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T498 Two Way Radio

VHF FM (138-174MHz)

Frequency Synthesized

(TM-498)

Issue A

TECHNICAL INFORMATION

For further information about this manual, or the equipment it describes, contact Customer Services Division, Tait Electronics Ltd at the above address.

UPDATING EQUIPMENT AND SERVICE MANUALS

In the interests of improving performance, reliability or servicing, Tait Electronics Ltd reserve the right to update their equipment and/or service manuals without prior notice.

SCOPE OF MANUAL

This manual covers General, Technical and Servicing Information for all versions of Tait T498 mobile two way radio.

The 'circuit' and 'encoding' diagrams relate specifically to T498s with serial numbers 259751 to 259850 manufactured under works order number 2930.

Note: The serial number is given on the front panel, and the works order number is printed on a label at the back of the T498.

Date of Issue

TM-498 - T498 Service Manual, Issue A. First publication August 1983.

Ordering Service Manuals

When ordering the T498 Service Manual, quote the Tait Internal Part Number (IPN) e.g. TM-498, and give full details of your equipment, e.g. Version T498/138174BTSO.

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SECTION 1 GENERAL INFORMATION

1.1 INTRODUCTION

The T498 is a high performance, fully-synthesized, all solid state, frequency modulated, mobile two way radio with a nominal RF power output of 25 watts. It is designed for operation in the 138 - 174MHz frequency range with 25kHz channel spacing and ±5kHz deviation (or 12.5kHz channel spacing, ±2.5kHz deviation). The standard set has 10 channels.

Operation of the T498 is by hand-held microphone and press-to-talk switch, plus three front panel controls, 'volume' with integral 'on/off' switch, 'squelch' and 'channel'. Visual indication of the 'transmit', 'busy' and 'call' (if selcall is fitted) functions, is by front panel mounted LEDs.

Provision is made for 'selcall' or 'CTCSS' to be incorporated within the case of the T498.

Channel information for the T498 synthesizer is stored in the TA-490 Memory Module, which is programmed by the T400 E-Prom Programmer. (Further information on the T400 and TA-490 can be obtained from the T400 Service Manual.)

The front panel, heat-sink, and five printed circuit boards are assembled on a simple frame which provides ready access to the circuit components above and below the printed circuit boards (PCBs). This frame slides into a robust, oxyplast finished metal sleeve which provides mechanical and environmental protection.

The single conversion receiver employs both discrete components and integrated circuits. It includes a 'noise reducer' effective against ignition noise, and a signal-to-noise ratio operated 'squelch' (mute) circuit. The receiver delivers approximately 3 watts of audio to a 3 ohm speaker.

The transmitter exciter provides about 350 mW of frequency modulated RF drive to the two stage broad-band RF power amplifier. An 'audio processor' which provides automatic modulation control and deviation limiting is included on the 'exciter PCB' along with a 'transmit timer' which returns the T498 to receive after one minute of transmission.

The T498 is light and compact, and it can be plugged into a T276 vehicle cradle, a T163 FM portable pack or a bench top power supply/speaker unit such as the T286 FM. The set is easily removed from its mounting as no wires need disconnecting. Provision is made to automatically reduce the transmitter RF power output when the T498 is plugged into a portable pack. The reduced power level may be preset between 5 and 15 watts (350mW if PA bypass circuitry is fitted).

The DC supply to the T498 **must** be negative earth and may be between 10.8 and 16 volts. The set is protected against reversal of the DC supply polarity.

1.2 SPECIFICATIONS

1.2.1 GENERAL

Where applicable the test methods used to obtain the following performance figures are those described in the New Zealand Post Office Specification RTA25.

The performance figures given are worst-case figures unless otherwise indicated.

Details of test methods and the conditions which apply for type approval testing can be obtained from Tait Electronics Ltd.

Modulation System	.. Frequency Modulation
Frequency Range	.. 138 to 174MHz
Channel Separation	.. 12.5kHz or 25kHz (to order; refer 1.3)
Number Of Channels	.. 10 or 100 (to order)
Switching Range:	
Transmitter	.. 5MHz
Receiver	.. 3MHz
Supply Voltage:	
Operating Range	.. 10.8 to 16 volts DC
Standard Test Voltage	.. 13.8 volts DC
Supply Current:	
Receiver Squelched (NMOS Memory)	.. 350mA
Full Audio	.. 650mA
Transmitter	.. 5.5 amps
Polarity Protection	.. Internal crow-bar diode
Co-axial Cable Impedance	.. 50 ohms
T/R Change-over Switching	.. Solid State
Operating Temperature Range	.. -30°C to +60°C
Dimensions:	
Length	.. 300mm
Width	.. 161mm
Height	.. 57mm
Weight:	
T498	.. 1.5kg
Cradle	.. 0.8kg

1.2.2 RECEIVER

Type	.. Single conversion superhet
I.F.	.. 10.7MHz
I.F. bandwidth	.. 7.5kHz or 15kHz (to order)
Sensitivity:	
With RF pre-amp 12dB Sinad	.. -122dBm (typical -124dBm)
Without RF pre-amp 12dB Sinad	.. -118dBm (typical -120dBm)
Signal-To-Noise Ratio : (RF: -107dBm, modulated to full system deviation)	
With RF pre-amp 15kHz B/W	.. 38dB (typical 40dB)
With RF pre-amp 7.5kHz B/W	.. 32dB (typical 34dB)
Without RF pre-amp 15kHz B/W	.. 34dB (typical 36dB)
Without RF pre-amp 7.5kHz B/W	.. 28dB (typical 30dB)
Selectivity : (adjacent channel)	
At ±12.5kHz with 7.5kHz B/W	.. 70dB
At ±25kHz with 15kHz B/W	.. 80dB
Spurious Response Attenuation	.. 85dB
Intermodulation Response Attenuation	.. 70dB
Audio:	
Output (Into 3 ohms)	.. 3 watts
Distortion (At 3 watts)	.. 5%
Response : 0.3 to 3kHz	.. Within +2dB, -4dB of a 6dB/octave de-emphasis characteristic. (ref. 1kHz)
Squelch Sensitivity	.. 6dB to 20dB Sinad (CTCSS to order)
Squelch Ratio	.. 70dB
Noise Limiter	.. Impulse noise blanker

1.2.3 TRANSMITTER

Modulation System	.. Direct frequency modulation
Power output:	
Maximum	.. 25 watts
PA Range Of Adjustment	.. 5 to 25 watts
PA Bypassed	.. 350mW (typical)
Frequency stability	.. (ref. 1.2.4)

Mismatch Capability	.. 10:1 VSWR at +13.8V DC supply
Spurious Emissions	.. 2.5µW
Deviation response:	
In limiting, 0.3 to 3kHz	.. Within ±1dB of deviation at 1kHz
Below limiting, 0.3 to 3kHz	.. Within +1, -3dB of 6dB/octave pre-emphasis (ref. 1kHz)
Above 3kHz	.. Greater than 30dB/octave roll off
Deviation Limiting	.. ±5kHz maximum Adjustable to ±5kHz
Audio Input For Maximum Deviation	.. 5mV p-p at 1kHz.
Audio Distortion: 1kHz Modulation (60% of Maximum Deviation)	.. 2%
Hum & Noise (below 60% of full system deviation)	.. 40dB

1.2.4 FREQUENCY REFERENCE

Stability:	
±10ppm (-10°C to +60°C)	.. TE/3
± 5ppm (-10°C to +60°C)	.. TE/9
± 5ppm (-30°C to +60°C)	.. TE/9 + crystal oven PCB
Oscillator frequency (refer Section 5.4.3):	
For channel spacing at multiples of 6.25kHz	.. 12.8MHz
For channel spacing at multiples of 5kHz	.. 10.24MHz

* TE/3, TE/9 refer to Tait Electronics Ltd crystal specification numbers.

1.3 VERSIONS

1. **T498/138174BTSO** 15kHz IF bandwidth, 10 channels

2. **T498/138174CTSO** 7.5kHz IF bandwidth, 10 channels

1.4 OPERATING INSTRUCTIONS

1. To Receive.

(a) Insert the T498 into the appropriate housing, e.g. Portable Pack, Vehicle Cradle or Power Supply.

(b) Ensure that the correct supply is present - mains supply correct - battery fully charged - vehicle supply correct voltage and polarity.

(c) Ensure that the aerial is securely fitted.

(d) Turn the volume control clockwise to switch on.

(e) Turn the squelch control clockwise until noise is heard, then turn it anti-clockwise 10° beyond the point at which the receiver quietens.

2. To Transmit

(a) Close the press-to-talk switch. (Always check that the channel is not in use before transmitting).

(b) The transmitter will revert to 'receive' after one minute of transmission. To continue transmitting, release, then close the press-to-talk switch.

3. Caution:

When using the T498 with a portable pack, it is advisable to switch the set off when it is not in use.

SECTION 2 CIRCUIT OPERATION

Refer to Block Diagram, Fold-Out 1, and relevant Circuit Diagrams, Fold-Outs 2, 3 and 4.

2.1 VCO and PHASE LOCKED LOOP (PLL)

A stable reference frequency is generated by IC401 and X401. The oscillator operates at 12.8MHz or 10.24MHz and is divided in IC401 to give the desired reference frequency (Refer Section 5.4.3). Q401 provides a buffered output of the reference oscillator at TP1.

The main Phase Locked Loop consists of a phase comparator programmable divider (IC401). The charge pump/voltage translator (Q402 to Q405), together with speed up circuit and low pass filter (IC402, Q407) controls the VCO, (Q409).

The VCO frequency is equal to the channel frequency for transmit, and channel frequency minus 10.7MHz for receive. The VCO frequency is divided by 40/41 within the prescaler (IC403) and is further divided in IC401. The division ratio is controlled by the output of the memory module, TA-490.

The output of the VCO, buffered by Q410 and Q412, is switched by D409 to the receiver, or by D410 to Q413 which amplifies to 350mW for the transmitter.

2.2 RECEIVER

The receiver is fed via the aerial switching diodes (D501 & D502) and a coaxial cable to the tuned RF amplifier (Q102) via RF pre-amp Q101, if fitted. The output of Q102 as well as the local oscillator injection voltage is applied to the balanced mixer stage (Q103, Q104). The local oscillator injection voltage is obtained from Q412 via D409 which is then buffered by a tuned amplifier Q105.

The IF output from the balanced mixer at a frequency of 10.7MHz (L116) is applied via a delay line (L117, L118), two 10.7MHz crystal filters (XF101 & XF201) and an IF amplifier (Q201, Q202) to an integrated circuit (IC201).

A 'noise limiter' circuit (IC101, IC102, Q109, Q110 and Q111) samples the signal at the input to the delay line. Impulse type of noise voltages are processed and used to turn on Q111 which short circuits the output of the delay line for the duration of the noise pulse.

The integrated circuit (IC201) provides further stages of IF amplification and limiting followed by a quadrature detector.

The output from the quadrature detector is applied to an audio pre-amplifier (IC202d) which provides high frequency roll-off above 5kHz and 6dB/octave de-emphasis. The output from IC202d is amplified by the audio power amplifier (IC203) to a maximum of 3 watts to drive a 3 ohm speaker.

2.3 SQUELCH (MUTING)

The circuit which controls the receiver squelching system consists of a bandpass filter, rectifier, dual smoothing circuits, adjustable threshold detector and a squelching device connected across the audio path. An additional circuit optimises the squelch characteristics in high signal conditions.

The squelch characteristics are described by the following parameters:

Hysteresis .. the difference in RF signal levels which causes the squelch to open and close (given as a ratio in dB)

Tail-time .. the length of time for which the squelch switch is open at the end of a signal

Turn-on time .. the time required for the receiver audio to turn-on after a signal is received

A front-panel control is provided as a means of adjusting the signal level required to open the squelch switch.

2.3.1 INPUT STAGES

An input signal to the squelching control circuit is obtained from the audio output of the IF detector. This signal has a noise level which is inversely related to an RF signal at the receiver input.

R-C networks in the first two stages cause the noise component to be band-pass filtered: C241/R241 and C242/R243 are high-pass sections at 15kHz; and C245, C246 cause roll-off above 60kHz.

Q203 is an amplifier with a gain control (RV245) in its emitter circuit, while Q204 is an active rectifier for the noise pulses.

2.3.2 RECTIFIER AND SMOOTHING CIRCUITS

Negative-going pulses at the base of Q204 cause the voltage of Q204 collector to rise, which enables C244 (the 'reservoir' capacitor) to charge via R247 and R249.

A dual time-constant circuit consisting of R251, D204 and C247 is used to obtain the DC control voltage for the squelch switch (Q206). C247 charges through R251, but discharges, via D204, at a much faster rate through R249.

The quasi DC voltage at pin 3 of IC202a is therefore representative of the noise level from the detector IC and is approximately 4.0 volts in the absence of an RF signal. The voltage level decreases as the RF signal level increases.

Audio turn-on time is determined by the combined decay time-constants for C244/C247, and at approximately 20mS provides a rapid response to the application of an RF signal.

The audio tail-time is determined by the combined attack time-constants for C244/C247 and the setting of the SQUELCH control; it has been optimised to minimise the occurrence of audio interruptions (chopping) in signal-fade conditions.

2.3.3 THRESHOLD DETECTOR AND HYSTERESIS

IC202a is configured as a voltage comparator with variable positive feedback and an adjustable reference voltage.

The reference voltage on pin 2 is set by the voltage divider consisting of R252, R256 and the squelch control, RV259.

Voltage feedback, and hence input voltage hysteresis, is obtained via R253; the amount of feedback is modified by the presence of D202, which acts to clamp the junction of R254 and R255 at a voltage which is determined by the squelch control setting.

When the squelch control is on a 'hard' setting (i.e. well back from threshold), D202 is forward biased and the amount of feedback is determined by a voltage which varies with the squelch control setting. Thus, the amount of feedback, and hence the input voltage hysteresis, reduce for the 'harder' settings.

With a 'light' setting on the squelch control D202 is reverse biased and the amount of feedback is fixed at a higher level by the voltage divider R254, R255. In this situation the input voltage hysteresis is increased.

The presence of this input voltage hysteresis at the voltage comparator affects two squelch characteristics:
(a) The voltage hysteresis is transferred to RF signal hysteresis at the receiver input; this is required to avoid squelch 'chatter' on constant level signals.
(b) A change in the voltage hysteresis means a corresponding change in the squelch tail-time since with less hysteresis the voltage on C247 has to rise a smaller amount (when the RF signal ceases) for the squelch to close.

2.3.4 DRIVE CIRCUITS

When a signal is received, the voltage on pin 3 of IC202a decreases, which causes the voltage comparator output (pin 1) to switch 'low'. In this condition, the squelching transistor (Q206) is turned OFF and the Busy LED driver (Q205) is turned on.

2.3.5 FAST SQUELCH

The AGC output from pin 13 of IC201 is stored in C290 on the input of comparator IC202C. When this level is higher than that preset on pin 10 of IC202C, the output is low enabling the fast squelch circuit.

When the received signal drops out, the average voltage on the collector of Q204 rises above IC202b threshold, causing the output of IC202b to switch high, turning on Q207 and effectively cutting short the squelch tail.

2.4 TRANSMITTER

The RF output from the exciter (Q413) is taken via a co-axial link to the RF power amplifier assembly (RF PA) where the power output is raised to the required level by the driver (Q501) and the final power amplifier (Q502). The RF from Q502 is taken via the aerial switching diodes (D501, D502) and the harmonic filter to the aerial.

The level of the RF power output may be set to a value between 5 and 25W by the power adjust circuit (Q314, Q315) which controls the drive to the RF PA by varying the supply voltage to the exciter output. This circuit utilizes a feedback loop to hold the output power constant at the preset level. RV376 and RV377 set the high and low power levels. D504 in the PA senses the RF power output.

An out of lock crowbar circuit (Q313) is also included to prevent the transmitter turning on if the synthesiser is out of lock.

Audio from the microphone (and selcall or CTCSS if fitted) is tailored to meet the required specifications by the audio processor (Q301, IC302, Q302 and Q303). The audio processor provides automatic modulation control (AMC), deviation limiting, and frequency compensation to suit the characteristics of the directly modulated, phase locked VCO.

2.5 TRANSMIT - RECEIVE SWITCHING

Note: The DC supply is fed to the PA assembly via a filter so that DC is present on this unit while the T498 is connected to the supply. The DC input is protected by a 'crow-bar' diode (D503) which will blow the fuse if the supply is reverse connected.

2.5.1 UNSWITCHED CIRCUITS AND REGULATED SUPPLIES

The positive supply is taken from the PA assembly via the exciter board hash filter (L301, C303) and the front panel mounted 'on/off' switch to:

1. Regulators on the exciter board (IC301, Q305, Q306, and Q307) provide continuous 5V & 10V supplies to the following circuits:

   Memory module
   P.L.L. control and divider
   Tx audio processor
   VCO & VCO buffer stages
   Loop filter stages
   Tx/Rx switching circuits.

2. +13.8V is continuously supplied to the receiver front end, mixer, noiseblanker, detector and audio amplifier on the receiver PCB.

2.5.2 RECEIVE

When the press-to-talk switch is 'open' the 'Tx/Rx switch' (IC303) performs the following functions:

a) Turns on Q309, allowing Q408 to turn on and shift the VCO to the receive frequency, and also to address the selected receive memory location.

b) Clamps pin 9 of IC302 via D303 to disable AMC.

c) Turns off transmit regulated switch, Q308, removing the +10V reg from the exciter PCB switched circuits.

d) Forward biases D502, connecting the aerial to the receiver.

e) Reverse biases D501, isolating the PA from the aerial.

f) Turns on receiver L.O. buffer, Q105, IF, Q201, Q202, squelch control and audio processor.

2.5.3 TRANSMIT

Note: When the microphone press-to-talk switch is 'closed' a timing signal is initiated within the Tx/Rx switch (IC303) which will return the T498 to receive after one minute of transmission.

Closing the press-to-talk switch also:

a) Turns off Q309, allowing VCO to switch back to Tx frequency, and also to address the selected transmit memory location.

b) Releases pin 9 of IC302 to enable audio processor AMC.

c) Turns on Q308 and indirectly, Q315. This applies regulated and unregulated supplies to the exciter.

d) Reverse biases D502, isolating the aerial from the receiver.

e) Forward biases D501, connecting the PA to the aerial.

f) Turns off sections of the receiver.

2.5.4 FREQUENCY INFORMATION

The channeling data for the T498 synthesizer is stored in the TA-490 memory module, which houses two 2716 E-PROMS. The memory module is programmed on the T400 E-PROM programmer and then inserted into the row of connectors in the T498 exciter PCB.

SECTION 3 ANCILLARY EQUIPMENT

Note: Further details of the ancillary equipment described briefly in this section can be obtained from the relevant service manual.

3.1 T276 VEHICLE CRADLE

The T276 vehicle cradle is supplied complete with mounting screws and connecting cables. It contains a mating socket, which connects the battery supply, speaker and aerial to the T498.

3.2 T163 FM PORTABLE PACK & ASSOCIATED CHARGERS

The T163 FM portable pack is used to provide 'personal portable' operation of the T498. The portable pack consists of robust metal housing with a built-in speaker. It is designed to accommodate a Tait T498 Miniphone and either a Tait T166 1.2Ah or a T166A 2.2Ah nickel cadmium battery pack as plug-in items.

A leather carrying case is available which will hold the complete two way radio. The microphone is held in a separate external pocket for easy access.

Provision is made to automatically reduce the transmitter output power of the set when it is plugged into the T163 FM.

The T166 or the T166A battery pack may be re-charged while still plugged into the portable pack, using a T270 Battery Charger.

3.3 T286/FM POWER SUPPLY

The T286/FM is a 13.8V DC, 6 ampere power supply, which will power the T498 from a 230V ±10% 50Hz mains source, or to special order from a 115V ±10% 60Hz mains.

The two way radio plugs into the T286/FM to give an attractive bench-top unit, with integral 3 ohm speaker. The aerial connection is via a coaxial connector at the back of the T286/FM.

A 12 volt lead acid cell can be float-charged with the T286/FM, under constant voltage conditions. The current limit circuit prevents the charging current from being excessive should a completely discharged battery be connected to the power supply.

The output of the T286/FM does not compensate for the temperature dependence of lead acid batteries, if this feature is required then a T273 Battery Charger /Power Supply should be used.

3.4 T220/2 EXTENSION SPEAKER ASSEMBLY

The T220/2 extension speaker assembly is intended for use with the T498. It comprises a heavy duty 3 watt speaker mounted in a rugged enclosure which pivots on its mounting bracket. The 3 ohm voice coil of the speaker is connected by a short lead terminated in a 2 pin cord mounted connector. The enclosure is compact and easily mounted in any convenient position.

3.5 T289/6 REMOTE CONTROL UNIT

The T289/6 is a remote control system designed for use with the T498. This system permits remote operation of all the two way radio front panel controls, plus LED displays, from a single control unit.

The control head itself is small and has a swivel mounting arrangement which allows it to be mounted in the most convenient position in any installation.

The T289/6 is a wire-for-wire extension of the two way radio front panel. Remote operation is thus obtained without the introduction of any additional electronic circuits. This includes 100 channel operation.

When a two way radio is converted for remote control operation, the front panel control PCB is removed and replaced by a PCB which serves as an interface between the set internal wiring and the remote interconnecting cable.

3.6 T281/2 SERVICE LEAD

The T281/2 bench service lead which should be used when bench testing the Tait T490 series two way radios is available from Tait Electronics Ltd. This service lead consists of a BNC connector wired to speaker plugs and battery leads.

3.7 T400 E-PROM PROGRAMMER

The Tait T400 is a field set-up ancillary dedicated for use with the Tait T490 series of synthesized two way radios. It is designed to programme the RF synthesizer memory, and if required, a tone calling memory.

The capacity of the RF programming is 100 channels, that is 200 frequencies. If reverse channel operation (contra) is required 400 frequencies may be programmed within the confines of 100 channels.

The T400 will programme either NMOS or CMOS variations of the industry standard '2716' ultra violet erasable PROM devices.

SECTION 4 INSTALLATION

4.1 VEHICLE INSTALLATION OF THE T498

1. Mount the T276 vehicle cradle in any convenient position in the vehicle. If remote operation of the T498 is required, a T289 remote control unit may be fitted (for details see the T289 service manual).

2. Connect the auto cable from the cradle to the battery circuit; include the in-line fuse holder in the 'live' lead. The fuse rating is 10 amps. Both leads must be connected (the cradle is isolated to DC). Ensure that the red lead goes to the battery positive. To minimize noise pick-up both leads should be taken direct to the battery.

3. Mount the speaker enclosure by its bracket in any convenient position.

4. Connect the 2/7/0.2 plastic lead from the cradle to the 2 pin parallel socket provided, and plug in the speaker.

5. Mount the aerial in the required location; the centre of the vehicle roof is the recommended location. A suitable aerial for this location is a base loaded 5/8 wavelength whip giving a gain of 2.5dB. If it is necessary to tune the aerial, a VSWR indicator or thru-line wattmeter (eg Bird 43) should be connected between the aerial and the T498.

   If the aerial must be side or fender mounted use an aerial giving a gain of 4.5dB (eg a centre loaded whip) instead of the base loaded whip mentioned above.

6. The T498 should be correctly tuned on the bench and this tuning should not be disturbed during installation.

7. Plug the T498 into the cradle and secure it with the two thumb screws (one on each side of the cradle at the front of the set).

8. After the installation has been completed, carry out a test call, or check the radiated power with a field strength meter.

4.2 TRIGGER BASE STATION INSTALLATION OF THE T498

For 'trigger base station operation' the T498 plugs directly into a T286/FM power supply (see section 3.3).

The T498 should be correctly tuned on the bench before being fitted to the power supply.

Any suitable type of aerial giving a low angle of radiation may be used. The skirted dipole is a suitable choice, being simple and easy to install. Details of installation may be found in Tait Technical Instruction TI-30.

SECTION 5 SERVICING

5.1 GENERAL

5.1.1 NOTES

If further information is required about the T498 or this manual, it may be obtained from Tait Electronics Ltd or accredited agents. When requesting this information, please quote either the equipment serial number or works order number (found on a label at the back of the set). In the case of the circuit diagrams quote the 'title' and 'issue' and for the service manual quote the internal part number (IPN) and issue, e.g. TM498, Issue A.

The equipment has been designed to operate over a wide range of aerial loading conditions. However it is strongly recommended that the transmitter is not operated in the absence of a suitable load. Failure to observe this precaution may result in damage to the transmitter power output stage.

CAUTION: BERYLLIUM OXIDE & POWER TRANSISTORS.

The RF power transistors in current use all contain some beryllium oxide. This substance while perfectly harmless in its normal solid form can become a severe health hazard when it has been reduced to dust. For this reason the RF power transistors should not be scratched, mutilated, filed, machined, or physically damaged in any way that can produce dust particles.

CAUTION: CMOS DEVICES.

The equipment contains CMOS devices which are susceptible to damage from static charges. Care when handling these devices is essential. For correct handling procedures refer to the manufacturers data books. eg Philips data books covering CMOS devices, or Motorola CMOS data books section 5 'handling', etc.

5.1.2 TECHNICAL INSTRUCTIONS (TI's)

From time to time TI's are issued by Tait Electronics Engineering Division. These TI's may be used to update equipment or information, or to meet specific operational requirements.

5.2 MECHANICAL

5.2.1 POSIDRIV & SUPADRIV RECESS HEAD SCREWS

Posidriv, or the improved Supadriv recess head screws are the preferred standard on all Tait manufactured equipment. The very real advantages of this type of screw will not be realised unless the correct screwdrivers are used by servicing personnel.

Posidriv No 1 screwdrivers will fit the posidriv and supadriv screws used in the T498. Phillips cross-head screwdrivers are not satisfactory for use on these screws.

5.2.2 DISASSEMBLY INSTRUCTIONS

1. Remove the securing screws and slide the T498 from the metal sleeve.

2. To Gain Access To The PCB Components:

   Invert the T498.
   Remove the 2 screws opposite the hinges (receiver PCB).
   Open out the receiver PCB.

3. To Gain Access To The PA PCB:

   Remove the 2 top screws from the PA heatsink assembly.
   Loosen the 2 bottom screws.
   Rotate the assembly.
   Remove the 2 grommets from the slots.
   Remove the PA assembly metal cover.

4. To Remove The PA PCB: Refer to Section 5.2.3 (2.)

5. To Reassemble:

   Carry out the reassembly in the reverse order to the disassembly.

   Note the cut-out in the metal sleeve which accommodates the microphone cord.

5.2.3 PA MODULE - SPECIAL INSTRUCTIONS

CAUTION: As the location of certain components in the PA is critical to performance, it is important that any components removed or disturbed be refitted in exactly the same location.

1. TO REPLACE THE PA TRANSISTORS

Unsolder the tabs by heating them with a soldering iron, then lifting them up towards the transistor with a thin stainless steel spike or screwdriver. Unscrew the transistor mounting screws or stud nuts and remove the transistor.

Trim the tabs of the replacement to make them similar to the faulty item, then lightly tin the underside of the tabs.

Smear the underside of the transistor with heat-sink compound.

Screw the transistor tightly to the heat-sink then solder the tabs.

CAUTION: Do not solder the tabs before tightening the screws, as this may cause the tabs to break.

2. TO REMOVE THE PA PCB FROM THE HEAT-SINK

Most components are soldered on the top-side only, but in some cases access to the underside of the PCB is necessary.

Remove the 3 PCB retaining screws and the transistor securing screws or stud nuts.

Insert the 'coaxial insert extractor tool' over the coaxial connector. Press firmly until the retaining clip is compressed.

Lift the PCB (with the transistors still attached) away from the heat-sink.

CAUTION: Do not operate the PA with the PCB detached from the heat-sink, because the heat-sink is used for earthing, and the transistors will quickly overheat.

3. TO REMOVE LARGE CASED MICA CAPACITORS

Apply a heavy duty soldering iron to the top of the capacitor case.

When the solder is molten, ease the capacitor away from the PCB with a thin stainless steel spike or screwdriver.

5.3 REPAIR

5.3.1 COMPONENT CHECKS

If a transistor is suspected of faulty operation, an indication of its performance can be assessed by measuring the forward and reverse resistance of the junctions. First make sure that the transistor is not shunted by some circuit resistance, (unless the device is completely unsoldered). An AVO model 8 or equivalent meter should be used for taking the measurements, using only the medium or low resistance ranges.

The collector current drawn by multijunction transistors is a further guide to their operating performance.

If an integrated circuit (IC) is suspect, the most reliable check is to measure the DC operating voltages. Due to the catastrophic nature of most IC failures, the pin voltages will usually be markedly different from the recommended values in the presence of a fault. These values can be found on the circuit diagram, or in the component data catalogue.

5.3.2 COMPONENT REPLACEMENT

To avoid damaging the printed circuit track, the removal and replacement of components requires careful attention. If it is necessary to remove a component from the PCB, the recommended procedure is to first clear all solder from the component leads using a solder sucker or solder wick. The lead should then be free in the hole so that it can be withdrawn from the PCB.

Soldering operations should be kept to a minimum. Printed circuit tracks should be cleaned before applying the soldering iron or solder, and the amount of heat and solder applied kept to a minimum. A fine-tip thermally controlled soldering iron and the use of solder wick or a solder sucker is strongly recommended. Do not attempt to withdraw any component or lead from the PCB while the solder is still molten.

Ensure that the soldering iron is earthed back to the frame of the set.

5.3.3 CHIP COMPONENT IDENTIFICATION

Chip components used in Tait T490 series two way radios can be identified as follows:

Colour	Component Type
Black	Metal film resistor
Light brown	Ceramic capacitor
Green	Ceramic capacitor
White (no marking)	Ceramic capacitor

5.3.4 CHIP COMPONENT REMOVAL/REPLACEMENT

Note: Temperature of soldering iron must be maintained at 600-700°F.

5.3.4.1 Component Removal

1. Place solder iron tip directly on component in order to melt solder and glue as shown in figure 1. Remove component with tweezers or long nose pliers.

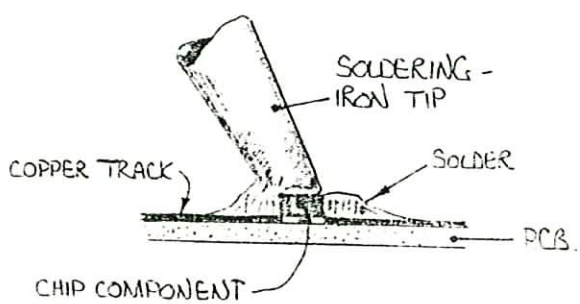


Figure 1

2. Completely remove old solder from PCB, using a desoldering tool. Application of a small amount of flux will greatly aid in the removal of old solder.

5.3.4.2 Chip Component Replacement

1. After component has been removed and PC pattern cleaned, apply a small amount of solder on PC pattern and let cool, as shown in figure 2.

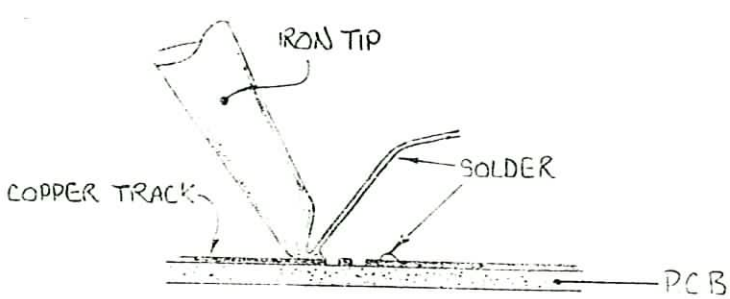


Figure 2

2. Insert new components and apply soldering iron tip to PC pattern as shown in figure 3 (a), (b) and (c).

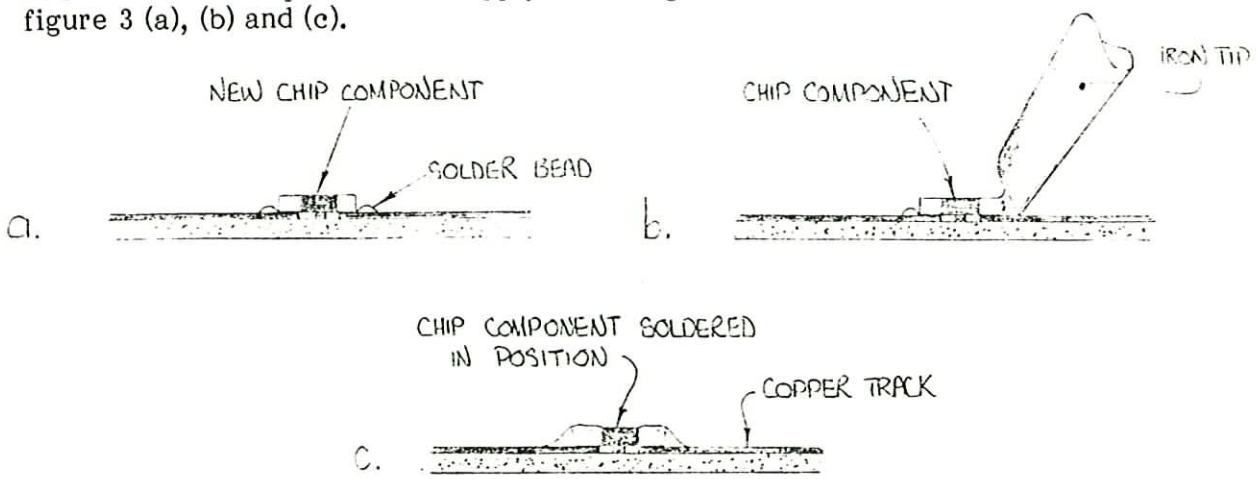


Figure 3

Caution: As patterns and components are close to each other, extreme care must be excercised when soldering, as not to damage components or bridge PC pattern paths. High soldering iron temperatures can cause component damage. Do not apply the soldering iron tip to the new component during installation.

5.3.5 INTER BOARD WIRING

To assist circuit tracing all plugs and connections are shown on the outer edge of the circuit diagrams, where the 'function', 'plug' and 'pin number' are all shown.

The 'terminal assignment diagram' (fold out 5) provides further assistance to the technician.

5.4 SETTING UP

5.4.1 TEST EQUIPMENT REQUIRED

1. Multimeter (eg AVO Model 8)
2. DC electronic voltmeter (eg Tech TE65)
3. RF power meter 30 watts FSD usable to 100MHz with 5 and 30 watt elements (eg Bird Model 6154 or 611).
4. Power Supply - output adjustable between 9 and 16 volts DC with a capacity of at least 8 amps.
5. Modulation meter (eg Sayrosa 252)
6. Sinad meter (eg Helper Instruments Sinadder)
7. VHF signal generator. Good quality FM. Useable from 0.1µV (-127dBm) to 200mV (0dBm) pd. External sweep facilities an advantage (eg HP 8640B, Boonton 102A/B).
8. VHF frequency counter accurate to within 2ppm.

9. Sweep generator with 10.7MHz markers (not necessary if item 7 will carry out this function).

10. Crystal reference oscillator 10.7MHz

11. Audio oscillator, 10Hz to 10kHz (eg HP 204C/D)

12. Audio amplifier, with about 1.5 watts output, to drive a small speaker which can be coupled to the T498 microphone. An adaptor should be made whch will hold the speaker and microphone close together.

13. AC millivoltmeter

14. Oscilloscope - good quality instrument usable to 10MHz.

15. Speaker 3 ohm voice coil

16. RF coupling device (see figure 5, page 5.20)

17. RF diode probe (see figure 6, page 5.20)

18. Ignition noise simulator (see figure 7, page 5.21)

19. Coaxial insert extractor tool (available from Tait Electronics Ltd).

20 Tait T281/2 bench service lead

21. Trimming tools: WT 9 Tait IPN 9360110
WT 10 Tait IPN 9360111
WT 11 Tait IPN 9360112

5.4.2 TUNING HINTS

1. The front panel 'on/off' switch removes power from the receiver and exciter PCBs only, the RF power amplifier assembly and the DC hash filter on the exciter PCB are not controlled by this switch.

2. When using the RF diode probe, the earth return should be kept as short as possible, and connected as close as possible to the point at which the measurement is being taken. This is to minimise stray pick-up which may affect the reading.

3. When the coils on the exciter or receiver PCBs are being tuned, all adjustments must be made through the PCB (a non-metallic tuning tool is recommended).

4. When a multi-channel set is being tuned, follow the procedures set out below, adjusting the tuning of each stage for the best compromise at the extremes of the frequency switching range.

5. RF coils type 618 each have a tap which is connected to the printed circuit during manufacture for operation in the top half of the frequency range. If it is desired to operate the T498 in the bottom half of the frequency range, this tap should be disconnected and the whole of the coil brought into circuit.

At frequencies near mid-band, check that the coil connections are correct by screwing the coil slug through its complete range of adjustment, two peaks should be observed. If only one peak is present the coil connections should be changed.

6. Check for obvious mechanical faults in the printed circuit boards, chassis, controls, microphone etc.

7. Check the printed fuse on the exciter PCB. Its rating is about 2 amps, and it can be replaced by a 0.1mm diameter copper link.

5.4.3 REFERENCE FREQUENCY SELECTION

Selection of the correct reference frequency is most important. To calculate whether the correct reference frequency has been selected, complete the following steps:

1. Divide transmit frequency by reference frequency. The answer should be an integer value (i.e. a complete number, with no digits after the decimal point).

2. Divide receive L.O. frequency (RF - IF) by reference frequency. The answer should be an integer value.

If both of the above conditions are met for all frequencies desired, then the correct reference frequency has been selected.

If either of the above conditions is not met for all frequencies desired, the correct reference frequency should be selected from the chart below.

Reference Frequency	Crystal X401	R435	R438	R440	R436 & R437	Pin 5 of IC401 linked to
5.0kHz	10.24MHz	39k	47k	68k	4k7	+V (pin 6)
6.25kHz	12.8MHz	39k	47k	68k	4k7	+V (pin 6)
12.5kHz	12.8MHz	22k	22k	39k	2k2	0V
Under normal usage, pin 4 of IC401 will remain linked to +5V (pin 6).						

5.4.4 TO SET THE CHANNEL SPACING TO 25kHz

Check that the crystal filter (XF101) is correct viz:
NDK 10F 15D, HY.Q QMF10712.

Adjust RV347 for ±5kHz deviation under limiting conditions (section 5.5.3).

5.4.5 TO SET THE CHANNEL SPACING TO 12.5kHz

Check that the crystal filter (XF101) is correct viz:
NDK 10F 7.5DH, HY.Q QMF 10F 26.

Adjust RV347 for ±2.5kHz deviation under limiting conditions (section 5.5.3).

5.4.6 CHANNEL PROGRAMMING

5.4.6.1 CONNECTING THE T400 TO THE T498

The T400 is connected to the two way radio by means of an 'Interface Cable and Connector' assembly.

During the 'set-up' procedure the TA-490 memory module is removed from the two way radio and the 'interface connector' is plugged into the position vacated by the memory module.

5.4.6.2 BRIEF DESCRIPTION OF OPERATION

The Tait T490 Series of two way radios employ a 'synthesizer' for generation of the radio frequency carrier.

The carrier frequencies are generated by digital dividing techniques, each frequency has a corresponding divide number.

The digital number associated with each channel is stored within an electronic memory device termed a PROM (Programmable Read Only Memory). The digital numbers in the memory are selected by the channel selector switch and fed to the synthesizer, causing the required carrier frequency to be generated.

Thus it can be seen that the method of altering the carrier frequency is to alter the divide number called from the memory. Obviously the required divide numbers must somehow be placed into the memory. This is the purpose of the T400 E-PROM Programmer.

When the T400 is connected to the two way radio it takes control of the synthesizer. The synthesizer can then be scanned through the RF band of interest and the digital numbers corresponding to the desired carrier frequencies entered into the two way radio memory.

The 'setting-up' procedure is divided into four steps:

Step 1: Involves setting the synthesizer reference oscillator on frequency (Section 5.5.2).

Step 2: Involves the trimming of the Voltage Controlled Oscillator (VCO) of the two way radio (Section 5.5.2).

Step 3: Involves setting up the T400 'Scratch Pad Memory', channel by channel and frequency by frequency. The setting up is then checked, and if necessary, the channels and frequencies can be edited.

The T400' Scratch Pad Memory' is used to store frequency information, where it may be easily altered. New information can be written directly over incorrect information. If the memory contents are not required, a memory location may be cleared by touching the 'Enter Vacancy' key.

The scratch pad permits alteration of the frequencies and channels prior to loading the two way radio memory module. It should be understood that once the two way radio memory module has been loaded with data, it must be erased under high intensity ultra violet light before being reloaded. (This precaution is not necessary when loading a previously vacant channel).

The scratch pad memory will retain information during 'power off' conditions.

Step 4: In this step the channel and frequency information written into the scratch pad is loaded into the two way radio memory module. When this procedure has been completed a verifying sequence is carried out which culminates in the illumination of either: the 'Pass' LED indicating that the memory module is ready for use; or the 'Fail' LED which indicates that the memory module has failed the loading procedure.

Locations previously entered 'Vacant' can be subsequently filled without erasing information previously loaded into other locations.

5.5 TRANSMITTER ADJUSTMENTS

5.5.1 PRELIMINARY CURRENT CHECK

Ensure that the supply is off.

Connect the T281/2 service lead.

Plug a pre-programmed memory module (TA-490) onto the exciter PCB. (Refer to T400 E-PROM Programmer 'Users Handbook' for programming a TA-490 Memory Module.)

Set the supply to 13.8 volts.

Note: Always have set turned off when inserting or removing memory modules.

2. Turn set on and check current drawn by set when muted is as follows for the EPROM being used:

NMOS EPROM $I < 350mA$

5.5.2 RF ALIGNMENT

Set the front panel channel switch to the highest frequency channel.

Plug the frequency counter onto the reference oscillator test point (TP1) and adjust L402 for the correct frequency (to the nearest 100Hz), refer to section 5.4.3.

Plug the frequency counter onto VCO test plug (TP3), close pressel, and alternately short the middle pin of TP2 to + & - (two outer pins of TP2) observing the frequency on the counter, and adjusting CV427 so that the VCO range of frequencies is approximately symmetrical about the required range of transmit frequencies.

Repeat the above step with the set on receive for the receive run up frequency adjusting CV425, (remembering IF offset), so that the VCO range of frequencies is approximately symmetrical about the required range of receiver oscillator injection frequencies.

With counter connected to TP3 readjust L402 for correct run up frequency.

Disconnect counter.

Turn RV376 & RV377 full clockwise.

Connect set to wattmeter, close pressel and adjust CV515 in PA for maximum power out.

Adjust RV376 for 25 watts and RV377 for 5 watts with lower power switch on. Ensure that the current drawn for 25 watts RF output does not exceed 5.5amps, and that the voltage at the set is 13.8V under full transmitter load.

Check for correct transmitter operation on all channels programmed.

5.5.3 MODULATION ADJUSTMENT

Connect an RF coupler between RF output and power meter.

Connect modulation meter to coupler; connect mic to tone box or connect audio oscillator to microphone pads on exciter. (See Section 5.4.1 item 12)

Set RV347 for maximum deviation.

Set oscillator to 1kHz sine wave.

Set the modulation meter to read '+' deviation.

SET THE CHANNEL SWITCH TO THE HIGHEST FREQUENCY CHANNEL

Close pressel and adjust the audio oscillator output level to produce +3kHz (or +1.5kHz) deviation.

Increase the audio input by 20dB and adjust RV347 to give a deviation of +5kHz (or +2.5kHz).

Slowly sweep the frequency of the audio oscillator between 300Hz and 3000Hz to find the frequency which produces maximum deviation, and readjust RV347 for a peak deviation of +5kHz (or +2.5kHz) at that frequency.

Reset the modulation meter to read '-'deviation.

Slowly sweep the audio frequency between 300Hz & 3000Hz; if the peak is found to exceed -5kHz (-or 2.5kHz) then re-adjust RV347 for a peak deviation of -5kHz (or -2.5kHz) at that frequency.

5.6 RECEIVER ALIGNMENT

5.6.1 GENERAL

Ensure that the VCO is adjusted as described in Section 5.5.2, paras 3 and 4.

Measuring the DC volts at the junction of L113, R110 and C127, tune L123 and L124 for maximum volts (approx 4V).

5.6.2 RF & IF ALIGNMENT

In this section two methods of IF alignment are described. In section (a) the 'sinad' method is given, while section (b) describes the 'sweep' alignment method. This method requires the use of a signal generator with sweep facilities and an oscilloscope. The sweep method is recommended when optimum IF pass-band response is required.

(a) SINAD ALIGNMENT (RF & IF Sections)

Ensure that the VCO-injection signal is correctly aligned as described in 5.6.1 above.

Connect a sinad meter (or distortion measuring set) to the audio output terminals.

Note: Set the VHF signal generator on the receive frequency.

Connect the VHF signal generator to the aerial input socket.

Set the signal generator for ±5kHz (or ±2.5kHz) deviation at 1kHz.

Set the signal generator output level to give a sinad of about 12dB.

Tune L105, L106, L111, L112, L116, L117, L118, L201 and L203 for best sinad, progressively reducing the signal generator output level to keep the sinad at about 12dB.

Repeat the tuning of all the above coils.

Reduce the signal generator deviation to ±3kHz (or ±1.5kHz).

Check that the output of the signal generator does not exceed -118dBm for a 12dB sinad.

(b) SWEEP ALIGNMENT (IF Section Only)

Ensure that the VCO-injection and coils L123, L124, L105, L106, L111, L112 and L203 are correctly aligned as in (a) Sinad Alignment above.

Externally modulate the VHF signal generator with a 10Hz signal; set the deviation to ±30kHz and the RF level to -100dBm.

Connect the AGC output (IC201 pin 13) to the oscilloscope 'Y' amp, with a DC load of 10k to -ve.

Connect the source of the 10Hz modulating signal to the 'X' amp.

Note: Both the 'X' and 'Y' amps, should preferably be DC coupled.

Tune L116 and L117 for the maximum amplitude on the oscilloscope waveform.

Tune L118 and L201 alternately to obtain minimum ripple on the oscilloscope waveform, consistent with maintaining the output amplitude.

Repeat the IF tuning of L116, L117, L118 and L201 to obtain a symmetrical response with minimum ripple, while maintaining output amplitude.

Disconnect the external modulation and the oscilloscope.

5.6.3 NOISE BLANKER ADJUSTMENT

Ensure that the RF & IF stages have been correctly aligned as in section 5.6.2 above.

Set the VHF signal generator to deliver an 'on channel' unmodulated signal.

Connect the signal generator to the receiver input.

Connect an EVM (10V DC range) to pin 5 of IC102.

Tune L125 & L127 for maximum on the EVM.

Typical amplifier noise sensitivity is between 10 and 20µV for a 0.5 volt DC rise in voltage at pin 5 of IC102.

Connect an ignition noise simulator (see figure 7) to the receiver input.

Listen to the receiver output, check the operation of the noise blanker by temporarily short circuiting Q111 base-emitter circuit, thus disabling the noise blanker.

The noise blanker should give a marked reduction in noise over a wide range of noise input amplitudes.

5.6.4 SQUELCH - NOISE AMP ADJUSTMENT

Plug aerial coax onto 50 ohm load, then measure volts on pin 5 of IC202 with a high impedance multimeter (½ a meg ohm or more) and adjust RV 245 to read 4 volts.

Then check that fine squelch opens between 6-12dB sinad.

5.7 RF COILS TYPE 618

RF coils type 618 each have a tap which is connected to the printed circuit during manufacture. For operation in the top half of the frequency range the tap is connected and the full coil connection is left open. For operation in the bottom half of the frequency band, the coil tap is cut and the full coil connected by a short link.

When frequencies near the mid band point are required, check that the coil connections are correct by adjusting the coil slug through its full range. Two peaks should be observed, if only one peak is present the coil connections should be changed.

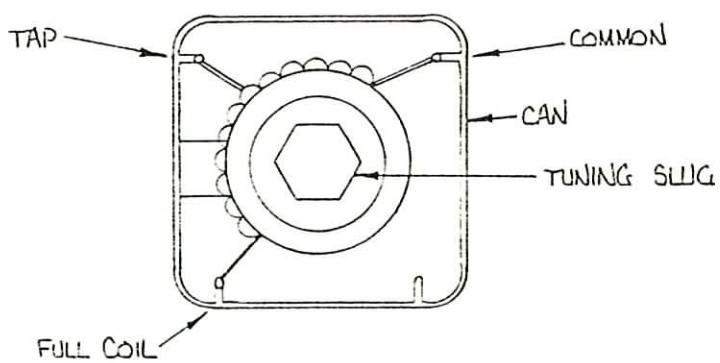


Figure 4: Coil 618 Pin Connections

5.8 FAULT FINDING

5.8.1 GENERAL

During servicing it may be necessary to measure specific performance parameters as a means of verifying the presence of a fault condition.

The following performance tests provide a means for checking the various two way radio parameters. When used in conjunction with the voltage level test points which are given on the circuit diagrams (shown in blue) a fault can be readily pin-pointed.

Unless otherwise specified, tests are for a set with a 15kHz bandwidth on receive and ±5kHz deviation on transmit, with RF preamp not fitted. For sets with 7.5kHz IF bandwidth, use ±2.5kHz as maximum deviation and refer to specifications (Section 1.2) for performance limits.

5.8.2 RECEIVER PERFORMANCE TESTS

5.8.2.1 SQUELCH

(a) To Check The Squelch Operation.

Connect a Sinad meter across the speaker terminals.

Connect a VHF signal generator to the aerial input terminal.

Set the signal generator output level to zero and the modulation to ±3kHz (or ±2.5kHz) deviation at 1kHz.

Adjust the front panel squelch control until the noise just disappears.

Slowly increase the signal generator output level until the squelch gate 'opens', this should be at about 6 to 12dB sinad.

(b) To Check The Squelch Ratio

Set the signal generator output level to -107dBm (1µV), modulated to ±5kHz (or ±2.5kHz) deviation at 1kHz.

Replace the sinad meter with a mV/meter across the speaker terminals.

Turn the squelch control fully anti-clockwise.

Adjust the volume control to give a reading of 3 volts on the mV/meter.

Reduce the signal generator output level to zero.

The fall in output is the 'squelch ratio' and this should be at least 70dB.

(c) To Check the High Level Fast Squelch

Connect a VHF signal generator to the aerial input socket, with the output set to -100dBm modulated to ±5kHz (or ±2.5kHz) deviation at 1kHz.

Listen to the receiver audio output.

Turn the signal generator RF off.

Adjust the squelch control to just close.

Turn the signal generator RF on (-100dB) (squelch should open).

Turn the signal generator RF off. The noise tail should be about 100mS, before the squelch closes.

Turn the signal generator RF on again, this time with an RF level of -80dBm.

Turn the signal generator RF off. There should be no noticeable squelch tail.

5.8.2.2 TO CHECK THE AUDIO OUTPUT LEVEL

Connect an AC mV/meter and an oscilloscope across the speaker terminals.

Connect a VHF signal generator to the aerial input socket, with the output set to -107dBm (1μV) modulated to ±5kHz (or ±2.5kHz) deviation at 1kHz.

Set the volume control to just below the onset of clipping.

The receiver output should be 3 watts (3 volts across 3 ohms) at +13.8V supply.

Check the distortion with the aid of a distortion analyzer connected across the speaker terminals.

The distortion should not exceed 5%.

5.8.2.3 TO CHECK THE SINAD SENSITIVITY

Connect a sinad meter across the speaker terminals.

Connect the signal generator to the aerial input terminal.

Set the signal generator accurately on receive frequency. (Couple a 10.7MHz reference oscillator loosely into the receiver IF stage, then tune the signal generator for a zero beat, uncouple the reference oscillator).

Set the signal generator deviation to ±5kHz (or ±2.5kHz) at 1kHz.

Note: It is important that the modulating frequency is within 5Hz of 1kHz.

Set the signal generator output level to zero.

Increase the signal generator output level until a sinad of 12dB is reached.

The output signal generator output should not be greater than -118dBm and is typically -120dBm.

5.8.2.4 TO CHECK THE SIGNAL+NOISE TO NOISE RATIO

Set-up the signal generator and mV/meter as in section 5.8.2.1 (b).

Set the squelch control fully clockwise.

Set the volume control for a reading of 0.8V ('0'dB) on a convenient scale on the mV/meter.

Switch the signal generator modulation off.

Note the reading on the mV/meter.

The fall in reading when the modulation is switched off should be at least 34dB for 15kHz B/W or 28dB for 7.5kHz B/W sets.

5.8.2.5 TO CHECK ULTIMATE SIGNAL TO NOISE RATIO

Note 1: Carry out the following check only after the alignment has been completed.

Note 2: A good quality low noise RF signal generator should be used for this check (eg, HP8640B or 8656).

Set the signal generator to give an 'on channel' signal, modulated to ±5kHz with a 1kHz tone.

Set the signal generator output level to -47dBm.

Connect an AC mV/meter across the speaker terminals.

Adjust the volume control for a reading of 0.8V ('0'dBm) on a convenient scale.

Turn the signal generator modulation off.

Note the reading on the mV/meter.

The fall in reading when the modulation is switched off should be at least 45dB, or 50dB with a crystal in the quad detector. (A low reading could be caused by a faulty IC201 or a noisy VCO).

5.8.3 TRANSMITTER PERFORMANCE TESTS

5.8.3.1 AUDIO PROCESSOR

(a) TO CHECK THE LIMITER CIRCUIT.

Connect an oscilloscope to monitor the waveform at pin 1 of IC302d.

Provide an audio signal to the audio processor as in section 5.5.3.

Set the frequency of the audio signal generator to 1kHz.

Slowly increase the signal generator output level until the waveform begins to distort (squaring) (indicating that limiting has commenced).

Any further increase in signal generator output level should not increase the amplitude of the waveform.

(b) TO CHECK THE AUDIO AGC OPERATION

Set up the audio signal as described above [section 5.8.3.1(a)].

Set the oscilloscope to monitor the waveform at pin 14 of IC302d.

Connect an EVM to the base of Q303.

Increase the output level of the signal generator to 10dB above the limiting level [section 5.8.3.1(a)]. Note the amplitude on the oscilloscope, then increase the signal generator output level by another 10dB.

Check that the amplitude of the waveform does not increase significantly.

The EVM should show a 'positive DC' reading.

(c) TO CHECK THE GAIN OF THE AUDIO PROCESSOR

Provide an audio signal to the audio processor as in Section 5.5.3.

Connect an RF power meter and a modulation meter (via an RF coupler) to the transmitter output terminal.

Connect a mV/meter across the microphone terminals on the exciter PCB. (To monitor the input to the audio processor).

Set the frequency of the audio signal generator to 1kHz.

Check the deviation control, RV347, as in Section 5.5.3.

Slowly increase the output level of the audio signal generator until a deviation of ±3kHz or (±1.5kHz) is reached.

Check that the mV/meter reads approximately 3mV p-p.

Note: The audio processor gain must be checked at a level below that at which the audio AGC or limiting are influencing the measurements.

5.8.3.2 MODULATION CHARACTERISTICS

(a) GENERAL

To determine the overall characteristics as a function of deviation versus modulation frequency:

Connect an RF power meter and modulation meter (via the RF coupler) to the T498 transmitter output.

Provide an audio signal to the audio processor.

Connect an oscilloscope pin 1 of IC302a.

Set the frequency of the audio signal generator to 3kHz.

Check the level at which limiting begins [section 5.8.3.1 (a)].

(b) TO CHECK THE ABOVE LIMITING RESPONSE

Increase the audio signal generator output level to 20dB above the limiting level [section 5.8.3.1 (a)].

Vary the frequency of the signal generator between 0.3 and 10kHz

Note the deviation on the modulation meter.

Below 3kHz the deviation should be within 2dB of maximum.

Above 3kHz the deviation should decrease at approximately 30dB/octave.

Refer to the specifications for limits.

(c) TO CHECK THE BELOW LIMITING RESPONSE

Decrease the audio signal generator output level to 10dB below the limiting level [section 5.8.3.1 (a)].

Vary the frequency of the audio signal generator between 0.3 and 10kHz.

Note the reading on the modulation meter.

Below 3kHz the deviation should decrease at the rate of 6dB/octave.

Above 3kHz the deviation rate of decrease should be approximately 30dB/octave.

See specifications for limits.

5.8.3.3 TO CHECK THE RF POWER CONTROL CIRCUIT

Connect an RF power meter to the transmitter output.

Close the PTT switch.

Ensure that the transmitter is correctly tuned (section 5.5).

Vary the supply voltage between 10 and 16 volts.

Above 13.8 volts the RF power output should not increase by more than 2 watts.

AT 10 volts the RF power output should be more than 12.5 watts.

5.8.3.4 TO CHECK THE TRANSMISSION TIMER.

Connect an RF power meter to the transmitter output.

Close the PTT switch.

Check that the T498 reverts to 'receive' after one minute of transmission time.

If the transmission time is not within ±10% of one minute, reset the transmission time accurately by changing the value of either C363 (47µF) and/or R362 (1M).

To increase the transmission time increase the value of resistance or capacitance as required.

5.8.3.5 TO CHECK THE VCO CONTROL RANGE

Plug a frequency counter onto the VCO test plug (TP3).

Short the middle pin on TP2 to the +ve and -ve (the two outer pins of TP2) alternately.

The frequency shift should be more than 9MHz.

5.8.3.6 TO CHECK THE LOOP FILTER SPEED UP & OUT OF LOCK CROW BAR CIRCUITS

Two methods may be used:

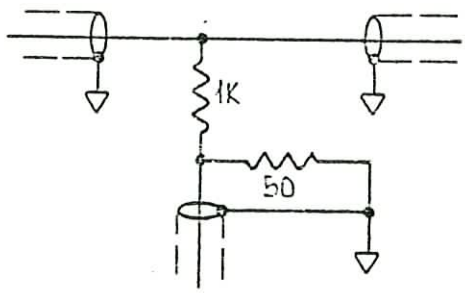
(a) Where two or more transmit frequencies are programmed, close the PTT switch then switch quickly from one channel to the other.

The transmit LED should blink off for less than 40mS.

(b) If only one channel is programmed, note how long it takes for the transmit LED to light when the PTT switch is closed. It should be less than 40mS.

RF Input From Transmitter

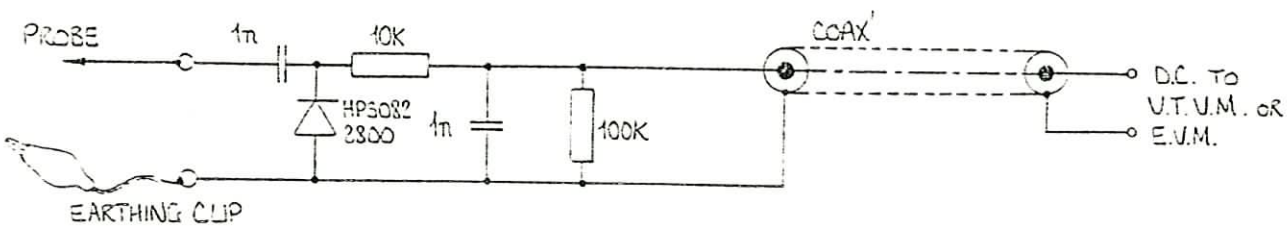
RF Output to Power Meter



RF Output to:
Modulation meter, Frequency counter,
Spectrum analizer, etc.

Suggested Construction: mount the components in a small metal box using chassis mounted coaxial sockets as the terminals.

Figure 5 RF Coupling Device.



This unit is not suitable for use on high voltage RF circuits

Figure 6 RF Diode Probe.

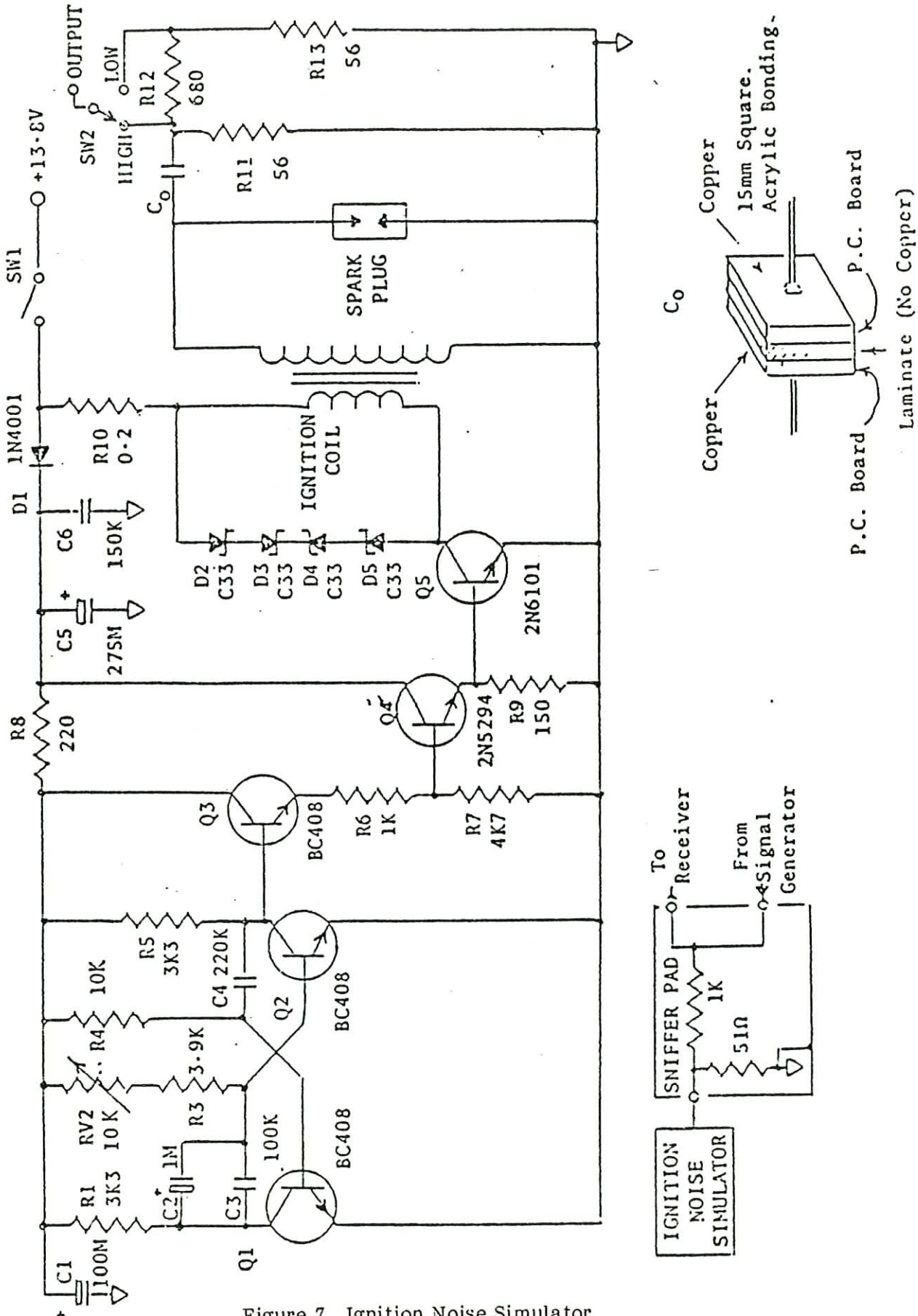


Figure 7 Ignition Noise Simulator

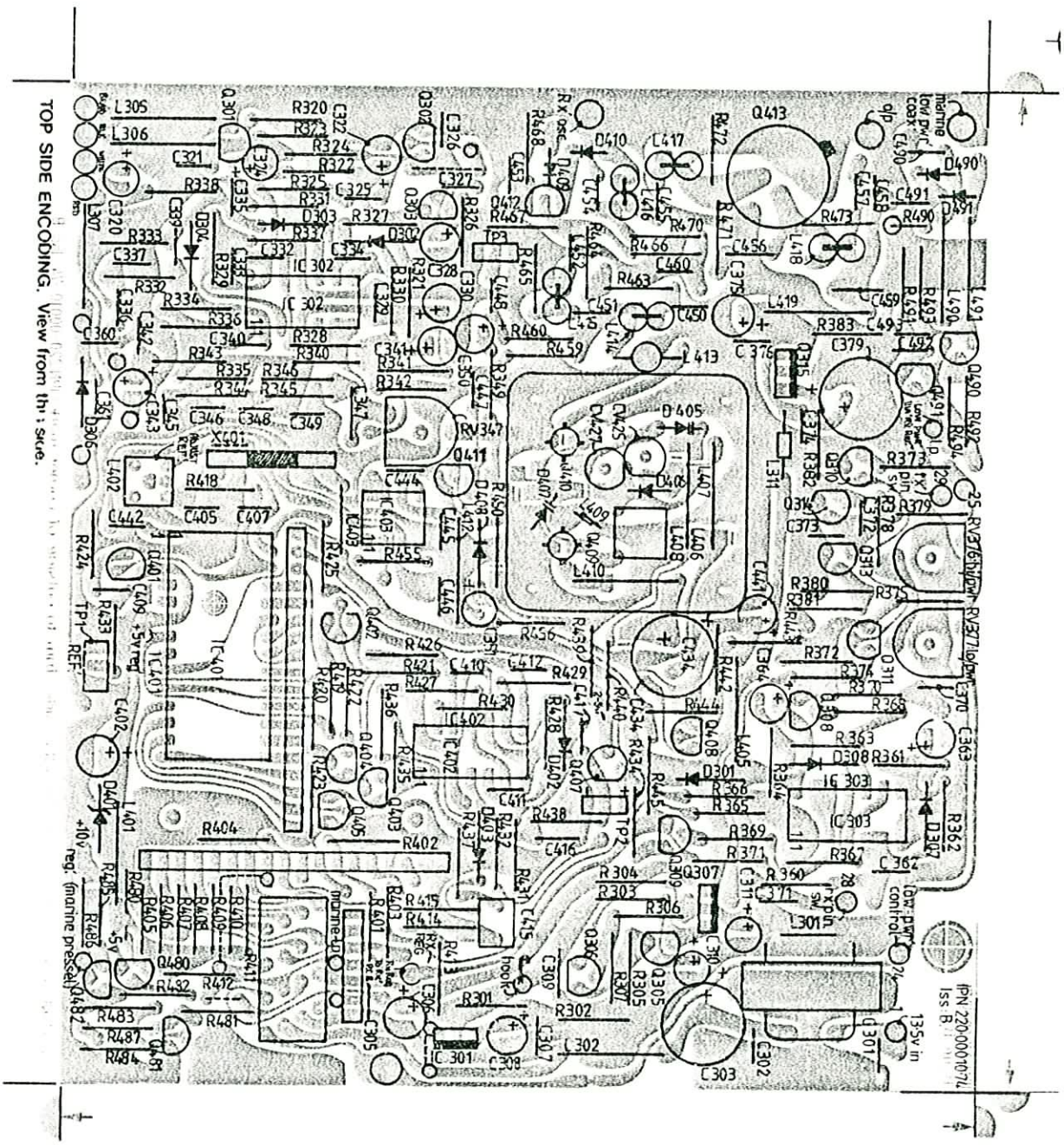


Figure 8 Exciter PCB Encoding

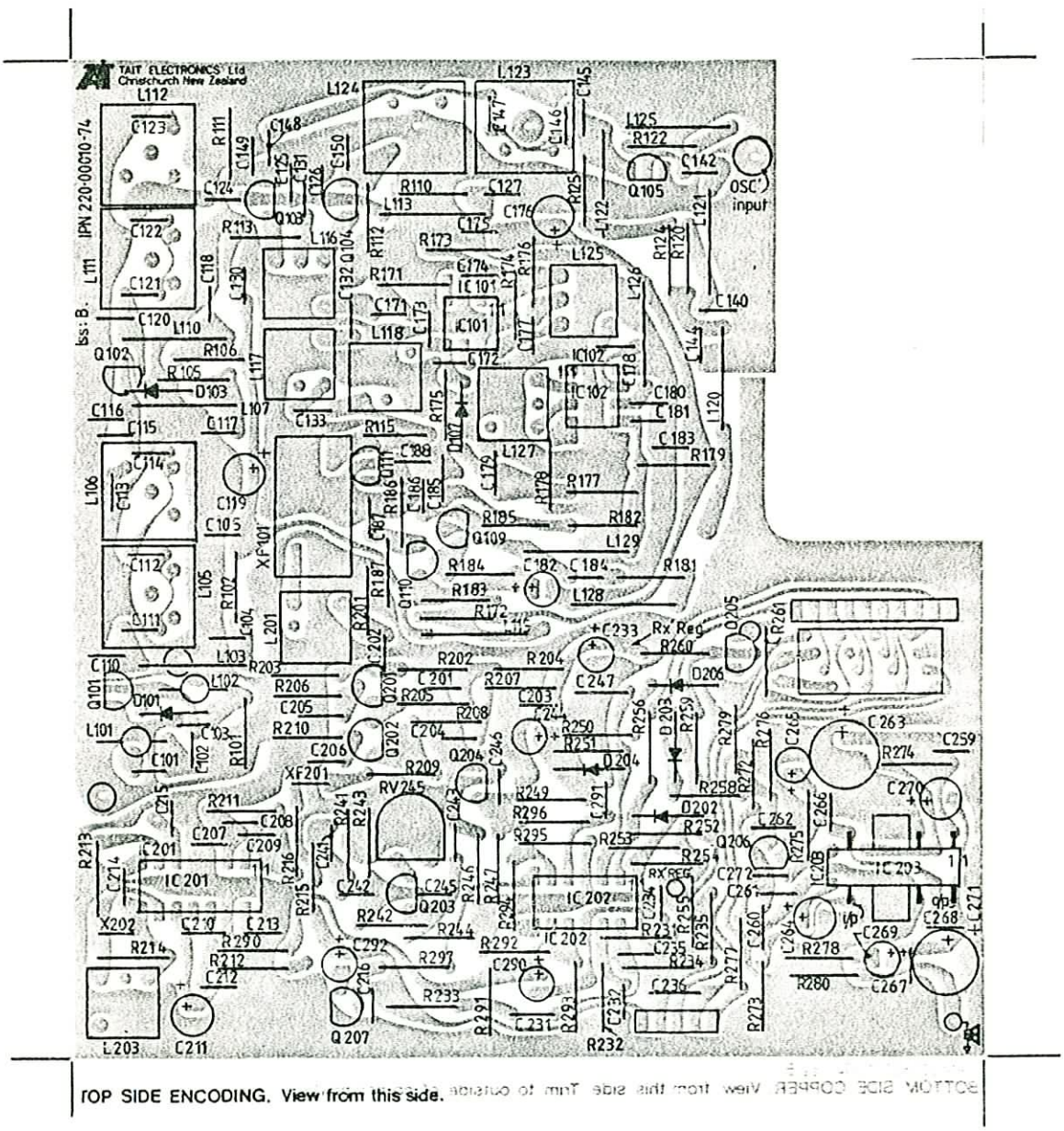


Figure 9: Receiver PCB Encoding

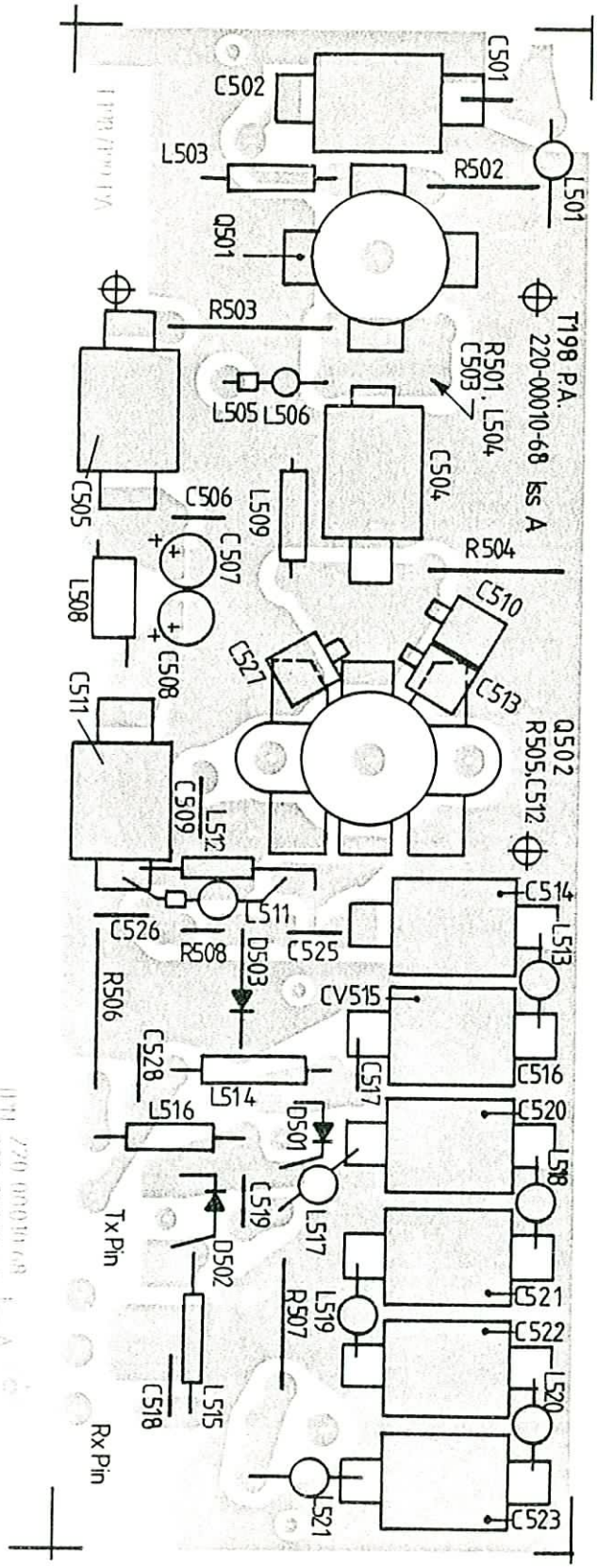


Figure 10: Power Amplifier PCB Encoding

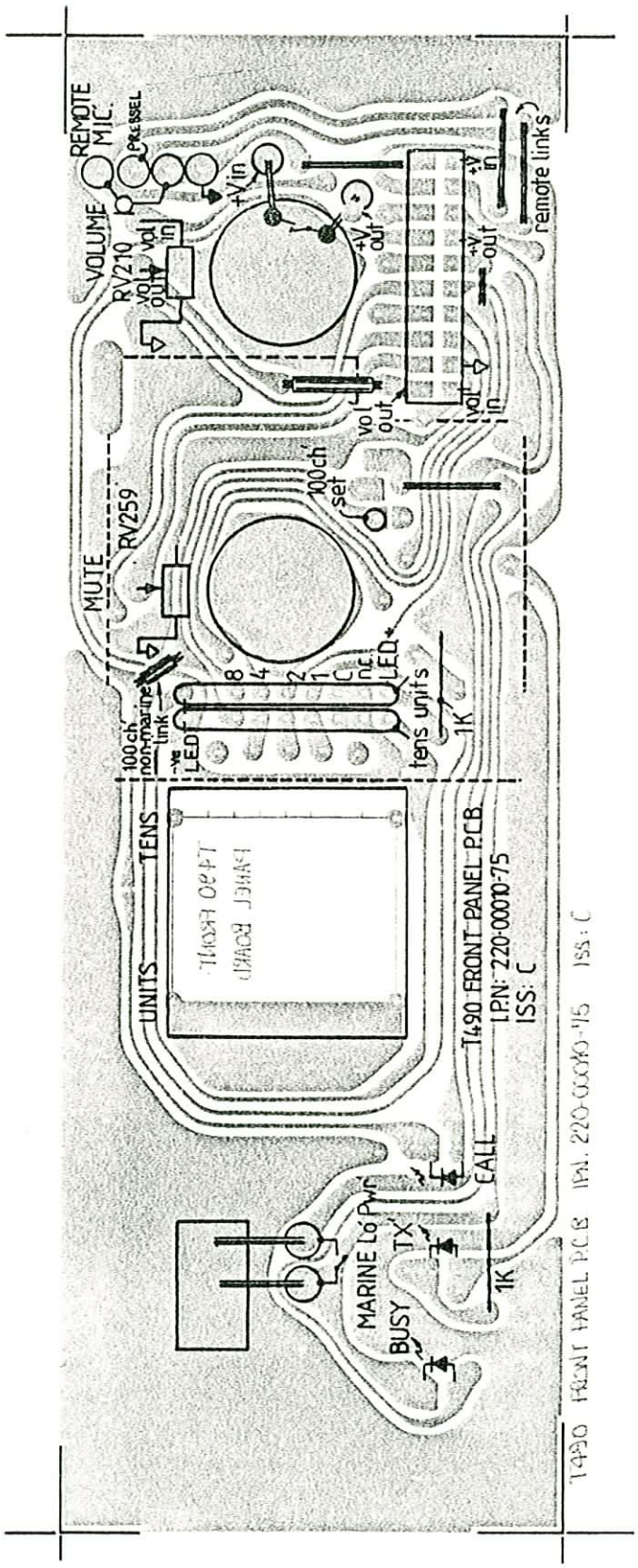


Figure 11: Front Panel PCB Encoding

SECTION 6 PARTS LIST

6.1 GENERAL

The 10 digit numbers (000-00000-00) in this parts list are 'internal part numbers' (IPN's).

Your spare parts orders can be handled more efficiently if you quote: equipment type, circuit reference and IPN, along with a brief description of the part.

6.2 B498/9 T498/9 RECEIVER EXCITER PCB ASSEMBLY

6.2.1 TRANSISTORS

000-00010-60	2	BC327 TRANSISTOR	Q308, Q309
000-00010-66	1	BC337 TRANSISTOR	Q206
000-00011-10	13	BC548B TRANSISTOR	Q109 Q203, Q204, Q207 Q302, Q303, Q305, Q306 Q310, Q313, Q314 Q402, Q405
000-00011-30	6	BC557B TRANSISTOR	Q110 Q205 Q311 Q403, Q404, Q408
000-00011-70	2	BD136 TRANSISTOR	Q307, Q315
000-00020-11	2	BF494 TRANSISTOR	Q201, Q202
000-00022-30	1	2N4427 TRANSISTOR	Q413
000-00022-45	3	2N5246 TRANSISTOR	Q301 Q401, Q407
000-00031-75	2	3SK97K TRANSISTOR	Q409, Q410
000-00031-90	2	MPSH11 TRANSISTOR	, Q111 Q411
000-00031-95	1	MPS3646 TRANSISTOR	Q412
000-00033-10	4	J310 TRANSISTOR	Q105, Q102, Q103, Q104

6.2.2 DIODES

001-00010-26	2	BA482 DIODE	D409, D410
001-00012-00	16	1N4148 DIODE	D107, D103 D202, D203, D204, D206 D301, D302, D303, D306 D307, D308 D304 D402, D403, D408

0010000126 8	1	MR47600 DIODE	D406
0010000151 2	1	BZX79/C5V6 ZENER	D401

6.2.3 INTEGRATED CIRCUITS

0020001021	1	CA3089E AGC INT CCT	Ic 201	82/2-575
0020001330	1	MC1330P INT CCT	Ic 102	
0020001350	1	MC1350P INT CCT	Ic 101	
0020001400	1	TBA810S INT CCT	Ic 203	
0020001440	2	MLM324P INT CCT	Ic 202, Ic 302	
0020001500	1	CD4011B INT CCT	Ic 303	
0020001570	1	CD4066B INT CCT	Ic 402	
0020001590	1	LM317 INT CCT	Ic 301	
0020001755	1	SP8793/MC12016 INT CCT	Ic 403 (REFER TO A4P165)	82/2-575
0020001760	1	MC145152 INT CCT	Ic 401	

6.2.4 CAPACITORS

0111012200 1	2	2P2 CAP NPO 63V ± 0.25P	C133 C214	
0111018200 1	1	8P2 CAP NPO 63V ± 0.25P	C348	
0111021500 1	1	15P CAP NPO 63V 5%	C132	
0111021800 0	1	18P CAP NPO 63V 5% CER PLT	C407	83/2-558
0111023900 0	1	39P CAP NPO 63V 5% CER PLT	C405	83/2-558
0111024700 1	7	47P CAP N150 63V 5%	C245 C246 C340, C349, C333 , C444, C447	 83/4-647
0111025600 1	1	56P CAP N150 63V 5%	C209	
0111031000 1	6	100P CAP N150 63V 5%	C131, C137, C188 C267 C332, C410	 83/4-647
0111032200 1	4	220P CAP N750 63V 10%	C334 C451, C452, C455	
0111034700 1	3	470P CAP N1K5 63V 10%	C184, C186 C453	

0110410001	16	1n CAP T/C B 63V 10%	C171, C178 C215, C241, C242, C268 C327, C360, C361, C362 C372 C409, C448, C460, C457 C458	
0110447002	53	4n7 CAP T/C B 63V 10%	C117, C118, C127, C130 C131, C140, C142, C144 C172, C173, C174, C175 C177, C180, C183. C201, C202, C203, C204 C206, C207, C208, C212 C213, C216, C234, C243 C259, C261, C291 C301, C302, C305, C307, , C321, C326, C329 C335, C342, C346, C370 C371, C373, C374, C376 C411, C412, C417 , C442, C445, C446 C454, C460	83/7-795 83/4-647

0150120001	1	2P0 CAP NP0 50V ±·25P 3·2×1·6mm CHIP	CC429	
0150150001	1	5P0 CAP N150 50V ±·25P 3·2×1·6mm CHIP	, CC428	
0150210001	1	10P CAP N150 50V ±·5P 3·2×1·6mm CHIP	CC430	
				83/2-559
0150410004	2	1n CAP T/C B 50V 10% 3·2×1·6mm CHIP	CC422, CC431,	
0150447001	5	4n7 CAP T/C B 50V 10% 3·2×1·6mm CHIP	CC423, CC432, CC433, CC440 CC418	83/1-550
0150547002	2	47n CAP 50V 20% 3·2×1·6mm CHIP	CC401, CC443	

0200071002	7	1µ CAP 50V ELECTRO 5×11mm VERT	C244, C269, C320, C324, C343, C350 C364	
0200081003	12	10µ CAP 50V ELECTRO 5×11mm VERT	C132 C233, C265, C290, C292 C308, C310, C311, C322 C328, , C341, C351	83/5-698
0200847002	11	47µ CAP 16V ELECTRO 6×11mm VERT	C119, C176 C211, C264, C270 C306, C363, C375, C330 C402, C441	
0200922001	2	220µ CAP 16V ELECTRO 10×12·5mm VERT	C263, C271	
0201910002	3	1000µ CAP 16V ELECTRO 12×25mm VERT	C303, C379 C434	83/1-550

0220510001	5	10n CAP 50V MYLAR VERT	C232, C266	
			C339, C345, C325	83/4-647
0220547001	12	47n CAP 50V MYLAR VERT	C179, C185,	
			C205, C210, C231, C260	
			C262, C247	
			C347, , C309	83/4-647
			, C416, C456	
0220610001	2	100n CAP 50V MYLAR VERT	C236,	
			C459	
0220710002	1	1M CAP 50V MYLAR VERT	C415	

6.2.5 RESISTORS

0300122000	3	2E2 RESISTOR 7x2.5mm 5% C/F	R278	
			R430, R470,	83/5-668
0300222000	2	22E RESISTOR 7x2.5mm 5% C/F	R370	
			R468	83/7-831
0300247000	13	47E RESISTOR 7x2.5mm 5% C/F	R105, R106, R113, R120	
			R172, R183, R122	83/1-950
			R212, R280	
			R374	
			R455, R463, R465	
			(R455 REFER TO PRODUCTION NOTE A4P165)	
0300310000	8	100E RESISTOR 7x2.5mm 5% C/F	, R124,	83/7-831
			R207, R274, R275	
			R375,	
			R460, R472, R434	
0300333000	12	330E RESISTOR 7x2.5mm 5% C/F	R110, R115, R173, R176	
			R205, R206, R211,	
			R301, , R371, R382	
			R467, R471	
0300368000	4	680E RESISTOR 7x2.5mm 5% C/F	R256	
			R305, R321	
			R459	

0300410000	20	1K RESISTOR 7x2.5mm 5% C/F	R177, R181, R186,	
			R208, R213, R260, R261	
			R276, R244	83/5-668
			R302, R303, R320, R360	
			R361, R338 R445	
			R424, R433, R473, R418	83/4-647
0300422000	21	2K2 RESISTOR 7x2.5mm 5% C/F	R125, R178	
			R201, R204, R209, R215	
			R216, R210	83/5-668
			R306, R307, R324, R327	
			R333, R336, R368, R369	
			R378, R380, R383,	
			R456, R466	83/4-647
0300433000	5	3K3 RESISTOR 7x2.5mm 5% C/F	, R179,	
			R258	
			R322, R379,	
			R439,	

0300447000	16	4K7 RESISTOR 7×2.5mm 5% C/F	R182, R185 R203, R259, R279, R297 R373, R381, R294 R421, R423, R427, R429 R432, R436, R437	83/4-647
0300468000	4	6K8 RESISTOR 7×2.5mm 5% C/F	R252 R335 R402, R404	83/7-795
0300482000	2	8K2 RESISTOR 7×2.5mm 5% C/F	R342, R293	
0300510000	33	10K RESISTOR 7×2.5mm 5% C/F	R111, R112, . R174 R175, R187, R202, R235, R241, R247, R250, R272, , R341, R344 R349, R365, R366, R401, R403, R405, R406 R407, R408, R409, R410 R411, R419, R420, R422 R425, R442, R412, R415 R464	
0300515000	3	15K RESISTOR 7×2.5mm 5% C/F	R243, R340, R345	83/4-647
0300522000	15	22K RESISTOR 7×2.5mm 5% C/F	R171, R184, R214, R233, R273, R290 , R295 R325, R328, R343, R330 R413, R426, R428, , R443,	83/3-647 83/4-647
0300539000	3	39K RESISTOR 7×2.5mm 5% C/F	R337, R346, R435	83/4-647
0300547000	4	47K RESISTOR 7×2.5mm 5% C/F	R249, R296, R292 R438	83/4-647
0300568000	6	68K RESISTOR 7×2.5mm 5% C/F	R242 R304, R323, R363 R450, R440	83/4-647 83/2-583
0300633000	4	330K RESISTOR 7×2.5mm 5% C/F	R255, R291 R329, R364	83/2-583
0300647000	9	470K RESISTOR 7×2.5mm 5% C/F	R231, R232, R254, R251 R326, R331, R334, R372 R414	
0300710000	6	1M RESISTOR 7×2.5mm 5% C/F	R234, R246, , R253 R362, R367 R431	
0360333001	1	330E RESISTOR 3.2×1.6mm 5% M/F CHIP	, RC451,	83/4-653
0360410001	3	1K RESISTOR 3.2×1.6mm 5% M/F CHIP	, RC453, RC453, RC447	83/4-653

0360422001	2	2K2 RESISTOR 3.2x1.6mm 5% m/F CHIP	RC457, RC461	83/2-663
0360522001	2	22K RESISTOR 3.2x1.6mm 5% m/F CHIP	RC452, RC454	83/4-653
0360610001	2	100K RESISTOR 3.2x1.6mm 5% m/F CHIP	RC348 RC449	83/4-653
0420347001	1	470E PRE-SET RESISTOR 10mm FLAT	RV245	
0420422001	3	2K2 PRE SET RESISTOR 10mm FLAT	RV347, RV376, RV377	

6.2.6 COILS

0500001602	3	COIL TAIT No 602	L117, L118 L201	
0500001617	1	COIL TAIT No 617	L402	
0500001618	7	COIL TAIT No 618	L105, L106, L111, L112 L123, L124 L408 (MODIFIED 618 COIL)	
0500001619	3	COIL TAIT No 619	L116, L125, L127	
0500001620	1	COIL TAIT No 620	L203	
0510001124	1	COIL A/W 5.5T/3mm VERT	L413	
0510006001	3	BALUN H-F3	L414, L416, L418	83/4-647
0510006002	2	BALUN L-F3	L415, L417	

0560002100	9	FXD IND TAIT No 100 3.3μH	L110, L113, L121, L122, L125 L419, L406, L407, L410	83/1-550
0560002101	5	FXD IND TAIT No 101 1.5μH	L107 L302, L305, L306, L307	
0560002102	7	FXD IND TAIT No 102 100μH	L115, L120, L126, L128 L129 L401, L405	
0560002106	1	FXD IND TAIT No 106 2mH. (Fe.Br)	L301	
0620001011	6	CAN 14mm sq x 19mm.	FOR 618 COILS.	
0650010004	1	FERRITE BEAD F8 4x2x5	L311	

6.2.7 PCB MISCELLANEOUS

2060001011	340 mm	COAX 50Z RG316-U		83/5-729
2200001074	1	PRINTED CCT BOARD		
2400002059	3	PLUG 3 WAY 1ROW PCB MTG MOLEX		83/3-610
2400002060	2	PLUG 18 WAY 1ROW PCB MTG MOLEX		83/3-610
2740001007	1	XTAL 12.8MHZ. TE 9	X401	
2760001020	1	XTAL FILTER 10F15A	XF101	
3033005008	2	EARTHING SPRING CONTACT A4M796		
3033005048	2	HINGE CLIP A4M915		
3088012028	1	HEATSINK REDPOINT 5F		
3190001053	1	SHIELD LID A3M1388		
3190001052	1	SHIELD BOX A3M1390		
3490002015	4	SCREW M2.5 x 6 PAN PZ TAPTITE	SHIELD LID & BOX	
3560001026	65	HARWIN TRACK PINS Rx 20, Sc95	REFER TO PRODUCTION NOTE A4P165	
3650011103	1	LABEL "TEST REPORT INSIDE" AAA267		83/6-772
3650010001	.002	THERMAL PRINT PAPER HP-85		83/6-772

6.3 C498 ADD TO B498/9 TO MAKE T498

0011000125 3	2	BB105B DIODE VARICAP	D405, D407
0111005001	1	0P5 CAP P100 50V ± 0.25P	C147
0111007501	1	0P75 CAP P100 50V ± 0.25P	C122
0111011001	1	1P CAP P100 63V ± 0.25P	C112
0111013901	1	3P9 CAP NPO 63V ± 0.25P	C120
0111016801	1	6P8 CAP NPO 63V ± 0.25P	C111
0111018201	1	8P2 CAP NPO 63V ± 0.25P	C148
0111021201	3	12P CAP NPO 63V 5%	C113, C123, C146
0111021801	1	18P CAP N150 63V 5%	C145
0111022201	1	22P CAP N150 63V 5%	C121
0111022701	2	27P CAP N150 63V 5%	C115, C116
0111023301	4	33P CAP N150 63V 5%	C110, C114, C124, C149
0111024701	1	47P CAP N150 63V 5%	C125, C150

0150110001	1	1PO CAP NPO 50V ±·1PF 3·2×1·6mm CHIP	CC426	
0150120001	1	2PO CAP NPO 50V ±·25P 3·2×1·6mm CHIP	CC424	83/3-650
0150150001	1	5PO CAP N150 50V ±·25P 3·2×1·6mm CHIP	CC421	
0280170001	2	7P TRIM CAP (BLUE) MURATA TZ.	CV425, CV427	
0511000101	1	COIL A/W 1·5T/3mm HOR	L409	
0560002104	1	FXD IND TAIT No 104 330mH.	L412	
3160006294	1	FRONT PANEL A2A288		

6.4 C198/138-174 PA COMPONENTS

6.4.1 TRANSISTORS

0000002165	1	SD1012 TRANSISTOR C/W NUT (STUD MTG)	Q501
0000003065	ALT.	2N6080 " " " " "	(MOTOROLA)
0000023300	1	SRF1585 TRANSISTOR (FLANGE MTG)	Q502
0000021750	ALT.	SD1128 " (MOT)	

6.4.2 DIODES

0010001160	1	SR2607 DIODE	D504
0010001250	2	UM9401 P.I.N DIODE	D501, D502
0010001350	1	DIODE HP5082-2200 OR AERTECH 425-800	D503

6.4.3 CAPACITORS

0100410001	2	CAP 1n TEMP CHAR B 10% 500V MUR D036	C517, C519
0110115001	1	CAP 1P5 P100 63V TOL C CER PLT	C525
0140082002	ALT.	CAP 0P82 P100 100V ± ·25P 2222-638-05827	83/3-643
0110239001	1	CAP 39P N150 5% 63V MUR RD871	C501
0110447002	6	CAP 4n7 TEMP CHAR B 10% 63V MUR RD873	C506, C509, C512
0110447003	ALT.	CAP 4n7 " " " " 50V MUR DO108	C518, C526, C528
0150410001	1	CAP 1n CER. CHIP 200V 10% MUR HOC60	C503
0200810003	2	CAP 10M 50V ELECTRO P.C.B MTG	C507, C508
0280230003	1	TRIM CAP 5/30P MURATA N750	CV515
0290222001	2	CAP 22P 350V 5% CASE MICA UNELCO T102	C520, C523
0290221001	2	CAP 21P 350V 5% CASE MICA UNELCO T102	C521, C522
0290233003	1	CAP 33P CASE MICA UNELCO T102 LESS LEGS	C516

0290282001	1	CAP 82P 350V 5% CASE MICA UNELCO T102	C504
0290312001	1	CAP 120P 350V 5% CASE MICA UNELCO T102	C502
0290315002	3	CAP 150P CASE MICA UNELCO 3HS-0006	C510, C513, C527 — Required when Q502 is SRF1585
0290315001	ALT	CAP 150P 350V 5% CASE MICA UNELCO T102	C510, C513 — Required when Q502 is SD1407.8
0290318001	1	CAP 180P 350V 5% CASE MICA UNELCO T102	C514
0290340010	1	400P x 3 SILVER MICA SPARK PLATE (SHINMEI ELECTRIC Co. LTD MODEL 3SP-400)	C524A, C524B, C524C
0290368001	2	CAP 680P 350V 5% CASE MICA UNELCO T102	C505, C511

6.4.4 RESISTORS

0300247000	1	RESISTOR 47E 7x2.5mm 5% C/F	R502
0300447000	1	RESISTOR 47K 7x2.5mm 5% C/F	R508
0300333001	2	RESISTOR 330E 10x4mm 5% C/F	R503, R506
0300515001	1	RESISTOR 15K 10x4mm 5% C/F	R507
0323222000	1	RESISTOR 22E 10·4mm 5% METAL FILM	R504
0323100000	3	RESISTOR 100E 10x4mm 5% METAL FILM	R505, R501, R505A

6.4.5 COILS

0510000102 7	1	COIL 6·5T/4mm I.D. HOR	L504 (S.I.T. RETURN UNUSED COILS TO STORE)	1631
0510000116	2	COIL 2·5T/3·5mm I.D. VERT	L501, L513	1631
0510000112 1	2	COIL 4·5T/3mm I.D. VERT	L517, L521	1631
0510000112 6	4	COIL 5·5T/4mm I.D. VERT	L511, L518, L519, L520	1631
0560000101 5	1	INDUCTOR FXD CHOKE No. 15 (PHILIPS 4312·020·36640)	L508	
0560002100	3	INDUCTOR FXD TYPE 100 3·3 µH	L514, L515, L516	
0560002101	1	INDUCTOR FXD TYPE 101 1·5 µH	L523	
0560002104	1	INDUCTOR FXD TYPE 104 330mH	L506	1631

0650001004	6	FERRITE BEAD 4x2x5 NEOSID F8	L503, L509 (2 PER CHOKE) L505 (1 FOR L511)	
0650001020	1	FERRITE BEAD TWIN, GRADE 4B1 (PH 4312·020·31520)	L522	

6.4.6 HARDWARE

2000001004	120 mm	WIRE 1/0·7 TINNED COPPER	R.F. O/P COAX PLUG JUMPER	
2001000302	160 mm	WIRE 7/0·2 PVC RED	+VE TO EXCITER	
2001000303	140 mm	WIRE 7/0·2 PVC ORANGE	TX P.I.N SW	1827
2001000304	110 mm	WIRE 7/0·2 PVC YELLOW	RX P.I.N SW	1827
2001000305	135mm	WIRE 7/0·2 PVC GREEN	P.W.R CONTROL P/B	
2001000306	180mm	WIRE 7/0·2 PVC BLUE	EXTERNAL PWR CONTROL	
2001000309	240mm	WIRE 7/0·2 PVC WHITE	SPEAKER	
2001000502	135mm	WIRE 23/0·2 14/8 AUTO RED.	+VE MAIN	
2001000510	130mm	WIRE 23/0·2 14/8 AUTO BLACK	-VE MAIN	
2006000101	44mm	COAX MIN 50Ω RG174 / U005	USED AS EARTHING STRAP	
2006000111	290mm	COAX RG316/U		1793
2006000112	40mm	COAX RG178/U	PA TO O/P PLUG	87/06-244
2009000102	44mm	SLOT CAR TRACK HAIRPIN 14 x 3·35 COPPER	L507	
2183000120	0	COAX CABLE RG-316/U CUT & STRIPPED	1 @ 160mm (PA TO RX) A4M 781/1	
2183000121	0	COAX CABLE RG-316/U CUT & STRIPPED	1 @ 105mm (PA TO EX) A4M 781/2	
2183000122	0	COAX CABLE RG-178/U CUT & STRIPPED	1 @ 50mm (PA TO AE.) A4M 781/3	
2183000123	0	COAX CABLE RG-174/U CUT & STRIPPED	1 @ 22mm (EARTHING) A4M 781/4	
2200001068	1	T498 P.A PRINTED CIRCUIT BOARD TOOLED A2C175		87/10-454
2400001041	1	PLUG DAM 11WIP CINCH/CANNON	PL501	
2400010041	1	COAX INSERT DM53740/5	(FOR ABOVE ITEM)	
3081201400	1	HEATSINK A1M774		
3160085015	2	GUIDE PINS A4M775		
3190001005	1	SHIELD A2M777		
3490002003	2	SCREW 4-40 x 1/4 PAN POZI TAPTITE	SPARK PLATE	1340
3490002009	5	SCREW 4-40 x 3/8 PAN POZI TAPTITE	P.C.B MTG, TRANSISTOR MTG.	1340
3520001043	2	NUT M3 A4M793	GUIDE PINS	
3530001013	2	WASHER M3 SHAKEPROOF INT BZ	GUIDE PINS	1826

3560001026	17	HARWIN TRACK PINS		1621
3600001021	2	GROMMET RUBBER 1/4" × 1/2" (RUBBERCRAFT) 3U/3		
4000002001	10mm	SLEEVING 0.7mm SILICONE RUBBER		2017
4000001050	5mm	PVC SLEEVING 5mm		1770

6.5 B490/MECH 490 SERIES MECHANICAL COMPONENTS

2340001026	1	PUSH BUTTON CODE SWITCH, REAR MTG	CHANNEL SELECT	83/3-608
2340002026	1 PR	SIDE COVERS FOR REAR MTG CODE SWITCH		83/3-608
2340002027	1	SWITCH DUMMY CODE REAR MTG		83/3-608
2520001012	1	MICROPHONE 600Ω WITH HANGER CONNECTION		
3020005169	2	BRACKET SWITCH MTG A4M1553	(TO SUPPORT REAR MTG CHNNL PUSH SW)	83/4-666
3030011153	2	CHASSIS SIDE PLATE (SHORT) A2M902	(TO BE MODIFIED - EXTRA HOLE)	
3030050046	2	CLAMP, HINGE CLIP RETAINING A4M914		
3050001018	1	ESCUTCHEON PLASTIC A1M582/3		83/2-534
3110001003	2	KNOB (MARKED) A1M580	SQUELCH, VOLUME	
3160087042	4	PILLARS A2M908		
3190020041	1	SLEEVE (SHORT) A2M936		
3450004006	1	SCREW M3×8mm PAN POZI ST BZ	IC 301 MTG (REGULATOR)	
3450004009	6	SCREW M3×6mm CSK POZI ST BZ	SLEEVE	
3450004015	4	SCREW M3×12mm CSK POZI ST BZ	SIDE PLATES TO ESCUTCHEON	

3470001001	2	SCREW 6-32UNC × 3/8" BUTTON HD. BLACK	FRONT PANEL
3490002003	12	SCREW 4-40 × 1/4" PAN POZI TAPTITE	PILLAR MTG. 8, PCB MTG 4.
3490002009	4	SCREW 4-40 × 3/8" PAN POZI TAPTITE	SIDE PLATES TO PA.
3520001008	1	NUT M3 COLD FORM	IC 301 MTG.
3530001010	1	WASHER M3 FLAT	IC 301 MTG.
3530001012	1	WASHER M3 SPRING	IC 301 MTG.
3540001033	6	M3 PEM FASTENER	ISSUED TO MANUFACTURER OF SIDE PLATES
3540001034	2	M4 PEM FASTENER	INSTALLATION INSTRUCTIONS A4M905
3570001002	3	SPIRE CLIPS, KNOB RETAINING	
3600001015	1	SNUB BUSH HEYCO	MIC CORD.
3620001005	1	MICA INSULATOR A4M930	IC301
3620001013	1	BUSH, INSULATING A4M930	IC 301

3650001031		1	LABEL REMOVEABLE		
~~3650001032~~		~~1~~	~~LABEL DESIGN MARK~~		
3990001010		1	RUBBER BAND	MIC BAG	

6.6 B490/FP PCB 490 SERIES FRONT PANEL PCB ASSEMBLY

0080001011	1	TLR 124 LED RED			
0080001013	1	TLY 124 LED YELLOW			
0080001015	1	TLG 124 LED GREEN			
0300410000	2	1K RESISTOR 7×2·5mm 5% C/F			
0400510004	1	10K LOG POT SPST SW	VOL		
0400510006	1	10K LOG POT LESS SW	SQUELCH		
2050002002	0·05	FLEXIBLE JUMPER STRIP (180 OF 25mm WIRES)	9 WIRES		83/4-676
2200010755	1	PRINTED CCT BOARD			
~~2340010214~~	~~1~~	~~SWITCH PUSH BUTTON CODE ILLUMINATED~~	~~CH SELECT~~	Put in with kit B490/INCCIT	
~~2340002024~~	~~1 PR~~	~~SIDE COVERS FOR SMC SW (SMC-P/K)~~			
~~2340020255~~	~~1~~	~~SCC DUMMY HOUSING~~			
2400020409	1	PLUG PCB 20WAY (2×10)			
3022005127	1	BRACKET ANCILLARY BOARD MTG A4M5141			
3033500008	2	EARTHING SPRING CONTACT A4M796			
3560001026	38	HARWIN TRACK PINS			83/5-733
2000001005	235mm	TINNED COPPER WIRE 0·5mm	115mm (5×20mm & 1×15mm) LINKS 30mm (1×30mm) SWITCH 10mm (1×10mm) SWITCH 50mm (1×50mm) VOLUME/MUTE		83/4-675
4000002001	55mm	SLEEVING 0·7mm SILICON RUBBER	(5×10mm & 1×5mm)		83/4-675

6.7 B490/LOOM 490 SERIES LOOM COMPONENTS

2050001015	205mm	CABLE FLAT 20 CORE ANSLEY 171-20			07/825
2400402040	2	16 WAY PCB CONNECTOR			
2400402043	1	20 WAY RIBBON SKT			

6.8 C490/7.5 IFBW 490 SERIES 12.5kHz CHANNEL PARTS

0113470002	1	470P CAP T/C B 63V 10%	C235		
2760001032	1	XTAL FILTER 07MHZ 7·5KHZ (10F 7·5DM)	XF101		

6.9 C490/15 IFBW 490 SERIES 25kHz CHANNEL PARTS

0	1	1	0	4	1	0	0	0	1	1	1m CAP T/C B 63V 10%	C235	
2	7	6	0	0	0	1	0	2	2	1	XTAL FILTER 10.7MHz 15kHz. (10F15D)	XF101	

6.10 C490/RVSN 490 SERIES HOOK SWITCH CHANNEL REVERSION PARTS

0	0	0	0	0	0	1	1	1	0	1	BC548B TRANSISTOR	Q481	
0	0	0	0	0	0	1	1	3	0	2	BC557B TRANSISTOR	Q480, Q482	
0	3	0	0	4	1	0	0	0	0	2	1K RESISTOR 7×2.5mm 5% C/F	R481, R485	
0	3	0	0	4	2	2	0	0	0	1	2K2 RESISTOR 7×2.5mm 5% C/F	R484	
0	3	0	0	5	1	0	0	0	0	2	10K RESISTOR 7×2.5mm 5% C/F	R480, R486	
0	3	0	0	5	2	2	0	0	0	1	22K RESISTOR 7×2.5mm 5% C/F	R483	
0	3	0	0	5	4	7	0	0	0	1	47K RESISTOR 7×2.5mm 5% C/F	R482	

6.11 C490/PTD 490 SERIES POWER TURN DOWN PARTS

0	0	0	0	0	0	1	1	1	0	1	BC548B TRANSISTOR	Q491	
0	0	0	0	0	0	1	1	3	0	1	BC557B TRANSISTOR	Q490	
0	0	1	0	0	0	1	2	5	0	1	UM9401 PIN DIODE	(IN PM)	
0	0	1	0	0	0	1	2	6	8	2	MA47600 PIN DIODE	D490, D491	
0	1	1	0	4	1	0	0	0	1	2	1m CAP T/C B 63V	C490, C491	
0	1	1	0	4	4	7	0	0	2	2	4m7 CAP T/C B 63V	C492, C493	
0	3	0	0	3	3	3	0	0	0	2	330E RESISTOR 7×2.5mm 5% C/F	R492, R490	
0	3	0	0	4	2	2	0	0	0	2	2K2 RESISTOR 7×2.5mm 5% C/F	R491, R494	
0	3	0	0	5	1	0	0	0	0	1	10K RESISTOR 7×2.5mm 5% C/F	R493	
0	5	6	0	0	0	2	1	0	0	2	FXD IND TYPE 100 3.3uH	L490, L491	

6.12 B/TA-490 490 SERIES MEMORY MODULE PARTS

											A4C421 PIN IDENTIFICATION		
													83/2-593
0	0	2	0	0	0	1	8	0	0	2	2716 INT CCT UV EPROM		
0	1	1	0	4	1	0	0	0	1	2	1m CAP T/C B 63V 10%		
0	3	0	0	5	1	0	0	0	0	2	10K RESISTOR 7×2.5mm 5% C/F		83/2-593
0	3	4	0	6	1	0	0	4	0	3	RES 100K×4 SIL 5% CERMET		83/2-593
2	3	5	0	0	0	1	1	0	7	1	PRINTED CCT BOARD TA-490		
2	1	0	0	4	0	2	0	6	0	2	SKT 15 WAY 1 ROW PCB MTG. (MOLEX)		

6.13 B/TA-490/11 490 SERIES 100 CHANNEL CONVERSION KIT

2	0	0	0	0	0	1	0	0	5	0.1 gm	WIRE 1/0.5 TINNED COPPER	1 x 35mm LNK, 1 x 20mm LNK		
2	0	5	0	0	0	2	0	0	1	0.05	JUMPER STRIP 150 x 25mm.	9 WIRES		
2	3	4	0	0	0	1	0	2	6	1	PUSH BUTTON CODE SW			
4	0	0	0	0	0	2	0	0	1	35mm	0.7mm SILICON SLEEVING	1 x 25mm, 1 x 10mm		