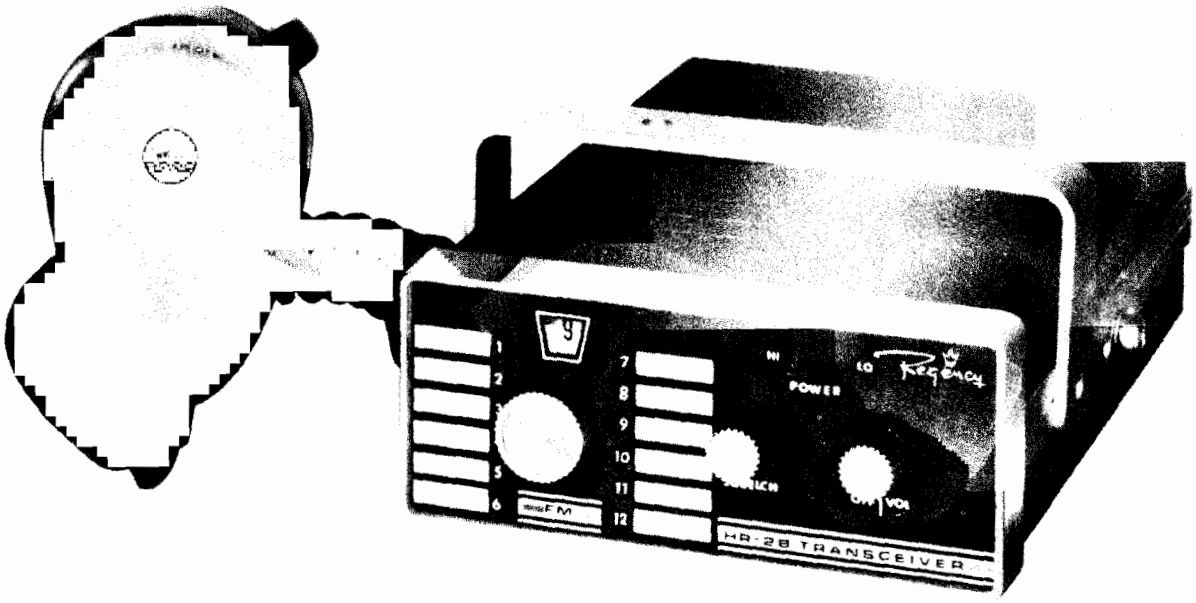
Regency ELECTRONICS INC.

SERVICE MANUAL



MODEL HR-2B

TWO METER AMATEUR FM TRANSCEIVER

7707 RECORDS STREET
INDIANAPOLIS, INDIANA 46226

PRINTED IN U.S.A.
1-75

PRICE $5.00
SM-10-467

HR-2B SERVICE MANUAL

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SECTION 5 PARTS LIST

SECTION 1 GENERAL INFORMATION

1-1 DESCRIPTION

The Regency HR-2B is a full 12-channel, all-transistor, narrowband FM transceiver designed for use in the 2 Meter (144-148 MHz) Amateur Band. The transmitter and receiver sections both employ bandpass circuitry so that maximum RF power output and receiver sensitivity are maintained across the entire band. Receive and transmit frequencies are crystal-controlled, utilizing crystals manufactured within an accuracy of .001%.

The receive section is a double-conversion, super-heterodyne type receiver. Silicon transistors (13) are utilized for dependability under widely varying ambient conditions. Also, two Integrated Circuits are used, providing for compactness and circuit reliability. In addition, a ceramic filter is employed in the second I.F. for optimizing receiving performance where numerous channels are active within the same area of the country.

The transmitter section also utilizes silicon transistors (11) throughout. Two ruggedized RF power transistors (BET or Balanced Emitter Transistor type) are employed for high power output, which typically is 17 watts. A large, copper heat sink on the "final" transistor ensures that there is virtually no power drop off during lengthy transmissions. In addition, an SWR Bridge Limiting Circuit provides the necessary protection to the RF power transistors in the event the antenna or its coaxial feedline becomes open or shorted.

The transmitter employs phase modulation, utilizing two varactor diodes. Internal controls are provided for adjusting the microphone gain and for setting the amount of deviation. The deviation control is factory adjusted for approximately 5 KHz deviation (10 KHz swing).

The attenuation of spurious emissions, frequency stability and performance under highly varying supply voltage and temperature conditions all exceed FCC limits as would be required for type acceptance. (Type Acceptance of the transmitter is NOT necessary for operation in the Amateur Service). The receiver section is Certified, as required, under Part 15, Subpart C of the FCC Rules and Regulations.

1-2 SPECIFICATIONS

RECEIVER

Antenna Impedance	50 Ohms
Channels	12; Crystal Controlled
Frequency Range	144-148 MHz
Sensitivity	0.35 μv (nom.), 20 DB Quieting

Selectivity	6 DB down, ±7 KHz 50 DB down, ±20 KHz
Image Rejection	50 DB
Spurious Rejections	60 DB
Intermediate Frequenices	1st I.F. -10.7 MHz 2nd I.F. -455 KHz (ceramic filter)
Modulation Acceptance	±7.5 KHz
Squelch System	"Noise" Operated
Audio Output (3 to 4 Ω Speaker)	3 Watts @ 10%, or less, Distortion; 5 Watts, maximum
Channels	12: Crystal Controlled
Crystal Installed (Channel 1)	146.94 MHz
FCC Certified	Part 15, Subpart C

TRANSMITTER

Antenna Impedance	50 Ohms
Frequency Range	144-148 MHz
Power Output (HI Power)	15 Watts (min.) @ 13.8 VDC
Power Output (LO Power)	1 Watt (approx.) @ 13.8 VDC
Power Bandwidth	15 Watts, typical from 144 to 148 MHz
Power Amplifier Protection	SWR Bridge Limiting Circuit
Harmonic and Spurious Emissions	55 DB, or more, below carrier
Microphone	plug-in, hand held; High Z ceramic
Mike Pre-Amp	FET, with level control (internal)
Modulation	Phase modulation with Automatic Deviation Limiting
Deviation	Factory adjusted to ±5 KHz; Internal adjustment of 0-10 KHz
Channels	12; Crystal Controlled with individual trimmer capacitors for frequency Netting
Crystal Frequency Multiplication	18
Crystal Installed (Channel 1)	146.94 MHz

POWER

Voltage Requirements	11.5-14.5 VDC
Current Requirements	@ 13.8 VDC
Receive (Squelched)	180 MA.
Receive (Max. Audio Output)	800 MA.
Transmit (HI Power)	3.0 Amps (max.)
Transmit (LO Power)	0.6 Amps (approx.)
Fuse Size	4 Ampere, 3 AG

SEMICONDUCTORS

Integrated Circuits	2

Silicon Transistors (Total)	24
BET RF Power Transistors	2
Field Effect Transistors	2
Diodes (Total)	9
Varactor Diodes	2
Zener Diodes	2
Signal Diodes	4
Rectifier Diode	1

GENERAL

Front Panel Size	5 5/8" x 2 5/16"
Depth (Including Knobs and Rear Panel Connectors)	9 1/16"
Weight (Including Microphone and Mounting Equipment)	3 lbs. 13 oz.
Antenna Connector	SO-239
Power Connector	4-pin, Polarized
Speaker Size	4 inch, Square

1-3 EQUIPMENT SUPPLIES

a. 1 - Transceiver Unit
b. 1 - Microphone and Connector
c. 1 - Mobile Mounting Bracket
d. 1 - Mobile Mounting Hardware
e. 1 - Mobile Mounting Security Bracket
f. 1 - DC Power Cord and Fuse
g. 1 - Owner's Instruction Manual

1-4 EQUIPMENT NOT SUPPLIED

a. 1 - Antenna
b. 1 - Coaxial Cable (Feedline)
c. 1 - Coaxial Cable Connector
d. 1 - Power Supply
e. 1 - Padlock (used with Security Bracket)

1-5 ACCESSORIES AVAILABLE

There are presently four accessories available for use with the HR-2B. A DC Power Supply, the P107, meets the necessary voltage and current requirements for using the HR-2B as a base station. It is a fully regulated power supply with fuse protection in both its primary (117 VAC) and DC output connections. The mating connector for the HR-2B's power plug is already installed on the power cord.

Another accessory is the AR-2, an all-transistor RF power amplifier designed for mobile use. It is a Class C amplifier capable of 80 Watts output

(maximum). With an input of 17 Watts (the typical power out from the HR-2B) the AR-2 will provide a power gain of approximately 5 DB. Thus, the 17 Watts from the HR-2B would be increased to approximately 54 Watts. The only connection needed between the HR-2B and the AR-2 is a length of 50 Ω coaxial cable, such as RG-58/U. The OFF-ON Switch on the AR-2 provides for normal straight through operation (OFF) or power amplification (ON).

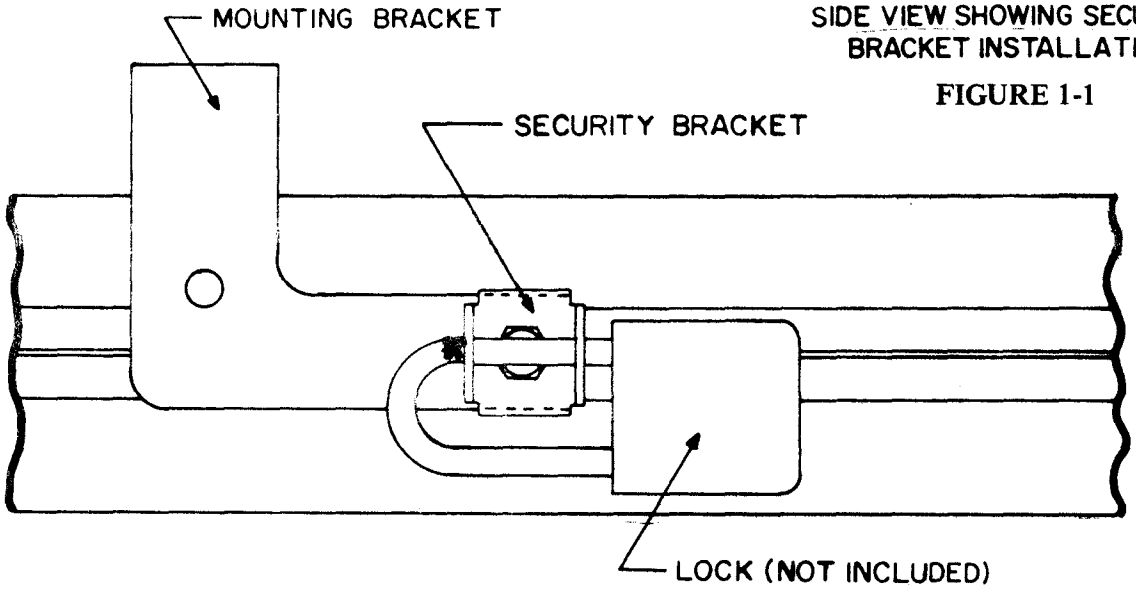
The third accessory is a DC Power Cord that can be plugged into a car's cigarette lighter. This accessory, Regency No. MA-10, provides for an easy or temporary mobile installation. The fourth accessory is a 4-inch speaker unit designed for remote mounting purposes. The MA-8 (the unit's accessory number) is a metal speaker enclosure with rubber feet and a bracket. The bracket is to be used for under-the-dash mounting or some similar application.

1-6 INSTALLATION

MOBILE (12 VDC) - the HR-2B is primarily designed for use in any car, truck, boat, etc. that has a 12 VDC negative ground system. The RED lead, with the fuseholder, must be connected to the POSITIVE (+) terminal of the battery. The BLACK lead should be connected either to the chassis or to the NEGATIVE terminal of the battery.

The Mounting Bracket is designed to permit mounting the unit in a variety of positions in most vehicles. The final mounting position should be selected to allow for easy operation by the user. The bracket must be securely fastened to a solid or substantially rigid surface in order to reduce the possibility of damage due to excessive vibration.

To reduce the possibility of theft, the Security Bracket should be installed as shown in Figure 1-1. The padlock used should be of substantial construction and can be either a key or combination operated type.



SIDE VIEW SHOWING SECURITY BRACKET INSTALLATION

FIGURE 1-1

The antenna used should be properly adjusted for the 50 ohm output impedance of the transmitter. A high SWR on the feedline (coaxial cable connecting the antenna to the unit) will reduce the power out, or may even shut off the transmitter entirely. It is recommended that an inline type wattmeter (such as a Bird Thruline) be used for optimizing the antenna system.

If it is impossible to reduce the SWR below 1.5 to 1 and the HR-2B's output is being reduced or lowered by the SWR Bridge Circuit, the following modification may be made. Solder a 4.7K, 1/4 watt resistor on the bottom side of the transmitter board, as shown in Figure 1-2. This resistor is electrically being connected between the base of Q304 and ground. This modification permits the unit to work into a load that is presenting an SWR of 2 to 1 or less, by reducing sensitivity of the SWR Bridge. There will still be adequate protection for the two RF power transistors for an SWR greater than 2 to 1, or if there is an open or short in the antenna system.

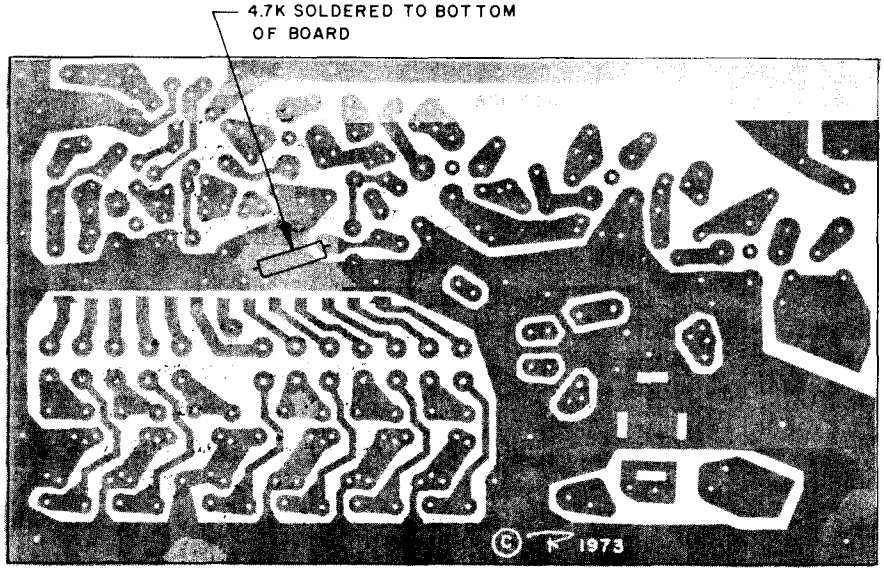


FIGURE 1-2

An external (or remotely mounted) speaker can be used by first opening the link between terminals No. 1 and No. 2. These terminals are located on the rear panel and are clearly marked on the label. Then, connect one lead of the external speaker to terminal No. 4 (chassis ground) and the other lead to terminal No. 1. A 3 to 4 ohm speaker (such as Regency's Accessory No. MA-8) is recommended for optimum performance.

For a quick and easier mobile installation, an accessory 12 VDC Power Cord with a cigarette lighter plug (Regency MA-10) can be utilized. In this case, the unit can be operated on the front seat of the vehicle.

BASE STATION (117 VAC) - The HR-2B may be used with any well filtered or regulated DC Power Supply that can supply at least 3 amperes at 12 to 14.5 VDC. The regulation of the Power Supply should be such that its output voltage does not get over 14.5 VDC when the unit is in the receive mode and squelched off. Damage to various components may occur if the supply voltage to the HR-2B exceeds 15 volts for any length of time.

The Power Supply and/or the power connection to the unit should be properly fused. In addition, the ripple on the supply's output voltage should be less than 1%. It is recommended that Regency's regulated Power Supply, the P107, be utilized for base station operation of the HR-2B.

The antenna's impedance should be adjusted or matched, as closely as possible, for use with 50 ohm coaxial cable. Use of RG-58/U should be considered only if the length of coax needed is 30 feet or less. For longer runs of feedline, it is recommended that a low-loss cable, such as RG-8/U (especially of the "foam" type) should be used.

1-7 OPERATION

The OFF-ON Switch is an integral part of the VOLUME control. Turning this control fully counter-clockwise until a click is heard will turn the unit off. The pilot or dial lamp will also visually indicate when the unit is on or off. Maximum volume, or audio output, occurs when the Volume Control is turned fully clockwise.

The receiver's audio is squelched off when the SQUELCH control is turned counter-clockwise until the noise disappears. This permits the receiver to be "quiet" until an actual signal is received. With this control set fully counter-clockwise (tight squelch), the receiver will still operate properly and will not be locked-out (prevented from responding to a proper signal). The dynamic range of the squelch control is approximately 8 or 9 DB. Thus, if Threshold Squelch (control set to where the noise just disappears) is at 0.25 μv signal, tight squelch would be at approximately 0.7 μv signal.

The CHANNEL SELECTOR is a twelve-position rotary switch which enables the operator to select any one of twelve crystal-controlled transmit-receive channels. Each switch position pairs up a specific transmit crystal with its respective receive crystal. For example, position 1 connects transmit crystal No. 1 and receive crystal No. 1 to their respective oscillator circuits.

The HI-LO POWER SWITCH provides the operator with the capability of selecting either one of two RF output power levels. With the switch in the HI position, the transmitter will develope its full rated power output. This power level is useful for mobile-to-mobile and repeater fringe areas. The LO power position limits the transmitter's output to approximately 1

watt. This power level is generally adequate for working through most repeaters.

To TRANSMIT, depress the PTT (push-to-talk) switch located on the side of the microphone. The Channel Selector must be turned to a channel that has a transmit crystal installed (or jumpered) at that position or there will be no RF power output from the transmitter section. The PTT switch must be held in during the entire transmission in order to keep the T/R (Transmit-Receive) relay activated.

1-8 CRYSTAL SPECIFICATIONS

Due to the numerous frequencies, or channels, involved, only one pair of crystals are installed by the factory. Miniature, plug-in crystals are simply installed by inserting them in the receptacles on the circuit board. 1-9 gives thorough instructions on the actual installation. Because of the accuracy required, Shepherd Industries' crystals are recommended. They are usually available at the source from which the transceiver was purchased. Specify the exact frequency (for example, 146.340 MHz) that you desire to receive or transmit on.

If desired, the crystals may be purchased from other manufacturers. The following information should be included in the order.

RECEIVE CRYSTAL:

a. Crystal frequency, determined as follows:

$$\text{Crystal frequency} = \frac{\text{receive frequency} - 10.7\ \text{MHz}}{3}$$

EXAMPLE:

$$\text{Crystal frequency} - \frac{146.94\ \text{MHz} - 10.7\ \text{MHz}}{3}$$

$$\text{Crystal frequency} = \frac{136.24\ \text{MHz}}{3} = 45.41333\ \text{MHz}$$

b. 3rd Overtone
c. Series resonance minus 600 Hz
d. Maximum equivalent series resistance of 35 ohms
e. Drive level of 2 MW
f. Holder: HC-25/U
g. Calibration: .001% @ 25°C
h. Frequency tolerance: .002% from -10° to +60°C

TRANSMIT CRYSTAL:

a. Crystal frequency, determined as follows:

$$\text{Crystal frequency} = \frac{\text{transmit frequency}}{18}$$

EXAMPLE:

Crystal frequency = $\frac{146.94 \text{ MHz}}{18}$ = 8.163333 MHz

b. Fundamental mode
c. Load capacitance: 32 PF
d. Maximum series resistance of 30 ohms
e. Drive level of 2 MW
f. Holder: HC-25/U
g. Frequency calibration: .001% @ 25°C
h. Frequency tolerance: .0015% from -10° to +60°C

1-9 CRYSTAL INSTALLATION

Prior to installing a crystal, the transceiver's cover will have to be removed. To remove this cover, unscrew the two large bolts located at each side of the unit. The cover may then be slipped off by sliding it toward the rear of the unit. It is not necessary to remove the four rubber feet located on the bottom surface of the cover.

Next, the speaker should be removed. Unscrew the two, small metal screws (one located on each side) holding the speaker brackets in place. Then, carefully place the speaker assembly along side of the unit.

Insert the crystal, or crystals, in the proper pair of socket pins as indicated on the Crystal Location Diagram, 4-10. The number by each pair of pins matches the dial and channel block designation that appears on the front panel. The unit is shipped from the factory with the transmit and receive crystals for 146.94 MHz installed in position (Channel) 1. If crystals are to be jumpered (reused in other positions), follow the instructions in 1-10 BEFORE installing the crystals.

For each transmit crystal, there is a variable capacitor that is to be used for "netting" (adjusting to the exact frequency) purposes. This netting or frequency adjustment should be made with an accurate frequency counter. See 3-9 for detailed netting instructions.

After all crystals are installed, and netted if necessary, reinstall the speaker assembly. Position the speaker assembly so that the cut-off corner is adjacent to the relay lugs. Then, carefully replace the cover and its hardware.

The frequency, or channel, blocks on the front panel will accept 1/4 inch wide embossing tape with up to five digits, letters, or other characters. These blocks are to be used to identify the particular frequencies installed in the unit.

1-10 CRYSTAL JUMPERING

By means of jumpering crystal positions, a crystal can be reused in more than one channel. In other words, whenever a frequency is to be repeated for another channel, the crystal installed for a previous channel can be used in another channel by adding a jumper connection between the two switch positions. An example of some typical transmit-receive combinations, utilizing the minimum number of crystals, will be demonstrated.

Suppose the following TRANSMIT-RECEIVE combinations are to be set up in the HR-2B:

Channel Selector Position	Transmit Frequency (MHz)	Receive Frequency (MHz)
1	146.94	146.94
2	146.16	146.76
3	146.22	146.82
4	146.28	146.88
5	146.34	146.76
6	146.34	146.94

Before installing the crystals, it is recommended that the jumpers required be worked out and installed. Thus, make out a simple chart or table indicating where the crystals are to be initially installed.

NOTE: It is recommended that no more than three additional positions be jumpered to the original crystal position. Also, the jumpering should be worked out so as to keep the continuous jumper length to a minimum.

Transmit Crystal	Initial Position	Receive Crystal	Initial Position
146.94	1	146.94	1
146.16	2	146.76	2
146.22	3	146.82	3
146.28	4	146.88	4
146.34	5		

To easily determine where jumpers are to be installed, add to the crystal's Initial Position all of the other positions desired. Thus, to continue on with the example, the following table would be compiled:

Transmit Crystal	Total Positions	Receive Crystal	Total Positions
146.94	1	146.94	1-6
146.16	2	146.76	2-5
146.22	3	146.82	3
146.28	4	146.88	4
146.34	5-6		

To jumper the two Receive crystals, solder two insulated wires on the copper side of the RECEIVE switch deck (No. 500-753) as illustrated in Figure 1 on page 10.

Connect the jumper on the copper side of the TRANSMIT switch deck (No. 500-753) as illustrated in Figure 2 on page 10: Position 5 to Position 6. For jumpers that are not connecting adjacent positions, it is recommended that insulated No. 22 or 24 gauge wire should be used to avoid a possible short circuit.

NOTE: Adding a jumper will slightly lower the Transmit crystal frequency. Adjust the associated trimmer capacitor on the transmitter board for correction.

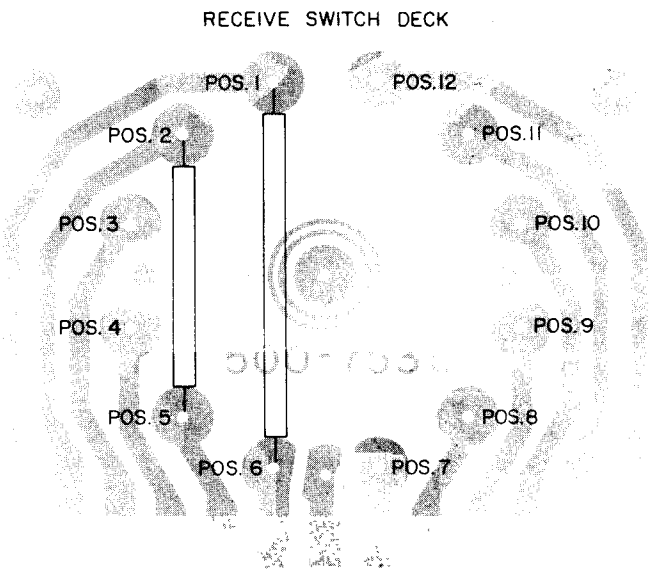


FIGURE 1

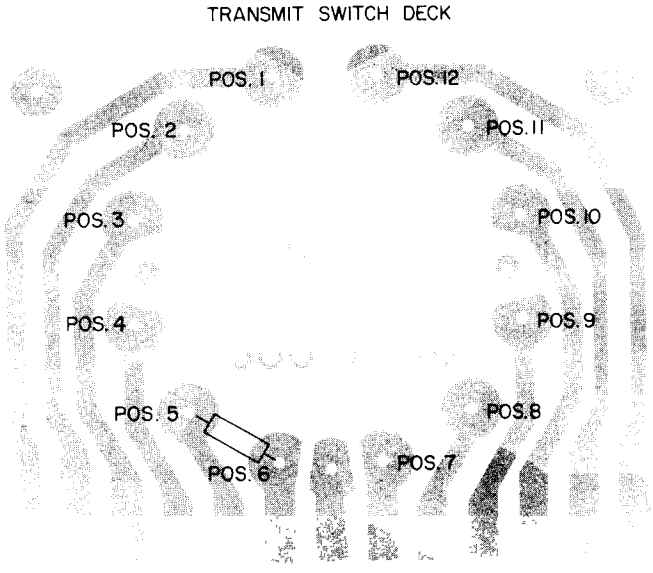


FIGURE 2

SECTION 2 CIRCUIT DESCRIPTION

2-1 RF-MODULATOR BOARD

Q201 is an RF amplifier with broad-band tuned circuits in its input and output circuitry. The output of the RF amplifier is coupled to the input of the mixer, Q202, a Field Effect transistor.

The first L.O. (local oscillator), Q204, uses third overtone crystals. (The frequency marked on the crystal is the receive frequency). Oscillator injection to the mixer is accomplished by mutual coupling to T101, the IF input tuned circuit.

The first L.O. (local oscillator), Q204, uses third overtone crystals. (The frequency marked on the crystal is the receive frequency). Oscillator injection to the mixer is accomplished by mutual coupling between the windings of T201.

The output frequency from the FET mixer is tuned to 10.7 MHz by T202. This output is link-coupled to T101, the IF input tuned circuit.

The Modulator Section of this board is described in 2-3 in conjunction with the transmitter board.

2-2 IF-AUDIO BOARD

The IF input circuitry consists of T101 and Q101, used as an IF amplifier. The output of this amplifier is fed to an integrated circuit, IC101, which contains the second mixer and L.O. circuitry, operating at 10.245 MHz. In some locations where a strong Image Signal has been encountered, this oscillator's frequency is moved to 11.155 MHz. (The crystal frequency is stamped on the top of the crystal).

The 455 KHz output of IC101 (terminal 5) is coupled through a tuned circuit to the input of the ceramic filter, CF-101. CF-101 is a narrow-band filter centered at 455 KHz. The excellent band-pass characteristics of CF-101 provide for very good adjacent channel rejection. The output of CF-101 is coupled through another tuned circuit to the input of integrated circuit IC102. IC102 is a series of amplifiers providing approximately 60 DB gain at 455 KHz. Also included in IC102 is the limiting circuitry and a quadrature detector circuit. L103, connected between terminals 2 and 12 of IC-102, is the adjustable quadrature coil.

The audio output from IC102 (terminal 1) is coupled to the input of the audio amplifier circuit and to the input of the noise-operated squelch circuit.

Transistor Q102 is an amplifier whose frequency response extends from approximately 5 KHz to 25 KHz. Q102 amplifies the "noise" occuring in this frequency range. The noise is coupled to the base of Q103. Q103 is used as a detector which rectifies the amplified noise and produces a DC voltage at its collector. When the DC voltage at the collector of Q103 is positive and of sufficient value to provide base bias for Q104, Q104 turns on and provides essentially a short circuit between the base of Q105 and ground. This action turns off Q105 and the audio output from the receiver is squelched (muted). When a signal (carrier) arrives, the noise input to the detector (Q103) is reduced to the point where the DC voltage at the base of Q104 is no longer sufficient to cause Q104 to conduct.

At this time, Q105 is allowed to conduct normally and the audio output of the unit is heard. With the audio pre-amplifier (Q105) operating normally, audio is applied through the volume control to the base of the audio amplifier, Q106. Q106 supplies a signal to the audio driver transistors, Q107 and Q108. The output transistors, Q109 and Q110, form a quasi-complementary, transformerless stage capable of delivering 5 watts to the speaker.

2-3 TRANSMITTER BOARD

Q308 is in a crystal oscillator circuit operating at approximately 8 MHz. Each crystal has a trimmer capacitor in series with it. This trimmer capacitor is used for fine (small) adjustments to the crystal's frequency.

The oscillator's frequency is phase modulated by two Varactor (voltage-varable capacitance) diodes, CR302 and CR303, which are connected across a coil (L306) that is lightly coupled to the emitter circuit of the oscillator. L306 is tuned to the crystal frequency. The oscillator's phase-modulated output is applied to the base of Q307. Q307 is a multiplier whose output frequency is three (3) times the crystal frequency. The signal from Q307 is transformer coupled to the base of Q306. Q306 is used as a tripler, a stage that multiplies its input signal's frequency by three. Thus, the output frequency of Q306 is nine (9) times the crystal frequency. This signal is then applied to Q303, which is operating as a doubler. The frequency of the output signal from Q303 is eighteen (18) times the crystal frequency. This frequency is the ultimate transmitter output frequency.

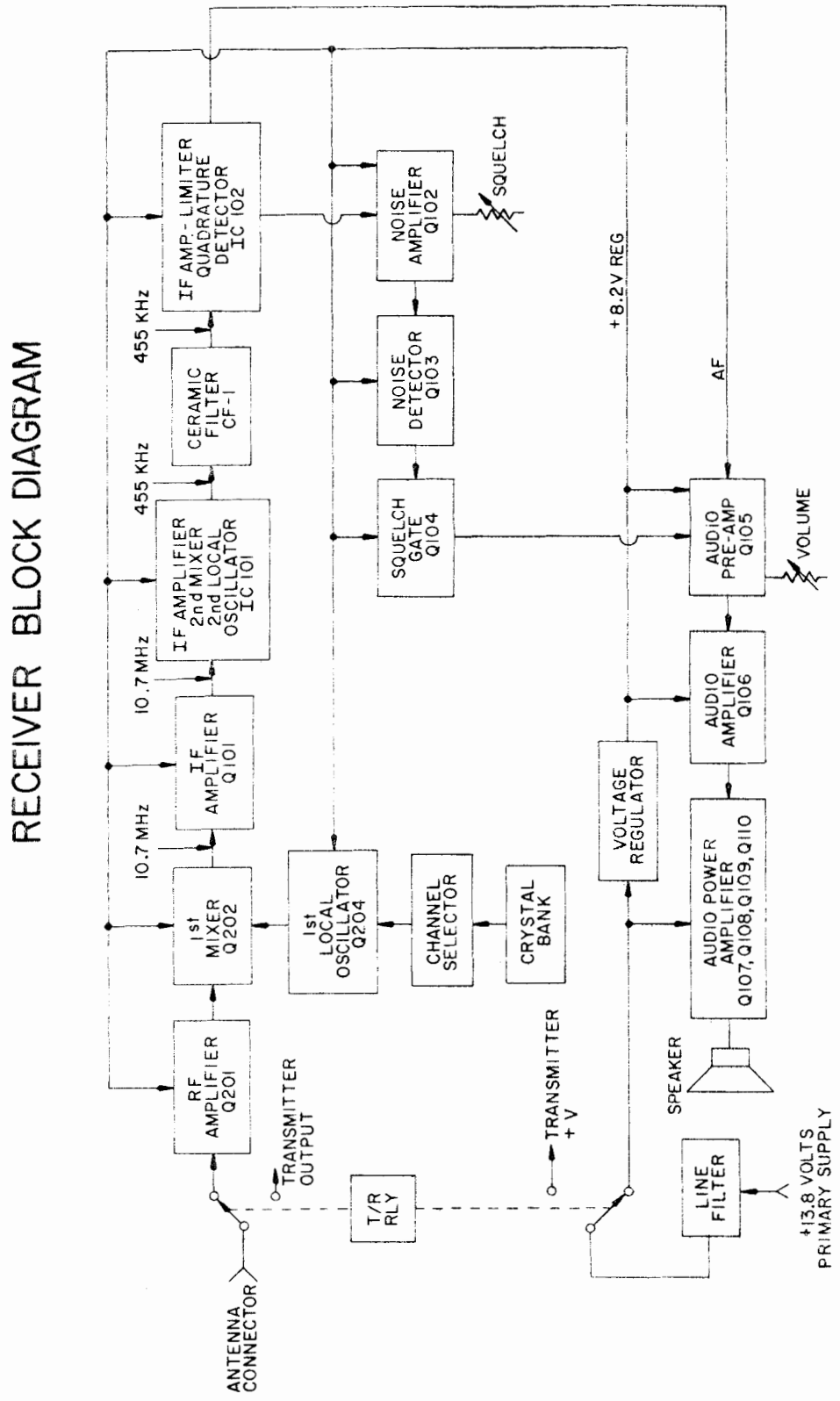
Q302 and Q301 are power amplifiers operating "straight through". Q302 provides the drive (RF signal) required by the "final" stage, Q301, to deliver at least 15 watts of RF power to the antenna through the impedance matching network in its collector circuit. Q301, Q302 and Q303 operate in the Class C mode.

The transmitter output transistor, Q301, is protected from damage due to excessive SWR on the antenna transmission line by SWR Bridge and Drive

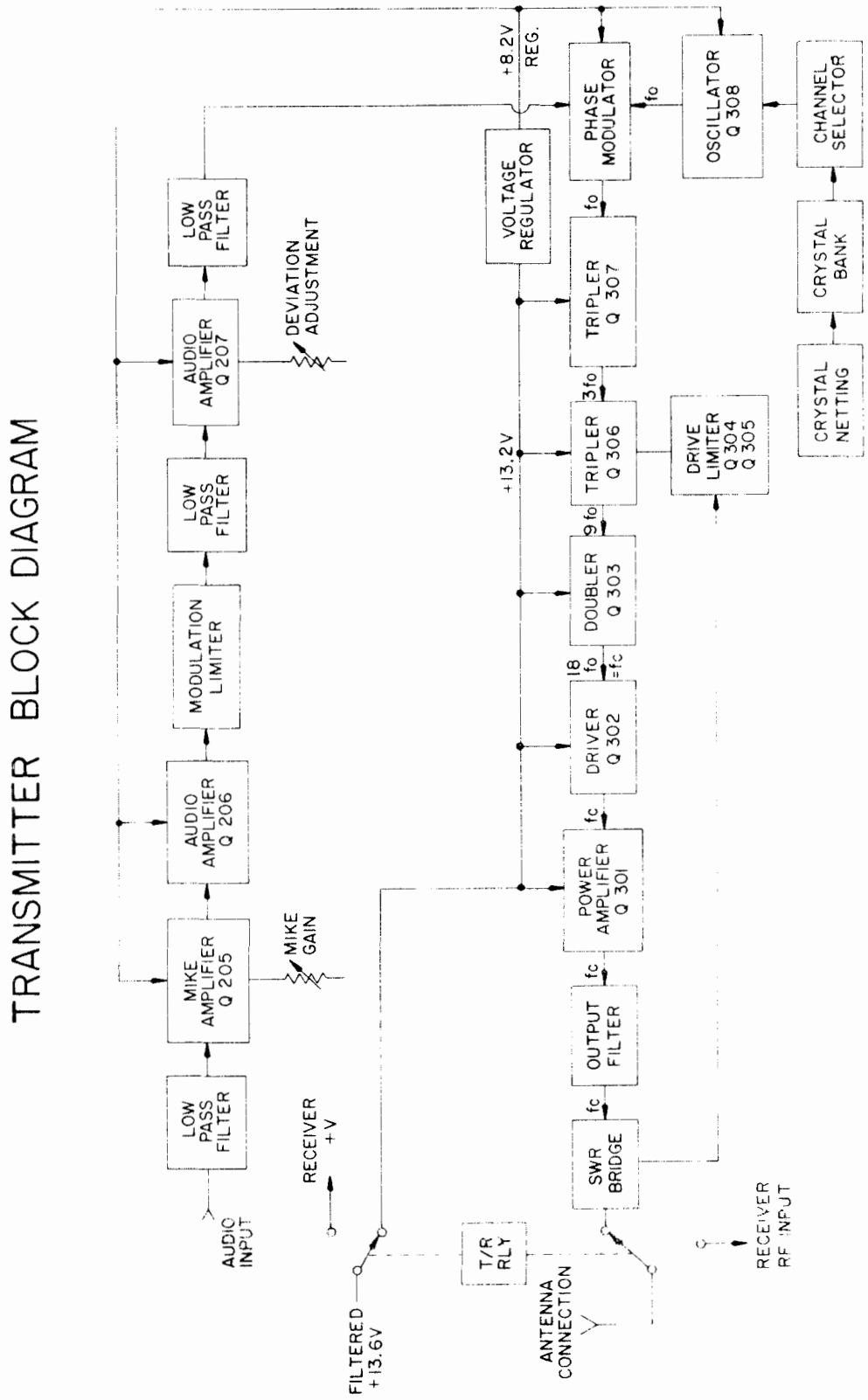
Limiter circuits. In the event of a load mismatch at the antenna terminals, the SWR Bridge consisting of T301, R301, R305 and CR301 detects the mismatch and sends a signal to the Drive Limiter circuitry. The first stage (Q304) of the Drive Limiter circuitry provides a controlling voltage (base bias) for the second Drive Limiter stage (Q305). Q305 is in the emitter circuit of Q306 and controls the gain of this stage. When the mismatch (high SWR) is detected, Q304 will bias Q305 to an unsaturated condition, which in turn will reduce the gain of Q306. As Q306's gain is reduced, less RF drive is delivered to the final power amplifier stage (Q301). With less RF drive (or no drive in case of a severe mismatch), Q301's power output is reduced to a level that will prevent possible damage to this stage.

The modulator section of the transmitter uses a high impedance ceramic microphone. The microphone signal is applied to a Field Effect transistor, Q205. The output of Q205 is applied through the microphone gain control (R217) to Q206. The mike gain control is adjusted to compensate for the output differences of various microphones and for differences in the voice levels of various operators and will normally be set at about 75% of maximum clockwise rotation. This control sets the mike signal to the proper clipping level for the logarithmic clipper diode circuitry between stages Q206 and Q207. Suitable pre-emphasis and de-emphasis is used preceding and following the diode clippers. The deviation control (R228) in the collector circuit of Q207 sets the level of the audio signal voltage applied to the Varactor diode modulator circuit. This level can be adjusted for a maximum of 10 KHz deviation with the clippers driven to full clip by a 1 KHz audio signal. As shipped from the factory, the deviation is set for approximately 5 KHz.

The push-to-talk (PTT) Switch in the microphone applies a ground to the transmit-receive relay coil, which activates the relay. The T-R relay switches the supply voltage between the receiver and transmitter. It also switches the antenna between the receiver and the transmitter.



2-4 RECEIVER BLOCK DIAGRAM



2-5 TRANSMITTER BLOCK DIAGRAM

SECTION 3 ALIGNMENT AND TUNING PROCEDURES

3-1 EQUIPMENT REQUIRED–RECEIVER ALIGNMENT

3-1-1 FM Signal Generator
3-1-2 Oscilloscope
3-1-3 AC VTVM
3-1-4 Noise Generator (To Be Used In 3-6 Only)

NOTE: During all steps of alignment, the squelch control should be in the maximum clockwise position (minimum squelch action).

All transceivers should be aligned to the channel nearest the center of the frequency range over which they will operate.

Diagrams 4-1 and 4-3 show the location of all coils to be adjusted.

3-2 QUADRATURE DETECTOR ALIGNMENT

3-2-1 Connect the FM Signal Generator to the antenna input jack. Accurately set frequency to the center of the channel being used for alignment. Modulate Signal Generator with 1000 Hz, 3 KHz deviation.

3-2-2 Connect the oscilloscope to Test Point A, (Junction of C126, C128, R113). See diagram 4-4.

3-2-3 Adjust output of Signal Generator until all noise in scope pattern just disappears.

3-2-4 Adjust L103 for maximum peak to peak amplitude, while maintaining symmetry of the detected signal. The 1000 Hz signal at Test Point A should be approximately 0.2 VRMS.

3-3 IF ALIGNMENT

3-3-1 Disconnect RF Signal Generator from antenna input.

3-3-2 Connect AC voltmeter across speaker terminals.

3-3-3 Adjust volume control for .5 volt noise reading on AC voltmeter.

3-3-4 Peak T102 (bottom core and top core, in that order) for maximum noise (maximum meter reading on AC voltmeter). If circuit is not badly misaligned, the correct point should be within 2 turns of the cores' present position.

NOTE: Coils will have two peaks; adjust core to peak away from the center of the coil form.

3-3-5 Adjust volume control for 1.0 volt noise reading on AC voltmeter.

3-3-6 Connect the R.F. Signal Generator to the antenna input jack. Turn modulation off. Set the generator to the operating crystal frequency.

3-3-7 Adjust the Signal Generator output until the voltmeter reads 0.2 volts.

3-3-8 Adjust T101, T202, T201 (bottom core) and T201 (top core), (in that order), for maximum quieting (lowest meter reading). Adjust Signal Generator to maintain reading on AC voltmeter between 0.1 and 0.2 volts. If two peaks occur, use the one away from the center of the coil form.

3-3-9 Set the generator frequency to the secondary image frequency. This is 910 KHz below the channel frequency.

NOTE: Some receivers may have the second oscillator at 11.155 MHz, if this is the case, the image frequency is 910 KHz ABOVE the channel frequency. Check the frequency marked on top of the crystal (10.245 MHz for BELOW and 11.155 MHz for ABOVE).

3-3-10 Adjust the Signal Generator output until voltmeter reads .2 volts.

3-3-11 Adjust T102 (bottom core), T102 (top core), T101 and T202 (in that order) for maximum quieting degradation (highest meter reading). Adjust Signal Generator output to maintain voltmeter reading between 0.1 and 0.2 volts. The correct position for the cores should be within two turns of the position in Step No. 4 and 8.

3-4 RF (RECEIVER) ALIGNMENT

3-4-1 Preset the cores of L201, L202, L203 flush with the tops of the coil forms.

3-4-2 Connect AC voltmeter across the speaker terminals.

3-4-3 With nothing connected to the antenna input, adjust the volume control until AC voltmeter reads 1 volt of noise.

3-4-4 Connect Signal Generator to antenna input jack. Set generator accurately to the center frequency of the channel being used for alignment. Turn modulation off.

3-4-5 Adjust output of Signal Generator until AC voltmeter reads .2 volts.

3-4-6 Adjust L201, L202 and L203, in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator output to maintain voltmeter reading between .1 and .2 volts. Repeat adjustments until no further improvement can be made. If two peaks occur on any core, use the peak with the core nearest the top of the coil form.

NOTE: The following step may be omitted if performed in IF Alignment section.

3-4-7 Adjust T102 (bottom core) and T201 (top core), in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator to maintain reading on AC voltmeter between .1 and .2 volts. If two peaks occur, use the one away from center of the coil form.

3-5 QUIETING SENSITIVITY MEASUREMENT

3-5-1 Connect the AC voltmeter across the speaker terminals.

3-5-2 Adjust the VOLUME Control for a 1 volt noise reading on the AC voltmeter.

3-5-3 Connect the FM Signal Generator to the antenna connector. Accurately set the generator's frequency to the receive frequency being used for alignment purposes. DO NOT modulate the generator's signal.

3-5-4 Adjust the output of the Signal Generator until the noise reading on the AC voltmeter decreases by 20 DB. (0.1 volt reading if the original reading was 1 volt). The setting on the generator's output control (or dial) indicates the unit's sensitivity for 20 DB of noise quieting.

3-6 NOISE BALANCE ADJUSTMENT

NOTE: This adjustment may be required only if excessive "ignition noise" is encountered. Usually, the "noise" problem is caused by improper or inadequate noise suppression of the vehicle's ignition system.

3-6-1 Using a "T" connector, connect the FM Signal Generator and the Noise Generator to the antenna input jack. If a "T" connector is not available, connect the FM generator to the antenna jack and feed in the noise signal by means of a 3 or 4 turn loop coupled to the input coil, L201.

3-6-2 Connect the oscilloscope to the junction of Q109's emitter and Q110's collector, or to the speaker terminals.

3-6-3 Apply a 3 to 10 microvolt signal, as accurately as can be set to the exact channel frequency (carrier only, no modulation), and adjust the output of the noise generator until spikes are clearly seen in the audio output as viewed on the oscilloscope. The noise spikes will be either mostly positive or negative if an unbalanced condition exists.

3-6-4 Tune L103 (quadrature detector coil) until the noise spikes are equally positive and negative in their amplitude. The overall amplitude of these spikes should be much less as a balance is achieved. Usually, only a 1/4 turn, or less, is needed to obtain the proper adjustment for best noise balance. If a proper balance can not be achieved, repeat the IF and RF alignments and then try the noise balance adjustment again.

3-7 EQUIPMENT REQUIRED–TRANSMITTER ALIGNMENT

3-7-1 RF Wattmeter (or any equivalent device which provides a 50 ohm load at the appropriate power range).

3-7-2 Frequency Counter – 150 MHz preferred; 50 MHz acceptable.

3-7-3 FM Modulation Meter – Lampkin 205 A or equivalent peak reading deviation meter.

3-7-4 Audio Generator – HP 200D or equivalent

3-7-5 VTVM

3-7-6 Oscilloscope

3-8 TRANSMITTER TUNING PROCEDURE

NOTE: The encircled numbers on diagram 4-9 correspond to the last digit in the following procedure steps. The unit must be connected to a suitable 50 Ω load for proper alignment of the final transmitter stage. The Tuning Procedure is the same for both versions (500-998 or 501-058) of the transmitter board.

3-8-1 Install crystals. For full bandwidth alignment, use crystals that cover each end of the band and also one whose frequency is near the center of the band. Alignment is done on the center frequency and then the bandwidth is checked using the high and low limit crystals.

3-8-2 Tighten trimmer capacitor C303.

3-8-3 Set the "Netting" capacitors (12 trimmers; see also diagram 4-10) to mid-range.

3-8-4 With the transmitter keyed and the center frequency crystal operating, voltage at this point should be 2.5 to 3.0 volts as read on a VTVM.

3-8-5 Move the VTVM's probe to this point and adjust L306 for a maximum reading (0.8 to 1.2 volts).

3-8-6 Move the VTVM's probe to this point. Alternately peak the upper and lower cores of T305 for a maximum reading (normally 1.3 to 2.0 volts). Check this reading at the lowest and highest crystal frequencies installed for proper bandpass alignment.

Repeat Steps 3-8-5 and 3-8-6 until no further improvement can be made. After these adjustments have been made. L306 and the primary (bottom core) of T305 should not be changed during the remainder of the alignment procedure.

NOTE: The frequency of the oscillator will change slightly whenever L306 and T305 are adjusted. Therefore, if the adjustment of these parts is ever changed, it is important to perform the Crystal Netting Procedure, 3-9.

3-8-7 Move the VTVM's probe to this point. Alternately peak the upper and lower cores of T304 for a maximum reading (0.3 to 0.6 volts) at this point.

3-8-8 T303: Set the bottom core (primary) so that the top edge is midway between the top of the coil collar and the bottom winding. Key the transmitter and adjust the top core (secondary) for maximum power output on the wattmeter. During Power Amplifier alignment, the secondary of T303 and, if necessary, the primary are retuned for maximum power.

NOTE: If the Power Amplifier Stage (Q301) is detuned to the extent that no power indication can be obtained, the following procedure can be used to set the cores of T303 near their correct position; Move the VTVM's probe to Test Point 8. Starting with the top core of T303, alternately adjust both cores for a MINIMUM voltage at this point. Now procede with 3-8-9 and the rest of the Tuning Procedure. With the transmitter delivering rated output power, the voltage drop across R329 will normally be 1.0 to 1.5 V.

3-8-9 Set the core of T302 to the center of the coil winding.

3-8-10 Power Amplifier Alignment

NOTE: The Power Amplifier alignment should be performed with the unit placed on a metal sheet (or its cabinet) so that the printed circuit side of the transmitter board is covered as it would be when the unit is installed in its cabinet.

a. The following adjustments are peaked in the order listed for maximum power output as indicated on the R.F. Wattmeter.

1.) Peak C303
2.) Peak C308
3.) Repeat the above two steps until no further improvement is noted
4.) Repeak T303 as in 3-8-8 above

b. Check bandwidth with low and high frequency crystals. Adjust T303 for best output compromise between high and low limits. Adjusting the slug of T302 will sometimes help widen the bandwidth. C308 is final adjustment for best compromise over frequency range.

3-9 CRYSTAL NETTING PROCEDURE

3-9-1 Use the following procedure if a 150 MHz Counter is available;

a. Connect the unit to the RF Wattmeter or dummy load.
b. Turn transmitter on (key the mike's PTT Switch or insert a shorting plug into J2).
c. Place an RF pick-up loop consisting of 3 or 4 turns near the final transistor's output circuit (near L301; see diagram 4-5 or 4-7).
d. Read the frequency on the counter.
e. Adjust the appropriate netting capacitor (see diagram 4-10 for their location) until the frequency being read on the counter is "on" channel. (Or at least to within 200 Hertz of the desired frequency).

3-9-2 Use the following procedure if only a 50 MHz counter is available;

a. Connect the unit to the RF Wattmeter or dummy load.
b. Turn transmitter on.
c. Place an RF pick-up loop neat the top of coil T305; see diagram 4-5 or 4-7.

NOTE: Due to a possible slight "pulling" of the crystal's frequency, couple the pick-up loop as lightly as possible to T305. Excessive coupling to the bottom coil will prevent a proper

crystal netting adjustment from being made. Use the maximum sensitivity available at the counter's input.

d. Multiply the frequency read on the counter by six (6) to find the ultimate frequency being transmitted.

EXAMPLE: Frequency read = 24.360000 MHz
Ultimate Frequency = 6 x 24.36000 = 146.16 MHz

e. Adjust the appropriate netting capacitor until the frequency being read is within the required tolerance at one-sixth (1/6) of the ultimate transmitted frequency. It is recommended that the crystal be netted to within 30 Hertz of the required one-sixth frequency.

EXAMPLE: Ultimate Frequency = 146.16 MHz
Counter Reading = $\frac{146.16 \text{ MHz}}{6}$ = 24.360000 MHz

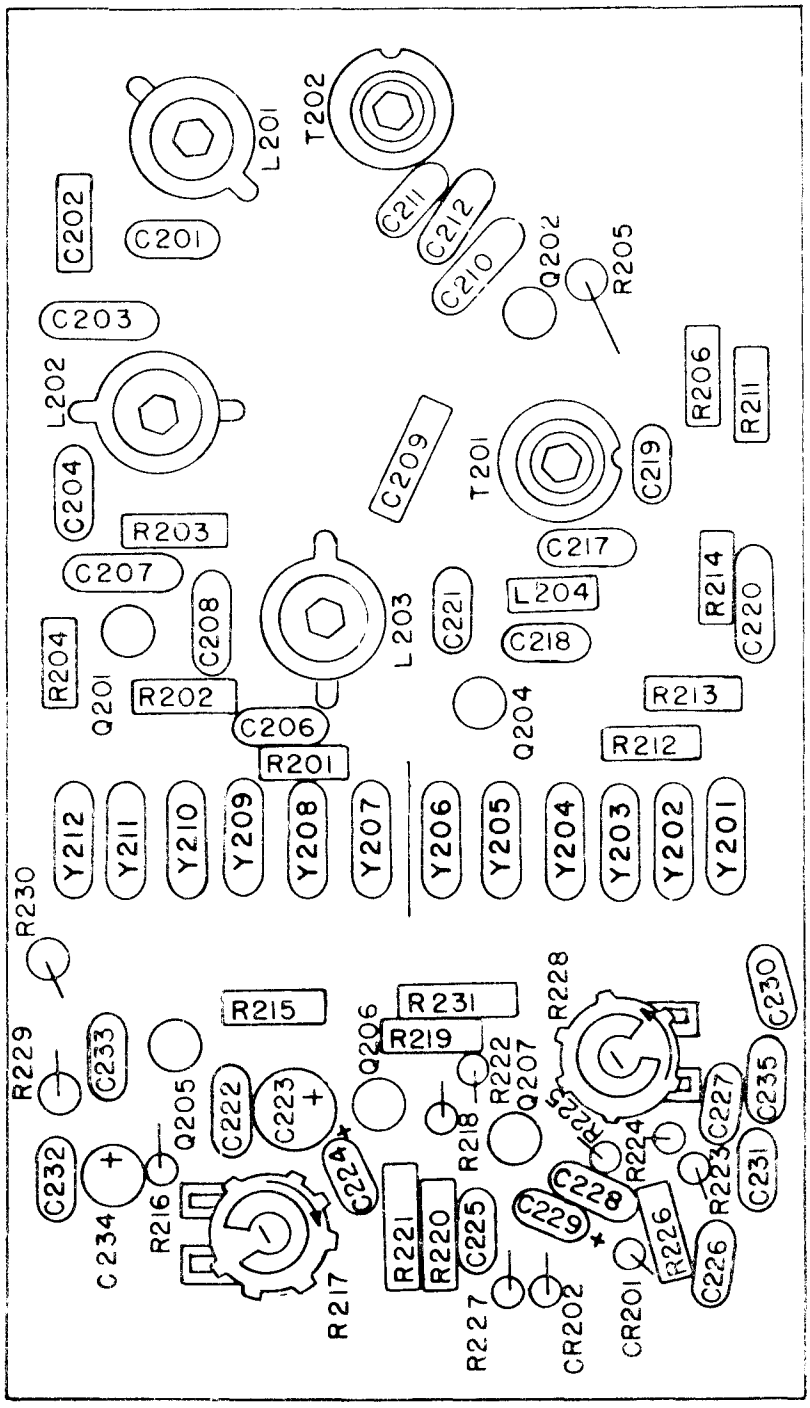
3-10 DEVIATION AND MIC GAIN ADJUSTMENT

3-10-1 Use the following procedure for proper adjustment of the Mike Gain (R217) and Deviation (R228) controls (see diagram 4-10 for their location);

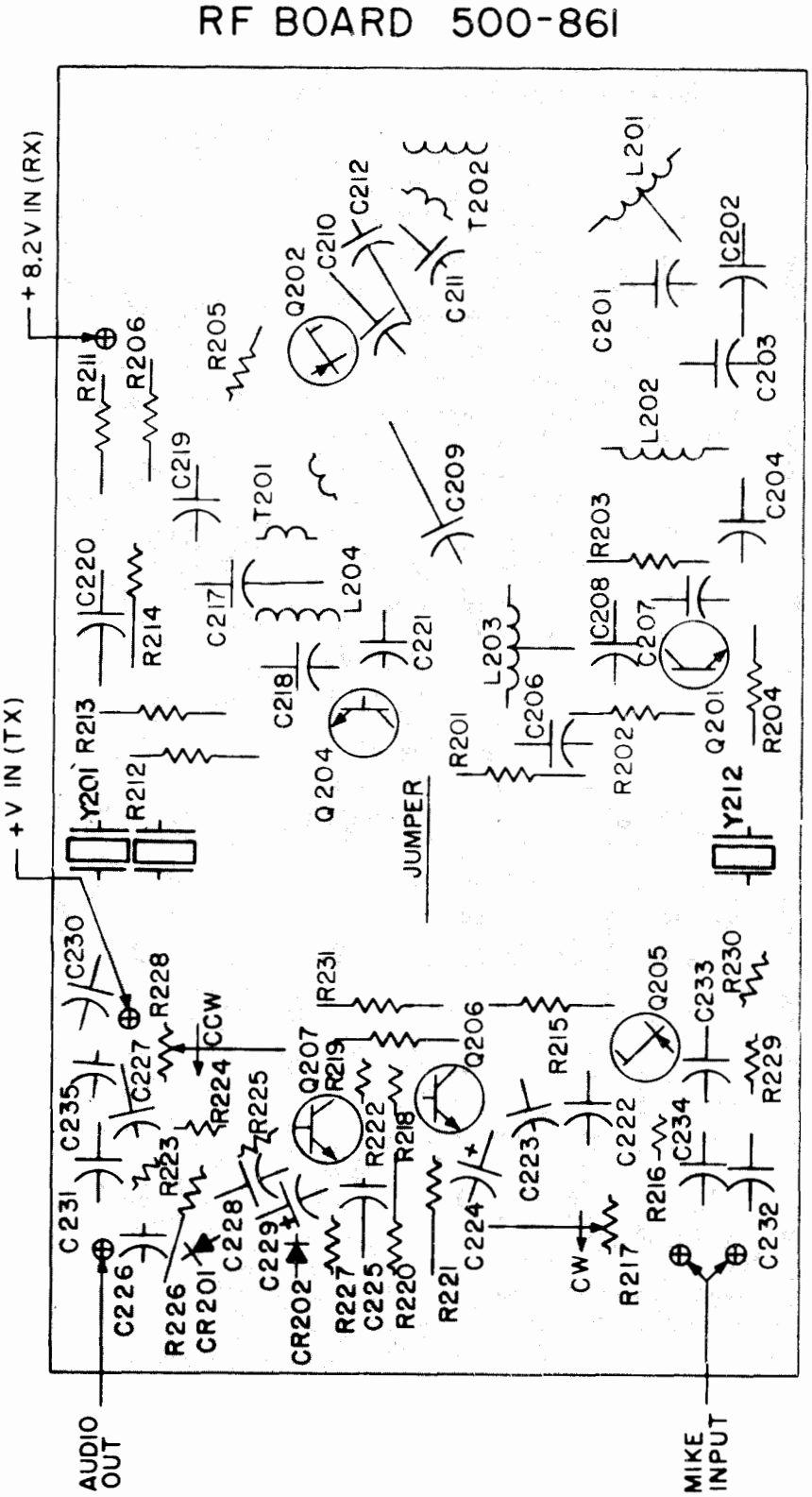
a. Connect the unit to the RF Wattmeter or dummy load.
b. Connect the scope probe to the junction of C225 and CR201. See 4-1 for location. It may be more convenient to connect the probe to the cathode lead of CR202.
c. Key the transmitter and talk into the microphone with a normal voice level. Observe the waveform on the scope and adjust R217 (Mike Gain) until approximately 10% of the voice peaks are clipped.
d. Connect the audio generator to the mike input terminals. Set the audio voltage level to 0.5 - 1.0 volts RMS at 1000 Hz.
e. Couple the FM Modulation Meter's RF pick-up to the transmitter.
f. Key the transmitter and adjust R228 (Deviation Control) so that the maximum deviation is no greater than 5 KHz (or whatever value up to 10 KHz is desired).
g. Reduce the audio input level to 0.25 volts RMS. The deviation should not be greater than the value adjusted for in the previous step.

SECTION 4 DIAGRAMS, VOLTAGE DATA AND SCHEMATIC

RF BOARD 500-861

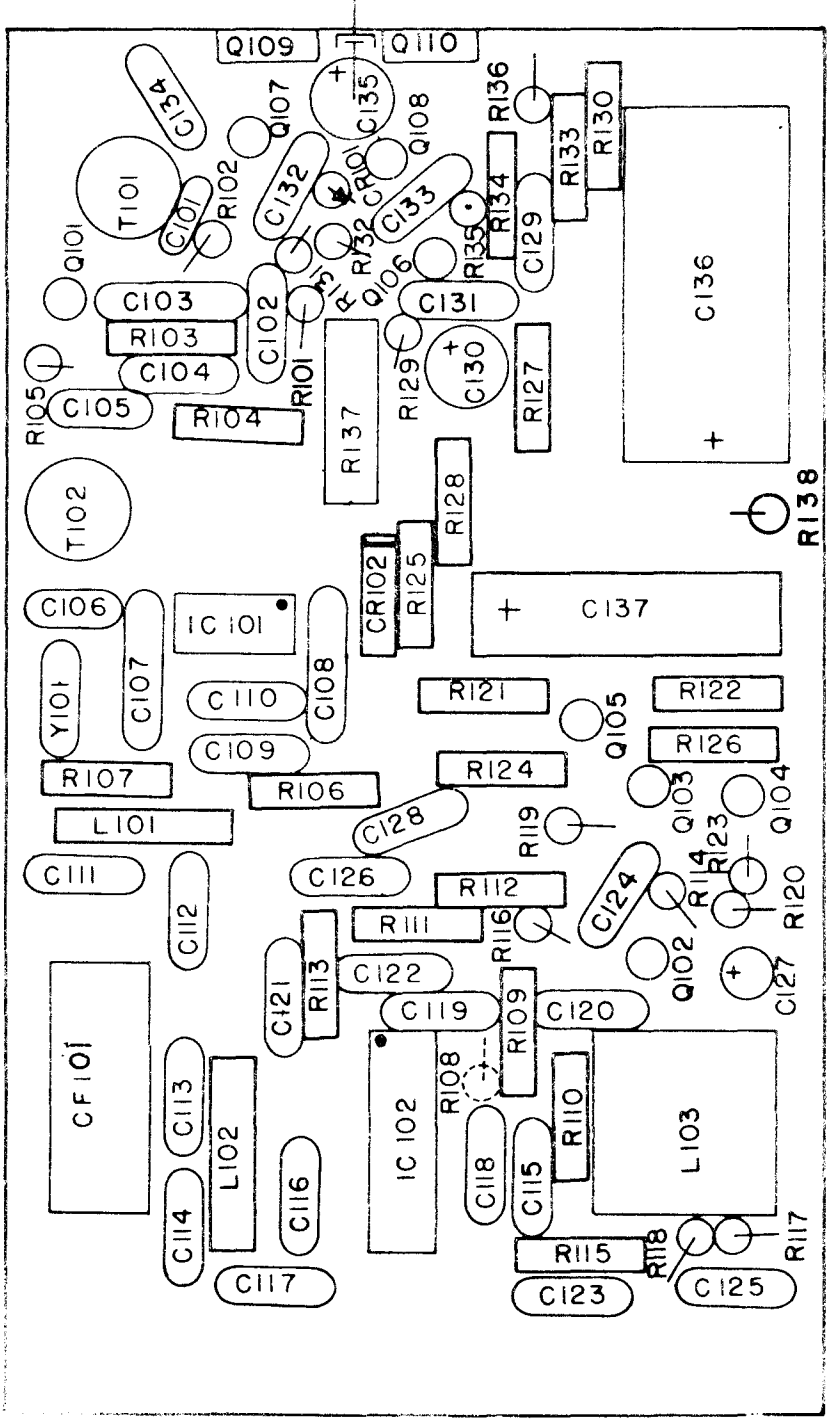


4-1 RF–MODULATOR BOARD PARTS PLACEMENT DIAGRAM



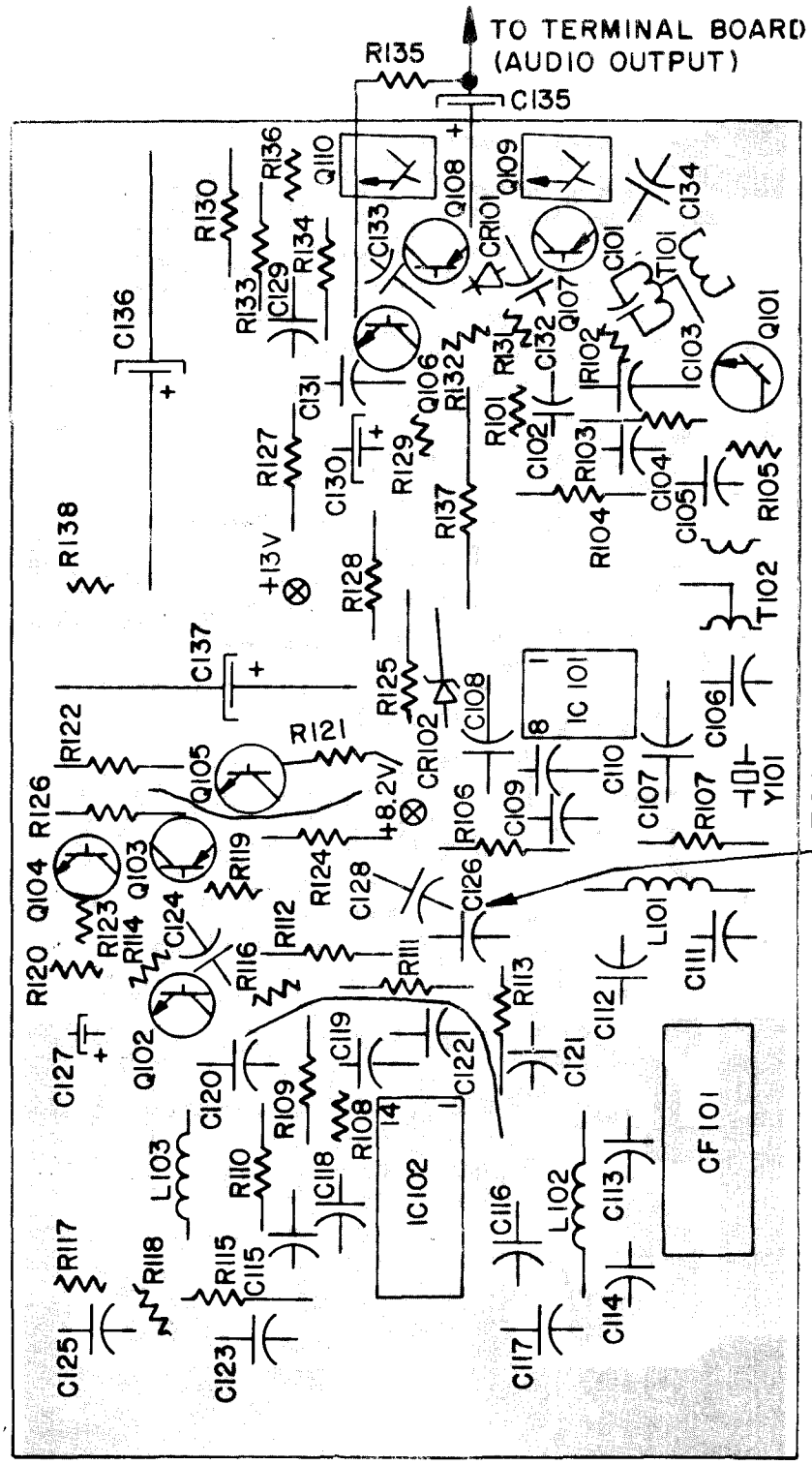
4-2 RF–MODULATOR BOARD BOTTOM VIEW

IF BOARD 500-858



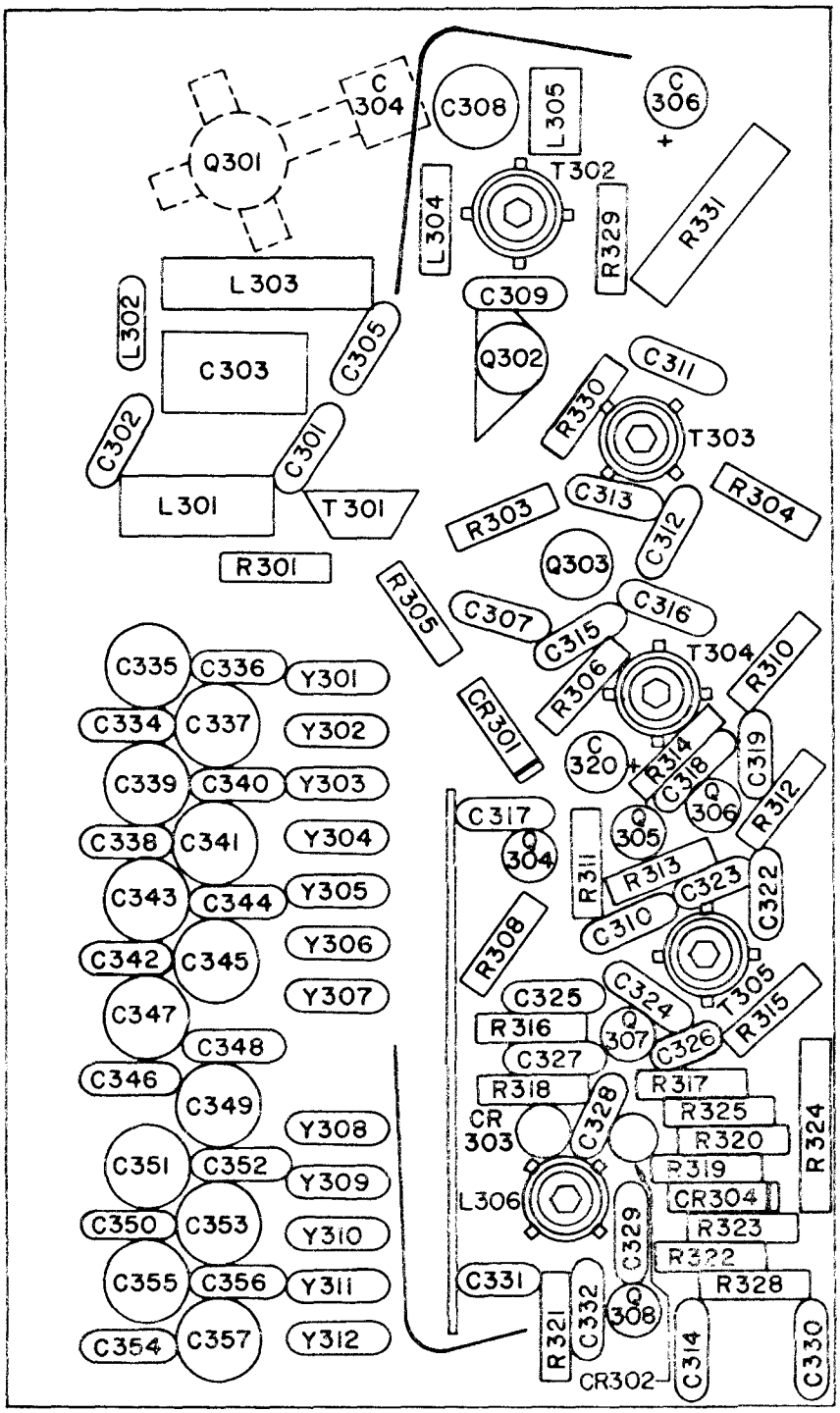
4-3 IF–AUDIO BOARD PARTS PLACEMENT DIAGRAM

IF BOARD 500-858



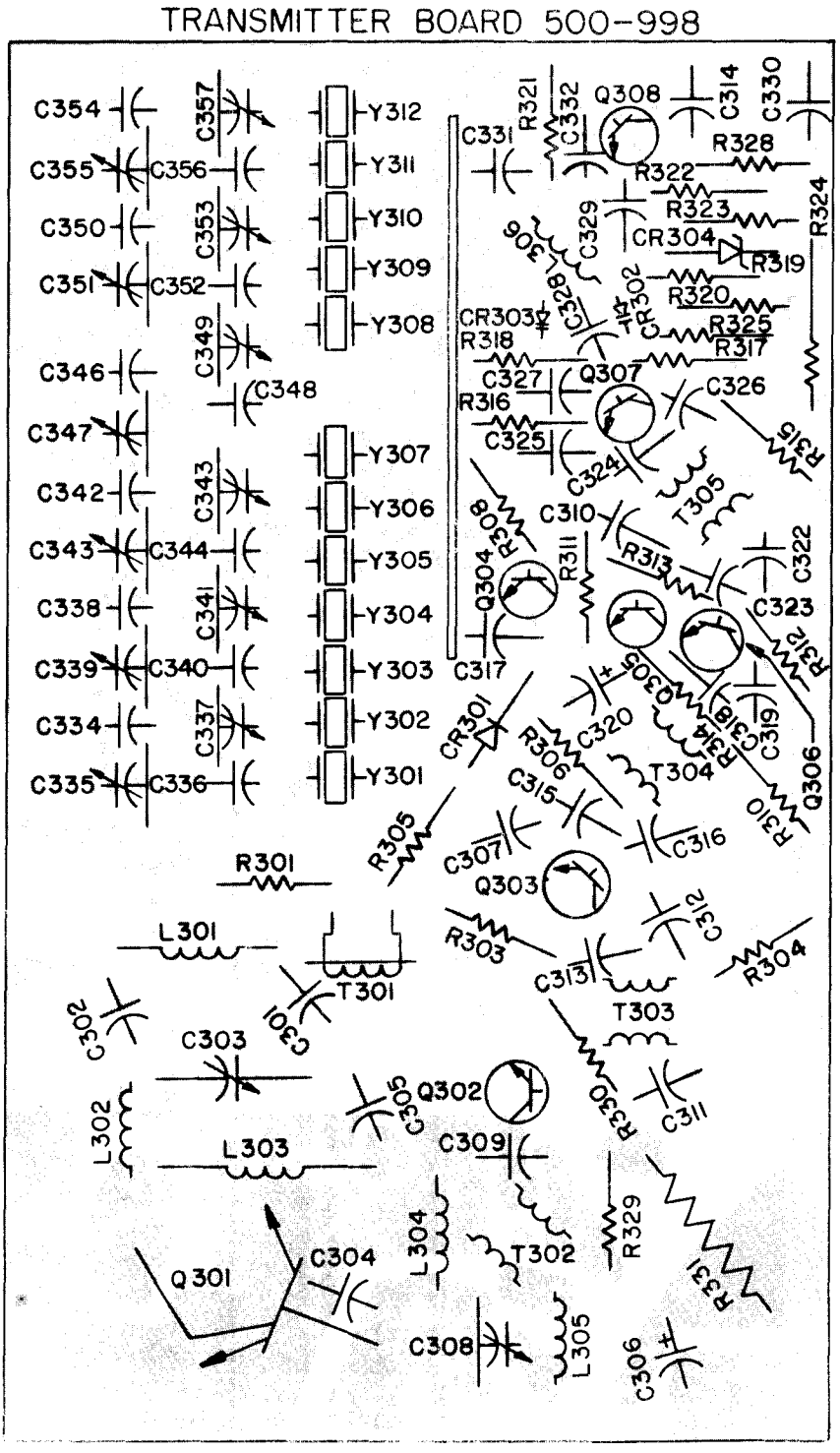
4-4 IF–AUDIO BOARD BOTTOM VIEW

TRANSMITTER BOARD 500-998



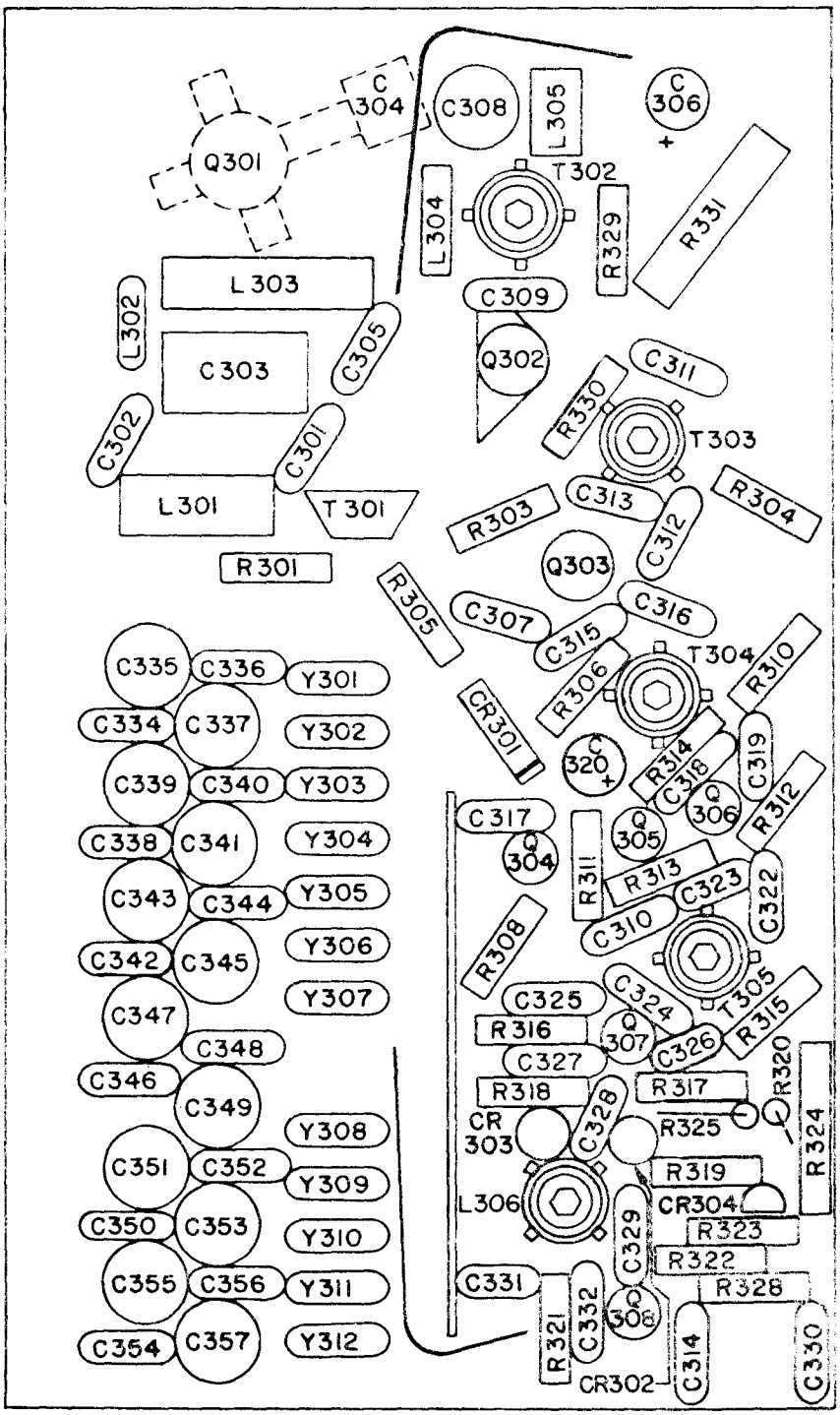
NOTE: Q301 & C304 ARE MOUNTED ON BOTTOM SIDE OF BOARD.

4-5 TRANSMITTER BOARD PARTS PLACEMENT DIAGRAM (500-998)



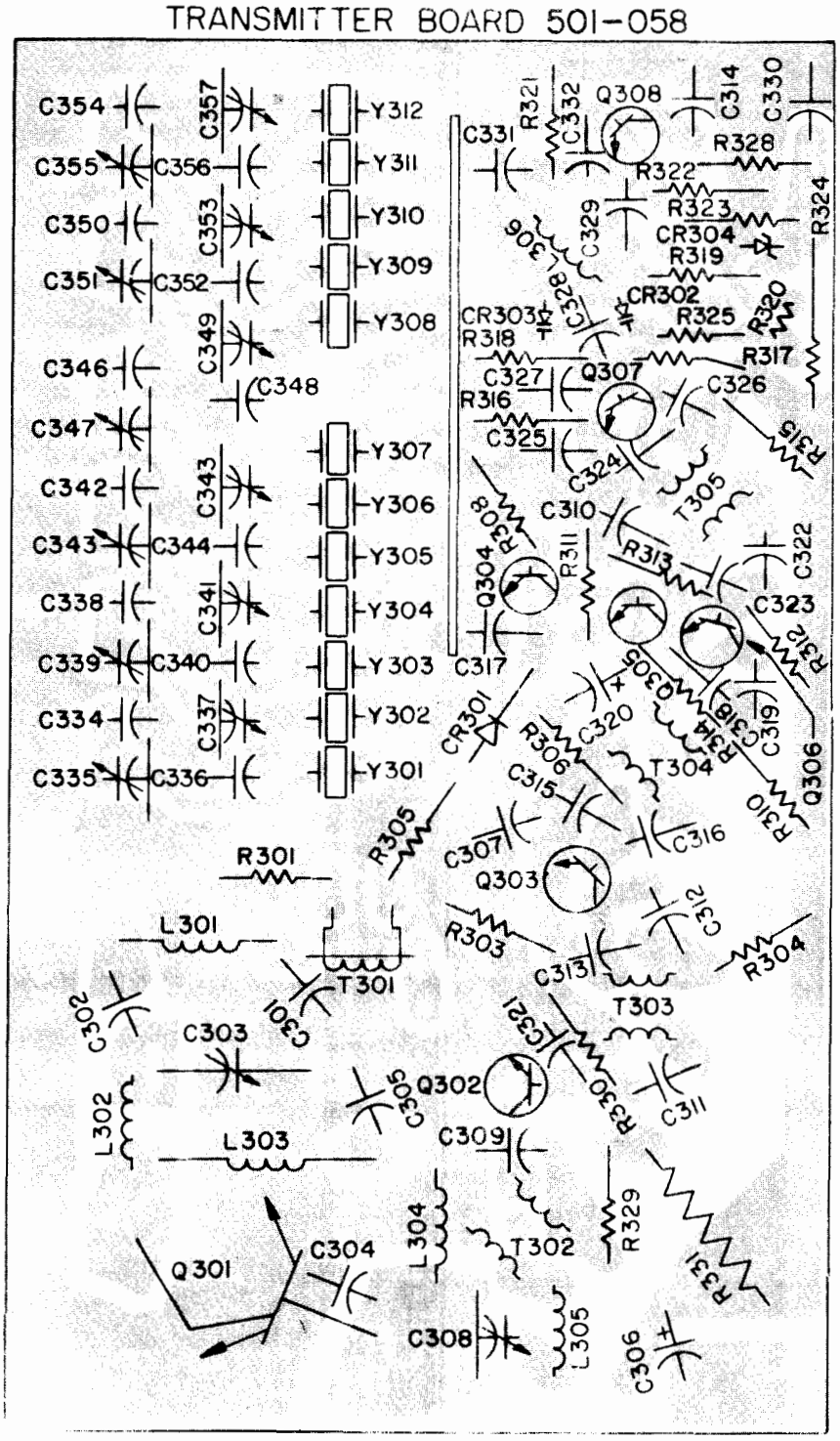
4-6 TRANSMITTER BOARD BOTTOM VIEW (500-998)

TRANSMITTER BOARD 501-058

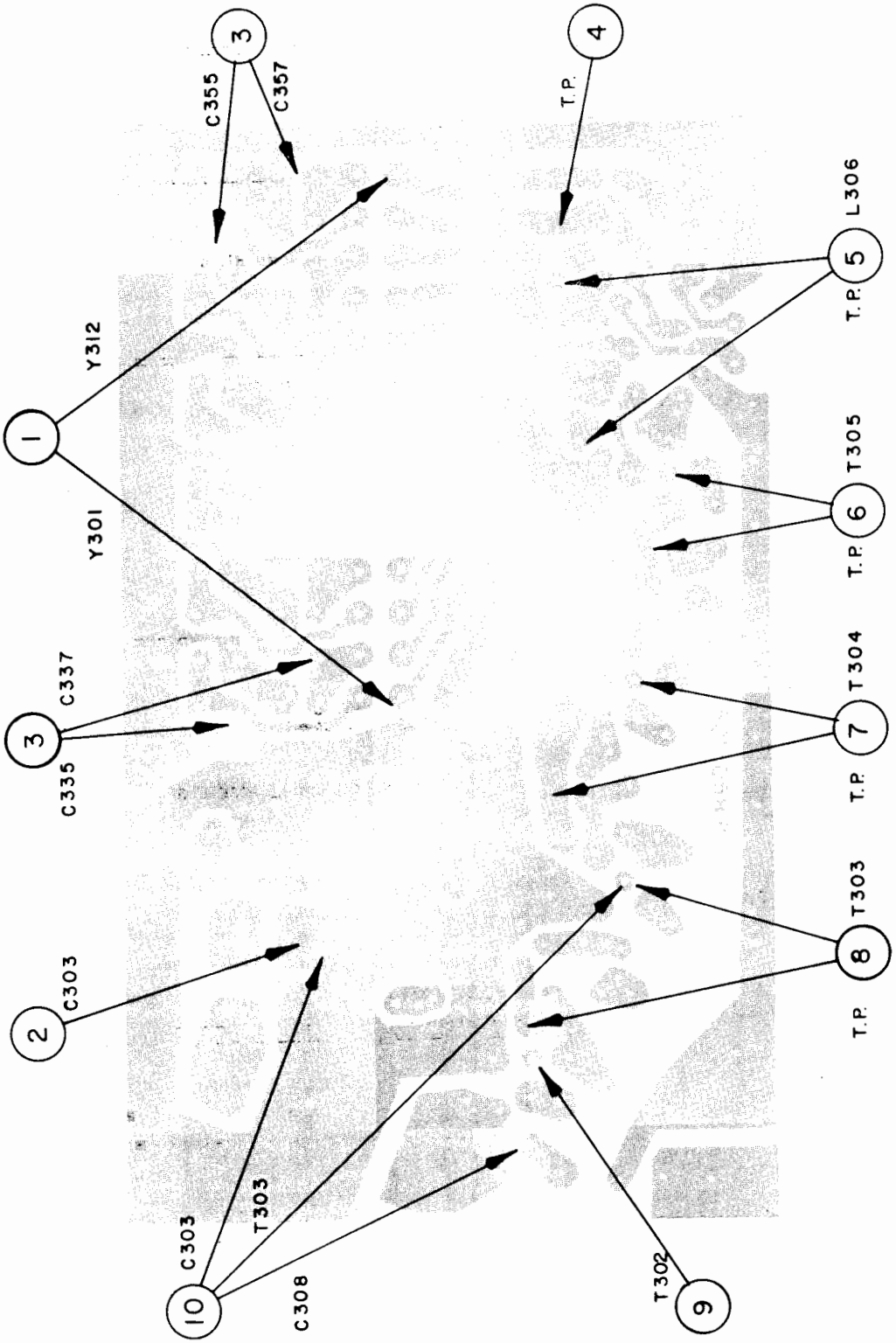


NOTE: Q301 & C304 ARE MOUNTED ON BOTTOM SIDE OF BOARD.

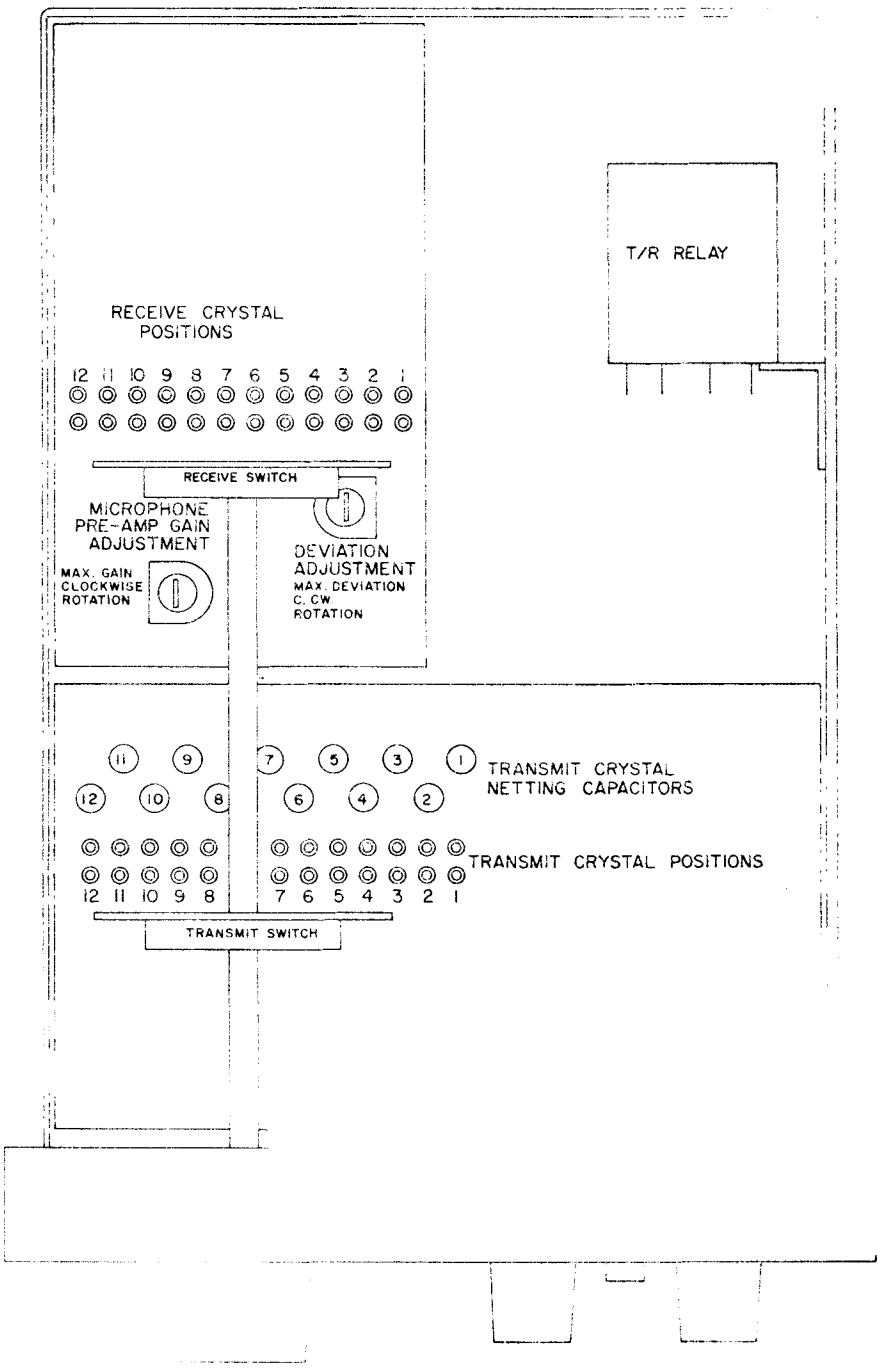
4-7 TRANSMITTER BOARD PARTS PLACEMENT DIAGRAM (500-058)



4-8 TRANSMITTER BOARD BOTTOM VIEW (501-058)



4-9 TRANSMITTER BOARD TUNE-UP TEST POINTS



4-10 CRYSTAL LOCATION AND ADJUSTMENT DIAGRAM

4-11 VOLTAGE DATA

NOTE: All voltages are nominal and are measured with a VTVM. 13.8 VDC supply voltage at power connector's No. 3 terminal.

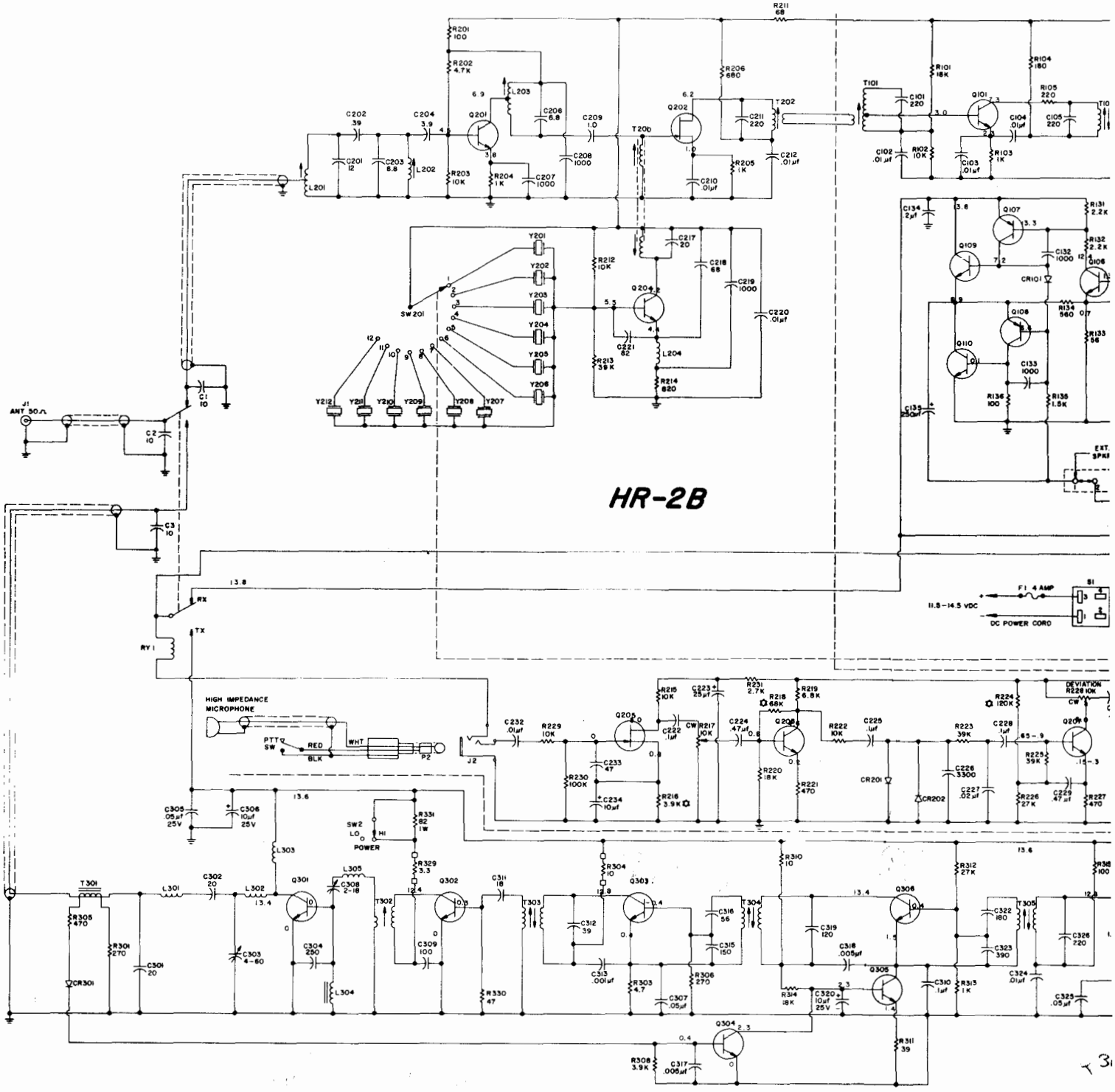
VOLTAGE DATA TRANSISTORS

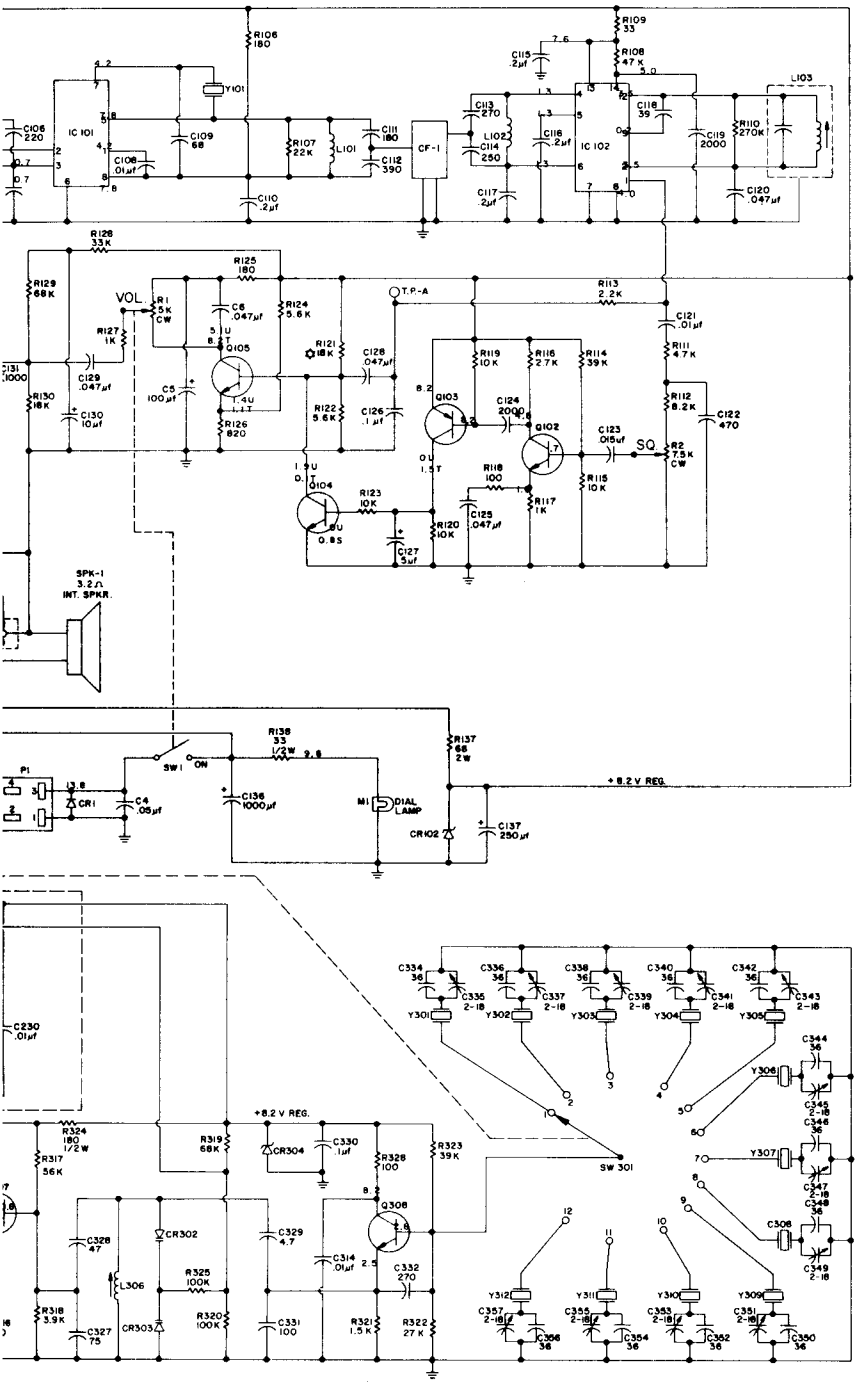
	Transistor	Emitter (Source)	Base (Gate)	Collector (Drain)	
RF Board No. 500-861	Q201	3.8	4.5	6.9	
	Q202 (FET)	1.0	–	6.2	
	Q204	4.4	5.0	7.2	
	Q205 (FET)	0.8	–	5.0	
	Q206	0.2	0.8	4.6	
	Q207	.15–.3	.65–.9	6.0*	(*varies with setting of R228)
IF Board No. 500-858	Q101	2.3	3.0	7.3	
	Q102	1.0	1.7	4.8	
	Q103 (PNP)	8.2	8.2	0	(unsquelched)
		8.2	8.2	1.0	(squelched)
		8.2	8.2	1.5	min. (tight squelch)
	Q104	0	0	1.9	(unsquelched)
		0	0.8	0.3	(squelched)
		0	0.8	0.1	(tight squelch)
	Q105	1.4	1.9	5.1	(unsquelched)
		1.1	0.1	8.2	(tight squelch)
	Q106	0.7	1.3	12.4	
	Q107 (PNP)	13.8	13.3	7.2	
	Q108 (PNP)	6.9	6.6	.10	
	Q109	6.9	7.2	13.8	
	Q110	0	0.1	6.9	
TX Board No. 500-998 or 501-058	Q301	0	0	13.4	(Final)
	Q302	0	– 0.3	12.4	(Drive)
	Q303	0.4	– 0.4	12.8	(Pre-Driver)
	Q304	0	0.4	2.3	(Bridge Amp.)
	Q305	1.4	2.3	1.5	(Drive Limiter)
	Q306	1.5	0.4	13.4	(Multiplier)
	Q307	1.2	0.8	12.8	(Multiplier)
	Q308	2.5	2.8	8.2	(Osc.)

VOLTAGE DATA - INTEGRATED CIRCUITS

NOTE: Both IC's are located on the IF Board, 500-858.

IC No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC 101	4.2	.7	.7	4.2	7.8	0	4.2	7.8	–	–	–	–	–	–
IC 102	4.0	3.5	0	1.3	1.3	1.3	0	0	0.2	1.4	2.9	3.5	7.6	5.0


HR-2B
HIGH IMPEDANCE MICROPHONE
PTT SW
RED
BLK
WHT
P2
J2
ANT 50Ω
J1
SW201
SW2
LO
HI
POWER
RX
TX
RY1
11.8-14.5 VDC
DC POWER CORD
F1 4 AMP
S1
DEVIATION R228 10K
CW
EXT. SPKR



NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTORS NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✡ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. —□— DENOTES A FERRITE BEAD PLACED ON THE COMPONENT LEAD.
4. ALL VOLTAGES (FIGURES IN RED) ARE NOMINAL VALUES AS MEASURED WITH A VTVM. SUPPLY VOLTAGE IS 13.8 VDC AS MEASURED AT PIN 3 OF P1.
   A. THE LETTER FOLLOWING A VOLTAGE INDICATES THE FOLLOWING CONDITIONS.
      U= UNSQUELCHED
      S= SQUELCHED— THRESHOLD
      T= SQUELCHED— TIGHT
   B. VOLTAGES INDICATED IN TRANSMITTER SECTION ARE MEASURED WITH THE TRANSMITTER OPERATING WITH A PROPER LOAD AND SW-2 SET TO HIGH POWER.

4-12 SCHEMATIC WITH VOLTAGES

SECTION 5 PARTS LIST

NOTE: When ordering parts, please include the following information:

a. Model Number (HR -2B)
b. Item Number
c. Description
d. Part Number

5-1 RF–MODULATOR BOARD 500-861

Item No.	Description	Part No.
	RESISTORS	
R201	100 ohm, 10%, ¼W	4701-0101-042
R202	4.7K, 10%, ¼W	4701-0472-042
R203	10K, 10%, ¼W	4701-0103-042
R204	1K, 10%, ¼W	4701-0102-042
R205	1K, 10%, ¼W	4701-0102-042
R206	680 ohm, 10%, ¼W	4701-0681-042
R211	68 ohm, 10%, ¼W	4701-0680-042
R212	10K, 10%, ¼W	4701-0103-042
R213	39K, 10%, ¼W	4701-0393-042
R214	820 ohm, 10%, ¼W	4701-0821-042
R215	10K, 10%, ¼W	4701-0103-042
R216	3.9K, 10%, ¼W	4701-0392-042
R217	10K, Trimmer	4751-0103-001
R218	68K, 10%, ¼W	4701-0683-042
R219	6.8K, 10%, ¼W	4701-0682-042
R220	18K, 10%, ¼W	4701-0183-042
R221	470 ohm, 10%, ¼W	4701-0471-042
R222	10K, 10%, ¼W	4701-0103-042
R223	39K, 10%, ¼W	4701-0393-042
R224	120K, 10%, ¼W	4701-0124-042
R225	39K, 10%, ¼W	4701-0393-042
R226	27K, 10%, ¼W	4701-0273-042
R227	470 ohm, 10%, ¼W	4701-0471-042
R228	10K, Trimmer	4751-0103-001
R229	10K, 10%, ¼W	4701-0103-042
R230	100K, 10%, ¼W	4701-0104-042
	CAPACITORS	
C201	12PF, 10%, NPO, 500V (Disc.)	1500-0120-605
C202	.39PF, 10% (composition)	1510-0398-900
C203	6.8PF, 10%, NPO, 500V (Disc.)	1500-0689-905
C204	3.9PF, 10%, NPO, 500V (Disc.)	1500-0399-905
C206	6.8PF, 10%, NPO, 500V (Disc.)	1500-0689-905
C207	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C208	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C209	1PF, 10% (composition)	1510-0010-900
C210	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C211	220PF, 5%, 50V (MICA)	1506-0221-550
C212	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C217	20PF, 10%, NPO, 500V (Disc.)	1501-0200-001
C218	68PF, 5%, 50V (MICA)	1506-0680-550
C219	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C220	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C221	82PF, 5%, 50V (MICA)	1506-0820-550
C222	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C223	25mfd, 10V, 85°C (Electrolytic)	1513-0250-001
C224	.47mfd, +80-20%, 3V (Disc.)	1502-0474-001
C225	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C226	.0033mfd, 10%, 100V (Mylar Film)	1508-0332-610
C227	.022mfd, 10%, 100V, (Mylar Film)	1508-0223-610
C228	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C229	.47mfd, +80-20%, 3V (Disc.)	1502-0474-001
C230	.01mfd, 10%, 100V (Mylar Film)	1508-0103-610
C231	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C232	.01mfd, 10%, 100V (Mylar Film)	1508-0103-610
C233	47PF, 5%, 50V (MICA)	1506-0470-550
C234	10mfd, 10V, 85°C (Electrolytic)	1513-0100-001

Item No.	Description	Part No.
	COILS	
L201	Input, Antenna (Brown)	1800-3152-001
L202	Input, RF AMP (Red)	1800-3152-002
L203	Output, RF AMP (Black)	1800-3152-008
L204	Oscillator, Emitter	1801-1236-900
T201	Oscillator/Mixer Input	1800-3170-100
T202	Output, Mixer	1800-3170-200
	DIODES	
CR201	Silicon, Signal	4805-1241-200
CR202	Silicon, Signal	4805-1241-200
	TRANSISTORS	
Q201	Silicon, NPN (Red Top)	4801-0000-035
Q202	Field Effect, Junction	4811-0000-030
Q204	Silicon, NPN	4801-0000-100
Q205	Field Effect, Junction	4811-0000-030
Q206	Silicon, NPN	4801-0000-010
Q207	Silicon, NPN	4801-0000-010

5-2 IF–AUDIO BOARD 500-858

Item No.	Description	Part No.
	RESISTORS	
R101	18K, 10%, ¼W	4701-0183-042
R102	10K, 10%, ¼W	4701-0103-042
R103	1K, 10%, ¼W	4701-0102-042
R104	180 ohm, 10%, ¼W	4701-0181-042
R105	220 ohm, 10%, ¼W	4701-0221-042
R106	180 ohm, 10%, ¼W	4701-0181-042
R107	22K, 10%, ¼W	4701-0223-042
R108	47K, 10%, ¼W	4701-0473-042
R109	33 ohm, 10%, ¼W	4701-0330-042
R110	270K, 10%, ¼W	4701-0274-042
R111	4.7K, 10%, ¼W	4701-0472-042
R112	8.2K, 10%, ¼W	4701-0827-042
R113	2.2K, 10%, ¼W	4701-0222-042
R114	39K, 10%, ¼W	4701-0393-042
R115	10K, 10%, ¼W	4701-0103-042
R116	5.6K, 10%, ¼W	4701-0562-042
R117	2.2K, 10%, ¼W	4701-0222-042
R118	100 ohm, 10%, ¼W	4701-0101-042
R119	10K, 10%, ¼W	4701-0103-042
R120	10K, 10%, ¼W	4701-0103-042
R121	18K, 10%, ¼W	4701-0183-042
R122	5.6K, 10%, ¼W	4701-0562-042
R123	10K, 10%, ¼W	4701-0103-042
R124	3.3K, 10%, ¼W	4701-0332-042
R125	180 ohm, 10%, ¼W	4701-0181-042
R126	560 ohm, 10%, ¼W	4701-0561-042
R127	1K, 10%, ¼W	4701-0102-042
R128	33K, 10%, ¼W	4701-0333-042
R129	68K, 10%, ¼W	4701-0683-042
R130	18K, 10%, ¼W	4701-0183-042
R131	2.2K, 10%, ¼W	4701-0222-042
R132	2.2K, 10%, ¼W	4701-0222-042
R133	56 ohm, 10%, ¼W	4701-0560-042
R134	560 ohm, 10%, ¼W	4701-0561-042
R135	1.5K, 10%, ¼W	4701-0152-042
R136	100 ohm, 10%, ¼W	4701-0101-042
R137	68 ohm, 10%, 2W (wire wound)	4710-0680-041
R138	33 ohm, 10%, ½W	4701-0330-044
	CAPACITORS	
C101	220PF, 5%, 50V (MICA)	1506-0221-550
C102	.01mfd, 10%, 100V (Mylar Film)	1508-0103-610
C103	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C104	.01mfd, 10%, 100V (Mylar Film)	1508-0103-610
C105	220PF, 5%, 50V (Mica)	1506-0221-550
C106	220PF, 5%, 50V (Mica)	1506-0221-550
C107	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C108	.01mfd, +80-20%, 500V (Disc.)	1503-0103-001
C109	68PF, 5%, 50V (Mica)	1506-0680-550
C110	.2mfd, +80-20%, 12V (Disc.)	1502-0204-006
C111	180PF, 5%, 50V (MICA)	1506-0181-550
C112	390PF, 5%, 50V (MICA)	1506-0391-550
C113	270PF, 5% 50V (MICA)	1506-0271-550
C114	250PF, 5%, 50V (MICA)	1506-0251-550
C115	.2mfd, +80-20%, 12V (Disc.)	1502-0204-006
C116	.2mfd, +80-20%, 12V (Disc.)	1502-0204-006
C117	.2mfd, +80-20%, 12V (Dics.)	1502-0204-006
C118	39PF, 10%, NPO, 500V (Disc.)	1500-0390-605
C119	.002mfd, 20%, 500V (Disc.)	1523-0202-001
C120	.047mfd, 10%, 100V (Mylar Film)	1508-0473-610
C121	.01mfd, 10%, 100V (Mylar Film)	1508-0103-610
C122	470PF, 20%, 500V (Dsic.)	1523-0471-001
C123	.015mfd, 10%, 100V (Mylar Film)	1508-0153-610
C124	.002mfd, 20%, 500V (Disc.)	1523-0202-001
C125	.047mfd, 10%, 100V (Mylar Film)	1508-0473-610
C126	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C127	5mfd, 50V, 85°C (Electrolytic)	1513-0050-004
C128	.047mfd, 10%, 100V (Mylar Film)	1508-0473-610
C129	.047mfd, 10%, 100V (Mylar Film)	1508-0473-610
C130	10mfd, 10V, 85°C (Electrolytic)	1513-0100-001
C131	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C132	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C133	.001mfd, +80-20%, 500V (Disc.)	1503-0102-001
C134	.2mfd, +80-20%, 12V (Disc.)	1502-0204-006
C135	250mfd, 16V, 85°C (Electrolytic)	1511-0251-002
C136	1000mfd, 16V, 85°C (Electrolytic)	1511-0102-002
C137	250 mfd, 10V, 85°C (Electrolytic)	1511-0251-001
	COILS	
L101	Choke, 820 uhy, 5%	1802-0000-001
L102	Choke, 820 uhy	1802-0000-002
L103	Quadrature Detector	1800-3151-700
T101	Input, 10.7 MHz IF AMP	1800-1250-700
T102	Output, 10.7 MHz IF AMP	1800-3168-300
	DIODES	
CR101	Silicon, Signal	4805-1241-200
CR102	Zener, 8.2V, 5%, 1W	4808-0000-009
	TRANSISTORS	
Q101	Silicon, NPN	4801-0000-010
Q102	Silicon, NPN	4801-0000-010
Q103	Silicon, PNP (White Top)	4801-0000-060
Q104	Silicon, NPN	4801-0000-010
Q105	Silicon, NPN	4801-0000-010
Q106	Silicon, NPN	4801-0000-010
Q107	Silicon, PNP, AF Driver	4801-0000-135
Q108	Silicon, PNP, AF Driver	4801-0000-135
Q109	Silicon NPN, AF Output	4802-0000-002
Q110	Silicon, NPN, AF Output	4802-0000-002
	INTEGRATED CIRCUITS	
IC101	IF Amplifier	3130-3167-901
IC102	IF Limiter / Detector	3130-3157-603
	CRYSTAL	
Y101	10.245 MHz (Standard)	2301-3151-601
Y101	11.155 MHz (Special)	2301-3151-602
	FILTER	
CF101	Ceramic, 455 KHz	2700-0000-007

5-3 TRANSMITTER BOARD 500-998 OR 501-058

Item No.	Description	Part No.
	RESISTORS	
R301	270 ohm, 10%, ¼W	4701-0271-042
R303	4.7 ohm, 10%, ¼W	4701-0479-042
R304	10 ohm, 10%, ¼W	4701-0100-042
R305	470 ohm, 10%, ¼W	4701-0471-042
R306	270 ohm, 10%, ¼W	4701-0271-042
R308	3.9K, 10%, ¼W	4701-0392-042
R310	10 ohm, 10%, ¼W	4701-0100-042
R311	39 ohm, 10%, ¼W	4701-0390-042
R312	27K, 10%, ¼W	4701-0273-042
R313	1K, 10%, ¼W	4701-0102-042
R314	18K, 10%, ¼W	4701-0183-042
R315	100 ohm, 10%, ¼W	4701-0101-042
R316	150 ohm, 10%, ¼W	4701-0151-042
R317	56K, 10%, ¼W	4701-0563-042
R318	3.9K, 10%, ¼W	4701-0392-042
R319	68K, 10%, ¼W	4701-0683-042
R320	100K, 10%, ¼W	4701-0104-042
R321	1.5K, 10%, ¼W	4701-0152-042
R322	27K, 10%, ¼W	4701-0273-042
R323	39K, 10%, ¼W	4701-0393-042
R324	180 ohm, 10%, ½W	4701-0181-044
R325	100K, 10%, ¼W	4701-0104-042
R326	100K, 10%, ¼W	4701-0104-042
R328	100 ohm, 10%, ¼W	4701-0101-042
R329	3.3 ohm, 5%, ¼W	4701-0339-042
R330	47 ohm, 10%, ¼W	4701-0470-042
R331	82 ohm, 10%, 1W	4701-0820-045
	CAPACITORS	
C301	20PF, 10%, NPO, 50V (Disc.)	1500-0200-650
C302	20PF, 10%, NPO, 50V (Disc.)	1500-0200-650
C303	4-60PF, Trimmer	1517-0000-002
C304	250PF, 350V (MICA)	1522-0251-001
C305	.05mfd, +80-20%, 25V (Disc.)	1502-0503-004
C306	10mfd, 20%, 25V (TANT)	1515-0100-005
C307	.05mfd, +80-20%, 12V (Disc.)	1502-0503-006
C308	2-18PF, Trimmer	1517-0000-001
C309	100PF, 5%, 50V (MICA)	1506-0101-550
C310	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C311	18PF, 10%, NPO, 50V (Disc.)	1500-0180-650
C312	39PF, 10%, NPO, 50V (Disc.)	1500-0390-650
C313	.001mfd, +80-20%, 50V (Disc.)	1503-0102-003
C314	.01mfd, +80-20%, 25V (Disc.)	1502-0103-004
C315	150PF, 5%, 50V (MICA)	1506-0151-550
C316	56PF, 5%, NPO, 50V (Disc.)	1524-0560-002
C317	.005mfd, +80-20%, 50V (Disc.)	1503-0502-005
C318	.005mfd, +80-20%, 50V, (Disc.)	1503-0502-005
C319	120PF, 5%, 50V (MICA)	1506-0121-550
C320	10mfd, 20%, 25V (TANT)	1515-0100-005
C322	180PF, 5%, 50V (MICA)	1506-0181-550
C323	390PF, 5%, 50V (MICA)	1506-0391-550
C324	.01mfd, +80-20%, 25V (Disc.)	1502-0103-004
C325	.05mfd, +80-20%, 12V (Disc.)	1502-0503-006
C326	220PF, 5%, 50V (MICA)	1506-0221-550
C327	75PF, 5%, NPO, 50V (Disc.)	1524-0750-002
C328	47PF, 5%, NPO, 50V (Disc.)	1524-0470-002
C329	4.7PF, 10%, NPO, 500V (Disc.)	1500-0479-905
C330	.1mfd, 20%, 12V (Disc.)	1502-0104-005
C331	100PF, 5%, 50V (MICA)	1506-0101-550
C332	270PF, 5%, 50V (MICA)	1506-0271-550
C334	36PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C335	2-18 PF, Trimmer	1517-0000-001
C336	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C337	2-18 PF, Trimmer	1517-0000-001
C338	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C339	2-18 PF, Trimmer	1517-0000-001
C340	36PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C341	2-18 PF, Trimmer	1517-0000-001
C342	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C343	2-18 PF, Trimmer	1517-0000-001
C344	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C345	2-18 PF, Trimmer	1517-0000-001
C346	36 PF, 5%, NPO. 50V (Disc.)	1524-0360-001
C347	2-18 PF, Trimmer	1517-0000-001
C348	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C349	2-18 PF, Trimmer	1517-0000-001
C350	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C351	2-18 PF, Trimmer	1517-0000-001
C352	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C353	2-18 PF, Trimmer	1517-0000-001
C354	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C355	2-18 PF, Trimmer	1517-0000-001
C356	36 PF, 5%, NPO, 50V (Disc.)	1524-0360-001
C357	2-18 PF, Trimmer	1517-0000-001
	COILS	
E301	Bead, Ferrite	2502-0000-001
E302	Bead, Ferrite	2502-0000-001
E303	Bead, Ferrite	2502-0000-001
E304	Bead, Ferrite	2502-0000-001
L301	Output, Antenna	1801-1275-600
L302	Output, Final	1801-1276-100
L303	Choke, RF Final (Collector)	1803-3189-800
L304	Choke, RF Final (Base)	1803-1245-900
L305	Input, RF Final	1801-1276-000
L306	Modulator, Phase (8 MHz)	1800-1275-500
T301	Bridge, VSWR	1800-1244-800
T302	Output, Driver	1800-1244-500
T303	Output, Pre-driver (144 MHz)	1800-3166-300
T304	Output, Doubler (72 MHz)	1800-3166-200
T305	Output, Tripler (24 (MHz)	1800-3166-100
	DIODES	
CR301	Silicon, Signal	4805-124 -200
CR302	Varactor, SMV1172	4809-0000-001
CR303	Varactor, SMV 1172	4809-0000-001
CR304	Zener, 8.2V, 5%, ½W	4808-0000-013
	TRANSISTORS	
Q301	Final, RF Power	4804-3169-501
Q302	Driver, RF Power	4804-3169-601
Q303	Pre-driver, RF Power	4804-3169-605
Q304	Silicon, NPN	4801-0000-010
Q305	Silicon, NPN	4801-0000-005
Q306	Silicon, NPN (Blue Top)	4801-0000-003
Q307	Silicon, NPN (Blue Top)	4801 0000-003
Q308	Silicon, NPN (Blue Top)	4801-0000-003

5-4 CHASSIS ASSEMBLY

Item No.	Description	Part No.
	ELECTRICAL COMPONENTS	
R1	5 K, Volume Control/Switch SW-1	4750-3211-201
R2	7.5 K, Squelch Control	4750-3211-202
C1	10 PF, 10%, NPO, 500V (Disc.)	1500-0100-605
C2	10 PF, 10%, NPO. 500V (Disc.)	1500-0100-605
C3	10 PF, 10%, NPO. 500V (Disc.)	1500-0100-605
C4	.05mfd, +80-20%, 25V (Disc.)	1501-0503-004
C5	100 mfd, 10V, 85°C (Electrolytic)	1511-0101-001
C6	.047 mfd, 10%, 100V (Mylar Film)	1508-0473-610
CR1	Diode, Silicon, Rectifier	4806-0000-004
M1	Lamp, Clear, 14.4 V	3901-0000-002
RY1	Relay, 3PDT, 12V (T/R)	4500-0000-004
SPK1	Speaker, 3.2 ohm, 4-inch, square (with mounting brackets)	7011-1069-700
SW2	Switch, Slide	5113-3220-701
SW201	Switch, PC Mount (Receive)	7011-1069-300
SW301	Switch, PC Mount (Transmit)	7011-1069-300
TB1	Terminal Board, 4-lug	2103-3007-914
Y200	Crystal, Receive (Specify Freq.)	2308-0000-000
Y300	Crystal, Transmit (Specify Freq.)	2318-0000-000
F1	Fuse, 4 AMP, 3AG	5106-0000-006
J1	Connector, Antenna (Chassis)	2105-0000-020
J2	Connector, Microphone (Chassis)	2101-0000-003
P1	Connector, Power (Chassis)	2104-0000-004
P2	Connector, Microphone (cable)	2104-0000-020
S1	Connector, Power (cable)	2108-0000-001
	Socket Pins, Crystal	2830-0000-004
	DC Power Cord Assembly	7011-1037-901
	Microphone, Ceramic (no connector)	1300-5080-902
	Microphone Assembly (with connector)	7011-1069-800
	MECHANICAL COMPONENTS	
	Detent, 12-position (Rotary Switch)	5105-1219-804
	Heat Sink, Driver Transistor	5400-0000-002
	Heat Sink, Final Transistor	5400-3211-800
	Bracket, Relay Mounting	1400-3211-100
	Bezel, Front Panel (Crome)	1405-5081-301
	Faceplate	2403-3209-100
	Knob, Channel Selector	2402-3178-801
	Knob, volume and squelch	2402-1276-201
	Dial Assembly (with bushing)	7011-1069-900
	Cabinet (wrap) Assembly	1408-6025-902
	Foot, Rubber	1402-0000-001
	Bracket, Mobile Mounting	1400-3143-100
	Bracket, Security (less lock)	1400-1241-500
	Hanger, Microphone	2830-0000-003
	Hardware Kit, Mounting (bolts, washers, Security Bracket, MIC Hanger)	7011-1070-000
	Manual, Owner's Instruction	7001-1046-700
	Manual, Service ($5.00 prepaid)	SM-10-467