JOHNSON

MESSENGER
100
110

CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-110
MODEL NO. 242-152
MODEL NO. 242-156

Third Printing
Covers Messenger 100/110 Models
August, 1975

SERVICE MANUAL

MESSENGER

100

110

CITIZENS RADIO TRANSCEIVER
MODEL NO. 242-110
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SECTION 1
GENERAL INFORMATION

1.1 SCOPE OF THIS MANUAL

This service manual includes servicing and alignment instructions for the Messenger 100 and 110 Transceivers. A special section on installation and mobile noise suppression is included. 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 a complete system diagram. Especially important are accessories used, attachments and modifications effected during or after installation.

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. In case 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

1.5 DESCRIPTION

The Messenger 100, Model 242-152-1/23 and Messenger 110, Model 242-110-1/23 are 6 and 5 channel respectively, Citizens Band Transceivers. The basic transceivers weigh 5-1/2 pounds and are completely solid state. Supply voltages to operate the transceivers are provided by the vehicle's battery in mobile operation or by an AC operated

13.8 Volt DC output power supply in base station operation. Specific references in this service manual to either the Messenger 100 or 110 will be made only where differences exist.

NOTE: An early model Messenger 100, Model No. 242-156-1/23, is identical to the Messenger 110 except that it has an illuminated channel indicator as in the current Messenger 100.

SECTION 2
SPECIFICATIONS

2.1 GENERAL

Frequency Range	26.965 - 27.255 MHz
Channels	Six (Messenger 110 has five)
Dimensions of Enclosure	2-1/2" high x 6-3/16" wide x 8-3/4" deep
Unit Weight	Approximately 5 lbs.
Shipping Weight (one unit)	Approximately 6 lbs.
Microphone	High capacity (low impedance) ceramic element. Cycolac case. Push-to-talk switch, hang up stud.
Circuitry	14 transistors, 7 diodes, and a thermistor

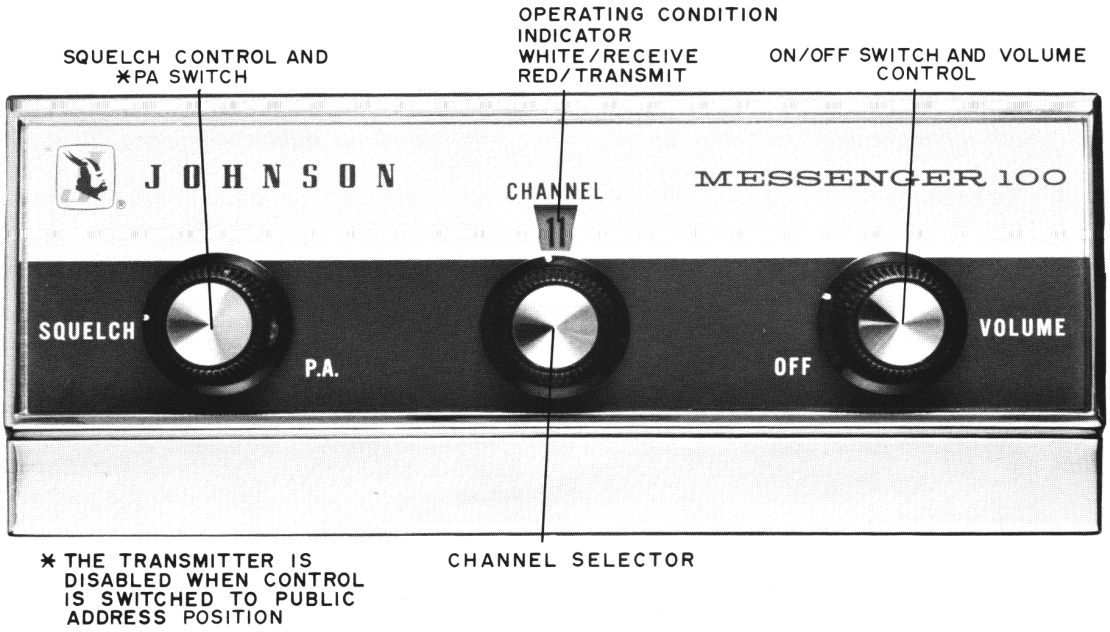
2.2 RECEIVER

(All microvolts are at antenna terminal and numbers are 1/2 the microvolts into a 50 ohm 6 dB pad.)

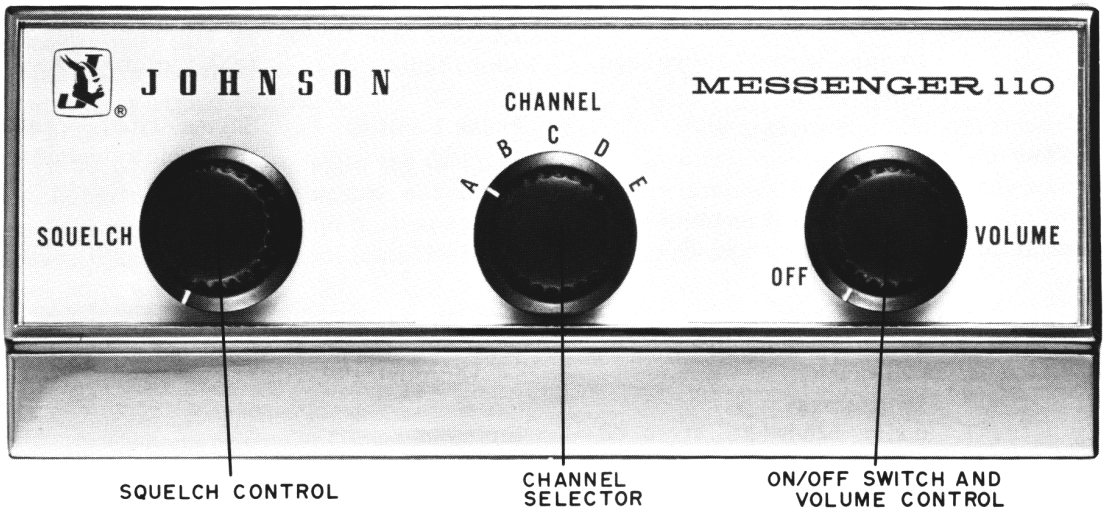
Sensitivity	8 dB minimum at 0.5 microvolts
Selectivity	6 kHz bandwidth at -6 dB (nominal) 30 kHz bandwidth at -60 dB (nominal)
Spurious Rejection	45 dB except image of 20 dB (nominal)
Antenna Impedance	50 ohms (nominal)
Audio Output Power	3 watts minimum at 10% distortion with 5 microvolts input
Speaker Impedance	3.2 ohms (nominal)
Squelch Range	15 microvolts minimum
Squelch Sensitivity	1 dB or less signal change for 40 dB of quieting at 1 microvolt.
Squelch Noise Immunity	Highly immune to impulse-type noise
Intermediate Frequencies	455 kHz
AGC Characteristics (See Figure 11)	20 ±10 dB roll-off from 500 to 0.5 microvolts
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 +60°C.
DC Power Input to Final	5 watts maximum at 13.8 VDC

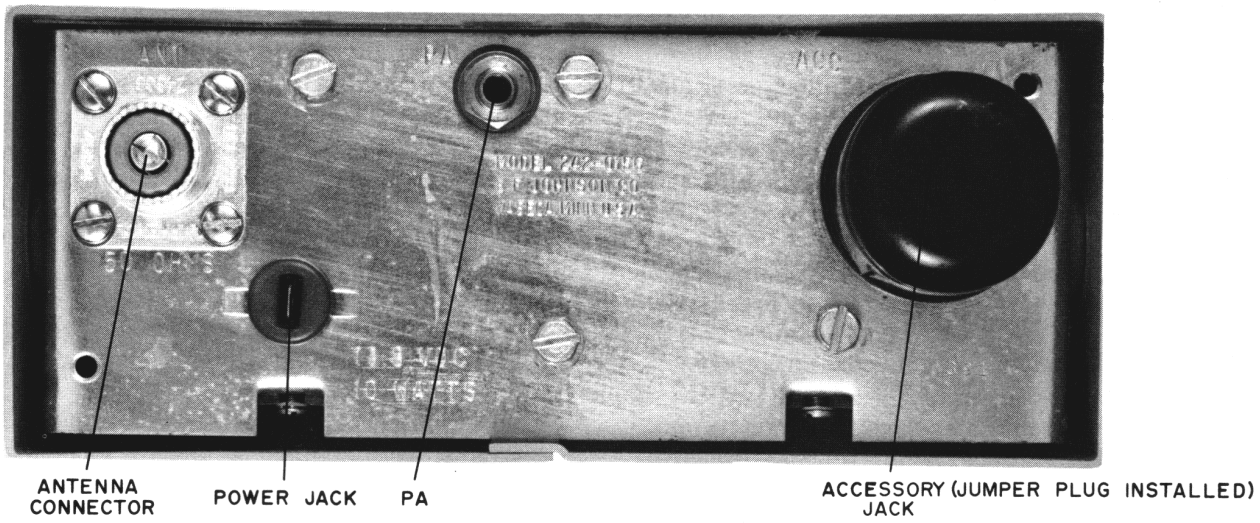


FRONT VIEW
MESSENGER 100

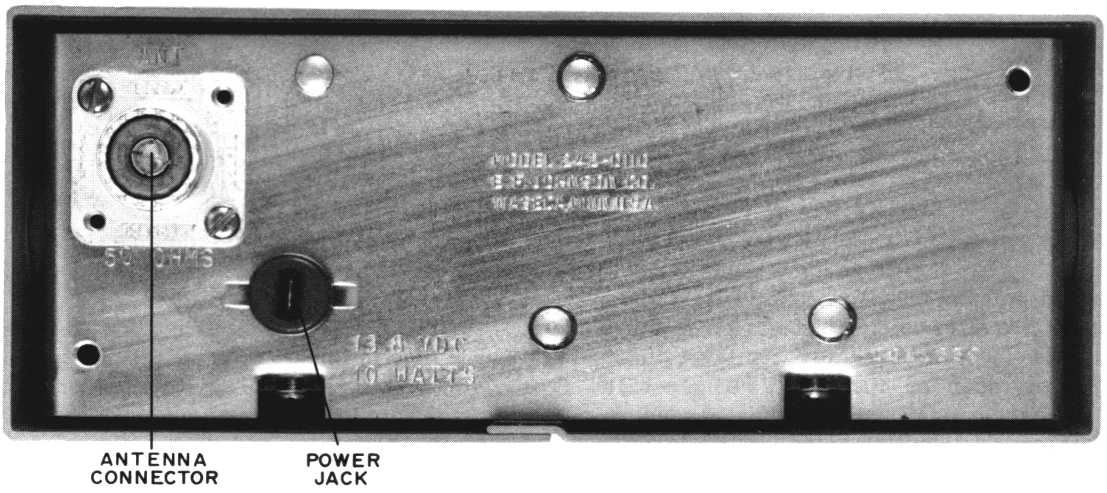


FRONT VIEW
MESSENGER 110

FIGURE 1



REAR VIEW
MESSENGER 100



REAR VIEW
MESSENGER 110

FIGURE 2

SPECIFICATIONS (cont'd)

RF Power Output	3 watts minimum at 13.8 VDC 2.8 watts for 110
RF Spurous and Harmonic Attenuation	Better than FCC and DOT requirements. (FCC and DOT type accepted)
Output Impedance	50 ohms (nominal)
Audio Input Impedance	1000 ohms (nominal)
Audio Frequency Response	±4 dB 400-3000 Hz
Modulation	High level AM, class B modulator, speech compression, clipping and audio filtering
Circuitry	70% minimum upward

2.4 POWER REQUIREMENTS

13.8 Volt DC input (EIA Standard)

Receive	0.1 - 0.3 amps
Transmit	0.6 amps

117 Volt AC (Power Supply Model No. 239-125)

Receive	4 watts
Transmit	8 watts

2.5 ACCESSORIES

AC Power Supply	Model No. 239-125
CB Matchbox	Model No. 250-49
"Antenna Meter"	Model No. 250-849
In-Converter	Model No. 239-120
Tone-Alert	Model No.250-861 (for Messenger 100 only)
Power Supply with Tone-Alert	Model No.239-123 (for Messenger 100 only)
Power Pack	Model No. 250-854-2

SECTION 3
VEHICLE INSTALLATION

3.1 GENERAL

A good antenna installation is essential for satisfactory transceiver performance. Select a good antenna location carefully. A level unobstructed area, such as the roof, will generally provide the best ground plane. When necessary, the trunk lid area will suffice as an antenna location but generally it is not as desirable as the roof area. In most instances, the hood area is generally unsuitable for antenna installation and use of this area for antenna mounting should be discouraged.

When selecting the antenna location consider the easiest and shortest route for the transmission line.

The transceiver should be mounted with the best maintenance accessibility and operating convenience in mind. Avoid mounting the transceiver in the direct hot air stream of the vehicle's heater.

If possible, connect the "hot lead" from the power plug to the accessory section of the ignition switch. This gives the operator the added feature of being able to turn the transceiver on and off with the ignition switch.

When installing the Messenger it is recommended that the following sequence of installation operations be followed.

3.1.1 INSTALLATION SEQUENCE

CAUTION:

Avoid installing the Messenger in the direct air stream from the vehicle's heater as temperatures in this area can measure to 150°F which

can result in component failure.

1. Install the antenna and transmission line.

2. Install the transceiver's dash mounting bracket with the hardware provided.

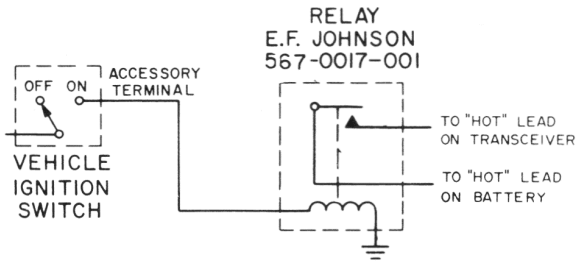
3. Install the microphone holder.

4. Install the transceiver in the dash mounting bracket.

5. Connect the "hot" wire to the accessories section of the ignition or to the "hot" side of the battery.

NOTE:

In some cases of severe DC line noise, the accessory terminal is not a desirable place to obtain B+ for the transceiver, as the windshield wipers, heater, turn signals, air conditioning, windshield washer and ignition sometimes all draw from the same line. Although the transceiver contains a noise filter it may not remove all noise generated on the accessory line. In this case, a direct line to the battery, or an accessory switch operated relay connected directly to the battery, is a good solution. See Figure 3.



CONNECTIONS FOR ACCESSORY SWITCH OPERATED POWER RELAY
FIGURE 3

6. Trim the antenna for minimum VSWR.

7. Test drive the vehicle.

8. Instruct the operator in the proper operation of the Messenger and correct voice communications procedures.

3.1.2 ANTENNA AND TRANSMISSION LINE INSTALLATION

1. Locate the area selected for mounting of the antenna. Drill the holes necessary to mount the antenna.

2. Route the transmission line from the antenna location to the transceiver. Keep the transmission line as short as possible. Refer to Figure 4 for the correct method of installing UHF connectors. When the installation of the transmission line is complete, check for continuity between the center conductor and the antenna with the antenna end of the transmission line connected. Also check for a shorted transmission line by disconnecting both ends of the line and measuring the resistance between the inner and outer conductors.

3.1.3 TRANSCEIVER INSTALLATION

1. Select the transceiver's mounting location. Make sure it is not in the direct air stream of the vehicle's heater. Using the mounting bracket as a guide drill the bracket mounting holes. Secure the mounting bracket.

2. Install the transceiver in the mounting bracket. Tighten the mounting bracket to the transceiver's cabinet.

3. Install the microphone holder.

3.1.4 ANTENNA TRIMMING

1. Insert a Johnson Model 250-849 VSWR bridge or a thruline wattmeter into the transmission line.

2. Key the transmitter and trim the antenna for the best VSWR. This should be a ratio of 1.5:1 or better.

3.1.5 OPERATIONAL CHECKOUT

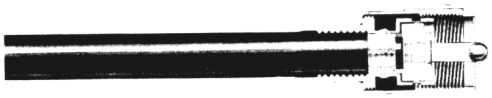
1. While test driving the vehicle give the trans-

RG-8/U

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

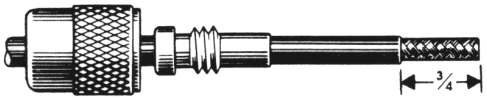
Bare 5/8" of center conductor. Trim braided shield. Slide coupling ring on cable. Tin exposed center conductor and braid.

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.

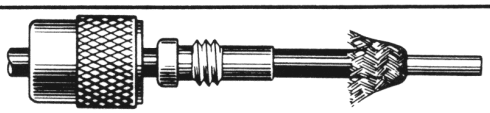


For final assembly, screw coupling ring on plug sub-assembly.

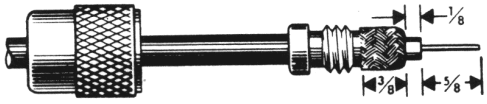
RG-58/U



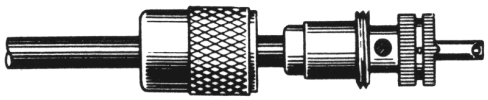
Cut end of cable even. Remove vinyl jacket 3/4". Slide coupling ring and adapter on cable.



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.

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UHF COAXIAL CONNECTORS
ASSEMBLY INSTRUCTIONS
FIGURE 4

ceiver a complete operational checkout. Make several contacts with the base station. If vehicle noise degrades the transceiver's performance, read the section on noise suppression and take appropriate action to correct any noise suppression deficiences.

3.2 NOISE SUPPRESSION

3.2.1 NEED FOR NOISE SUPPRESSION

Any radio installed in an automobile or truck has to contend with electrical noise generated by the engine's ignition system and generator system when the engine is running. Of course, when the engine is not running, the noise is not present. However, if the radio is to be really useful and versatile , it must be abe to receive the weaker radio signals while the vehicle is traveling at reasonably high rates of speed. Unfortunately, the electrical noise from the engine increases as the engine speed increases. This noise takes the form of whining, popping, crackling, etc. and can make it difficult to understand a voice through the interference. It can completely "cover up" weak signals when the vehicle is operating at extended distances from the base station or other mobile stations (in "fringe areas"). Therefore, the electrical noise from the engine will materially determine the amount of "range" that the mobile station has while it is in motion and how fast the vehicle can travel at any given range and still satisfactorily receive the base station.

3.2.2 CAUSES OF IGNITION NOISE

The engine of any vehicle contains at least a dozen or more tiny "spark" radio transmitters such as spark plugs, regulator points, distributor points, generator brushes etc. The ignition wiring of the engine acts as an antenna to radiate the radio noise from these arcs into the radio. Additional noise may be generated by unnecessary arcs which are caused by poor connections. Loose connections between the spark plugs and the connectors on the spark plug wires or between the wires and the distributor cap cause unnecessary arcs. Another noise source is the build-up of static electricity on moving parts of the engine and its accessories, such as the armature of the generator. When these charges of static electricity "discharge", the effect is much the same as a bolt of lightning only on a much smaller scale. Due to the fact that the car body is usually used as part of the electrical circuit (ground return) for lights, accessories and ignition system, small arcs may occur between various parts of the car body that are not properly bonded together electrically. These small arcs also generate noise.

Spark plug noise is identified by a regular popping noise which increases with engine speed. Generator noise is characterized by a whining sound which also increases with engine speed. Regulator noise creates an uneven, rasping sound only when the generator is charging.

3.2.3 METHODS OF SUPPRESSING IGNITION

One of the first methods of reducing ignition noise is to insure that the ignition system of the engine is in good condition and working properly. This means that the distributor points and condenser should be in good condition and the points properly adjusted. The regulator points should be free from pitting and should be properly adjusted. The spark plugs should be clean and properly adjusted. The generator brushes and commutator should be in good condition and the brushes properly seated. The generator cover should be free of paint and grease that might prevent good electrical connection to the generator frame. All connections in the high voltage wires between the spark plugs and the distributor should be making good contact. Soldering the wires to the connectors on the ends of the wires will insure this. All other connections in the ignition system should be free of corrosion and thoroughly tightened. All the wires in the distributor cap should be pushed as far into the cap as they will go. The high voltage wire to the coil should also be pushed into its socket as far as it will go. The inside of the distributor cap should be free of any dirt or carbon deposits since they can cause arcing between the distributor terminals.

When the entire ignition system is in good condition, the next step toward suppressing ignition noise is to install noise suppressing devices in the ignition wiring of the engine. The noise suppressing devices to be installed consist mainly of distributor and spark plug suppressors, coaxial capacitors and shielded wires. The distributor and spark plug suppressors are small devices

similar to radio resistors, which are inserted in the distributor and spark plug wires. They suppress the electrical noise caused by the spark plugs and distributor. The coaxial capacitors are highly efficient electrical devices which "filter out" or "bypass" directly to ground (ground is the car frame, body or engine) the electrical noise caused by the generator and regulator. The shielded wires provided are to prevent the escape of any remaining noise from the generator and regulator wires.

3.2.4 RESISTOR-TYPE SPARK PLUGS

Resistor-type spark plugs may be installed in place of the regular spark plugs. Resistor-type spark plugs are normally "quieter" than standard plugs with suppressors. Since resistor-type spark plugs are standard equipment on some of the later model cars, they should be checked before resistor-type plugs are purchased. Spark plug suppressors should not be used with resistor spark plugs.

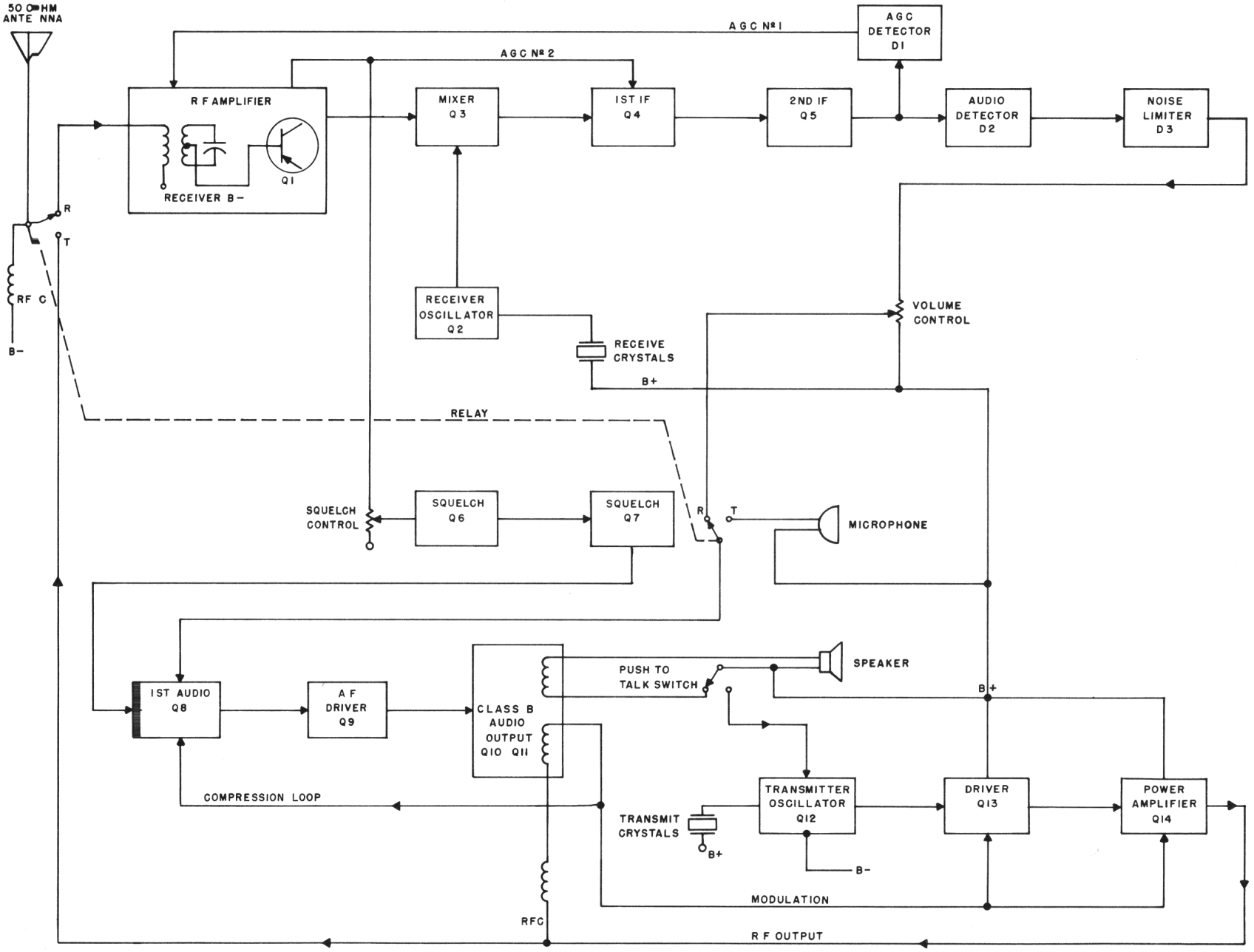
Radio resistor ignition wire is standard equipment on most late model vehicles. If the vehicle does not have radio resistor ignition wire, then it should be installed.

3.2.5 ADDITIONAL NOISE SUPPRESSION MEASURES

1. Installing short lengths of heavy shield braid or metal straps between various parts of the automobile and engine to improve the electrical bonding will usually reduce interference in the more stubborn cases. These straps should be installed between the firewall and the engine, the engine and the frame, the generator and the frame (or the engine or both), the exhaust pipe and the frame (in one or more places) and in some cases the hood to the frame or firewall. Be sure the cases of the coil and the regulator are well grounded also.

2. In stubborn cases of generator whine, a carbon brush (mounted on a short spring-loaded bracket) which rides on the end of the generator shaft will usually reduce this interference. Be sure the brush and bracket are well grounded to the generator or car frame with a short connection .

3. Some interference may be caused by the dash instruments, accessories (such as electric windshield wipers, heater blowers and fans, etc.) and the lighting system. In cases where this interference is objectionable, it may be reduced by installing bypass capacitors from the terminals of the troublesome instruments or accessories directly to ground (car frame or dash, etc.). The wire leads of the capacitors should be kept as short as possible. These capacitors should be of the mica or ceramic disc variety and should be from 0.001 μF to 0.01 μF.



MESSENGER 100 & 110
BLOCK DIAGRAM
FIGURE 5

SECTION 4
CIRCUIT DESCRIPTION

4.1 RECEIVER

The Messenger receiver is a completely solid state single-conversion superheterodyne unit. The intermediate frequency is 455 kHz.

You should become familiar with the tranceiver by studying the schematic diagram found at the back of the manual, and the block diagram, Figure 5, while following the receiver circuit description.

4.1.1 RF AMPLIFIER

The incoming signal is coupled to the base of the RF amplifier, Q1, through C39, a set of contacts on the relay and the input transformer L1. The signal is amplified by Q1 and applied to the base of mixer stage, Q3, through L2.

4.1.2 MIXER

The output of the crystal oscillator, operating 455 kHz below the signal from the RF amplifier, from the secondary of L3 is directly injected to the emitter of the mixer stage, Q3. The mixer output transformer, L4, is tuned to the difference frequency or to 455 kHz.

4.1.3 OSCILLATOR

The crystal oscillator, Q2, is a grounded base type using a third overtone crystal. The oscillator operates at 455 kHz below the incoming received signal.

4.1.4 IF

The receiver IF section consists of IF amplifiers Q4, Q5 and double tuned transformers, L5 and L6.

The IF output is taken off the collector of Q5 and coupled to the detector diode D2 by transformer L6. A small portion of the output of the second IF amplifier is coupled by C15 to a rectifier filter network consisting of D1, R8, 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.

4.1.5 AGC

An increase in the gain of the second IF amplifier, the ultimate 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 L1. A positive going voltage appearing at the base of Q1 tends to reduce 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, Q4. Therefore, any change in the emitter voltage of Q1 will be felt on the base of Q4. This results in a gain reduction of the first IF amplifier, Q4.

4.1.6 AUDIO

The audio from the detector diode, D2, 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 is coupled through the relay contacts to the base of the audio pre-amplifier, Q8. The amplified signal is then coupled to the audio driver stage, Q9, for further amplification. Q9 furnishes power to drive the

Class B output stage, Q10 and Q11. The driver transformer, T1, provides the proper impedance match between the collector of Q9 and the bases of the Class B stage. The output of the Class B amplifier is transformed by T2 and applied to the speaker. Transformer, T2, 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 T2 and from T2 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, Q8.

4.1.7 SQUELCH

In the squelched condition, Q7, the second squelch amplifier is turned off. Its collector voltage is several volts more negative than the emitter of the audio amplifier, Q8. In this condition diode D5 is forward biased. With D5 forward biased the emitter of Q8 is at the same potential as the collector of Q7 minus the drop across D5. The base emitter junction of Q8 is reverse biased and turns 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 Q6 to go more positive. As the base bias of Q6 goes positive, the stage is conducting less and its collector voltage is increasing. The collector of Q6 and the base of Q7 are direct coupled and therefore at the same electrical potential. The rising collector voltage of Q6 tends to turn Q7 on. The harder Q7 conducts the more the collector voltage drops. When the collector voltage of Q7 becomes less than the emitter voltage of Q8, diode D5 becomes reverse biased. With D5 reverse biased, Q8 becomes forward biased and the audio is enabled.

Squelch temperature compensation is provided by thermistor RT14.

4.2 TRANSMITTER

Refer to the schematic and block diagram, Figure 5, while following the transmitter circuit description.

4.2.1 AUDIO

The audio signal from the microphone during transmit condition is coupled through the relay contacts to the base of the audio pre-amp, Q8. The signal is amplified by Q8 and Q9 and coupled through the driver transformer, T1, to the bases of the Class B audio output stage, Q10 and Q11. The amplified audio signal from Q10 and Q11 is coupled through the orange and yellow leads on T2 to provide modulation of the driver, Q13, and power amplifier, Q14.

Audio compression is also provided in this unit by rectifying part of the signal appearing at the secondary of T2. This signal is applied to the emitter of the 1st audio stage, Q8. 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 T2. This in turn places a higher voltage at the emitter of Q8 and reduces its gain, thus maintaining a relatively constant audio level for a given input signal.

4.2.2 OSCILLATOR

The transmitter oscillator, Q12, is a modified Colpitts type. The oscillator utilizes a third overtone crystal to produce low level RF signals in the 26.965 to 27.255 MHz range. There is no frequency multiplication. The crystal oscillates at the carrier frequency. Temperature compensation is provided by capacitors C42 and C43. Transformer L10 provides frequency tuning.

4.2.3 DRIVER

The driver raises the power of the RF signal from the oscillator to a level sufficient to drive the power amplifier, Q14.

4.2.4 POWER AMPLIFIER

The power amplifier, Q14, is operated Class C and designed to operate at 5 watts DC power input. Q14 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.

SECTION 5
MAINTENANCE

5.1 CRYSTAL INSTALLATION

a. Remove the Messenger from its mount and disconnect the power lead and antenna cable at the rear of the cabinet.

b. Remove the two screws at the side of the cabinet.

c. With the cabinet on a flat surface, grasp the front panel and carefully withdraw the panel and chassis assembly from the cabinet. The chassis will slide out easily, do not force.

d. Note that the crystal sockets are marked by letters corresponding to positions on the channel switch. The marking REC indicates the location of receiver crystals and TRANS indicates the location of transmitter crystals. Each crystal is marked by channel number and by function. For example, a crystal marked R5 is a receiver crystal for channel 5 and should be used with a transmitter crystal marked T5. Receiver and transmitter crystals must have the same channel number and be placed in the crystal sockets bearing the same letter designation to provide operation on that channel.

Carefully re-install the chassis in the cabinet. Be sure that the protective rubber grommet on the microphone cable is seated in the notch in the cabinet and the cabinet is seated in the panel groove. Insert and tighten the two cabinet screws at the side of the cabinet. Connect the antenna and power lead. The unit is now ready for operation.

Record the channel number opposite the channel switch position letter, so that you will know precisely which channels you have set up and the corresponding channel switch position.

Merely select the desired channel of operation by use of the Channel Selector switch. Operation is instantaneous and channels may be changed as often or as rapidly as desired. Avoid operating the Messenger on channel positions which have no crystals inserted.

5.2 CHANNEL SELECTOR DIAL REPLACEMENT

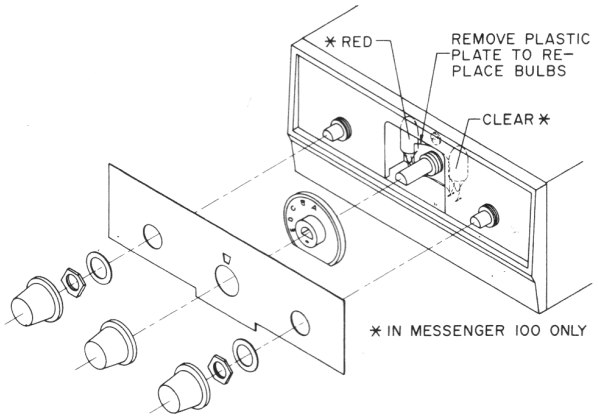
You may find it desirable to have your Messenger channel indicator dial read in numbers. The following procedure is recommended to facilitate making this change.

To prevent errors, we suggest that you first make a list relating the channel positions to channel numbers. For example:

A = Channel 1
B = Channel 7
C = Channel 9
D = Channel 11
E = Channel 13

Use this list to set up the channel numbers on the dial. The channel numbers, supplied with the Messenger, are die cut to fit the channel selector dial, and are adhesive backed for easy mounting. A pair of tweezers will be found useful for removing the numbers from the card and attaching them to the dial. Fold the card on the perforated line--tear

the card on this line to expose one edge of that row of numbers. Replace this portion of the card to protect the adhesive backing on the remaining numbers in that row. Use Figure 6 as a guide for the following channel selector dial conversion.



FRONT PANEL EXPLODED VIEW
FIGURE 6

a. Loosen the set screws and remove the three front panel knobs.

b. Remove the two nuts and washers on the two outside controls.

c. The front panel overlay can now be removed.

d. Remove the channel dial by carefully sliding it from the channel selector switch shaft.

e. Peel off the lettered mask on the dial face.

f. TURN THE DIAL AROUND and place the channel numbers in the spaces corresponding to the letters you previously listed (letters are molded into dial).

g. Slide the dial onto the channel selector shaft with the numbered side forward.

h. Replace the front panel overlay and the washers and nuts on the two outside controls.

i. Replace the three knobs and tighten the set screws.

5.3 CONVERSION FOR USE IN POSITIVE GROUND SYSTEMS

The Messenger may be used in positive ground systems by modifying the unit in accordance with the following outline: (See Figure 7)

1. Remove the Messenger from the cabinet by removing the screws at the sides of the cabinet.

2. Remove the screws at the rear of the chassis which secure the filter choke, L7, and ground lug.

3. Lay the filter choke back toward the front of the chassis to expose the circuit board area shown in Figure 7.

4. Unsolder one end of the black lead, W12, at hole "B".

5. Unsolder the red lead at hole "A" as shown in Figure 3 and resolder in hole "B".

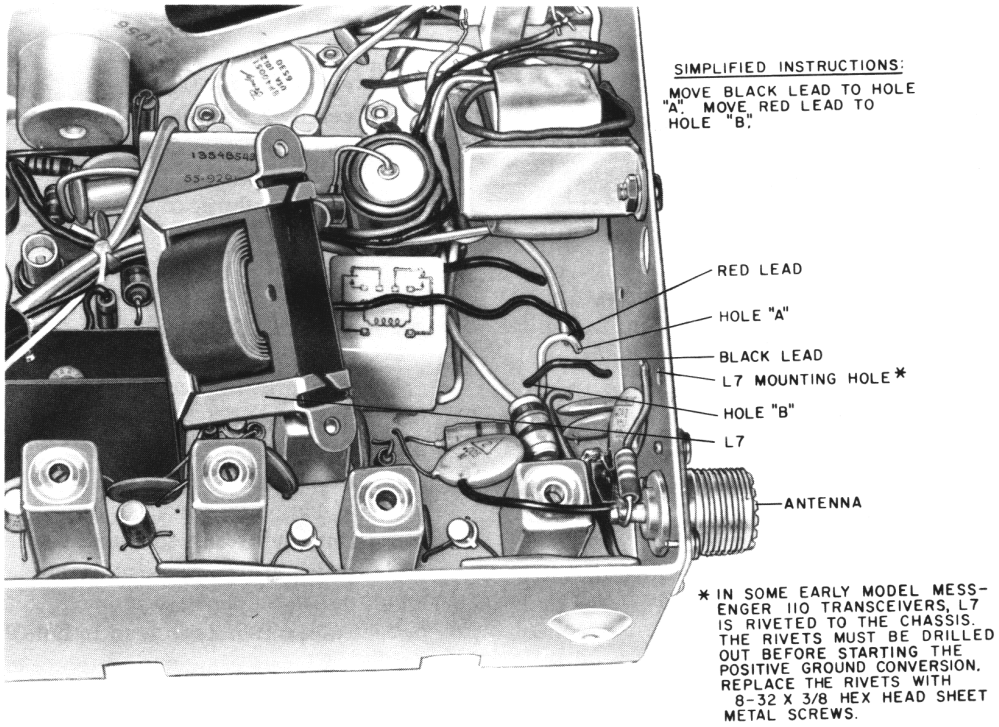
6. Solder the black lead in hole "A".

7. Replace the filter choke and ground lug using the screws previously removed.

8. Install the Messenger in the cabinet and secure with the screws at the sides.

This completes the conversion for positive ground operation. We recommend that the rear of the chassis be marked or tagged in some manner to indicate that the unit has been re-wired for positive ground operation.

NOTE: The Messenger accessory AC Power Supply, Model 250-848-1, is for operation with NEGATIVE GROUND units only. DO NOT ATTEMPT TO USE THE POWER SUPPLY WITH POSITIVE GROUND MESSENGERS.



CONVERSION FOR USE IN POSITIVE GROUND SYSTEMS
FIGURE 7

SECTION 6
SERVICING

6.1 TRANSISTOR TROUBLE SHOOTING

6.1.1 GENERAL

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

6.1.2 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 to 2 volts under load.

A high impedance DC voltmeter is usually the only measuring instrument required for determining the operational status of an in-circuit transistor. The meter is used to measure the transistor bias voltages. See Figure 8 for the correct voltmeter connections for measuring in-circuit transistor bias.

6.1.3 IN-CIRCUIT TRANSISTOR TESTING

a. Refer to Figure 8 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 conducting 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 high level stages under driving conditions.

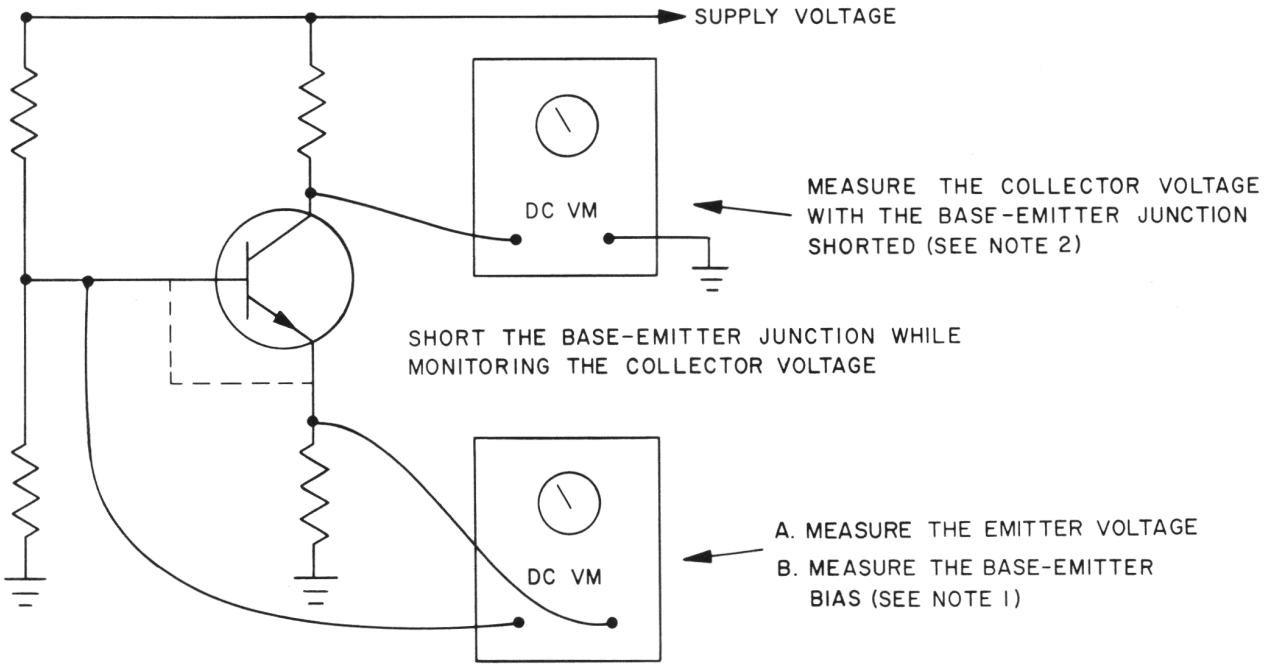
6.1.4 OUT OF CIRCUIT TRANSISTOR TESTING

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. A current limiting resistor may be used in series with ohmmeter probes to make the lower ranges safe for measuring semiconductor resistances. If a current limiting resistor is used its value must be subtracted from the ohmmeter reading. The following section describes a method for determining the short circuit current capabilities of ohmmeters.

6.1.5 HOW TO DETERMINE OHMMETER CURRENT

When the ohmmeter test probes are shorted together (measuring the forward resistance of a diode or the emitter - base 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



TEST CONNECTIONS FOR
IN-CIRCUIT TRANSISTOR TESTING
FIGURE 8

NOTE 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.

NOTE 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.

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 325 mA on the RX1 range. Obviously, the Rx1 range of this meter cannot be used to measure the resistance of semiconductors.

When the value of R1 is known for the Rx1 range it can then be determined for any range by multiplying R1 by the multiplier value of the range. The value of R1 for the Rx10 range of a meter with an R1 value on the Rx1 range of 4.62 ohms is 4.62 x 10 or 46.2 ohms. The short circuit current on the Rx10 range can then be calculated: 1.5 volts divided by 46.2 ohms equals 32.5 mA. By using this method, the lowest safe range for measuring semiconductor resistance may be determined for any ohmmeter.

The following chart indicates the results that should be obtained from operational transistors measured out of the circuit.

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

6.2 RECEIVER SERVICING

6.2.1 EQUIPMENT REQUIRED

Equivalent or superior equipment may be substituted.

Power Supply	Messenger 100 AC Power Supply - Cat. No. 239-125 or Hewlett Packard 6201A, 13.8 Volts DC, 1.5 amperes required.
Oscilloscope	Tektronix Model 561A
AC-VTVM	Heath Model AV-3
RF Generator	0.455 to 50 MHz with attenu-

	ated output of 1 microvolt to 0.1 volt capable of modulation at 1000 Hz at 30% - Hewlett Packard 606A.
Audio Generator	1000 Hz - Heath Model IG72
VTVM	Triplett Model 850 with RF Probe
6 dB Pad	Connect to output of RF signal generator for all trouble shooting and alignment procedures.
Tuning Tools	Radio Industries peaker tool-XA0378
	General Cement - 8606 Hex. tuning tool

6.2.2 TEST EQUIPMENT CONNECTIONS

a. The Messenger Transceiver is "floated" above ground and care must be exercised during test equipment connection. The test equipment called for in the equipment list will work satisfactorily if connected as shown in Figures 9 and 10. The AC-VTVM and oscilloscope connections may be made as shown in Figure 10.

b. If an audio generator or VTVM other than the ones described in the equipment list are used, they must be isolated from ground. It may be necessary in the use of the audio generator, to place a capacitor in series with the ground lead as well as the hot lead. The RF signal generator used for the receiver tests and alignment is connected to the receiver through a 6 dB pad for all measurements. In some instances the signal generator output may also be in series with a 0.1 μF capacitor. This will be indicated where appropriate. The test equipment connection to the receiver for trouble shooting and alignment will be as follows, except where noted in text.

c. Connect the test equipment to the receiver as shown in Figure 9.

d. The DC power supply is connected to J2 through a fused power lead. Ground the power supply to the Messenger chassis rail.

e. Connect the AC-VTVM and oscilloscope across the speaker leads.

f. Connect the RF signal generator to the transceiver antenna jack thru a 6 dB pad. Set the signal generator to receiver frequency. Remove the transmitter crystal. This will protect the signal generator in case the transmitter should be inadvertently keyed during receiver servicing.

6.2.3 PRELIMINARY RECEIVER TEST

a. Set RF output level from the signal generator at 1 microvolt into the 6 dB pad, and modulate with 1000 Hz at 30%. This can be internal modulation as in the case of a HP-606A, or external modulation from a separate audio generator.

b. Turn the receiver on and set the VOLUME control to maximum (cw); set the SQUELCH to minimum (ccw).

c. Check the receiver current drain, it should be approximately 210 mA at 13.8 volts DC.

d. The AC-VTVM across the speaker should indicate approximately 0.8 VAC (0 dB) of audio.

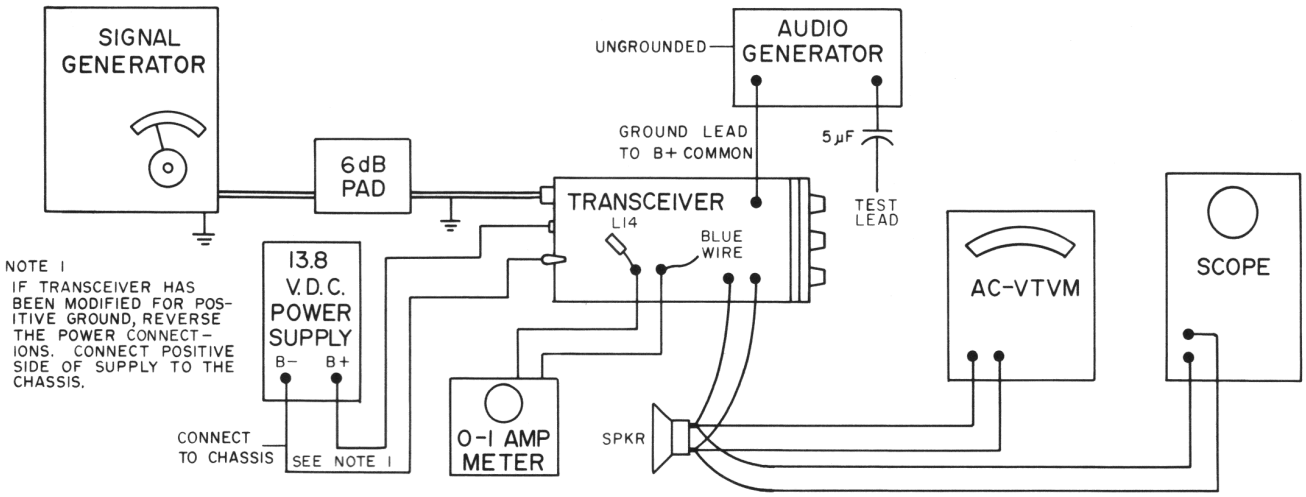
If the above conditions are not obtained, continue with the following receiver trouble shooting procedure.

NOTE:

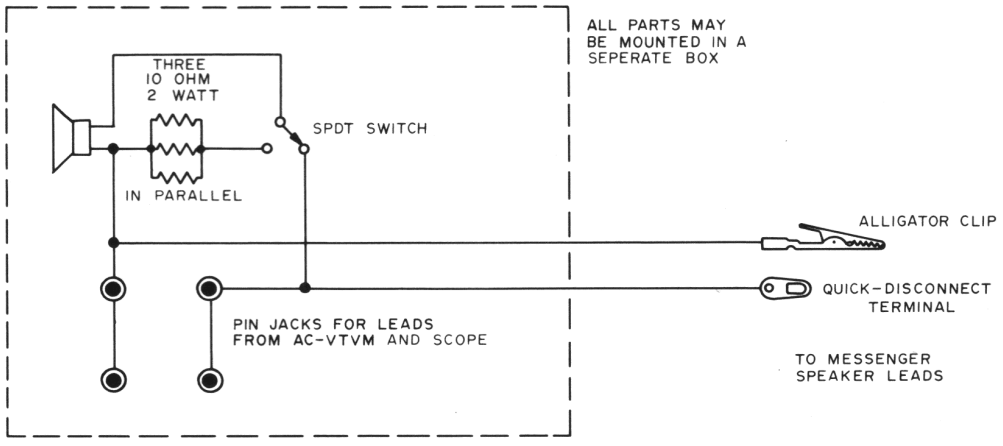
The first check for trouble shooting should be visual, then measure the bias voltages of the various stages. When performing DC voltage measurements the meter common must be connected to B+ as it is the reference point.

6.2.4 AGC

a. The Messenger utilizes a single AGC system. AGC is applied to the base of Q1 in the RF stage. Since AGC can affect many stages, it is important to make checks on this stage



RECEIVER TEST INSTRUMENT CONNECTIONS
FIGURE 9



TEST ASSEMBLY FOR
CONNECTING AC-VTVM AND SCOPE
FIGURE 10

first.

b. AGC problems will cause:

- receiver to be completely inoperative
- severe overloading on strong signals
- erroneous voltage readings at the bases of Q1, Q3 and Q4

c. To check the AGC stage:

- Connect test equipment as indicated in Section 6.2.2.
- Connect VTVM to the junction of R8, C13 and C14 - See Schematic
- Increase the output of the RF signal generator from 1 microvolt to 0.1 volt.
- The AGC voltage measured on the VTVM should go more positive as the signal is increased. See Figure 11 for a typical AGC curve (audio output vs. RF input).
- If the AGC voltage does not change, check the AGC detector, D1, and its associated network.

6.2.5 SQUELCH

a. Connect a VTVM (-15 volts DC range) to the emitter of Q8. Test equipment previously connected will not affect the SQUELCH and may be ignored during this check.

b. While monitoring the VTVM, rotate the SQUELCH control from minimum to maximum.

c. The voltage should vary from approximately -2.6 to -6.5 volts.

d. If the voltage does not change at Q8, check for an open diode, D5, by bridging it with

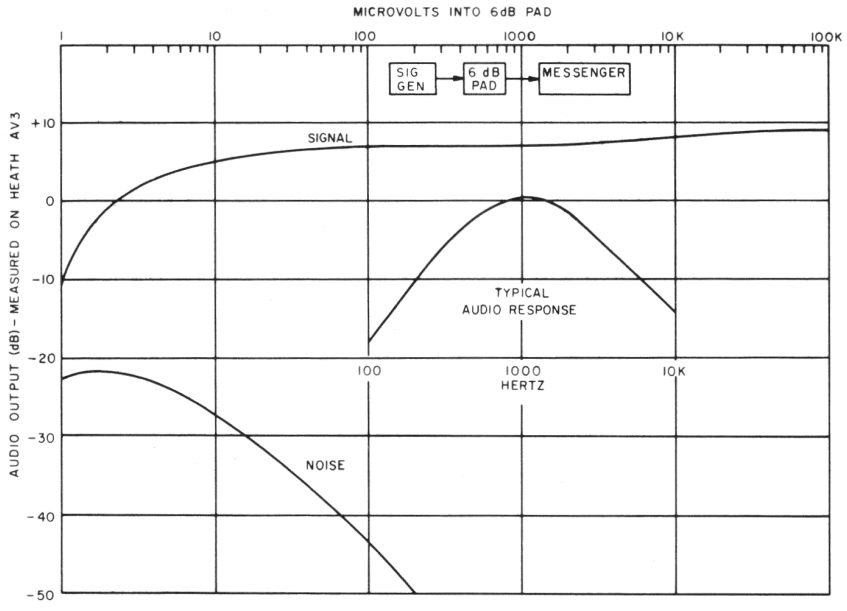


FIGURE 11

one known to be good.

e. If the diode is not open, disconnect one end and measure the front to back ratio with an ohmmeter. A normal diode will have a front to back ratio of approximately 10:1 or more.

f. Check the voltages on Q6 and Q7. If D5 is shorted, the voltage at Q7 will be normal and the squelch will operate very slowly. The emitter of Q8 in this case will read very low at minimum squelch.

6.2.6 AUDIO

a. Connect test equipment as indicated in Section 6.2.2.

b. Connect an audio generator through a 5 μF capacitor to the top of the VOLUME control.

c. Set the audio generator for an output of 0.0025 volts RMS ±10% at 1000 Hz. Connect the generator ground lead to the receiver B+.

d. Adjust the volume control for 2.5 VAC (+10 dB) indicated on the AC-VTVM and turn the squelch control to minimum (ccw).

e. The audio output as monitored on the oscilloscope should be 2.5 VAC (+10 dB) undistorted.

f. If these conditions are not met, check the bias of Q8, Q9, Q10 and Q11.

g. Check the voltages at the emitters and bases of the Class B audio transistors, Q10 and Q11. The voltages should be the same. If one of the transistors shows no voltage difference between emitter and base, it is probably defective.

6.2.7 IF STAGES

NOTE:
A shorted transistor in the Class B audio output stage will cause R20 to burn and possibly blow the fuse.

a. Connect test equipment as in Section 6.2.2, except connect RF signal generator through 6dB pad and a 0.1 μF capacitor to the base of the second IF transistor, Q5.

b. Set the signal generator to 455 kHz, modulated 30% at 1000 Hz.

c. Set the signal generator output to 0.01 volts RF.

d. The AC-VTVM should indicate approximately 0.8 volts AC. If this level is not reached, check voltages on Q5, L6 and associated circuitry. Replace defective components and refer to the receiver alignment chart for re-adjustment.

NOTE:
Move the signal generator from the base of Q5 to the base of Q4. Set the generator output level to 250 microvolts. The AC-VTVM should indicate circuitry if the level is abnormally low. Refer to the receiver alignment for adjustment.

Repeat the procedure in the above note with the signal generator connected to the base of Q3 and set for an output level of 30 microvolts.

6.2.8 RF AMPLIFIER - 1st MIXER

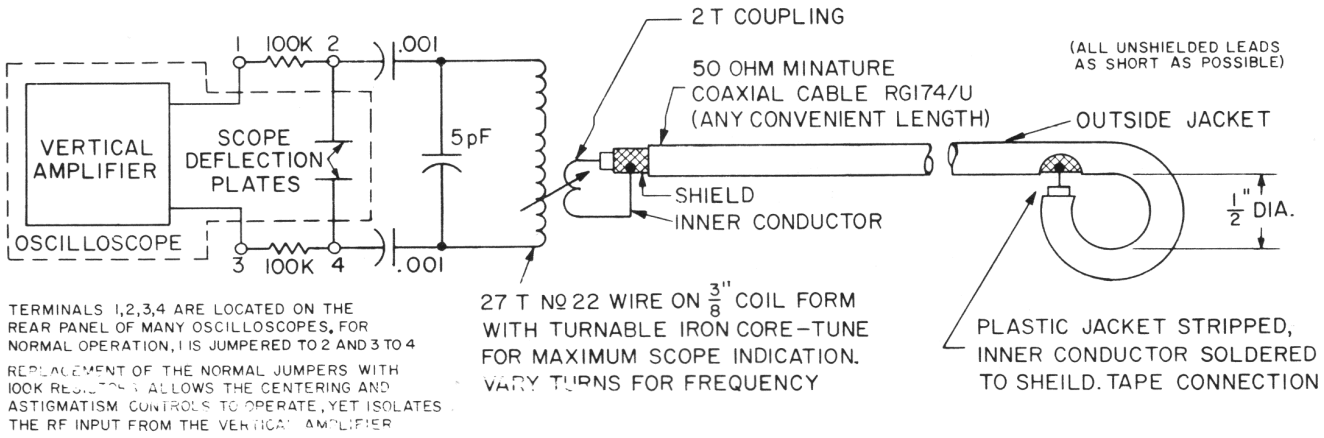
a. Connect test equipment as indicated in Section 6.2.2.

b. Set signal generator at the assigned frequency, 1 microvolt modulated with 1000 Hz at 30%.

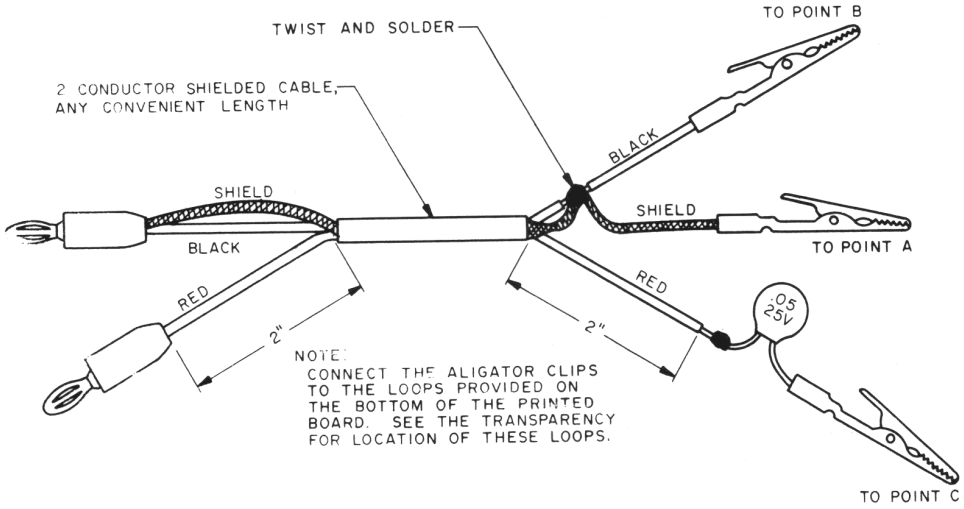
c. With the VOLUME control at maximum, the output across the speaker terminals is measured on the AC-VTVM and oscilloscope should be at least 0.8 VAC (0.5 dB) undistorted.

d. If the receiver output is not normal, check the emitter of the oscillator, Q2, with an RF probe (see Figure 16). The oscillator injection voltage at this point should be approximately 100 mV ±20 mV volts RMS.

e. If the oscillator output is normal, check the voltages at Q1 and Q3.



OSCILLOSCOPE RF PICK-UP LOOP
AND METHOD OF CONNECTION
FIGURE 12



AUDIO GENERATOR CABLE
FIGURE 13

f. If it is necessary to replace either L2, L3 or L4, re-align the stage as outlined in the receiver alignment chart.

6.3 TRANSMITTER SERVICING

6.3.1 EQUIPMENT REQUIRED

Power Supply	Messenger AC Power Supply-Model No. 250-823-2, or Hewlett Packard 6201A, 1.5A.
Frequency Meter	
Oscilloscope	Tektronix Model 561A or equivalent with RF pick-up loop capable of direct connection to the vertical plates of the oscilloscope (Figure 12 illustrates a simple RF pick-up loop which may be fabricated from spare parts.)
0-1 Amp DC Ammeter	Triplett 630
Dummy Antenna	50 ohms, 5 watts (with RF power indicator).
Sine-Wave Generator	1000 Hz, 0.01 Volts

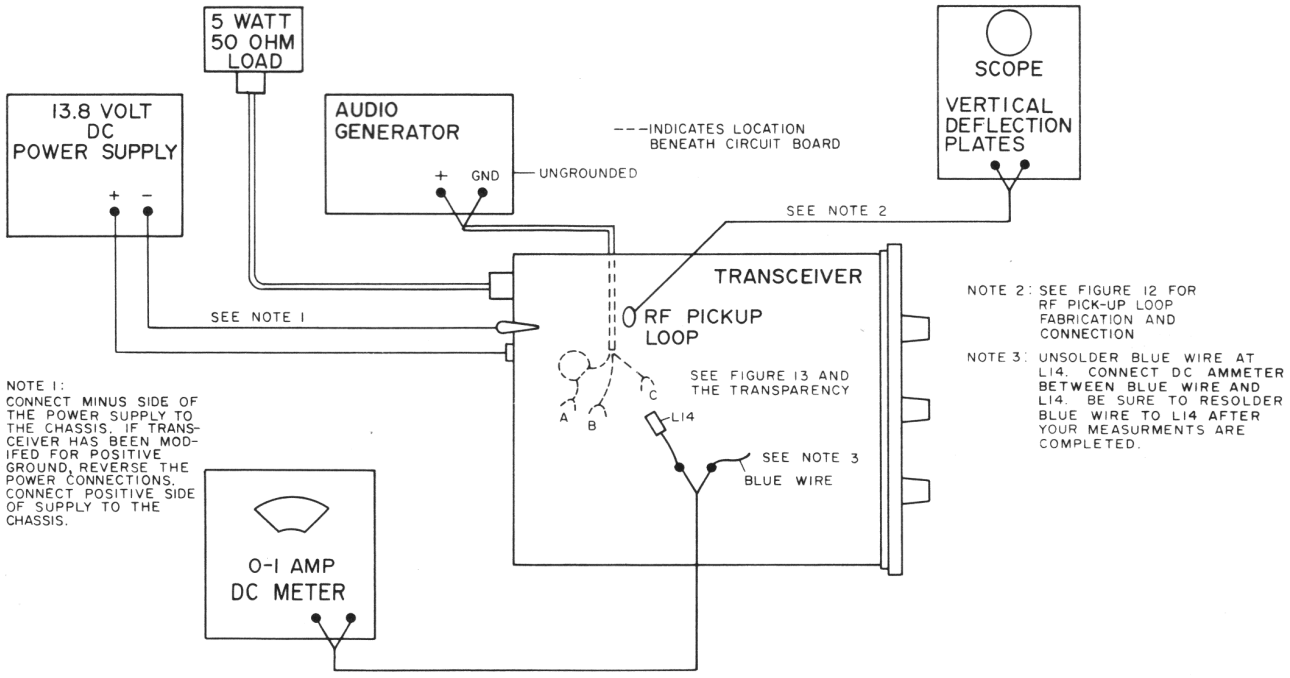
6.3.2 TEST EQUIPMENT CONNECTIONS

a. Connect the test equipment as shown in Figure 14. Be sure to connect the 50 ohm load.

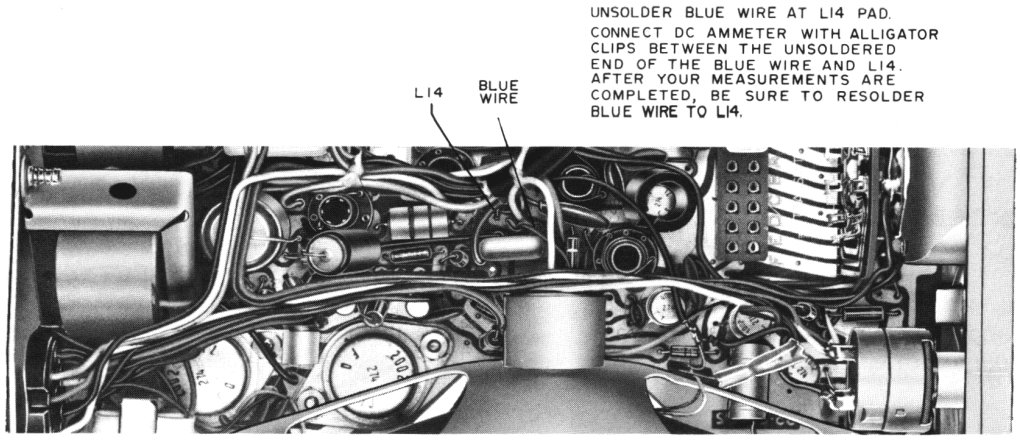
b. Connect the audio generator to points A, B and C. Figure 13 shows the audio generator test cable. Set the generator at zero output.

c. Couple RF pick-up loop from the oscilloscope to L16 of the power amplifier stage.

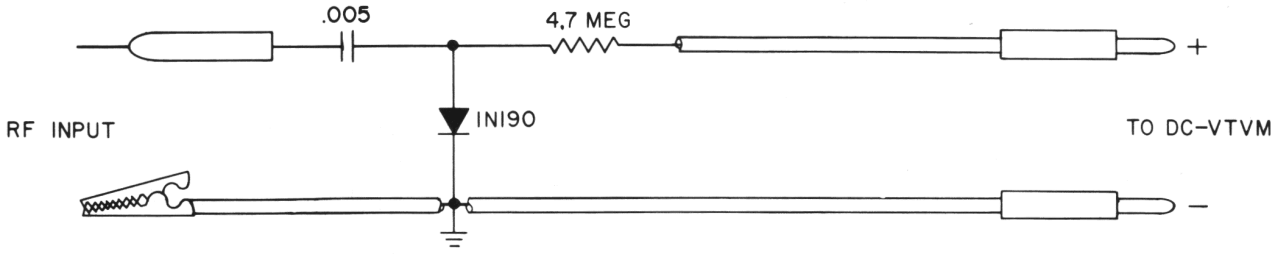
d. Monitor the transmitter frequency with the frequency meter.



TRANSMTTER TEST INSTRUMENT CONNECTIONS
FIGURE 14



DC AMMETER METER CONNECTIONS
FIGURE 15



CONNECTIONS SHOULD BE MADE AS SHORT AS POSSIBLE TO AVOID STRAY CAPACITANCE WHICH WILL AFFECT THE FREQUENCY RESPONSE OF THE PROBE

THE MAXIMUM INPUT MUST NOT EXCEED 30 VOLTS OF RF. THE OUTPUT OF THE PROBE IS NEGATIVE DC AND THE VTVM FUNCTION SHOULD BE SET ACCORDINGLY

RF PROBE FOR DC-VTVM
FIGURE 16

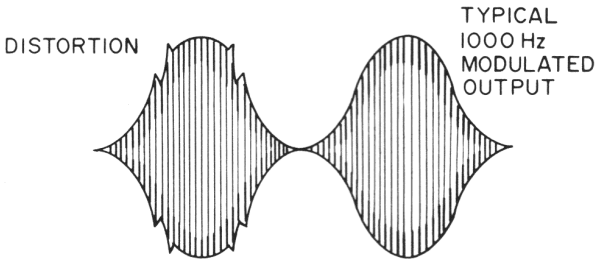
6.3.3 PRELIMINARY TRANSMITTER TEST

a. Turn the transceiver on and key the transmitter.

b. Measure the power output. See the specifications for minimum accepted power output. (Make sure RF pick-up loop is not affecting the reading.)

c. Set the audio generator for 1000 Hz. While monitoring the oscilloscope, increase the audio generator output level to obtain maximum modulation.

d. The modulated waveform should be symmetrical and undistorted. A mis-aligned or defective transmitter may cause distortion as shown in Figure 17. If distortion occurs, refer to the transmitter alignment chart for adjustment.



MODULATED
RF WAVEFORM DISTORTION
FIGURE 17

6.3.4 OSCILLATOR TROUBLE SHOOTING

a. A defective or mis-aligned oscillator stage can result in:

- loss of transmitter output
- intermittent operation on some channels
- distorted modulation
- spurious or adjacent channel "splatter".

b. To check the oscillator stage:

- key the transmitter and check for oscillator starting. If the oscillator does not start, check the bias of Q12 and replace defective components as necessary.

c. Check the modulated RF waveform for distortion or unsymmetrical waveform. If distortion exists, check oscillator adjustments - see Transmitter Alignment Chart.

d. Check the transmitter carrier frequency. If out of tolerance, refer to transmitter alignment section.

If the above conditions are not obtained, continue with the following transmitter trouble shooting procedure.

6.3.5 DRIVER AND POWER AMPLIFIER TROUBLE SHOOTING

a. A defective or mis-aligned driver or power amplifier will result in:

- reduced power output
- excessive current drain at reduced power
- distorted modulation

b. Check the bias of Q13 and Q14. Replace defective components as necessary and refer to Transmitter Alignment Section for adjustments.

6.3.6 RESISTANCE MEASUREMENTS

	Winding	Lead	DC Resistance
Transformer T1 (audio driver)	Primary	Blue to Red	200 ohms maximum
	Secondary	Orange Yellow	25 ohms maximum
Transformer T2 (audio output modulation)	Primary	Blue to Brown	2.4 ohms maximum
	Secondary #1	Yellow to Orange	1.4 ohms maximum
	Secondary #2	Green to Black	0.22 ohms maximum
Relay	Coil		195 ohms +0%, -20%

SECTION 7
ALIGNMENT

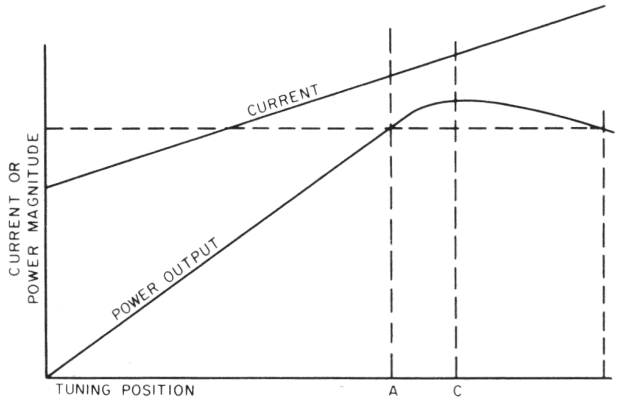
7.1 RECEIVER ALIGNMENT CHART

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
455 kHz IF	Connect test equipment as in Section 6.2.2. Set the output of the signal generator for a low level (one that produces about 10 dB signal-to-noise ratio is best).	Peak L6, L5 and L4 for maximum on the AC-VTVM.
1st Mixer	Connect test equipment as in Section 6.2.2. Connect an RF probe to the emitter of Q3.	Adjust L3 starting with the slug at the top of the coil. Tune L3 through the first peak and 1/4 to 1/2 turn past point where oscillator starts on second peak. The injection voltage on the emitter of Q3 should be 0.08 volts RF minimum. Typical is 0.11 volts RF. If injection voltage exceeds 0.15 volts RF, turn slug farther beyond point where oscillator starts. Check oscillator starting on all channels.
RF Amplifier	Connect test equipment as in Section 6.2.2. Set signal generator for 1 microvolt output (30% modulated at 1000 Hz). Set volume control for 0.8 VAC on the AC-VTVM.	Peak L2 and L1 for maximum on the AC-VTVM. Check for clean signal on oscilloscope. Readjust VOLUME control as necessary to maintain 0.8 VAC. Peak L1 for cleanest sine wave, which is best signal-to-noise. Detune L1 about 1 dB from peak on the maximum signal-to-noise side of resonance. Check receiver gain on channels 1, 11 and 21. Adjust L2 and L1 for uniform gain and signal-to-noise. Gain should be uniform on channels 1, 11 and 21.

7.2 TRANSMITTER ALIGNMENT CHART

ALIGNMENT	CONNECTIONS AND SETTINGS	ADJUSTMENTS
Oscillator	Connect test equipment as in Section 6.3.2.	Adjust L10 for oscillator starting on channels 1, 11 and 21. Adjust L10 for absence of distortion (Figure 17). If distortion appears, refer to additional adjustments for distortion at end of this chart.
Driver-Power Amplfier	Connect test equipment as in Section 6.3.2. Set audio generator to zero output.	Adjust*C54 and L16 for peak power output. Adjust L13 for maximum power output. This is a broad adjustment, tune for center of maximum. Adjust L15, L16 and C54 for maximum power output while not exceeding 415 mA of Q14 collector current (meter inserted on series with blue lead). Adjust L15, L16 and C54 for maximum power output with minimum current - see power curve, Figure 18.
Distortion Adjustment	Connect test equipment as in Section 6.3.2. Set audio generator for 1000 Hz. Increase audio input level slowly to point of maximum modulation without clipping.	Readjust L10 and L13 to eliminate distortion. Check for symmetrical waveform and oscillator starting on all channels.

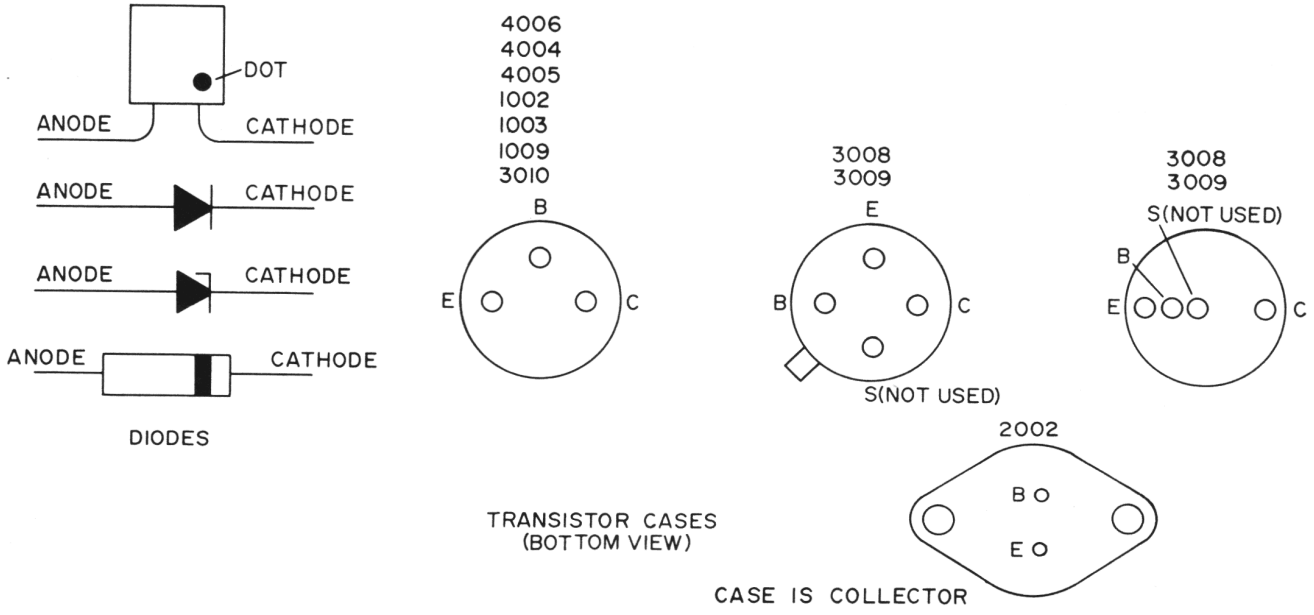
* C54 has been deleted on late models of Messenger 100 and 110 to improve tuning. The value of C52 is changed from 220 pF to 390 pF (see parts list). We recommend that a defective C54 be removed and the value of C52 changed from 220 pF to 390 pF.



TRANSMITTER
CURRENT—POWER CURVE
FIGURE 18

NOTE:

This illustration shows two points (A and B) which give the same power output. One point (B) requires more input current or input power than the other (A) for the same amount of output power. Therefore point A is more efficient than point B. Point C shows the place where maximum efficiency is obtained.



SEMICONDUCTOR CASE DIAGRAMS
FIGURE 19

SECTION 8
PARTS LIST

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	BRACKETS	
BKT	Dash mounting bracket	017-1249-001
	CAPACITORS	
C1	100 pF ±5%, N150	510-3016-101
C2	0.001 μF ±20%, 50 volt	510-3002-102
C3	100 pF ±5%, N150	510-3016-101
C4	39 pF ±5%, N750	510-3020-390
C5	180 pF ±5%, N750	510-3020-181
C6	0.01 μF ±80% -20%, 50 volt	510-3003-103
C7	0.01 μF +80% -20%, 50 volt	510-3003-103
C8	0.01 μF +80% -20%, 50 volt	510-3003-103
C9	270 pF ±5%	510-0001-271
C10	270 pF ±5%	510-0001-271
C11	210 pF ±5%, N080	510-3015-211
C12	210 pF ±5%, N080	510-3015-211
C13	0.01 μF +80% -20%, 50 volt	510-3003-103
C14	6.8 μF, 35 volt, tantalum	510-2045-689
C15	150 pF ±5%	510-0001-151
C16	190 pF ±5%, N150, polystyrene	510-1103-191
C17	190 pF ±5%, N150, polystyrene	510-1103-191
C18	0.1 μF +80% -20%, 25 volt	510-3007-104
C19	0.033 μF ±20%, 16 volt, Y5U	510-3010-333
C20	1.0 μF, 35 volt	510-2045-109
C21	1.0 μF, 35 volt	510-2045-109
C22	0.01 μF +80% -20%, 50 volt	510-3003-103
C23	470 μF, 2.5 volt	510-4001-006
C24	150 μF +100%-10%, 25 volt	510-4006-006
C25	6.8 μF, 35 volt, tantalum	510-2045-689
C26	0.047 μF ±20%, 25 volt	510-3010-473
C27	22 μF, 15 volt	510-2003-220
C28	1.0 μF, 35 volt	510-2045-109
C29	6.8 μF, 35 volt, tantalum	510-2045-689
C30	0.22 μF ±20%	510-1004-224
C31	56 μF, 6 volt	510-2001-560
C32	150 μF +100%-10%, 25 volt	510-4006-006
C33	0.022 μF ±20%, 50 volt	510-3002-223
C34	0.022 μF ±20%, 50 volt	510-3002-223
C35	1000 μF +100% -10%, 16 volt	510-4006-005
C36	0.01 μF +80% -20%, 50 volt	510-3003-103
C37	0.01 μF +80% -20%, 50 volt	510-3003-103
C38	0.0047 μF +80%-20%, 500 volt	510-3005-472
C39	0.0047 μF ±20%, 125 VAC	510-3001-472
C40	0.047 μF +80%-20%, 50 volt	510-3003-473
C41	22 pF ±5%, N750	510-3020-220
C42	22 pF ±5%, N750	510-3020-220
C43	150 pF ±5%, N750	510-3020-151
C44	0.0047 μF +80%-20%, 500 volt	510-3005-472
C45	0.0047 μF +80%-20%, 500 volt	510-3005-472
C46	0.001 μF ±20%, 50 volt	510-3002-102
C47	47 pF ±5%, NPO	510-3013-470
C48	33 pF ±5%, N150	510-3016-330
C49	0.0047 μF +80%-20%, 500 volt	510-3005-472
C50	0.001 μF ±20%, 50 volt	510-3002-102
C51	27 pF ±5%, NPO	510-3013-270
C52	390 pF ±5%, 500 volt	510-0004-391
C53	100 pF ±5%, N150	510-3016-101
C55	330 pF ±5%, 500 volt	510-0004-331
C56	0.001 μF ±20%, 50 volt	510-3002-102
C57	6.8 pF ±5%, N750	510-3020-689
C58	0.0047 μF ±10%, 500 volt	510-3061-472
C59	0.047 +80%-20%, 50 volt	510-3003-473
C60	22 μF, 15 volt	510-2003-220
C61	0.01 μF +80%-20%, 50 volt	510-3003-103

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	CHASSIS PARTS	
CH1	Cabinet assembly Includes:	023-2201-002
	Cabinet Insulator	018-0817-008
	Cabinet shell	017-1431-001
	Captive nut	013-1003-002
CH2	Chassis rail (Messenger 100 only)	017-1430-004
CH2	Chassis rail (Messenger 110 only)	017-1430-006
CH3	Front panel	015-0756-002
CH4	Overlay assembly (Messenger 100 only)	023-2204-002
CH4	Overlay (Messenger 110 only)	559-2025-001
CH5	Dial channel indicator	032-0149-003
CH6	Channel indicator label	559-3006-002
	DIODES	
D1	1N67A	523-1000-067
D2	1N67A	523-1000-067
D3	1N881	523-1000-881
D4	10 volt zener	523-2003-100
D5	1N67A	523-1000-067
D6	1N881	523-1000-881
D7	1N2326	523-1002-326
	ELECTRICAL PARTS	
E1	Printed circuit board	035-0032-001
E2	Heat sink	013-1074-001
E3	Heat sink	017-1432-001
E4	Heat sink clamp	017-1434-001
E5	Insulating spacer (under relay)	018-0518-004
E6	Heat sink, audio (for Q10 and Q11) (on later model 100 and 110)	017-0631-001
E7	Bushing (for Q10 and Q11) (on later model 100 and 110)	018-0781-101
E8	Insulator, Mica (for Q10 and Q11) (on later model 100 and 110)	018-0829-001
	HARDWARE	
H	Screw, 1/4 - 20 x 5/16 hex head CPS (Connects mobile mounting bracket to cabinet assembly)	011-0322-010
H	Screw, #4-40 x 1/4, pad hd. NPS	011-0807-008
H	Screw, #4-40 x 3/16 B.H. NPB (E1 to CH2)	011-0012-006
H	Screw, #4-40 x 3/8 B.H. NPB (Q14)	011-0012-012
H	Screw, #6-32 x 1/4 B.H. NPB (CH3 to CH2)	011-0114-008
H	Screw, #8-32 x 1/4 B.H. NPB (CH1 to CH2)	011-0221-008
H	Screw, #8-18 x 3/8 CPS hex sheetmetal (T2 and L7 to CH2)	011-0823-012
H	Screw, 1/4 - 20 x 5/16 hex head CPS (Connects mobile mounting bracket to cabinet assembly)	011-0322-010
	BULBS	
I1	Light bulb, clear (Messenger 100 only)	549-3001-003
I2	Light bulb, red (Messenger 100 only)	549-3001-004
	JACKS	
J1	Antenna jack	142-0101-002
J2	Terminal bushing	515-4100-001
J3	Jack, external speaker/PA (Messenger 100 only)	515-2001-002
J4	Plug, 11 pin (Messenger 100 only)	515-0005-011
	TRANSFORMERS	
L1	Transformer, 27 MHz input	592-5016-001
L2	Transformer, 27 MHz output	592-5006-002
L3	Transformer, 27 MHz oscillator	592-5006-003
L4	Transformer, 455 kHz input	592-5016-005

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
L5	Transformer, 455 kHz interstage	592-5016-006
L6	Transformer, 455 kHz output	592-5016-007
T1	Transformer, audio driver	592-1007-003
T2	Transformer, audio output - modulation	592-1013-001
	CHOKES AND COILS	
L7	Audio filter choke (18 mH)	542-5007-001
L8	RF choke (13 μH)	542-3003-001
L9	RF choke (13 μH)	542-3003-001
L10	Oscillator coil	592-5014-001
L11	RF choke (13 μH)	542-3003-001
L12	RF choke (13 μH)	542-3003-001
L13	Driver coil	592-5014-002
L14	RF choke (13 μH)	542-3003-001
L15	Series output coil	542-1005-010
L16	Pi output coil	542-1005-004
	SPEAKER	
LS	Speaker	589-1002-002
	MICROPHONE	
M1	Microphone	023-2708-001
	MECHANICAL PARTS	
MP1	Bulb, holder (Messenger 100 only)	018-0844-002
MP2	Knob (Messenger 100 only)	547-0001-004
MP2	Knob (Messenger 110 only)	022-1755-001
MP3	Rubber grommet	574-0002-007
MP4	Cable clamp	572-0001-003
MP5	Clamp, heat sink: for D7	017-1288-001
MP6	Fiber washer (under C35)	029-0333-001
	JUMPER PLUGS	
P4	11 pin jumper plug (Messenger 100 only)	023-1659-002

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	TRANSISTORS	
Q1	3012 RF amplifier	576-0003-012
Q2	3009 oscillator	576-0003-009
Q3	3009 mixer	576-0003-009
Q4	3010 IF	576-0003-010
Q5	3010 IF	576-0003-010
Q6	1002 squelch	576-0001-002
Q7	3017 audio	576-0003-017
Q8	1013 audio	576-0001-013
Q9	1013 audio	576-0001-013
Q10	2002 audio output	576-0002-002
Q10	Quick-disconnect lead assembly	597-0005-001
	12 volt battery cable assembly	023-1652-001 -002
	Includes:	
	Fuse 1.0 amp	534-0002-019
	Fuse, 2 ampere	534-0003-024
	Fuseholder for 1/4 dia x 1-1/4 L. fuse	534-1004-005
	Quick-disconnect lead assembly	597-0003-001
	Quick-disconnect lead assembly	597-0003-005
Q11	2002 audio output	576-0002-002
Q12	4006 RF oscillator	576-0004-006
Q13	4004 RF driver	576-0004-004
Q14	4005 final output (Messenger 100 only)	576-0004-005
Q14	4011 RF power output (Messenger 110 only)	576-0004-011
	RESISTORS	
R1	33 ohms ±10%, 1/2 watt (Messenger 100 only)	569-1004-330
R2	62 ohms ±5%, 1/2 watt	569-1003-620
R3	2700 ohms ±10%, 1/2 watt	569-1004-272
R4	470 ohms ±10%, 1/2 watt	569-1004-471

PARTS LIST (cont'd)

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
R5	680 ohms ±10%, 1/2 watt	569-1004-681
R6	1,000 ohms ±10%, 1/2 watt	569-1004-102
R7	1,000 ohms ±10%, 1/2 watt	569-1004-102
R8	5,600 ohms ±10%, 1/2 watt with SPST switch	569-1004-562
R9	10,000 ohms ±10%, 1/2 watt	569-1004-103
R10	Potentiometer, 10,000 ohms (Messenger 100 only)	562-0010-002
R10	Potentiometer, 10,000 ohms (Messenger 110 only)	562-0010-005
R11	6,800 ohms ±10%, 1/2 watt	569-1004-682
R12	Potentiometer, 5000 ohms (Messenger 100 only)	562-0007-006
R12	Potentiometer, 5,000 ohms (Messenger 110 only)	562-0007-018
R13	470 ohms ±10%, 1/2 watt	569-1004-471
R14	Thermistor, 8,000 ohms	569-3001-001
R15	1,000 ohms ±10%, 1/2 watt	569-1004-102
R16	3,300 ohms ±10%, 1/2 watt	569-1004-332
R17	5,600 ohms ±10%, 1/2 watt with SPST switch	569-1004-562
R18	470 ohms ±10%, 1/2 watt	569-1004-471
R19	1,500 ohms ±10%, 1/2 watt	569-1004-152
R20	2.2 ohms ±10% 1/2 watt wirewound	569-2003-229
R21	22 ohms ±10% 1/2 watt	569-1004-220
R22	510 ohms ±5% 1/2 watt	569-1003-511
R23	5,100 ohms ±5%, 1/2 watt	569-1003-512
R24	51 ohms ±5%, 1/2 watt	569-1003-510
R25	120 ohms ±10%, 1/2 watt	569-1004-121
R26	47 ohms ±10%, 1/2 watt	569-1004-470
R27	47,000 ohms ±10%, 1/2 watt	569-1004-473
R28	100 ohms ±10%, 1/2 watt	569-1004-101

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	RELAY	
RY	DPDT PC mount	567-0011-001
	SWITCH	
S1	Crystal (Messenger 110 only)	583-2008-003
	WIRE	
W1	Wire harness assembly (Messenger 100 only)	023-2206-001
W1	Wire harness assembly (Messenger 110 only)	023-2381-001
	CRYSTALS	
	Crystals, receive	519-0011-301 -323*
	Crystals, transmit	519-0011-001 -023*

* The last 3 digits of the crystal part no. indicate the channel number. Thus a part no. 519-0011-301 is a receiver crystal for channel 1; part no. 519-0011-001 is the corresponding transmitter crystal.

	CRYSTAL BLOCK	
XY	Crystal block (10 position)	126-0110-001
	P.E.C.	
Z1	RF (Messenger 100 only)	544-0003-011
Z1	RF (Messenger 110 only)	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	Audio (Messenger 100 only)	544-0002-006
Z6	Audio (Messenger 110 only)	544-0002-026

PARTS LIST (cont'd)

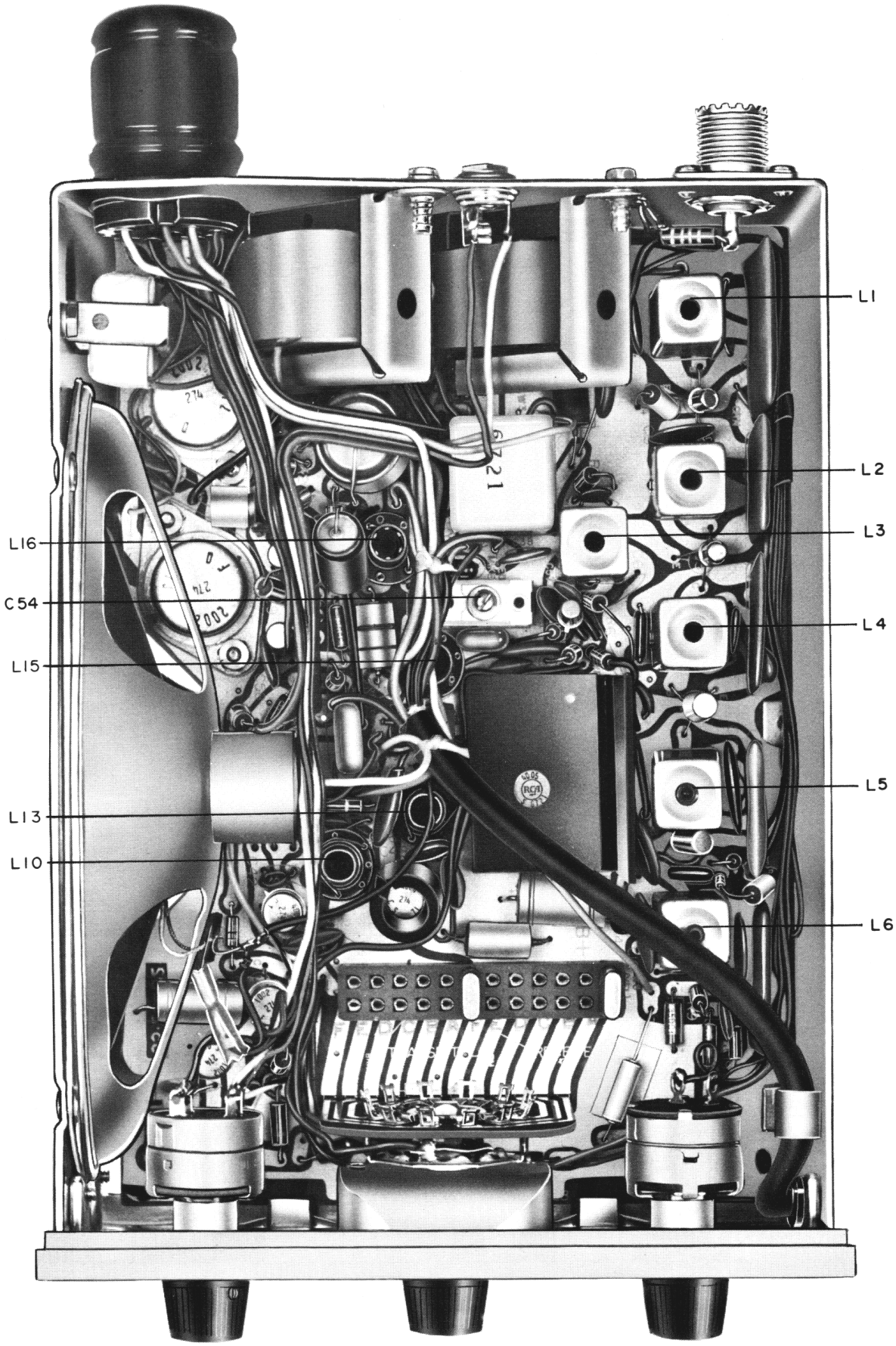
ACCESSORY PACKAGE ITEMS

SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	MESSENGER 100	
	Operating Manual	002-0028-001
	Part 95 Rules - Citizens Radio Service	022-1635-001
	FCC Form 505 - License Application Form	022-1636-001
	FCC Identification Card	022-1598-004
	Warranty Registration Card	041-0419-014
	Microphone holder (with extra 1/4" dia. hole)	537-9004-002
	Screws for microphone holder (#4 sheet metal)	011-0807-006
	Channel number stickers	022-2327-001
	Screws for dash mtg. bracket 10-32	011-0229-020
	Nuts for dash mtg. bracket 10-32	012-0109-002
	Internal tooth lockwashers #10	029-0001-003
	12 V. Battery Cable assembly	023-1652-001
	Reduced Schematic	022-2435-001
	Tap Connector Package	023-2209-001

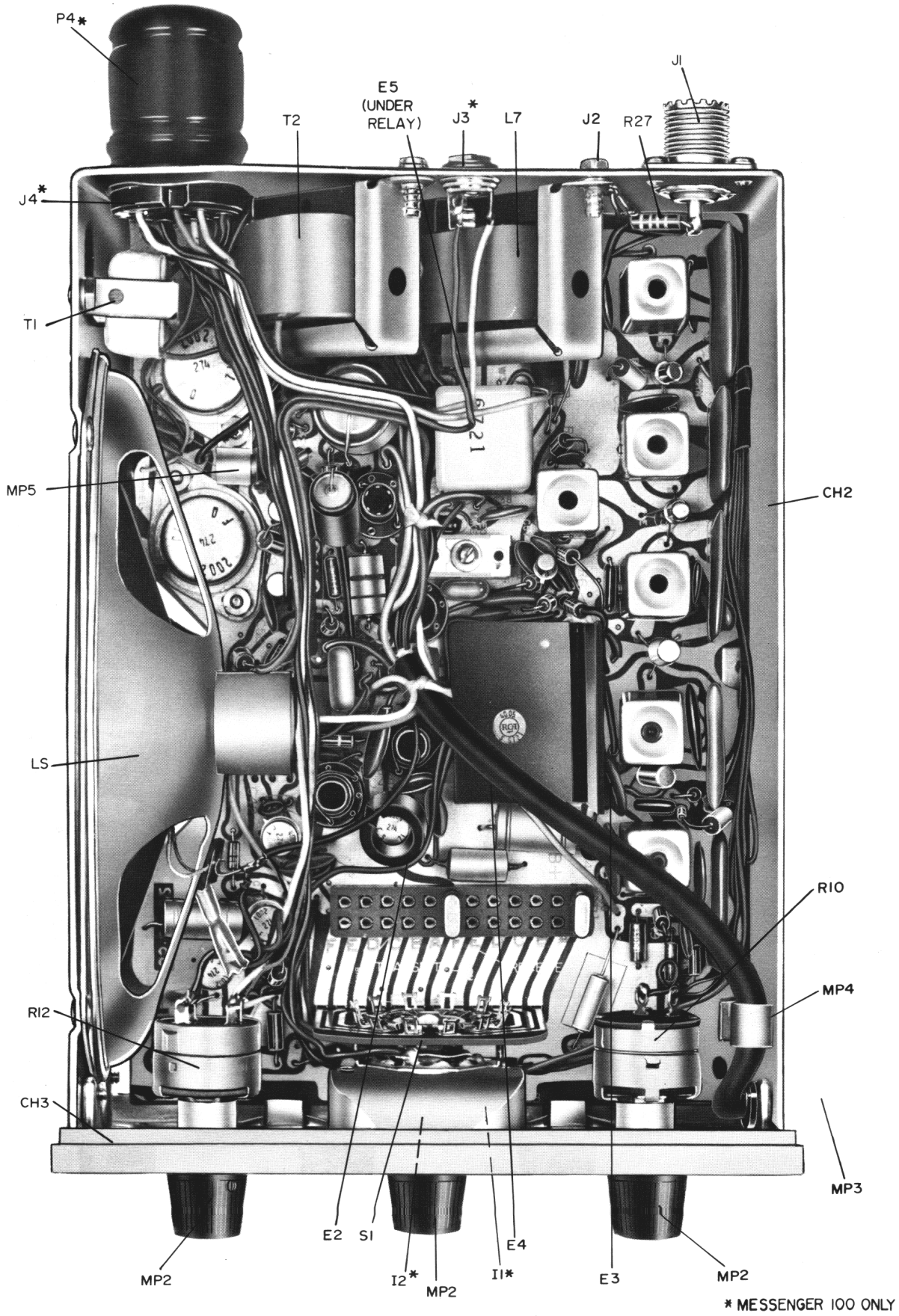
SCHEMATIC SYMBOL NO.	DESCRIPTION	PART NO.
	MESSENGER 110	
	Operating Manual	002-0061-001
	Part 95 Rules - Citizens Radio Service	022-1635-001
	FCC Form 505 - License Application Form	022-1636-001
	FCC Identification Card	022-1598-004
	Warranty Registration Card	041-0419-014
	Microphone holder (with extra 1/4" dia. hole)	537-9004-002
	Screws for microphone holder (#4 sheet metal)	011-0807-006
	Screws for dash mtg. bracket 10-32	011-0229-020
	Nuts for dash mtg. bracket 10-32	012-0109-002
	Internal tooth lockwashers #10	029-0001-003
	12 V. Battery Cable assembly	023-1652-001
	Reduced Schematic	564-3000-110
	Screw, 1/4 - 20 x 3/8 hex head (Contains captivated Lockwasher, 1/4 external tooth)	011-0322-012

NOTE:

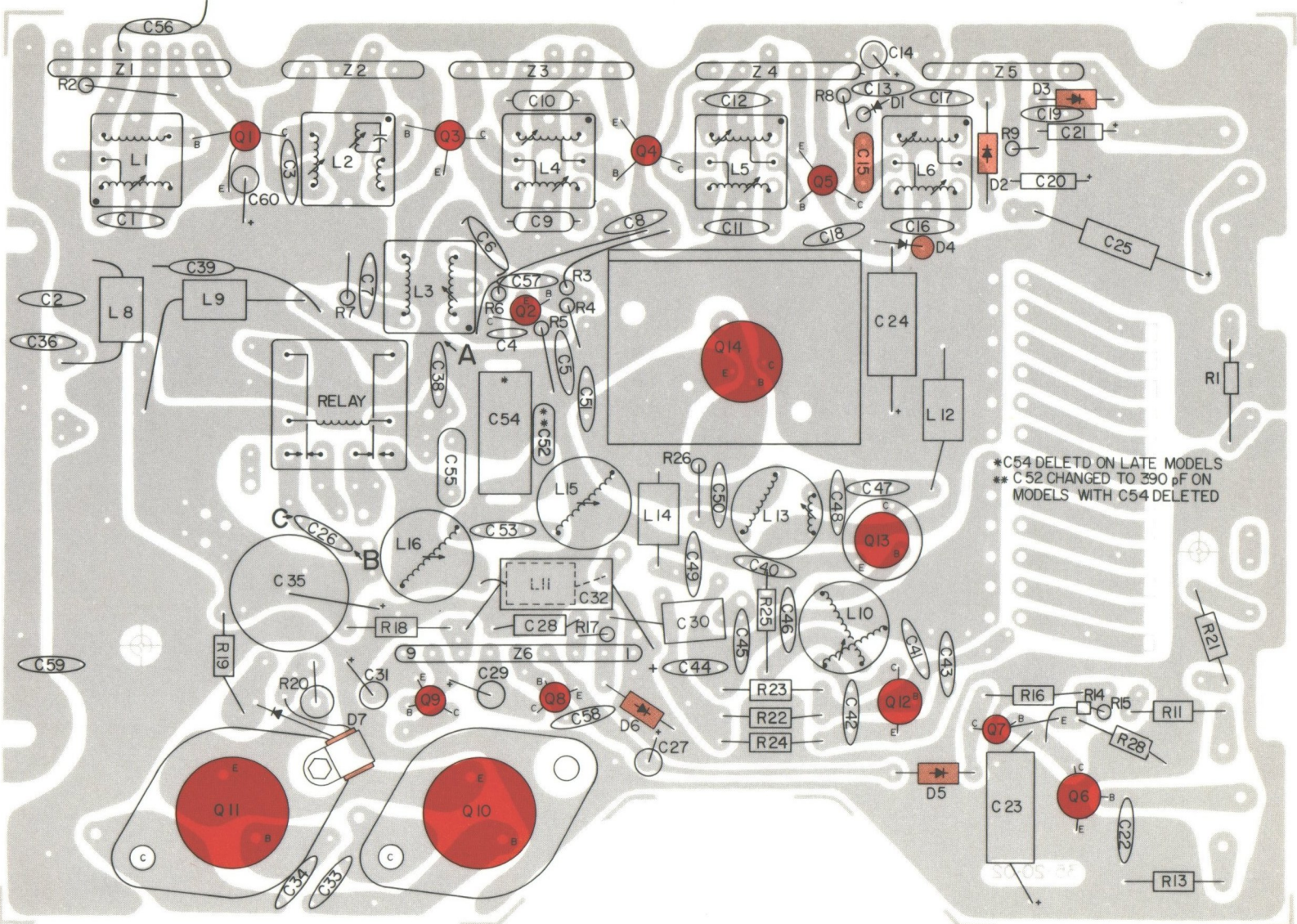
The value of many components used in Johnson equipment are being changed to coincide with Electronic Industries Association (EIA) standard values. These value changes are being made where performance of the unit is not affected by the change. Orders for a particular part number may be filled with either a new or old value part, depending upon availability.



ALIGNMENT POINTS
FIGURE 20



TOP VIEW SHOWING PARTS NOT LISTED
ON THE TRANSPARENCY
FIGURE 21


MESSENGER 100/110 PRINTED CIRCUIT BOARD
(Top View)
*C54 DELETD ON LATE MODELS
** C52 CHANGED TO 390 pF ON
MODELS WITH C54 DELETED
Z1
Z2
Z3
Z4
Z5
Z6
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
L13
L14
L15
L16
RELAY
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
D1
D2
D3
D4
D5
D6
D7
C1
C2
C3
C4
C5
C6
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C59
C60
R1
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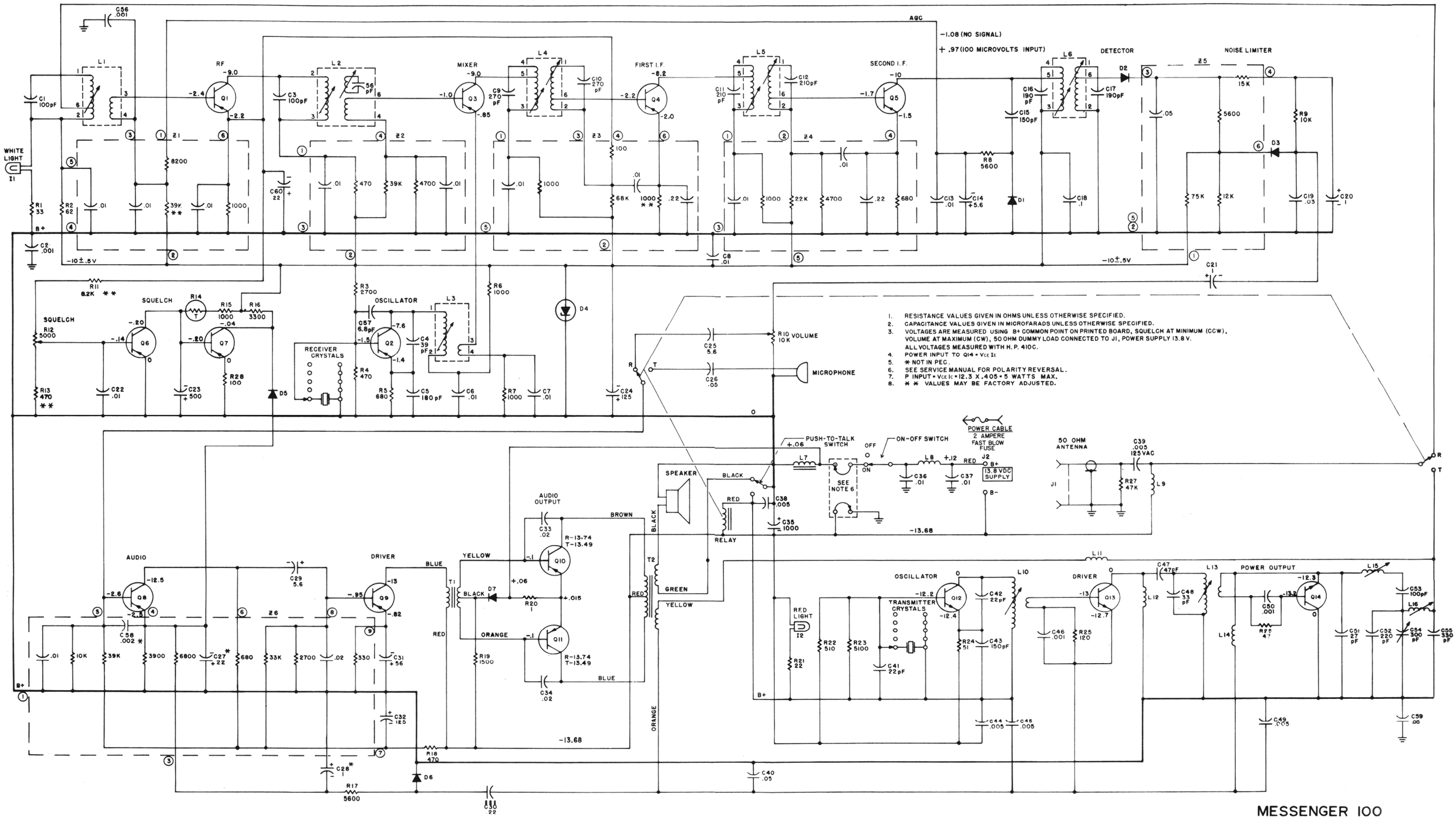
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R28
A
B
C



1. RESISTANCE VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED.
2. CAPACITANCE VALUES GIVEN IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. 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 13.8 V. ALL VOLTAGES MEASURED WITH H. P. 410C.
4. POWER INPUT TO Q14 = V_{CE} I_E
5. * NOT IN PEC.
6. SEE SERVICE MANUAL FOR POLARITY REVERSAL.
7. P INPUT = V_{CE} I_C = 12.3 X .405 = 5 WATTS MAX.
8. * * VALUES MAY BE FACTORY ADJUSTED.

MESSENGER 100
MODEL NO. 242-152

AGC

-1.08 (NO SIGNAL)

+ .97 (100 MICROVOLTS INPUT)

RF -9.0 -2.4 -2.2 Q1

MIXER -9.0 -1.0 -.85 Q3

FIRST I.F. -8.2 -2.2 -2.0 Q4

SECOND I.F. -10 -1.7 -1.5 Q5

DETECTOR

NOISE LIMITER

WHITE LIGHT I1

B+

-10±.5V

SQUELCH

RECEIVER CRYSTALS

OSCILLATOR -7.6 -1.5 -1.4 Q2

-.20 -.14 Q6

-.20 -.04 Q7

D4 Shot

D5

D6

D7

R10 VOLUME 10K

MICROPHONE

PUSH-TO-TALK SWITCH

ON-OFF SWITCH

POWER CABLE 2 AMPERE FAST BLOW FUSE

13.8 VDC SUPPLY

50 OHM ANTENNA

SPEAKER

RELAY

J3 P.A.-EXT. SPEAKER

PA SWITCH

RED LIGHT I2

TRANSMITTER CRYSTALS

P4 / J4

1 SQUELCH
2 RECEIVER B-
3 RECEIVER OUTPUT
4 AUDIO INPUT
5 AUDIO SWITCHING
6 B+
7 B-
8 RELAY
9 SPEAKER
10 T1
11 DRIVER

AUDIO -12.5 -2.6 -2.5 Q8

DRIVER -13 -.95 -.82 Q9

AUDIO OUTPUT Q10 R-13.74 T-13.49

Q11 R-13.74 T-13.49

OSCILLATOR -12.2 -12.4 Q12

DRIVER -13 -12.7 Q13

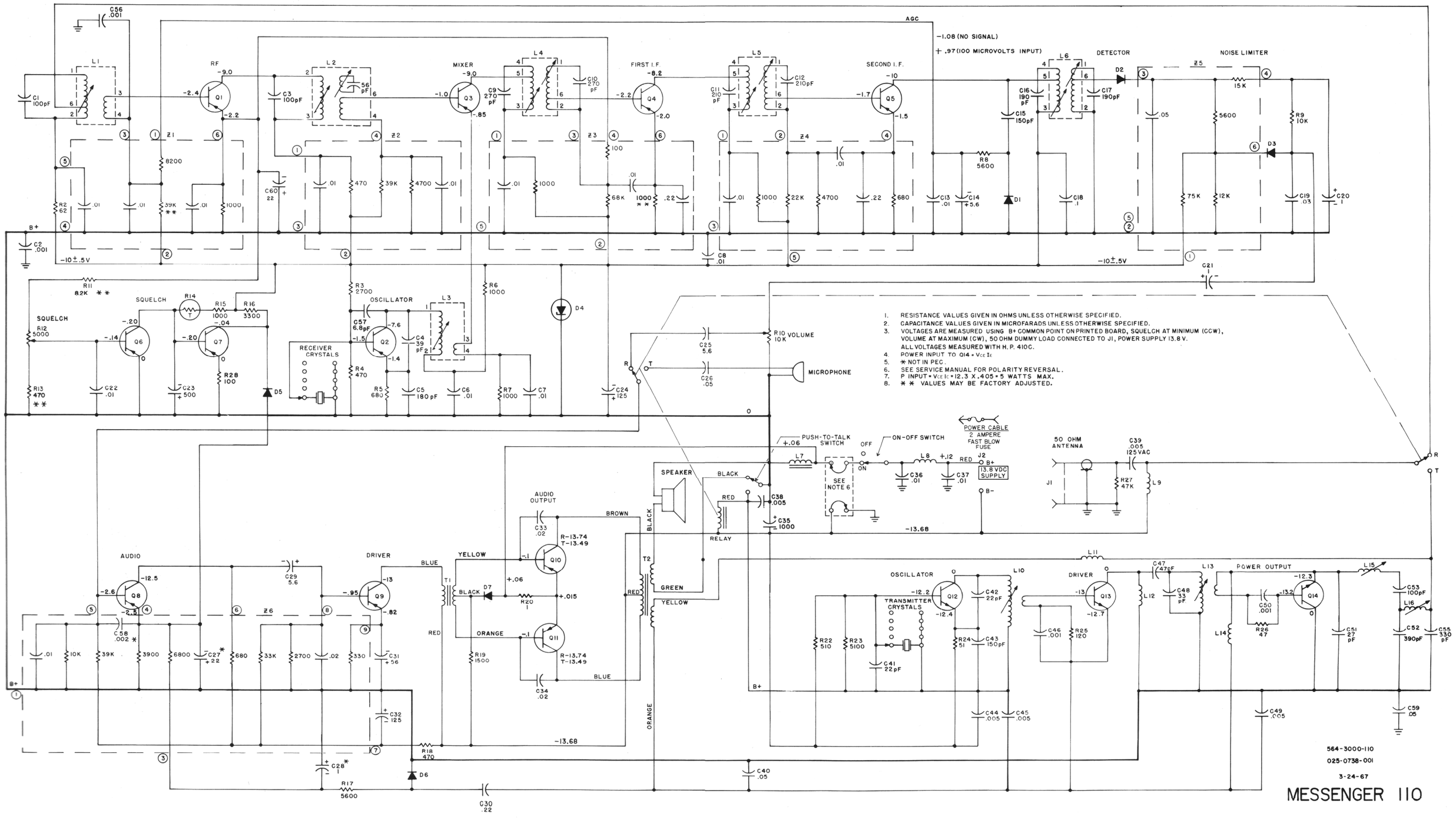
POWER OUTPUT -12.3 -13.2 Q14

-13.68

1. RESISTANCE VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED.
2. CAPACITANCE VALUES GIVEN IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. 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 13.8 V. ALL VOLTAGES MEASURED WITH H. P. 410G.
4. POWER INPUT TO Q14 = V_{CE} I_E
5. * NOT IN PEC.
6. SEE SERVICE MANUAL FOR POLARITY REVERSAL.
7. P INPUT = V_{CE} I_C = 12.3 X .405 = 5 WATTS MAX.
8. * * VALUES MAY BE FACTORY ADJUSTED.

MESSENGER 100

MODEL NO. 242-156



1. RESISTANCE VALUES GIVEN IN OHMS UNLESS OTHERWISE SPECIFIED.
2. CAPACITANCE VALUES GIVEN IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. 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 13.8 V. ALL VOLTAGES MEASURED WITH H. P. 410C.
4. POWER INPUT TO Q14 = $V_{CC} I_C$
5. * NOT IN PEC.
6. SEE SERVICE MANUAL FOR POLARITY REVERSAL.
7. P INPUT = $V_{CC} I_C$ = 12.3 X .405 = 5 WATTS MAX.
8. ** VALUES MAY BE FACTORY ADJUSTED.

564-3000-110
025-0738-001
3-24-67

MESSENGER 110

QUALITY ELECTRONIC PRODUCTS SINCE 1923

EXCELLENCE  THROUGH HALF A CENTURY OF EXPERIENCE.

E. F. JOHNSON CO.
WASECA, MINN. 56093

Printed in U.S.A. 8-75 NCP Part No. 001-0028-002