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M E S S E N G E R

1 2 4 / 1 2 4 - M

CITIZENS RADIO TRANSCEIVER

MODEL NO. 242-0124

242-0134

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SECTION 1

GENERAL INFORMATION

1.1 SCOPE OF MANUAL

This service manual includes servicing and alignment instructions for the Messenger 124 transceiver. Also included at the back of this manual is a Service Manual Addition which covers Messenger 124-M transceiver alignment and servicing information.

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

1.2 FACTORY CUSTOMER SERVICE

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

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

For any of the above requirements contact:

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

1.3 PURCHASE OF PARTS

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

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

1.4 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.

1.5 DESCRIPTION

The Messenger 124, Model 242-124, is a completely solid state, 5 watt (DC input to the final RF stage) Citizens Radio transceiver. A 10 crystal, 23 channel frequency synthesizer generates both the receiver and transmitter mixing frequencies. The synthesizer output is electronically switched between receive and transmit conditions by diodes.

Supply voltage for operating the transceiver is provided by the vehicle battery in mobile operation and by the built-in regulated 117 V AC power supply in base station operation.

1.6 SERIAL NUMBER INTERPRETATION

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

SECTION 2 SPECIFICATIONS

Electrical specifications are nominal unless otherwise stated.

2.1 GENERAL

Frequency Range	26,965-27,255 MHz
Channels	23
Dimensions of Enclosure	5 9/16" high x 11" wide x 9 1/16" deep.
Unit Weight	Approximately 10 lbs.
Shipping Weight	Approximately 14 lbs.
Microphone	High capacity ceramic element. Cylolac case. Push-to-talk switch, hang up stud.
Power Requirements	13.8 VDC negative ground input Receive: Squelched, 0.53 ampere Transmit: 1.3 ampere 117 VAC 60 Hz input Receive: Squelched, 23 watts Transmit: 53 watts
Circuit Protection	13.8 VDC, 2 ampere fuse 117 VAC, 0.5 ampere fuse
Circuitry	26 transistors, 18 diodes and 4 thermistors
Antenna Impedance	50 ohms
Compliance	FCC Type Accepted Part 95 DOT Type Approved RSS 136
Frequency Control	±0.005% crystal from -22° F. to +140° F., transmit and receive.

2.2 RECEIVER

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

Sensitivity	10 dB (S + N)/N ratio with 0.5 microvolts at the antenna terminal (30% modulated 1000 Hz)
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Selectivity	7 kHz bandwidth at -6 dB 19 kHz bandwidth at -60 dB (EIA 2 signal generator method)
Spurious Rejection	50 dB
Audio Output Power	3 watts at 10% distortion
Speaker Impedance	3.2 ohms
Squelch Range	0.3 to 20 microvolts at the antenna terminal
Squelch Sensitivity	1 dB or less signal change for 40 dB of quieting at 1 microvolt at the antenna terminal
Intermediate Frequencies	4.3 MHz (crystal filter) and 455 kHz
AGC Characteristics	Flat within ±4 dB from 500,000 to 5 microvolts at the antenna terminal with 14 dB rolloff from 5 to 0.5 microvolts for superior noise quieting
Noise Limiting	Series-type, automatic threshold adjustment and IF clipping
Circuitry	Solid state, double conversion superheterodyne

2.3 TRANSMITTER

Emission	6A3
RF Power Output	4 watts maximum
RF Spurious and Harmonic Attenuation	Better than FCC and DOT requirements
Audio Input Impedance	200,000 ohms
Audio Frequency Response	±4 dB, 400-3000 Hz.
Modulation	High level AM, Class B modulator, speech compression, clipping and audio filtering
Circuitry	Solid state

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

TABLE 2-1
TRANSISTOR COMPLEMENT

<u>TRANSISTOR</u>	<u>TYPE</u>	<u>FUNCTION</u>	<u>E. F. J. PART NUMBER</u>
Q1	3008	Receiver RF Amplifier	576-0003-008
Q2	3008	Receiver First Mixer	576-0003-008
Q3	3008	Receiver Second Mixer	576-0003-008
Q4	3010	First IF Amplifier	576-0003-010
Q5	3010	Second IF Amplifier	576-0003-010
Q6	3010	AGC Amplifier	576-0003-010
Q7	3010	AGC Amplifier	576-0003-010
Q8	3008	Receiver Oscillator	576-0003-008
Q9	1002	Squelch Amplifier	576-0001-002
Q10	1003	Squelch Amplifier	576-0001-003
Q11	6003	Transmitter First Audio Amp	576-0006-003
Q12	3008	Synthesizer LF Oscillator	576-0003-008
Q13	3008	Synthesizer Mixer	576-0003-008
Q15	3008	Synthesizer HF Oscillator	576-0001-008
Q16	1003	Audio Amplifier	576-0001-003
Q17	1009	Audio Driver	576-0001-009
Q18	2002	Audio Output	576-0002-002
Q19	2002	Audio Output	576-0002-002
Q20	3008	Transmitter Oscillator	576-0003-008
Q21	3008	Transmitter Mixer	576-0003-008
Q22	4004	Transmitter RF Amplifier	576-0004-004
Q23	4004	Transmitter RF Driver	576-0004-004
Q24	4005	Transmitter RF Output	576-0004-005

TABLE 2-2
DIODE COMPLEMENT

<u>DIODE</u>	<u>TYPE</u>	<u>FUNCTION</u>	<u>E. F. J. PART NUMBER</u>
D1	1N67A	AGC Rectifier	523-1000-067
D2	1N67A	Detector	523-1000-067
D5	1N881	Noise Limiter	523-1000-881
D6	1N881	Synthesizer Receiver Output Switch	523-1000-881
D7	1N67A	Squelch Gate	523-1000-067
D13	1N881	Synthesizer Transmitter Output Switch	523-1000-881
D14	1N881	S Meter Compensation	523-1000-881
D15	1N67A	Meter Rectifier	523-1000-067
D16	1N881	RY1 Coil Suppressor	523-1000-881
D17	1N881	Audio Compressor Rectifier	523-1000-881
D18	1N2326	Audio Output Temperature Compensation	523-1002-326
D201	200V, 1.5 amp	Power Supply Rectifier	523-0001-002
D202	200V, 1.5 amp	Power Supply Rectifier	523-0001-002
D204	200V, 1.5 amp	Power Supply Rectifier	523-0001-002
D205	200V, 1.5 amp	Power Supply Rectifier	523-0001-002
DZ1	10V, 2 watt	Receiver B+ Regulator	523-2004-100
DZ2	10V, 1 watt	Synthesizer B+ Regulator	523-2003-100
DZ201	10V, 1 watt	Power Supply B+ Regulator	523-2003-100

2.4 SPECIFICATIONS (Minimum Performance)

The specifications listed in this section are absolute service minimums. Receiver RF input values are given at the input to a 6 dB 50 ohm pad.

2.4.1 RECEIVER

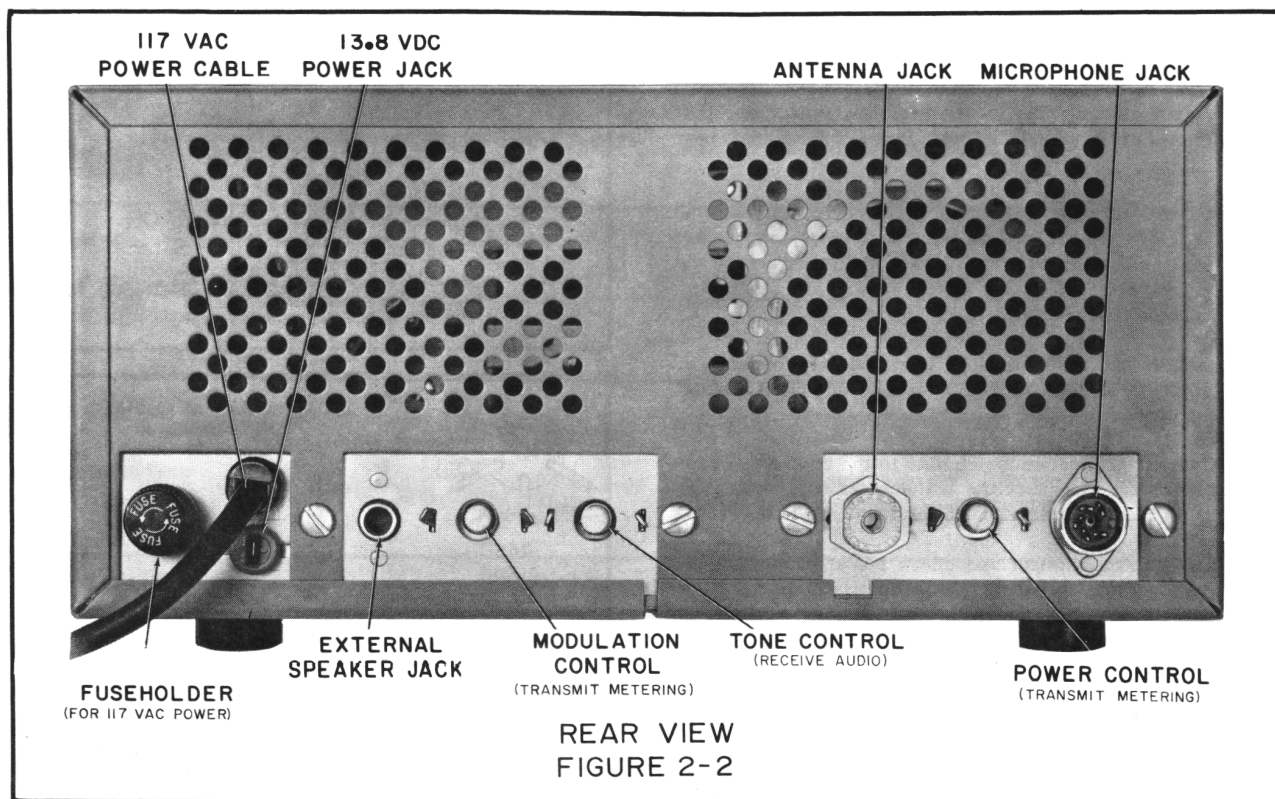
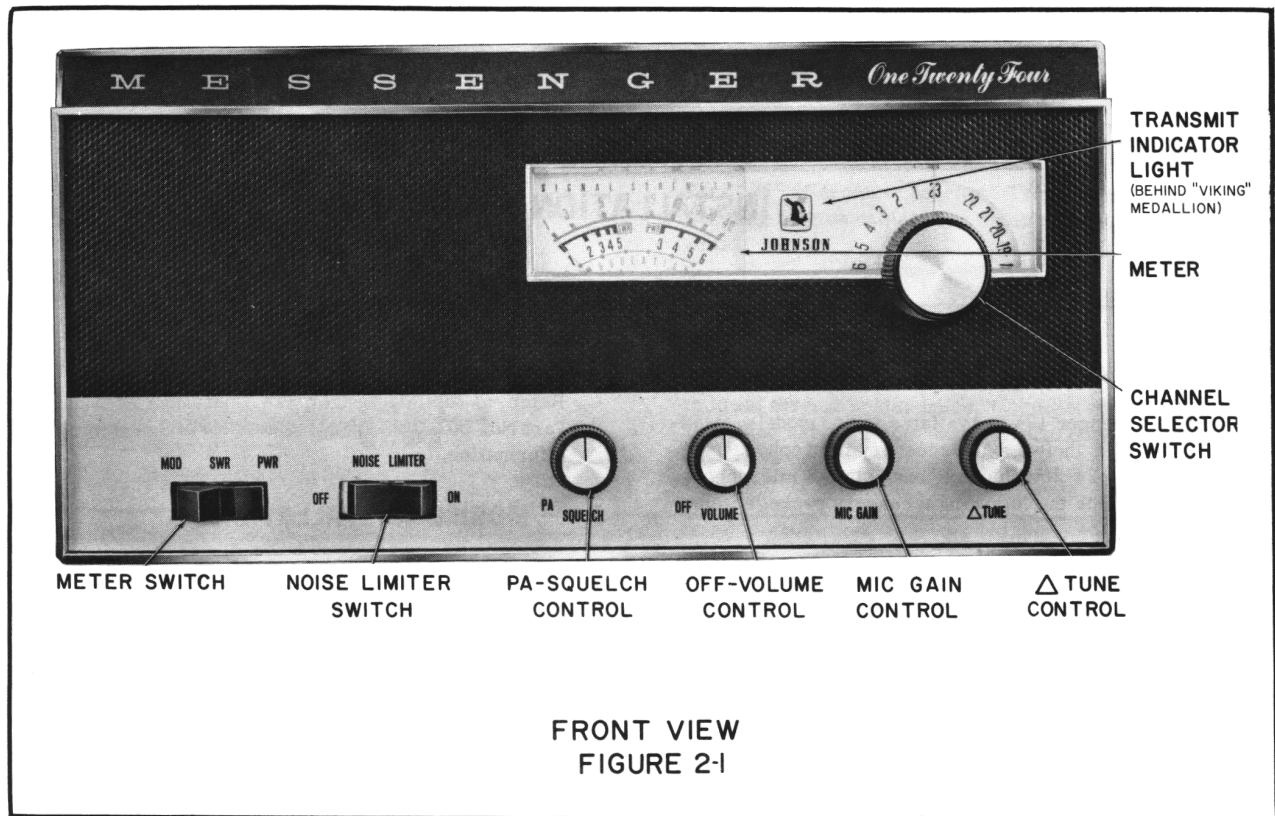
IF Bandwidth	6 kHz minimum at -7 dB points 9 kHz maximum at -7 dB points
Audio Gain	+4 dB output with -48 dB input at 1000 Hz
Synthesizer Injection	50 mV minimum, 400 mV maximum
Across Band Receiver Change in Gain	±3 dB (channels 1 through 23, 1 μV, modulated 30% with 1000 Hz)
AGC Flat	5 dB maximum, 100,000 μV to 10 μV
AGC Rolloff	6 dB minimum, 18 dB maximum, 10 μV to 1 μV
S+N/N	8 dB minimum (1 μV, modulated 30% with 1000 Hz)
Total Receiver Gain	0 dB minimum output across speaker voice coil (1 μV, modulated 30% with 1000 Hz)
Hum Level	-50 dB maximum across voice coil (no signal, volume control full CCW)
Tight Squelch	Open at 30 μV minimum
Minimum Operating Voltage	Must function with 11 VDC supply
Noise Limiter	Audio output decrease at least 4 dB but not more than 10 dB when limiter is switched from OFF to ON (1 μV unmodulated input)

S Meter

Adjust R49 for S5 with 10μV input

2.4.2 TRANSMITTER

Power Output	3.0 watts minimum 4.0 watts maximum
Audio Input Level	-50 dB or less for 50% modulation at 1000 Hz
Modulation Capability	80% minimum, 100% maximum on positive and negative peaks (input 16 dB above that required for 50% modulation at 1000 Hz)
Waveform	Free of all spurious signals when observed on a high frequency oscilloscope.
Power Output Balance	0.5 watts maximum change in power output, channels 1 through 23.
Standing Wave Ratio Meter Error	Error at 1:1 and 5:1 25% maximum on SWR scale
% Modulation Meter	Set at half scale reading on modulation scale with 50% modulation at 1000 Hz
Minimum Operating Voltage	Must function with 11 VDC supply
Output Frequency	±0.004% maximum deviation at 25°C (78°F) and after 15 minute heat run, 50% duty cycle (30 sec transmit, 30 sec receive) ±0.005% maximum deviation from -30°C (-22°F) to +50°C (+122°F)
Spurious Signals	-50 dB minimum
Power Meter	Set at 4 on PWR scale with unmodulated carrier (50 ohm antenna)



SECTION 3 INSTALLATION

3.1 GENERAL

The Messenger 124 is available in two models. Model No. 242-124-1 includes an accessory microphone plug. Model No. 242-124-2 includes a base station microphone. Both models include the following accessory package items:

- Operating Manual
- FCC Rules and Regulations part 95
- FCC License Application Form 505
- FCC Identification Card, Form 452-C
- Warranty Registration Card

3.2 MICROPHONE CONNECTOR WIRING

Refer to Figure 3-1, Microphone Connector Assembly Details, and Figure 3-2, Microphone Diagram.

3.3 BASE INSTALLATION

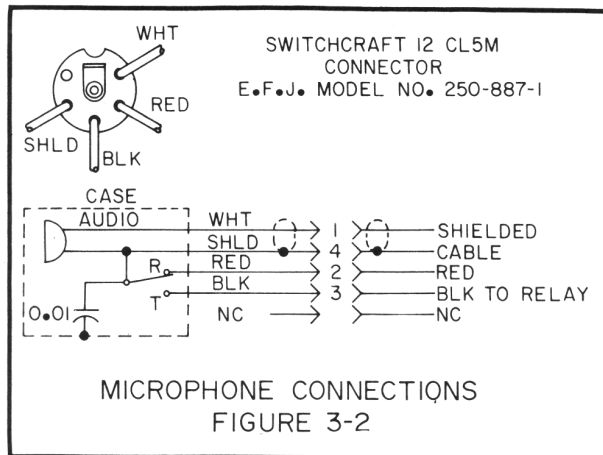
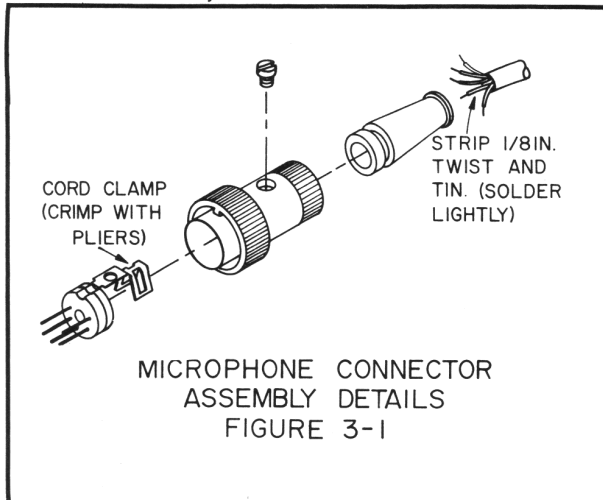
- a. Select an operating location for the transceiver that allows air to circulate freely through the transceiver cabinet.
- b. Ground the transceiver for safety. Attach one end of a #14 copper ground wire to one of the cabinet shell mounting screws. Attach the other end of the ground wire to a cold water pipe or any other convenient grounded metallic material.
- c. Install the transmission line coaxial connectors. Figure 3-3 illustrates the correct method of installing connectors.
- d. Connect the transmission line to the transceiver antenna jack. Connect the transceiver AC power cord to a 117 VAC outlet. Turn the transceiver on.
- e. Key the transmitter and check power output indications per the operating manual instructions.
- f. Key the transmitter and measure the SWR, per the operating manual instructions. For best performance and range, this ratio should be 1.5 to 1 or less. If the SWR is more than 1.5 to 1 the antenna should be tuned to the lowest SWR by adjusting its length or by use of the E. F. Johnson CB Matchbox, Model No. 250-49.

NOTE

Refer to the Messenger 124 Operating Manual, Part No. 002-0103-001, for antenna and operating information.

3.4 MOBILE INSTALLATION

The Mobile Mounting and Cable Kit, Model No. 251-403-1, is intended for mobile operation of the Messenger 124. It includes mobile installation instructions, Part No. 004-0084-001, a dash mounting bracket, a fused DC power cable and necessary hardware.



RG-8/U



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



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



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

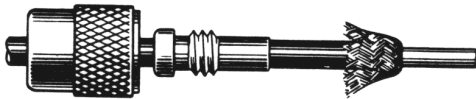


For final assembly, screw coupling ring on plug sub-assembly.

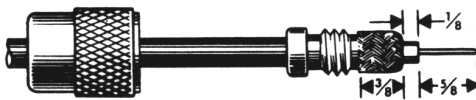
RG-58A/U



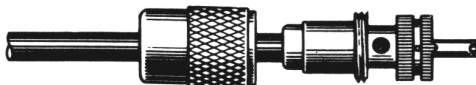
Cut end of cable even. Remove vinyl jacket 3/4". Slide coupling ring and adapter on cable.



Fan braid slightly and fold back as shown.



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



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



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

UHF COAXIAL CONNECTORS ASSEMBLY INSTRUCTIONS FIGURE 3-3

SECTION 4 CIRCUIT DESCRIPTION

4.1 GENERAL

The Messenger 124 is a completely solid state 23 channel transceiver for the Citizens Radio Service 27 MHz band. It uses a 10-crystal frequency synthesizer for frequency control. The synthesizer, antenna, power supply and most of the audio circuitry are common to both transmitter and receiver. A meter on the front panel indicates received signal strength, % modulation, voltage standing wave ratio (VSWR) of the antenna system, and RF power output. The receiver frequency is tunable ± 3 kHz at each of the 23 channels.

Refer to the block diagram and the schematic while following the circuit description.

TABLE 4-1 SYNTHESIZER SCHEME			
CHANNEL POSITION	HF CRYSTAL FREQUENCY	LF CRYSTAL FREQUENCY	SYNTHESIZER FREQUENCY
1	32.845	10.180	22.665
2	32.845	10.170	22.675
3	32.845	10.160	22.685
4	32.845	10.140	22.705
5	32.895	10.180	22.715
6	32.895	10.170	22.725
7	32.895	10.160	22.735
8	32.895	10.140	22.755
9	32.945	10.180	22.765
10	32.945	10.170	22.775
11	32.945	10.160	22.785
12	32.945	10.140	22.805
13	32.995	10.180	22.815
14	32.995	10.170	22.825
15	32.995	10.160	22.835
16	32.995	10.140	22.855
17	33.045	10.180	22.865
18	33.045	10.170	22.875
19	33.045	10.160	22.885
20	33.045	10.140	22.905
21	33.095	10.180	22.915
22	33.095	10.170	22.925
23	33.095	10.140	22.955

4.2 FREQUENCY SYNTHESIZER

4.2.1 GENERAL

A frequency synthesizer consisting of ten crystals, two oscillators, a mixer and two diode switches generates a signal which is always 4.3 MHz less than the channel frequency. This synthesizer output is diode switched between additional mixers for control of the transmitting or receiving frequency. There is no frequency multiplication in the synthesizer or in other circuits.

4.2.2 LF OSCILLATOR

The low frequency oscillator is made up of Q12 and its associated circuitry, and crystals Y1-Y4 which operate at their fundamental frequencies. Switch SW1A selects one of these crystals. Refer to Table 4-1, synthesizer scheme, for the low frequency crystal frequencies. The output of the selected crystal is applied directly to the base of Q12. The signal from the emitter of Q12 is coupled through C53 to the base of the synthesizer mixer, Q13. A capacitive voltage divider consisting of C53 and C54 reduces the voltage at the base of Q13 and provides the proper impedance match.

4.2.3 HF OSCILLATOR

The high frequency oscillator, Q15, operates with third overtone crystals, Y5-Y10. Switch SW1B selects one of the HF crystals at the same time as SW1A selects an LF crystal. Refer to Table 4-1, synthesizer scheme, for the HF oscillator crystal frequencies. The signal from the selected series resonant crystal is applied directly to the base of the HF oscillator, Q15. The signal from the collector of Q15 is coupled through the oscillator transformer, T9, to the emitter of the synthesizer mixer, Q13.

4.2.4 SYNTHESIZER MIXER

The output of the LF oscillator, Q12, is applied to the base of the synthesizer mixer, Q13. The output of the HF oscillator is coupled through T9 to the emitter of Q13. The output of Q13 is tuned for the difference frequency. For example, when the channel switch is in position 1, the HF crystal frequency is 32.845 MHz and the LF crystal frequency is 10.180 MHz. The difference (mixer output) frequency is 32.845 MHz - 10.180 MHz = 22.665 MHz. Refer to Table 4-1 for a list of the crystal combinations used for each channel. The mixer output frequency is coupled through double tuned transformer T8 to D6 and