Messenger 350 Service Manual

JOHNSON

MESSENGER 350

SINGLE SIDEBAND
CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-0154

SERVICE MANUAL

MESSENGER

350

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SECTION I
GENERAL INFORMATION

The Messenger "350", Model 242-154, is a compact, 2 channel Single Sideband (SSB) Citizens Band transceiver small enough to fit easily under the dashboard or another convenient location in any car, truck, or boat. The "350" may also be operated as a base station or a completely portable field unit. The accessory AC power supply, Model 239-0122 is used for base station operation; the Power Pack, Model 250-0855 is used for portable field operation.

The Messenger "350" features: greater "talk power"; all electronic switching to eliminate potentially troublesome relays; three simple to operate controls and four switches on the front panel to provide complete control of this versatile unit. The "350" has been completely tested and tuned at the factory. Retuning, except in extremely exceptional cases, will never be necessary when your radio is new. If performance is less than expected, it is advised to carefully check the antenna used and its installation before checking the "350". The antenna and installation should be checked frequently in any case.

The Messenger "350" is a single sideband transceiver which requires extremely close tolerance crystals (±.001% - the FCC requires only .005% crystals for the Citizens Radio Service). When changing or adding operating channels, use only the crystals listed in the Crystal Parts List. The Messenger "350" will operate properly only with the best quality .001% tolerance crystals. The transceiver should be retuned whenever operating channels are added or changed - see Section 4.1.

The Messenger "350" meets FCC and DOT frequency requirements at temperatures from -30° to +60° C (-20° to +140° F) when using Johnson approved crystals. To insure best performance and legal operation of this unit, use only Johnson approved crystals which meet rigid engineering specifications as well as all FCC requirements.

Transmitting with the Messenger "350" without a license is illegal. The operator must obtain a license if he does not already have one to operate the "350". Illegal operation can result in severe penalties. The Operating Manual for the Messenger "350" tells how and where a license can be obtained.

SECTION II
SPECIFICATIONS

2.1 GENERAL

Frequency Range	- 26.965 MHz; CB channels 1 - 23.
Channels	- Two Upper and Lower sidebands on each channel.
Dimensions of Enclosure	- 2 1/2" high x 8" wide x 9-1/2" long.
Unit weight	- 6 lbs.
Microphone	- High capacity (low impedance) ceramic element. Cycolac case. Push-to-talk switch, hang-up stud.

SPECIFICATIONS (cont'd)

Controls	- Squelch, Tune, Off-Volume, Mode-PA/TR, Sideband - L/U, Channel - A/B, Silencer - OFF/ON.
Switching	- All diode switching and no mechanical relays.
Circuitry	- 25 transistors, 25 diodes and 3 zener diodes.

2.2 RECEIVER

Sensitivity	- Typical 0.2 μV at antenna terminals for 10 dB S/N ratio.
Selectivity	- 2.7 kHz bandwidth at -6 dB.
Frequency Control	- ±.001% stability. Crystal temperature compensated over range of -30° C to +60° C.
Image Rejection	- Greater than 60 dB.
Antenna Impedance	- 50 ohms.
Audio Output Power	- Greater than 3 watts on receive and PA.
Speaker Impedance	- 3.2 ohms.
Squelch Range	- 0.3 μV to 30 μV.
Squelch Sensitivity	- 1 dB or less signal change for 60 dB of quieting.
Intermediate Frequency	- 8.75 MHz (crystal filter).
AGC Characteristics	- Output flat within 3 dB from 10 μV to 0.1 volt with 7 dB roll-off from 10 to 1 μV for superior noise quieting. Fast attack, slow delay audio operated.
Noise Limiting	- Series type IF noise silencer.
Receiver Type	- Superheterodyne, single conversion.

2.3 TRANSMITTER

Emission	- 3A3J (SSB).
Frequency Control	- ±.001% crystal. Temperature compensated from -30° C to +60° C.
RF Power Input	- 10 watts, PEP.
RF Power Output	- Typical 3.6 watts PEP.
RF Spurious and Harmonic Attenuation	- Better than 60 dB below PEP.
Unwanted sideband and carrier suppression	- Better than 40 dB below PEP.
Antenna Output Impedance	- 50 ohms.
Audio Input Impedance	- 1000 ohms.
Audio Frequency Response	- ±3 dB from 300 to 2800 Hz.
Modulation	- Single sideband suppressed carrier. Automatic level control prevents overmodulation.
Transmitter type	- Filter type SSB generation with single conversion, translation and amplification.

2.4 POWER REQUIREMENTS

Voltage Requirements	- 13.8 volts DC input.
Current Consumption	- Receive: 0.4 amps. Transmit: Less than 1 amp.
Circuit Protection	- 2 ampere fuse.

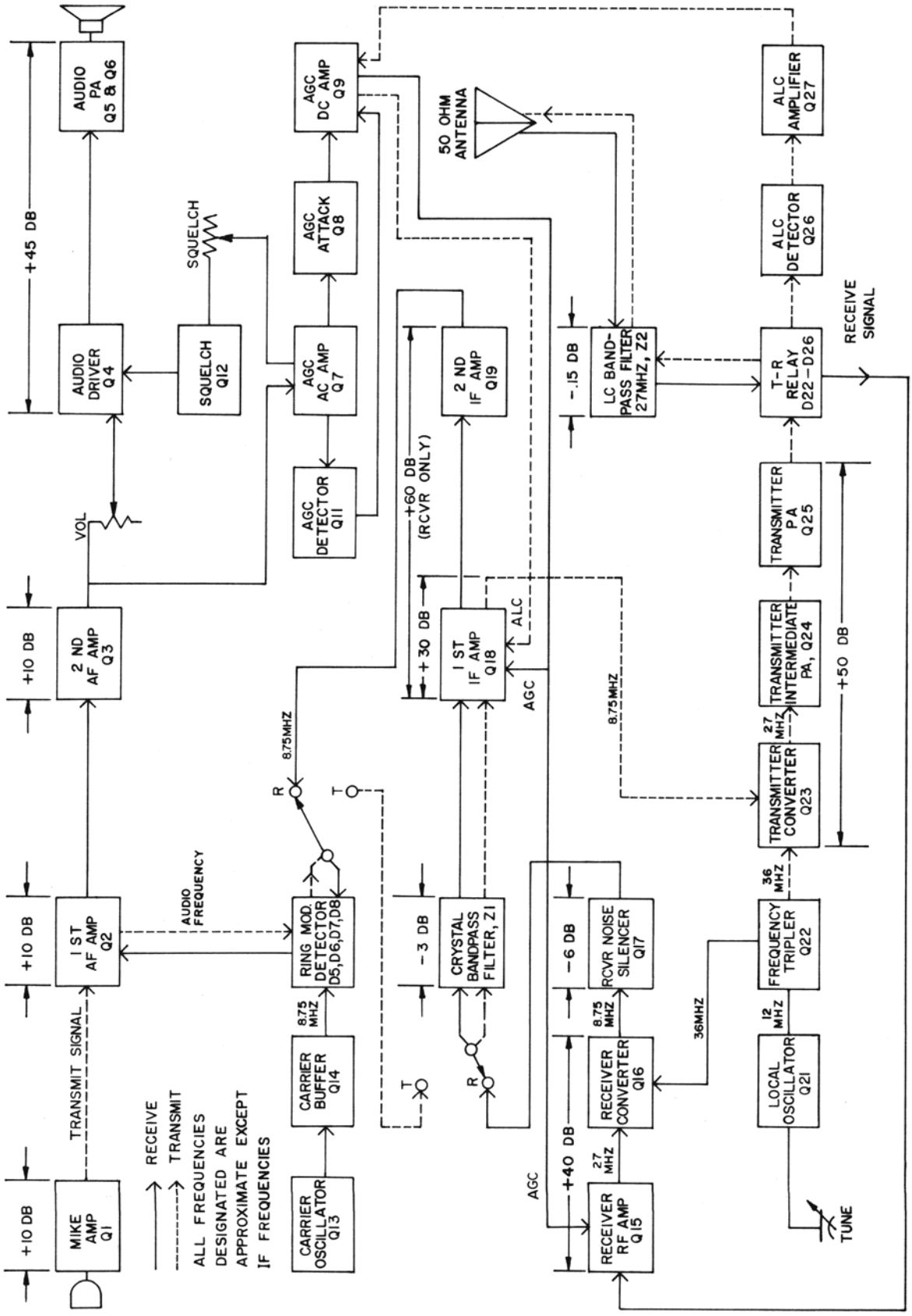

FIGURE 1
MESSENGER 350
BLOCK DIAGRAM

2.5 ACCESSORIES REQUIRED FOR VARIOUS OPERATING VOLTAGES

The Messenger "350" can be operated from any voltage or polarity from 6 VDC to 32 VDC, positive and negative ground, and from 115 VAC, when the suitable accessory is used.

Application	Accessory Needed	Catalog No.
12 VDC negative ground	No Accessory Needed	
115 VAC 60 Hz	"350" AC Power Supply	239-0122-001
12 VDC, nickel-cadmium rechargeable battery pack for hand-carried operation.	Power Pack	250-0855-001
24 to 32 VDC negative ground	Voltage Regulator	239-0119-002
24 to 32 VDC positive ground	Voltage Regulator and In-Converter	239-0119-001 239-0120-001
6 VDC positive or negative ground	In-Converter	239-0120-001
12 VDC positive ground	In-Converter	239-0120-001

SECTION III
THEORY OF OPERATION

The Messenger "350" is an SSB single conversion transceiver operating in the 11 meter Citizens Band. Most of the circuitry is not complex. However, some areas will require study to understand the theory involved. These more difficult circuits will be discussed in detail in this section. The following circuitry characteristics should be noted before attempting maintenance on the Messenger "350".

In the microphone PTT switch, voltages are connected to the transmit or receive B+ lines. Receive B+ (RB+) is ON and the transmit B+ (TB+) is OFF and shorted to ground when the microphone bar is not depressed and the unit is in the receive condition. While the bar is depressed in the transmit contition, the TB+ lines will be ON and the RB+ lines will be OFF and shorted to ground.

This technique enables the circuit used only for transmit or receive to be turned on only when in use. In addition to this, another B+ line (BB+) is on all of the time if the volume switch is on. The circuits connected to the BB+ line therefore are on in both conditions. This might be a useful clue in following the operation of the Messenger "350". Inasmuch as the RB+ or TB+ lines are either ON or OFF, a useful operating voltage and impedance can be used to control the switching diodes. When following the signal, it will be noted that diodes such as D9, D13, D15, D16, D20, and D22 will either pass or block a signal depending on the biasing of the diode. Other diodes will only block a signal by shunting it to ground impedance.

3.1 RECEIVER CIRCUITS

While studying the theory of operation, it may be desirable to refer to the block diagram, Figure 1, for a better understanding of the circuitry involved.

3.1.1 27 MHz FILTER

The incoming signal is picked up by the antenna and fed into the 27 MHz filter, Z2. This filter is located adjacent to the antenna plug on the corner of the wrap around. Z2 is a low-pass filter connected in series with a high-pass filter which results in a bandpass filter. This bandpass filter characterizes a low insertion loss and good rejection of receiver and transmitter images, harmonics and other spuriouses. Spurious and harmonic frequencies generated during transmitting at full power will be at least 60 dB below Peak Envelop Power (PEP) over all of the TV channels. The FCC requirement at present is 50 dB below PEP.

3.1.2 DIODE SWITCHING

The filtered signal is then received by the T-R Relay which sends the signal to the Receiver RF Amplifier. The T-R Relay operates only by diode switching of the diodes D23, D24, D25, and D26. No mechanical relays are used in the Messenger "350". Instead, all signal-path switching is done with silicon diodes. This is based on the theory that a forward biased diode will act as a low impedance path and a reverse biased diode acts as a high impedance path, therefore, a network of diodes can be constructed to be used as a diode relay.

On receive, D22 disconnects Q25 from the antenna since TB+ is grounded, thus leaving the forward-bias voltage of the silicon diode, D22, less than .7 volts. A silicon diode has a very high resistive impedance at forward biasing voltages less than .7 volts, thus acting as an open circuit.

3.1.3 LOCAL OSCILLATOR

A receive signal is amplified at Q15 after being adjusted by the AGC. So far the receive signal still has a frequency of approximately 27 MHz. The receive frequency converter has inputs of 27 MHz from the RF Amplifier and 36 MHz from the local oscillator and frequency Tripler.

In the Messenger "350", high side local oscillator injection is used at the transmit and receive converters. The injected frequency is about 36 MHz. Since either sideband reception and transmission is desirable with only one passband filter in use, it is necessary to shift the injection frequency 3 kHz when changing sidebands. To establish a crystal controlled 3 kHz shift at 36 MHz proves to be difficult. For this reason, the Messenger "350" local oscillator, Q4, and crystals generate a 12 MHz frequency and shift only 1 kHz. This signal is then tripled by Q22 and filtered by T6 before it is applied to the converters. Capacitors C79, C81, C82, and C84 enable the local oscillator to be adjusted precisely on frequency independently on each channel and each sideband. C77 is an incremental tuning control and is located in the center of the front panel.

3.1.4 NOISE SILENCER

The 8.75 MHz signal passes through the noise silencer to the crystal bandpass filter. The Messenger "350" noise silencer operates by disconnecting the input of the crystal filter each time there is a noise pulse. This switching is done by diode, D17, which is driven by the noise amplifier, Q17. Noise voltage is obtained by a detector circuit at the collector of the receive mixer, Q16. Strong signals that are in the passband of the receiver, RF and mixer stages can cause the noise silencer to become less effective. Extremely strong signals (thousands of microvolts) may interfere with the derived signal due to mixing at D17. This effect can be reduced by switching the noise silencer to OFF, thus increasing the forward bias of D17 making it a better conductor but a poorer switch.

3.1.5 IF AMPLIFIER

The crystal bandpass filter receives the signal from the noise silencer. Here the crystal filter selects the designated channel and sideband frequency to pass on to the IF amplifier stages, while the undesirable signals are filtered out by the crystal filter. The switch for the lower and upper sidebands for the Messenger "350" is located on the front panel for convenient operation during communication. The selected signal is now

passed to the two IF amplifiers for an increase in gain. The gain of the signal is regulated by the AGC which will be discussed later on in the AGC section.

3.1.6 CARRIER OSCILLATOR AND RING MODULATOR DETECTOR

The ring modulator detector receives signals from the IF amplifier Q19, and the carrier oscillator, Q13. The signal from the IF amplifier is very selective and has acquired the required level. The signal from the carrier oscillator consists of a basic carrier frequency of 8.75 MHz ±1.5 kHz. The carrier buffer, Q14, prevents any strong signals received from the IF stages from changing the frequency of the carrier oscillator. The buffer, however, does not effect the carrier oscillator frequency or level. The buffer is coupled to the ring modulator detector by C43 through which the carrier signal passes to "beat" with the IF signal. The resulting signal is the audio signal which is then sent to the audio stage.

The ring modulator detector consists of four diodes D5, D6, D7, and D8 which are arranged so that it will work for transmitting and receiving, in conjunction with the first audio amplifier. In receive conditions the ring modulator detector acts as a detector, and in transmit it acts as a modulator.

3.1.7 AF CIRCUITS

The audio signal is fed into the emitter of Q2, the first audio amplifier, where it is amplified. The signal receives further amplification at the second audio amplifier, Q3. The amplified signal is then fed through the volume control and coupled to the audio driver, Q4, for still further amplification to feed the bases of the push-pull output stage, Q5 and Q6.

The driver transformer, T8, provides the proper impedance match between the collector of the driver transistor and the bases of the push-pull stage. The output of the push-pull amplifier is then fed directly to the speaker and the external speaker jack.

3.1.8 AGC CIRCUIT

Perhaps one of the most significant differences between AM and SBB receivers is the AGC requirements. Since it is desirable that no manual RF gain control be required, the demands of AGC are severe. The AGC must be able to attack in 10 ms or less, and then sustain that established gain for 200 ms or longer if smooth sounding audio is to result.

Referring to the schematic, note that the AGC voltage comes from the audio as does the squelch voltage. These voltages are amplified by Q7, and applied to the AGC amplifier and to the squelch stage, respectively. One of the AGC detectors, called the attack amplifier (Q8), serves to detect the presence of a signal and cut down the voltage on C26 (56 μF) to a level that will reduce the input signal to the desired level. By reducing the voltage on C26, the forward bias current is reduced on Q18 (1st IF amplifier), thus reducing the gain. The receiver RF amplifier gain is then reduced by the AGC current from the first IF amplifier because of the decrease in its gain. Also, whenever there is adequate signal, the release AGC detector (Q11) is turned on due to audio signal rectification at the emitter-base junction. This prevents C26 from charging until the signal level is reduced or removed, thus Q11 will stop conducting allowing C25 (100 μF) to charge through R41 (22 K), thus restoring the voltage in C26 (56 μF) via diode, D3. Thus, the attack time of the AGC is determined by C26 (56 μF) shorted by the saturation resistance of Q8 and the release time is determined by C26 (56 μF) +C25 (100 μF)= 156 μF and R41 = 22 K. The Messenger "350" has sufficient AGC to provide less than 3 dB change in the audio output from 10 μV to 100 μV.

3.1.9 SQUELCH CIRCUIT

Since no carrier is transmitted with SSB reception, there is no tell-tale signal or AGC voltage present while someone depresses the microphone bar on another Messenger "350". The squelch voltage must be derived by the audio signal either directly or indirectly. The Messenger "350" derives a squelch control voltage directly from the audio that is present on the high side of the volume control.

A stage of audio amplification, Q7, is used from the high side of the volume control to the squelch detector diodes, D4 and D10. This stage also drives the AGC detector circuit. Since the squelch transistor, Q12, controls the base current of the audio driver, Q4, feedback is employed between the emitters of Q12 and Q4. The feedback is connected via a 560 ohm resistor, R46. The feedback causes the squelch to be either in the ON or OFF condition by allowing a certain amount of hysteresis in the squelch control voltage.

Because the squelch is controlled by the audio, time constants must be long or else the squelch will flutter on and off when receiving an audio signal. As a result, the squelch control must be adjusted very slowly to reduce the possibility of allowing the squelch sensitivity to become too low.

3.2 TRANSMITTER CIRCUITS

3.2.1 AF CIRCUITS

The audio signal from the microphone during transmission is coupled to the base of Q1, the mike amplifier. The audio signal is amplified by Q1 and the first audio amplifier, Q2, and coupled to the ring modulator detector through C9 and L2.

3.2.2 CARRIER OSCILLATOR AND RING MODULATOR DETECTOR

As described in the Receiver Circuits, Section 3.1.6, the carrier oscillator injects a carrier frequency of 8.75 MHz ±1.5 kHz into the ring modulator circuit. For transmitting, the carrier frequency is protected against extremely strong audio signals from the microphone through the use of the carrier buffer. The audio signal and the carrier signal are mixed at the ring modulator detector to yield a combination signal containing both the upper and lower sideband frequencies together with the carrier frequency which has been nulled down by the ring modulator. Thus the carrier signal will be so small that it will no longer be detectable. The signal now passes to the crystal filter where the desired sideband is passed and the undesired sideband with any spuriouses are filtered out. At the first IF amplifier the single sideband (SSB) signal is amplified to a level of +30 dB above the previous level and still has a frequency of approximately 8.75 MHz.

3.2.3 TRANSMITTER FINAL STAGES

Q23 serves as the transmit frequency converter. The SSB signals at about 8.75 MHz from the first IF amplifier, 36 MHz, depending upon absolute frequency, is also injected into the base of Q23 via D19. The local oscillator works the same for transmitting conditions as for receiving conditions; therefore, the theory of operation is found in the Receiver Circuits section 3.1.3. Diode, D19, serves to disconnect the injection from the base of Q23 during receive conditions, thus reducing receive spurious responses. At Q23, the two injected signals are allowed to "beat" and supply a frequency of approximately 27 MHz to the base of the transmitting intermediate PA, Q24. Some selectivity in the 27 MHz band is provided by C98 and L5 which couples Q23 to Q24. The intermediate power amplifier, Q24, drives the final RF power amplifier, Q25.

The network following Q25 matches the antenna impedance to the collector of Q25 and also provides a tap-off point for the automatic level control (ALC) detector diodes D23 and D24. The voltage generated by the ALC detector diodes is applied to reverse-bias D25, which disconnects the antenna from the receiver during transmit. D22 acts to connect the transmitter to the antenna during transmit because Q25 collector current must pass through D22 in a forward direction.

3.2.4 ALC CIRCUITS

The transmitter ALC circuits are capable of protecting the final PA transistor under various VSWR conditions. The ALC will act to reduce the power input according to the VSWR, so it is important to have a VSWR that is as low as possible if maximum range is desirable. Voltage from the ALC detector diode is applied to Q26 and Q27, which establishes the threshold point and amplifies the ALC, which is then applied to the AGC circuit. The gain of Q18, the 1st IF amplifier, is then adjusted by the forward bias applied by the AGC final amplifier.

SECTION IV
MAINTENANCE

4.1 CRYSTAL INSTALLATION

The Messenger "350" covers all 23 channels of the Class D Citizens Radio Service. Two crystals, which function on both transmit and receive on the channel specified, are included with the radio. Additional crystals may be ordered by referring to the PARTS LIST under CRYSTALS of this manual. When changing crystals, the oscillator should be re-aligned, which requires special equipment and should be done ONLY by an Authorized E. F. Johnson Co. Service Center, or properly licensed (2nd or 1st class radio telephone license required by FCC) and adequately equipped servicemen.

a. Remove cabinet by unscrewing 4 #6 flathead screws on the rear of chassis, and slide unit through the front of the cabinet. Be sure the 1/4 inch mounting bolts are not binding against the sides of the unit.

b. Crystal locations are marked "A" and "B", corresponding to positions "A" and "B" of the CHANNEL switch, so install the new crystal in the appropriate holder.

c. If no frequency standard is available, no alignment is possible. Therefore, install the unit in the cabinet. Adjustment of the TUNE control will be necessary when changing channels or sidebands.

d. If a frequency standard is available, proceed as follows:

e. Connect a 12 to 14 volt DC source, with a capability of at least 1 amp, to unit, via power cable (use a Messenger 350 AC supply if available). Connect a 50 ohm resistive load to Antenna Connector.

f. Select the best frequency standard available. Some of the following are suggested:

- Frequency counter.
- Short-wave receiver with crystal calibrator, adjusted for proper channel frequency as indicated in crystal parts list.
- Frequency meter, calibrated to proper channel frequency as indicated in crystal parts list.
- Another Messenger 350 that has the desired frequency crystals installed, and has been checked on a known frequency standard.

g. Adjust the controls as follows:

- OFF VOL: turn unit ON.
- SQUELCH: fully counter-clockwise.
- TUNE: in center on range.
- MODE: in TR position.
- SIDEBAND: L(Lower) position.
- CHANNEL: in position corresponding to new crystal.
- SILENCER: either position.

h. Connect the frequency standard, by an appropriate means, to the unit (a coupling pick up loop, pickup antenna, coupling attenuator, etc).

i. Adjust the BAL-C capacitor to one extreme, so there will be RF output when keying the microphone. Key microphone and adjust the appropriate frequency trimming capacitor for the proper frequency. Consult the crystal parts list.

Channel	Adjustment
A	AL Lower sideband (C79)
B	BL Lower sideband (C81)

j. Change sideband switch to U (upper) position and adjust the appropriate frequency trimming capacitor for the proper frequency. Again consult the crystal parts list.

Channels	Adjustment
A	AU Upper (C82)
B	BU Upper (C84)

k. Return the BAL-R control to its original position.

l. By using some kind of output indicating device, such as the following, carefully adjust the BAL-R control for minimum output.

- S-meter on a receiver.
- Wattmeter.
- Field strength meter.

m. Disconnect all cables and leads. Install unit in cabinet.

4.2 INSTALLATION

4.2.1 ANTENNAS

The Messenger "350" is designed to operate with a 50 ohm CB antenna. The results obtained with your Messenger "350" will be determined to a large part by the antenna system used. After installation of the antenna, its VSWR (Voltage Standing Wave Ratio) should be checked before use. It is recommended that the VSWR be monitored on a regular and frequent basis.

A VSWR bridge, coupler, or its equivalent should be used to measure the degree of mismatch of VSWR, between the antenna and Messenger "350". For best performance and range, this ratio should be 1.5:1 or less. If it is not, the antenna should be tuned to the lowest VSWR by adjusting the length of the antenna or by use of the Johnson CB Matchbox, Model 250-0049. The Matchbox is specifically designed for use on the citizens band frequencies, and will reduce any VSWR of 5:1 to 1.2:1 or less. When measuring the VSWR, it is necessary to whistle into the microphone so a transmitting signal will be generated. Since the Messenger "350" incorporates ALC, the level and pitch of the whistle is not critical, as long as the microphone is held close enough.

The Messenger "350" incorporates a noise silencer, therefore it may be found desirable to use an ordinary quarter-wave whip antenna on mobile installations rather than a loading coil type antenna. This is because the noise silencer works best with a relatively wide-band antenna. Loading coil type antennas most often are quite selective.

For the base station model, the antenna should be mounted as high as possible, but not more than 20 feet above the highest point of the existing building upon which it is mounted (according to FCC rules).

The location of mobile antennas used on autos, trucks, and boats will be determined largely by the type and length of antenna used. If a regular 102 inch whip antenna is used, the normal location is on the left rear fender or body. If you are using a base or top loaded mobile antenna, the short length of this type permits roof top or trunk deck mounting. The largest consideration for location, aside from efficiency, will be placing the antenna so that it can be easily bent over and clamped down, or be short enough to clear obstructions such as garage doors, low hanging tree limbs, etc.

4.2.2 MOBILE

CAUTION: The SSB Messenger "350" is wired at the factory for use in NEGATIVE grounded vehicles only. In vehicles with POSITIVE ground, such as some boats and imported cars, it will be necessary to use the F. F. Johnson In-Converter, Part No. 239-0120-001.

The Messenger "350" is supplied with a mounting bracket and all hardware necessary for installation. Mount the bracket in a place for convenient operation with two screws which are supplied. The Messenger can then be mounted in the bracket with two 1/4 inch cap screws and lock washers. Connect the red power lead and plug into the jack at the rear of the "350". The "U" shaped spade lug can then be connected to the ignition switch accessory terminal or another convenient voltage point. The chassis must be grounded to the vehicle if the Messenger "350" is mounted on a nonmetalic dash panel. Complete the installation by connecting the lead-in from a properly installed 50 ohm CB antenna.

SECTION V
TROUBLE SHOOTING

5.1 RECEIVER CIRCUITS

5.1.1 EQUIPMENT REQUIRED

Power Supply	- Messenger 350 Power Supply Cat. No. 239-0122-001 Power Designs 3240 or equivalent.
Oscilloscope	- Low Frequency for checking audio circuits.
VTVM	- General Purpose VTVM with RF probe, Heath V-7 or equivalent.
RF Generator	- Hewlett - Packard Model 608 or equivalent with 6 dB pad on output. See Figure 4.
Audio Generator	- Heath IG-72 or equivalent.
Current Meter	- 0-1 Ampere.
Noise Generator	- See Figure 4.

5 1 2 PRELIMINARY RECEIVER CHECKS

Connect the equipment as shown in Figure 2, 3, 4, and 5 to perform the following check.

1. Adjust power supply for 13.8 V at the transceiver terminals.
2. Set receiver VOLUME to maximum position (CW); TUNE to midway position; squelch to minimum (maximum CCW) position; MODE switched to TR; SILENCER off, SIDEBAND and CHANNEL switches to desired position.
3. Set the RF Generator on the channel and adjust its frequency for about a 1 kHz tone. Set the RF level to 1 μV.
4. The AC-VTVM across the speaker should read not less than 0 dB (.78 volts RMS).
5. Maximum input current drain should not be more than 0.3 amps with volume at minimum. Current increases with increased audio ouput.

NOTE: If the above conditions are not obtained, continue with the Trouble Shooting procedure of the section in question. The first check should be visual, then check voltages as indicated on the schematic. Proper transistor voltages generally indicate good transistors.

5.1.3 AUDIO CHECK

1. Connect the VTVM across the speaker terminals or a 3.2 Ω, 7 watt dummy load in place of the speaker. A dummy load can easily be connected using the external speaker jack.
2. Connect the Audio Generator to the base of Q1 via a 1 μF capacitor. This point is easily identified as the place where the white mike wire connects to the board.
3. Adjust the output of the generator for -50 dB, (.0025 volts RMS) at 600 Hz.
4. Set the MODE switch to PA position.
5. Set the VOLUME to the maximum CW position.
6. Key the microphone, the output should be +5 dB (1.4 volts RMS) ±5 dB (±.78-2.5 volts RMS).
7. If the output is below normal or is distorted as viewed on the scope, check the voltages and circuits of Q1 - Q6.

NOTE: A defect in Q1 and its circuit would not affect receive operation, but would affect transmit and PA operation.

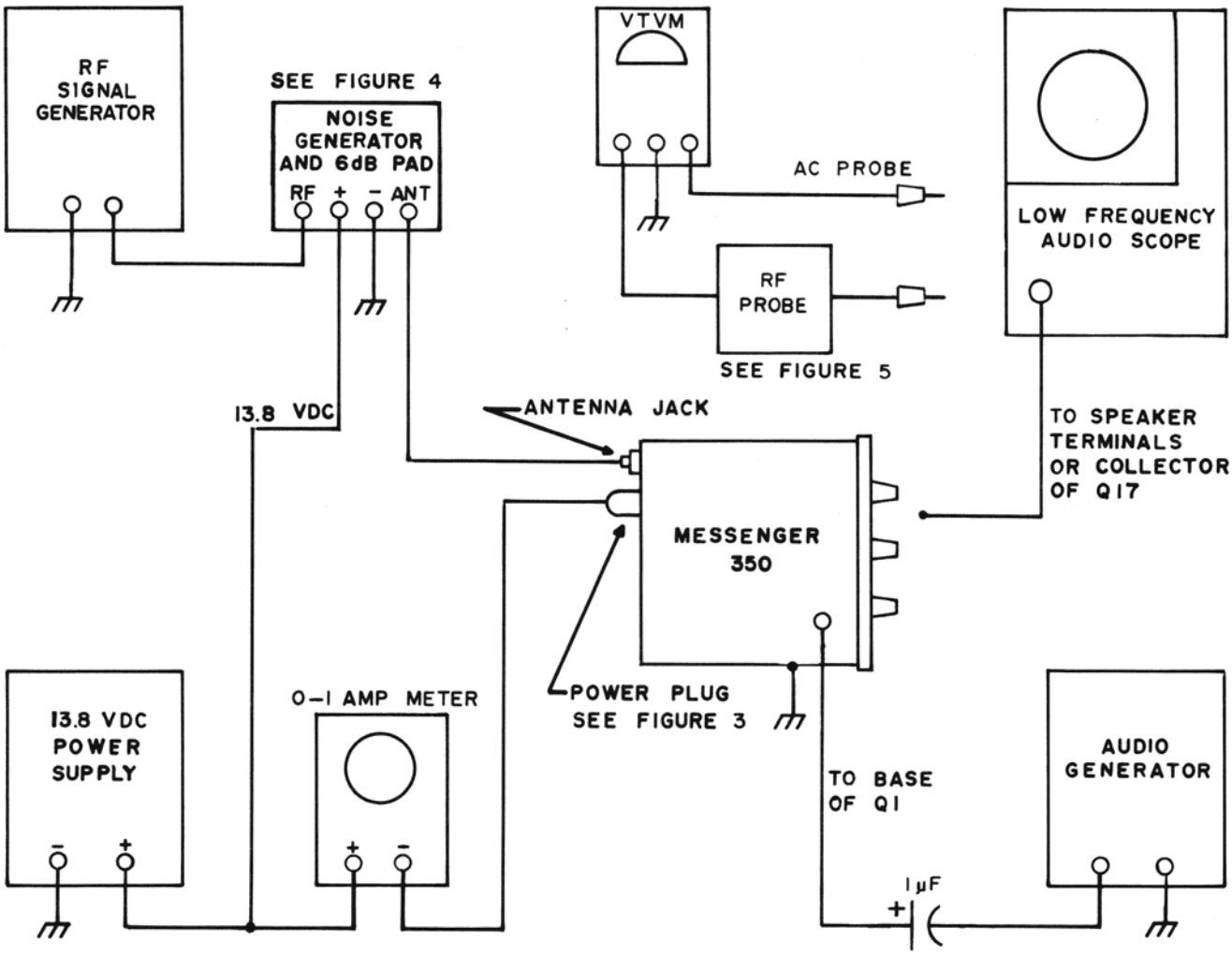

FIGURE 2

RECEIVER TEST
CONNECTIONS

5.1.4 SQUELCH

1. Set MODE switch to TR.

2. Set SIDEBAND switch to USB.

3. Adjust generator for about a 1 kHz note on USB.

4. Switch to LSB and adjust the SQUELCH control to quiet, then change back to USB and the squelch should open.

The SQUELCH, when set to quiet at 1 μV input from the generator, should open with less than 1.5 μV.

If these conditions are not met, check the voltages and circuitry of the squelch transistor Q12. Squelch control voltage is obtained from the audio circuit through the AGC AC amplifier. Difficulty in these circuits could also affect the squelch.

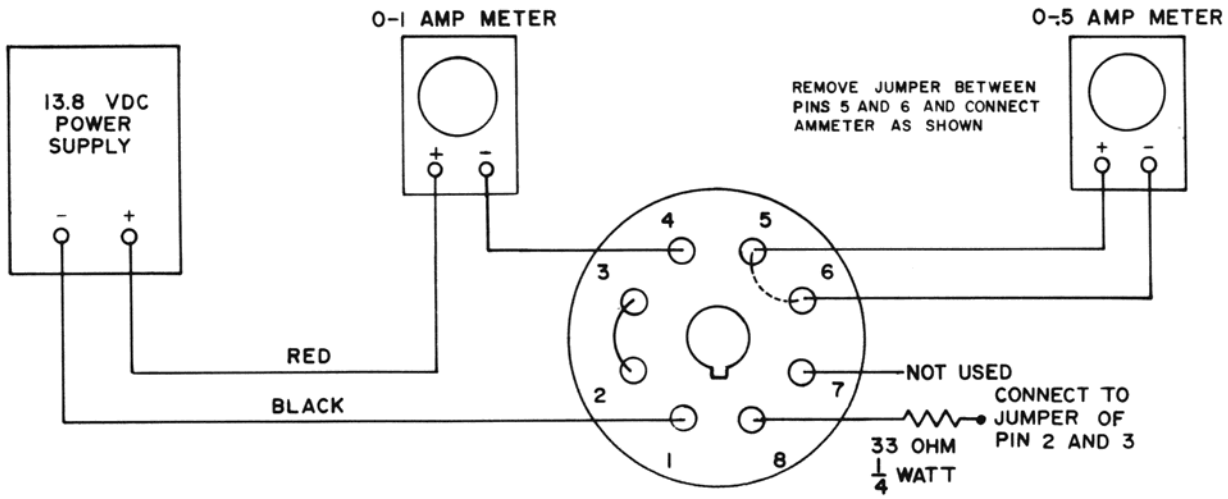

FIGURE 3
TEST POWER CABLE CONNECTION

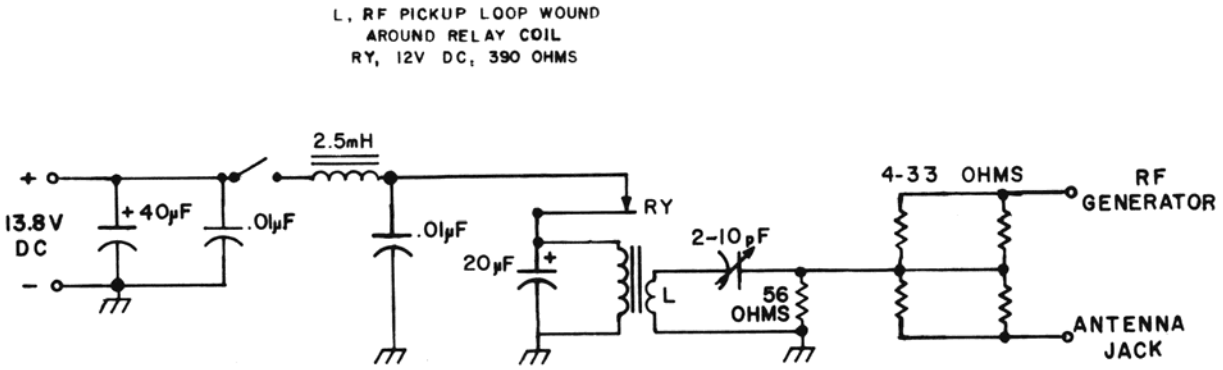

FIGURE 4

NOISE GENERATOR WITH 6dB PAD

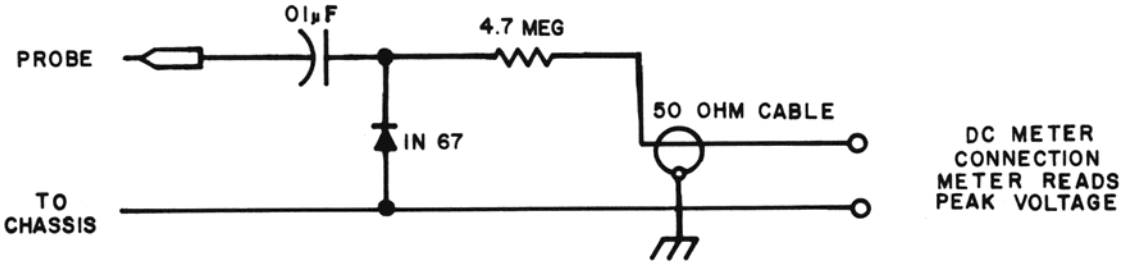

FIGURE 5

RF PROBE FOR METERS
WITH 11 MEGOHM INPUT