JOHNSON

MESSENGER

123

CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-123

Second Printing
Covers A-G Models
January, 1975

SERVICE MANUAL

MESSENGER

123

CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-123

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SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual includes servicing and alignment instructions for the Messenger 123 Transceiver.

Revision notices will be published as this unit is revised. Insert these notices in order at the back of this service manual.

1.2 FACTORY CUSTOMER SERVICE

A liaison between the customer and the factory is provided by the E. F. Johnson Company Customer Service Department. This department is available for consultation and assistance on technical problems, parts information, and availability of local and factory repair facilities.

If it is necessary to write to the Customer Service Department, please include any information you feel will help solve your problem.

For any of the above requirements contact:

E. F. JOHNSON COMPANY
Customer Service Department
Waseca, Minnesota 56093

1.3 FACTORY RETURNS

Normally, repair service is available locally through authorized Johnson Citizens Band Radio Service Centers; a list of these service centers is available upon request from the factory Customer Service Department. Do not return any equipment to the factory without authorization from the Customer Service Department.

1.4 PURCHASE OF PARTS

The authorized Johnson Service Centers stock commonly needed replacement parts. If a part is not available locally it may be ordered from the Customer Service Department. When ordering please supply the following information:

Model number of the unit
Serial number of the unit
Description of the part
Part number of the part

1.5 DESCRIPTION

The Messenger 123 is a 23 channel Citizens Band transceiver. A 14 crystal, 23 channel solid state frequency synthesizer generates either the transmitter frequency or the mixing frequency for the receiver mixer. The synthesizer outputs are electronically switched between transmit and receive by diodes.

Supply voltage to operate the transceiver is provided by the vehicle battery in mobile operation or by the base station power supply, Model 239-125-1, in base operation.

1.6 SERIAL NUMBER INTERPRETATION

The E. F. Johnson Company utilizes a white adhesive-backed cloth printed with the unit serial number and attached to the back of the transceiver chassis rail. Each serial number contains an alphabetical designator which indicates a major revision. For example: An A in the serial number indicates that the unit includes all the changes specified in revision A. Units with a major revision are referred to by their alphabetical designator in this manual. A unit with revision A is called an A model, with revision B a B model, etc.

SECTION 2
SPECIFICATIONS

Electrical specifications are nominal unless otherwise stated.

2.1 GENERAL

Frequency Range	26.965 - 27.255 MHz
Channels	23
Dimensions of Enclosure	2 1/2" high x 6 3/16" wide x 8 3/4" deep
Unit Weight	Approximately 5 lbs.
Shipping Weight	Approximately 6 lbs.
Metering	S meter and Relative RF Output
Microphone	High capacity ceramic element. Cycolac case. Push-to-talk switch, hang-up stud.
Circuitry	17 transistors, 13 diodes
Compliance	FCC Type Accepted Rule 95 (D) DOT Type Approved RSS 136

2.2 RECEIVER

Sensitivity	10 dB (S + N)/N ratio with 0.5 microvolts at the antenna terminal (30% modulation at 1000 Hz).
Selectivity	6 kHz bandwidth at -6 dB 30 kHz bandwidth at -60 dB
Frequency Control	±0.005% crystal from -30° C to +50° C
Spurious Rejection	47 dB except image of 18 dB
Antenna Impedance	50 ohms
Audio Output Power	3 watts at 10% distortion
Squelch Range	0.3 to 15 microvolts at the antenna terminal
Squelch Sensitivity	1 dB or less signal change for 40 dB of quieting at 1 microvolt at the antenna terminal.
Squelch Noise Immunity	Highly immune to impulse-type noise.
Intermediate Frequencies	455 kHz
AGC Characteristics	Flat within ±6 dB from 250,000 to 5 microvolts at the antenna terminal with 18 dB rolloff from 5 to 0.5 microvolts for superior noise quieting.
Noise Limiting	Series-type, automatic threshold adjustment and IF clipping.
Circuitry	All transistor single conversion.

2.3 TRANSMITTER

Emission	6A3
Frequency Control	±0.005% crystal from -30° C to +50° C
DC Power Input	5 watts maximum at 13.8 VDC
RF Power Output	3.5 watts at 13.8 VDC
RF Spurious and Harmonic Attenuation	Better than FCC and DOT requirements.
Output Impedance	50 ohms
Audio Input Impedance	1000 ohms
Audio Frequency Response	±4 dB 400-3000 Hz
Modulation	High level AM, class B modulator, speech compression, clipping and audio filtering.
Circuitry	All transistor solid state.

2.4 POWER SOURCE REQUIRED

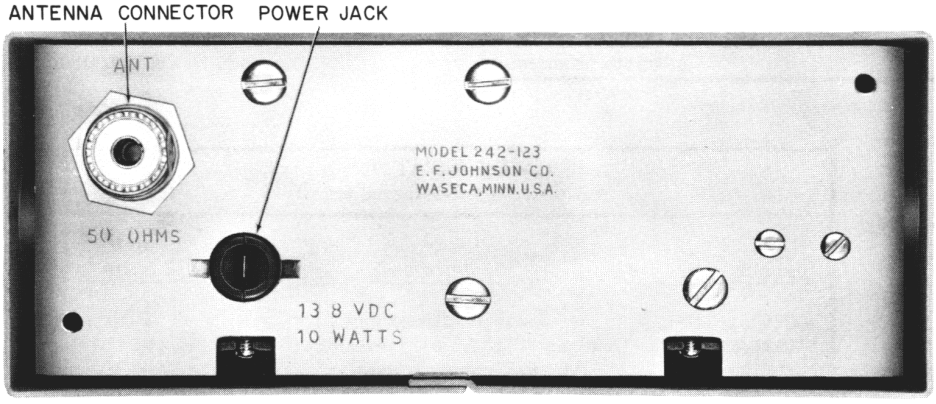
13.8 volts DC input
Receive: Squelched .35 ampere
Transmit: .85 ampere

2.5 117 VOLT POWER SUPPLY

117 volt AC, 50-60 Hz. Input with Model 239-125-1 AC Power Supply. 39 watts maximum. Dimensions: 2 1/2" high x 6" wide x 8" deep. Weight: 2 1/2 lbs.

Circuit Protection	0.3 ampere fuse

FRONT VIEW
FIGURE 2-1



REAR VIEW
FIGURE 2-2

2.6 ACCESSORIES

250-845-2	Power Pack
239-120-1	Inconverter
250-49-1	Matchbox, C.B.
250-849-1	Antenna Meter
250-826-1	Ni-Cad Rechargeable Battery
137-828-1	4 ft. fiberglass antenna - 27 MHz
250-1801-1	Car Noise Suppressor Kit
142-1801-5	100 ft. coaxial cable
142-1801-4	50 ft. coaxial cable
239-125-1	117 VAC Power Supply

The E. F. Johnson Company reserves the right to change prices or specifications without notice and without incurring obligation.

2.7 SPECIFICATIONS (MINIMUM PERFORMANCE)

The specifications listed in this section are absolute service minimums. Receiver RF input values are given at the antenna terminal and are typically 1/2 the level into a 6 dB pad.

2.7.1 RECEIVER

Sensitivity	7 dB minimum at 1.0 microvolt
Audio Output Power	0.09 watts minimum at 0.5 microvolts
Squelch Range	15 microvolts minimum
AGC Characteristics	20 ±10 dB rolloff from 500 to 0.5 microvolts

2.7.1 TRANSMITTER

RF Power Output	2.8 watts minimum and 4.0 watts maximum at 13.8 VDC
Modulation	70% minimum upward

SECTION 3
INSTALLATION

3.1 VEHICLE INSTALLATION

3.1.1 Antenna

A good antenna installation is essential for satisfactory transceiver performance. Consider the easiest route for the transmission line when selecting the antenna location. A level unobstructed area, such as the roof, will generally provide the best ground plane. The trunk area can also be used. Avoid the hood area for antenna mounting.

3.1.2 Transceiver

Mount the transceiver with best maintenance accessability and operating convenience in mind. The dash mounting bracket necessary for vehicle installation is supplied with the transceiver. Refer to the instructions in section 3.4 when installing the dash mounting bracket.

3.1.3 Items Supplied for Installation and Operation

Check the items listed in Table 3-1 against the items supplied with the transceiver to insure that the necessary items are on hand for installation and operation.

3.1.4 Special Tools Required

The following tools should be on hand when installing the transceiver.

center punch

1/4" electric drill

No. 43 drill (0.089 inch diameter) for drilling starter holes for the No. 4 self-tapping sheet metal screws used to mount the microphone hanger if the holes provided in the cabinet shell are not used.

No. 21 drill (0.159 inch diameter) for drilling holes for the No. 10 transceiver mounting bracket screws.

TABLE 3-2
Items Supplied for Operation

	Part Number
Operating Manual	002-0071-001
Part 95 - FCC Rules	022-1635-001
FCC Form 505	022-1636-001
License application form	
Transmitter identification card	564-1001-001
Warranty registration card	041-0419-014
Schematic diagram	564-3001-123

TABLE 3-1
Items Supplied for Installation

Item in Figure 3-1	Qty.	Description	Part Number
1	1	Dash Mounting Bracket	017-1363-001
2	2	Screws, 1/4-20 (3/8" hex head) for dash mounting bracket.	011-0322-012
3	2	Cushion washers for dash mounting bracket.	018-0822-001
4	2	Screws, 10-32 x 5/8, for dash mounting bracket.	011-0229-020
5	2	Lockwashers, No. 10, for dash mounting bracket.	029-0001-003
6	2	Nuts, No. 10, for dash mounting bracket.	012-0109-002
7	1	Microphone hanger	537-9004-002
8	2	Screws, No. 4 self-tapping, for microphone hanger.	011-0807-006
9	1	Tap connector for connecting power lead from transceiver to ignition switch.	023-2209-001
10		Power cable	023-1652-001

3.2 POWER CABLE INSTALLATION

CAUTION

The Messenger 123 is wired for negative ground operation at the factory. Serious damage will result if it is installed in a positive ground vehicle without first performing the modification outlined in Section 3-9. If desired, an E. F. Johnson Inconverter, Model 239-120, can be substituted for the positive ground modification.

a. Connect the cable to the accessory terminal of the vehicle ignition switch or to another 12 VDC source using the tap connector illustrated in Figure 3-2. Installation instructions are on the front of the tap connector package.

b. The power cable does not contain a ground lead. The ground is obtained through the outer connector of the transmission line or the dash mounting bracket.

3.3 ANTENNA INSTALLATION

a. Refer to the instructions included with the antenna for installation details.

b. Route the transmission line.

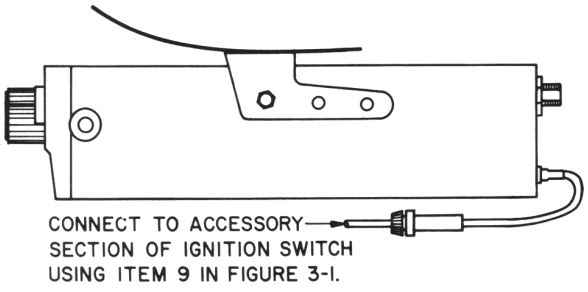
c. Install the coaxial connectors. Refer to Figure 3-3 for details.

3.4 DASH MOUNTING INSTALLATION

(Refer to Figure 3-1)

CAUTION

Avoid installing the transceiver in the direct air stream of the vehicle heater. Temperatures in this area can measure up to 150° F and can cause component failures.



TRANSCEIVER DASH MOUNTING DETAILS
FIGURE 3-1

a. Determine the transceiver location.

b. 1. Hold the transceiver in its proposed location with the mounting bracket (item 1 in Figure 3-2) attached. Mark the mounting bracket location.

2. Remove the mounting bracket from the transceiver.

3. Hold the mounting bracket up to the dash at the location you marked. Mark the mounting bracket slot positions. Check for a free space behind the dashboard in the area marked (no obstructions such as wires, brackets, etc.)

4. Center punch and drill two holes separated as much as the mounting bracket and area selected allow, using a No. 21 drill.

c. Install the mounting bracket. Use the No. 10 hardware illustrated by items 4, 5 and 6 in Figure 3-2.

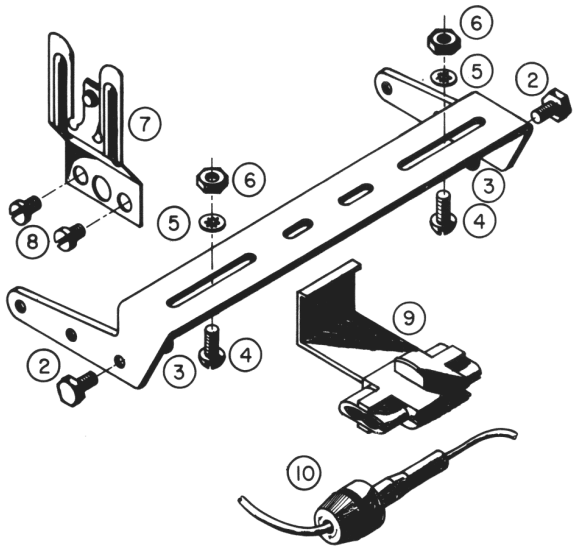
d. Install the transceiver in the mounting bracket. Use items 2 and 3 illustrated in Figure 3-2.

NOTE

Do not connect transmission line to the transceiver antenna terminal until after final checkout.

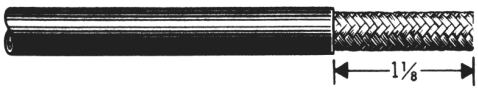
e. Attach the power cable to the transceiver power jack.

f. Perform the steps in section 3.7.



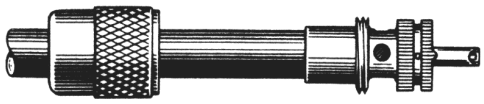
ITEMS SUPPLIED FOR INSTALLATION
FIGURE 3-2

RG-8/U



Cut end of cable even. Remove vinyl jacket 1-1/8", except 83-1SP plug remove vinyl jacket 1-1/4".

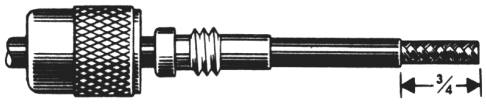
Bare 5/8" of center conductor. Trim braided shield. Slide coupling ring on cable. Tin exposed center conductor and braid.



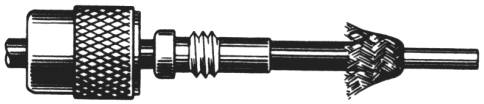
Screw the plug sub-assembly on cable. Solder assembly to braid through solder holes, making a good bond between braid and shell. Solder conductor to contact. Do not use excessive heat.

For final assembly, screw coupling ring on plug sub-assembly.

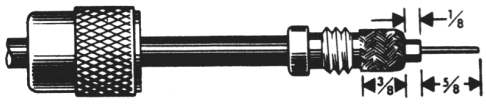
RG-58A/U



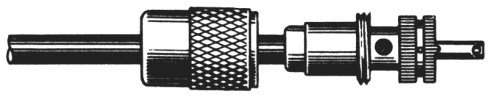
Cut end of cable even. Remove vinyl jacket 3/4". Slide coupling ring and adapter on cable.



Fan braid slightly and fold back as shown.



Position adapter to dimension shown. Press braid down over body of adapter and trim to 3/8". Bare 5/8" of conductor. Tin exposed center conductor.



Screw plug sub-assembly on adapter. Solder braid to shell through solder holes. Use enough heat to create bond of braid to shell. Solder conductor to contact.

For final assembly, screw coupling ring on plug sub-assembly.

UHF COAXIAL CONNECTORS
ASSEMBLY INSTRUCTIONS
FIGURE 3-3

Reprinted by permission of Amphenol RF Division, Amphenol Corporation.

3.5 MICROPHONE HANGER INSTALLATION

a. Determine a location for the microphone hanger (item 7 in Figure 3-2).

b. Follow the procedure outlined in section 3.4 b. for drilling starter holes for the No. 4 sheet metal mounting screws, item 8 in Figure 3-2. Use a No. 43 drill.

NOTE

The microphone hanger can be attached to the transceiver cabinet. Holes are provided for the No. 4 screws on the side opposite the microphone.

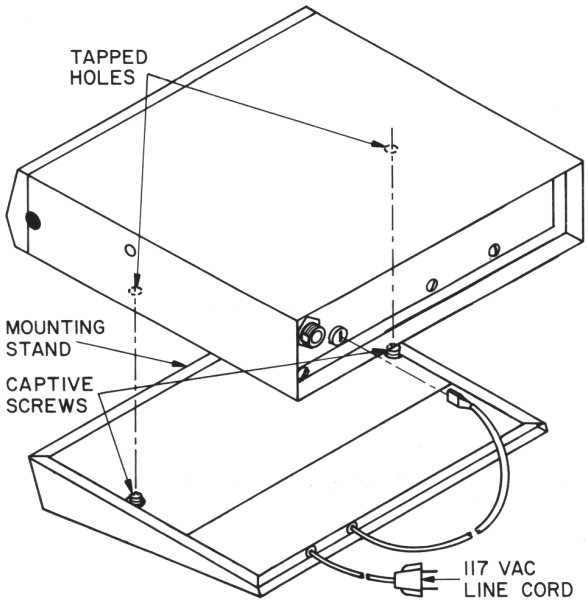
3.6 BASE STATION INSTALLATION

a. Select an operating location for the transceiver that allows air to circulate freely around the transceiver cabinet.

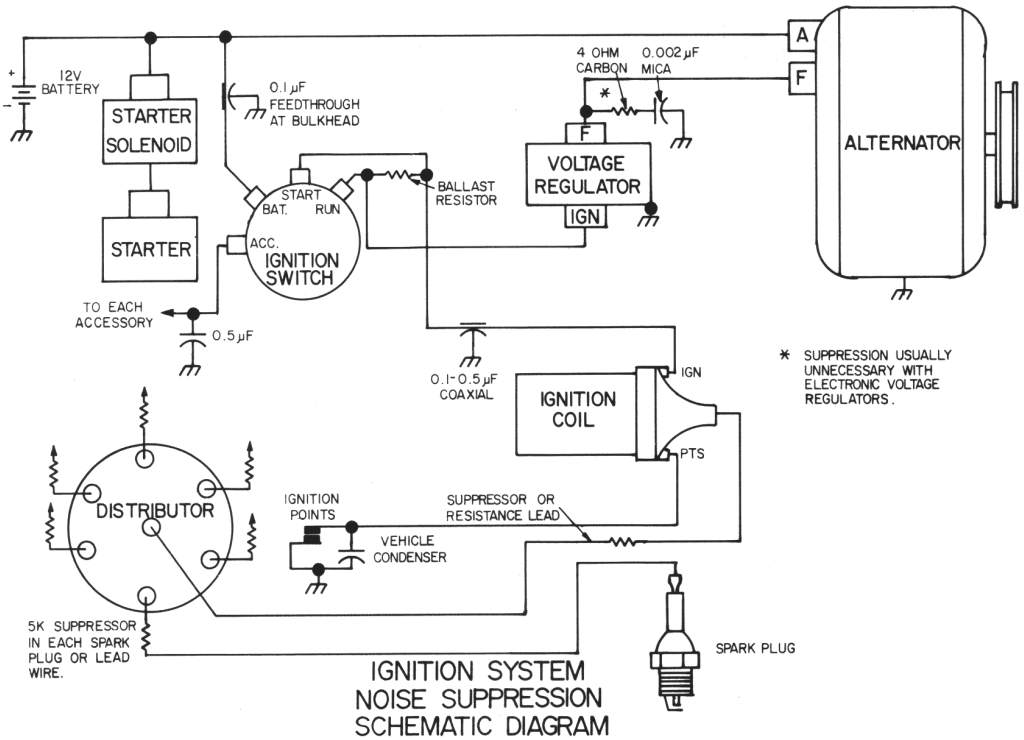
b. Attach the base station power supply to the transceiver. Refer to Figure 3-4 for details.

c. Ground the transceiver for safety. Attach one end of a No. 14 copper ground wire to one of the cabinet shell mounting screws located at the rear of the transceiver. Attach the other end of the ground wire to a cold water pipe or another convenient ground.

d. Perform final checkout outlined in section 3.7.



BASE STATION MOUNTING DETAILS FIGURE 3-4



IGNITION SYSTEM NOISE SUPPRESSION SCHEMATIC DIAGRAM FIGURE 3-5

3.7 FINAL CHECKOUT

a. Connect a Bird Model 43 with 10A element or equivalent wattmeter into the transmission line.

b. Trim the antenna for best VSWR. The transceiver has been tuned at the factory and the output network will not require tuning to match it to the antenna. The VSWR obtained should be 1.5 to 1 or less.

c. Check the transmitter power output. Typical power is 3.5 watts. Refer to the specifications in section 2 for minimum and maximum power output.

d. Check the transmitter frequency with a frequency meter. The maximum allowable deviation from the center frequency is 0.005%.

e. Check the modulation. Minimum acceptable is 70% upward and 80% downward. A suggested method is outlined in section 5.

f. Give the transceiver a complete operational checkout. Make several contacts with another unit. Correct any noise suppression problems that affect vehicle operated transceiver performance.

3.8 NOISE SUPPRESSION

Vehicle electrical noise of some sort is a problem in almost all new mobile radio installations.

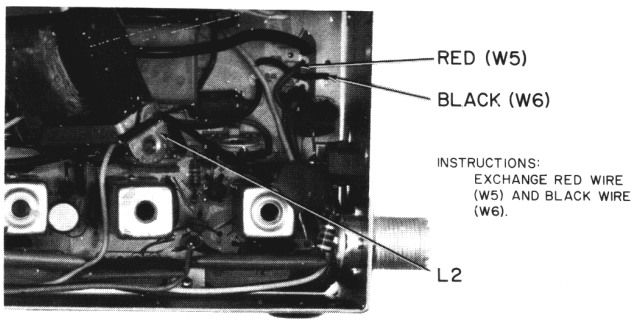
Before beginning any special noise suppression steps, be sure that the vehicle is well tuned. Clean and tighten all electrical connections, including alternator, battery, regulator and coil connections. Perform the following maintenance steps as necessary: solder crimped spark plug and distributor leads; clean and regap or replace spark plugs and ignition timing; check and clean alternator rings and brushes. Retune the engine every 10,000 miles or twice a year, whichever occurs first.

Ordinarily several sources of noise are present in any vehicle, with the strongest covering the others. Drive to a relatively quiet location (free of man-made electrical interference such as noisy power lines, industrial noise or other vehicles).

Test for ignition noise with a weak signal on channel. Vehicle may be standing still. Ignition noise will be present at all engine speeds and, if severe, may make a normally readable signal unreadable.

To reduce ignition noise, install resistor type spark plugs if these are not already installed and if non-resistance ignition wiring is used. Add a 10,000 ohm suppressor resistor in the center tower of the distributor and 5000 ohm suppressor resistors at each spark plug tower of the distributor. Install a coaxial capacitor at the ignition coil primary as close to the coil primary as possible.

A "whining" noise which varies with engine speed and continues with the ignition turned off with the vehicle



POSITIVE GROUND CONVERSION DETAILS
FIGURE 3-6

coasting in gear is characteristic of the alternator. Check and clean the alternator rings and brushes.

An irregular "clicking" sound which disappears at a slow idle characterizes the voltage regulator. Install a 4 ohm carbon resistor as close to the field terminal of the regulator as possible, then a 0.002 μF mica capacitor in series with and as close to the resistor as possible: connect the capacitor to ground.

Irregular popping noises which vary with road surfaces indicate static discharge at any of several locations in the vehicle. Tighten loose nuts and bolts and bond large areas such as the fenders, exhaust pipe, firewall, etc. to the frame with lengths of heavy braid. Figure 3-5 illustrates these and a few other suggested noise suppression steps.

3.9 MODIFICATION FOR POSITIVE GROUND

The following procedure outlines the modification required to use the Messenger 123 in a vehicle with a positive ground electrical system. Refer to Figure 3-6 for details.

NOTE

If an In-converter, Model 239-120, is used, the following modification is not necessary.

a. Remove the transceiver cabinet shell.

b. Remove the two screws that attach the filter choke, L2, to the chassis rail. Lay the filter choke away from the rear chassis rail to expose the circuit board area shown in Figure 3-6.

c. Unsolder the end of wire W6 (black) furthest from the rear of the chassis and wire W5 (red) from the circuit board. Reverse the position of the wires and solder.

d. Replace filter choke and screws.

e. Reinstall cabinet shell.

SECTION 4
CIRCUIT DESCRIPTION

4.1 GENERAL

The Messenger 123 is an all solid state transceiver. Its frequency generating source is a 14 crystal, 23 channel, solid state frequency synthesizer. The synthesizer crystal frequency and channel frequency outputs are diode switched between receive and transmit conditions. The synthesizer receiver output is 455 kHz below the received frequency. The synthesizer transmitter output is at the channel frequency. The power source, audio circuitry and antenna are common to both the receiver and transmitter. A front panel mounted meter indicates received signal strength and relative output of the transmitter.

Refer to the block diagram, Figure 4-1, and the schematic while following the circuit description.

4.2 FREQUENCY SYNTHESIZER

4.2.1 GENERAL

The synthesizer consists of three crystal banks, two oscillators, a mixer, a diode switch driver and two diode switching networks. The synthesizer receiver output is 455 kHz below the received frequency and the synthesizer transmitter output is the channel frequency. This is accomplished by two oscillators and one mixer operating in a single side-step operation. There is no frequency multiplication in the synthesizer or in other circuits.

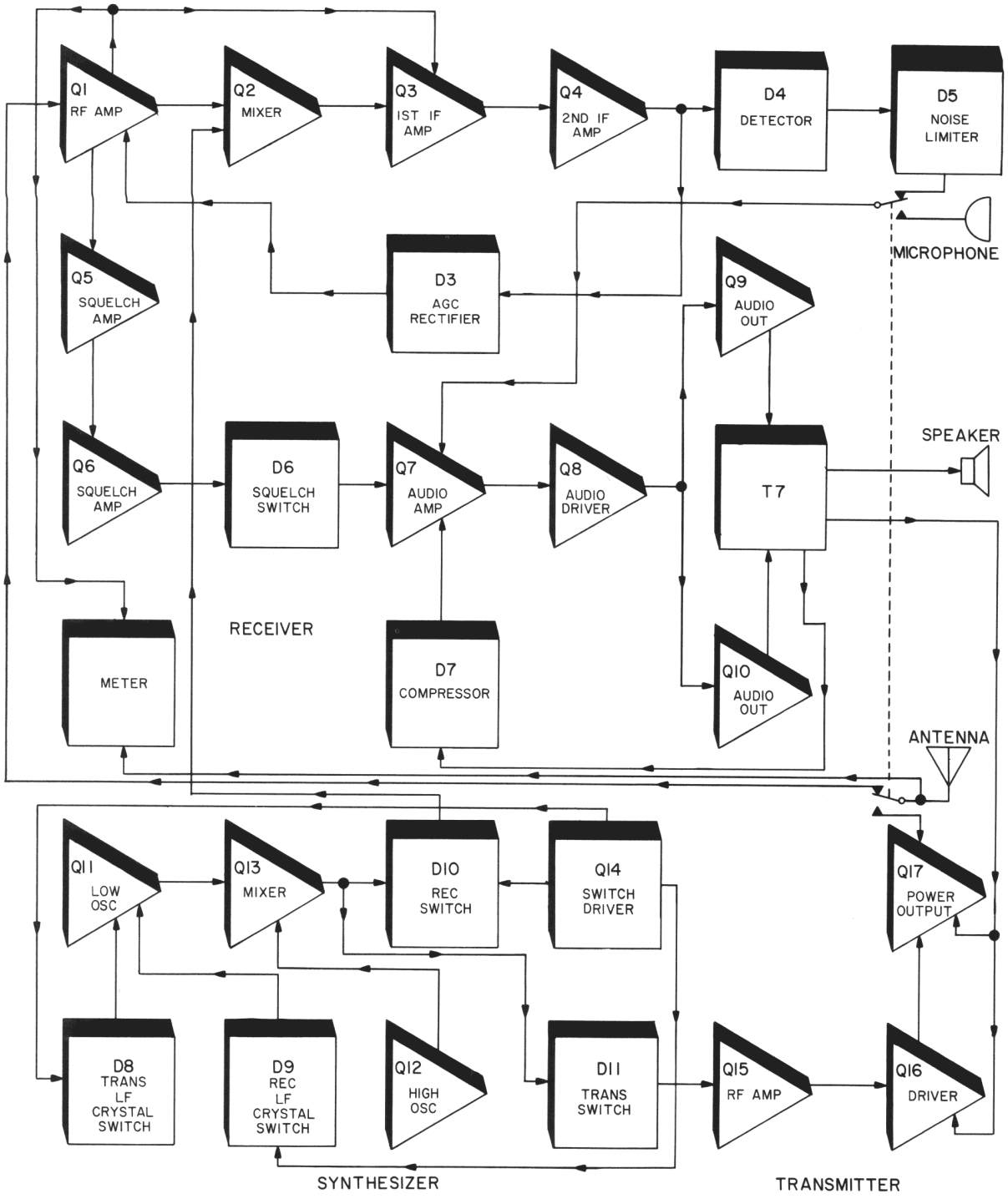
4.2.2 LF OSCILLATOR

The low frequency oscillator is made up of Q11 and

TABLE 4-1
SYNTHESIZER SCHEME

CHANNEL	HF CRYSTAL	RECEIVE LF CRYSTAL	RECEIVE OUTPUT	TRANSMIT LF CRYSTAL	TRANSMIT OUTPUT
1	32.700	6.190	26.510	5.735	26.965
2	32.700	6.180	26.520	5.725	26.975
3	32.700	6.170	26.530	5.715	26.985
4	32.700	6.150	26.550	5.695	27.005
5	32.750	6.190	26.560	5.735	27.015
6	32.750	6.180	26.570	5.725	27.025
7	32.750	6.170	26.580	5.715	27.035
8	32.750	6.150	26.600	5.695	27.055
9	32.800	6.190	26.610	5.735	27.065
10	32.800	6.180	26.620	5.725	27.075
11	32.800	6.170	26.630	5.715	27.085
12	32.800	6.150	26.650	5.695	27.105
13	32.850	6.190	26.660	5.735	27.115
14	32.850	6.180	26.670	5.725	27.125
15	32.850	6.170	26.680	5.715	27.135
16	32.850	6.150	26.700	5.695	27.155
17	32.900	6.190	26.710	5.735	27.165
18	32.900	6.180	26.720	5.725	27.175
19	32.900	6.170	26.730	5.715	27.185
20	32.900	6.150	26.750	5.695	27.205
21	32.950	6.190	26.760	5.735	27.215
22	32.950	6.180	26.770	5.725	27.225
23	32.950	6.150	26.800	5.695	27.255

NOTE: All frequencies in MHz



MESSENGER 123
BLOCK DIAGRAM
FIGURE 4-1

its associated circuitry and crystals Y1 through Y8 which operate at their fundamental frequency. Switch SW3A selects one of these crystals. Refer to Table 4-1, synthesizer scheme, for the low frequency crystals. The signal from the selected crystal is applied directly to the base of Q11, which has a common collector to provide a high input impedance. The signal from the emitter of Q101 is coupled through C49 to the base of the synthesizer mixer, Q13. A capacitive voltage divider, C49 and C50, reduces the voltage at the base of Q13 and provides the proper impedance match.

4.2.3 HF OSCILLATOR

The high frequency oscillator, Q12, operates with third overtone crystals, Y9 through Y14. Switch SW3B selects one of the HF crystals at the same time as SW3A selects a LF crystal. Refer to the synthesizer scheme for the high frequency crystal frequencies. The signal from the selected series resonant crystal is applied directly to the base of the HF oscillator, Q12. The signal from the collector of Q12 is coupled through the oscillator transformer, T8, to the emitter of the synthesizer mixer, Q13.

4.2.4 SYNTHESIZER MIXER

The signal from the low frequency (LF) oscillator, Q11, is coupled to the base of the mixer, Q13, by C49. The signal from the high frequency (HF) oscillator is coupled by T8 to the emitter of the mixer. The mixer output transformer, T9, is tuned for the difference frequency, i.e., the HF oscillator output minus the LF oscillator output. On channel 1 receive this would be: 32.700 MHz - 6.190 MHz = 26.510 MHz. While referring to the crystal chart, notice that in the receive condition the synthesizer output is always 455 kHz below the channel frequency. In transmit the synthesizer output is the channel frequency.

4.2.5 DIODE SWITCHING

The synthesizer contains two diode switching networks. Diodes D8 and D9 switch transmit and receive LF crystals respectively. D10 switches the synthesizer output in receive and D11 switches the output in transmit.

The diode switch driver, Q14, is conducting during receive condition. Its conduction forward biases D9, the receive low oscillator switch, and D10, the synthesizer receive output switch, enabling the receiver.

The synthesizer is switched to the transmit condition by closing the push-to-talk switch. This action grounds (shorts out) the collector of Q14 and causes it to turn off (not conducting). The collector voltage of Q14 rises to 7.9 volts, reverse biasing D9 and D10 and forward biasing D8, the transmit low frequency crystal switch, and D11, the synthesizer transmit output switch.

4.3 RECEIVER

4.3.1 RF AMPLIFIER

The incoming signal is coupled to the base of the RF amplifier, Q1, through C75, a set of contacts on the relay and the input transformer T1. The signal is amplified by Q1 and coupled to the base of mixer stage, Q2, by T2.

4.3.2 RECEIVER MIXER

The output of the synthesizer, operating 455 kHz below the signal from the RF amplifier, from the secondary of T9 is coupled through C55, D10, C54 and C6 to the base of the receiver mixer, Q2. The mixer output transformer, T3, is tuned to the difference frequency, 455 kHz.

4.3.3 IF

The receiver IF section consists of IF amplifiers Q3, Q4 and double tuned transformers T4 and T5.

The IF output is taken off the collector of Q4 and coupled to the detector diode D4 by transformer T5. A small portion of the output of the second IF amplifier is coupled by C15 to a rectifier filter network consisting of D3, R9, C14 and C13. The DC output of the network is the AGC voltage which controls the gain of the RF amplifier and, indirectly, the first IF amplifier.

4.3.4 AGC

An increase in the gain of the second IF amplifier, the result of a stronger received signal from the antenna, causes more output from the second IF amplifier to be coupled to the AGC rectifier. This in turn causes the output of the AGC rectifier to go more positive. This positive going output is coupled to the base of the RF amplifier through a voltage divider network in Z1 and the secondary of T1. A positive going voltage appearing at the base of Q1 lowers the gain of that stage. The emitter voltage of Q1 follows the base and also goes in a positive direction. The emitter of Q1 is connected to the base of the first IF amplifier, Q3. Any change in the emitter voltage of Q1 is transferred to the base of Q3. This controls the gain of Q3.

4.3.5 AUDIO

The audio from the detector diode, D4, is applied through a noise limiting network, Z5, and the volume control to a set of contacts on the relay. During receive condition, the audio from detector D4 is coupled through Z5, R10, C21, R11, L12, C22 and a set of contacts on the relay to the base of the audio pre-amplifier, Q7. The amplified signal is then coupled to the audio driver stage, Q8, for further amplification. Q8 furnishes power to drive the Class B output stage, Q9 and Q10. The driver transformer, T6, provides the proper impedance match between the collector of Q8 and the bases of the Class B stage. The output of the Class B amplifier is transformed by T7 and applied to the speaker. T7 is a combination audio and modulation transformer. The green and black leads are the

3.2 ohm speaker windings during receive. During transmit, the orange and yellow leads provide audio for modulation. One side of the speaker is connected to B+. The other side of the speaker is connected to T7 and from T7 to ground through the push-to-talk switch on the microphone. The push-to-talk switch contacts are used to open the receiver audio during transmit and apply audio from the microphone to the pre-amp, Q7.

4.3.6 SQUELCH

In the squelched condition, Q6, the second squelch amplifier, is turned off. Its collector voltage is several volts more negative than the emitter of the audio amplifier, Q7. In this condition diode D6 is forward biased. With D6 forward biased the emitter of Q7 is at the same potential as the collector of Q6 minus the drop across D6. The base emitter junction of Q7 is reverse biased and Q7 is turned off, disabling the receiver audio.

When an RF signal is present the AGC line goes in an increasingly positive direction. This causes the base and emitter voltages of Q1 to go in a positive direction. The positive going emitter of Q1 causes the base bias of Q5 to go more positive. As the base bias of Q5 goes positive, the stage is conducting less and its collector voltage is increasing. The collector of Q5 and the base of Q6 are direct coupled and therefore at the same electrical potential. The rising collector voltage of Q5 tends to turn Q6 on. The harder Q6 conducts the more the collector voltage drops. When the collector voltage of Q7 becomes less than the emitter voltage of Q7, diode D6 becomes reverse biased. With D6 reverse biased, Q7 becomes forward biased and the audio is enabled.

Squelch temperature compensation is provided by a thermistor in Z6.

4.4 TRANSMITTER

4.4.1 AUDIO

The audio signal from the microphone during transmit condition is coupled through the relay contacts to the base of the audio pre-amp, Q7. The signal is amplified by Q7 and Q8 and coupled through the driver transformer, T6, to the bases of the Class B audio output stage, Q9 and Q10. The amplified audio signal from Q9 and Q10 is coupled through the orange and yellow leads on T7 to provide modulation of the driver, Q16, and power amplifier, Q17.

Audio compression is provided in this unit by rectifying part of the signal appearing at the secondary of T7, and applying it to the emitter of the 1st audio stage, Q7. A large signal from the microphone (caused when an operator shouts into the microphone) will in turn provide a larger signal at the secondary of T7. This in turn places a higher voltage at the emitter of Q7 and reduces its gain, thus maintaining a relatively constant audio level for a given input signal.

4.4.2 TRANSMITTER RF AMPLIFIER AND DRIVER

The synthesizer transmit output is coupled through D11, C57 and double tuned transformer T10 to the base of the transmitter RF amplifier Q15. Here the synthesizer output is increased to a level sufficient to drive the driver stage Q16. T11 couples the output of Q15 to Q16. The output of Q16 is coupled by C66, T12 and C68 to the base of the power output stage, Q17.

4.4.3 POWER AMPLIFIER

The Class C power amplifier, Q17, is designed to operate at 5 watts DC power input. Q17 is in emitter follower configuration and drives the antenna through a pi network and a set of contacts on the relay. The pi network serves as an impedance matching device and as a low pass filter for harmonic attenuation.

4.5 METER

The front panel meter, M1, serves a dual purpose. During receive it functions as an S-Meter. In transmit it indicates relative power output.

The positive side of M1 is connected directly to B+. The negative side is connected to the emitter of Q1 through R3 and R4. The meter is adjusted for an electrical zero in receive by R4. The junction of R4 and D1 is connected to the emitter of Q1 (Q1 is actually connected to B+ through R4, R3 and the meter). Any increase in the base bias of Q1 (caused by a signal at the base) also changes its emitter voltage which in turn reduces the current through M1, giving a signal strength indication.

In transmit, as in receive, a reverse current is applied to the meter which reduces the current through it; offsetting the pointer from its electrical zero and giving a relative power output indication. This is accomplished by coupling RF from the junction of L9 and C75 to rectifier diode D1 by C5. The positive output from D1 reduces the current flow through the meter. Zeroing bias is applied to the meter in transmit through D2 and R5. The meter is adjusted for an electrical zero by R5.

SECTION 5
SERVICING

5.1 GENERAL SERVICING INFORMATION

The information in this section serves as a guide for servicing the Messenger 123 transceiver. Carefully read this information before attempting to isolate malfunctions. A little beforehand knowledge is always an asset when troubleshooting.

Refer to the circuit description, block diagrams, and the schematics at the back of this manual to familiarize yourself with the transceiver circuitry.

5.1.1 IDENTIFICATION OF PARTS

The parts list in this service manual is in alphabetical and numerical order by item number, i.e., capacitors first, chassis parts second, etc.

5.1.2 PREVENTIVE MAINTENANCE

The transceiver should be placed on a regular maintenance schedule, and an accurate record of its performance should be maintained. Important items to check are receiver sensitivity, transmitter power output, and frequency output. Use the performance test procedures in the receiver and transmitter servicing sections as guides.

5.1.3 REPLACEMENT TRANSISTORS

The transistors used in this unit are listed with E. F. Johnson house numbers. These transistors are selected for specific parameters. They must be replaced with the transistors listed in the parts list of this service manual. Refer to Section 1 in this service manual for detailed instructions on ordering replacement parts.

5.1.4 TUNING INFORMATION

The Messenger 123 generally requires tuning of only those stages that have been repaired. Unnecessary tuning wastes valuable servicing time and can actually degrade the performance of a unit if not accomplished by an experienced technician. The alignment section includes detailed tuning instructions and illustrates the tuning tools required.

5.1.5 GENERAL SOLDERING INFORMATION

The same basic soldering practices used on other printed circuit boards can be used on the Messenger 123 circuit board. Avoid using small wattage soldering irons. Apply the amount of heat that will cause the solder to flow quickly. No iron smaller than 47 watts should be used. Use a vacuum bulb desoldering device, such as a "solder sipper", to remove excess old solder from the circuit board.

Use a heatsink pliers on RG-174 (subminiature) coaxial cable shields when unsoldering and soldering the center conductor. Do this by grasping the shield with needle-nose pliers when heat is applied. This method will prevent melting the coax center conductor insulation.

5.1.6 REMOVING CABINET SHELL

a. Remove the No. 8 screws (one on each side at the rear) that fasten the cabinet shell to the chassis rail.

b. Grasp the front panel with one hand and the cabinet shell with the other.

c. Carefully slide the cabinet shell away from the front panel.

5.1.7 GENERAL TROUBLESHOOTING INFORMATION

Always give a malfunctioning unit a quick visual check before attempting to isolate troubles. A visual check may spot an overheated or burned component. Most transceiver malfunctions will probably be the result of transistor or diode failures.

Always check transistor emitter voltages first when troubleshooting. They will usually give the first indication of trouble.

5.2 TRANSISTOR TROUBLESHOOTING

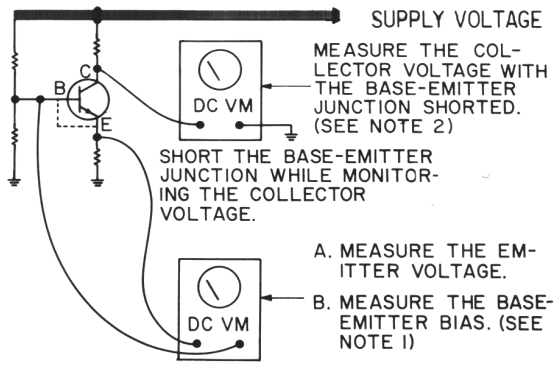
5.2.1 GENERAL

The following information is intended to aid troubleshooting and isolation of transistor circuit malfunctions.

5.2.2 TRANSISTOR OPERATING CHARACTERISTICS

For all practical purposes the transistor base-emitter junction and the transistor base-collector junction can be considered to be diodes. For the transistor to conduct collector to emitter its base-emitter junction must be forward biased in the same manner as a conventional diode. In a germanium transistor the typical forward biased junction voltage is 0.2 to 0.4 volts. A typical silicon transistor will have forward biased junction voltage of 0.5 to 0.7 volts. When collector current is high the base-emitter voltage of both germanium and silicon transistors increases from 0.1 to 0.2 volts. The base-emitter bias voltage in the forward biased condition is then 0.4 to 0.5 volts for a germanium transistor and 0.7 to 0.9 volts for a silicon transistor. High current silicon transistors may go up 2 volts under load.

A high impedance DC voltmeter is usually the only measuring instrument required for determining the operating status of an in-circuit transistor. The meter is used to measure the transistor bias voltages. See Figure 5-1 for the correct voltmeter connections for measuring in-circuit transistor bias.



TEST CONNECTIONS FOR IN-CIRCUIT TRANSISTOR TESTING
FIGURE 5-1

NOTES

1. Enough loop current is present in the leads of some electronic voltmeters to destroy transistors if measurements are made directly across transistor junctions. If an electronic voltmeter is used, perform the above measurements with respect to the circuit voltage common.

2. If the collector voltage is measured with a VOM the meter leads may be connected directly across the collector resistor. The difference between the supply voltage and the collector voltage will then be indicated directly on the VOM.

3. Be careful when connecting test leads to in-circuit transistors. Operating transistors can be ruined by shorting the base to the collector and, in some circuit configurations, the emitter to ground.

4. Turn power off when removing or installing transistors.

5.2.3 IN-CIRCUIT TRANSISTOR TESTING

a. Refer to Figure 5-1 for test connections.

b. Measure the emitter voltage. Compare your measurement to the voltage listed on the schematic diagram. A correct emitter voltage reading generally indicates that the transistor is working properly. If you are in doubt as to the condition of the transistor after measuring the emitter voltage, proceed to the following tests.

c. Measure the base-emitter junction bias. The voltage measured across a forward biased junction should be approximately 0.3 volts for a germanium transistor and 0.6 volts for a small signal silicon transistor.

d. Check for amplifier action by shorting the base to the emitter while monitoring the collector voltage.* The transistor should cut off (not conduct emitter to collector) because the base-emitter bias is removed. The collector voltage should rise to near the supply level. Any difference is the result of leakage current through the transistor. Generally, the smaller the leakage current the better the transistor. If no change occurs in the collector voltage when the base-emitter junction is shorted the transistor should be removed from the circuit and checked with an ohmmeter or a transistor tester. The following section describes the technique for testing transistors out of the circuit with an ohmmeter.

* Not recommended for power transistors under driving conditions.

5.2.4 OUT OF CIRCUIT TRANSISTOR TESTING

Only high quality ohmmeters should be used to measure the resistance of transistors. Many ohmmeters of both VOM and electronic types have short circuit current capabilities in their lower ranges that can be damaging to semiconductor devices. A good "rule of thumb" is to never measure the resistance of a semiconductor on any ohmmeter range that produces more than 3 milliamperes of short circuit current. Also, it is not advisable to use an ohmmeter that has an open circuit voltage of more than 1.5 volts. The following section describes a method for determining the short circuit current capabilities of ohmmeters.

5.2.5 HOW TO DETERMINE OHMMETER CURRENT

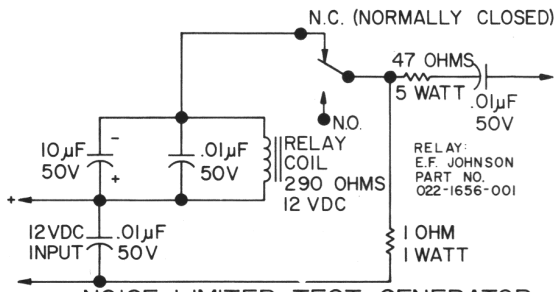
When the ohmmeter test probes are shorted together (measuring the forward resistance of a diode or the base-emitter junction of a transistor amounts to the same thing) the meter deflects full scale and the entire battery voltage appears across a resistance that we will designate as R1. The current through the probes is the battery voltage divided by the resistance of R1. A very easy method is available for determining the value of R1. Look at the exact center of the ohmmeter scale. Your reading is the value of R1 on the Rx1 range.

The only other unknown required to calculate the short circuit current of an ohmmeter is the internal battery voltage. Let's take a well known meter that has a center scale reading on the ohms scale of 4.62 and a battery voltage of 1.5 volts. Its short circuit current can be calculated by using Ohm's Law. Dividing 1.5 volts by 4.62 ohms equals a short circuit current of 324 mA on the Rx1 range.

TABLE 5-1

OUT OF CIRCUIT TRANSISTOR MEASUREMENTS

Transistor Type		Ohmmeter Connections + lead	-lead	Resistance in ohms
Germanium PNP	Power	Emitter	Base	30 to 50 ohms
		Emitter	Collector	Several hundred
	Small Signal	Emitter	Base	200 to 250 ohms
		Emitter	Collector	10k to 100k ohms
Silicon PNP	Small Signal	Emitter	Base	10k to 100k ohms
		Emitter	Collector	Very high (Might read open)
Silicon NPN	Power	Base	Emitter	200 to 1000 ohms
	Small Signal	Collector	Emitter	High; often greater than 1 megohm
		Base	Emitter	1k to 3k ohms
		Collector	Emitter	Very high (Might read open)



NOISE LIMITER TEST GENERATOR
FIGURE 5-2

5.3 RECEIVER PERFORMANCE TEST

(With troubleshooting information.)

Receiver RF input values are given into a 6 dB 50 ohm pad.

5.3.1 TEST INSTRUMENT CONNECTIONS

Refer to Table 5-2 for test instruments required.

NOTE

Any 117 VAC operated test instruments with grounded power plugs used for servicing the Messenger 123 must be "floated" (ungrounded).

a. Connect an RF signal generator through a 6 dB pad to the antenna jack.

b. Connect an audio voltmeter across the speaker terminals. Connect the "hot" side of the voltmeter to the top terminal.

c. Use B+ as the test instrument common when injecting signals and making voltage measurements.

d. Connect a VOM in series with the power lead. Set the function switch to DC current and the range selector to the range nearest one ampere full scale.

5.3.2 SENSITIVITY AND RECEIVER CURRENT DRAIN

a. Set the volume control maximum clockwise (maximum volume) and the squelch control to maximum counterclockwise (minimum squelch).

b. Set the channel selector to channel 11.

c. Set the signal generator output for 1µV modulated 30% at 1000Hz on channel 11 (27.085 MHz). Use a crystal controlled generator equivalent to the one listed in Table 5-2.

d. Adjust the volume control for a -10 dB indication on the audio voltmeter.

e. Switch the signal generator audio off. The indication on the audio voltmeter should drop 8dB or more.

f. Reset the volume control to maximum clockwise

TABLE 5-2

TEST INSTRUMENTS REQUIRED FOR SERVICING AND ALIGNMENT

TYPE	REQUIRED CHARACTERISTICS	USE	RECOMMENDED MODEL
VTVM	A low range of 0-1.5 volts on AC and DC	Measure RF, AF and DC voltages	Heath IM-11 with RF probes or equivalent
Oscilloscope with RF Pickup Loop	Direct connection to vertical plates, or vertical amplifier good to 30 MHz. Refer to Figure 5-8 for pickup loop fabrication details.	Check modulated waveforms and audio.	Heath I0-12 or equivalent modified for direct connection to vertical plate. Precision ES-550B
Audio Voltmeter	Measure from -40 dB to +10 dB	Measure audio	Heath IM-21 or equivalent
Audio Generator	With variable attenuator and frequency of 400 to 2500 Hz	Check audio amps. Modulate transmitter.	Heath IG-72 or equivalent
Frequency Meter	Accuracy of ±0.0005% Frequency range of 455 kHz and from 25 to 30 MHz	Measure receiver and transmitter RF frequencies	Viking Instruments Model VFS 700
Thruline Wattmeter	Input and output impedance of 50 ohms. 5 or 10 watts. Accuracy of ±5% of full scale reading.	Measure transmitter power output. Measure antenna VSWR.	Bird Model 43 with 5A or 10A element
DC Current Meter		Measure receiver and transmitter current drain.	Simpson 270 or Triplett 630 or equivalent
Dummy Antenna	Power rating of at least 5 watts 50 ohms resistive	Load for Thruline Wattmeter	Bird Model 80 coaxial resistor or equivalent
Crystal controlled RF Signal Generator with 6 dB 50 ohm pad	23 CB frequencies plus 455 kHz and attenuated output of 1 to 100,000 microvolts capable of 30% modulation at 400 and 1000 Hz	Receiver RF source	Radio Research, Model 71-4 or Model 72 or equivalent. Accuracy ±0.0005% except ±.01% at 455 kHz
RF Voltmeter with	10 mV - 300 volts	Measure RF voltages	Millivac 38B or equivalent

The following is a list of instruments that can be used if the instruments in the above list are not available.

TYPE	CHARACTERISTICS	USE
International crystal C-12B test set NOTE: This instrument lacks 1000 Hz modulation for signal generator and accuracy is lower than the 0.0005% desired, but offers a desirable combination of features at low cost. It is battery operated and portable.	Frequency Meter - 23 CB frequencies, 26.965 to 27.255 MHz, with an accuracy of ±0.0015%.	Measure receiver and transmitter RF frequencies
	RF Power Meter - 5 watts ±1/4 watt	Measure transmitter power output
	Dummy antenna - 5 watts	Load for transmitter
	RF signal generator - 23 CB frequencies ±0.0015%, output 1 to 100 microvolts, 30% modulation at 400 Hz	Receiver RF source
	AM modulation meter - range 0-100% accuracy 3% at 400 Hz and 80% modulation.	Measure transmitter percent of modulation
E. F. Johnson antenna meter, Model 250-849	50 ohms	Measure antenna VSWR

(maximum volume). Switch the signal generator audio on.

g. Check the receiver current drain. It should be approximately 500 mA with 2.5 VAC across the speaker terminals.

5.3.3 AUDIO

1. Performance Test

a. Set the squelch control fully counterclockwise.

b. Set the audio voltmeter range selector to the 3 volt range.

c. Set the volume control full on.

d. Set the signal generator output for 1μV modulated 30% at 1000 Hz.

e. The audio output on the voltmeter should be 2.5 volts ±3dB on channels 1, 11 and 21.

2. Troubleshooting

The condition of the receiver audio can be checked by signal injections. Refer to the following procedure.

a. 1. Connect the "hot" side of an audio generator to a 5 μF capacitor. Connect the common side of the audio generator to B+.

2. Set the volume control maximum clockwise and the squelch control maximum counterclockwise.

b. 1. The reference level for Table 5-3 is 2.5 volts RMS of audio across the speaker terminals.

2. Use an oscilloscope to check stage to stage distortion.

3. Table 5-3, Typical Audio Levels, lists the audio gain distribution, measured with an audio voltmeter, that should be obtained from a typical audio section.

NOTES

(Class B audio output transistors Q9 and Q10)

1. Check the base and emitter voltages of the class B audio output transistors, Q9 and Q10. The voltages should be approximately equal. If one of the transistors shows no voltage difference between emitter and base, it is probably faulty.

2. Severe audio distortion may be the result of an open Q9 or Q10. A shorted transistor can cause R17 to burn and possibly blow the fuse. The faulty transistor may have an excessively warm case.

TABLE 5-3
TYPICAL AUDIO LEVELS

Test Point	Volts RMS
	Levels required to produce 2.5 RMS
top of volume control	0.0012
collector of Q7	0.015
base of Q8	0.015
collector of Q8	2.35
base of Q9	2.1 drops to 0.75 when 5 μF cap is touched to base of Q9
collector of Q9	---

5.3.4 AGC

1. AGC Performance Test

a. Set the channel selector to channel 11.

b. Set the squelch control to the maximum counterclockwise position.

c. Set the signal generator output to 0.1 volt modulated 30% at 1000 Hz on channel 11 (27.085 MHz).

d. Adjust the volume control for a 0 dB indication on the audio voltmeter.

e. Reduce the signal generator output to 1 μV. The audio voltmeter should drop 12 dB ±6 dB.

2. AGC Troubleshooting

a. Increase RF signal generator output from 1 μV to 0.5 V. The audio voltage at the speaker should increase relatively fast at first, as signal generator output is increased from 1 μV-10 μV, then tend to level off.

b. If the voltage at the speaker increased proportionately as the input voltage increased, check D3 by bridging it with a new diode, and check its associated circuitry.

c. If D3 and its associated circuitry appear to be good, connect a DC voltmeter between the junction of C14, C13, R9 and B+. The AGC voltage measured here should go less negative as the input voltage is increased from 1 μV to 0.1 V.

d. Refer to Table 5-4 for a list of typical AGC voltage readings.

TABLE 5-4
TYPICAL AGC LEVELS

Test Conditions:

Volume control advanced for reference of 2.5 VRMS at the speaker terminals with 1000 μV input to 50 ohm 6 dB pad between generator and antenna terminal. Signal generator set to 27.085 MHz (channel 11) at 30% modulation, 1000 Hz. Audio measured across the speaker.

RF Input to 6 dB pad (microvolts)	Relative Audio Output (dB)	Voltage at Junction of C14, C13 and R9
1	-4	-0.9
3	+4	-0.65
10	+8.2	-0.21
30	+8.8	+0.21
100	+10.3	+0.52
300	+10.3	+0.74
1,000	+10	+0.88
3,000	+10.6	+0.98
10,000	+11.8	+1.06
30,000	+12.5	+1.14
100,000	+13.2	+1.23
300,000	+13	+1.53
1,000,000	+4.5	+2.63
3,000,000	+12	+3.5

5.3.5 IF and RF Troubleshooting

Check the RF and IF stages by signal injection. Connect an audio voltmeter across the speaker terminals. Set the signal generator to 30% modulation at 1000 Hz. Set the channel selector to channel 11. Table 5-5 lists the injection points and the input levels necessary to obtain 3 VRMS at the speaker terminals with the volume control set to maximum and the squelch control to minimum.

TABLE 5-5
TYPICAL RF AND IF LEVELS IN RECEIVER

Conditions: The input levels listed in this table are the levels required to produce 3 VRMS at the speaker terminals with the volume maximum and the squelch minimum.

Test Point	Input Frequency	Input Level
Antenna terminal	27.085 MHz	1.13 μV
Base of mixer	27.085 MHz	58 μV
Base of first IF amp	455 kHz	290 μV
Base of second IF amp	455 kHz	8.4 mV
Collector of second IF amp	455 kHz	450 mV

5.3.6

1. Squelch Threshold Performance Test

   a. Set the channel selector to channel 11 (27.085 MHz).

   b. Disconnect the signal generator (if connected) from the antenna terminal.

   c. Adjust the squelch control until the background noise disappears.

   d. Set the signal generator to 100 μV 30% modulated at 1000 Hz.

   e. Connect the signal generator to the antenna jack. The squelch should open.

   f. Reduce the signal generator to 1 μV. The squelch should remain open.

2. Squelch Troubleshooting

   a. The squelch amplifiers Q5 and Q6 obtain their information from the AGC line. When squelch action is faulty, check the AGC section first.

   b. If the AGC section appears to be functioning properly, connect a DC voltmeter to the emitter of Q7 (-15 VDC range).

   c. With power applied to the receiver, monitor the DC voltmeter while rotating the squelch control from minimum to maximum. The voltage indicated should go from approximately -2.6 V to 6.5 V.

   d. If the voltage does not change at Q7, substitute D6 with a diode known to be good.

NOTE

If D6 is shorted, the voltage at Q6 will be normal but the squelch will operate very slowly. The emitter of Q7 would read very low at minimum squelch and normal at maximum squelch.

   e. Check the voltages at Q5 and Q6.

5.3.7 Noise Limiter Performance Test

A noise limiter test generator such as illustrated in Figure 5-2 must be available to perform the following test.

   a. Turn the squelch control full counterclockwise.

   b. Connect the noise generator illustrated in Figure 5-2 to the center conductor of the antenna jack inside the chassis. The signal generator is connected to the antenna jack at the outside of the chassis rail.

   c. Set the RF signal generator to 1μV unmodulated.

   d. Connect an audio voltmeter across the speaker terminals and set the volume control for an indication of 0 dB.

e. Turn the noise generator on. The audio voltmeter should indicate an increase of no more than 5 dB.

5.3.8 S-Meter Performance Test

Refer to the Receiver Alignment section for S-meter calibration instructions.

5.4 TRANSMITTER PERFORMANCE TEST
(With troubleshooting information)

5.4.1 Test Instrument Connections

a. Refer to Table 5-2 for test instruments required.

b. Connect a wattmeter and 50 ohm load to the antenna jack.

c. Connect the "hot" side of an audio generator through a 0.05 μF capacitor to the junction of C23 and RY1. Connect the common side to B+.

Connect a jumper wire between the junction of C23 and the microphone white lead to B+.

d. Connect a DC current meter (VOM) to the free (unsoldered at C74 and L6) end of wire W9 (minus lead) and the junction of C74 and L6 (positive lead). Set the function switch to DC current and the range selector to the range nearest 1 ampere full scale. Refer to Figure 6-2.

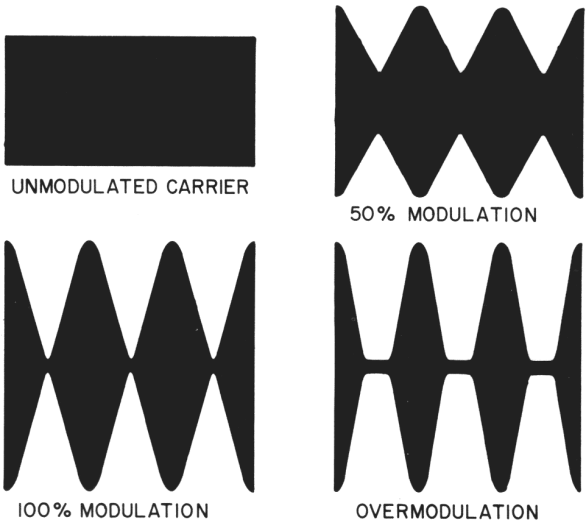
e. Have an RF pick-up loop as illustrated in Figure 5-3 available for checking modulation.

5.4.2 RF Power Output and Modulation

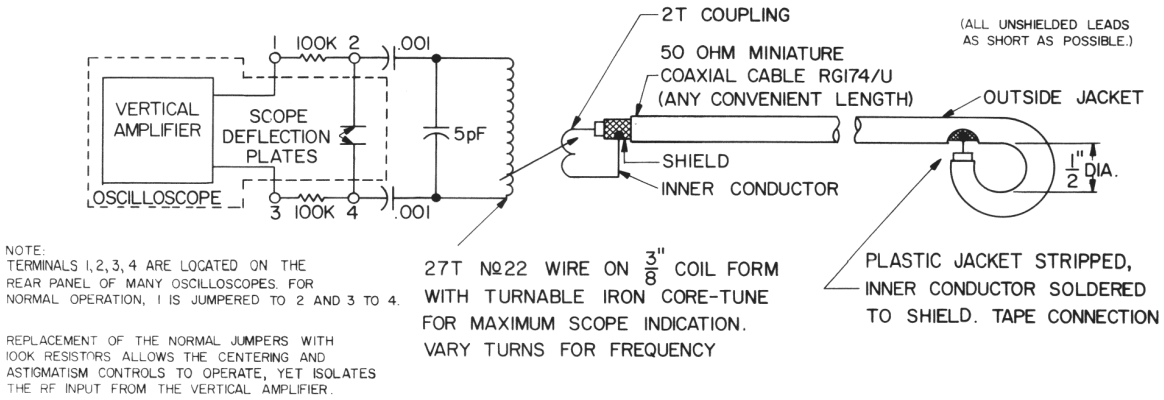
NOTE

All the measurements given in this section are for a normally operating transceiver with 13.8 VDC power supply.

a. Key the transmitter with no modulation applied. Check the power output on channels 1 through 23. The limits are 4.0 watts maximum and 2.8 watts minimum with a Q17 emitter current of 410 mA as measured with the DC current meter. The power output difference between any two channels should not be more than 0.5 watts. Re-



TRANSMITTER WAVEFORMS
FIGURE 5-4



fer to section 6 for the transmitter alignment procedure. Check the relative power output meter with no modulation. It should indicate approximately mid-scale.

b. Connect an RF pick-up loop, constructed as illtrated in Figure 5-3,to L8.

c. Set the audio generator output level to 4 mV. Key the transmitter. Approximately 50% modulation should be indicated on the oscilloscope. Refer to the transmitter waveforms illustrated in Figure 5-4.

d. Increase the audio level to 8 mV. The modulation should increase to at least 70% minimum upward and 80% minimum downward.

e. Increase the audio to 80 mV. The waveform should be clean and free of RF distortion.

TABLE 5-6
FREQUENCY SYNTHESIZER TROUBLESHOOTING

Trouble	Probable Cause
Receiver and transmitter completely inoperative. No apparent synthesizer output.	Q13
Receiver completely inoperative.	D9, D10
Transmitter inoperative.	D8, D11
Transceiver operation intermittent.	Alignment improper. Selector switch dirty.
Transceiver inoperative on some channels, operates normally on others.	Faulty crystal. Refer to Table 5-8 and Figure 5-5.

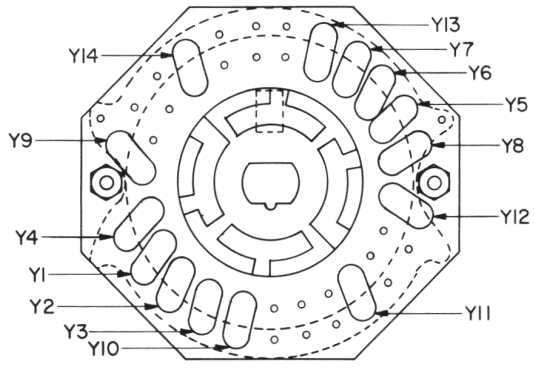
5.5 SYNTHESIZER

The following measurements are necessary only if the synthesizer has been repaired or is suspected of functioning improperly. Refer to Tables 5-6, 5-7 and 5-8 for synthesizer troubleshooting information.

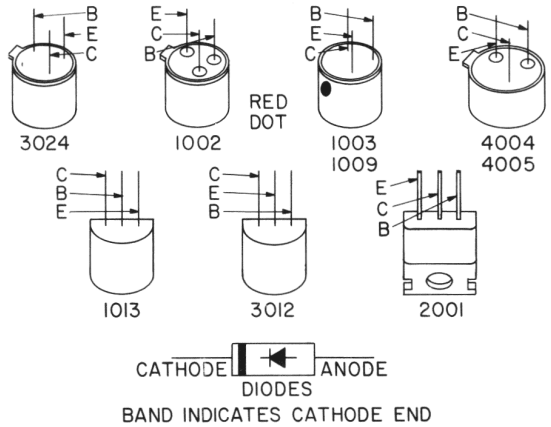
a. Couple a small sample of the transmitter power output, unmodulated, to a frequency meter or electronic counter.

b. Measure the frequency on channels 1, 6, 11, 16, 20 and 23. Table 5-7 lists the maximum frequency variations at a standard temperature of +25° centigrade (72° fahrenheit).

c. If the synthesizer fails to meet the limits listed in Table 5-7, refer to Table 5-6 and 5-8 and the synthesizer alignment instructions in section 6. Refer to section 5-2 and Figure 5-6, semiconductor case diagrams, if a semiconductor is suspected of being faulty. Refer to the transparency for component identification.



CRYSTAL MOUNTING DETAILS
(REAR VIEW)
FIGURE 5-5



SEMICONDUCTOR CASE DIAGRAMS
BOTTOM VIEWS
FIGURE 5-6

TABLE 5-7
LIMITS FOR TRANSMITTER FREQUENCY VARIATION

CHANNEL NO.	FREQUENCY, kHz	0.004% HIGH LIMIT, kHz	0.004% LOW LIMIT, kHz
1	26,965.000	26,966.079	26,963.921
6	27,025.000	27,026.081	27,023.919
11	27,085.000	27,096.083	27,033.917
16	27,155.000	27,156.086	27,153.914
20	27,205.000	27,206.088	27,203.912
23	27,255,000	27,056.090	27,253.910

TABLE 5-8
SYNTHESIZER CRYSTAL TROUBLESHOOTING

Channels Inoperative	Receive Inoperative	Transmit Inoperative	Faulty Crystal
1, 2, 3 and 4	X	X	Y9
5, 6, 7 and 8	X	X	Y10
9, 10, 11 and 12	X	X	Y11
13, 14, 15 and 16	X	X	Y12
17, 18, 19 and 20	X	X	Y13
21, 22 and 23	X	X	Y14
1, 5, 9, 13, 17 and 21	X		Y5
2, 6, 10, 14, 18 and 22	X		Y6
3, 7, 11, 15 and 19	X		Y7
4, 8, 12, 16, 20, 23	X		Y8
1, 5, 9, 13, 17 and 21		X	Y1
2, 6, 10, 14, 18 and 22		X	Y2
3, 7, 11, 15, 19		X	Y3
4, 8, 12, 16, 19 and 23		X	Y4

TABLE 5-9
TYPICAL COMPONENT RESISTANCE READINGS

Component	Winding	Lead	Value
RY1	Coil	Pin 13 to Pin 14	195 $^{+0}_{-20}$% ohms
T6	Primary	Across side with two leads	200 ohms (maximum)
	Secondary	Across outside leads on side with three leads	25 ohms (maximum)
T7	Primary	Brown to Blue	3.4 ohms (maximum)
	Secondary No. 1	Yellow to Orange	1.4 ohms (maximum)
	Secondary No. 2	Green to Black	0.22 ohms (maximum)

SECTION 6
ALIGNMENT

6.1 GENERAL

All test instruments used for alignment must be "floating" (ungrounded). The common (ground) point for the test instruments is B+ on the circuit board.

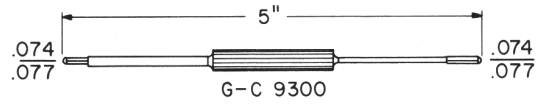
6.2 RECEIVER

Test Instrument Connections
(Refer to Table 5-1 for test instruments required and Figure 6-1 for alignment tools.)

a. Connect a signal generator through a 6 dB 50 ohm pad to the antenna terminal.

b. Connect an RF millivoltmeter to the junction of T9 and C55.

c. Connect an audio voltmeter and oscilloscope across the speaker. Connect the "hot" instrument lead to the bottom of the speaker terminal strip. Connect the common lead at the top (B+).



ALIGNMENT TOOL REQUIRED
FIGURE 6-1

Preliminary

a. Connect a 13.8 VDC source to the transceiver.

b. Check that the lights and on/off switch operate normally.

Synthesizer Adjustment

a. Connect an RF voltmeter to the junction of D10 and D11.

b. Set the channel selector to channel 23.

c. Adjust T8 until the RF voltmeter abruptly begins to indicate the presence of RF. Advance the core until a peak in output is observed.

d. Set the channel selector to channel 12.

e. Adjust T9 for a maximum reading on the RF voltmeter. Tune on the outside peaks. Your indication should be 200 mV minimum.

f. The synthesizer receive crystal starting can be checked by setting the channel selector switch to channels 1, 6, 11, 16, 20 and 23. The meter should read approximately the same for all channels.

IF and RF

a. Set the channel selector switch to the blank channel (between 22 and 23). Adjust the squelch control full counterclockwise.

b. Connect an RF signal generator to the antenna jack at 30% modulation. Set the generator modulation to 1000 Hz at 30%. Connect an audio voltmeter and oscilloscope across the speaker.

c. Set the signal generator to 455 kHz and peak T3, T4, and T5 for maximum audio output. Use as little signal input as convenient. (One that produces a S+N/N of 10 dB, or one that produces about 1 volt RMS of audio is desirable).

d. Set the channel selector to channel 11.

e. Tune the RF signal generator to channel 11 with modulation the same as step b and set the RF level to 1000 μV (1 mV), and increase the volume control until an indication of 0 dB is obtained on the audio voltmeter.

f. Peak T1 and T2, bottom core, for a maximum indication on the audio voltmeter. Reduce the generator output to maintain an audio output between 0 dB and +6 dB.

g. Set generator RF output level to 1 μV, and finish peaking T1 and T2.

h. Peak T1 for cleanest audio output, as seen on an oscilloscope.

Image Trap Adjustment

a. Set the channel selector to channel 1.

b. Set the signal generator to channel 1. Set the RF output level to obtain approximately 10 dB S+N/N, with modulation set at 1000 Hz at 30%.

c. Tune the top slug of T2 to a dip as observed on the audio voltmeter. Turn through dip until audio reaches a peak. Back off until audio starts to drop.

d. Return the signal generator and channel selector to channel 11. Set signal generator RF output level to 1 μV. Set volume control to give 0 dB on the audio voltmeter.

e. T2, bottom slug, can be retuned slightly for maximum audio output.

f. Check receiver gain on channels 1, 11, and 21. Adjust T1 and T2, bottom slug, for uniform gain and signal to noise (gain as observed on the audio voltmeter). The gain should be ±3 dB.

g. Set channel selector to channel 11.

h. Set signal generator to channel 11, 1000 μV, modulated at 1000 Hz 30%. Adjust the volume control to obtain +10 dB on the audio voltmeter.

i. Reduce signal generator output to 1 μV. The audio should drop 20 ±10 dB.

j. Increase Volume Control to maximum. The audio voltmeter should read -3 dB minimum. If possible set the Volume Control to obtain 0 dB audio output. (on low gain units a 100 K 1/2 W. resistor may be added between leads 2 and 3 of 1, or a 1 K resistor may be added between leads 5 and 6 of Z3.)

k. Reduce the modulation to zero. The audio voltmeter should drop 7 dB minimum.

Squelch Test

a. Set the signal generator to 30 μV modulated at 1000 Hz 30%. Advance the squelch control clockwise; the signal should disappear at some point, (for tight squelch problems a 39 K, 1/2 watt resistor may be placed between pins 1 and 2 of Z6).

b. Set the signal generator to 1000 μV; the signal should appear.

6.3 TRANSMITTER ALIGNMENT

Test Instrument Connections
(Refer to Table 5-1 for test instruments required and Figure 6-1 for alignment tools.)

a. Connect the "hot" side of an audio generator through a 0.05 μF capacitor to the junction of C23 and RY1. Connect the common side of the generator to B+ on the circuit board.

b. Connect a jumper wire between the junction of C23 and microphone white lead to B+.

c. Connect an RF millivoltmeter to the base of Q16. Connect the common side of the meter to B+.

d. Connect a 0 to 500 mA DC current meter (this can be a VOM) between the junction of a C74 and L6 (positive) and the free end of W9 (negative). Refer to Figure 6-2 for details.

e. Connect a 50 ohm wattmeter to the antenna terminal.

Alignment Procedure

a. Set channel selector to channel 11.

b. Key the transmitter and adjust T10 for maximum on the RF millivoltmeter. Tune to the outside peaks. Disconnect the meter.

c. Key the transmitter. Adjust L8 for peak current and power output. Adjust L7 to keep final current below 450 mA. Use a 0.001 μF RF bypass capacitor across the current meter terminals.

d. Adjust T12 for maximum current and power output.

e. Adjust T11 for maximum current and power putput.

f. Adjust L7 and L8 for maximum current and power output. The final current must not exceed 410 mA. (Load for maximum power out with minimum current.)

g. Power output should be between 2.8 watts and 4.0 watts. If output exceeds 4.0 watts, repeat step f adjusting for 4.0 watts maximum.

h. Check power output on all 23 channel selector positions. The power output on the 23 CB channels should not vary more than 0.5 watts.

i. Connect an RF pick-up loop (details are illustrated in Figure 5-3) to L8.

j. Turn up the audio level and note the modulation envelope, as viewed on the oscilloscope, for distortion. Readjust T11 and T12 as necessary to eliminate any visible distortion.

k. Set the audio input to obtain 50% modulation. The input required should be less than 4 mV RMS. Increase the input 20 dB above 50% modulation. Check for normal waveform and modulation percentage. This should be 70% minimum upward and 90% minimum downward, 100% maximum.

l. Check all CB channels for clean modulation and absence of spurious oscillations.

m. Disconnect the audio generator and microphone jumper.

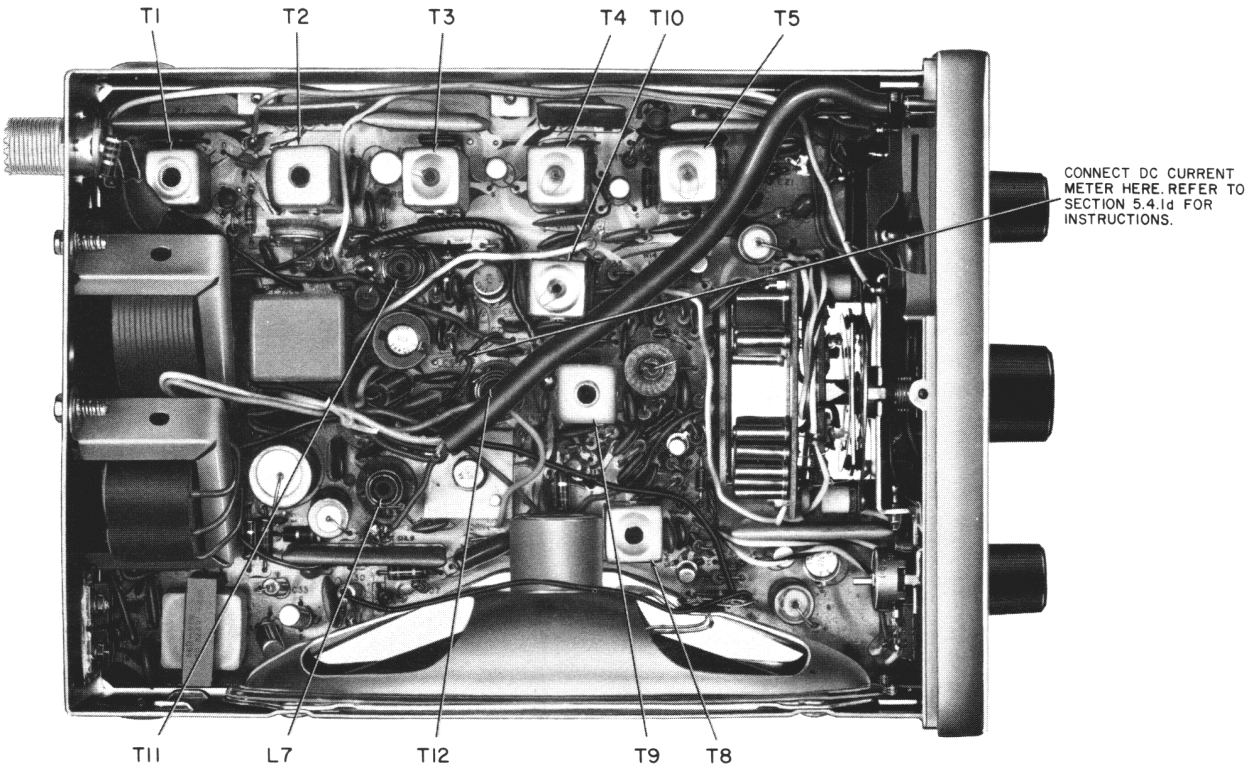
n. Key the transceiver and speak into the microphone. Check for proper modulation.

6.4 METER ADJUSTMENT

a. Set the channel selector to the blank channel between 22 and 23. With 13.8 VDC applied to the transceiver adjust R4 for a zero reading (pointer at left end of scale).

b. Key the transceiver and adjust R5 for a zero reading (pointer at left end of scale).

c. Set the channel selector to channel 23 and key the transceiver. The meter should read up scale (toward right).



ALIGNMENT POINTS
FIGURE 6-2

SECTION 7
PARTS LIST

SYMBOL NO.	DESCRIPTION	PART NO.
	ASSEMBLIES	
ASY1	Low pass filter	023-2763-001
ASY2	Cabinet assembly	023-2201-002
ASY3	Front panel assembly	023-2618-001
	Includes:	
	Front panel	015-0799-002
	Overlay, upper	559-2032-001
	Overlay, lower	559-2033-001
	Knob, channel indicator	547-0008-004
	Knob, volume & squelch	547-0008-001
	Dial, channel indicator	032-0154-101
	Chassis rail	017-1430-007
M1	Meter	554-0015-002
	Crystal switch assembly (See list of crystals for parts included)	583-2029-101
	Bracket, switch support	017-0679-001
R12	Potentiometer, squelch	562-0002-011
R11	Potentiometer, volume	562-0016-004
	Clip	016-1749-001
I1, I2	Incandescent lamp, unbased	549-3001-007
	Spring pin	537-9011-001
	"Rib-Loc" standoff	260-0102-001
L12	Inductor, 20μH	543-3002-002
	Tubing, 0.053ID	042-0240-500
	CAPACITORS	
C1	100pF ±5%, N150	510-3016-101
C2	6.8μF, 35V	510-2045-689
C3	0.01μF +80-20%, 50V	510-3003-103
C4	100pF ±5%, N150	510-3016-101
C5	22pF ±5%, N750, 200V	510-3020-220
C6	15pF, ±5%, mica	510-0004-150
C7	0.01μF +80-20%, 50V	510-3003-103
C8	270pF, ±5%	510-0001-271
C9	Same as C8	
C11	210pF, ±5%, N080	510-3015-211
C12	Same as C11	
C13	0.01μF, +80-20%, 50V	510-3003-103
C14	6.8μF, 35V	510-2045-689
C15	150pF, ±5%	510-0001-151
C16	190pF, ±5%, N150	510-1103-191
C17	0.1μF, +80-20%, 16V	510-3007-104
C18	190pF, ±5%, N150	510-1103-191
C19	0.033μF, ±20%, 16V	510-3010-333
C20	1.0μF, 35V	510-2045-109
C21	Same as C20	
C22	6.8μF, 35V	510-2045-689
C23	0.047μF, +80-20%, Y5U, 50V	510-3003-473
C24	0.01μF, +80-20%, 50V	510-3003-103
C25	Same as C24	
C26	1000μF, +100-10%, 16V	510-4006-005
C27	470μF, 2.5V	510-4001-006
C28	150μF, 25V	510-4006-006
C29	0.022μF, ±20%, Y5U, 50V	510-3002-223
C30	22μF, 15V	510-2003-220
C31	6.8μF, 35V	510-2045-689
C32	2.2μF, 35V	510-2045-229
C33	56μF, ±20%, 6V	510-2001-560
C34	150μF, 25V	510-4006-006
C35	0.22μF, ±20%	510-1004-224
C36	0.022μF, ±20%, Y5U, 50V	510-3002-223
C37	Same as C36	
C38	0.047μF, +80-20%, Y5S, 16V	510-3007-473
C39	Same as C38	
C40	33pF, ±5%, NPO, 200V	510-3013-330
C41	150pF, ±5%	510-0001-151
C42	47pF, ±5%	510-0001-470
C43	0.01μF, +80-20%, 50V	510-3003-103
C44	6.8pF, N750	510-3020-689
C45	18pF, N150	510-3016-101
C46	22pF, ±5%, N150, 200V	510-3016-220
C47	0.01μF, +80-20%, 50V	510-3003-103
C48	Same as C47	
C49	39pF, ±5%, NPO, 200V	510-3013-390
C50	82pF, N750	510-3020-820
C51	56pF, N150, 200V	510-3016-560
C52	0.01μF, +80-20%, 50V	510-3003-103
C53	68pF, ±5%, N150, 200V	510-3016-680
C54	0.01μF, +80-20%, 50V	510-3003-103
C55	Same as C54	
C56	Same as C54	
C57	Same as C54	
C58	56pF, N150, 200V	510-3016-560
C59	Same as C58	
C60	0.001μF, ±20%, 50V	510-3002-102
C61	22pF, ±5%, NPO, 200V	510-3013-220
C62	12pF, ±5%, N750, 200V	510-3020-120
C63	0.01μF, +80-20%, 50V	510-3003-103
C64	0.0047μF, ±20%, 50 VDC	510-3003-470
C65	0.001μF, ±20%, 50V	510-3002-102
C66	47pF, ±5%, NPO	510-3013-470
C67	47pF, ±5%, N150	510-3016-470
C68	0.001μF, ±20%, 50V	510-3002-102
C69	27pF, ±5%, NPO	510-3013-270
C70	100pF, ±5%, N150	510-3016-101
C71	330pF, ±5%	510-0001-331
C72	330pF, ±5%,	510-0004-331
C73	0.047μF, +80-20%, Y5U, 50V	510-3003-473
C74	Same as C73	
C75	.0047μF, ±20%, 125VAC	510-3001-472
C76	0.047μF, +80-20%, Y5U, 50V	510-3003-473
C77	0.01μF, +80-20%, 50V	510-3003-103
C78	0.0047μF, ±20%, 50 VDC	510-3003-472
	DIODES	
D1	1N67A	523-1000-067
D2	Same as D1	
D3	Same as D1	523-1000-295
D4	Same as D1	
D5	silicon, 50V	523-1000-001
D6	1N67A	532-1000-067
D7	silicon, 50V	523-1000-001
D8	1N881	523-1000-881
D9	Same as D8	
D10	Same as D8	
D11	Same as D8	
DZ1	zener, 10V	523-2003-100
DZ2	Same as DZ1	
E1	Insulator for T8 and L5	018-0817-004
	GROMMET	
G1	Grommet, rubber	574-0002-007

PARTS LIST (cont'd)

SYMBOL NO.	DESCRIPTION	PART NO.
	HARDWARE	
HW	Screw, 4-40 x 3/16, B.H., N.P.B. (board to rail)	011-0012-006
HW	Screw, 4-40 x 1/4, B.H., N.P.B. (audio transistors to rail)	011-0012-008
HW	Screw, 6-32 x 1/4, B.H., N.P.B., (front panel to rail)	011-0114-008
HW	Screw, 8-32 x 1/4, B.H., N.P.B. (cabinet to rail)	011-0221-008
HW	Screw, 8-18 x 3/8 cps, hex sheetmetal (L2 & T7 to rail)	011-0823-012
HW	Nut, 4-40, NPB (audio transistors to rail)	012-0823-012
	JACKS	
J1	Jack, power	515-4100-001
J2	Jack, PA	515-2001-002
	shoulder bushing for PA jack	029-0211-004
J3	Jack, antenna	142-0101-002
	SPEAKER	
LS1	Speaker	589-1002-002
	INDUCTORS	
L1	13μH, RF choke	542-3003-001
L2	18mH, filter choke	542-5007-001
L3	2.4mH	022-1193-001
L4	20μH	542-3002-002
L5	13μH, RF choke	542-3003-001
L6	Same as L5	
L7	series output	542-1005-010
L8	pi output	542-1005-004
L9	13μH, RF choke	542-3003-001
L10	Same as L9	
L11	20μH	542-3002-002
	HEAT SINK	
MP1	driver	013-1074-001
MP2	final	016-1773-001
	MICROPHONE	
MIC1	Microphone	023-2708-001
	MECHANICAL PARTS	
MP4	Terminal tab, solder type (for power jack)	515-4101-001
MP5	Dash mounting bracket	017-1249-001
	TRANSISTORS	
Q1	RF amp, receive	576-0003-012
Q2	Mixer, transistor	576-0003-025
Q3	IF amp	576-0003-010
Q4	Same as Q3	
Q5	squelch	576-0001-002
Q6	squelch, audio, gate driver	576-0001-003
Q7	Same as Q6	
Q8	audio driver	576-0001-009
Q9	audio output	576-0002-001
Q10	Same as Q9	
Q11	L.F.osc, H.F.osc, mixer	576-0003-024
Q12	Same as Q11	
Q13	Same as Q11	
Q14	1013	576-0001-013
Q15	RF amp, RF driver	576-0004-004
Q16	Same as Q15	
Q17	RF output	576-0004-005
	RESISTORS	
R1	62 ohm, ±5%, 1/2watt	569-1003-620
R2	150 ohm ±10%, 1/2watt	569-1004-151
R3	680 ohm, ±10%, 1/2 watt	569-1004-681
R4	Potentiometer, 2.0k ohm, 1/8 watt, thumb wheel	562-0004-202
R5	Potentiometer, 5.0k ohm, 1/8 watt, thumb wheel	562-0004-502
R6	3.3k ohm, ±10%, 1/2 watt	569-1004-332
R7	47 ohm, ±10%, 1/2 watt	569-1004-470
R8	1.0k ohm, ±10%, 1/2 watt	569-1004-102
R9	5.6k ohm, ±10%, 1/2 watt	569-1004-562
R10	10k ohm, ±10%, 1/2 watt	569-1004-103
R13	3.3k ohm, ±10%, 1/2 watt	569-1004-332
R14	470 ohm, ±10%, 1/2 watt	569-1004-471
R15	680 ohm, ±10%, 1/2 watt	569-1004-681
R16	27 ohm, ±10%, 1/2 watt	569-1004-270
R17	1.0 ohm, ±10%, 1/2 watt	569-2003-109
R18	22k ohm, ±10%, 1/2 watt	569-1004-223
R19	Same as R18	
R20	39k ohm, ±10%, 1/2 watt	569-1004-393
R21	33k ohm, ±10%, 1/2 watt	569-1004-333
R22	2.7k ohm, ±10%, 1/2 watt	569-1004-272
R23	Same as R22	
R24	470 ohm, ±10%, 1/2 watt	569-1004-471
R25	680 ohm, ±10%, 1/2 watt	569-1004-681
R26	120 ohm, ±10%, 1/2 watt	569-1004-121
R27	390 ohm, ±10%, 1/2 watt	569-1004-391
R28	120 ohm, ±10%, 1/2 watt	569-1004-121
R29	6.8k ohm, ±10%, 1/2 watt	569-1004-682
R30	39k ohm, ±10%, 1/2 watt	569-1004-393
R31	10k ohm, ±10%, 1/2 watt	569-1004-103
R32	330 ohm, ±10%, 1/2 watt	569-1004-331
R33	120 ohm, ±10%, 1/2 watt	569-1004-121
R34	2.2k ohm, ±10%, 1/2 watt	569-1004-222
R35	Same as R34	
R36	200 ohm, ±10%, 1/2 watt	569-1004-221
R37	120 ohm, ±10%, 1/2 watt	569-1004-121
R38	68 ohm, ±10%, 1/2 watt	569-1004-680
R39	33 ohm, ±10%, 1/2 watt	569-1004-330
R40	470 ohm, ±10%, 1/2 watt	569-1004-471
R41	3.3k ohm, ±10%, 1/2 watt	569-1004-332
R42	47 ohm, ±10%, 1/2 watt	569-1004-470
R43	120 ohm, ±10%, 1/2 watt	569-1004-121
R44	47 ohm, ±10%, 1/2 watt	569-1004-470
R45	47k ohm, ±10%, 1/2 watt	569-1004-473
R47	2.2k ohm, ±10%, 1/2 watt	569-1004-222
R48	330 ohm, ±10%, 1/2 watt	569-1004-331
	RELAY	
RY1	Relay, DPDT, PC mount	567-0011-001

PARTS LIST (cont'd)

TRANSFORMERS

SYMBOL NO.	DESCRIPTION	PART NO.
T1	27MHz, input	592-5016-001
T2	27MHz, RF amp	592-5006-002
T3	mixer	592-5016-005
T4	1st IF	592-5016-006
T5	2nd IF	592-5016-007
T6	audio driver	592-1007-004
T7	audio out/ modulation	592-1013-001
T8	32MHz, oscillator	592-5010-011
T9	26.5MHz, mixer	592-5008-011
T10	27MHz, xmit RF amp input	592-5023-001
T11	27MHz, xmit RF amp output	592-5014-001
T12	driver	592-5014-002

CRYSTALS

Crystal	Frequency	
Y1	5.735	519-0023-004
Y2	5.725	519-0023-003
Y3	5.715	519-0023-002
Y4	5.695	519-0023-001
Y5	6.190	519-0023-008
Y6	6.180	519-0023-007
Y7	6.170	519-0023-006
Y8	6.150	519-0023-005
Y9	32.700	519-0024-001
Y10	32.750	519-0024-002
Y11	32.800	519-0024-003
Y12	32.850	519-0024-004
Y13	32.900	519-0024-005
Y14	32.950	519-0024-006

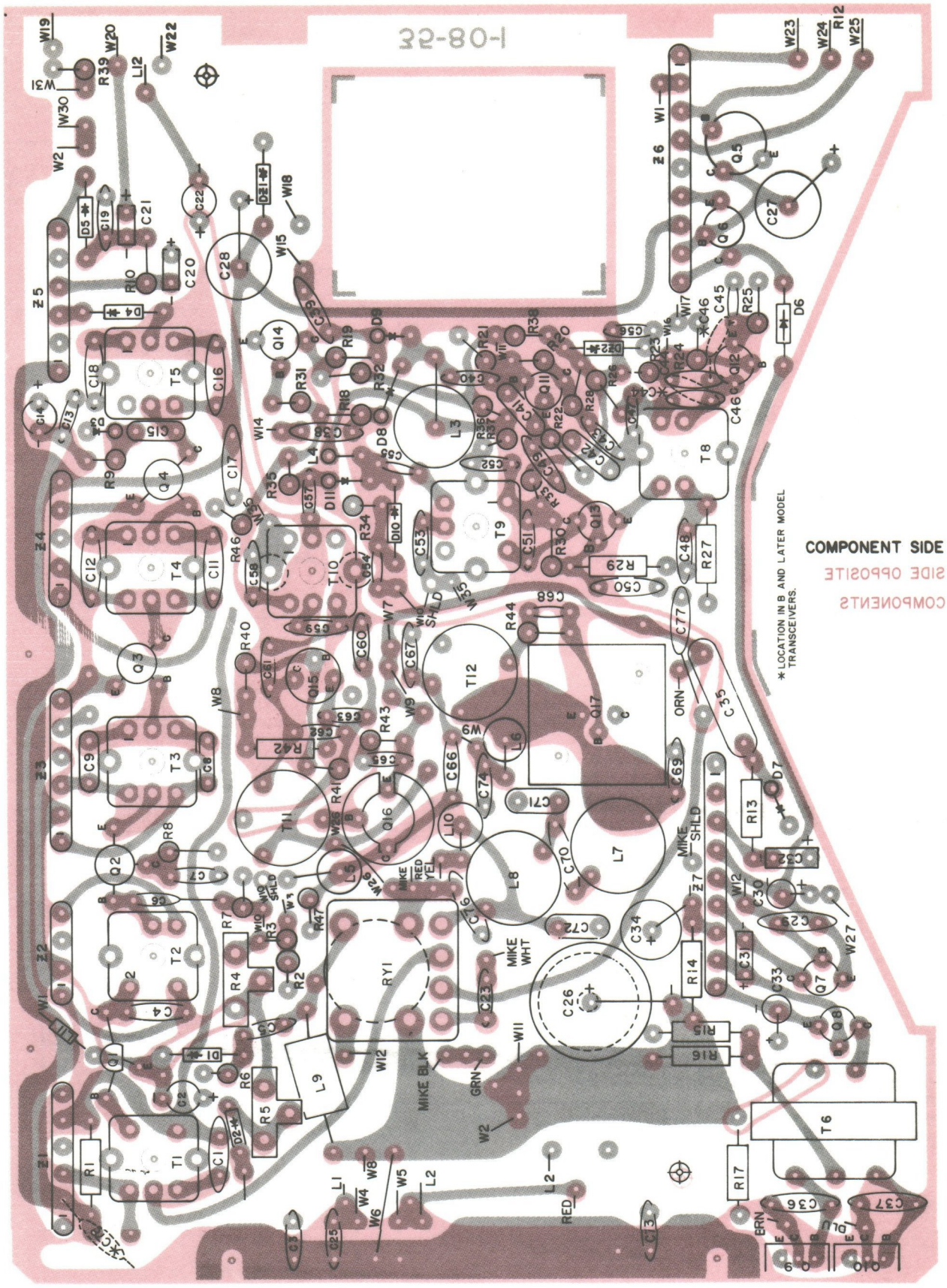
NOTE

When ordering crystals, specify if the crystal has an orange or red color code.

PEC

Z1	RF amp	544-0003-001
Z2	mixer	544-0002-001
Z3	1st IF	544-0003-003
Z4	2nd IF	544-0002-004
Z5	noise limiter	544-0002-015
Z6	squelch	544-0002-008
Z7	audio	544-0002-006

SYMBOL NO.	DESCRIPTION	PART NO.
	ACCESSORY PACKAGE ITEMS	
	Accessory Package	023-2576-001
	Operating Manual	002-0071-001
	FCC Rules-Part 95	022-1635-001
	License Application, FCC Form 505	022-1636-001
	Transmitter ID Card	564-1001-001
	Warranty Registration Card	041-0419-017
	Instruction Sheet	004-0022-001
	Tap Connector Assembly	023-2209-001
	Tap connector	515-9005-001
	Instructions envelope	559-4013-001
	Microphone Holder	537-9004-002
	Screws	011-0807-006
	Mounting Bracket Hardware	023-2615-001
	2 screws, No. 10-32 x 5/8	011-0229-020
	2 nuts, No. 10-32	012-0109-002
	2 lockwashers, No. 10	029-0001-003
	2 screws, 1/4 x 20 x 5/16	011-0322-010
	2 screws, 1/4 x 20 x 3/8	011-0322-012
	2 washers, cushion	018-0822-001
	2 screws, No. 10 sheet metal	011-0808-012
	2 screws, No. 8-32 x 1/4	011-0221-008
	2 screws, 1/4 - 20 x 3/4	011-0052-024
	2 nuts, 1/4 - 20	012-0011-001
	2 lockwashers, 1/4	029-0031-003
	3 screws, 1/4 sheet metal	011-0800-016
	2 screws, 10-32 x 1/4 slotted hex head	011-0358-008
	Reduced Schematic	564-3001-123
	Power Cable	023-1652-001
	Fuse holder, (1/4 dia. 1 1/4 long fuse)	534-1004-005
	Fuse, 2 ampere	534-0003-024
	Quick disconnect lead ass'y	023-2558-001
	Quick disconnect lead ass'y	597-0003-005
	Fuse, 1 ampere	534-0002-019
	Wire No. 18, stranded, red	071-0912-042
	Marker, fuse value (2 amp)	559-3009-002
	Marker, fuse value (1 amp)	559-3009-001



MESSENGER 123 CIRCUIT BOARD

ENGINEERING CHANGES

Serial Number stickers can be used as a guide to unit revisions, but should not be considered absolutely accurate in every instance. For example, a D Model unit might not include every D Model change, and an E Model might include an F Model change. These changes are listed as a servicing aid, they should not be considered absolutely accurate in all cases.

REVISION B

Components Changed	From	To	New Part Number	Reason
* C45	18pF, N750	100pF, N150	510-03016-101	To improve crystal starting
* C32	1.0μF	2.2μF	510-2045-229	Corrects a self modulation problem in transmit.

Components Added	Description	Part Number	Reason
C78	0.001μF, ±20%, 50V	510-3002-102	Improve receiver front end stability.

* Location changed on circuit board. Refer to the transparency for the location in Revision B transceivers.

REVISION C

Component Changed	Schematic Location	From	To	New Part Number	Reason for Change
Q2	A-4	3009	3025	576-0003-025	Oscillation
R31	C-4	22K	10K	569-1004-103	Q14 bias change
C16	A-8	Mica Disc	Polystyrene	510-1103-191	Oscillation
C18	A-8	Mica Disc	Polystyrene	510-1103-191	Oscillation
C27	B-3	470μF	47μF	510-4003-004	Squelch delay
Components Added					
C81	B-7	-	0.0047μF	510-3003-472	Increased modulation
R48	B-7	-	330 Ω	569-1004-331	Increased modulation
Components Deleted					
C78	A-1	(Connected from pin 4 of T1 to chassis)			Improvement no longer needed (See Service Manual Revision B)

REVISION D

Components Changed					
Q6	B-4	1003	3017	576-0003-017	Cost Reduction
Q7	B-6	1003	1013	576-0001-013	
Q8	B-7	1009	1013	576-0001-013	
Z7	B-6	2006	2026	544-0002-026	

REVISION E

Component Changed	Schematic Location	From	To	New Part Number	Reason For Change
C68	D9	Y5U	Y5S	510-3061-102	Improved cold weather performance
MK1	B10	Turner	E. F. Johnson	023-2708-001	Availability
Component Added		**Description**			
C79	B9	470 pF capacitor		510-3004-471	Improved EFJ microphone performance
Component Deleted					
C23	B9	0.047 μF coupling capacitor			Not required with EFJ microphone

REVISION F

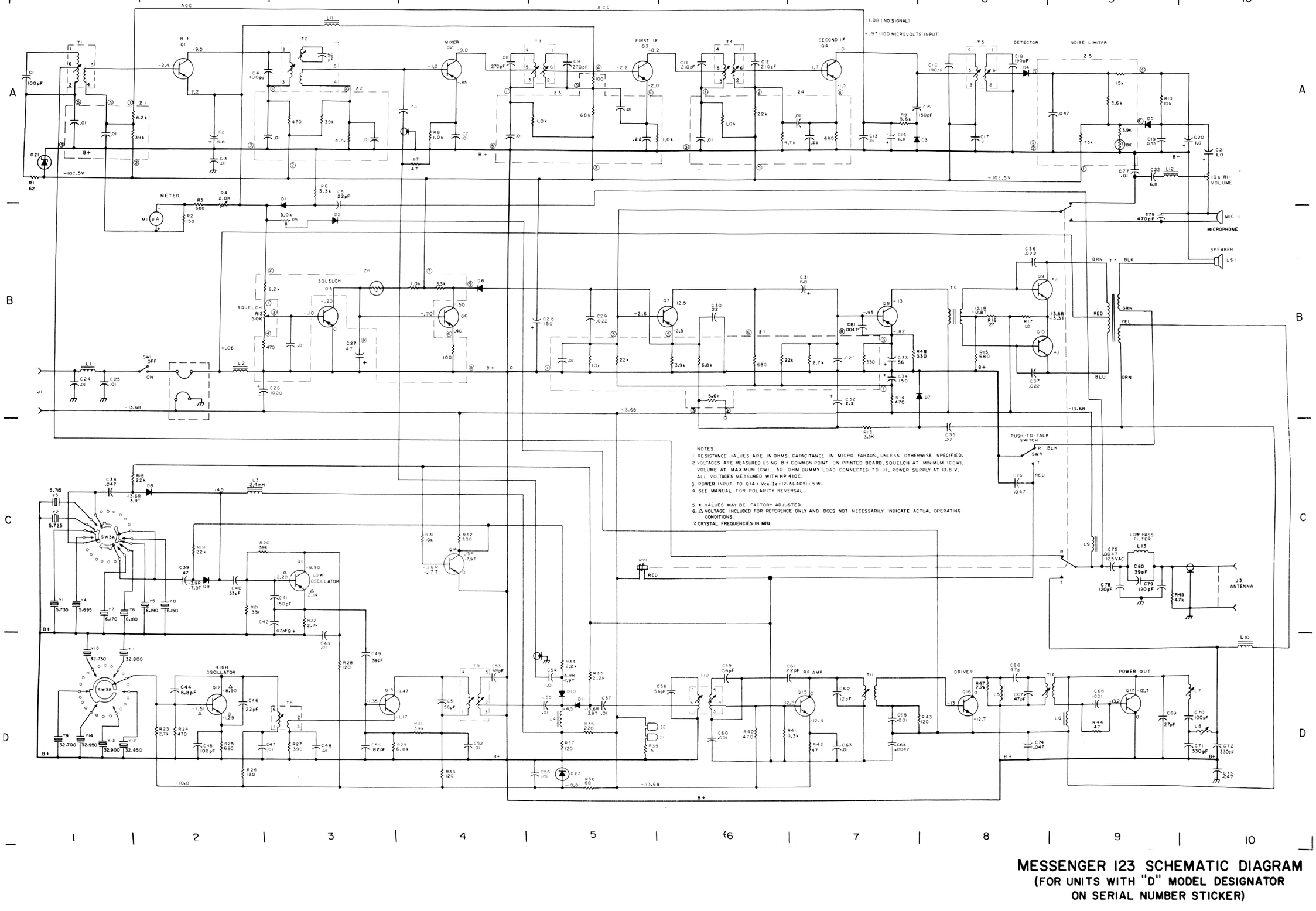
Component Changed	Schematic Location	From	To	New Part Number	Reason For Change
D8	C2	0881	0882	523-1000-882	Transmitter crystal starting
D9	C2	0881	0882	523-1000-882	Receiver crystal starting
Q2		3025	3009	576-0003-009	Availability
Q11, 12 and 13		3024	3008	576-0003-008	Availability
Component Added		**Description**			
L3 and R49 network	C2	220 μH choke in series with a 1K ohm resistor		542-2004-221 and 569-1002-102	Low frequency crystal dropout
Component Deleted					
L3	C2	2.4 mH choke			Replaced with new L3 and R49 network

REVISION G

Component Changed	Schematic Location	From	To	Reason For Change
C38	C1	0.047 μF	jumper wire	Prevents 30 pF crystal dropout
C39	C2	0.047 μF	jumper wire	Prevents 30 pF crystal dropout

Refer to the back side for field rework procedure.

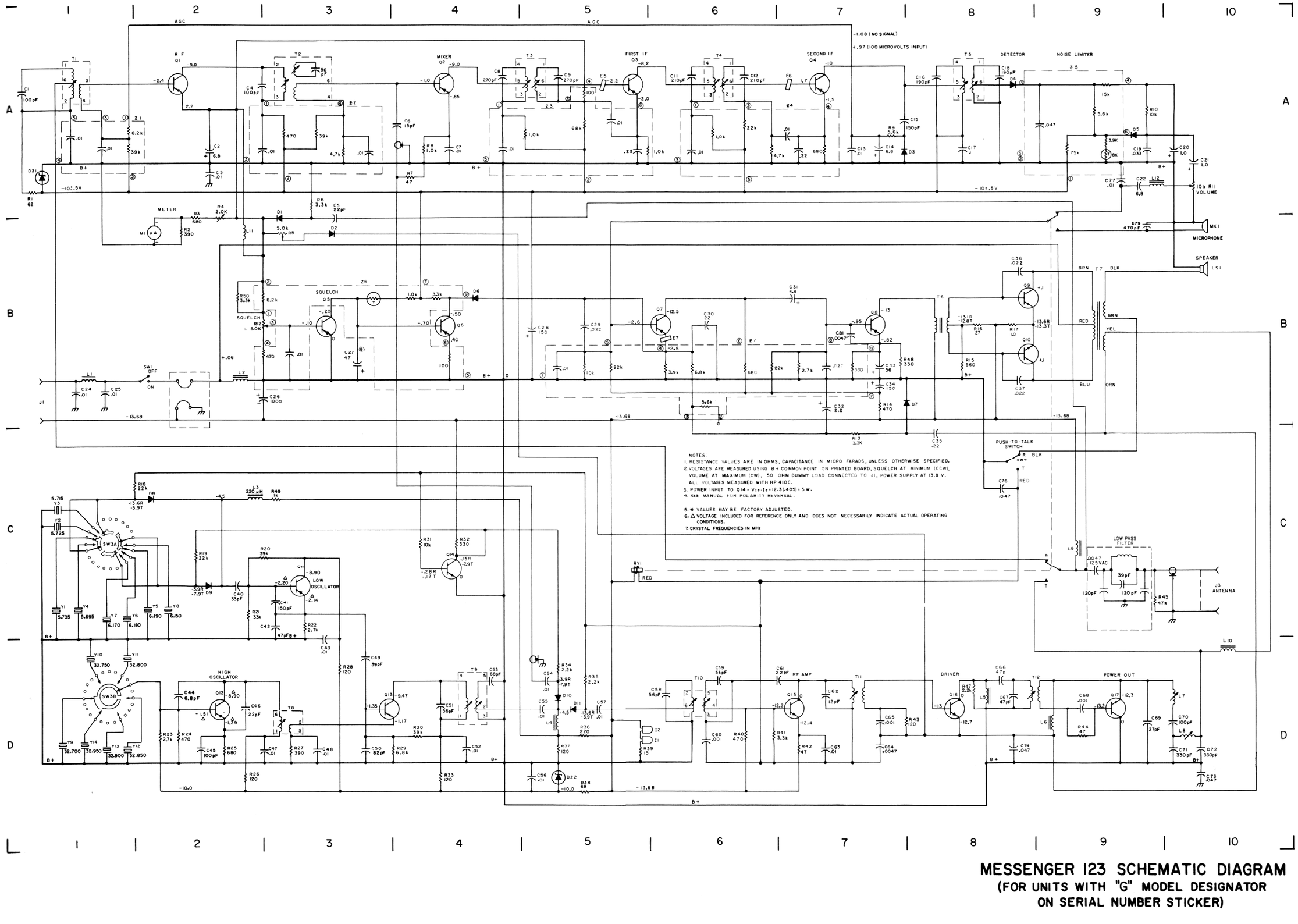

MESSENGER 123 CIRCUIT BOARD
COMPONENT SIDE
SIDE OPPOSITE COMPONENTS
32-80-1
*LOCATION IN B AND LATER MODEL TRANSCEIVERS.
Z1
Z2
Z3
Z4
Z5
Z6
Z7
W1
W2
W30
W31
W19
W20
W22
W23
W24
W25
R39
R12
L12
C14
C19
C21
C20
C22
C28
D5
D4
D21
W18
W15
W14
Q14
R31
R35
R46
C17
C16
C18
R9
R10
Q4
T5
T4
T3
T2
T1
C11
C12
C9
C8
C7
C6
C5
C4
C2
C1
D1
D2
R1
R2
R3
R4
R5
R6
R7
R8
Q1
Q2
Q3
W8
R40
C58
C61
C59
C60
C62
C63
R42
R41
T11
L5
W26
Q15
Q16
C65
R43
W7
W9
C67
W10
SHLD
C66
L10
C74
W9
T12
L6
R44
C68
Q17
C69
C71
C70
L7
C72
C76
L8
C23
MIKE
WHT
C26
W11
L2
RED
GRN
W2
MIKE BLK
RY1
W12
L9
L1
W4
W8
W6
W5
L2
C25
C3
C13
R16
R15
R14
R17
MIKE
SHLD
ORN
C77
C48
R27
C50
R29
R30
Q13
C49
R31
C51
T9
C52
C53
W35
D10
R34
C54
C55
D8
R32
D9
L3
C40
R36
R37
R21
W11
C41
Q11
R38
R22
C42
C43
R28
R26
D12
C56
C47
C44
R23
R24
W16
W17
C46
C45
R25
D6
Q12
T8
C46
Q6
Q5
C27
C35
C31
C30
C32
C29
C33
Q7
Q8
W27
R13
D7
T6
C37
C36
Q10
Q9
DLU
ERN



NOTES:

1. RESISTANCE VALUES ARE IN OHMS, CAPACITANCE IN MICRO FARADS, UNLESS OTHERWISE SPECIFIED.
2. VOLTAGES ARE MEASURED USING B+ COMMON POINT ON PRINTED BOARD, SQUELCH AT MINIMUM (CCW), VOLUME AT MAXIMUM (CW), 50 OHM DUMMY LOAD CONNECTED TO J1, POWER SUPPLY AT 13.8 V. ALL VOLTAGES MEASURED WITH HP 410C.
3. POWER INPUT TO Q14 = $V_{CE} \times I_E = 12.3 \times (.405) = 5$ W.
4. SEE MANUAL FOR POLARITY REVERSAL.
5. * VALUES MAY BE FACTORY ADJUSTED.
6. △ VOLTAGE INCLUDED FOR REFERENCE ONLY AND DOES NOT NECESSARILY INDICATE ACTUAL OPERATING CONDITIONS.
7. CRYSTAL FREQUENCIES IN MHz

MESSENGER 123 SCHEMATIC DIAGRAM
(FOR UNITS WITH "D" MODEL DESIGNATOR ON SERIAL NUMBER STICKER)



MESSENGER 123 SCHEMATIC DIAGRAM

(FOR UNITS WITH "G" MODEL DESIGNATOR ON SERIAL NUMBER STICKER)

QUALITY ELECTRONIC PRODUCTS SINCE 1923

E. F. JOHNSON COMPANY
WASECA, MINNESOTA 56093

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