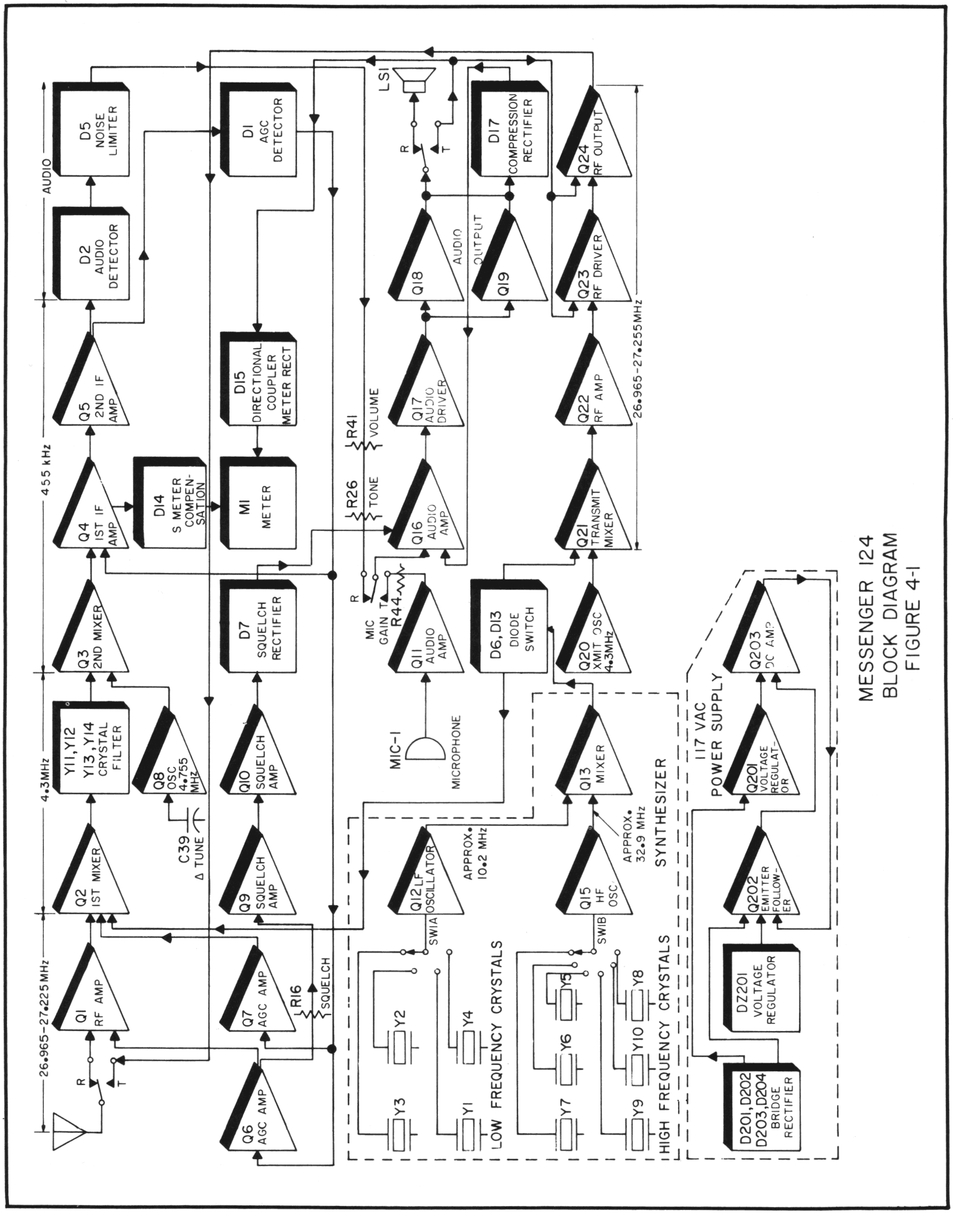


MESSENGER 124
BLOCK DIAGRAM
FIGURE 4-1

D13, the synthesizer diode switch. The synthesizer output frequency is always 4.3 MHz less than the desired channel frequency. On channel 1 the synthesizer output frequency is: 26.965 MHz - 4.3 MHz = 22.665 MHz.

4.2.5 SYNTHESIZER DIODE SWITCH

The diode switch (SPDT) consists of D6 and D13 which are used to couple the synthesizer output to the emitter of Q2 during receive and to the emitter of Q21 during transmit.

During receive D13 is reverse biased and D6 is forward biased, allowing the synthesizer output to pass through D6 to the emitter of Q2. D13 isolates the synthesizer signal from the transmitter.

During transmit, D6 is reverse biased and D13 forward biased allowing the synthesizer output to pass through D13 to the emitter of Q21. D6 is cut off and blocks the synthesizer output signal path to the receiver first mixer.

4.3 RECEIVER

4.3.1 RF

During receive, relay RY1 connects the antenna to the base of Q1, the RF amplifier, through T1. Q1 amplifies the incoming signal which is then coupled to the base of the first mixer, Q2, through T2.

4.3.2 FIRST MIXER

The signal from the RF amplifier is coupled to the base of Q2, the first mixer. At the same time, the signal from the synthesizer mixer (Q13) is coupled to the emitter of Q2 by conduction of D6. The output of Q2 is tuned to the difference between the incoming antenna frequency and the output from the synthesizer. For example, when the channel selector is in the channel 1 position, the received frequency is 26.965 MHz and the synthesizer frequency is at 22.665 MHz. The first mixer output frequency then is 26.965 MHz - 22.665 MHz = 4.300 MHz. Synthesizer frequencies are chosen to insure that the first mixer output frequency will always be 4.300 MHz.

4.3.3 CRYSTAL FILTER

The crystal filter is a high Q selective circuit which produces a narrow peaked, very steep sided, IF selectivity curve. The filter consists of crystals Y11-Y14 which make up two half lattices in series. The output of the first mixer is coupled to the second mixer stage through the crystal filter network. The variable capacitor C10 adjusts the shape of the nose of the selectivity curve.

4.3.4 OSCILLATOR

The receive oscillator, Q8, operates at 4.755 MHz and is tunable ±3 kHz by the Δ Tune control, C39. Frequency control is provided by the tuned circuit consisting of L5 and the parallel combination of C39, C31, and C48 in series with C30 and C38.

For good frequency stability, relative large capacities are used in the tuned circuits. Capacitor types are also chosen for temperature compensation. The signal from the emitter of Q8 is coupled through C28 to the base of Q3, the second mixer.

4.3.5 SECOND MIXER

The second mixer, Q3, produces the 455 kHz IF frequency. The 4.3 MHz signal from the crystal filter is coupled to the base of Q3, as is the 4.755 MHz signal from the receiver oscillator, Q8. The output transformer of the second mixer is tuned to the difference frequency of the two inputs, or 455 kHz.

4.3.6 IF CIRCUITS

The two IF amplifiers, Q4 and Q5, amplify the 455 kHz IF signal produced in the second mixer. The three IF transformers, T5, T6 and T7, are double tuned for additional selectivity. The amplified IF signal is coupled from the collector of Q5 through T7 to the detector diode, D2.

4.3.7 AUDIO CIRCUITS

The detected audio from D2 is coupled through the noise limiter, D5, the volume control, R14, and tone control, R26, to a set of contacts on the relay. During receive, the audio is coupled through the relay contacts to the base of audio amplifier, Q16. The schematic diagram shows the relay contacts in the receive (normally closed) position. The amplified audio is coupled to the base of Q17, the audio driver, for further amplification and then coupled through T10 to the bases of the class B audio output stage, Q18 and Q19. The driver transformer T10, provides the correct impedance match between the collector of the driver transistor and the bases of the class B stage. The output of the class B amplifier is coupled through T11 to the speaker during receive. T11 is a combination audio output and modulation transformer.

One side of the speaker is connected to the audio output-modulation transformer, T11, in parallel with the external speaker jack. The other side of the speaker is connected to T11 through a set of contacts on the relay. When the PTT switch on the microphone is depressed, the relay is energized, opening the speaker windings and connecting the microphone audio output to the transmitter first audio amplifier, Q11.

4.3.8 AGC CIRCUIT

The AGC detector, D1, produces a positive-going DC voltage, the AGC voltage, which is applied to the base of Q4, Q6 and Q7 through a thermistor-resistor assembly, Z4. The AGC voltage is amplified by Q6, then applied to the emitter of the RF amplifier, Q1, to reduce the receiver gain on strong signals. The AGC voltage is also amplified by Q7, then applied to the emitter of the first mixer, Q2, also reducing receiver gain. The AGC voltage applied to the base of Q4, the first IF amplifier, is used to further reduce receiver gain. The thermistor-resistor network, Z4, provides temperature compensation (resistance decreases as temperature increases) by reducing the effect of temperature changes on the receiver gain.

4.3.9 SQUELCH

The squelch amplifiers, Q9 and Q10, receive their signal from the emitter of Q6, the AGC amplifier, through a 5000 ohm potentiometer, R16, which determines the input signal level at the base of Q10. The output of the squelch circuit at the collector of Q10 is coupled through D7 to the emitter of Q16, and biases off the audio when no signal is received. The thermistor-resistor assembly, Z7, in the squelch circuit provides temperature compensation, thereby reducing the squelch circuit's sensitivity to changes in temperature.

4.4 TRANSMITTER

4.4.1 AUDIO CIRCUITS

When the PTT switch on the microphone is depressed, one set of contacts on the PTT switch energizes the relay RY1, closing the normally open contacts shown on the schematic. Signals from the microphone are coupled through one set of relay contacts to the base of the transmitter first audio amplifier, Q11. Q11, an FET, provides high gain and a high input impedance for the microphone. The AF signal is amplified by Q11, Q16, and Q17 and coupled through T10 to the push-pull class B audio stage, Q18 and Q19. The amplified signal from Q18 and Q19 is coupled through T11, to provide modulation of the RF driver, Q23, and the RF output, Q24. The RF driver and output stages are both modulated for higher modulation capabilities.

Modulation limiting is obtained from an audio compressor consisting of C78, R78, D17, C76, C73 and 6800 ohm and 3900 ohm resistors in Z8. This compressor rectifies a sample of the output of the audio output stage at T11 and applies the DC voltage thus obtained to the emitter of audio amplifier Q16 to reduce gain. A high signal level from the microphone (caused by operator whistling or shouting into the microphone, for example) will cause a high signal level at the secondary of T11. The high level at T11 will cause a higher voltage at the emitter of Q16, biasing the stage to reduce the gain for the duration of the high signal level condition. Thus the audio compressor circuit maintains a relatively constant audio output level over a wide range of input levels.

4.4.2 OSCILLATOR

The transmit oscillator, Q20, operates with the transmit crystal, Y16, in a parallel resonant circuit to produce a 4.3 MHz signal. The 4.3 MHz output of Q20 is coupled to the base of transmit mixer, Q21.

4.4.3 TRANSMITTER MIXER

The 4.3 MHz signal from the transmit oscillator, Q20, is coupled to the base of Q21. At the same time, the signal from the synthesizer mixer, Q13, is coupled through the synthesizer diode switch, D13, to the emitter of Q21. At Q21, the signal from Q20 and the signal from Q13 are mixed. The sum frequency is selected by the double tuned transceiver, T12, in the collector circuit. Assuming operation on channel 1, the signal from the synthesizer is 22.665 MHz (exact frequency determined by the channel selector switch - refer to Table 4-1). The transmitter output frequency then is the synthesizer frequency plus 4.3 MHz, or for channel 1 it is 22.665 MHz + 4.3 MHz = 26.965 MHz.

4.4.4 FIRST RF AMPLIFIER

The output of the transmit mixer, Q21, is coupled from its collector through a double-tuned transformer, T12, to the base of the first RF amplifier, Q22. The signal is amplified, then coupled through T13 to the RF Driver.

4.4.5 RF DRIVER

The RF driver, Q23, operates class C, and amplifies the RF signal from Q22. The signal is then coupled to the RF output transistor, Q24, through T14. Modulation is applied to the emitter and base of the RF driver transistor to improve modulation linearity and increase modulation capability of the RF output stage.

4.4.6 RF OUTPUT

The grounded collector power amplifier, Q24, is designed to operate class C at 5 watts DC power input. The power amplifier drives a 50 ohm antenna through a double pi network and a set of contacts on the relay. Modulation is applied to the emitter and base of Q24.

4.5 METERING

To indicate the strength of received signals, the S-Meter is connected in a bridge circuit between potentiometer R48 and the emitter resistor of Q4, the first IF amplifier. The voltage at R48 is constant and serves as a reference. The emitter voltage at Q4 is positive-going with increasing signal strength because of AGC action. (AGC detector D1 applies positive-going bias to the base of Q4 which reduces the emitter current and hence the emitter voltage is positive going.) This induces an up-scale reading on the meter. Diode D14 conducts at higher signal levels to compensate the meter action for non-linear change of AGC voltage.

Potentiometer R48 functions as the S-Meter electrical zero set and is adjusted under no-signal conditions. Potentiometer R49 adjusts sensitivity (pointer is set at S5 with 10 microvolts into a 6 dB pad). Calibration is approximately 5 dB per S unit. Thermistor Z9 compensates for temperature effects on the zero setting.

On transmit, relay RY1 disconnects the DC power from circuits associated with the S-Meter, leaving the S-Meter at rest. For "PWR" (power output) and "SWR" (voltage standing wave ratio) the meter uses a directional coupler to sample the RF energy at the antenna terminals.

This energy is rectified by diode D15. With the meter switch in the "PWR" position, the meter scale indicates power into a 50 ohm load. The meter is set (on channel 11 with unmodulated carrier) to read a nominal "4" using the "PWR" adjustment (R25) on the rear panel. This also calibrates the meter for SWR measurements.

With the meter switch set at "SWR" (standing wave ratio), the directional coupler samples the RF energy reflected from the antenna back through the transmission line. The meter scale is calibrated to indicate voltage standing wave ratio, here called simply Standing Wave Ratio (SWR) for convenience. Calibration of the "PWR" meter setting as above is the only adjustment required.

The MOD (per cent modulation) meter measures the AF voltage at the secondary of the audio output transformer on a scale that indicates per cent modulation. With the meter switch at "MOD", a sample of the audio output is taken from the secondary of output transformer T11, and rectified by diode D15. The meter scale reads 0 to 100%, with divisions at 20, 40, 60 and 80%. The meter is calibrated by adjusting the RF output wave form (as viewed in a CRO) for 50% modulation with 1000 Hz sine wave input, then setting the meter to half scale by turning the "MOD" adjustment (R23) on the rear panel. The "PWR" meter adjustment (R25) affects the indication of per cent modulation, so the MOD adjustment should be done after setting the "PWR" meter control.

Refer to the Messenger 124 Operating Manual, part no. 002-0103-001, for additional operation information.

4.6 RELAY SWITCHING

The Messenger 124 relay, RY1, performs the following functions when the microphone PTT switch is depressed:

The movable contact at relay pin 9 transfers the antenna from T1, the receiver input (pin 1) to the transmitter output (pin 5).

The movable contact at relay pin 10 removes the audio output transformer (T11) speaker windings from the speaker (pin 2) and connects the modulation winding of T11 and +13.8 VDC to the modulated transmitter stages (pin 6).

The movable contact at relay pin 11 transfers -13.8 VDC from the receiver circuits (pin 3), to transmitter circuits (pin 7).

The movable contact at relay pin 12 transfers the input circuit of the common audio amplifier from pin 4, the output of the receiver detector (after ANL volume and tone controls) to pin 8, the output of the microphone amplifier Q11.

4.7 POWER SUPPLY

The regulated power supply furnishes 13.8 VDC to the transceiver. The approximately 15 VDC output of the bridge rectifier, D201 through D204, is connected to the series regulator, Q201, and the emitter-follower stage, Q202. A sample of the DC output voltage is taken from Q201 and fed to the base of Q203 through R205. Q203 functions as a voltage amplifier. Regulation of the output voltage is accomplished by this voltage feedback which is compared with the voltage at the emitter of Q203. The emitter of Q203 is fixed by the zener diode, DZ201, at 10 volts. R105 determines the output voltage of the regulator, and has been selected to provide a 13.8 VDC output during receive conditions. A 0.5 ampere fuse located on the rear of the chassis provides power supply circuit protection. A shorted output or a continuous overload, above approximately 1.5 amperes DC output, will blow this fuse.

SECTION 5
SERVICING

5.1 GENERAL SERVICING INFORMATION

The information in this section serves as a guide for servicing the Messenger 124 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 diagram, and the schematic 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 output frequency. Use the performance test procedures in the receiver and transmitter servicing sections as guides.

5.1.3 REPLACEMENT TRANSISTORS

You will notice when referring to the parts list that the transistors used in this unit are listed with E. F. Johnson house numbers. These transistors are specially selected for specific parameters. They must be replaced with 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 124 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 124 circuit boards. 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 needlenose pliers when heat is applied. This method will prevent melting the coax center conductor insulation.

5.1.6 REMOVING CABINET SHELL

a. Remove the four No. 8 sheet metal screws that retain the cabinet shell at the rear of the chassis.

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.

For DC operation, connect the chassis rail to the grounded negative side of the battery and connect the fused DC power cable between the power jack, J2, and the positive terminal of a 13.8 volt battery.

The B- circuit is internally connected to the chassis rail. The B+ common circuit operates at +13.8 VDC with respect to ground, but is by-passed to ground for AF and RF signals.

The lead to the microphone input circuit should be shielded and the shield grounded to the body of the microphone connector. Use ground jumper from Messenger 124 chassis to the chassis of the oscilloscope.

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 5-2 for the correct voltmeter connections for measuring in-circuit transistor bias.

NOTES

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.

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.

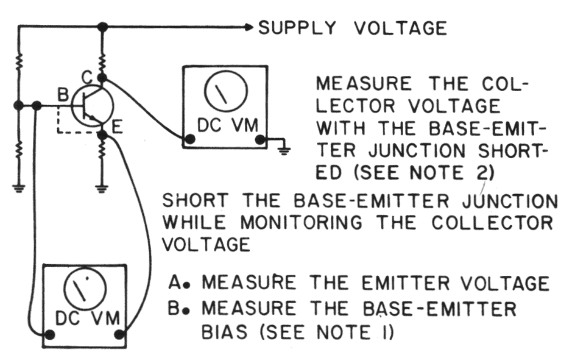
Be careful when connecting test leads to in-circuit transistors. Operating transistors can be ruined by shorting the base to the collector and, in some circuit configurations, the emitter to ground.

Turn power off when removing or installing transistors.

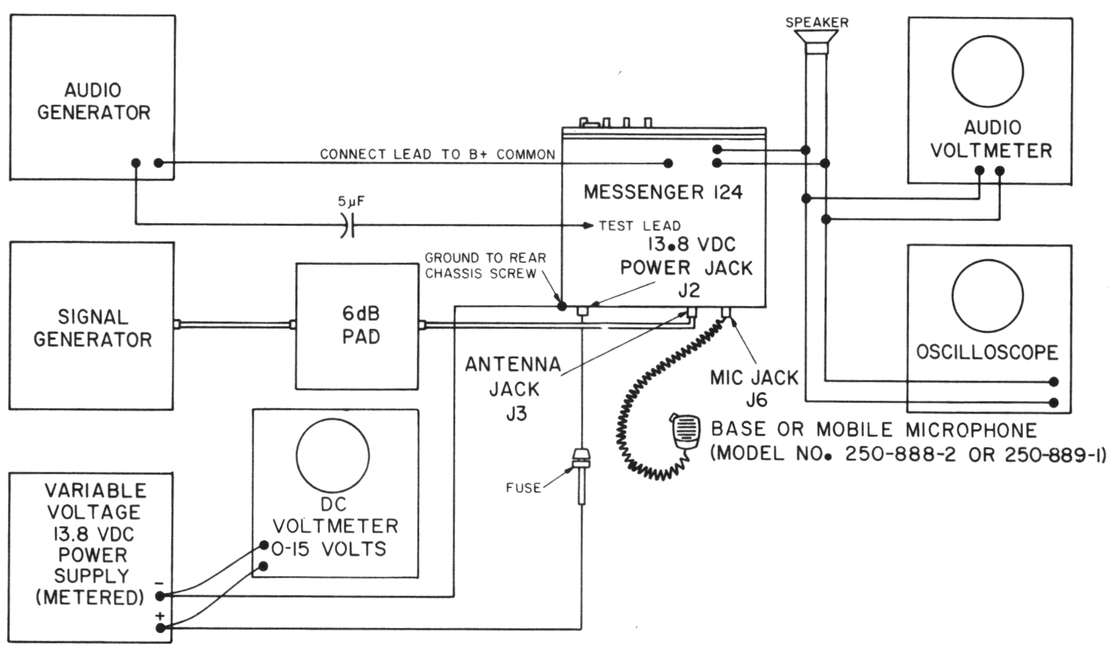
5.2.3 IN-CIRCUIT TRANSISTOR TESTING

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.



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



TEST INSTRUMENT CONNECTIONS FOR
RECEIVER SERVICING AND ALIGNMENT
FIGURE 5-2

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. 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.

Remember that you should not measure any semiconductor resistance on any ohmmeter range which produces more than three milliamperes of short circuit current.

Table 5-1 indicates the results that should be obtained from operational transistors measured out of circuit.

TABLE 5-1
OUT OF CIRCUIT TRANSISTOR MEASUREMENTS

Transistor Type		Ohmmeter Connections + lead	Ohmmeter Connections - 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	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)

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 IO-12 or equivalent modified for direct connection to vertical plate. Precision ES-550B
Audio Voltmeter	Measure from -50 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	Frequency range 25 - 30 MHz with accuracy ± 0.0005% and 455 kHz with accuracy of ± 0.01%.	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 ±0.01 at 455 kHz
RF Voltmeter	10 mV - 300 volts	Measure RF voltages	Millivac 38B or equivalent

The following instrument 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 per cent of modulation

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

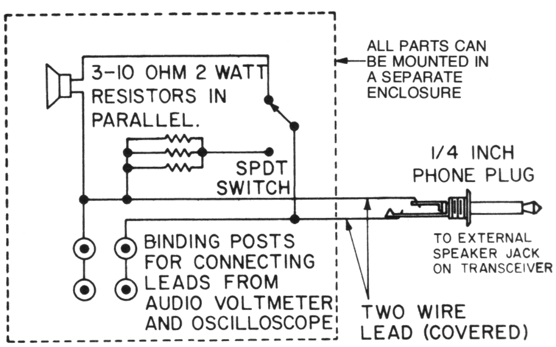
Refer to Figure 5-2 for test instrument connections and Table 5-2 for test instruments required.

NOTES

Any 117 VAC operated test instruments with grounded power plugs, used for servicing the Messenger 124, must be "floated" (ungrounded).

The audio voltmeter called for in Table 5-2 can be connected directly across the speaker coil or to a test assembly constructed as illustrated in Figure 5-3. Disconnect the black lead from the lower terminal of the speaker when using this test assembly.

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



TEST ASSEMBLY CONNECTING AUDIO VOLTMETER AND OSCILLATOR
FIGURE 5-3

5.3.2 SENSITIVITY

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

b. Set the channel selector to channel 11.

c. Set the signal generator output for 1 μV modulated 30% at 1000 Hz 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 8 dB or more. (Typical 10 dB)

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 1 μV modulated 30% at 1000 Hz.

   e. The audio output on the voltmeter should be 0.775 volts (0 dB) minimum on channels 1, 11 and 21 (typical 1.5 volts).

2. Troubleshooting

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

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

   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 (+10 dB) 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.

TABLE 5-3
TYPICAL AUDIO LEVELS

Test Point	Volts RMS
	Levels required to produce 2.5 V RMS across speaker terminals.
top of volume control	0.0036
base of Q16	0.00235
collector of Q16	0.021
base of Q17	0.021
collector of Q17	3.1

NOTES

(Class B audio output transistors Q18 and Q19)

Check the base and emitter voltages of the Class B audio output transistors. Q18 and Q19 base and emitter voltages should be approximately equal when each stage is turned on.

Severe audio distortion may be the result of an open Q18 or Q19, or a defective D18. A shorted transistor can cause R58 to burn and possibly blow the fuse. The faulty transistor may have an excessively warm case.

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

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 -10 dB indication on the audio voltmeter.

   e. Reduce the signal generator output to 10 μV. The audio voltmeter indication should drop 5 dB maximum.

   f. With 10 μV signal generator output, adjust audio output to -10 dB.

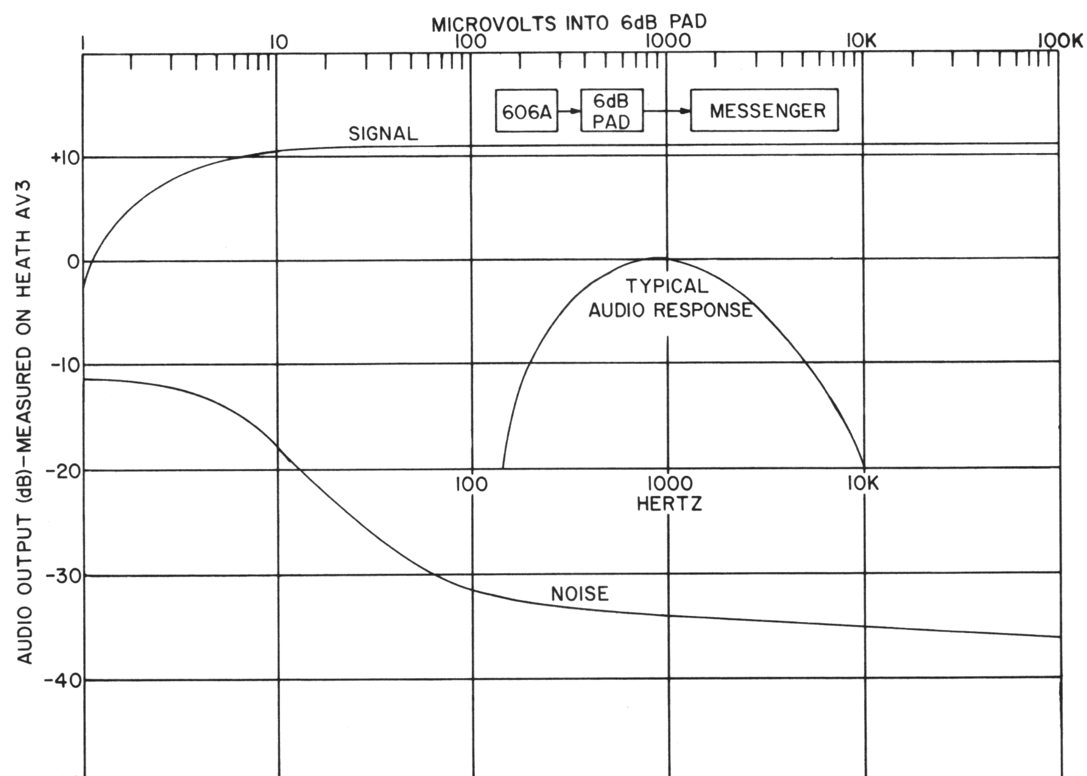
   g. Reduce the signal generator output to 1 μV. The audio voltmeter indication should drop 12 dB ±6 dB from the 10 μV reading.

2. AGC Troubleshooting

   a. Increase RF signal generator output from 1 μV to 0.1 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, following the general signal curve illustrated in Figure 5-4.

   b. If the voltage at the speaker increased proportionately as the input voltage increased, check D1 by bridging it with a new diode, and check its associated circuitry.

   c. If D1 and its associated circuitry appear to be good, connect a DC voltmeter between Z3 terminal 4 and B+ common. The AGC voltage measured here should go less negative as the input voltage is increased from 1 μV to 0.1 V.



AUDIO RESPONSE & AGC CURVES
FIGURE 5-4