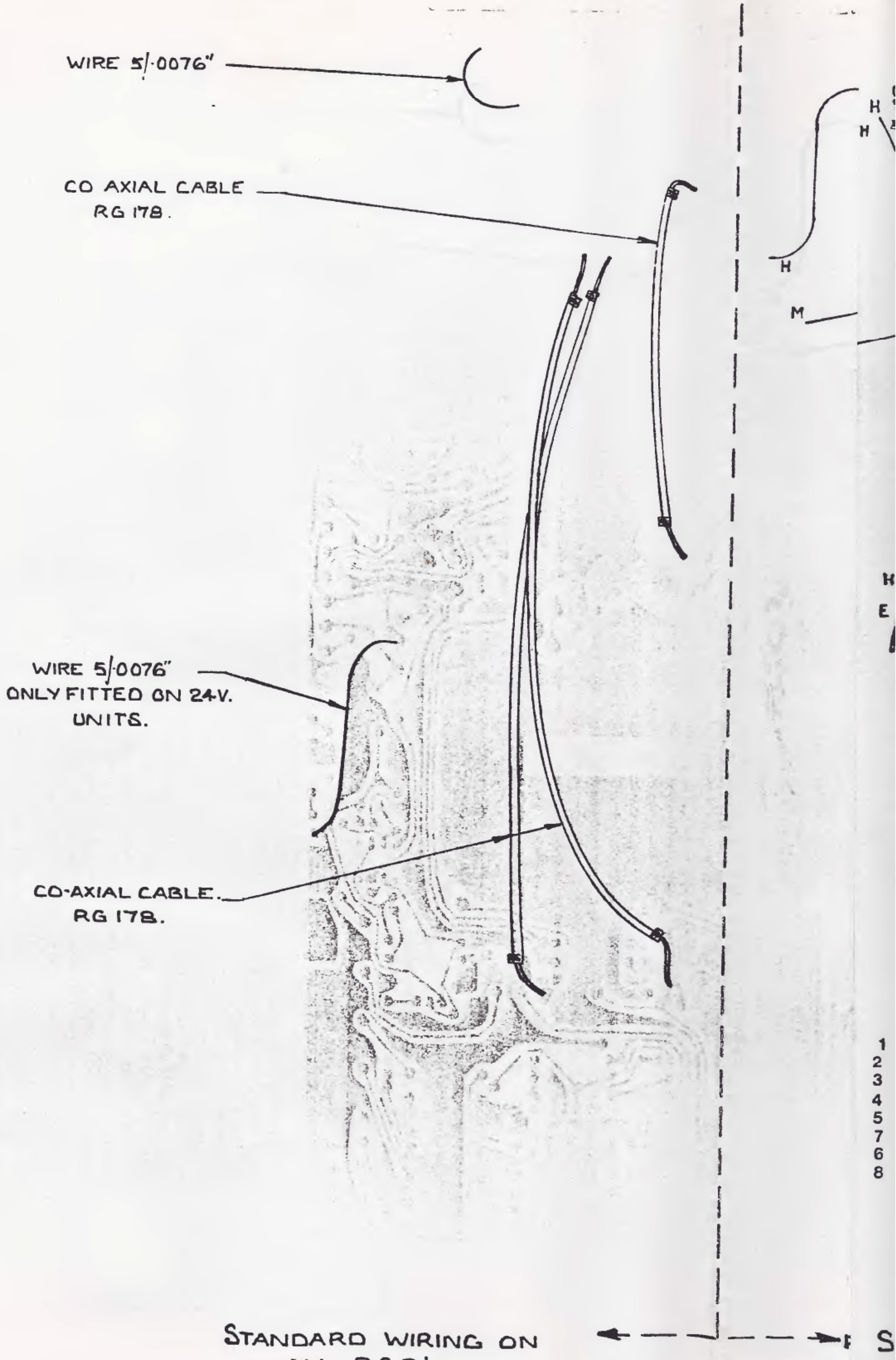
W I R I N G D E T A I L S

Wires A,B,C,D,E,F, & G are Teflon coax. RG 178 B/U.

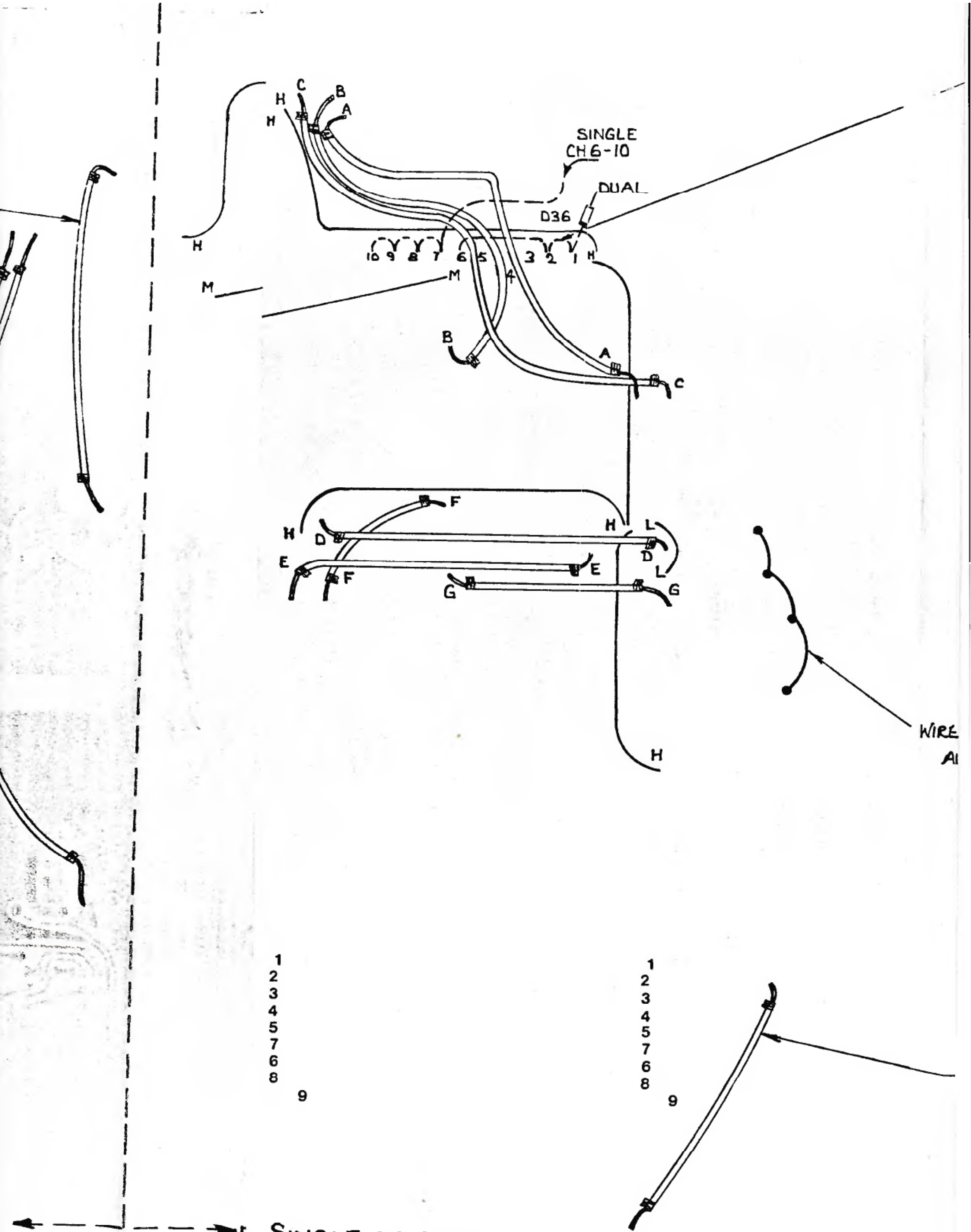
Wire H is 5/.0076"

Wires L & M are 5/.0076"

ASSEMBLY & WIRING DIAGRAM
20 frequency SSB A2 13829



STANDARD WIRING ON ALL P.C.B's



SINGLE OR DUAL
FREQUENCY WIRING
ON P.C.B's

NOTE: CHANNELS 1 AND 6 ARE NORMAL TWO FREQ. SIMPLEX.
I.E. SW. TO CH. 1 : RX FREQ 1, TX FREQ 6
OR " " " 6 : " FREQ 1, TX FREQ 6.
CHANNELS 2 AND 7 ARE SPECIAL TWO FREQ SIMPLEX WITH EXTRA SINGLE FREQ. OPERATION.
IE. SW. TO CH 2 : RX FREQ 2, TX FREQ 7
(NORMAL TWO FREQ OPERATION)
SW. TO CH. 7 : RX FREQ 7, TX FREQ 7
("EXTRA" SINGLE FREQ CH. 7 OPERATION).

WIRING DETAILS.

WIRES A, B, C, D, E, F & G ARE TEFLON CO AX RG 178 B/U
WIRES H 5/·0076"
WIRES L & M 5/·0076"
WIRES BLACK (SHOWN DOTTED) DENOTES SINGLE AND DUAL FREQUENCY OPERATIONS.
SHOWN IS A DUAL FREQUENCY OF CHANNELS 1 & 6, A SPECIAL TWO FREQ CH 2 OR SINGLE FREQ CH 7 AND SINGLE FREQUENCY OF CHANNELS 8, 9 & 10
CHANNELS 3 4 & 5 ARE ALSO SINGLE. FREQUENCY.

WIRE LINKS TO BE ADDED ON ALL SETS. (LINKS TO BE TINNED COPPER)

CO-AXIAL CABLE RG 178 FITTED ON ALL UNITS.

MATERIAL	
ROUGH SIZE	
PROCOM ELECTRONICS PTY. LTD.	
TITLE WIRING DIAGRAM FOR DUAL FREQ. & STANDARD WIRING ON BOTTON SIDE OF M.B.B. SSB.	
DRAWING No A2 13713 C	STATUS C / USED ON

10. CHANNELLING PROCEDURE

The following paragraphs provide the procurement and component information for the installation of additional channels.

A channel kit comprises the following 8 components:-

Channel crystal circuit Ref X2.

Crystal trimming capacitor - VC1.

27pF fixed capacitor ceramic N.P.O. - C105.

R.F. Amplifier input coil - L1-L10

R.F. Amplifier output coil _ L11-L20

3 x LPA Filter capacitors - C124,C135,C145

Additional hook up wire is required for Tap selection on L25 and L26 in the LPA filter assembly.

CHANNEL KITS

These are now available under the following part numbers:-

FREQUENCY RANGE	PART NO.
2.0 - 2.4 MHz	13726
2.4 - 2.9 MHz	13727
2.9 - 3.1 MHz	13728
3.1 - 3.5 MHz	13729
3.5 - 4.2 MHz	13730
4.2 - 5.0 MHz	13731
5.0 - 6.0 MHz	13732
6.0 - 7.2 MHz	13733
7.2 - 8.0 MHz	13734
8.0 - 8.6 MHz	13735
8.6 - 10.3 MHz	13736
10.3 - 12.0 MHz	13737

Crystals to accompany these kits should be ordered by frequency and, to avoid costly errors, it is suggested that channel frequency be specified and we can then make the necessary calculation before procuring the crystal. It is essential that suppressed carrier frequency be stated NOT "Assigned Frequency".

TABLE 10.1

10 CHANNELLING PROCEDURE (Continued)

TABLE 10.2 RF AMPLIFIER INPUT COIL ASSEMBLY

1. Frequency 2.0 - 3.1 MHz

   Coil Assembly Z13075-05-1 consisting of:-

   a) C1 - C10 - 180pF
   b) C11- C20 - 2700pF
   c) Coil - L1-L10

2. Frequency 3.1 - 5.0 MHz

   Coil Assembly Z13075-05-2 consisting of:-

   a) C1 - C10 - 120pF
   b) C11- C20 - 1800pF
   c) Coil - L1-L10

3. Frequency 5.0 - 8.0 MHz

   Coil Assembly Z13075-05-3 consisting of:-

   a) C1 - C10 - 68pF
   b) C11- C20 - 1000pF
   c) Coil - L1-L10

4. Frequency 8.0 - 12.0 MHz

   Coil Assembly Z13075-05-4 consisting of:-

   a) C1 - C10 - 33pF
   b) C11- C20 - 470pF
   c) Coil - L1-L10

TABLE 10.3 RF AMPLIFIER OUTPUT COIL ASSEMBLY

1. Frequency 2.0 - 3.0 MHz

   Coil Assembly Z13081-05-1 consisting of:-
   Coil L11 - L20
   Capacitor C25 - C34, 2 x 680pF

2. Frequency 3.1 - 5.0 MHz

   Coil Assembly Z13081-05-2 consisting of:-
   Coil L11 - L20
   Capacitor C25 - C34, 2 x 680pF

3. Frequency 5.0 - 8.0 MHz

   Coil Assembly Z13081-05-3 consisting of:-
   Coil L11 - L20
   Capacitor C25 - C34, 2 x 680pF

4. Frequency 8.0 - 12.0 MHz

   Coil Assembly Z13081-05-4 consisting of:-
   Coil L11 - L20
   Capacitor C25 - C34, 2 x 680pF

10 CHANNELLING PROCEDURE (Continued)

The following notes will assist in the channel installation:-

1. Tables 10.2 and 10.3 specify L1 - L10 and L11 - L20 for the required frequencies.

2. Harmonic Filter Chart specifies L.P.A. Filter capacitors and coil links for the required frequencies.

3. Accompanying illustration shows component location and link numbering.

4. In marine sets where Channel 10 is 2182 KHz installation of channel components is simplified when the highest channel number as designated on the front panel is used for the lowest frequency of operation. On land sets, the reverse is frequently convenient.

5. If two or more frequencies fall within the same frequency range of the L.P.A. filter, then only one set of filter components is necessary for these frequencies. These channels may be paralleled with links.

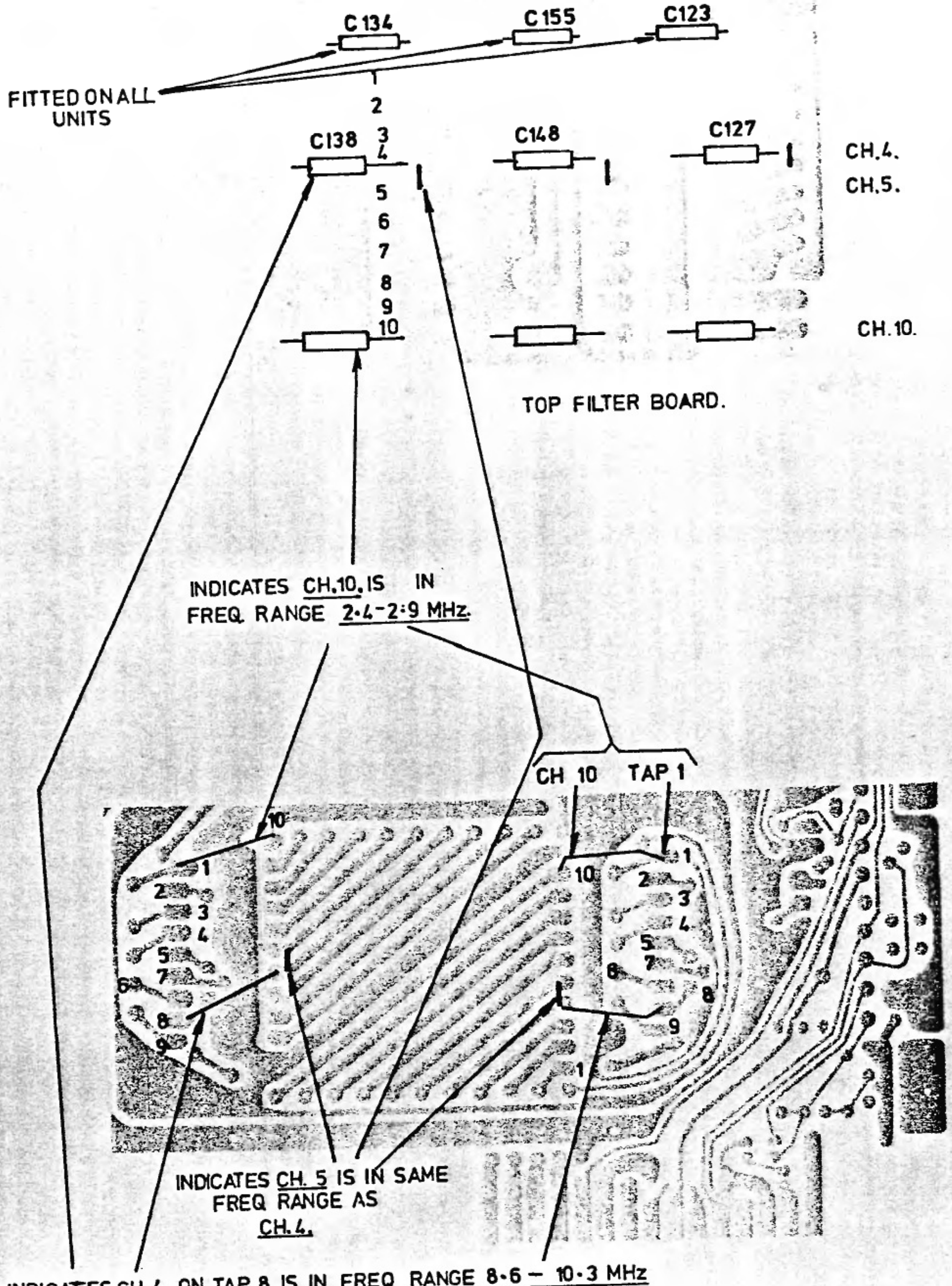
6. To prevent floating circuitry developing high voltages and causing instability, all unused capacitor mounting pads for the centre row of capacitors in the L.P.A. filter must be linked to LPA ground on the top board of the filter.

The channel may then be aligned per Sections 5.3 and 5.7 "Receiver and Transmitter Alignment".

HARMONIC FILTER CHART

FREQUENCY MHZ	C124-C133 C145-C154 pF	C135-C144 pF	L25 AND TURNS	L26 TAP
2.0 - 2.4	820	1800	23	NO TAP
2.4 - 2.9	680	1500	19-1/8	1
2.9 - 3.5	560	1000	16-7/8	2
3.5 - 4.2	390	820	14-1/8	3
4.2 - 5.0	300	680	12-1/8	4
5.0 - 6.0	220	470	9-7/8	5
6.0 - 7.2	150	300	9-1/8	7
7.2 - 8.6	82	180	7-7/8	6
8.6 - 10.3	33	68	6-7/8	8
10.3 - 12.0	-	-	6-1/8	9

TABLE 10.4



PART VIEW OF UNDERSIDE OF MAIN BASEBOARD

HARMONIC FILTER TAPPING

11. MUTE

11.1 PRINCIPLES OF OPERATION

The heart of the Mute system is the Phase Locked Loop (PLL) integrated circuit . Essentially a voltage controlled oscillator looks at incoming audio and changes frequency according to the energy content of that audio. This change is detected and used to drive a FET gate. Note that more low frequency energy exists when voice or signal is present on channel, than when noise only exists.

11.2 DETAILED DESCRIPTION

IC1 and IC2 fulfill most functions required. IC1 is a Quad Operational Amplifier, having four independent amplifiers of conventional high impedance input design similar to Type 741. IC2 is a CMOS Phase Locked Loop with various input, output and control capabilities.

Audio from transceiver detectors enter at Pin 6. IC1/a is a high gain clipping amplifier. Semi-clipped audio is observable on Pin 10 at about 5Vdc. IC1/b further amplifies this signal. Hard limited (clipped) audio is observable on Pin 4 at about 5Vdc. This signal is applied to IC2, Pin 14 via C5.

C7, R7, R6, the Mute control position and the incoming audio control the frquency of the PLL Voltage Controlled Oscillator (VCO).

With 'of air' signals a jittery sawtooth waveform appears on Pins 6 and 7 (1M ohm minimum load) at VCO frequency. R8, R9, D5 and C8 control the rate of change of VCO frequency to 'off air' signals. This derived voltage on C8 is observable on TP1, as a dc voltage. When voice is present this voltage drops away quickly in sympathy, and rises slowly in sympathy.

There are two Mute control options available, an on-off switch or a theshold potentiometer. In the following text information is given for both methods of control. Certain parts of the information apply only to one or the other method, and should not be confusing if read with this in mind.

P7 Mute potentiometer (or S1 switch) and R7 control TP1 voltage to be above 5Vdc for transceiver muted and below 5Vdc for transceiver unmuted.

IC1/c is a comparator, i.e., when Pin 2 is above Pin 1, the Pin 3 output goes high and vice-versa. Pin 1 reference voltage is derived from +10Vdc rail via R13, R14 divider and Q1. Q1 is normally on hence reference voltage on Pin 1 is 5Vdc. IC1/c output TP2 is high when there is no signal on channel and low when signal is present and Mute control adjusted correctly.

11.2 DETAILED DESCRIPTION (Continued)

IC1/c output drives Mute gate FET via D7, R16, R17, C10 and R22 network. This network gives a fast attack (opening of gate) and slow decay (closing of gate).

When Mute control is hard to ground (anticlockwise) or mute switched off, Q1 turns off, IC1/c Pin 1 goes high, hence Pin 3 low and the Mute gate opens, irrespective of TP1 volts.

11.3 SETTING UP AND ADJUSTING CONTROLLABLE MUTE

It is essential that this adjustment procedure be followed carefully. Any other method of setting up will result in poor performance.

1. Set Mute knob to half scale.
2. Connect an antenna and a signal generator to the antenna lead of the transceiver.
3. Select a channel that is not carrying noticeable signals.
4. Set the signal generator to produce an audio signal of about 400Hz and a signal to noise ratio of about 10dB.
5. Adjust preset pot on the Mute board so that the signal is just breaking with noise.
6. Disconnect the signal generator and connect transceiver to a normal antenna.
7. Set Mute threshold by turning panel knob anticlockwise until Mute breaks, and then backing off slightly. Mute will 'hang' for 4 to 5 seconds before switching off audio, so this adjustment must be made carefully.
8. If the operator is not satisfied with the Mute operation, repeat steps 5, 6 and 7, varying the Mute threshold, until satisfactory operation is achieved.
9. When setting up the Mute take care that the noise from the antenna does not take the form of a tone of less than 600Hz, as this may keep the Mute latched off, i.e., audio passing.

Note: Any departure from the conditions in step 4 above will cause a serious malfunction of the Mute, possibly even locking out completely on good signals, particularly if the adjustment has been made on too good a signal to noise ratio.

11.4 SETTING UP SWITCHED MUTE

1. Set preset pot on panel switch at half scale.
2. Turn Mute switch to unmuted position (toggle down).
3. Proceed as for 'Adjusting Controllable Mute' above.

11.5 SERVICING

11.5.1 EQUIPMENT REQUIRED

1. High impedance meter (FET or VTVM)
2. CRO with 10:1 probe
3. 10V regulated supply (may be taken from transceiver)

11.5.2 PROCEDURE

For ease of accessability, remove Mute PCB from the main PCB by desoldering, and connect a ground wire between the two boards.

Remove loom termination in sets prior to Serial No. 4500 and re-connect this to the main PCB where the Mute board is removed.

Leave other wires and coax lines connected.

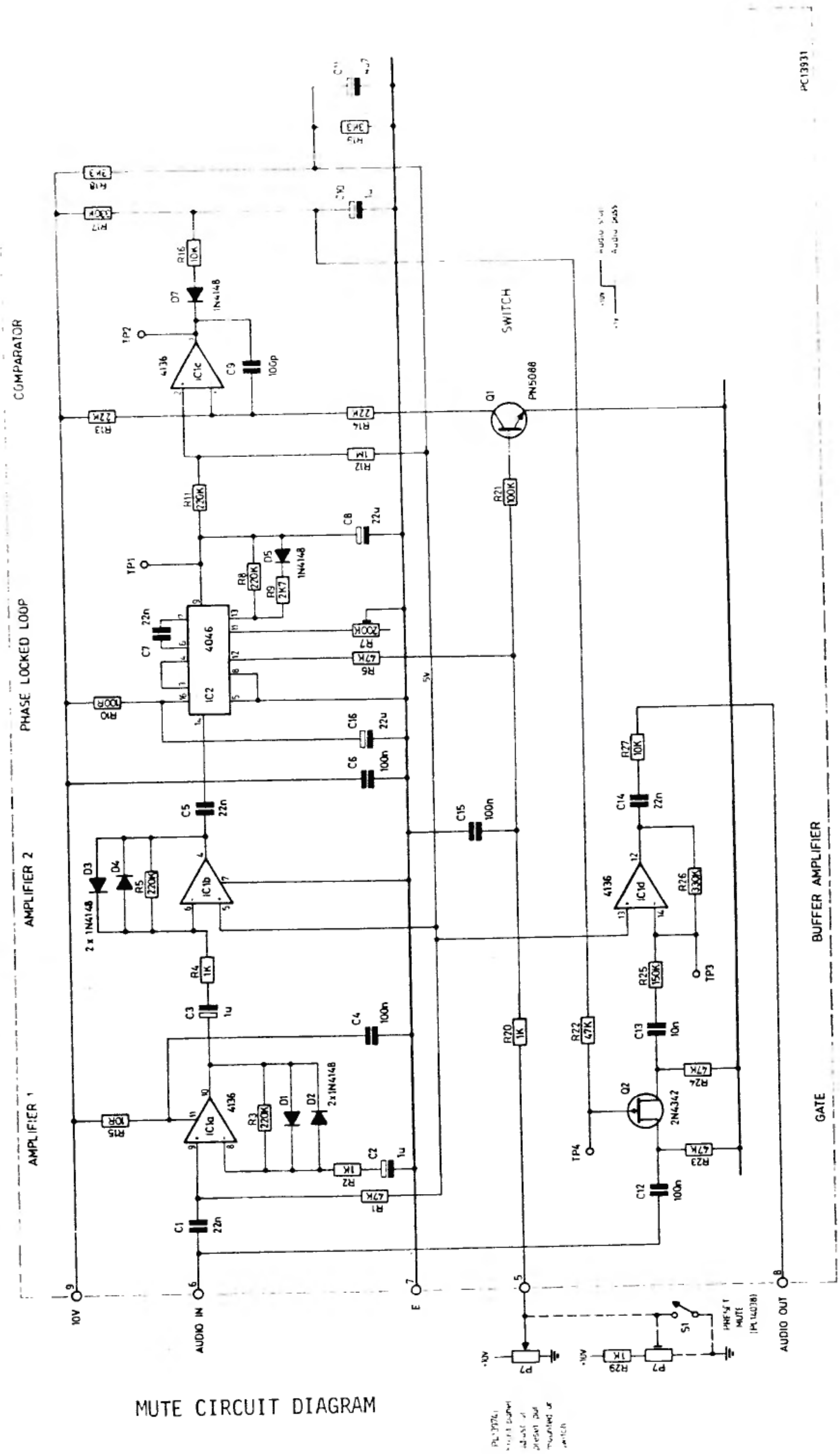
First check dc voltages:

IC1	Pin 1	variable (see text)	Pin 2	5V	+ Muted - Unmuted
	Pin 3	variable (see text)	Pin 4	5V	
	Pin 5	5V	Pin 6	5V	
	Pin 7	0V	Pin 8	5V	
	Pin 9	5V	Pin 10	5V	
	Pin 11	10V	Pin 12	5V	
	Pin 13	5V	Pin 14	5V	

IC2	Pin 1	NC	Pin 2	NC
	Pin 3	-	Pin 4	-
	Pin 5	0V	Pin 6	-
	Pin 7	-	Pin 8	0V
	Pin 9	variable (see text)	Pin 10	NC
	Pin 11	variable with R7	Pin 12	1V
	Pin 13	5V	Pin 14	-
	Pin 15	NC	Pin 16	10V

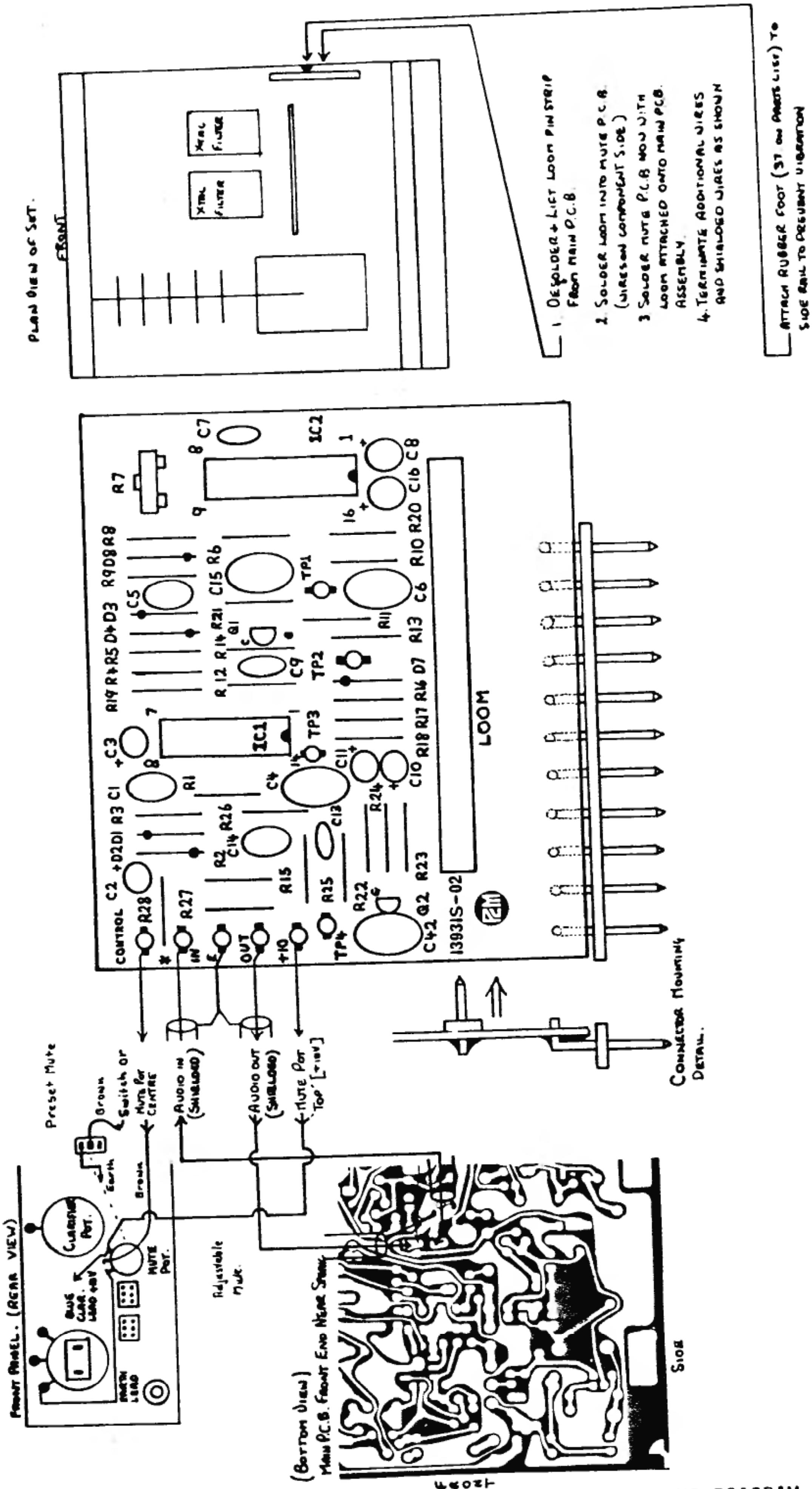
Q1 Emitter 0V (all times)
Base 0.6V (Muted), <0.6V (Unmuted)
Collector <1V (Muted), >5V (Unmuted)

Q2 Gate >5V (Muted), approx. 1V (Unmuted)
Source and Drain 0V (all times)



PCM Drg. No. 13930

MUTE CIRCUIT DIAGRAM



MUTE WIRING DIAGRAM

11.5 SERVICING (Continued)

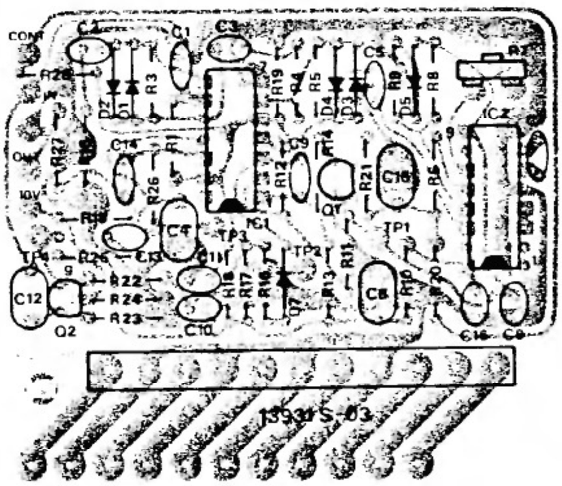
Second step is to check that audio is being processed correctly and is reaching Pin 14 of IC2.

If dc voltages are correct at IC2 and audio is present at Pin 14, it will be necessary to replace IC2 if no change of dc voltage takes place at TP1 when audio is stopped and started. Allow 5 seconds for 'hang' time of Mute.

When change of state occurs at TP1, but no accompanying change of Mute status occurs, check operation of IC1/c which is a dc amplifer, having its output at TP2.

The gate of Q2 (the actual Mute switch) is connected directly to TP4.

If TP4 shorted to ground does not pass audio out, fault will have to be either Q2 or IC1/d or associated components.



MUTE PCB LAYOUT DIAGRAM

11.6 PARTS LIST

REFERENCE	DESCRIPTION	PART NO.
	PCB Assembly	13940
	Wiring Diagram	A3-13938
	Shaft Adaptor Collett,(see P7 below)	13961
	Knob	KNB-00002
	Nut Cover	KNB-00009
	Knob Insert	KNB-00003
	Coax Cable, 40cms	CBL-00002
	Wire, Black, 10cms	WIR-00016
	Rubber Foot, Small	GMT-00004
C1,5,7,14	Capacitor, Polyester, 22nF, 100VW	CAP-101-5223
C2,3,10	Capacitor, Tant, 1uF, 15VW min.	CAP-501-2105
C4,6,12,15	Capacitor, Polyester, 100nF, 100VW	CAP-101-5104
C8	Capacitor, Tant, 22uF, 10VW min.	CAP-501-1226
C9	Capacitor, Ceramic, 100pF, 63VW	CAP-012-4101
C11	Capacitor, Tant, 4.7uF, 15VW min.	CAP-501-2475
C13	Capacitor, Ceramic, 10nF, 63VW	CAP-012-4103
C16	Capacitor, Tant, 22uF, 25VW min.	CAP-501-2226
D1,2,3,4,5,6,7	Diode, In4148	DSG-00001
P7	Pot, 1/4in Dia shaft, 25K	POT-00010
	or	
	Pot, Min, 50K	POT-00044
IC1	Op. Amp., Quad, RC4136N, Texas	ICL-00022
IC2	CMOS, PLL, 4046	ICL-00019
Q1	Transistor, 2N(PN)5088	TGN-00002
Q2	J.FET, 2N(PN)4342	TFP-00001
R1,22,23,24	Resistor, 47K, 5%, 1/4W	RES-302-6473
R2,4,20	Resistor, 1K, 5%, 1/4W	RES-302-6102
R3,5,8,11	Resistor, 220K, 5%, 1/4W	RES-302-6224
R6,21	Resistor, 100K, 5%, 1/4W	RES-302-6104
R7	Trimpot, Vert Mount, 200K	POT-00042
R9	Resistor, 2K7, 5%, 1/4W	RES-002-6272
R10	Resistor, 100 ohm, 5%, 1/4W	RES-302-6101
R12	Resistor, 1M, 5%, 1/4W	RES-302-6105
R13,14	Resistor, 22K, 5%, 1/4W	RES-302-6223

11.6 PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
R15	Resistor, 10 ohm, 5%, 1/4W	RES-302-6100
R16,27,28	Resistor, 10K, 5%, 1/4W	RES-302-6103
R17,26	Resistor, 330K, 5%, 1/4W	RES-302-6334
R18,19	Resistor, 3K3, 5%, 1/4W	RES-302-6332
R25	Resistor, 150K, 5%, 1/4W	RES-302-6154
R29	Resistor, 1K 5%, 1/4W	RES-002-6103
TP1,2,3,4,5,6, 7,8,9	Test Pins and Terminating Stakes	PCH-00012
	Pin Strip, 11 Pin, Right Angle	TML-00001

12. TWO TONE ENCODER

12.1 CIRCUIT DESCRIPTION

The IC used in this circuit is a quad Norton Amplifier with low impedance current inputs, unlike the normal operational amplifier which is voltage actuated. With a Norton Amplifier, the input voltages are about 0.6V above ground and the output rises if the current into the positive input exceeds the current into the negative input.

Normally I.C.1A has a low output held by the current flowing through R11 into the negative input. In this condition I.C. 1B and I.C. 1E are switched off as no bias current flows through R23 and R18. When the front panel alarm button is operated, pin 4 of I.C. 1A (output) goes high and the oscillators I.C. 1B and I.C. 1E are biased to about mid-rail at their outputs.

Each oscillator is similar, so a description of I.C. 1B only will suffice.

The Bridged-Tee negative feedback network sets the frequency via R1, R2, R7, R5, R6, C3 and C4. These components are chosen for low drift and high stability. R6 and R7 provide some small adjustments if required, but R5 can usually be adjusted to cover the required frequency range and allow for tolerances.

Posivite feedback is provided through R14 and R15, with D2 and D3 conducting and shorting out the positive feedback beyond 1.2V p-p at their terminals. This corresponds to about 3V p-p at the oscillator output ensuring a low distortion output with about 4% Total Harmonic Distortion.

The other oscillator is similar except for the values of some resistors, which are changed for frequency, positive feedback, and bias. With R24 at about the middle of its adjustment range, equal tone amplitudes are picked off, but this should be finally adjusted for clean crossovers in the transmitter output while transmitting.

The transmit tones are connected into the input of the speech compressor so the levels are not critical. The output buffer I.C. 1D prevents the microphone circuit from loading R24. Side-tone is fed to the volume potentiometer via R21 and a shielded wire earthed at the potentiometer end only.

Users are advised that a 15 second operation of the alarm button will be adequate to raise the alarm in the Royal Flying Doctor Service (RFDS) networks using 1320 Hz and 880 Hz as alarm tones.

12.2 SETTING UP PROCEDURE

12.2.1 EQUIPMENT REQUIRED

1. 10V Power Supply
2. Frequency Counter
3. CRO
4. Multimeter

12.2.2 SETTING UP PROCEDURE

1. Set all pots to mid range.
2. Connect 10V to pin 4 +ve, pin 1 -ve.
3. Short pins 3 and 4. Check DC voltages (see Item 10). Connect freq. counter to R15 or pin 5 of IC 1. Adjust R5 for 1320 Hz ± 1 Hz.
4. Transfer freq. counter to R20 or pin 9 of IC 1. Adjust R8 for 880 Hz ± 1 Hz.
5. Connect counter to pin 2 and rotate R24 through whole range. Check that freq. changes from 880 to 1320 Hz, then reset pot to mid range.
6. Transfer CRO probe to pin 5,check that the O/P is approx. 2V DC with 2V AC p-p into 1M probe.
7. Transfer CRO probe to pin 2. Check that the O/P is 4V AC p-p approx.
8. Leave CRO probe on pin 2. Remove short from pin 3. Ensure that the O/P drops to zero.
9. When installed in a transceiver, rotate R24 to get two equal RF tones on transmit.
10. Voltage Table

POSITION	DCV	ACV
IC pin 4 (R18,R23)	10V Hi 0V Lo	
IC pin 5 (R15)	5V	3 to 4V p-p
IC pin 9 (R20)	"	"
Wiper R24	"	"
IC pin 10	"	"
Pin 5	"	"
Pin 2	0V	"

All inputs of amplifiers should be 0.6V when working.

12.3 FAULT FINDING GUIDE

Refer to Printed Circuit Layout 13731 and Circuit Diagram A2-13723.

NOTE: LM 3900 IC may be regarded as a very robust device, so long as correct polarity is observed. It may have any individual output connected to rail voltage or ground direct (one output at a time) and any input may be connected to rail or ground through a resistor of not less than 10K for testing purposes.

1. Check that input voltages are correct and switch on and off at pin 3 with alarm button operation.

2. Remove IC and plug in a new one making sure of correct orientation.

3. Connect a 470K resistor to +10V rail and touch it on pin 1 of the IC to check operation of the 1320 Hz oscillator and pin 13 to check 880 Hz oscillator.

4. Should neither oscillator operate, check that rail voltage is actually reaching pin 14 of the IC and that pin 7 is solidly connected to ground (negative). No other single fault can cause total failure of all functions except a failure within the IC.

5. Check voltages as per voltage table in setting up procedure (Sub-Section 12.2.2, Step 10).

6. Before checking for faulty individual components, investigate the PC board closely for shorts, broken tracks or dry joints.

7. If either oscillator amplitude is too high, a failure of D2, D3 or C8 (or corresponding parts) is indicated. If these parts short, oscillator is unlikely to start.

8. If frequency is out of range, the network of R1,2,5,6,7 C3 and C4 (or corresponding parts) is likely to be at fault, and the resistors may be quickly checked with a multimeter. The capacitors are best checked by substitution.

9. In the event of further trouble, return the printed circuit board to the factory.

12.4 PARTS LIST

12.4.1 PCB ASSEMBLY

REFERENCE	DESCRIPTION	PART NO.
	PCB, Drilled	A3-13721
Pins 1 to 5 and TP1 & 2	PCB, Stakes	PCH-00001
IC 1	Integrated Circuit LM 3900N	ICL-00012
	IC 1 Mounting Socket, 14 pin	SKT-00001
D1,2,3,4,5	Diode IN 914	DSG-00001
C1,2,9	Capacitor, Disc Ceramic, 0.1uF	CAP-015-4104
C3,5	Capacitor, Polystyrene, 200pF 125VW DC 5%	CAP-203-6221
C4,6	Capacitor, Polystyrene 10nF 125VW DC 5%	CAP-203-6103
C7,8	Capacitor, Tantalum, 0.47uF 16VW DC 5%	CAP-501-3474
R1	Resistor, Metal Film, MR30 82K 2% ½W	RES-203-5823
R2	" " " 62K " "	RES-203-5623
R3	" " " 120K " "	RES-203-5124
R4	" " " 100K " "	RES-203-5104
R5,8,24	Potentiometer, Cermet, 50K	POT-00002
R6	Resistor, Carbon, 220K 5% ¼W	RES-002-6224
R7,10	Not used. Wire linked out.	
R9	Not used.	
R11,16,17,23	Resistor, Carbon 470K 5% ¼W	RES-002-6474
R12	Not used.	
R13	Resistor, Carbon 100K " "	RES-002-6104
R14	" " 560K " "	RES-002-6564
R15,20	" " 22K " "	RES-002-6223
R18	" " 680K " "	RES-002-6684
R19	" " 820K " "	RES-002-6824
R21	" " 1M " ½W	RES-003-6105
R25	" " 68K " ¼W	RES-002-6683

12.4 PARTS LIST (Continued)

12.4.2 FITTING KIT

REFERENCE	DESCRIPTION	PART NO.
	PCB Assy.	PL-13722
	Front Panel Insert	A3-13725 Sh1
	Screw, 5-40 UNC x 0.290 in. long Taptite, Phillips Head, Zinc Pl.	SCR-00261
	Washer, Nylon No. 6, Flat	WHR-00065
	Switch, Pushbutton, Snap Acting SPD 8125	SWH-00008
	Cap, Pushbutton, Large Red P/N 7527	KNB-00010
	Fitting Diagram	A3-13724
	PCB Circuit Diagram	A2-13723

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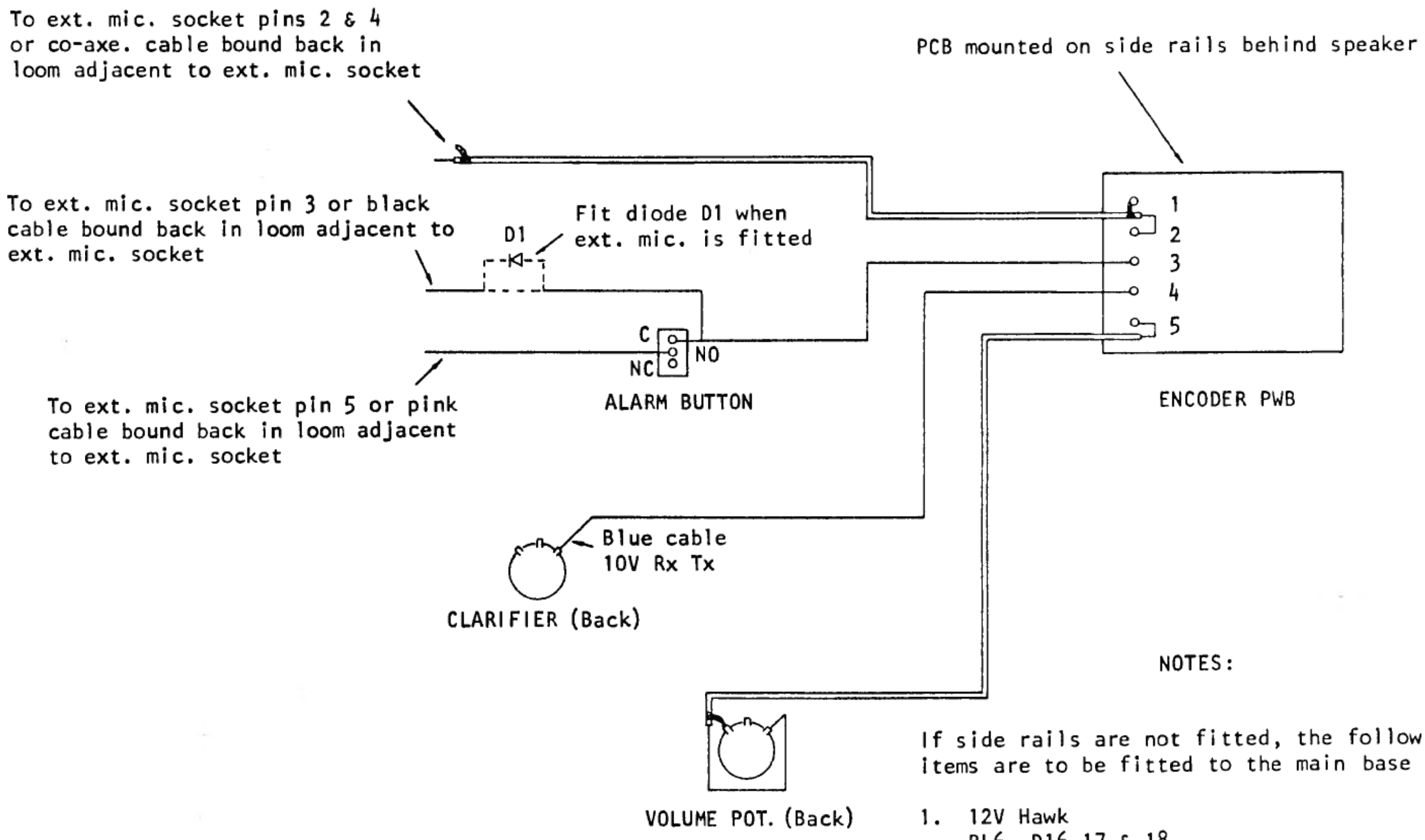


NOTES:

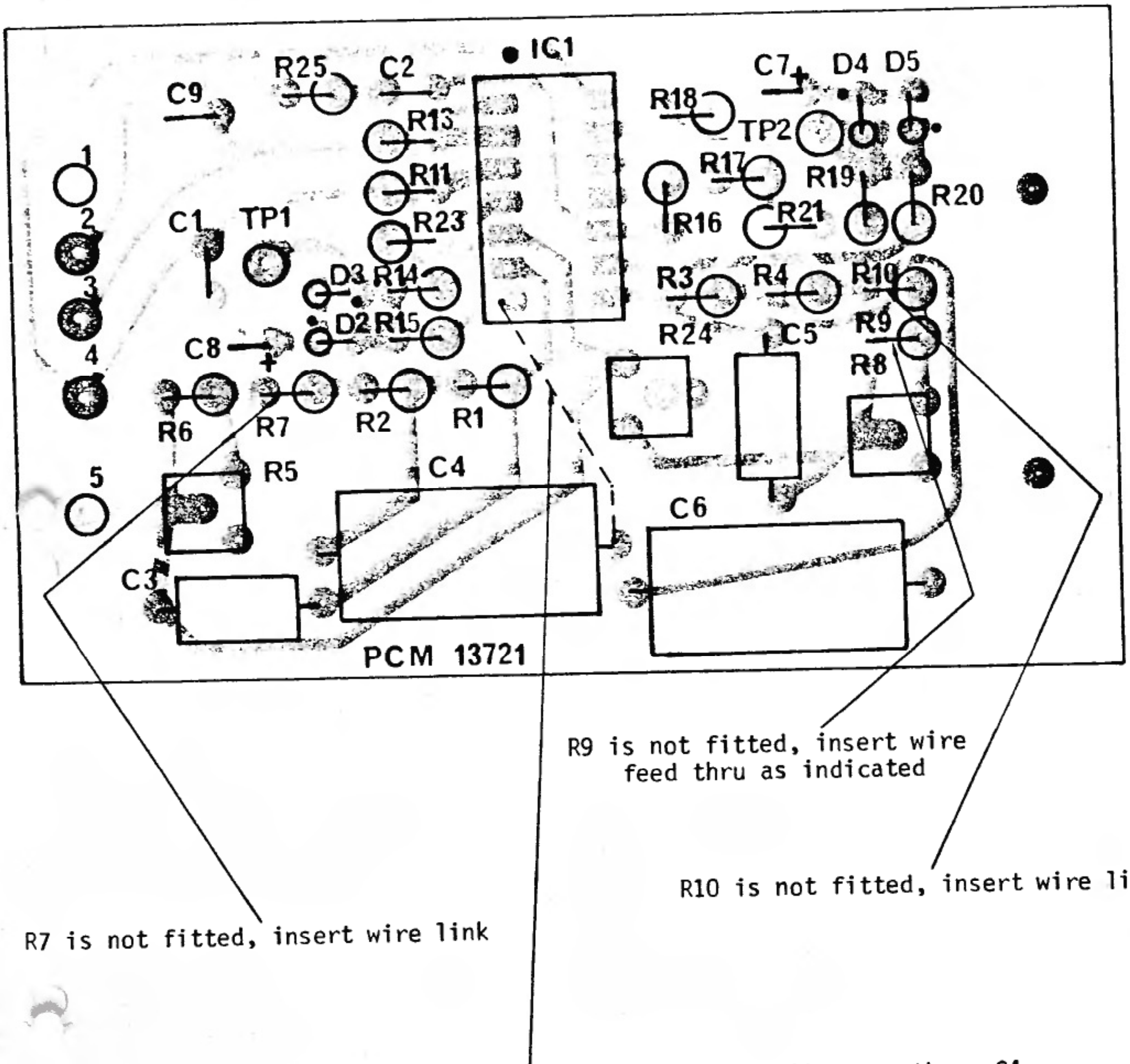
If side rails are not fitted, the following items are to be fitted to the main base board

1. 12V Hawk
   RL6, D16,17 & 18

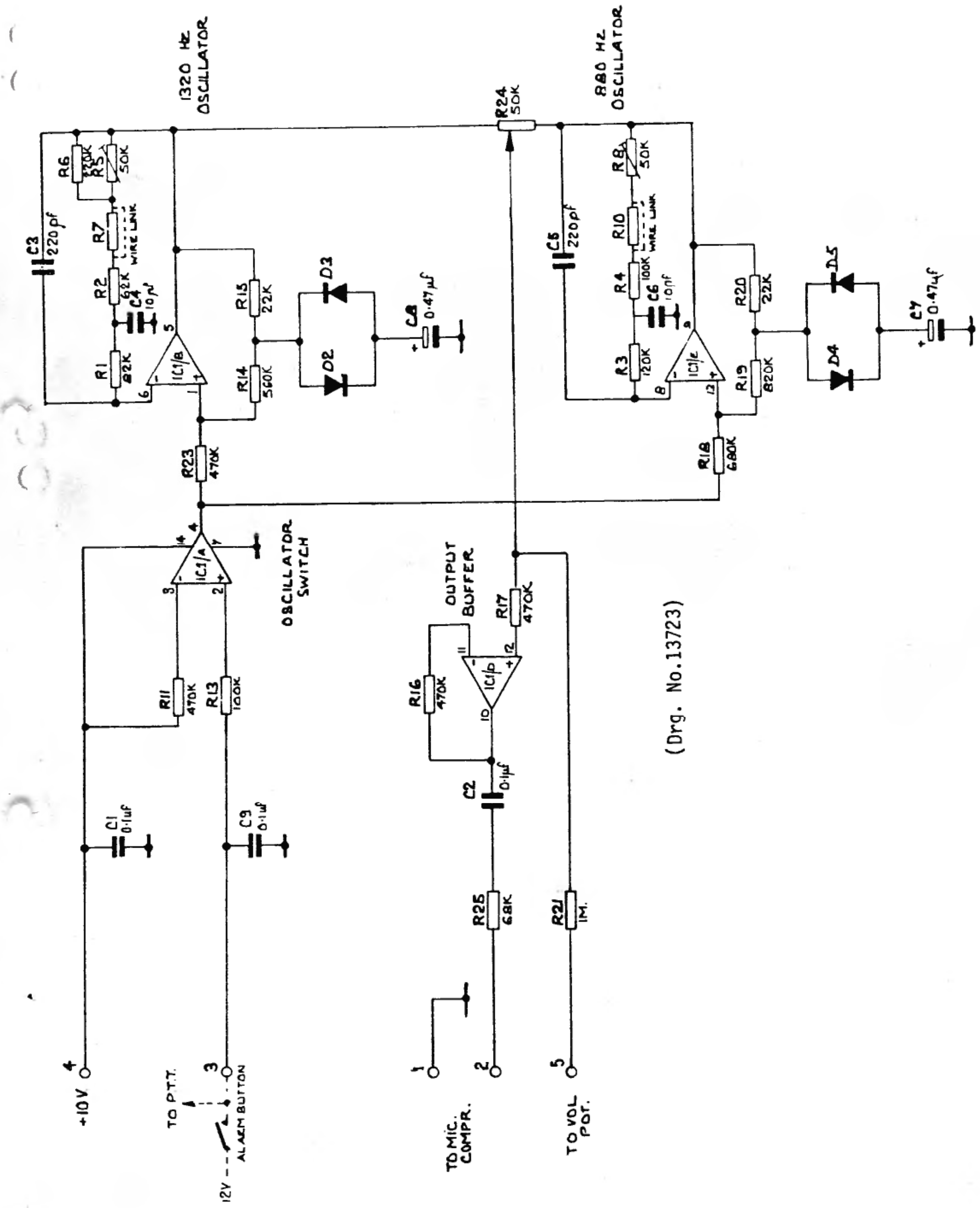
2. 24V Hawk
   RL6, R111 & 158, D16,17 & 18

Refer to handbook for component location

2-TONE R.F.D.S. ALARM ENCODER FITTING INSTRUCTIONS



2-TONE R.F.D.S. ENCODER PCB LAYOUT DIAGRAM



(Drg. No.13723)

2-TONE R.F.D.S. ENCODER CIRCUIT DIAGRAM

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13. PARTS LIST

13.1 PARTS GROUPING

The following sections are set out as listed below:-

13.2 MECHANICAL PARTS

REFERENCE	DESCRIPTION	PART NO.
	Front Panel Moulding	13428
	Loudspeaker Grille	13415
	Label Serial No.	13617
	Front Panel Insert	13669
	Knob, Black Ch. Sw.	KNB-00001
	Grommet	GMT-00001
	Knob	KNB-00002
	Cap	KNB-00003
	Microphone with Mtg. Bkt.	13030
	Mtg. Bracket Only	MIC-00003
	Clamp, Microphone Cable	CBL-00001
	Loom Assy.	13668
	Side Rail R.H.	13077-02
	Filter Shield	13272
	Side Rail L.H.	13076-01
	12V LPA 100-130W	13658
	12V LPA 25-50W	13659
	24V LPA 100-130W	13694
	Cradle	13113
	Rubber Block, Brown	GMT-00003
	Rubber Spacer, Grey	GMT-00004
	Screw, Case Holding, 1/4" UNC	13097
	Screw, LPA to Main Assy., 5/8" Taptite, 8-32 UNC	SCR-00263
	Screw, PCB Fastening, 3/8" Taptite, 8-32 UNC	SCR-00262
	Cleats, LPA to Case	13491

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST

REFERENCE	DESCRIPTION	PART NO.
C21,23,24 35,38,43, 44,45,49,50, 54,55,60,63 64,65,68,70 71,73,81,84, 86,89,91,96 98,99,104, 156,159,160 161,162,171, 172,173,174, 175,178,179, 180,181,182, 183,184,185, 190,191	Capacitor, Polyester, G. Cap, 0.1uF, 100VW or Capacitor, Ceramic, 0.1uF, 63VW Min.	CAP-101-5104 CAP-012-4104
C22,36,39, 41,46,47,51, 52,53,61,62, 66,69,74,75, 76,79,82,83, 85,87,88,90, 92,93,100,101, 117,120,158	Capacitor Disc Ceramic Hi-K 0.01uF 63VWMin.	CAP-012-4103
C42,115,118, 122,169,163	Capacitor, Tantalum 4.7uF, 16VW	CAP-501-2475
C56,57,58,59, 176	Capacitor N750 100pF, 25VW	CAP-012-4101
C77,165	Capacitor Polyester G'Cap 0.015uF, 25VW	CAP-101-5153
C78,164,168	Capacitor Electrolytic 100uF 16VW	CAP-401-2107
C80	Capacitor Polyester G'Cap 0.33uF 25VW	CAP-101-5334
C94,95,177	Capacitor Polystyrene 1.0nF, 25VW	CAP-203-6102
C97	Capacitor Disc Ceramic, 4.7pF, 25VW NPO	CAP-014-7479
C37,102,103	Capacitor, Polystyrene, 470pF, 25VW	CAP-203-6471
C105 thru C114	Capacitor Ceramic NPO 27pF ± 5% VW	CAP-014-7270
C116,167	Capacitor Tantalum, 0.47uF, 16VW	CAP-501-3474
C119	Capacitor, Polyester, .0047uF 100VW	CAP-101-5472
C121	Capacitor, Polyester, .022uF 100VW	CAP-101-5223
C123,155	Capacitor Silver Mica 220pF ± 5% 500VW	CAP-612-7221

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST
(Continued)

REFERENCE	DESCRIPTION	PART NO.
C124 thru C133 and C145 thru C154	Capacitor Silver Mica	
	Freq. (MHz) 2.0- 2.4 820pf ±5% 500VW	CAP-612-7821
	" " 2.4- 2.9 680pF " "	CAP-612-7681
	" " 2.9- 3.5 560pF " "	CAP-612-7561
	" " 3.5- 4.2 390pF " "	CAP-612-7391
	" " 4.2- 5.0 2x 150pF " "	CAP-612-7151
	" " 5.0- 6.0 220pF " "	CAP-612-7221
	" " 6.0- 7.2 150pF " "	CAP-612-7151
	" " 7.2- 8.6 82pF " "	CAP-612-7820
	" " 8.6-10.3 33pF " "	CAP-612-7330
	" " 10.3-12.0 (Not required)	
C134	Capacitor Silver Mica 470pF 500VW	CAP-612-7471
C135 thru C144	Capacitor Silver Mica	
	Freq. (MHz) 2.0- 2.4 1800pF " "	CAP-612-7182
	" " 2.4- 2.9 1500pF " "	CAP-612-7152
	" " 2.9- 3.5 1000pF " "	CAP-612-7102
	" " 3.5- 4.2 820pF " "	CAP-612-7821
	" " 4.2- 5.0 680pF " "	CAP-612-7681
	" " 5.0- 6.0 470pF " "	CAP-612-7471
	" " 6.0 -7.2 2x 150pF " "	CAP-612-7151
	" " 7.2- 8.6 180pF " "	CAP-612-7181
	" " 8.6-10.3 68pF " "	CAP-612-7680
	" " 10.3-12.0 (Not required)	
C157	Capacitor Polyester G'Cap 0.47uF 25VW	CAP-101-5474
C166	Capacitor Polyester G'Cap 0.22uF 100VW	CAP-101-5224
C170	Capacitor Electrolytic 1000uF 16VW	CAP-404-2108
C188	Capacitor Polyester G'Cap .0033uF 25VW	CAP-101-5332
D1,25,35,36	Diode EM402 or IN4002	DGP-00001
D2 thru D10, 12,14,15,20,21 22,23,33,34	Diode AN2002 or IN4148	DSG-00001
D13	Diode Varicap MV1404	DGP-00003
D19,27,32	Diode LED RL4440	LED-00001
D31	Diode Zener BZY79/C5V1	DZE-00001
FX1,2,3	Ferrite Bead	FER-00001
I.C.1,2	Integrated Circuit MC1496	ICL-00001
I.C.3,4	Integrated Circuit UA741	ICL-00005

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
L1 thru L10	Coil Freq. (MHz) 2.0- 3.1 3.1- 5.0 5.0- 8.0 8.0-12.0	 PL-13075-04-SH1 PL-13075-04-SH2 PL-13075-04-SH3 PL-13075-04-SH4
L11 thru L20	Coil Freq. (MHz) 2.0- 3.1 3.1- 5.0 5.0- 8.0 8.0-12.0	 PL-13081-04-SH1 PL-13081-04-SH2 PL-13081-04-SH3 PL-13081-04-SH4
L21	Coil IF Trap (1650 KHz)	13242
L22,23,24	Coil IF Transformer (1650 KHz)	13004
L25,26	Coil Filter	13304
Q1,5,7	FET Dual Gate MOS MFE 121 or MPF 121	TFM-00001
Q2,13,15,16 18,19	Transistor 2N3564 or PN3564	TGN-00001
Q3,4,12,22, 26,28	Transistor PN5088 or 2N3565 or PN3565	TGN-00002 TGN-00006
Q6,20,23,24, 27	Transistor 2N4250	TGP-00001
Q8,9,10,14 17	Transistor 2N4121	TGP-00002
Q11,21	Transistor 2N4342	TFP-00001
Q25,31	Transistor TIP 2955	TPP-00001
Q29	Transistor 2N3568	TGN-00003
Q30	Transistor 2N4355	TGP-00003
Q32	Transistor TIP 3055	TPN-00004

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST
(Continued)

REFERENCE	DESCRIPTION				PART NO.
R1,41,43,50 51	Resistor	47K	5%	1/4W	RES-002-6473
R2,16,46,132, 135,137,112	"	1K	"	"	RES-002-6102
R3,44,87,104,	"	27K	"	"	RES-002-6273
R4,133	"	150ohm	"	"	RES-002-6151
R5,59,124, 125,126	"	2K7	"	"	RES-002-6272
R6,10,13,27 28,66,67,93, 101	"	47ohm	"	"	RES-002-6470
R7,8,17,68,77	"	1K5	"	"	RES-002-6152
R9,39,47,71 152	"	100ohm	"	"	RES-002-6101
R11,24	"	180ohm	"	"	RES-002-6181
R12,48	"	18ohm	"	"	RES-002-6180
R14,18,23,72 73,89,102,106	"	470ohm	"	"	RES-002-6471
R15,19,57,61, 86,103,128,129	"	6K8	"	"	RES-002-6682
R21,40,118,75	"	2K2	"	"	RES-002-6222
R22,25,60	"	1K8	"	"	RES-002-6182
R26,37,38,55	"	8K2	"	"	RES-002-6822
R29,153,53	"	22K	"	"	RES-002-6223
R30	"	68K	"	"	RES-002-6683
R31,69,79,81 83,144	"	680ohm	"	"	RES-002-6681
R32,34,36	"	820ohm	"	"	RES-002-6821
R33,35,74,76	"	3K9	"	"	RES-002-6392
R42,97	"	220K	"	"	RES-002-6224
R45,52,82, 115,119,170	"	330ohm	"	"	RES-002-6331

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST
(Continued)

REFERENCE	DESCRIPTION				PART NO.
R49,65,96, 116,117,165	Resistor	100K	5%	1/4W	RES-002-6104
R54	"	15K	"	"	RES-002-6153
R58,63,88,98 99,105,121, 126,150,151	"	10K	"	"	RES-002-6103
R64,123	"	470K	"	"	RES-002-6474
R70,154	"	4K7	"	"	RES-002-6472
R80,130	"	3K3	"	"	RES-002-6332
R90,107	"	390ohm	"	"	RES-002-6391
R91,92,94 104,108,109	"	12K	"	"	RES-002-6123
R113,139, 140,142	"	1M	"	"	RES-002-6105
R114	"	150K	"	"	RES-002-6154
R141	"	2M2	"	"	RES-002-6225
R143	"	330ohm	"	"	RES-002-6331
R146,148	"	18ohm	"	"	RES-002-6180
R147,149	"	3.3ohm	"	1/2W	RES-002-6339
R155,156	"	39ohm	"	1/4W	RES-002-6390
R157	"	10ohm	"	"	RES-002-6100
R20,78,100, 136	Potentiometer 2K TRIMPOT				POT-00001
R95	20K 'A' Clarifier Potentiometer				POT-00010
R131	Potentiometer 50K TRIMPOT				POT-00002
R138	" 500K 'C' (Volume Control)				POT-00004

13.3 MAIN BOARD, 12v.-24v. COMMON PARTS LIST
(Continued)

REFERENCE	DESCRIPTION	PART NO.
RL1,2,3,4,5, 6,7,8,9,10, 11,12	Relay National RS 12V	REL-00002
S1/1,2,3, 11,12	Switch Bandswitch Wafer Assy.	13013
S1/9.10,13	Switch Filter, Wafer Assy.	13245
S1/4,5,6,7 8	Switch Wafer Assy.:- Single Freq. Two Freq.	 13013 13414
	Switch Mechanism only to suit above	12990
S1	Switch DPDT Toggle 3 Way MST206P	SWH-00001
S2	Switch DPDT Toggle 2 Way MST206N	SWH-00002
T1	Transformer Isolation	13281
VC1 thru VC10	Capacitor Variable 1-6pF	CAV-00001
X1	Crystal 30pF Parallel Freq. 1650 KHz	12730
X2 thru X11	Crystal Channel Oscillator	XTAL. FREQ.
XF1	Crystal Filter (SSB) Type QF1B65(QF01602)	CTL-00002
XF2	Crystal Filter (AM) Type QF1A65(QF01601)	CTL-00001
XF3	Crystal Filter LSB(SSB) Type QF1F65(QF01606)	CTL-00005

13.4 MECHANICAL AND MAIN BOARD PARTS LIST FOR 24v. MARINE (KESTREL)

MECHANICAL

REFERENCE	DESCRIPTION	PART NO.
1	Label (Kestrel) SSB 131-24 SSB 061-24	13691 13789
2	Case (Kestrel)	13108
SK2	Socket, Ext. Microphone 5 contact DIN 180°	CON-00004
SK3	Socket, Ext. Loudspeaker 2 contact	CON-00005
SK4	Socket, ATU control, 11 contact	CON-00013
PL2	Plug, Ext. Microphone 5 pin DIN 180°	CON-00006
PL3	Plug, Ext. Loudspeaker (Specify if with cover)	CON-00007
PL4	Plug, AATU Control	CON-00010
SPEAKER	Loudspeaker, 15 ohm	LSP-00005

MAIN BOARD

R111	Resistor 100 ohm 5% 2W	RES-407-6101
R127	" 330 ohm " 1/2W	RES-003-6331
R134	" 1K " 1W	RES-004-6102
R145,150	" 3.3K " 1/4W	RES-002-6332
R146,148	" 100 ohm " "	RES-002-6101
R155	" (fitted underboard) 100W - 150 ohm 5% 1/4W & 130W	RES-002-6151
	50W - 330 ohm " "	RES-002-6331
R158,159	Resistor 270 ohm 5% 1/2W (R158 fitted underboard)	RES-003-6271
R160	Resistor 3.3 ohm 5% 1/2W	RES-003-6339
D13	Diode BA163 or MV1403	DGP-00003
D24,26,28,29 30,16,17,18 D37	Diode EM402 or IN4002 (D37 fitted underboard)	DGP-00001
D40	Diode BZX79C15	DZE-00004
D41	Wire Link	

13.4 MECHANICAL AND MAIN BOARD PARTS LIST FOR 24v. MARINE (KESTREL) (Continued)

REFERENCE	DESCRIPTION	PART NO.
RL6,7,8,9, 10,11	Relay National RS 12V	REL-00002
C97	Capacitor 4.7pF, 24V DC Disc Ceramic (C97 fitted only when D13 type MV1403 fitted)	CAP-002-8479
SCR1	Silicon Rectifier 2N4441 (NOTE: Link SCR1 anode to test pin 16 underboard)	RSC-00001

13.5 MECHANICAL AND MAIN BOARD PARTS LIST FOR 12v. MARINE (KESTREL)

MECHANICAL

REFERENCE	DESCRIPTION	PART NO.
1	Label (Kestrel) SSB 131-12 SSB 061-12	13673 13686
2	Case (Kestrel)	13108
SK2	Socket, Ext. Microphone 5 contact DIN 180°	CON-00004
SK3	Socket, Ext. Loudspeaker 2 contact	CON-00005
SK4	Socket, ATU Control 11 contact	CON-00013
PL2	Plug, Ext. Microphone 5 pin DIN 180°	CON-00006
PL3	Plug, Ext. Loudspeaker (specify if with cover)	CON-00007
PL4	Plug, AATU Control	CON-00010
SPEAKER	Loudspeaker 3.5 ohm	LSP-00004

MAIN BOARD

R111	Wire Link	
R127	Resistor 330 ohm 5% 1/2W	RES-003-6331
R134	" 470 ohm " "	RES-003-6471
R145	" 1K " 1/4W	RES-002-6102
R150	" 10K " "	RES-002-6103
D13	Diode BA163 or MV1403	DGP-00003
D16,17,18,24 26,28,29,30,37	Diode EM402 or IN4002 (NOTE: D37 fitted underboard)	DGP-00001
D41	Wire Link	
RL6,7,8,9, 10,11	Relay National RS 12V	REL-00002
C97	Capacitor 4.7pF, 25V (NOTE: C97 only used when D13 is type MV1403)	CAP-002-8479

13.6 MECHANICAL AND MAIN BOARD PARTS LIST FOR 12v. LAND (HAWK)

MECHANICAL

REFERENCE	DESCRIPTION	PART NO.
1	Front Panel Plate	13669
2	Case (Hawk)	13107
3	Label (Hawk) SSB 101-12 SSB 061-12	13672 13671
4	Speaker 3.5 ohm	LSP-00004

MAIN BOARD

R111	Wire Link	
R134	Resistor 470 ohm 5% 1/2W	RES-003-6471
R145	" 1K " 1/4W	RES-002-6102
D13	Diode BA102 (yellow dot)	DGP-00002
D17	Wire Link	
D41	Wire Link	
C97	Capacitor 2-20pF	CAV-00003
C105	Capacitor 27pF	CAP-014-7270
VC1	Capacitor 1-6pF	CAV-00001
RL6	Wire Link	
RL9	Wire Link	
RL10	Wire Link	
RL11	Wire Link	

13.7 MECHANICAL AND MAIN BOARD PARTS LIST FOR 24v. LAND (HAWK)

MECHANICAL

REFERENCE	DESCRIPTION	PART NO.
1	Front Panel Plate	13669
2	Case (Hawk)	13107
3	Label (Hawk) SSB 101-24 SSB 061-24	13790 13789
4	Speaker 15 ohm	LSP-00005

MAIN BOARD

R111	Resistor	100 ohm	5%	2W	RES-407-6101
R134	"	1K	"	1W	RES-004-6102
R145,150	"	3.3K	"	1/4W	RES-002-6332
R146,148	"	100 ohm	"	"	RES-002-6101
R160	"	3.3 ohm	"	"	RES-002-6339
SCR1	S.C.R. 2N 4441 (NOTE: SCR1 anode to TP16 underneath board)				RSC-00001
D40	Diode BZX79C15				DZE-00004
C13	Diode BA 102 (yellow dot)				DGP-00002
C97	Capacitor 2-20pF				CAV-00003
C105	Capacitor 27pF				CAP-014-7270
VC1	Capacitor 1-6pF				CAV-00001
D17,41,RL6	Wire Link				
RL9,10,11	Wire Link				
R155	Resistor (fitted under board) 100W - 150 ohm 50W - 330 ohm				RES-002-6151 RES-002-6331

13.8 24v. LINEAR POWER AMPLIFIER PARTS LIST

REFERENCE	DESCRIPTION	PART NO.
C1	Capacitor Disc Ceramic 470pF 630VW	CAP-011-8471
C2,8	Capacitor Disc Ceramic 220pF 630VW	CAP-011-8221
C3	Capacitor Disc Ceramic 22pF 630VW	CAP-011-8220
C4	Capacitor Disc Ceramic 1.5nF 630VW	CAP-011-8152
C5	Capacitor Disc Ceramic 680pF 630VW	CAP-011-8681
C11,13,14,16, 17,18,19,23 24,31,36,39,54 41,49,52,53,55	Capacitor Disc Ceramic 0.1uf 63VW min.	CAP-015-4104
C12,20,21, 29,43	Capacitor Disc Ceramic .01uF 63VW Min	CAP-012-4103
C15,27,30	Capacitor Polyester .47uF ±10% 100V Max.	CAP-105-5474
C28	Capacitor Electrolytic 470uF 63V	CAP-404-4477
C32	Capacitor Disc Ceramic 2.2pF 630V	CAP-002-8229
C33,34	Capacitor Polyester G'Cap .047uF 200V	CAP-101-5473
C35	Capacitor Disc Ceramic 15pF 630VW	CAP-009-8150
C37,46	Capacitor Electrolytic 4.7uF 16VW	CAP-401-2475
C38	Capacitor Electrolytic 22uF 10VW	CAP-501-1226
C42	Capacitor Electrolytic 1000uF 6.3VW	CAP-401-1108
C44	Capacitor Electrolytic 1uF 50 DCVW	CAP-401-4105
C45	Capacitor Disc Ceramic 100pF 63VW	CAP-012-4101
C47,48,50,51	Capacitor Disc Ceramic 0.22uF 63VW	CAP-012-4224
C61,62	Capacitor Tantalum 4.7uF 25V	CAP-501-2475
D1,2,3,4,9	Diode AN2002, IN4148	DSG-00001
D10,11	Diode IN4148 (cemented to Q5/6 with Thermal Bond)	DSG-00001
D6	Diode IN5624, IN5402, 30S.2	DRP-00004
D7	Diode IN4002 or EM402	DGP-00001
FS1	Fuse 2A 3AG	FUS-00010
FS2	Fuse 15A 3AG	FUS-00014
IC1	Integrated Circuit UA 741	ICL-00005
L1	Coil Pre-driver	13594
L2,3	Choke R.F.	13002
L4,5,6,9	Choke R.F.	13001
L7	Choke P.A. Supply	13698
	Plug Power Supply:	
	Plug Body (Utilux H2290)	CON-00002
	Plug Terminal (Utilux H2247)	TML-00004

13.8 24v. LINEAR POWER AMPLIFIER PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
Q1	Transistor PN4121	TGP-00002
Q2	Transistor PN 3866	THN-00007
Q3,4	Transistor 2N 5942, 2N 6370	THN-00009
Q5,6	Transistor 9780, MRF 463	TPN-00014
Q7,8,15	Transistor PN 4250	TGP-00001
Q9,10,16,17	Transistor PN 5088 or PN 3565	TGN-00002 TGN-00006
Q11	Transistor PT 5737	DRP-00003
Q12,13	Transistor PN 3568	TGN-00004
Q14	Transistor FT 3055	TPN-00004
RL1	Relay Type NV23027	REL-00014
RL2	Relay Type NV23016	REL-00013
SK1	Connector Edge	PCH-00003
T1	Transformer Assy., Pre-driver	13574
T2	Transformer Assy., Driver	13619
T3	Transformer Assy., Output	13696
R1	Resistor Carbon 68 ohm 1/4W 5%	RES-002-6680
R2	Resistor Carbon 220 ohm " "	RES-002-6221
R3,6	Resistor Carbon 22 ohm " "	RES-002-6220
R4	Resistor Carbon 10 ohm " "	RES-002-6100
R5,8,57	Resistor Carbon 100 ohm " "	RES-002-6101
R7	Resistor Carbon 330 ohm " "	RES-002-6331
R9,40,41,48, 49,	Resistor Carbon 47 ohm " "	RES-002-6470
R10,11,47	Resistor Carbon 150 ohm " "	RES-002-6151
R18	Resistor Carbon 4K7 ohm 1W "	RES-004-6472
R19	Resistor Carbon 1K2 ohm 1/4W "	RES-002-6122
R20	Resistor Carbon 27K ohm " "	RES-002-6273
R21,30,43	Resistor Carbon 1K ohm " "	RES-002-6102
R22,37,50	Resistor Carbon 470 chm " "	RES-002-6471
R23,24	Resistor Carbon 560 ohm 1W "	RES-004-6561
R25,26	Potentiometer 50K Helitrim 72P Bourne 3386P-1-503, Dale 87A Cermet V.T.P.	POT-00002
R27	Resistor Carbon 10K ohm 1/4W 5%	RES-002-6103
R28	Resistor Carbon 18K ohm " "	RES-002-6183

13.8 24v. LINEAR POWER AMPLIFIER PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
R29,34	Resistor Carbon 100K ohm 1/4W 5%	RES-002-6104
R31,32,44,58	Resistor Carbon 2K2 ohm " "	RES-002-6222
R33	Resistor Carbon 3K9 ohm " "	RES-002-6392
R35	Resistor Carbon 39 ohm " "	RES-002-6390
R38,42,54	Potentiometer 2K Helitrim 72P, Bourne 3386P-1-202 Dale 87A, Cermet V.T.P.	POT-00001
R45	Resistor Carbon 6K8 ohm 1/4W 5%	RES-002-6682
R52	Resistor Carbon 22K ohm " "	RES-002-6223
R55,56	Resistor Carbon 47K ohm " "	RES-002-6473
R59,60	Resistor Carbon 3.3 ohm " "	RES-302-6339
	Spacer 3/32" LG	13240-3
(For Q2)	Transistor Spacer T05	TRH-00001
	PCB Stake 5011-04-08	PCH-00001
	Pin Harwin TC2	PCH-00002
(For Q2)	Heatsink Type F5 Redpoint	HSK-00002
	Label SSB 131 24V Floating Earth	13697
	Label SSB 061 24V Floating Earth	13791
	Label SSB 101 24V Floating Earth	13792
	Heatsink Drilled	13407
	Power Lead, Complete	13699
	Terminals, Power	TML-00004
	Connector, Power Lead	CON-00002
	Antenna Lead, Complete	13239
	Connector, Antenna Lead	CON-00001
	Cable Clamp	13252
SK1	Connector Edge, 15 Pin	PCH-00003
R36	Resistor Carbon 470K ohm 1/4W 5%	RES-002-6474

13.9 12v. LINEAR POWER AMPLIFIER PARTS LIST

REFERENCE	DESCRIPTION	PART NO.
C1	Capacitor Disc Ceramic 470pF 630VW	CAP-011-8471
C2	Capacitor Disc Ceramic 220pF 630VW	CAP-011-8221
C3	Capacitor Disc Ceramic 22pF 630VW	CAP-009-8220
C4	Capacitor Disc Ceramic 1.5nF 630VW	CAP-011-8152
C5,8	Capacitor Disc Ceramic 680pF 630VW	CAP-011-8681
C6,10	Capacitor Disc Ceramic 150pF 630VW	CAP-011-8151
C7	Capacitor Disc Ceramic 2.2nF 630VW	CAP-011-8222
C9	Capacitor Disc Ceramic 68pF 630VW	CAP-009-8680
C11,13,14,16, 17,18,19,23, 24,25,26,31, 36,39,41,49, 52,53,54,55	Capacitor Disc Ceramic 0.1nF 63VW	CAP-015-4104
C12,20,21, 29,43	Capacitor Disc Ceramic .01uF 63VW	CAP-012-4103
C15,27,30	Capacitor Polyester Metalised Film 0.47uF 100VW	CAP-105-5474
C22	Capacitor Tantalum 22uF 16VW	CAP-501-2226
C28	Capacitor Electrolytic 2200uF 16VW P/T	CAP-404-2258
C32	Capacitor Disc Ceramic 2.2pF 200VW NPO	CAP-002-8229
C33,34	Capacitor Polyester G'Cap .047uF 200V	CAP-101-5473
C35	Capacitor Disc Ceramic 15pF 630VW	CAP-009-8150
C37,46	Capacitor Electrolytic 4.7uF 16VW S/E	CAP-401-2475
C42	Capacitor Electrolytic 1000uF 6.3VW	CAP-401-1108
C44	Capacitor Electrolytic 1uF 50VW	CAP-401-4105
C45	Capacitor Disc Ceramic 100pF 63VW	CAP-012-4101
C38	Capacitor Tantalum 47uF 35V	CAP-501-3476

13.9 12v. LINEAR POWER AMPLIFIER PARTS LIST (Continued)

REFERENCE	DESCRIPTION	PART NO.
D1,2,3,4,8	Diode AN2002	DSG-00001
D6	Diode Silicon 3A200V 305-2 or IN5624 or IN5402	DRP-00004
D7	Diode IN4002 or EM402	DGP-00001
FS1	Fuse 2A 3AG type L1055	FUS-00010
FS2	Fuse 20A 3AG type L1055	FUS-00015
IC1	Integrated Circuit UA741	ICL-00005
L1	Coil pre-drive peaking	13594
L2,3,4,5,6	Choke RF	13002
L7	Choke PA Supply	13592
L9	Current Transformer RF	13001
Q1	Transistor PN4121	TGP-00002
Q2	Transistor PT5604 or 2N4427	THN-00001 TPN-00006
Q3,4	Refer list for 50W, 100W and 130W	
Q5,6	Refer list for 50W, 100W and 130W	
Q7,8	Transistor PN4250	TGP-00001
Q9,10	Transistor PN5088 or PN3565	TGN-00002 TGN-00006
Q11	Transistor PT5737 (Diode connected)	DRP-00003
Q12,13	Transistor PN3568 or 3569	TGN-00004
Q14	Transistor TIP 3055	TPN-00004
R1	Resistor 68 ohm 5% 1/4W	RES-002-6680
R2	Resistor 220 ohm " "	RES-002-6221
R3,6,9	Resistor 22 ohm " "	RES-002-6220
R4	Resistor 10 ohm " "	RES-002-6100
R5,8,48	Resistor 100 ohm " "	RES-002-6101
R7	Resistor 330 ohm " "	RES-002-6331
R10,11,47	Resistor 150 ohm " "	RES-002-6151

13.9 12v. LINEAR POWER AMPLIFIER PARTS LIST (Continued)

REFERENCE	DESCRIPTION				PART NO.
R12,13,14, 15,16,17	Resistor or "	68 ohm 22 ohm	5% "	1W 4W (2 only)	RES-004-6680 RES-210-5220
R18,43	"	4K7	"	"	RES-004-6472
R19	"	1K2	"	1/4W	RES-002-6122
R20	"	33K	"	"	RES-002-6333
R21,30	"	1K	"	"	RES-002-6102
R22,37,39	"	470 ohm	"	"	RES-002-6471
R23,24	"	560 ohm	"	1W	RES-004-6561
R25,26	Potentiometer 50K Helitrim 72P				POT-00002
R27	Resistor	10K	5%	1/4W	RES-002-6103
R28	"	18K	"	"	RES-002-6183
R29,34,36	"	100K	"	"	RES-002-6104
R31,32,44	"	2K2	"	"	RES-002-6222
R33	"	3K9	"	"	RES-002-6392
R35	"	39 ohm	"	"	RES-002-6390
R36	"	470K	"	"	RES-002-6474
R38,42	Potentiometer 2K Helitrim 72P				POT-00001
R40,41,49	Resistor	47 ohm	5%	1/4W	RES-002-6470
R45	"	6K8	"	"	RES-002-6682
R46	"	2K7	"	"	RES-002-6272
R57	Not fitted				
RL1	Relay Ant. 12V 1 C/O				REL-00014
RL2	Relay Power 12V 2 N/O				REL-00013
SK1	Connector, edge, 15 pin				PCH-00003
T1	Transformer (pre-Driver)				PL-13574
T2	Transformer (Driver)				PL-13575
T3	Transformer Assembly Output				PL-13576

13.9 12v. LINEAR POWER AMPLIFIER PARTS LIST (Continued)

MECHANICAL

REFERENCE	DESCRIPTION	PART NO.
	Heatsink Drilled	13407
	Power Lead, Complete	13005
	Terminals, Power	TML-00004
	Connector, Power Lead	CON-00002
	Antenna Lead, Complete	13239
	Connector, Antenna Lead	CON-00001
	Cable Clamp	13252
	Label SSB 101-12V Floating Earth	13679
	Label SSB 131-12V Floating Earth	13681
	Label SSB 161-12V Floating Earth	13683
	Spacer 3/32" LG	13240
	Transistor Spacer T05 for Q2	TRH-00001
	Heatsink Type FS Redpoint for Q2	HSK-00002

ALTERNATIVE POWER TRANSISTORS FOR 12V SETS

Q3,4	Transistor, 2N5590 or MRF433 or PT6691	TPN-00025 TPN-00019 TPN-00005
Q5,6	130W Set	
	Transistor, PT9785 or MRF421	TPN-0008
	100W set	
	Transistor, MRF454 or MRF420	TPN-00012 TPN-00013
	50W Set	
	Transistor, PT9797A or PT5741 or MRF460	TPN-00001 TPN-00003

13.10 PARTS AVAILABLE FOR UPDATING EARLIER 12V MODELS

REFERENCE	DESCRIPTION	PART NO.
RL1,3,6	ERNI Subst. Board C/W National Relay	13934
	Board Only	13909
	Connecting Pins Only	31157
	Relay Only	REL-00002
RL4,5,11	ERNI Subst. Board C/W National Relay	13935
	Board Only	13908
	Connecting Pins Only	31157
	Relay Only	REL-00002

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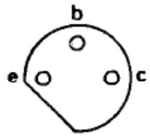
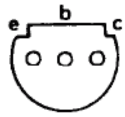


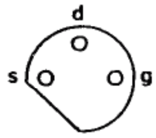
2N3564
2N3568
2N4121
2N4250
2N4355

Bottom View



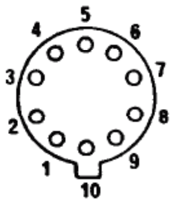
PN5088
PN3564
PN3568
PN4121
PN4250
PN4355

Bottom View



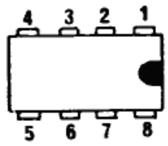
2N4342
2N5486

Bottom View



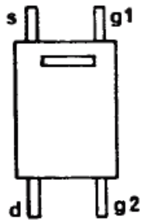
uA 796
LM1496

Bottom View



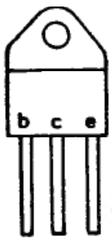
LM 741

Top View



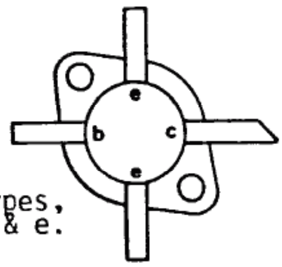
MRF 121

Top View



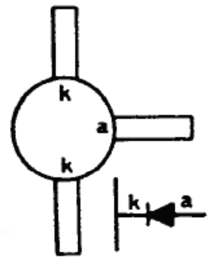
TIP2955
TIP3055
For MJE types,
reverse b & e.

Metal Side Away



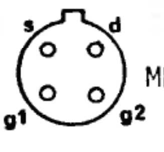
PT9785
MRF463
MRF433
2N6370
2N6368
MRF420
MRF421

Top View



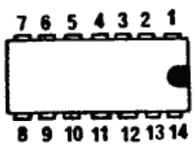
2N5589
PT5737

Top View



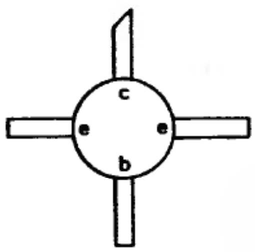
MFE121

Bottom View



LM3900
MC3401P

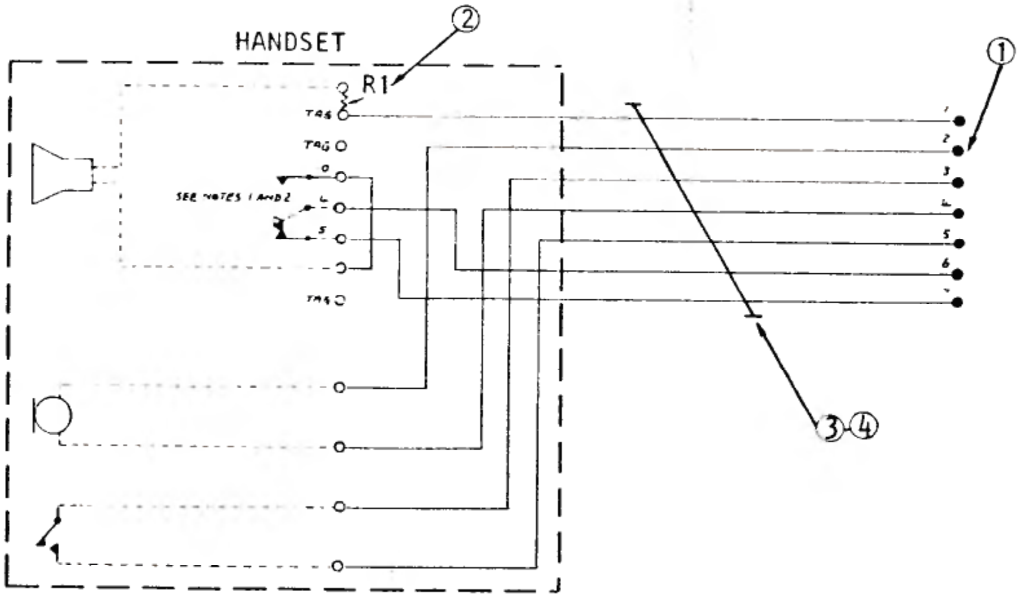
Top View



PT6619
PT9797A
PT5741

Top View

TRANSISTORS AND I.C. CONNECTIONS

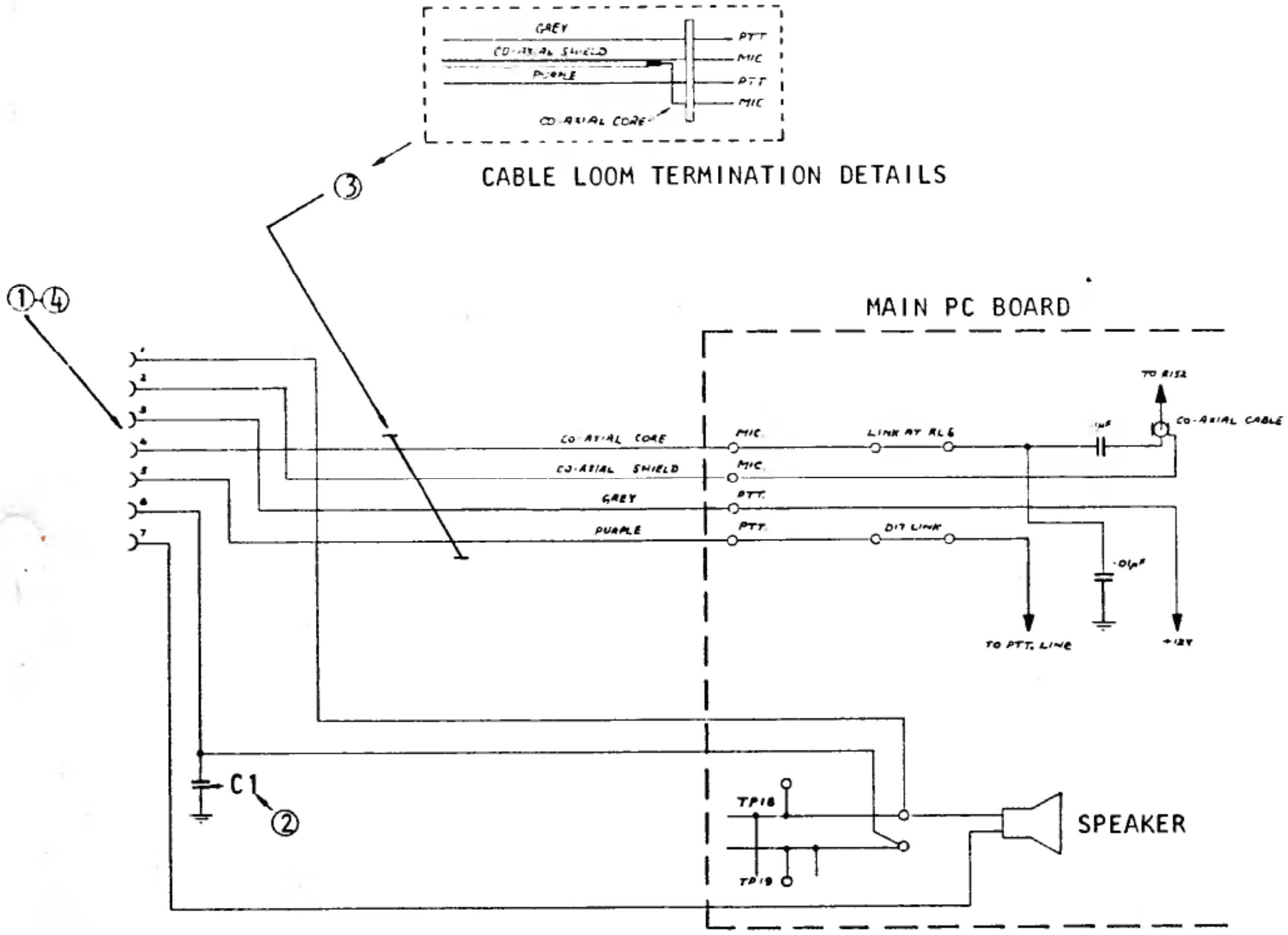


NOTES:

1. Pins 4, 5 & 10 are on handset cradle switch (Shown with handset on cradle)
2. 'Normal Mode' - Handset off cradle, earpiece operating
3. Drg. Ref. Parts List - 13957
   Main PCB - 13687
   Wir. Dia. Handset Socket - 13956

REF.	DESCRIPTION	PT. NO.
	HANDSET, Wall or Desk Mounted	HST-00001
1.	CONNECTOR, 7 Pin, DIN Plug	CON-00047
2.	RESISTOR (R1), Carbon Film, 68ohm 1W	RES-004-6680
3.	CABLE, 6 Core, Shielded	CBL-00020
4.	Clip, P Type, ½in.	CBL-00010

TELEPHONE HANDSET WIRING DIAGRAM AND PARTS LIST



NOTE:
Drg. Ref. Parts List - 13956
Main PCB - 13687
Wir. Dia. Handset - 13957

REF.	DESCRIPTION	PT. NO.
1.	CONNECTOR, 7 Pin, DIN Socket	CON-00046
2.	CAPACITOR (C1), Polyester Film, 0.1μF 100VW	CAP-101-5104
3.	CABLE LOOM (with fittings)	PL-13774
4.	LABEL, 'TELEPHONE HANDSET' (adjacent to DIN socket mounting)	13719
Misc.	PANEL INSERT, Front	13763
Misc.	LABEL, Operating Instructions and Channel Frequencies	13764

TELEPHONE HANDSET SOCKET WIRING DIAGRAM AND PARTS LIST

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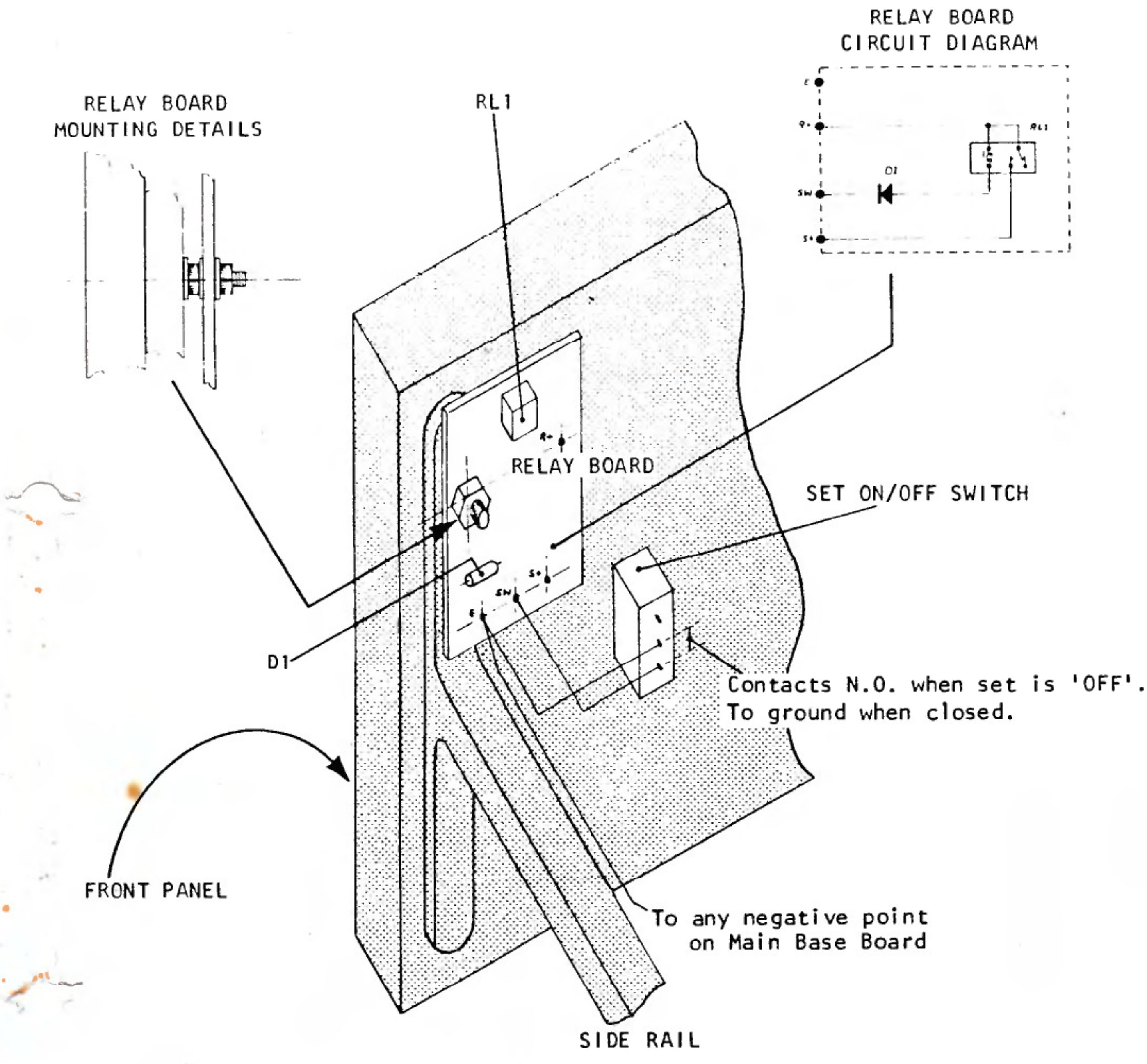
14. REVERSE POLARITY PROTECTION

14.1 FITTING PROCEDURE

1. Fit relay board as shown. Ensure copper side of board facing rear of set.
2. Disconnect ON/OFF switch wires and connect as follows:
   2.1 Heavy red wire to relay board terminal 'R+'
   2.2 Heavy yellow wire and light red wire to relay board terminal 'S+'
3. Connect wire on relay board terminal 'SW' to ON/OFF switch bottom terminal (off position).
4. Connect one of two green wires on relay board terminal 'E' to ON/OFF switch middle terminal; the other wire to any negative on MBB.

14.2 TEST PROCEDURE

1. Ensure correct polarity of supply. Switch set 'ON'.
2. Operate set in both receive and transmit modes and check for correct operation. Switch set 'OFF'.
3. Change supply to incorrect polarity. Switch set 'ON'.
4. Check no operation and that fuse remains intact. Switch set 'OFF'.
5. Change supply to correct polarity.



NOTE:

Ref. Parts List - 13778

PARTS REQUIRED

DESCRIPTION	PT. NO.
PCB ASY.	13741
NUT	NUT-00136
WASHER (2off)	WHR-00035

REVERSE POLARITY PROTECTION LAYOUT DIAGRAM AND PARTS LIST