# 6. MAINTENANCE

NOTE: In order to avoid making unnecessary adjustments it is best to first assess the basic transceiver performance using the steps outlined in Section 6.3 below.

## 6.1 GENERAL

BASIC DISASSEMBLY:

NOTE: No disassembly of the unit is generally required for calibration of the unit.

1. Prepare a clean surface in the work area. Static-free precautions are recommended. Place radiotelephone on work surface and remove the eight #4 self tapping screws which fixes the front panel bezel in place. The front panel bezel may then be removed, providing access to the interior of the radiotelephone.

CHASSIS DISASSEMBLY:

The Main PCB is not field removable from the chassis casting. Contact the factory for return authorization if the main PCB is damaged.

## 6.2 RECOMMENDED TEST EQUIPMENT:

1. 13.6 volt, regulated DC power supply with ammeter, rated for minimum 6 amps continuous duty.
2. Calibrated RF wattmeter (Bird Model 43) with 25 watt and 1 watt, 150mHz elements and a 50 ohm 25 watt load or power attenuator.
3. Volt-ohmmeter plus RF probe. eg: Fluke 75 plus Fluke 85RF probe.
4. VHF frequency counter, accurate to 10 Hz resolution.
5. Calibrated frequency deviation meter.
6. Sinewave audio signal generator.
7. Calibrated RF signal generator with FM capability, 50 ohm output impedance and minimum 40 watt reverse power protection.
8. Audio distortion (SINAD) and audio voltmeter.
9. Four Ohm, four Watt resistive audio load.
10. Spectrum analyzer, 1 to 1000mHz, 1 KHz resolution.
11. Oscilloscope. (50mHz bandwidth required for receiver first IF alignment.)
12. 50 ohm, 20 or 30 dB RF power attenuator.
13. VHF marine FM monitor receiver.

## 6.3 BASIC PERFORMANCE TESTS:

GENERAL:

NOTE: No disassembly is required to perform basic performance tests. The orange audio output wire and the yellow internal speaker wire must be connected together if internal speaker operation is desired.

1. DISPLAY/KEYPAD AND MAIN MEMORY CHECK: When the main power is turned on, the display will cycle through a self-check sequence. Following this self-check cycle, the front panel will revert to the normal RADIO front panel indication.

2. NON-VOLATILE MEMORY FUNCTION CHECK: Change the priority channel to a new channel number. eg: Select USA or INT channel list, then push, 1 followed by 3 to select Channel 13, then push and hold the ENT key until the Channel Operation menu is displayed. Use the rotary control to select “Make PRI Channel” and then press the ENT key. The radio will return to the main display and PRI will be displayed on Channel 13. Cycle radio power OFF then ON. Push 16 key and then push 1 followed by 3, the radio will go to Channel 13 and PRI should be on the display. Reset the priority channel to the desired channel number (USA Channel 16 is recommended).

BASIC TRANSMITTER TESTS:

Set up the equipment as shown in Figure 6.1, "Transmitter Test Setup".

1. TRANSMITTER FREQUENCY AND POWER CHECK: Key the transmitter on channel 16 (156.800mHz). The frequency should read within $\pm$ 780 Hz of the assigned frequency at room temperature. The wattmeter should read 25 $\pm$ 2 watts in the 25 watt mode and 0.7 to 1.0 watt in the 1 watt mode. Repeat this test on channels 01 (156.050mHz) and 88 (157.425mHz). During transmission the TX annunciator should be displayed when either the 1 watt or 25 watt mode is selected. The DC current should not exceed 6 amperes in the 25 watt mode.

2. TRANSMITTER PEAK FREQUENCY DEVIATION CHECK: Key the microphone on the desired channel and speak in to the microphone in a normal speaking voice. Verify that the peak deviation averages more than 4 KHz but does not exceed 5 KHz. Listen for "clean" sounding audio on a good monitor receiver.

3. TRANSMITTER AUTO POWER REDUCTION AND OVERRIDE CHECK: Set the radiotelephone to channel 13 USA. Verify that the 1 watt (1W) annunciator is ON and that the transmitter power is 1 watt unless manual override is used (Holding down the FUNC key while transmitting). The 1W/25W display flag will indicate the current transmit power level.
   Repeat on channel 67 USA.

BASIC RECEIVER TESTS:

Set up the equipment as shown in Figure 6.2, "Receiver Test Setup".

1. RECEIVER SENSITIVITY AND AUDIO POWER CHECK: Select the USA channel list. Set both the receiver and signal generator frequency to channel 16 (156.800mHz). Set the squelch threshold to open. Apply 1000 Hz sinusoidal, 3 KHz peak deviation modulation to the signal generator. Start with the signal generator set to approximately 1 millivolt (-47 dBm) amplitude.

   Set the volume to maximum. The audio voltmeter should read about 4 volts RMS. Reduce volume to approximately 50% audio power (2.8 volts RMS on the audio voltmeter).

   Reduce signal generator RF amplitude until 12 dB SINAD is obtained. This should occur at approximately 0.3 microvolts (-117 dBm) or less. Repeat check on channel 01A (156.050mHz) and weather channel 1 (162.550mHz).

2. SQUELCH SENSITIVITY CHECK: Turn off signal generator RF output. Increase the squelch threshold until the squelch just closes. Start with the signal generator RF amplitude at minimum setting and increase slowly until the squelch just opens. The signal generator amplitude should not exceed 0.2 microvolts (-121 dBm).

3. MODULATION ACCEPTANCE CHECK: This test checks for proper alignment of the receiver. Set the signal generator and receiver to channel 16 (156.800mHz). Set the signal generator modulation to 1 KHz sinusoidal, 3 KHz peak deviation. Set the signal generator amplitude to obtain 12 dB SINAD. Increase the signal generator amplitude 6 dB (double the output voltage) and then increase the peak deviation until the SINAD ratio drops back to 12 dB SINAD. The final deviation should be 7 KHz or greater.

## 6.4 TRANSMITTER ALIGNMENT (TUNE UP PROCEDURE):

GENERAL: Avoid making unnecessary adjustments. Some or all of the following procedures should be performed only after identifying specific problems during the Basic Performance Tests, Section 6.3 above.

Transmitter calibration should be performed by qualified service technicians using the proper test equipment and only with specific factory authorization. To obtain authorization, contact the factory with the serial number of the unit for an authorization code.

Enter the service menu by pressing FUNC-ENT and entering the service menu activation code. The various adjustments are selectable by rotating the front panel control and pressing ENT when the desired adjustment is displayed. The service menu allows adjustment of deviation, clock frequency, 1W power level, 25W power level. DSC transmitted high tone, low tone and dotting pattern are also available for testing purposes. During all of the service menus PTT is active so that the transmitter can be tested.

Set up equipment as shown in Figure 6.1, "Transmitter Test Setup".

NOTE: In the event of synthesizer malfunction (unlocked condition) all display annunciators will flash repeatedly, the computerized operating system will fail to respond and radiotelephone transmit function will be inhibited.

1. Ensure that a 50 ohm, 25 watt power load or power attenuator is connected to the antenna terminals. Ensure that the DC power source is supplying 13.6 ± 0.5 volts to the radio power lead (Red lead positive, Black lead negative) under 25 watt transmit conditions. DO NOT EXCEED 16 VOLTS UNDER ANY CONDITION. If the transmitter is operated at 25 watts output for long periods, carefully monitor the temperature of the chassis for evidence of excessive heating.

2. TRANSMITTER FREQUENCY: Place the radio on any desired channel. Enter the service menu and select the “CLKTUN” mode. Push microphone push-to-talk button (PTT) to key transmitter on any desired channel. Rotate the front panel control until the transmitter is within 100 Hz of the assigned frequency. The display will show an adjustment of 0-200 and will typically be approximately 100. Press “ENT” to store the setting. All other transmitter and receiver channel frequencies are automatically set by this adjustment.

3. TRANSMITTER POWER: Set the radiotelephone to channel 14 (156.700mHz) or any other channel in that range. Select 25 watt output level. Enter the setup mode and select the “25W ADJ” mode. (NOTE: Avoid prolonged transmitter testing on the emergency channel (16)). Key the transmitter and adjust the front panel rotary control for exactly 25 watts output. Press “MODE” to store the value. Use a 25 watt wattmeter element for maximum accuracy. Select “1W ADJ” in the setup menu and temporarily adjust the front panel rotary control for minimum output power. The TX annunciator on the front panel display should extinguish, even though the transmitter is keyed. Change wattmeter element to a 1 watt unit for maximum accuracy and adjust for 0.95 watts. Press “MODE” to store the setting. Change wattmeter element back to 25 watts. Check channels 01 and 99 for 25 ± 2 watts in the 25 watt mode and 0.7 to 1 watt in the 1 watt mode. The TX annunciator should now come on in either the 1 watt or 25 watt modes when transmitting.

5. TRANSMITTER PEAK FREQUENCY DEVIATION:

NOTE: The DSP transmit audio processing adjusts the audio gain to a wide range of audio input levels. The deviation adjustment sets the transmitter deviation level and is not a microphone gain adjustment. Once properly factory set it should not require readjustment for the life of the unit.

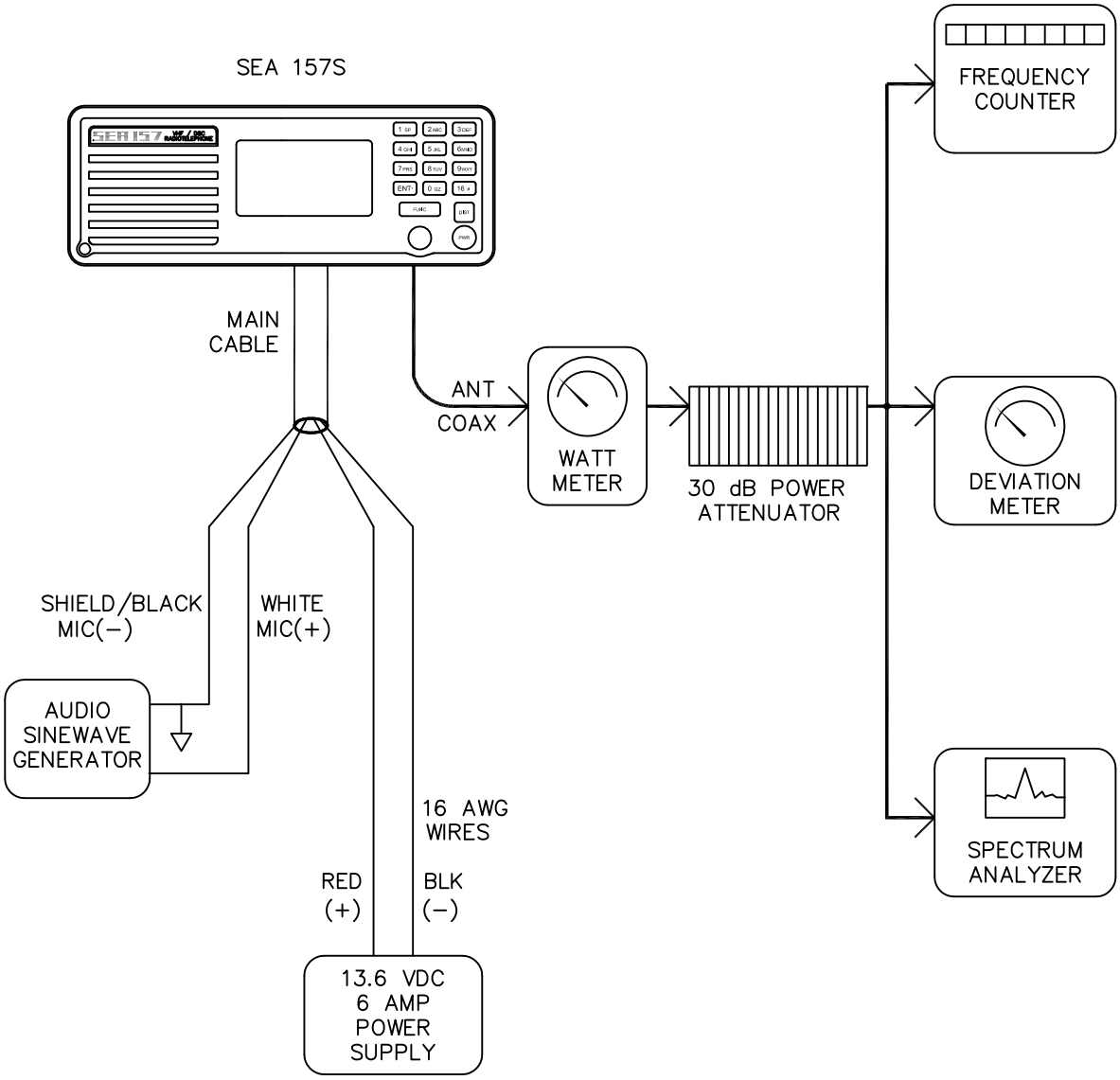
Connect an audio sinewave generator to the microphone terminals. If the audio generator amplitude cannot be attenuated below 5 millivolts at the microphone terminals, insert a 10 Kohm or greater resistor between the audio source and the external microphone terminal. Set the audio generator to 1 KHz. Enter the service menu and select the deviation adjustment as described above. Key the transmitter and watch the deviation meter while varying the audio frequency for maximum deviation. Once the maximum is found, adjust the deviation using the front panel control for 4.8 KHz peak deviation. The LCD display will show a deviation setting between 0 and 200 and should typically be about 100. Press the ENT key to store the deviation setting. The resulting audio level at the external microphone terminals should be approximately 40 millivolts peak-to-peak or 14 mv RMS. Now set the generator to 2500 Hz and verify that the deviation does not exceed 5 KHz peak under any amplitude condition up to at least 400 millivots RMS at the microphone terminals. Remove the series dropping resistor from the audio generator path if necessary to achieve this audio drive level.

Disconnect the audio generator. Key the transmitter and speak loudly into the microphone to verify that the frequency deviation does not exceed 5 KHz. Now speak at normal volume into the microphone and verify that the deviation averages 4 KHz or more. NOTE: The particular damping characteristics of the deviation meter must be taken into account since most deviation meters will overshoot on voice peaks. Listen for "clean" audio on a good monitor receiver.

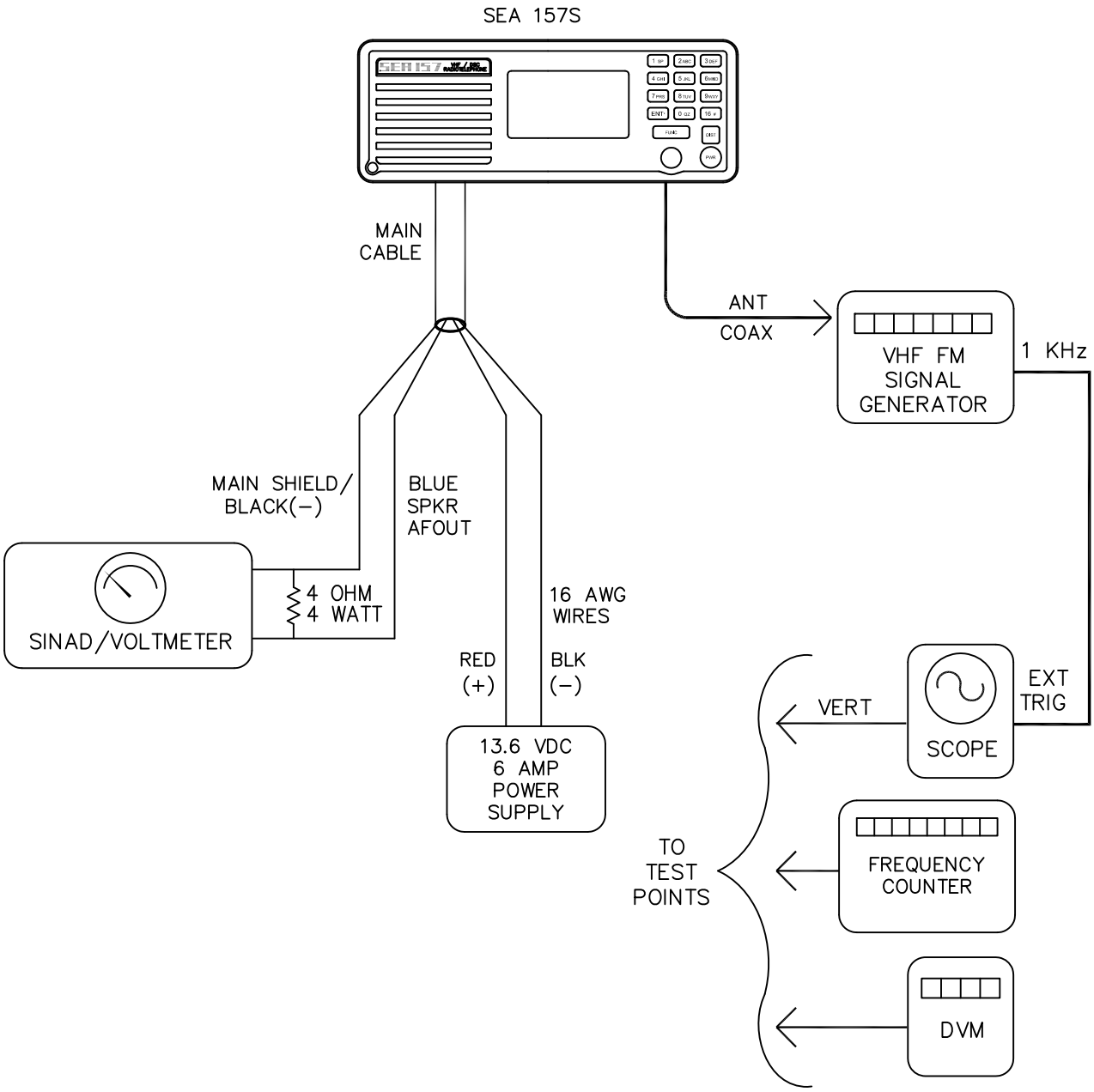
6. SPECTRAL PURITY: Connect a 1000mHz spectrum analyzer through the power attenuator and verify that harmonics or spurious signals do not exceed -60 db with respect to 25 watts (-16 dbm) during both modulated and unmodulated conditions. Change to 1 watt output power mode and verify that harmonics or spurs do not exceed -46 dB with respect to 1 watt (-16dbm) during both modulated and unmodulated conditions. CAUTION! Spectrum analyzer overload will lead to erroneous results, especially at the transmitter harmonic frequencies. To avoid overload, 60 or 70 minimum attenuation is usually required between the transmitter output terminals and the first mixer of the spectrum analyzer, regardless of the center frequency and span being viewed.

## 6.5 RECEIVER ALIGNMENT:

GENERAL: The receiver is factory aligned and has no field serviceable adjustments. If specific receiver performance problems are identified, contact the factory for return authorization.




SEA 157S
Transmitter Test Setup
Figure 6.1




SEA 157S
Receiver Test Setup
Figure 6.2