2. Set the RF signal generator output for 1000 μV on 27.085 MHz (channel 11), modulated with 1 kHz at 30%.

3. Set the transceiver to channel 11 and adjust the volume control for a 0 dB audio VTVM indication.

4. Reduce the RF signal generator output to 1 μV. The audio VTVM should drop 20 dB ±2 dB. If this requirement is not met, adjust R2 and repeat steps 3 and 4.

5. If the audio reading still does not meet the preceding requirement, proceed with AGC troubleshooting.

b. AGC Troubleshooting

1. Measure the no signal input AGC voltage at the junction of R3 and C7. It should read approximately 0.4V.

2. Increase the RF signal generator output from 1 μV to 100,000 μV while observing the audio output meter indication. Refer to Table 5-1 for typical AGC levels.

3. Isolate the AGC circuitry from the squelch stage by disconnecting the interconnecting lead from squelch control R7. This will separate squelch problems from defective AGC indications.

4. If the audio output meter indication does not follow the general trend of the data shown in Table 5-1, check CR1, Q1 and associated circuitry.

TABLE 5-1
TYPICAL AGC LEVELS

RF Input to 6 dB pad (In Microvolts)	Relative Audio Output (In dB)
1	-23.0
3	-17.0
10	-8.5
30	-5.5
100	-4.1
300	-3.5
1,000	-3.0
3,000	-2.7
10,000	-2.0
30,000	-0 (10 dB reference)
100,000	-2.9

Test Conditions: Connect the RF signal generator through a 6 dB pad to the transceiver antenna connector, and set the frequency to 27.085 MHz. (channel 11), modulated with 1 kHz at 30%.

Set the volume control for a 10 dB reference level as measured across the speaker terminal with a 30,000 μV RF signal generator input.

TABLE 5-2
TYPICAL RECEIVER SIGNAL LEVELS

Test Point	Input Frequency	Input Voltage Level
Antenna Connector	27.085 MHz	1.0 μV
Q1 Base	27.085 MHz	1.46 μV
Q1 Collector	27.085 MHz	22.4 μV
Q2 Base	27.085 MHz	19.0 μV
Q2 Collector	455 kHz	1.1 mV
Q4 Base	455 kHz	0.2 mV
Q4 Collector	455 kHz	4.0 mV
Q5 Base	455 kHz	1.9 mV
Q5 Collector	455 kHz	325.0 mV
CR2 Cathode	1 kHz	82.0 mV
CR3 Anode	1 kHz	4.5 mV
C11 + side	1 kHz	2.4 mV
CR9 Anode	1 kHz	1.4 mV
Q7 Base	1 kHz	1.3 mV
Q7 Collector	1 kHz	7.6 mV
Q8 Base	1 kHz	7.5 mV
Q8 Collector	1 kHz	1.3 V
Q9-Q10 Base	1 kHz	0.3 V
Q9-Q10 Collector	1 kHz	5.0 V

Test Conditions: Set the volume control for maximum audio output and the squelch control for minimum squelch.

Connect the RF and audio signal generators through a 1.0 μF capacitor to the listed test points, and set the generator output levels for a 10 dB reference level as measured across the speaker terminals.

Modulate the RF signal generator with a 1 kHz tone at 30% modulation.

5.3.5 RF AND IF STAGES

Proper RF and IF stage operation can be quickly checked by injecting calibrated signals at various points and measuring for a reference output voltage level (signal injection method).

a. Refer to Table 5-2 for test conditions, test points, frequencies and voltage levels.

b. Connect the RF or IF signal generator through a 1.0 μF capacitor to indicated test points, and compare readings with those listed.

c. Half split troubleshoot.

1. First connect the generator to Q5 collector. If there is audio output, work towards the receiver front end until the defective stage is isolated.

2. If there is no audio output, proceed with audio troubleshooting.

5.3.6 AUDIO TROUBLESHOOTING

a. Refer to Table 5-2 for test conditions, test points, frequency and voltage levels.

b. Connect the audio signal generator through a 1.0 μF capacitor to indicated test points, and compare readings with those listed.

c. First connect the generator to Q9 and Q10 collector. If there is audio output, work toward CR2 until the defective stage is isolated.

d. If audio distortion is apparent, use an oscilloscope to trace trouble to defective stage and component.

e. Severe audio distortion can be the result of an open Q9 or Q10. A shorted Q9 or Q10 can cause R24 to burn and possibly blow the line fuse.

5.3.7 SQUELCH

a. Squelch operation can be checked by performing a tight squelch test. Proceed as follows to perform this test:

1. Connect the RF signal generator to the antenna connector and adjust the squelch control full right.

2. Set the RF signal generator to 30 μV, modulated with 1 kHz at 30% (channel 11 frequency). Squelch should not open.

3. Set the RF signal generator to 3000 μV. The squelch should open, allowing audio output to be heard.

4. If the preceeding requirements are not met, proceed with squelch troubleshooting.

b. Squelch Troubleshooting

1. Measure the emitter voltage of first audio amplifier Q7 while adjusting the squelch control from minimum to maximum squelch. The voltage indication should go from approximately +10.5 to 0.5 VDC.

2. Since squelch gate Q6 receives its control voltage from the amplified AGC line (AGC2), the AGC circuitry should be checked before proceeding with squelch troubleshooting.

3. After determining that the AGC circuitry is not defective, check squelch gate Q6 and associated circuitry.

4. Measure Q6 DC voltages and compare with those indicated on the schematic.

5.3.8 NOISE LIMITER

The noise limiter condition should be checked by using signal injections and resistance measurements.

1. If signal injections indicate a defective noise limiter circuit, unsolder CR3 and substitute with a known good diode. Check associated components.

2. The front-to-back resistance ratio should measure approximately 1:10 for a typical noise limiter diode.

TABLE 5-3
TYPICAL TRANSMITTER RF VOLTAGE READINGS

Test Point	RF Voltage Reading
Q11 Collector	3.6 VRF
Q12 Base	1.5 VRF
Q12 Collector	11.0 VRF
Q13 Base	2.4 VRF
Q13 Collector	11.5 VRF
Antenna Connector	15.4 VRF

Test Conditions:
RF voltage readings were measured with a Boonton 91C RF voltmeter using a 100:1 RF probe.

Measurements were made on an unmodulated transmitter which had an RF power output of 3.7 watts.

5.4 TRANSMITTER TROUBLESHOOTING

Refer to the alignment section for test setup details and Table 5-3 for typical transmitter RF voltage readings.

5.4.1 TRANSMITTER CURRENT DRAIN

a. Connect a current meter in series with the positive voltage lead and key the transmitter.

b. Normal current drain should measure between approximately 0.9 A and 1.1 A with 3.0 to 3.8 watts power output, no modulation, or 1.3 A maximum with full modulation.

5.4.2 OSCILLATOR AND DRIVER

a. Key the transmitter and measure the emitter voltage of the oscillator, Q11. A typical DC voltage reading of 0.6V should be measured. Remove the T crystal. The voltage reading should drop to approximately 0.4 volts DC.

b. Insert the T crystal and measure Q11 collector RF voltage. It should measure approximately 3.6 VRF.

c. Measure the RF voltage on the base and collector of driver Q12. Typical readings of approximately 1.5 and 11.0 VRF respectively should be measured.

5.4.3 POWER AMPLIFIER, ANTENNA SWITCHING DIODE AND LOW PASS FILTER

a. Key the transmitter and measure the RF voltage on the base and collector of power amplifier Q13. Typical readings of approximately 2.4 and 11.5 VRF respectively, should be measured.

b. Measure the RF voltage across R32. A typical reading of approximately 15.4 VRF should be measured.

1. If no RF voltage is developed across R32, check antenna switching diode CR7.

2. Check tuning of low pass filter (L3 and L4), and check associated components.

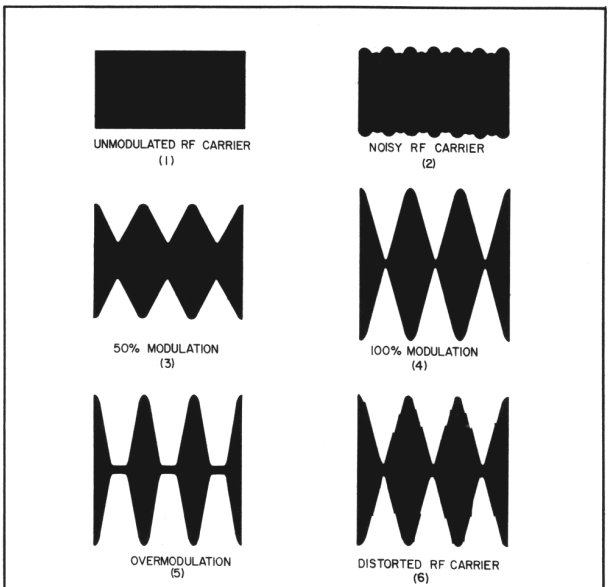
5.4.4 MODULATOR AND AUDIO COMPRESSOR

a. Couple the pickup loop to L4. Refer to Figure 5-5 for pickup loop fabrication and oscilloscope connection.

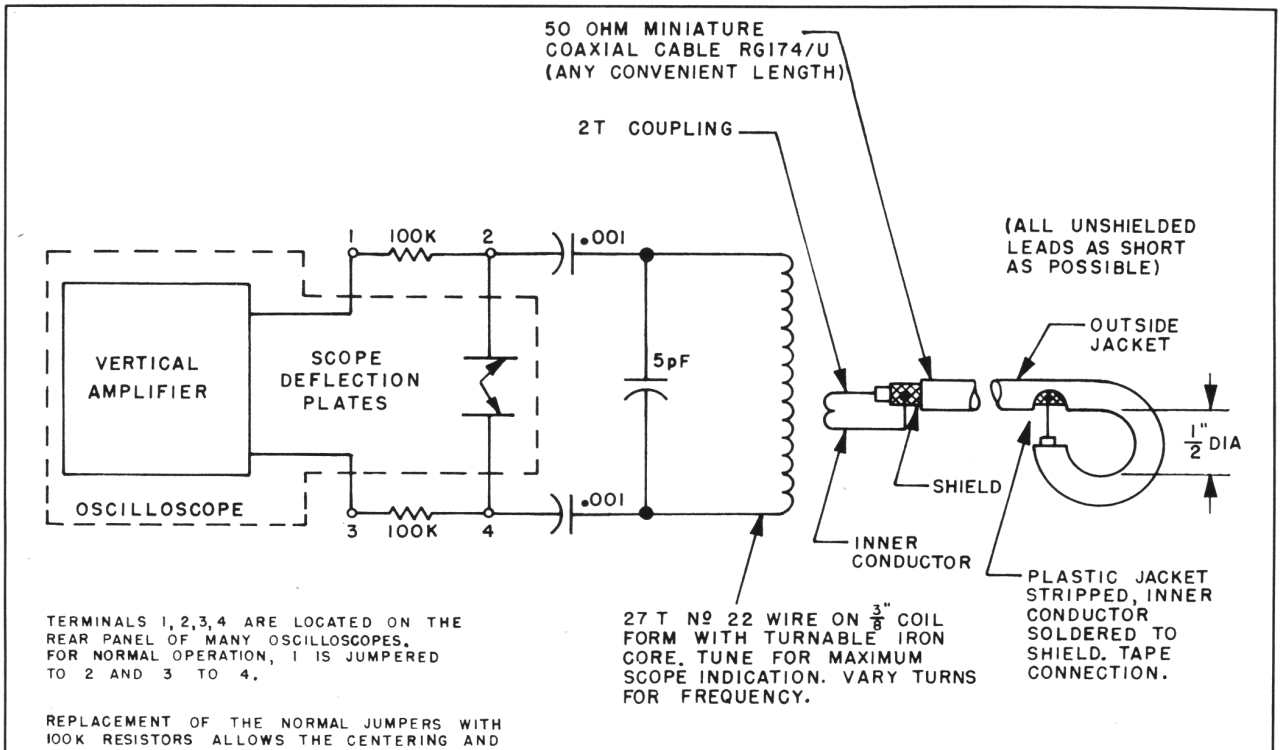
b. Key the transmitter and observe the unmodulated RF carrier oscilloscope waveform. The waveform should be free from noise. Refer to Figure 5-4 (1) for normal waveform.

1. If noise is riding on top of the waveform refer to Figure 5-4 (2), check for a noisy Q7 or Q8 and other associated defective components.

c. Connect the audio input through a 6800 pF capacitor to contact 2 of switch S1B. Refer to the Alignment section for test setup details.



TRANSMITTER RF WAVEFORMS
FIGURE 5-4



OSCILLOSCOPE RF PICK-UP LOOP FABRICATION
AND METHOD OF CONNECTION
FIGURE 5-5

1. Set the audio generator frequency to 1 kHz and the output level to 10 mV (-38 dB). The oscilloscope should indicate at least 50% modulation. Refer to Figure 5-4 (3) for normal waveform.

2. Increase the audio generator output level to 63 mV (-22 dB). The oscilloscope should indicate not less than 80% and not more than 100% modulation on negative and positive peaks. Refer to Figure 5-4 (4) for 100% modulation oscilloscope waveform.

d. Check for modulation waveform distortion and correct if present.

1. When the audio compressor is functioning properly, the transmitter cannot be overmodulated with a 1 kHz microphone input. If upward or downward overmodulation is apparent (refer to Figure 5-4 (5), suspect audio compressor trouble.
2. Check C25, CR5, C22, C20 and associated components.

3. The waveform should be clean and free of RF distortion. If RF distortion is present (refer to Figure 5-4 (6)), first try to eliminate by retuning the transmitter. Then check C36, C33, C34 and C35.

5.5 SELECTIVE CALLING

5.5.1 TONE NOT RECEIVED IN STBY POSITION

a. Check the transceiver by listening to tone transmissions with the STBY switch out.

b. Make sure that the STBY switch button locks in the standby position.

c. Check tone frequency determining components C105 and R107 for proper values and socket contact.

1. Refer to Section 1 of the service manual and Table 1 on the schematic diagram.

d. Measure the selective calling section voltages and check for proper waveforms.

1. Refer to the schematic diagram for proper voltage readings and oscilloscope waveforms.

e. Measure the tone frequency and adjust as necessary.

1. Refer to the alignment section.

5.5.2 CALL FUNCTION INOPERATIVE

a. Check the call function by depressing the call switch button for four or more seconds.

1. Called station (with STBY switch button out) should receive an alerting tone from the calling station.

b. Make sure that the call switch button is being fully depressed.

c. Check tone frequency determining components C105 and R107 for proper values and socket contact.

1. Refer to Section 1 of the service manual and Table 1 on the schematic diagram.

d. Measure the selective calling section voltages and check for proper waveforms.

1. Refer to the schematic diagram for proper voltage readings and oscilloscope waveforms.

e. Measure the tone frequency and adjust as necessary.

1. Refer to the alignment section.

5.5.3 CALL LIGHT

a. Call light is inoperative.

1. Measure for open call light DS101.

2. Measure the voltages as marked on the schematic for multivibrator Q106 and Q107.

b. Call light turns on and tone sounds when not being called (falsing).

1. Check for proper selective calling section alignment. Refer to the Alignment section for details.
2. Check audio switch Q105 and associated circuitry.

5.5.4 CHANGING TONE FREQUENCY

a. Remove frequency determining components C105 and R107 and replace with the listed values for the desired tone frequency.

1. Refer to the components layout and Table 1 on the schematic diagram.

b. Realign the selective calling section.

1. Refer to the Alignment Section for alignment details.

5.6 AC POWER SUPPLY

The Messenger 120 AC Power Supply, Part No. 239-0125-001, is a regulated 13.8 VDC power source used for base installations.

CIRCUIT DESCRIPTION

The approximately 15 VDC output from the bridge rectifier, D101 through D104, is connected to the series regulator, Q101, and the emitter follower, Q102. A sample of the DC output voltage from Q101 is fed back to the base of the voltage amplifier, Q103, by R105. Regulation

of the output voltage is accomplished by comparing this feedback voltage to the emitter voltage of Q103. The emitter of Q103 is fixed by the reference zener diode, D106, at 10 volts. The difference voltage between the output and reference source is amplified by Q103 and it is fed back to Q101 and Q102, effectively biasing for more or less DC voltage output. The regulator output voltage is adjusted By R105 and it is factory adjusted for 13.8 VDC output in receive condition. Power supply circuit protection is provided by a 0.3 ampere fuse connected in the primary winding of the power transformer, T101. A shorted output or continuous overload of approximately 1.5 ampere will open this fuse.

AC POWER SUPPLY SERVICING

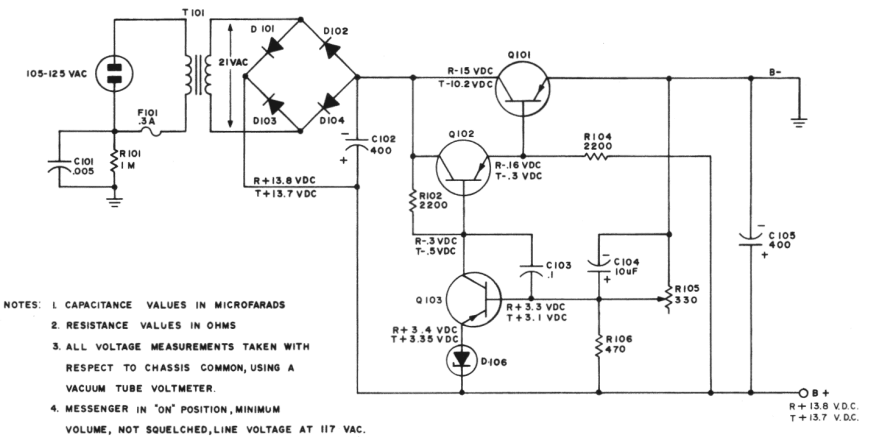
For ease of power supply servicing, a dummy load can be constructed to replace the transceiver. Seven, 2-watt 100 ohm resistors connected in parallel across B+ and ground will simulate transmit conditions. Two, 2-watt 100 ohm resistors connected in parallel across B+ and ground will simulate receive conditions.

a. When trouble has been isolated to the power supply, refer to Table 5-4 for troubleshooting tips.

CAUTION

If the cover assembly and mounting bracket for Q101 are removed for trouble analysis, do not allow Q101 case to touch the power supply chassis, as permanent transistor damage can result.

b. If any components are replaced, be sure to check and adjust R105 for 13.8 VDC output to the dummy load or transceiver in receive condition.



AC POWER SUPPLY SCHEMATIC
FIGURE 5-6

TABLE 5-4
POWER SUPPLY TROUBLESHOOTING

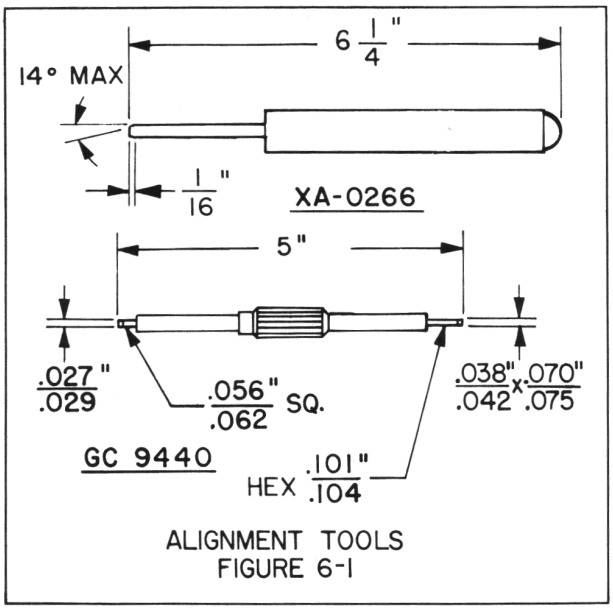
TROUBLE	PROBABLE CAUSE	CHECK
Abnormal transceiver operation	High power supply B+ output voltage	a. Check the B+ output voltage. b. Check Q101, Q102 and Q103 DC bias voltages. Refer to the schematic for typical voltage readings.
Power Supply inoperative	0.3 ampere fuse	a. Check and replace the fuse as necessary. b. Check the transceiver for B+ short before reconnecting the power supply.
Power Supply continues to blow fuse	Defective transistor or filter capacitor	a. Check the power supply resistance readings. b. Check C105.
R105 will not adjust to 13.8 VDC	Defective D106, R105 or Q103	a. Check D106, R105 and Q103. b. Remove and replace the defective component.

SECTION 6
ALIGNMENT

6.1 GENERAL

Use care and the proper alignment tool when adjusting the various transformers to prevent core damage.

Refer to Figure 6-7 for alignment point locations and Figure 6-1 for the required alignment tools.



ALIGNMENT TOOLS
FIGURE 6-1

6.2 RECEIVER ALIGNMENT

NOTE

Low pass filter adjustments L3 and L4 should be peaked for maximum power output before the receiver is aligned. Refer to the transmitter tuneup section for details.

CONNECTIONS AND SETTINGS

a. Connect the test setup as shown in Figure 6-2.

b. Turn the transceiver on and set the squelch control for minimum squelch action.

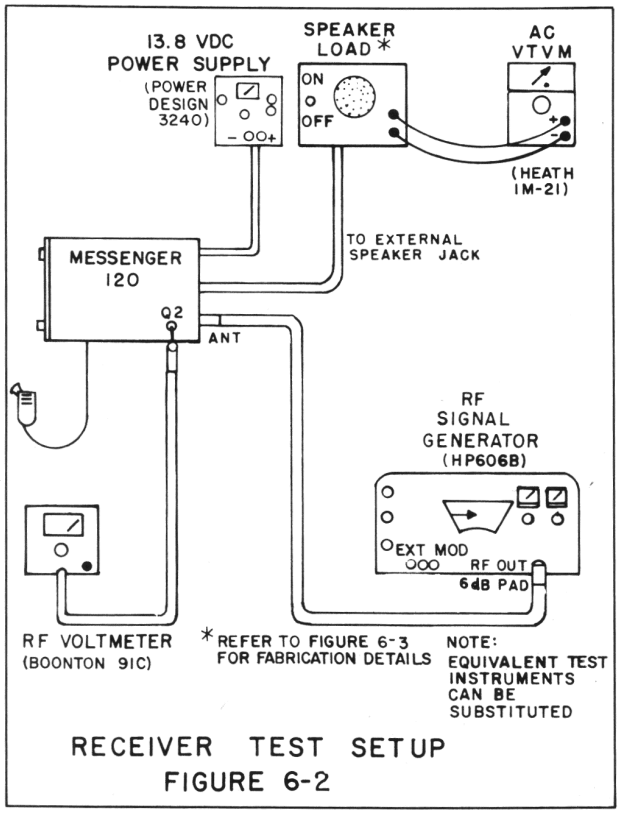
OSCILLATOR

a. Set the channel selector switch to channel 11 (27.085 MHz) or to the available channel which is close to the center of the CB band. (Crystal should be within ±500 Hz from marked crystal frequency .)

b. With the RF voltmeter connected to the emitter of Q2, adjust T3 1/4 turn beyond the peak RF voltage reading. A typical reading of 0.1 to 0.15 VRF should be indicated.

c. Check for oscillator starting and uniform injection voltage on the available channels.

d. Readjust T3 or replace the required channel crystal to correct oscillator starting problems.



RECEIVER TEST SETUP
FIGURE 6-2

RF AND IF SECTION (Channel Peaking Method)

a. Set the RF signal generator output level to 10,000 μV, modulated 30% at 1 kHz.

b. Adjust T1, T2, T4 and T5 for a maximum audio voltmeter indication while reducing the RF signal generator output level for an on scale meter reading.

NOTE

Do not adjust ceramic filter Z4 using this method.

c. Set the RF signal generator output level to 1 μV, modulated 30% at 1 kHz.

d. Readjust T1, T2, T4 and T5 for maximum audio output. Make final adjustment of T1 for best signal to noise ratio.
   1. Refer to the Receiver Performance Test Section for proper signal plus noise to noise ratio and audio output tests.

RF AND IF SECTION (455 kHz Generator Method)

a. Remove the receiver crystal. Connect a calibrated 455 kHz signal generator through a 22 μF coupling capacitor to the base of Q2.

b. Adjust T4 and T5 for a maximum audio voltmeter indication while reducing the generator output level (an excessive generator output level will cause improper IF Amplifier alignment). Keep the audio output below +10 dB to avoid overloading.

c. Replace the receiver crystal (crystal selected should meet the requirements outlined under step a. of oscillator alignment.

d. Remove the IF signal generator and connect the RF signal generator to the antenna connector. Set the generator output level to 1 μV, modulated 30% at 1 kHz on the channel frequency—refer to Table 6-1.

e. Readjust T1 and T2 for maximum audio output. Make final adjustment of T1 for best signal to noise ratio.

1. Refer to the receiver performance test section for proper signal plus noise to noise ratio and audio output tests.

NOTE

Ceramic filter Z4 does not normally require realignment. However, if the receiver response curve indicates that ceramic filter alignment is necessary, do so with a sweep generator while monitoring the receiver response curve.

RECEIVER PERFORMANCE TESTS

a. Perform a signal plus noise to noise ratio and audio output test as follows:

1. Set the RF signal generator to the channel frequency and the output level to 1 μV, modulated 30% at 1 kHz.

2. Increase the receiver volume control to maximum. The audio voltmeter should indicate at least 0 dB (+12 dB typical).

3. Readjust the receiver volume control for a 0 dB meter indication, then turn the RF signal generator modulation off.

4. The audio voltmeter indication should drop 8 dB or more.

b. Perform an AGC roll-off test as follows:

1. Set the RF signal generator to the channel frequency and the output level to 1000 μV, modulated 30% at 1 kHz.

2. Adjust the receiver volume control for a 0 dB meter indication, and then set the RF signal generator output level to 1 μV.

3. The audio voltmeter indication should drop 20 dB ±2 dB.

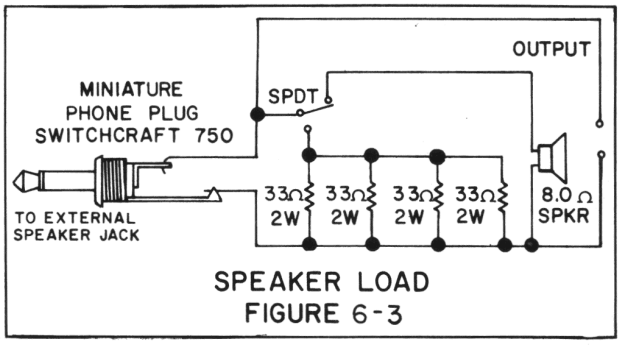
4. Adjust IF gain control R2 as necessary and repeat steps 1, 2 and 3.

c. Perform the squelch test as follows:

1. Set the RF signal generator to the channel frequency and the output level to 30 μV, modulated 30% at 1 kHz.

2. Adjust the receiver squelch control for maximum squelch. The receiver audio output should squelch off.

3. Reset the RF signal generator output level to 2000 μV. The receiver audio output should become audible.



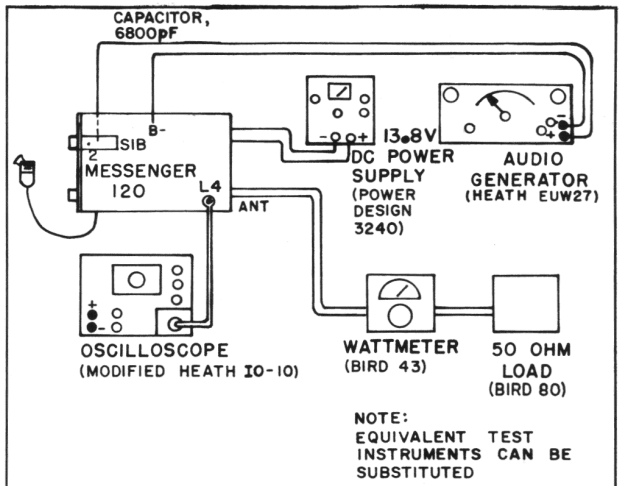
SPEAKER LOAD
FIGURE 6-3

6.3 TRANSMITTER TUNEUP

CONNECTIONS AND SETTINGS

a. Connect the test setup as shown in Figure 6-4.

b. Turn the transceiver on and key the microphone.



TRANSMITTER TEST SETUP
FIGURE 6-4

OSCILLATOR, RF DRIVER AND POWER AMPLIFIER

a. Tune T8, T9, L3 and L4 for maximum power output with minimum current drain.

b. The wattmeter should indicate 3 watts minimum, 4 watts maximum.

c. The total transceiver current drain should not exceed 970 milliamperes with no modulation.

TABLE 6-1
CHANNEL FREQUENCIES

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	26.965	13	27.115
2	26.975	14	27.125
3	26.985	15	27.135
4	27.005	16	27.155
5	27.015	17	27.165
6	27.025	18	27.175
7	27.035	19	27.185
8	27.055	20	27.205
9	27.065	21	27.215
10	27.075	22	27.225
11	27.085	23	27.255
12	27.105		

Note:
FCC Regulations require all measured channel frequencies to be within ±0.005% from these listed channel center frequencies.

TRANSMITTER FREQUENCY CHECK

To check the transmitter frequency, proceed as follows:

a. Loop couple a frequency counter or meter to L4.

b. Refer to Table 6-1 for channel frequencies and readjust T8 to within ±0.005% of channel 11 center frequency.

c. Check other channel frequencies. Measured frequencies should be within ±0.005% of each listed channel center frequency.

d. Replace channel crystals which exceed the ±0.005% specification.

OSCILLATOR STARTING AND MODULATION CHECK

a. Switch between channels 1 and 23 (if available) and other channels installed and check for normal oscillator starting.

1. Readjust T8 as necessary for proper oscillator starting.

b. Check for normal waveform and percent of modulation.

1. Couple the oscilloscope RF pickup loop to L4.

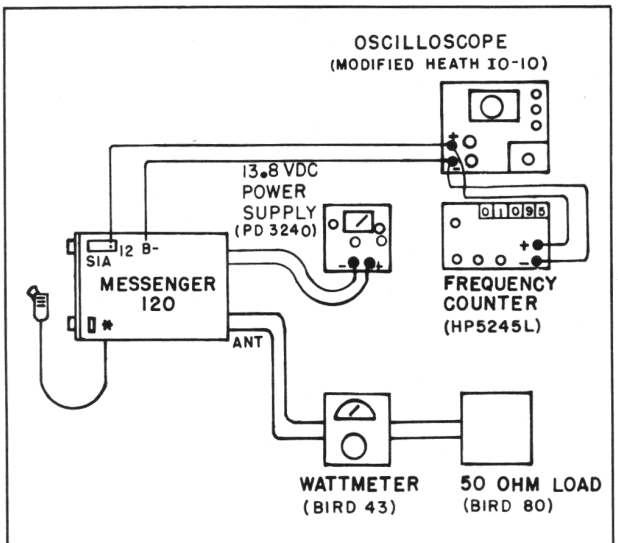
2. Set the audio generator frequency to 1 kHz and the output level to -38 dB (10 mV). The oscilloscope should indicate at least 50% modulation.

3. Increase the audio generator output level to 16 dB above that required for 50% modulation. The oscilloscope should indicate not less than 80% or more than 100% modulation on both positive and negative peaks.

c. Check each channel for clean modulation and absence of oscillations.

1. Adjust T8 and T9 as necessary to eliminate modulation distortion.

2. If T8 is readjusted in the previous step, recheck oscillator starting on each used channel.



TONE TRANSMISSION TEST SETUP
FIGURE 6-5

6.4 SELECTIVE CALL

TONE TRANSMISSION

a. Connect the test setup as shown in Figure 6-5.

b. Press the call button and check for proper frequency and waveform.

1. Adjust L101 for the correct call frequency. Refer to Table 6-2 for the required frequency period count.

c. Check for proper waveform, making sure that clipping or unsymmetrical sine wave is not evident.

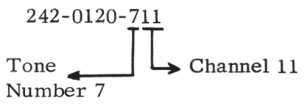
NOTE: To change the tone frequency, simply replace tone frequency determining components R107 and C105, and readjust L101. Refer to Table 6-2.

TABLE 6-2

Tone frequencies and tone frequency determining component values.

Transceiver Part Number	Tone Number	Tone Freq. in Hertz	C105 Value	R107 Value	Call Osc. Period Count in μs	Low Limit	High Limit
242-0120-1xx	1	750	0.047 μF	330K	1333.333	1329.787	1336.898
-2xx	2	825	0.039 μF	390K	1212.121	1209.189	1215.066
-3xx	3	895	0.033 μF	390K	1117.318	1114.827	1119.820
-4xx	4	985	0.027 μF	470K	1015.228	1013.171	1017.293
-5xx	5	1095	0.022 μF	680K	913.2420	911.5770	914.9130
-6xx	6	1210	0.018 μF	820K	826.4462	825.0825	827.8145
-7xx	7	1280	0.016 μF	820K	781.2500	780.0312	782.4726
-8xx	8	1420	0.013 μF	1M	704.2253	703.2348	705.2186
-9xx	9	1545	0.011 μF	1M	647.2491	646.4124	648.0881
-0xx	10	1615	0.010 μF	1M	619.1950	618.4291	619.9628

NOTE:
The transceiver part number includes the tone number of the selective tone and the operating channel.
Example:



TONE RECEPTION

a. Connect the test setup as shown in Figure 6-6.

b. Press the transceiver stby button and set the RF signal generator output level for 1.5 μV.

c. Switch the RF signal generator to external modulation position and set the audio generator frequency to 25 Hz above the transceiver tone frequency. Set the audio generator output level for 30% modulation as indicated on the RF signal generator modulation meter.

d. Adjust bandwidth sensitivity control R113.

1. Adjust R113 for audible tone output within 7 seconds after the tone is applied.

2. Reset the audio generator to 35 Hz above the transceiver tone frequency. No audible tone output should be heard.

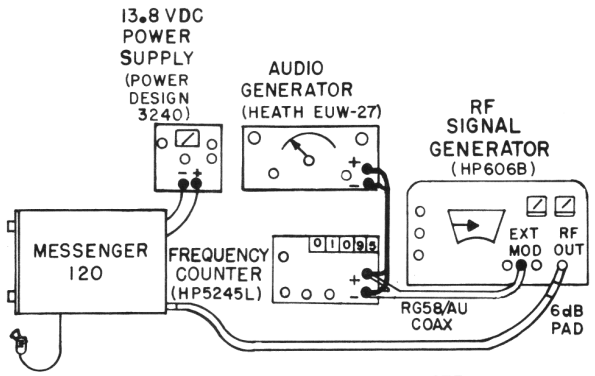
e. Adjust time delay control R129.

1. Reset the audio generator back to 25 Hz above the transceiver tone frequency.

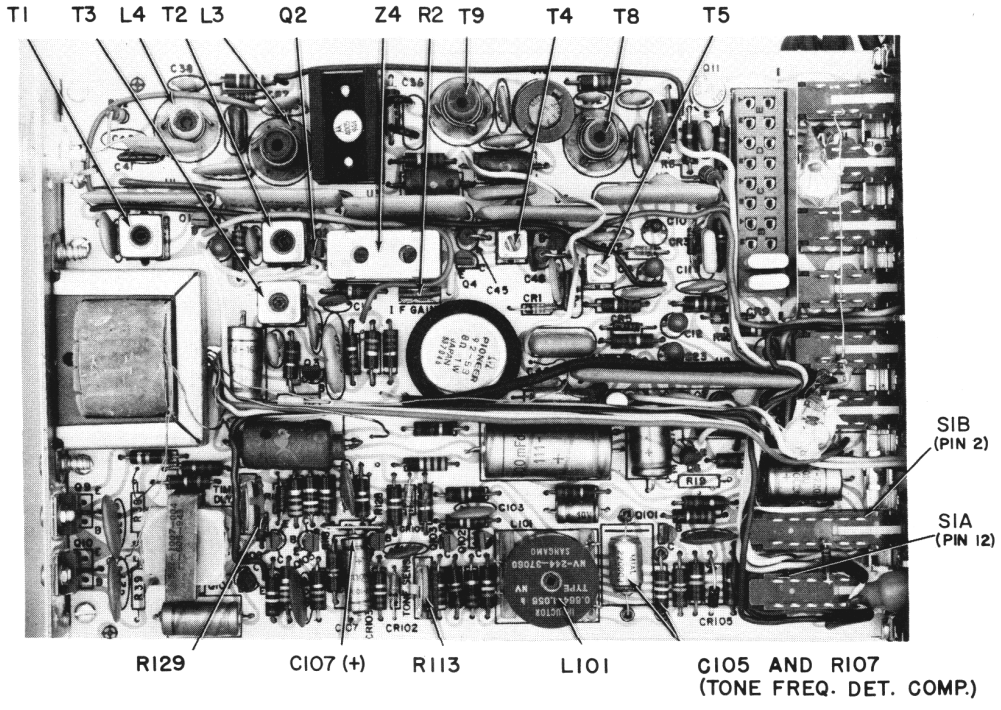
2. Connect the multimeter to the plus lead of C107. With no incoming tone, C107 will charge to ap-

proximately +7.5 VDC in 60 seconds after the STBY button is depressed. The call light triggers at approximately +1.8 VDC.

3. Adjust R129 for call light indication and audible tone output (output should be heard 3.0 sec ±10% after the tone is applied).



TONE RECEPTION TEST SETUP
FIGURE 6-6



ALIGNMENT POINT AND TONE
FREQUENCY DETERMINING COMPONENT LOCATIONS
FIGURE 6-7

SECTION 7
PARTS LIST
120

SYMBOL NO.	DESCRIPTION	PART NO.
	BRACKETS	
BKT1	Bracket, cabinet mounting	016-1884-003
BKT2	Bracket, channel indicator	016-1886-001
BKT4	Dash mounting bracket	017-1249-001
	CAPACITORS	
C1	6.8 µF M 35V dipped	510-2045-689
C2	4700 pF M 50V Y5U disc	510-3204-472
C3	27 pF J 200V N750 cera	510-3220-270
C4	0.010 µF M 50V Y5U	510-3202-103
C5	150 pF J 100V 1DM15	510-0001-151
C6	6.8 µF M 35V dipped	510-2045-689
C7	0.010 µF M 50V Y5U	510-3202-103
C9	4700 pF M 50V Y5U disc	510-3204-472
C10	1.0 µF M 35V dipped	510-2045-109
C11	0.047 µF K 250V flatfoil	510-1003-473
C12	6.8 µF M 35V dipped	510-2045-689
C13	1000 pF M 1KV Y5S disc	510-3261-102
C14	0.010 µF M 50V Y5U disc	510-3002-103
C15	27 pF J 200V N150 cera	510-3216-270
C16	510 pF J 200V N750 cera	510-3220-511
C17	4700 pF M 50V Y5U disc	510-3204-472
C18	0.22 µF Z 3V Y5T disc	510-3009-224
C19	0.010 µF M 50V Y5U disc	510-3002-103
C20	22 µF M 15V tubular	510-2003-220
C21	150 µF 25V aluminum	510-4006-006
C22	6.8 µF M 35V dipped	510-2045-689
C23	Same as C22	
C24	56 µF M 6V tubular	510-2001-560
C25	0.22 µF M 250V flatfoil	510-1004-224
C26	0.022 µF M 50V Y5U	510-3202-223
C27	Same as C26	
C28	4700 pF M 50V Y5U disc	510-3204-472
C29	22 pF J 200V N750 cera	510-3220-220
C30	Same as C29	
C31	150 pF J 200V N750 cera	510-3220-151
C32	1000 pF M 1KV Y5S disc	510-3261-102
C33	43 pF J 200V N150 cera	510-3216-430
C34	4700 pF M 50V Y5U disc	510-3204-472
C35	0.047 µF M 50V Y5U	510-3202-473
C36	1000 pF M 1KV Y5S disc	510-3261-102
C37	27 pF J 200V NPO cera	510-3213-270
C38	1000 pF M 1KV Y5S disc	510-3261-102
C39	100 pF J 200V N150 cera	510-3216-101
C40	300 pF J 100V 1DM15	510-0001-301
C41	330 pF J 100V 1DM15	510-0001-331
C42	4700 pF M 1.4KV Z5U	510-3001-472
C43	1000 µF 16V aluminum	510-4006-005
C44	220 µF 16V aluminum	510-4006-004
C45	1 pF J 500V composition	510-9002-109
C46	Same as C45	
C48	0.010 µF M 50V Y5U	510-3202-103
C50	1.0 µF M 35V dipped	510-2045-109
C51	Same as C50	
C101	220 µF 16V aluminum	510-4006-004
C102	0.10 µF M 16V Y5S	510-3210-104
C103	4700 pF M 50V Y5U disc	510-3204-472
C104	47 µF 10V aluminum	510-4003-004
C105	0.022 µF J 25V polystyrene	510-1101-223
C106	0.033 µF M 16V Y5S	510-3210-333
C107	100 µF 10V aluminum	510-4003-005
C108	0.10 µF M 16V Y5S	510-3210-104
C109	Same as C108	
C110	330 µF 4V aluminum	510-4001-005
C121	0.010 µF M 50V Y5U	510-3202-103
	CHASSIS PARTS	
CH1	Front panel	032-0271-001
CH10	Cabinet assembly	023-2920-001
	Rear panel assembly	023-2919-003
	DIODES	
CR1	1N67A germ diode	523-1500-067
CR2	Same as CR1	
CR3	1N881 sil diode	523-1500-881
CR5	Same as CR3	
CR6	1N4003 200V 1A rect	523-0501-002
CR7	1N881 sil diode	523-1500-881
CR8	Same as CR7	
CR9	Same as CR7	
CR10	1N881 silicon diode	523-1000-881
CR11	1N67A 80V 30 mA germ.	523-1000-067
CR12	1N881 silicon diode	523-1000-881
CR101	1N67A germ. diode	523-1500-067
CR102	Same as CR101	
CR103	1N881 sil diode	523-1500-881
CR104	Same as CR103	
CR105	10V J 1W zener	523-2503-100
	LAMPS	
DS1	2172D 14.4V 0.12A clear	549-3001-005
DS2	Same as DS1	
DS101	Same as DS1	
	ELECTRICAL PARTS	
EP1	Insulator	018-0817-025
EP2	Terminal	022-0069-008
EP3	Terminal tab	515-4101-001
	HARDWARE	
HW1	SCR 4-40 PH slot CPS	575-0504-008
HW2	Captive screw	013-1338-002
HW3	Spkp pad foam ring	574-5006-001
HW4	Washer shr 1/4 x 063 nylon	596-9117-016
HW5	Lockwasher int 4 x 015 thk NPB	596-2104-008
HW6	SCR 4-20 PH slot CPS	575-5504-010
HW7	SCR 4-40 PH slot NPB	575-2504-012
HW8	Washer ins 1/4 x 015 pheno	596-9075-016
HW11	Nut 4-40 x 0.063 thk NPB	560-2104-006
HW12	SCR 8-32 PH slot CPS	575-0508-008
	JACKS	
J1	CC tini-jax NTT312	515-2001-001
J3	Terminal bushing, red	515-4100-001
	COILS AND CHOKES	
L1	13 µH choke	542-3003-001
L2	Same as L1	
L3	10 1/2 T ind. 0.75-1.0 µH	542-1005-010

COMPONENT CODES
1DM15 - 1 coat dipped mica, size 15 J - ±5% M - ±20%
K - ±10% Z - +80-20%

PARTS LIST (cont'd)

SYMBOL NO.	DESCRIPTION	PART NO.
L4	4 1/2 T ind. 0.24-0.32 μH	542-1005-004
L5	20 μH audio choke	542-8001-011
L8	6.8 μH RF choke	542-3004-689
L101	864-1056 μH var. ind.	542-8006-104
	MICROPHONE	
MK1	Microphone assembly	023-2708-005
	MECHANICAL PARTS	
MP1	Knob	032-0236-001
MP2	0.58 x 0.28 blk pushbutton	547-0006-020
MP3	Heat sink for TO-39	013-1074-001
MP4	Knob	547-0006-120
MP5	Plate	016-1881-003
MP6	Plate	016-1881-004
MP13	Light shield	018-0972-001
MP16	Heat sink	014-0671-002
NP4	Overlay/M120	559-2054-002
	TRANSISTORS	
Q1	SI NPN 50 MHz amp TO92	576-0003-018
Q2	SI NPN gen. purp. TO92	576-0003-011
Q3	Same as Q2	
Q4	Same as Q2	
Q5	Same as Q2	
Q6	SI NPN high gain TO92	576-0001-008
Q7	GE PNP audio amp. TO1	576-0001-017
Q8	Same as Q7	
Q9	MJE2480 SI NPN pwr amp	576-0002-026
Q10	Same as Q9	
Q11	Silicon transistor	576-0004-035
Q12	0.4 W 27 MHz amp. TO39	576-0004-004
Q13	3.4 W 27 MHz amp. TO39	576-0004-005
Q101	SI PNP 50 MHz amp. TO92	576-0003-017
Q102	Same as Q101	
Q103	Same as Q101	
Q104	SI NPN gen. purp. TO92	576-0003-011
Q105	Same as Q104	
Q106	Same as Q104	
Q107	SI NPN darlington TO92	576-0007-001
	RESISTORS	
R1	22K ohm K 1/2 W	569-1504-223
R2	1.0K trim pot.	562-0019-102
R3	4.7K ohm K 1/2 W	569-1504-472
R5	10K ohm K 1/2 W	569-1504-103
R7	5K malloslide	562-0025-004
R9	100 ohm K 1/2 W	569-1504-101
R10	6.8K ohm K 1/2 W	569-1504-682
R11	1.2K ohm K 1/2 W	569-1504-122
R12	680 ohm K 1/2 W	569-1504-681
R13	2.2K ohm K 1/2 W	569-1504-222
R14	1.0K ohm K 1/2 W	569-1504-102
R16	10K malloslide	562-0025-003
R19	1.5K ohm K 1/4 W	569-1002-152
R20	3.3K ohm K 1/2 W	569-1504-332
R21	470 ohm K 1/2 W	569-1504-471
R22	27 ohm K 1/2 W	569-1504-270
R23	510 ohm J 1/2 W	569-1003-511
R24	1.0 ohm K 1/2 W	569-2503-109
R26	5.1K ohm J 1/2 W	569-1503-512
R27	510 ohm J 1/2 W	569-1503-511
R28	51 ohm J 1/2 W	569-1503-510
R29	120 ohm K 1/2 W	569-1504-121
R30	47 ohm K 1/2 W	569-1504-470
R31	470 ohm K 1/2 W	569-1504-471
R32	47K ohm K 1/2 W	569-1004-473
R33	1.2K ohm K 1/2 W	569-1504-122
R34	330 ohm K 1/2 W	569-1004-331
R35	150K ohm K 1/2 W	569-1504-154
R36	100K ohm K 1/2 W	569-1504-104
R37	78K ohm K 1/2 W	569-1504-683
R40	1.0K ohm K 1/2 W	569-1504-102
R41	15 ohm K 1/2 W	569-1004-150
R42	Same as R41	
R43	2.2K ohm K 1/4 W	569-1002-222
R101	1.0K ohm K 1/2 W	569-1004-102
R102	62 ohm J 1/2 W	569-1503-620
R103	56K ohm K 1/2 W	569-1504-563
R104	8.2K ohm K 1/2 W	569-1504-822
R105	10K ohm K 1/2 W	569-1504-103
R106	1.2K ohm K 1/2 W	569-1504-122
R107	680K ohm K 1/2 W	569-1004-684
R108	680K ohm K 1/2 W	569-1504-684
R109	2.2M ohm K 1/2 W	569-1504-225
R110	220K ohm K 1/2 W	569-1504-224
R111	10K ohm K 1/2 W	569-1504-103
R112	Same as R111	
R113	10K 1/8 W PC trim pot.	562-0004-103
R114	1.0K ohm K 1/2 W	569-1504-102
R115	56K ohm K 1/2 W	569-1504-563
R116	33K ohm K 1/2 W	569-1504-333
R117	22K ohm K 1/2 W	569-1504-223
R118	10K ohm K 1/2 W	569-1504-103
R119	100K ohm K 1/2 W	569-1504-104
R120	220K ohm K 1/2 W	569-1504-224
R121	3.9K ohm K 1/2 W	569-1504-392
R122	33K ohm K 1/2 W	569-1504-333
R123	33K ohm K 1/4 W	569-1002-333
R124	330K ohm K 1/2 W	569-1504-334
R125	4.7K ohm K 1/2 W	569-1504-472
R126	100K ohm K 1/2 W	569-1504-104
R127	18K ohm K 1/2 W	569-1504-183
R128	1.5K ohm K 1/2 W	569-1002-152
R129	25K 1/8 W PC trim pot.	562-0004-253
R130	150 ohm K 1/2 W	569-1004-151
	- NOTE -	
	All resistors are carbon composition type, unless otherwise indicated.	
	SPEAKER	
	Speaker assembly	023-2927-001
	SWITCH	
S1	Switch, pushbutton	583-4008-012
	TRANSFORMERS	
T1	10MM 27 MHz ant.	592-5015-001
T2	10MM 27 MHz mix.	592-5015-002
T3	10MM 27 MHz osc.	592-5015-004
T4	7MM 455 kHz IF	592-5020-004
T5	Same as T4	
T6	Input/driver	592-1007-004
T7	Out/mod	592-1013-006
T8	25-40 MHz osc.	592-5014-001

PARTS LIST (cont'd)

SYMBOL NO.	DESCRIPTION	PART NO.
T9	25-50 MHz driver	592-5014-002
	PEC'S	
U1	PEC RF amp. silicon	544-0003-011
U2	PEC 1st mixer silicon	544-0002-011
U3	PEC 1st IF 120 silicon	544-0003-043
U5	PEC 2nd IF silicon	544-0002-014
U6	PEC noise limiter germ.	544-0002-015
U8	PEC audio silicon	544-0002-026
	PRINTED CIRCUIT BOARD	
U11	PC board	035-0125-001
	CRYSTAL BLOCK	
X1	Crystal block, 10 position	126-0110-103
	CERAMIC FILTER	
Z4	Interim CB 455 kHz filter	023-3254-001
	AC POWER SUPPLY Part No. 239-0125-001	
	CABINET PARTS	
CH101	Cabinet	023-1662-002
CH102	Grill assembly	023-1663-002
CH103	Cover assembly	023-1699-001
	CAPACITORS	
C101	0.0047 μF ±20% MFD 125 VAC	510-3001-472
C102	470 μF 40 VDC electrolytic	510-4009-001
C103	0.1 μF +80-20% 25V	510-3007-104
C104	10 μF 16 VDC electrolytic	510-4006-002
C105	470 μF 16 VDC electrolytic	510-4006-001
	DIODES	
D101	Silicon	523-0001-002
D102	Same as D101	
D103	Same as D101	
D104	Same as D101	
D106	Zener, 10 volt, 1 watt	523-2001-100
	FUSE	
F101	Fuse, 0.3 amp	534-0002-011
FH101	Fuseholder	534-1002-001
	ELECTRICAL PARTS	
E1	Transistor insulator (mica)	018-0829-001
E2	Bushing, nylon	018-0036-011
G101	Rubber feet	574-1001-001
	TRANSISTORS	
Q101	40051	576-0003-017
Q102	40253	576-0002-004
Q103	Same as Q102	
	RESISTORS	
R101	1 MΩ ±10% 1/2 W	569-1004-105
R102	2200Ω ±10% 1/4 W	569-1002-222
R104	Same as R102	
R105	330Ω rheostat	562-0017-001
R106	470Ω ±10% 1/4 W	569-1002-471
	TRANSFORMER	
T101	Power transformer	592-3001-001
	LINE CORD	
W101	Line cord, black, type SV	597-1001-001
	ACCESSORY PACKAGE	

Refer to page 10 for Installation Items.

Non Installation Items:

Operating Manual	002-0126-001
Schematic Diagram	564-3001-120
Transmitter ID Card	564-1001-001
FCC Part 95 rules	022-1635-001
FCC License Application form 505	022-1636-001

MESSENGER 121
SERVICE MANUAL ADDITION

This service manual addition covers alignment and servicing instructions for the Messenger 121 Citizens Radio Transceiver. Also included is a complete parts list and schematic diagram.

Refer to the Messenger 120 Service Section for complete transceiver installation, alignment and service information.

DESCRIPTION

The Messenger 121 is a 5 channel citizens radio transceiver which includes a 3 watt public address function.

With a remote speaker plugged into the transceiver external speaker jack and the PA function switch depressed, the transceiver can be used as a public address system. With the PA function switch out, the receiver can be remotely monitored.

The transceiver comes fully equipped for operation in any vehicle with a 12 volt negative ground electrical system, and with the addition of the optional 117 VAC Power Supply, Part No. 239-0125-001, it can be used as a base station radio.

INSTALLATION

Refer to the service manual for vehicle and base station installation information.

RECEIVER ALIGNMENT

NOTE

Low pass filter adjustments L3 and L4 should be peaked for maximum power output before the receiver is aligned. Refer to the **transmitter** tuneup section for details.

OSCILLATOR

a. Set the channel selector switch to channel 11 (27.085 MHz) or to the available channel which is close to the center of the citizens band. (Crystal should be within ±500 Hz from marked crystal frequency.)

b. With the RF voltmeter connected to the emitter of Q2, adjust T3 1/4 turn beyond the peak RF voltage reading. A typical reading of 0.1 to 0.15 VRF should be indicated.

c. Check for oscillator starting and uniform injection voltage on the available channels.

d. Readjust T3 or replace the required channel crystal to correct oscillator starting problems.

RF AND IF SECTION (Channel Peaking Method)

a. Set the RF signal generator output level to 10,000 μV, modulated 30% at 1 kHz.

b. Adjust T1, T2, T4 and T5 for a maximum audio voltmeter indication while reducing the RF signal generator output level for an on scale meter reading.

NOTE

Do not adjust ceramic filter Z4 using this method.

c. Set the RF signal generator output level to 1 μV, modulated 30% at 1 kHz.

d. Readjust T1, T2, T4 and T5 for maximum audio output. Make final adjustment of T1 for best signal to noise ratio.

1. Refer to the Receiver Performance Test Section for proper signal plus noise to noise ratio and audio output tests.

RF AND IF SECTION (455 kHz Generator Method)

a. Remove the receiver crystal. Connect a calibrated 455 kHz signal generator through a 22 μF coupling capacitor to the base of Q2.

b. Adjust T4 and T5 for a maximum audio voltmeter indication while reducing the generator output level (an excessive generator output level will cause improper IF amplifier alignment). Keep the audio output below +10 dB to avoid overloading.

c. Replace the receiver crystal (crystal selected should meet the requirements outlined under step a. of oscillator alignment.)

d. Remove the IF signal generator and connect the RF signal generator to the antenna connector. Set the generator output level to 1μV, modulated 30% at 1 kHz on the channel frequency - refer to Table 6-1.

e. Readjust T1 and T2 for maximum audio output. Make final adjustment of T1 for best signal to noise ratio.

1. Refer to the service manual receiver performance test section for proper signal plus noise to noise ratio and audio output tests.

NOTE

Ceramic filter Z4 does not normally require realignment. However, if the receiver response curve indicates that ceramic filter alignment is necessary, do so with a sweep generator while monitoring the receiver response curve.

c. Check other channel frequencies. Measured frequencies should be within ±0.005% of each listed channel center frequency.

d. Replace channel crystals which exceed the ±0.005% specification.

TABLE 6-1
CHANNEL FREQUENCIES

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	26.965	13	27.115
2	26.975	14	27.125
3	26.985	15	27.135
4	27.005	16	27.155
5	27.015	17	27.165
6	27.025	18	27.175
7	27.035	19	27.185
8	27.055	20	27.205
9	27.065	21	27.215
10	27.075	22	27.225
11	27.085	23	27.255
12	27.105		

Note:
FCC Regulations require all measured channel frequencies to be within ±0.005% from these listed channel center frequencies.

TRANSMITTER TUNEUP

OSCILLATOR, RF DRIVER AND POWER AMPLIFIER

a. Tune T8, T9, L3 and L4 for maximum power output with minimum current drain.

b. The wattmeter should indicate 3 watts minimum, 4 watts maximum.

c. The total transceiver current drain should not exceed 970 milliamperes with no modulation.

TRANSMITTER FREQUENCY CHECK

To check the transmitter frequency, proceed as follows:

Loop couple a frequency counter or meter to L4.

Refer to Table 6-1 for channel frequencies and readjust T8 to within ±0.005% of channel 11 center frequency.

OSCILLATOR STARTING AND MODULATION CHECK

a. Switch between channels 1 and 23 (if available) and other channels installed and check for normal oscillator starting.

1. Readjust T8 as necessary for proper oscillator starting.

b. Check for normal waveform and percent of modulation.

1. Couple the oscilloscope RF pickup loop to L4.

2. Set the audio generator frequency to 1 kHz and the output level to -38 dB (10 mV). The oscilloscope should indicate at least 50% modulation.

3. Increase the audio generator output level to 16 dB above that required for 50% modulation. The oscilloscope should indicate not less than 80% or more than 100% modulation on both positive and negative peaks.

c. Check each channel for clean modulation and absence of oscillations.

1. Adjust T8 and T9 as necessary to eliminate modulation distortion.

2. If T8 is readjusted in the previous step, recheck oscillator starting on each channel installed.

SERVICING

PUBLIC ADDRESS (PA) FUNCTION

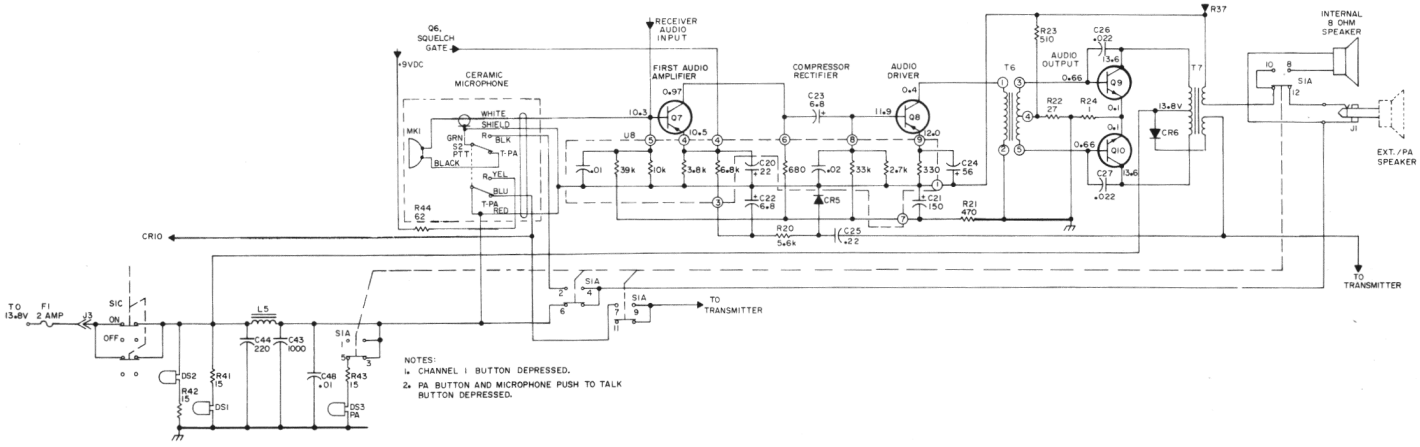
Refer to the simplified schematic diagram and proceed with troubleshooting.

TRANSCEIVER

Refer to the service manual for complete transceiver service information.

NOTE

Be sure to check pushbutton switches for proper operation.



PUBLIC ADDRESS (PA) FUNCTION
(SIMPLIFIED SCHEMATIC DIAGRAM)