A UNIT OF DATAMARINE INTERNATIONAL INC.

SEA 7157

VHF/DSC Radiotelephone

INSTRUCTION AND MAINTENANCE MANUAL

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PRELIMINARY

P/N: MAN-7157
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7157

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1 INTRODUCTION

The SEA 7157 VHF FM Transceiver is designed for general purpose marine communications applications. Additionally, The SEA 7157 integral VHF Digital Selective Calling Controller, permits compliance with the requirements of CFR 47, Part 80, Subpart W -- Global Maritime Distress and Safety System (GMDSS), Paragraph 80.1101, Performance standards.

This SEA 7157 Service Manual provides detailed technical information for use by installation and service technicians.

General operating instructions and installation drill templates are provided in the SEA 7157 Operator's Handbook (SEA P/N OPR-7157) supplied with each SEA 7157.

SEA continually strives to improve its products so that we may better serve our customers. SEA reserves the right to make changes to SEA 7157 specifications, hardware, software or documentation at any time without notice.

SEA's Marine Service Department is always available to provide additional help with technical difficulties.

Please call SEA's Service Department to obtain a Return Authorization Number (RA#) before shipping equipment to SEA.

Service parts are available through SEA's Marine Sales/Service Departments. Please order parts using SEA part numbers found in Section 8.

2 SEA 7157 SPECIFICATIONS:

2.1 GENERAL

FREQUENCY RANGE:	TX 155-159 MHz US TX 156.0-157.45 MHz RX 155-163.6 MHz
FREQUENCY RESOLUTION:	25 KHz
CHANNELS:	All US, Canadian, Int'l plus 10 WX, 10 Special
POWER REQUIREMENT: NOTE: Basic radio circuitry operates at 12 volts. Radio contains INTERNAL 24/12 volt converter for 24 volt use.	Voltage, 12 V +30, -10% 13.6 volts nominal, OR 24 V +30, -10% Chassis floating
CURRENT: (12 Volt operation)	Max TX: 4.5 amps (25W) 1.0 amps (1W) RX (STBY) 0.5 amp RX (Max Audio 1 amp
(24 Volt operation)	Max TX: 2.35 amps (25W) 0.80 amps (1W) RX (STBY) 0.3 amp RX (Max Audio 0.5 amp
FUSES:	7.5 amp, internal (12V) 7.5 amp, external (12V) 5 amp external ONLY (24V)
COMPLIANCE:	FCC Parts 80, 15 GMDSS (Para 80.1101) EIA RS-204C, RS152B
FCC IDENTIFIER:	BZ6SEA7157

2.2 TRANSMITTER

EMISSION:	16K0G3E
POWER OUTPUT:	25W, 1W into 50 ohms
SPURIOUS EMISSIONS (RADIATED):	-80 dB or better
SPURIOUS EMISSIONS (CONDUCTED):	-80 dB or better
AUDIO HARMONIC DISTORTION:	10% max. (EIA)
AUDIO FREQUENCY RESPONSE:	+1,-3 dB of +6 dB/octave preemphasis 300-3000 Hz

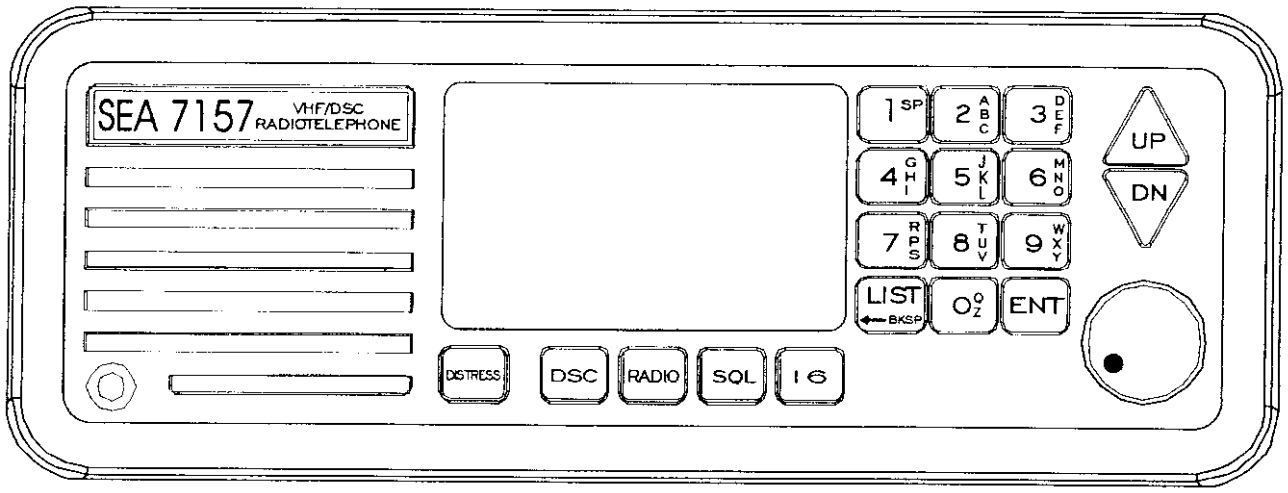
2.4 MECHANICAL

DIMENSIONS:	(HEIGHT-WIDTH-DEPTH) In: 3.9 x 10.5 x 10.9 mm: 99 x 265 x 278
WEIGHT:	Lbs: 7.75 Kgs: 17

2.5 CHANNEL 70 MONITOR GENERAL SPECIFICATIONS

FREQUENCY:	CH70 (156.525 MHz)
SENSITIVITY:	$\leq$ 1.0 uv for 20 dB SINAD
BANDWIDTH:	$\geq$ 16 KHz
ADJACENT CHANNEL SELECTIVITY:	$\geq$ -70 dB @ 25 KHz
SPURIOUS RESPONSE REJECTION:	$\geq$ -70 dB
INTERMODULATION REJECTION:	$\geq$ -65 dB
MODE OF RECEPTION:	G2B
SPURIOUS EMISSION, RADIATION:	$\leq$ 2.0 nW, 9 KHz to 2 GHz
WARMUP TIME:	$\leq$ 1 Minute
DSC FACILITY:	$\leq$ 1 uv for 1E-2 B.E.R.,

NOTE: The SEA 7157 Channel 70 Watch Receiver is designed to be in compliance with the general and specific requirements of CFR 47, PART 80, Subpart W--Global Maritime Distress and Safety System (GMDSS), Paragraph 80.1101 Performance standards. The configuration so described has been tested for compliance with IEC FUTURE PUBLICATION 1097-8, Shipborne VHF DSC watchkeeping receiver Operational and performance requirements, Methods of testing and required test results, Working draft Version 2.3, October 1994.



Not to scale

SEA 7157
Front View
Figure 2.1

3. OPERATION

3.1 FRONT PANEL CONTROLS

Figure 2.1, Page 2-5 illustrates the front panel of the SEA 7157. The functions of the individual controls and indicators are listed below.

3.1.1 ROTARY CONTROLS

One rotary control is provided. This is the ON/OFF/VOLUME control provides for main power control and adjustment of the loudspeaker audio volume from the internal audio power amplifier.

3.1.2 KEYPAD

A 19 key backlighted keypad is provided which, together with the LCD graphics display, provides an operating system which permits the operator to control both the radiotelephone and digital selective calling (DSC) features of the SEA 7157.

3.2 DISPLAY

The LCD display used in the SEA 7157 is a graphics display with an array of 128 X 64 pixels. The display is backlighted and is used interactively with the keypad to provide an effective operator interface to the radiotelephone/DSC functions of the SEA 7157.

3.3 PUSH TO TALK

The radio is put into transmit mode by pressing the microphone push to talk key. It remains in transmit mode until the push to talk switch is released or until the internal 5 minute timer expires. The TX annunciator is displayed during transmit. Note that the internal DSC controller can also initiate transmissions independent of the push to talk switch on the microphone.

3.4 RADIOTELEPHONE OPERATING SYSTEM FUNCTIONS

3.4.1 CHANNEL SELECTION

The radio channel can be changed during receive only. To step through the channels press the UP or DN keys. Holding the key down will cause the radio to scroll through the channel list. Alternatively, the desired channel can be selected through the numeric keypad. Select the desired channel by entering a 1, 2 or 3 digit number followed by the "ENT" key. For example, channel 8 can be selected by any of the following methods: 008 ENT; 08 ENT; 8 ENT; 8 (wait 2 seconds).
For US channels where both the simplex and duplex channels are available, key in the desired channel followed by the UP arrow key to get the simplex channel (e.g. 8, 8, UP gives channel 88A).

3.4.9 SCAN

To activate scan mode press the RADIO key. This will cause the RADIO menu to appear. Press 8 to start the scan. The SCN annunciator will appear. The display returns to the normal radio mode. Press the UP key to skip an active channel. Hold UP for one second to lock out a channel. To stop the scan mode press ENT or enter a channel number.

3.4.10 PRIORITY SCAN

If the priority channel is selected BEFORE entering the scan mode, the receiver scans the priority channel in between each channel.

3.4.11 SCAN CHANNEL PROGRAMMING

To toggle a selected channel into or out of the scan list press the RADIO key. This will cause the RADIO menu to appear. Press 7 to toggle the memory status of the selected channel. The MEM annunciator will appear if the channel is in the scan list. The display returns to the normal radio mode.

3.4.12 PRIORITY CHANNEL PROGRAMMING

To designate a selected channel as the priority channel press the RADIO key. This will cause the RADIO menu to appear. Press 9 to establish the selected channel as the priority channel. The display returns to the normal radio mode. Note that channel 16 is the priority channel by default. The PRI annunciator will appear if the priority channel is selected.

3.4.13 SEARCH MODE PROGRAMMING

To program the search mode (continuous vs. stop-and-go) press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 2 to toggle the mode. The mode will be displayed for 2 seconds and the display will then return to the normal radio mode. In continuous mode search stops on the first active channel and resumes when it becomes inactive for a hang time. In stop-and-go mode search stops for 2.5 seconds on an active channel and then resumes.

3.4.14 SCAN CHANNEL CLEAR

To clear all channels from the scan list and reset the priority channel to 16 press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 5 to clear the scan list. The display returns to the normal radio mode.

3.4.20 LOCAL/DISTANCE MODE CONTROL

To toggle the radio between LOCAL and DISTANCE mode press the RADIO key. This will cause the RADIO menu to appear. Press 6 to toggle the mode. The display returns to the normal radio mode. In LOCAL mode the radio main receiver sensitivity is reduced in order to obtain better performance in the presence of strong interferers. The LOC annunciator is displayed when the receiver is in the local mode and the radio is not transmitting.

3.4.21 MODIFYING CHANNEL NAMES

In the normal radio display an alphanumeric name is shown below the channel number. This name can be modified. Press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 8 to modify the name of the selected channel. The name will appear with a cursor at the end. Use the LIST key for a backspace. Use the alphanumeric keypad for entering digits. Use the UP and DN keys to cycle through the characters on the key. For example, to enter a "U" press the 8(TUV) key followed by UP twice. The display will change from "8" to "V" to "U". In this fashion, enter the desired name up to 9 characters long. (Legal characters are 0-9, A-Z and SPACE. When the desired channel name has been entered, press ENT. The display will return to normal radio mode.

3.5 DIGITAL SELECTIVE CALLING OPERATING SYSTEM

3.5.1 DISTRESS CALLING

Lift cover over the DISTRESS key and press key. Press DISTRESS key a second time to confirm. Enter position if requested (position data more than 15 minutes old). Enter nature of distress. Press ENT key to transmit call.

3.5.2 CALL COMPOSITION

Press DSC key. The primary DSC menu will appear. Most calls will conform to one of the five predefined formats which have a simplified calling procedure: [1] Routine individual calls on Channel 70 (Press 3); [2] Routine individual calls on an alternate calling (Press 4); [3] Distress relay calls (Press 5); [4] All ships calls (Press 6); [5] Automatic telephone calls (Press 7). If the desired call does not fit one of these categories, Press 8 to request a complete composition procedure. Some calls which require the full Class A composition procedure are Geographic Area Calls, Group Calls, Nonvoice (e.g. FAX and data) Calls, Position Request Calls and Polls. The RADIO key can be used to ABORT at any point in this process and return to the main radio display.

Select a receiving station as described in Section 3.5. Select a phone number as described in Section 3.7. Transmit the call as described in Section 3.8. The working channel is generally assigned by the coast station in it's acknowledgement.

3.5.2.6 CLASS A DSC CALL

Any call format defined by the ITU 493 can be composed from the Class A menu. To transmit any DSC call press 8 from the primary DSC menu. Select a format. Prompts will appear for various other fields depending on which format is initially selected. As required, select the nature of distress (distress calls only), distress location (distress calls only and only if no valid position data is available), priority category (nondistess only), form of subsequent communication (first telecommand, nondistress only), ID of ship in distress (distress relay and acknowledgement only), coordinates of addressed rectangular area (geographic area call only), destination address (group, individual and phone call only), phone number (phone call only), and end of sequence character. Then transmit the call as described in Section 3.8

3.6 SELECTING A RECEIVING STATION

In order to send a call to an individual station (or to a group of stations) an ID code must be selected. A menu of stored ID's will be displayed. The first entry is always the last number called. Press the UP or DN keys to scroll through the pages (labeled A-F) or press 0 to enter a number manually.

3.7 SELECTING A TELEPHONE NUMBER

When an automatic phone call is required a subscriber number is needed. A menu of stored numbers will be displayed. The first entry is always the last number called. Press the UP or DN keys to scroll through the pages (labeled A-F) or press 0 to enter a number manually.

3.8 TRANSMITTING A CALL

When the call has been composed all the information is displayed. To change the working channel simply change the channel as you would from the main display using the UP and DN keys or numeric entry. To transmit the call press the DSC key. To abort the call press the RADIO key.

3.9 RECEIVING A CALL

Received calls are displayed immediately under most circumstances. In addition, an alarm tone is sounded. The display format depends on the nature of the call received.

3.17 PROGRAMMING THE TELEPHONE DIRECTORY

Press the DSC key and then press 2 to get the DSC program menu. Press 2 to get to the directory of telephone numbers. Use the UP and DN keys to scroll through the pages labeled A-F and use the numeric keys (1-8) to select an entry to reprogram. You will be prompted for the name and number. When entering names use the UP and DN keys to cycle through the letters shown on each alphanumeric key. Press ENT when finished. The LIST key is used as a backspace in these entries.

3.18 USING TEST AND DIAGNOSTIC UTILITIES

Press the DSC key and then press 2 to get the DSC program menu. Press 8 to get the utility menu. This menu allows the user to output FSK tones or a dot pattern either to the speaker or to transmit as well as test the various alarm tones. There are also capabilities to perform error rate tests and other functions which are not accessible to the normal user.

3.19 ADDITIONAL OPERATING PROCEDURES AND INFORMATION

3.19.1 Programming expansion (special) channels:

CAUTION: Prior Authorization is required before enabling transmission on special channels or transmitting on any frequency provided in this radio equipment.

A. PREPARATION:

Inspect the expanded channel list in Section 3.3 of this manual to identify the frequencies and channel numbers required. The maximum allowable number of expansion (special) channels which can be enabled is ten (10).

The internal switch, SW1 on the CPU/DSC printed circuit board (ASY-7157-02), must be operated to enter the special channel programming code.

First disconnect primary power from the unit. Remove the bottom cover by removing the four cover retaining screws. Locate the internal switch, SW1. (SW1 is the small pushbutton switch mounted near the inside front corner of the large shield can on the bottom PC board assembly.

Apply primary power to the radio and turn the power on. Select the USA or INT channel list. Depress and release SW1 to enter the programming mode.

NOTE: Transmission is disabled throughout the programming process.

6. Repeat steps 1 through 5 for each additional special channel desired, up to a maximum of 10.

7. EXITING SPECIAL CHANNEL PROGRAMMING MODE: To exit programming mode, turn the radio power switch OFF.

8. VERIFYING SPECIAL CHANNELS: Turn the radio power switch ON. Then push LIST until you have entered the special channel list. Use the channel selector knob to review the special channels which you have enabled. Remember that if the "A" follows the channel number, the channel is SIMPLEX; otherwise the channel is DUPLEX. If the 1W annunciator is on, the power level cannot be changed to 25 watts (unless you reprogram that special channel).

9. COMPLETION: Remove primary power from the unit.

C. REMOVING OR MODIFYING A SPECIAL CHANNEL:

If you are not already in the special channel programming mode, you must first enter this mode as instructed in paragraph A above. Select the special channel of interest using the channel selector knob.

You must first remove a special channel before you can modify it. Push RADIO 7 to remove the special channel. The SPL annunciator will go off. You may now reprogram this channel or program a different channel using the procedure in part B above.

D. SPECIAL CHANNEL BULK ERASE:

After entering the special channel programming mode as instructed in part A above, you may erase ALL existing special channels at once by pushing RADIO 1, 5. Do NOT use this function if you wish to retain ANY previously programmed channels. After cycling the radio power to exit the programming mode, the special channel bulk erase function is disabled.

3.2 USING EXPANSION (SPECIAL) CHANNELS:

A. TO SELECT A PROGRAMMED SPECIAL CHANNEL:

Press LIST key until the SPECIAL list has been entered and then use the UP and DN keys or the numeric keys to select the special channel.

B. TO ADD A PROGRAMMED SPECIAL CHANNEL INTO SCAN MEMORY:

After selecting the special channel per paragraph A, press RADIO 7 keys to add the channel to the scan list. Special channels tagged as memory channels will be included in the USA or international scan modes.

Channel Number	Transmit Freq, MHz	Receive Freq,MHz Simplex	Receive Freq,MHz Duplex	Channel Number	Transmit Freq,MHz	Receive Freq,MHz Simplex	Receive Freq,MHz Duplex
80	157.025	157.025	161.625	120	155.975	155.975	160.575
81	157.075	157.075	161.675	121	155.950	155.950	160.550
82	157.125	157.125	161.725	122	155.925	155.925	160.525
83	157.175	157.175	161.775	123	155.900	155.900	160.500
84	157.225	157.225	161.825	124	155.875	155.875	160.475
85	157.275	157.275	161.875	125	155.850	155.850	160.450
86	157.325	157.325	161.925	126	155.825	155.825	160.425
87	157.375	157.375	161.975	127	155.800	155.800	160.400
88	157.425	157.425	162.025	128	155.775	155.775	160.375
89	157.475	157.475	162.075	129	155.750	155.750	160.350
90	157.525	157.525	162.125	130	155.725	155.725	160.325
91	157.575	157.575	162.175	131	155.700	155.700	160.300
92	157.625	157.625	162.225	132	155.675	155.675	160.275
93	157.675	157.675	162.275	133	155.650	155.650	160.250
94	157.725	157.725	162.325	134	155.625	155.625	160.225
95	157.775	157.775	162.375	135	155.600	155.600	160.200
96	157.825	157.825	162.425	136	155.575	155.575	160.175
97	157.875	157.875	162.475	137	155.550	155.550	160.150
98	157.925	157.925	162.525	138	155.525	155.525	160.125
99	157.975	157.975	162.575	139	155.500	155.500	160.100
100	158.025	158.025	162.625	140	155.475	155.475	160.075
101	158.075	158.075	162.675	141	155.450	155.450	160.050
102	158.125	158.125	162.725	142	155.425	155.425	160.025
103	158.175	158.175	162.775	143	155.400	155.400	160.000
104	158.225	158.225	162.825	144	155.375	155.375	159.975
105	158.275	158.275	162.875	145	155.350	155.350	159.950
106	158.325	158.325	162.925	146	155.325	155.325	159.925
107	158.375	158.375	162.975	147	155.300	155.300	159.900
108	158.425	158.425	163.025	148	155.275	155.275	159.875
109	15.475	158.475	163.075	149	155.250	155.250	159.850
110	158.525	158.525	163.125	150	155.225	155.225	159.825
111	158.575	158.575	163.175	151	155.200	155.200	159.800
112	158.625	158.625	163.225	152	155.175	155.175	159.775
113	158.675	158.675	163.275	153	155.150	155.150	159.750
114	158.725	158.725	163.325	154	155.125	155.125	159.725
115	158.775	158.775	163.375	155	155.100	155.100	159.700
116	158.825	158.825	163.425	156	155.075	155.075	159.675
117	158.875	158.875	163.475	157	155.050	155.050	159.650
118	158.925	158.925	163.525	158	155.025	155.025	159.625
119	158.975	158.975	163.575	159	155.000	155.000	159.600

4. INSTALLATION

4.1 PRELIMINARY CHECK:

Prior to installation, the transmit frequency, peak frequency deviation and RF power output level should be checked on a calibrated FM service monitor or equivalent equipment. See Section 6 of this manual for more detailed procedures.

4.2 SHELF OR OVERHEAD MOUNTING:

See Figure 4.1, Page 4-2 for dimension drawings of SEA 7157.

4.3 BULKHEAD MOUNTING:

A special bulkhead mounting bracket (SEA P/N KIT-0235-30) is available from SEA which permits through-bulkhead mounting of the SEA 7157. The required depth behind the bulkhead is approximately 11.5 inches (290 mm). Contact SEA at (425) 771-2182.

4.4 POWER SUPPLY WIRING:

Use either a 12 volt +30%/-10% (10.8 to 15.6 vdc) OR a 24 volt +30%/-10% (21.6 to 31.2 vdc) DC power source for proper operation. Direct connection to the battery or power supply is recommended. Connect the RED positive (+) power lead to the positive supply rail. The BLACK negative (-) power lead connects to the negative supply rail. NOTE: The chassis of the SEA 7157 is NOT connected to either supply rail. Connect the #10 stainless steel ground stud to a suitable earth ground. GROUNDING THE CHASSIS OF THE SEA 7157 WILL NOT CREATE A GROUND FAULT WITH EITHER SIDE OF THE DC PRIMARY SUPPLY VOLTAGE.

CAUTION: If the power wires are connected backward, i.e., reverse polarity power is accidentally applied to the radiotelephone, the fuse will blow. It is also likely that the reverse-polarity protection diode, CR20, which is near the power lead connections on the main circuit board will also be damaged. Application of voltages greater than the maximum rated voltage will produce the same result. (Refer service of this equipment to a qualified technician.)

NOTE: As described above, the SEA 7157 radiotelephone is designed to support operation on either a 12 volt or 24 volt power system. The internal radiotelephone circuitry is designed to conform to FCC Part 80.215(g) with respect to operation from a 12 volt lead-acid battery power source WHEN STRAPPED FOR 12 VOLT OPERATION! When operation from 24 volt power sources is required, the internal 24/12 volt power converter is strapped in. The converter provides a 13.6 volt regulated power rail for the operation of the internal 12 volt radiotelephone circuitry. Check the rear apron of your radiotelephone for the operating voltage required for your radio.

4.5 ANTENNA WIRING:

Use only the best available antennas, 50 ohm coaxial antenna feedline cable and connectors. The antennas must be vertically polarized. The antenna cables should be terminated with properly installed PL-259 (Type UHF male) connectors which should be securely screwed to the antenna connectors on the rear panel of the transceiver. NOTE: The MAIN system antenna should be mounted above the Channel 70 Monitor Receiver antenna with sufficient vertical spacing to provide isolation between the two antennas. All antenna feedline connections should be carefully protected from the weather.

4.6 EXTERNAL SPEAKER WIRING:

An external speaker can be added with or without the internal speaker remaining active. Both receiver audio and the internal speaker are brought out to pins on the Accessory Connector, P3, on the rear apron. For normal operation of the internal loudspeaker, a jumper is connected between pin 5 (INT SPKR) and pin 6 (AF OUT). Connect an external loudspeaker between pin 6 (AF OUT) and pin 8 (GND). For maximum audio volume, the external speaker should be a high-efficiency type rated for 4 ohms, 4 watts minimum. NOTE: Do not attempt to use either the radiotelephone chassis or "ship's ground" for audio circuits. Often, confusing audio problems can be avoided if none of the external speaker wiring is allowed to contact the radio chassis or ship's ground. If using external microphone(s), be sure to install independent speaker and microphone audio ground wiring.

4.7 EXTERNAL MICROPHONE WIRING:

Do not use an amplified ("power") microphone. It will not increase the range ("talk power") of the radiotelephone but will instead muffle and distort your transmissions.

EXTERNAL DYNAMIC MICROPHONE:
Use a dynamic microphone rated for 500 or 600 ohms. Besides the normal push-to-talk (PTT) switch, it should contain an additional internal switch ganged to the PTT button which disconnects the microphone element from the MIC+ line when not transmitting, especially if the front-mounted microphone is to be retained.

Dynamic microphone cable runs exceeding five feet should be avoided. Do not bundle microphone cabling with power cables or mount near other sources of electrical noise.

Connect the microphone cable shield wire to pin 1, (GND), of the Accessory Connector P3 located on the radiotelephone rear panel. Connect the microphone audio line to pin 2, (MIC), of P3. Connect the push-to-talk line to pin 3, (PTT), of P3. To avoid audio problems, do not attempt to use "ship's ground" for audio ground return paths.

5. THEORY OF OPERATION

Block diagrams, schematic wiring diagrams and printed circuit board layout drawings are provided in this in Section 7. See the table on page 7-1 for aid in locating applicable reference drawings.

5.1 FREQUENCY SYNTHESIZER:

GENERAL: Refer to the RF Mainboard block and schematic diagrams. The SEA 7157 makes use of a multi-loop synthesizer system to provide conversion frequencies for the Main Receiver, the Channel 70 Monitor Receiver and the Transmitter. The Main Transmitter synthesizer also serves as the first conversion loop for the Main Receiver and consists of the voltage controlled oscillator (VCO) Q11, RF buffers/amplifiers Q12 and Q13, synthesizer LSI chip U10 including reference oscillator crystal Y1, and the loop filter.

VCO: The low-noise VCO is a grounded-gate JFET oscillator operating in two frequency bands as selected by Q10 and CR8. CR8 is "off" for transmit and L28 and L29 set the frequency band to the 155-159 MHz range. CR8 is "on" for receive and L28 sets the 200-208.6 MHz receiver local oscillator (LO) range. The tuning voltage from the loop filter is applied to varactors CR6 and CR7. The tuning voltage ranges from 2 to 7 volts with lower voltages corresponding to lower frequencies. The more sensitive VCO components (The JFET oscillator, tuning inductors, bandswitching components, etc.), are located under a metal shield can which is soldered down to the main PC board. The can cover is removable for service.

VCO RF AMPLIFIERS: Q12 and Q13 amplify the VCO signal up to +13 dBm (20 mW) nominal. The signal is then fed through a 6 dB resistive pad attenuator to the receive mixer MIX1. CR10 is turned "on" only during transmission to supply approximately +10 dBm excitation to the transmitter amplifier chain.

SYNTHESIZER CHIP: A sample of the amplified VCO signal is derived from the output of Q13 and fed to the N and A dividers of U10. The N and A divider modulus is preset by the microcomputer via the clock, data and enable digital lines. The total frequency division (N and A) reduces the RF signal down to a 12.5 KHz comparison frequency at U10's internal phase detector. For example, the total division for transmission on 156.800 MHz is the 156,800/12.5 = 12544. For a receive frequency of 156.8 MHz, the required LO frequency is 156.800 + 45.000 = 210.800 MHz. The division factor is 201,800/12.5 = 16,144. The 12.800 MHz master reference oscillator is divided by a fixed 1024 modulus to produce the 12.5 KHz reference frequency. The U10 phase detector output at pin 5 is tri-state and drives the loop filter. A seperate lock detect (LD) output from U10 pin 7 goes mostly low when out of lock. The LD signal is fed back to the microcomputer which disables the transmitter in the unlocked state.

FREQUENCY DEVIATION CONTROL: R103 sets the transmitter peak frequency deviation. Q19 is switched "on" during receive mode to insure that no modulation is applied to the synthesizer during reception.

5.3 MAIN RECEIVER CIRCUITS:

GENERAL: Refer to RF Mainboard Schematic Diagrams, Sheets 1 and 2. The receiver is a double-conversion superheterodyne with a total of 10 poles of receiver IF filtering.

MAIN RECEIVER RF FRONT END: Bandpass filtered RF from the antenna relay K1 is applied to the low-noise RF preamplifier MMIC, U5. This is a switchable amplifier with approximately 12 dB gain in the "ON" condition and approximately 10 dB loss in the "OFF" condition. Under normal operating conditions, the amplifier is switched "ON" and provides the required sub-microvolt sensitivity required for the receiver in the "DISTANT" mode. When the operator selects the "LOCAL" operating mode, U5 is turned off, reducing the front end gain by approximately 22 dB and providing additional protection from extremely strong in-harbor signals. After passing though U5, the signal passes through the three stage, top coupled bandpass filter consisting of L19, L20, L21 and their associated capacitors. The 50 ohm output of the bandpass filter is then applied to the double balanced passive diode mixer, MIX1. The mixer is provided with +7 dBm LO high-side injection from the VCO buffer through a 6 dB resistive pad consisting of R26, R27 and R28. The desired mixer output is the 45.0 MHz first intermediate frequency (IF).

45 MHZ IF AMPLIFIERS: Q6, the first IF amplifier circuit uses a low noise JFET in the common gate configuration. This circuit provides a wideband termination for the mixer, MIX1. IF transformer T1 matches the first 45 MHz filter, FL3, to the output impedance of Q6. Transistors Q7 and Q8 form a emitter coupled differential amplifier, the second 45 MHz IF amplifier stage. The input impedance of Q7, together with inductor L3 matches FL3's output impedance and the combination of R36 and L38 matches the input impedance of the second 45 MHz filter, FL4. "L" network C70 and L23 matches FL4 to the input of the multipurpose FM receiver chip, U6.

SECOND CONVERSION: The second mixer is of the Gilbert cell type and is part of the multipurpose FM receiver chip, U6. Mixing the first IF of 45.0 MHz with the second conversion oscillator results in a second IF frequency of 455 KHz. This signal is filtered by six-pole ceramic filter FL5, and then passed on to the limiter-amplifier in U6. The second local oscillator frequency is generated by a phase locked loop which consists of the oscillator section of the multipurpose FM receiver chip U6, buffer transistor Q9, dual PLL chip U7 and the loop filter components R43, R44, C83 and C84. The frequency reference for this oscillator is the same 12.8 MHz temperature stabilized crystal used in the first

permits the audio signal from U12A to pass unrestricted to the front panel VOLUME control. The same signal from pin 15 of U6 is also used as a Scan Stop line to control the microprocessor. The squelch comparator in U6 has a built in hysteresis which minimizes squelch "chatter". Additional hysteresis is provided by the CPU which manipulates the position of the "wiper" of the squelch control.

5.4 CHANNEL 70 MONITOR RECEIVER CIRCUITS:

GENERAL: Refer to the Channel 70 Monitor Receiver Schematic Diagram. The Channel 70 monitor receiver is a single channel, dual conversion, crystal controlled FM receiver. The operating frequency is 156.525 MHz (CH 70), the first IF is 21.4 MHz and the second IF is 455 KHz.

FIRST MIXER: The first mixer, U1, is a double balanced Gilbert cell type. The Channel 70 Monitor Receiver uses a antenna separate from the main transceiver. Signals from this antenna pass through an isolation capacitor, 3 dB pad and VHF bandpass filter to the input of U1. The mixer output circuit is naturally compatible with impedance of the 21.4 MHz first IF filter.

FIRST IF FILTER: The output from the mixer stage is passed through a 4-pole monolithic IF filter to the input of the multipurpose FM receiver chip U2. U2 contains much of the remaining receiver circuitry.

FIRST LOCAL OSCILLATOR: The first local oscillator circuit consists of JFET Q1, a low-noise VCO operating at 67.5625 MHz. The oscillator frequency is controlled by a PLL which consists of one half of dual PLL chip U3. U3 uses the same 12.8 MHz master clock oscillator as the main receiver. Phase detector output from U3 passes through loop filter components R12, R13, C33 and C34 before being applied to varactors CR2 and CR3. The VCO frequency is buffered by Q2 and doubled in Q3 and the resulting 135.125 MHz LO signal is filtered by a bandpass filter consisting of L11, L12 and their associated capacitors. The receiver mixer and local oscillator circuitry operate from +8 volts and U4 provides a stabilized +5 volt line for U2, U3 and other voltage sensitive receiver circuitry.

MULTIPURPOSE RECEIVER CHIP: U2 is a Motorola MC3371 single chip FM receiver. The filtered first IF frequency of 21.4 MHz is presented to the first mixer input of U2. The second conversion oscillator is a phase locked VCO which uses the oscillator transistor in U2, together with VCO buffer Q4 and the second half of dual synthesizer chip U3. The reference counter in U3 is set to 417, resulting in a reference frequency of 30.695444 KHz, while the divide-by-N counter is set to 712. This results in a second local oscillator frequency of 21.855155 MHz. The mixer output of U2, at the second IF frequency of 455 KHz, is passed through a 6-pole crystal

+8 volt TX rail, R88, R94 (plus R95 in the one watt condition only). The difference, if any, is amplified by operational amplifier U9B and is current amplified by Q16 and Q17. Q17's collector voltage provides the collector supply for Q15 and the first stage of U8. This voltage rises if additional RF gain is needed and decreases if less RF gain is needed. Factors affecting Q17's collector voltage are selection of 1 watt or 25 watt power transmitter output level, power supply voltage and ambient temperature. The transmitter output power level is held essentially constant under a wide range of voltages and temperatures.

TX LOGIC DETECTOR: The DC level from rectifier CR12 which represents RF power output is amplified and converted to a logic level by U9A and Q18. The collector of Q18 goes low when a power level of at least 1/2 watt is detected by CR12. This logical low is fed to the microprocessor which then turns on the TX annunciator on the front panel liquid crystal display.

5.8 SQUELCH GATE, MUTE AND POWER AUDIO CIRCUITS:

Refer to RF Mainboard Schematic Diagram and the CPU/DSC Schematic Diagram. Voice audio from the multipurpose FM receiver chip, U6, is routed through amplifier/deemphasis network, U12A, to the squelch gate and front panel volume control potentiometer, Rxx. Audio from the wiper of the volume control potentiometer is then presented to the audio power amplifier chip, U14. Q8 acts as a shunt squelch gate and, when biased on, mutes the receiver audio. Normal receiver squelch operation is provided from the multipurpose FM receiver chip squelch comparator through diode CR12. Receive audio provided through C64 from the VOLUME control is amplified up to 4 watts maximum by U14. Keypad audible feedback ("Beep" audio) from the microprocessor is provided through R126/C66 to the inverting input of U14.

EXTERNAL MUTE OPERATION: A rather sophisticated external muting system is provided in the SEA 7157. This system permits the interconnection of a number of radiotelephones in such a fashion as to permit transmission on ANY radio to mute the receiver audio in ALL interconnected radios. This system is operational even when some of the radiotelephones so interconnected are powered down. Operation of the MUTE circuitry is described below:

Power MOSFET Q12 serves to disconnect the MUTE line (P3, pin 7 on the rear panel) of the radiotelephone when the power switch is OFF. This prevents an unpowered radiotelephone from loading the MUTE line and interfering with the MUTE system between other, powered up radiotelephones. When power is applied to the radio, the gate of Q12 is held high through R122 which connects to the +5V rail. Under these conditions, Q12 is essentially a short circuit, connecting the external MUTE line to the gate of Q13 ??? and through CR28 to the collector of Q19.

13VTX rail are both derived from the output of the internal 24/12 volt DC/DC converter. Internal strapping lets the ON/OFF switch control the DC/DC converter in the 24 volt mode.

Various control switches and regulators are operated from the +13VSW line. (See both DSC/CPU Board and Mainboard Schematic Diagrams). On the DSC/CPU Board, U16 operates from the 13VSW line and provides the +5 volt rail for the CPU circuitry. U14, the audio power amplifier also operates from the +13VSW rail. U15 is a 15 volt regulator which is used to provide a regulated voltage to the DC/DC converter controller chip (U18) when the radio is strapped for 24 volt operation.

On the RF Mainboard, U18 operates from the +13VSW rail and provides the primary +5 volt rail for the Mainboard. U4 provides a dedicated +5 volt line for the Channel 70 Monitor Receiver and is powered from the +8 volt rail. Q23 and Q24 are inverted PNP switches operating from the +13VSW rail and controlled by the microprocessor. When the RX line from the microprocessor is high, Q23 saturates and provides the +13VRX rail. U16 is connected between the RX and TX outputs from the microprocessor in such a way as to insure that the transmitter cannot operate UNLESS the receiver is off. The output of U16B is thus the NOT TX Interlocked line. When this line goes high, inverted PNP switch Q24 (See Sheet 2, Mainboard Schematic Diagram) saturates, energizing the 13VTX rail. This voltage source powers the transmitter buffer amplifier, Q14, and provides power for the power control feedback amplifier, U9B.

"INSTANT ON" OPTION: The radiotelephone can be simply modified so that it will turn itself "on" when primary power is applied. This is accomplished by placing jumper JU1 across the main power switch terminals. So connected, the jumper bypasses the normal front panel mounted ON/OFF switch, placing the radiotelephone in it's permanently ON condition.

5.10 THE 24/12 VOLT CONVERTER CIRCUIT:

As described above, the basic radiotelephone circuitry in the SEA 7157 is designed to operate from a 12 volt lead-acid battery source. When operation from a 24 volt source is desired, a 24/12 volt converter is required. In the SEA 7157, such a converter is provided inside the unit on the CPU/DSC Board. The converter makes use of a modern single chip controller U18, a pair of power MOSFET switch transistors Q3 and Q4 in a "totem pole" arrangement, "catcher" diodes CR16 and CR17 and ringing inductor L6. When the equipment is "strapped" for 24 volt operation, the primary power is applied to the 24/12 volt converter circuitry and the radiotelephone is operated from the resulting 13.6 volt regulated supply rail which the converter provides. The external line fuse must be changed (together with the mylar rear panel "voltage" label) when 24 volt operation is desired.

5.13 DISPLAY/DISPLAY LIGHTING:

DISPLAY: The front panel display is a LED backlighted LCD graphic module. Various display configurations are provided which permit the operator to monitor all the various radiotelephone parameters such as channel number, power level, memory mode, etc. The display is controlled by the system microprocessor through ports on latch U6. Display contrast is adjusted by trimming the voltage applied to Vo (Pin 3 on connector P7). This is accomplished through the microprocessor by using the operating system to adjust the voltage from the "wiper" of electronic potentiometer U8B, to the inverting input of contrast buffer amplifier U7.

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:

1. Prepare a clean surface in the work area. Static-free precautions are recommended. Place radiotelephone on work surface and remove the eight 6-32 machine screws which fix the top and bottom covers in place. The covers may now be removed, providing access to the interior of the radiotelephone.

   NOTE: The internal fuse may now be accessed without further disassembly. This fuse, F1 (not to be confused with the in-line main power fuse) is located immediately in front of the internal DC/DC converter on the DSC/CPU Board Assembly and is used on 24 operation ONLY. Replace with 7.5 amp autoblade type fuse (SEA PN# FUS-0013-075) ONLY. Do NOT use "slow-blow" type fuses in this radiotelephone.

   All basic adjustment points are now accessible.

CHASSIS DISASSEMBLY:

1. REMOVING THE RF MAINBOARD ASSEMBLY:

   If it is necessary to remove the RF Mainboard Assembly (ASY-7157-01) from the septum, remove the nine 4-40 screws (Including the two screws at the ends of the hybrid final amplifier assembly, U8.) Unplug the 16 pin DIP cable from J1, the 8 pin DIP cable from J2 (On the RF Mainboard) and the 16 gauge Red/Black twisted pair (P15/P16 on the CPU/DSC Board). The Mainboard Assembly can now be separated from the bottom plate as a unit, leaving the thermal link for U8 attached to the septum. (NOTE! Do NOT attempt to operate the RF Mainboard Assembly in the transmit mode with the thermal link disconnected from U8. The hybrid module will quickly overheat and be damaged if such operation is attempted.)

2. REMOVING THE CPU/DSC BOARD ASSEMBLY:

   If it is necessary to remove the CPU/DSC Board Assembly from the septum, unplug the cable assemblies which connect the CPU/DSC Board from the RF Mainboard (P8, P9, P15 and P16) and the cable assemblies which connect the CPU/DSC Board from the Front Panel Assembly (P6, P7, P11, P12, P13 and P14). Remove the nine 4-40 screws

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 load.
10. Spectrum analyzer, 1 to 1000 MHz, 1 KHz resolution.
11. Oscilloscope. (50 MHz 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 jumper wire between pins 5 and 6 of P3, the rear panel Accessory Connector must be installed if internal speaker operation is desired. (This jumper is normally installed at the factory.)

1. DISPLAY/KEYPAD AND MAIN MEMORY CHECK: When the main power is tuned 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. 3. ENT, RADIO 9. Wait one second. Cycle radio power OFF then ON. Push 16 twice and verify that the newly chosen priority channel number (13 in our example) is displayed. 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 (156.800 MHz). 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 (156.050 MHz) and 88 (157.425 MHz). During transmission the TX annunciator should be ON when either the 1 watt or 25 watt mode is selected. The DC current should not exceed 6

receiver to channel 16 (156.800 MHz). 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 amlitude 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.

Set up equipment as shown in Figure 6.1, "Transmitter Test Setup". Perform basic disassembly of the 7157 per section 6.1 if necessary.

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 terminals (Rear panel Power Connector P2, positive on pin 1, negative on pin 2) 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 bottom plate and chassis for evidence of excessive heating.

2. TRANSMITTER FREQUENCY: Push microphone push-to-talk button (PTT) to key transmitter on any desired channel. Use plastic handle alignment tool to set C162 on the Mainboard Assembly to within 200 Hz of the assigned frequency. (C162 is located approximately 1 inch from the left front corner of the VCO shield can which is located just right of center on the Mainboard). All other transmitter and receiver channel frequencies are automatically set on frequency by this adjustment. It is normal for the transmitter frequency to drift slightly downward as the radiotelephone heats up above room temperature.

3. TRANSMITTER POWER: Set the radiotelephone to channel 14 (156.700 MHz) or any other channel in that range. Select 25 watt output level. (NOTE: Avoid prolonged transmitter testing on the emergency channel (16)). Key the transmitter and adjust R94 on the Mainboard Assembly for exactly 25 watts output. (R94 is located approximately 1 inch to the left of the main receive mixer). Use a 25 watt wattmeter element for

6. SPECTRAL PURITY: Connect a 1000 MHz 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 (-16 dBm) during both modulated and unmodulated conditons. CAUTION! Spectrum analyzer overload will lead to erroneous results, especially at transmitter harmonic frequencies. to avoid overload, 60 or 70 Db 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.

7. OTHER TRANSMITTER AND SYNTHESIZER ADJUSTMENTS: The settings for C113, L39, L40 and L41 are not critical and should not require adjustment during the life of the radiotelephone. The voltage controlled oscillator (VCO) is factory aligned and has no field serviceable components. If a problem is suspected with these components or associated circuits, factory service is recommended.

6.5 RECEIVER ALIGNMENT:

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.

See Figure 6.2 for "Receiver Test Setup". A ten minute warmup period is recommended before making receiver adjustments.

1. DC VOLTAGE CHECKS: The 8 volt regulator (U19 on Mainboard) typically exhibits 8.1 volts DC at TP8V on the Mainboard Assembly. TP5V and TP1 both typically exhibit 5.0 volts.

2. SYNTHESIZER FREQUENCY: The synthesizer (LO) frequency is 45.000 MHz HIGHER than the receive channel frequency during reception. eg: Receive channel 16, 156.800 MHz, corresponds to receive LO frequency of 201,800 MHz. If the transmitter frequency was found to be correct in Section 6.3 above or was adjusted properly per Section 6.3, Step 2 above, no adjustment of C162 is necessary. The receive LO frequency can be checked at TP6 on the Mainboard. The frequency counter probe ground lead should be kept as short as possible while this measurement is being made.

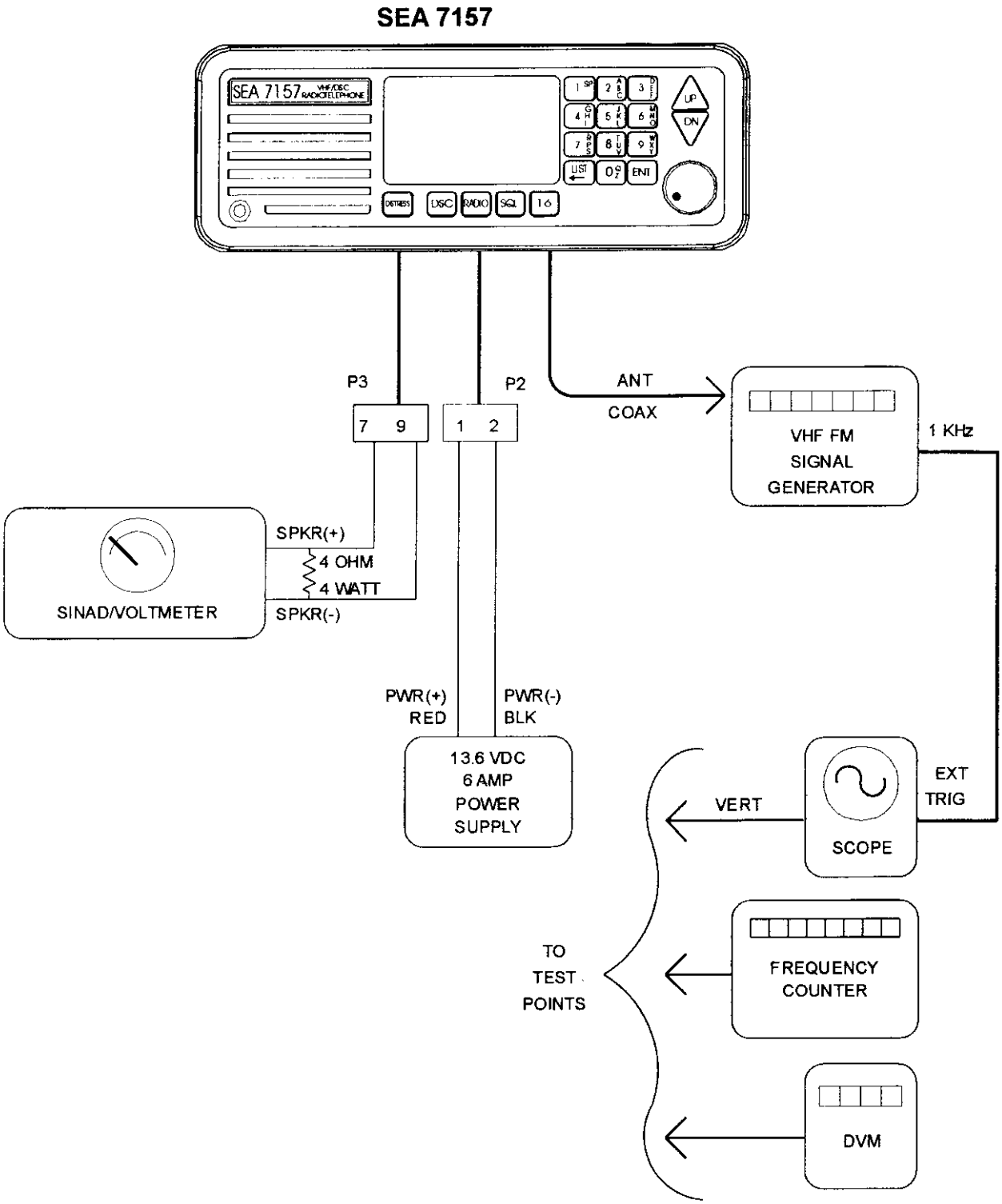
as needed. Use the "16" key to alternate between channel 16 and weather channel 4 and balance the SINAD sensitivity between the two channels. When adjustment is complete, 12 dB SINAD sensitivity should be less than 0.3 microvolts on both channels and typically will not vary more than .05 microvolts when changing channels.

6.6 ALIGNMENT OF THE CH70 MONITOR:

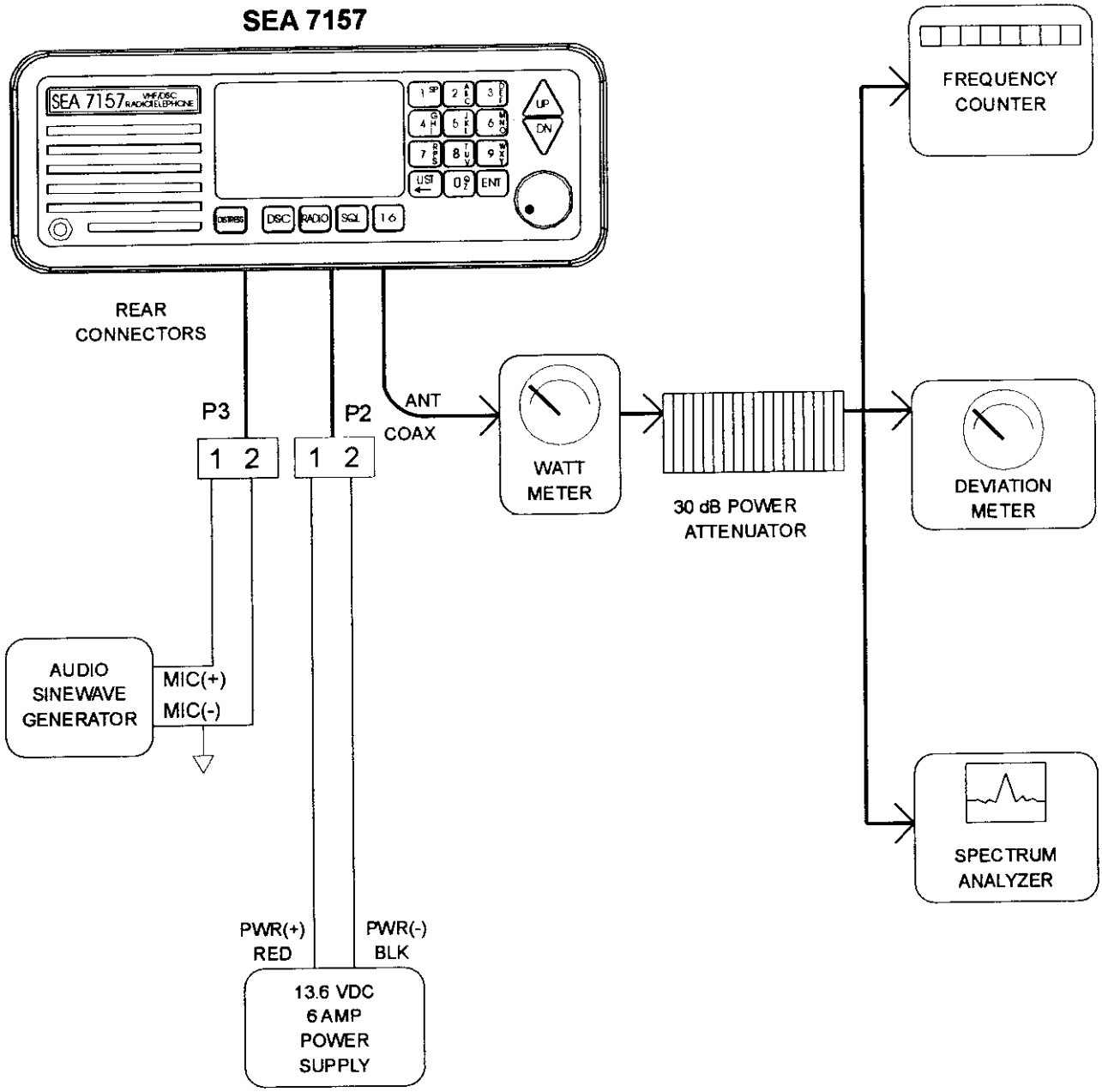
GENERAL: See the Schematic Diagram for the monitor receiver circuitry and the Mainboard Schematic Diagram, Sheet 3, for details.

1. Connect the AF voltmeter and SINAD meter to the CH70 AF pin (Pin 14, U12D). Using the signal generator, inject a channel 70 (156.525 MHz) signal, 3 KHz deviation at 1000 Hz, to the Channel 70 Monitor Receiver RF connector of the SEA 7157. Adjust the signal generator to an output level sufficient to provide 12 dB SINAD at the audio output terminals. Adjust RF coils L4, L5, L6 and quadrature coil L7 for maximum output.

   Set signal generator to an output level sufficient to provide 20 dB SINAD. Signal level should be approximately 0.75 microvolts (-110 dBm).



SEA 7157
Receiver Test Setup
Figure 6.2



SEA 7157
Transmitter Test Setup
Figure 6.1

3. 45 MHz FIRST IF ALIGNMENT: Set up the equipment as follows:

Receiver:	Channel 16 receive.
Signal Generator:	Frequency: 156.800 MHz. Modulation: 1 KHz sinusoidal, 5 KHz peak deviation. Amplitude: 5 mv (-33 dBm).
Oscilloscope:	Bandwidth: 50 MHz minimum. Vert. Sens: Approx. 50 mv/div. Ext. Trig: From 1 KHz audio mod. Horizontal: 0.5 msec/div. Probe: To TP5 with shortest possible ground lead length.

Adjust T1 and then C70, first for maximum amplitude and then for minimum ripple. Repeat until no further improvement is noted. Peak-to-peak ripple is normally not greater than 20% of the overall amplitude when using 5 (five) KHz peak frequency deviation.

4. RECEIVE CONVERSION OSCILLATOR FREQUENCY: This is measured at TP16. Note that this frequency is controlled by a PLL which, when locked, results in a second conversion oscillator frequency of 45.4548 MHz. Adjusting trimmer capacitor C85 will adjust the in-lock voltage at TP17. This voltage should normally run at about 2.5 volts.

5. QUADRATURE COIL ADJUSTMENT: Reduce the signal generator peak deviation to 3 KHz. Connect the 'scope and the SINAD meter to the speaker audio line. Set the volume to a convenient level which does not clip. Adjust L24 for maximum output amplitude.

6. MODULATION ACCEPTANCE CHECK: This test verifies that IF and quadrature coil alignment is correct. Using 3 KHz deviation, reduce the signal generator amplitude until 12 dB SINAD is indicated. Increase signal generator amplitude 6 dB (double the output voltage). Then increase the deviation until SINAD is reduced to 12 dB. the new deviation setting should be 7 KHz or greater. If it is not 7 KHz or more, repeat all steps above.

7. RF FRONT END FILTER ALIGNMENT: Avoid making unnecessary adjustments. Check the receiver SINAD sensitivity per Section 6.3, Step (Of the "Basic Receiver Tests") 1 before proceeding with these adjustments.

Start on channel 16 (156.800 MHz). Adjust L19 through L21 in the bandpass filter for maximum SINAD. Note SINAD reading. Change receiver and signal generator to check SINAD on weather channel 4 (163.275 MHz). Readjust L19, L20 and L21 slightly

maximum accuracy. Select 1 watt and temporarily adjust R95 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 R95 for 0.95 watts. (R95 is located on the Mainboard, immediately to the right of the 25 watt power adjustment potentiometer R94). 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.

4. AUDIO LOW PASS FILTER ALIGNMENT: Monitor the clock frequency of the audio filter at pin 4 of U13 (TP20) on the Mainboard with an AC coupled, high impedance frequency counter probe. The frequency should be 350 KHz (400 KHz for Europe) ± 15 KHz. Clock frequency is adjusted by R124. R124 is located approximately 2 inches left of the microprocessor chip, U15, and 1/2 inch in front of the 1 watt power adjustement potentiometer, R95.

5. TRANSMITTER PEAK FREQUENCY DEVIATION: Connect an audio sinewave generator to the external microphone terminals. (Rear panel Accessory Connector, P3, pins 2 (mic. hot) and 1 (gnd)). 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. Key the transmitter and watch the deviation meter while varying the audio generator for maximum deviation. Once the maximum is found, adjust the deviation set potentiometer (R103 on the Mainboard) for 4.8 KHz peak deviation. (R103 is located approximately 1 inch from the left front corner of the board). 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.

amperes in the 25 watt mode (13.6 volt operation), or 2.5 amperes in the 25 watt mode (24 volt operation).

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 any key while transmitting). 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 chananel 16 (156.800 MHz). Set the squelch threshold 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.

   NOTE: A 4 ohm, 4 watt resistive load can be attached to the external speaker terminals (Accessory Connector P3, pin 7 to pin 9. Remove jumper between pins 6 and 7 to silence internal speaker.)

   Rotate the front panel VOLUME knob fully clockwise. 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 (156.050 MHz) and weather channel 1 (162.550 MHz).

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 IF tuning, conversion oscillator and quadrature coil alignment. Set the signal generator and

(Including one screw under each of the shield can covers.) Unplug the DC line cable from P9 and P10. The CPU/DSC Board can now be removed from the radiotelephone.

3. The entire front panel assembly may be removed from the chassis by removing four 6-32 flat-head screws located at the front of the side panels. (NOTE! Disconnect the various cable assemblies between the front panel assembly and the CPU/DSC Board Assembly before removing the panel screws in order to avoid damage to the interconnecting wiring.)

4. To remove the front panel Graphics Display Assembly (ASY-7157-0) from the front panel, proceed as follows:

   A. Remove front panel assembly from the chassis as described in Procedure 3.

   B. Remove the four 6-32 Plastite screws which hold the Graphics Display Assembly into the front bezel.

   C. The Graphics Display Assembly can now be removed from the front bezel.

5. To remove the front panel mounted Keyboard Assembly from the front panel, proceed as follows:

   A. Remove front panel assembly from the chassis as described in Procedure 3.

   B. Remove the Graphics Display Assembly as described in Procedure 4.

   C. Remove the four 4-40 Plastite screws which hold the Keyboard Assembly into the front bezel.

   D. Remove the keyboard PC assembly by lifting it out of the bezel.

   E. With the PC board removed, the elastomer keypad mat can be readily removed from the front panel assembly.

6.2 RECOMMENDED TEST EQUIPMENT:

1. 13.6 volt, regulated DC power supply with ammeter, rated for minimum 6 amps continuous duty. (For 24 volt radiotelephones, substitute a 24 volt regulated DC power supply with ammeter, rated for minimum 4 amps continuous duty.)
2. Calibrated RF wattmeter (Bird Model 43) with 25 watt and 1 watt, 150 MHz elements and a 50 ohm 25 watt load or power attentuator.
3. Volt-ohmmeter plus RF probe. eg: Fluke 75 plus Fluke 85RF probe.

5.11 MICROCOMPUTER CIRCUITRY:

Refer to Sheet 1 of the DSC/CPU Board schematic diagram.

MICROCOMPUTER: U1 is the microprocessor CPU chip, a Motorola 68HC812A4CP. This chip, in conjunction with the FlashROM (Uxx) which contains the system firmware, controls the keypad, display, memory storage and other system functions as well as providing MODEM functions of the internal DSC CONTROLLER. Various of the CPU parallel port pins are buffered and/or level shifted to provide an RS-232 port, an NMEA0183 port, squelch control line, audible keypress beep and various housekeeping functions. The computer clock is crystal controlled at 14.7456 MHz by Y1, a frequency which provides (from an internal counter) the correct baud rate for the RS-232 communications port supported by U10. Non-volatile memory functions (Scan lists, special channel programs, etc.) are provided by U5, a serial EEPROM. No memory backup batteries are required.

RESET CIRCUIT AND BROWNOUT PROTECTION: When power is applied, CR1, a 6.8 volt zener diode is "on". The cathode of CR2 is held at supply voltage minus 6.8 volts. This forces CR2 to be normally non-conductive which allows R3 to charge C28 to +5 volts with a relatively slow time constant. In this manner, the microprocessor is held in the reset condition long enough for the +5 volt supply line to stabilize. During operation, if a power brownout occurs such that the main supply voltage drops (even momentarily) below approximately +8 volts, CR2 will conduct and discharge C28 quickly through R2. The desired result is that the microprocessor is always reset before its own +5 volt rail drops out of regulation.

5.12 KEYPAD/KEYPAD LIGHTING:

KEYPAD: Primary control of the SEA 7157G is through the 19 key keypad. This keypad is of the conductive rubber type and is backlighted with internal LEDs. Both the keyswitch stators and backlighting components are mounted on a PC board. The keypad PC board is mounted behind the sheet metal front panel with the elastomer switch layer sandwiched between the PC board and the sheet metal. The individual keys protrude through holes cut in the sheet metal and the front panel bezel. A 18 pin connector is provided on the PC board which facilitates connection to the CPU/DSC Board electronics through a short cable. Backlighting LEDs are configured in four series strings and light level is controlled by the microprocessor through two outputs of octal latch U6. The two latch outputs are resistively summed and buffered by emitter follower Q2. The output of Q2 is then applied to the input of Q5 and Q6. Q5 controls the keypad backlighting intensity and Q6 controls the LCD display backlighting intensity. Four intensity levels are provided: OFF, LOW, MEDIUM and HIGH intensity.

When a radiotelephone is in the RECEIVE mode, the gate of Q13 is held high through R124. Thus the drain of Q13 is held low and CR12 is off, permitting normal operation of the squelch gate MOSFET, Q8. Additionally, the rear panel MUTE pin is connected to the +5V line through R124 and transistor Q12.

When a radiotelephone is in the TRANSMIT mode, both the gate of Q13 and the source of Q12 are pulled low by the drain of Q14. This accomplishes two things: The drain of Q13 goes high, switching Q8 on through diode CR12 and muting the receiver audio. At the same time, the low signal on the source of Q12 is connected to the external MUTE pin on the rear panel.

A low signal on the external MUTE pin causes (in a powered up radiotelephone in the RECEIVE mode), a low on the gate of Q13 which in turn causes a high signal through CR12 to the gate of the squelch gate MOSFET, Q8. The conduction of Q8 mutes the receiver audio.

If the receiver audio is neither SQUELCHED or MUTED, the low level signal is directed to the front panel mounted VOLUME control. The volume adjusted signal from the wiper of Rxx is directed back onto the CPU/DSC PC board assembly and on to the non-inverting input of audio power amplifier U14. This is a conventional 4 watt audio power amplifier integrated circuit which boosts the audio to a level of approximately 4 watts, sufficient to drive either the internal loudspeaker or externally mounted loudspeakers. Note that the BEEP signal from the CPU is applied to the inverting input of U14 through R126 and C66. This signal (when selected by the operator) provides aural feedback when a key is pressed on the front panel keyboard.

5.9 MISCELLANEOUS DC POWER CONTROL:

Refer to the DSC/CPU Board Schematic Diagram. The circuitry in the SEA 7157 is designed to operate from a floating ground battery source. Operation from <u>either</u> a 12 volt <u>or</u> 24 volt DC power source is supported by designing the basic radiotelephone for 12 volt operation for use directly from 12 volt battery supplies or using the built-in 24/12 volt DC/DC converter when operation from a 24 volt power source is desired. Conversion from 12 to 24 volt operation is simply a matter of positioning internal jumpers and installing the correct line fuse. (See Chapter 6, Section xx for details.)

Power for most of the internal circuitry is derived from the 13 volt switched (13VSW) rail. This rail is, in the 12 volt mode, derived directly from the fused and filtered input voltage from the main power source. When in the 12 volt mode, the 13VTX rail is directly connected to the fused and filtered main power source as well, bypassing the front panel mounted ON/OFF switch. When operation from 24 volt mains is desired, the 13VSW rail and the

bandpass filter (FL3) to the internal limiter circuitry. Limiter output is then demodulated by the internal quadrature type demodulator circuit which is set on frequency by L7. The demodulated output from U2 is then deemphasized and passed on to the CH 70 audio amplifier, U12D.

AUDIO AMPLIFIER: Demodulated audio from U2 is passed through U12D where it is amplified, deemphasized and passed on to the circuitry on the CPU/DSC PC Board Assembly.

5.5 TRANSMIT AMPLIFIERS:

GENERAL: Refer to Sheet 2 of the Mainboard Schematic Diagram. The transmit amplifier chain consists of two discrete RF amplifiers plus a hybrid RF power amplifier module which contains two more gain stages. Overall gain is typically 40 or more dB.

PRE-DRIVERS: The approximately +10 dBm signal from the synthesizer is first amplified by Q14. The output of Q14 is narrowband matched to the low impedance input of Q15 by L35 and C113. The output of Q15 (up to 0.6 watts) is matched into the nominal 50 ohm input impedance of U8. DC power for Q14 is controlled by DC switch Q24.

FINAL AMPLIFIERS: U8 is a hybrid amplifier containing two gain stages providing approximately 20 dB overall gain (25 watt mode) and 25 watts or 1 watt output as required. DC power for the final stage is obtained directly from the fused 13 volt power source.

5.6 ANTENNA INTERFACE CIRCUITS:

TRANSMIT/RECEIVE SWITCHING: Antenna changeover between transmit and receive is accomplished by high speed relay K1. One advantage of a physical relay in this application is the reduced level of high order harmonics of the transmitter signal which can be generated by P.I.N. diode antenna switching systems.

TRANSMIT/RECEIVE FILTERING: A VHF bandpass filter which consists of a 7-section low-pass filter combined with a 3-section high-pass filter. The resulting bandpass filter has good subharmonic rejection which helps eliminate 2nd order problems in the receiver and excellent VHF and UHF harmonic rejection for transmitter harmonics and receiver images.

5.7 AUTOMATIC RF POWER CONTROL (APC) AND TX LOGIC:

APC: In transmit mode a servo loop stabilizes Rf output power. The loop is formed by sampling the RF voltage at the PA output, comparing to a preset reference level and indirectly adjusting the gain of two of the RF amplifier stages. C141 samples the RF output which is then rectified to a DC level by CR12. The rectified DC level is then compared with the reference DC level provided by the

conversion oscillator, Y1. The divide-by-N divider in U6 is set to 1076, while the reference counter is set to 303. This results in an oscillator frequency of 45.454785 MHz. (12.8 MHz/303 = 42.2442 KHz X 1076 = 45.454785 MHz)

QUADRATURE DETECTOR: The output of the limiter-amplifier of U6 is internally fed to the quadrature detector whose phase shift circuit is provided by quadrature coil L24. The raw baseband detected audio emerges from U6 on pin 9 (approximately 0.7 volts peak-to-peak for a 1 KHz tone, 3 KHz deviation) and is fed to the deemphasis/volume control and squelch circuits.

DEEMPHASIS/VOLUME CONTROL CIRCUIT: The raw audio from U6 pin 9 is fed to operational amplifier U12A which has deemphasis network R127 and C213 in the feedback path. The output of U12A is then fed to the front panel mounted VOLUME control potentiometer. The wiper of the VOLUME control potentiometer is then connected to the input of the audio power amplifier U19, through the squelch gate circuitry.

SQUELCH CIRCUITS: Raw detector audio from U6 pin 9 is fed to an operational amplifier internal to the chip which functions as a high frequency bandpass noise filter. Bandpass filtered noise at a level of several volts peak-to-peak is provided from this noise filter to the detector diode CR5, under no signal conditions. A threshold bias voltage is also applied to the cathode of CR5 from the squelch level controller IC, U8A. U8 is a dual electronic potentiometer located on the CPU/DSC PC Assembly. The setting of U8A and thus the CR5 reference voltage is varied by the operating system. The DC output from CR5 depends on both the bias voltage from U8A and the noise from the noise filter. The negative going voltage at the anode of CR5 and the +5 volt rail voltage are summed together through R45 (+5 volts) and R46 (DC signal from CR5). This summed voltage is applied to the input of the squelch trigger comparator on pin 12 of U6. When no signal is being received, the noise level from the filter is high and, if the CR5 bias voltage is nominal, the negative voltage at the anode of CR5 pulls the voltage at pin 12 of U6 toward ground from the +5 volts provided through R45. When the summed voltage drops below the trigger threshold of the squelch comparator, gate pins 14 and 15 are open and the Scan Stop/Squelch signal at pin 15 is <u>high</u>. The Scan Stop/Squelch signal is sent through the parallel/serial interface chip (U14) to the CPU on the DSC/CPU Board. When the operating system senses that the Scan Stop/Squelch signal is high, the CPU "SQL" pin is pulled high. This high causes squelch gate transistor Q8 on the CPU/DSC board to conduct, grounding the audio input to the volume control. When a signal is received, the receiver quiets, output from the noise amplifier drops, reducing the DC output from the noise rectifier, CR5. The resulting higher positive voltage at Pin 12 of U6 causes the squelch trigger between pins 14 and 15 to be closed which in turn causes the Scan Stop/Squelch signal to be <u>low</u>. This low signal tells the CPU to pull the "SQL" pin low which opens squelch gate transistor Q8 on the CPU/DSC board, which in turn

MASTER REFERENCE OSCILLATOR: The active portion of the master crystal oscillator is provided by a CMOS gate in U10. The oscillator crystal, Y1, is stabilized at 12.800 MHz by C153 and the positive-temperature-coefficient (PTC) thermistor RT1. The PTC draws significant current only at temperatures below freezing. C162 is the transmitter frequency netting adjustment.

LOOP FILTER: R98-R101 and C149-C151 comprise the loop filter. Processed transmitter audio is also injected at R98 during transmit only.

5.2 MODULATION CIRCUIT:

MICROPHONE AMPLIFIER: Operational amplifier U12B amplifies the transmitter microphone audio input to about 1 volt peak-to-peak at typical voice levels and provides low impedance audio to the next circuit. Microphone signal level into the voice clipper/filter circuit passes through potentiometer R108. R108 in parallel with R110 sets the input impedance of the microphone audio circuitry to about 600 ohms.

DSC LINE INPUT (DATA): The digital modulation signal from the CPU/DSC PC board assembly is passed through a separate level potentiometer, R109. From R109, the signal passes through coupling capacitor C174 and summing resistor R121 to the modulation buffer amplifier, U12C.

AUDIO PREEMPHASIS: C171, C172, CR14, R115 and R116 form a combination preemphsis and two-sided clamper/clipper network. The frequency response is +6 dB per octave over the voice frequency range of 300-3000 Hertz.

AUDIO LIMITING/CLIPPING: Operational amplifier U12C amplifies audio processed by the previous network. At low input levels it is linear. As the input level rises it begins to symmetrically clip the wave due to the output amplitude attaining voltage peaks equal to the power supply rails. As the microphone input audio level increases even further the diodes in CR2 "clip" the inner portions of the incoming wave. The net effect at the output of the limiting amplifier, U12C, is that the duty ratio of the clipped wave first approaches a square wave shape and then the duty ratio decreases as microphone input level continues to rise. This method maximizes average voice energy within the set deviation limit while minimizing audio harmonic distortion levels.

AUDIO LOWPASS FILTER: U13 is a five-pole switched capacitor audio lowpass filter which attenuates audio components above approximately 3000 Hertz. Its self-contained clock operates at 350 KHz (400 KHz in Europe) as adjusted by R124. The maximum output amplitude of the low pass filter is about 7 volts peak-to-peak.

EXTERNAL CARBON MICROPHONE(S):
The SEA 7157 supports the use of carbon microphones. Connect the carbon microphone in the same manner as the dynamic microphone (as explained above). The internal microphone selector jumper is located on the CPU/DSC PC board (ASY-7157-02). Move the jumper between pins 1 and 2 (dynamic) to pins 2 and 3 (carbon). Multiple carbon microphones (used one at a time) are feasible if each microphone PTT switch incorporates an internal element cutout switch. The SEA 7157 carbon microphone level potentiometer, VR1 "carbon mic level", on the CPU/DSC PC board assembly is adjusted at the factory for proper operation with typical carbon "F1" buttons.

4.8 EXTERNAL SPEAKER MUTE WIRING:

Pin 7, (MUTE), on the Accessory Connector, P3, provides access to the unique "mute" function of the SEA 7157. The mute circuitry senses a low impedance condition on the mute line (with respect to negative supply rail) in the receive mode and presents a low impedance condition on the mute line in the transmit mode. Two or more SEA 7157's can be wired for cross-muting if they all share a common negative supply rail. To accomplish the cross-muting interconnection, simply connect the MUTE pins (pin 7) of the radiotelephone Accessory Connector, P3, together. In order to insure that the negative supply rails are also common, connect the GND pins (pin 8) together as well. Interconnected in this fashion, any TRANSMITTING SEA 7157 will mute the receiver audio output on all interconnected SEA 7157's. Note that an external momentary switch can also be wired between pins 7 (MUTE) and 8 (GND) of an individual SEA 7157 to permit momentary muting from another source.

4.9 GMDSS INSTALLATIONS:

The SEA 7157 VHF DSC Radiotelephone system complies with the requirements of CFR 47, Part 80, Subpart W -- Global Maritime Distress and Safety System (GMDSS), Paragraph 80.1101 Performance Standards and is suitable for use in shipboard GMDSS installations.

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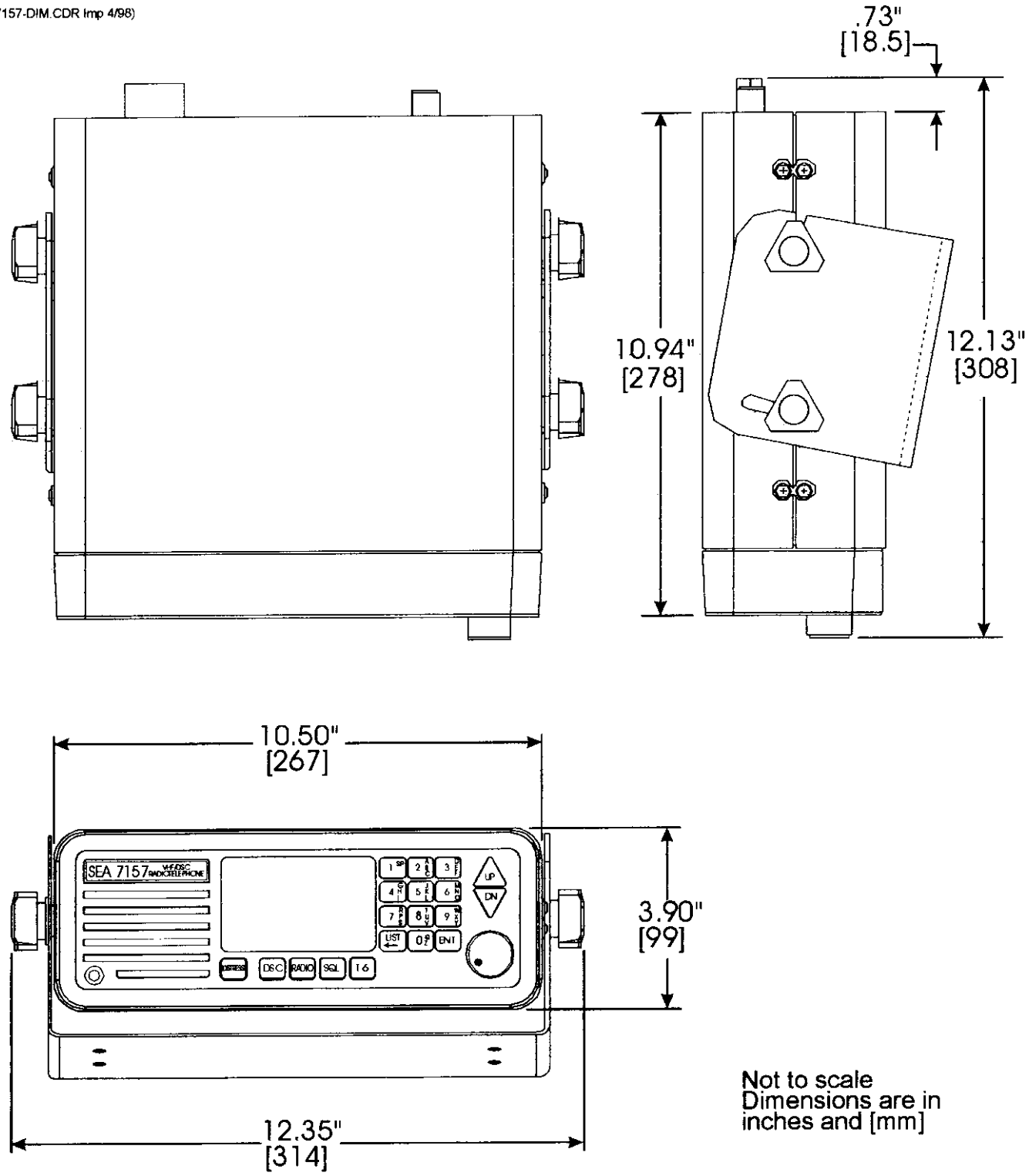


Not to scale
Dimensions are in
inches and [mm]

SEA 7157
Outline Dimensions
Figure 4.1

3.20 MASTER LIST OF EXPANSION (SPECIAL) CHANNELS

Channel Number	Transmit Freq, MHz	Receive Freq,MHz Simplex	Receive Freq,MHz Duplex	Channel Number	Transmit Freq,MHz	Receive Freq,MHz Simplex	Receive Freq,MHz Duplex
00	156.000	156.000	160.600	40	158.000	158.000	162.600
01	156.050	156.050	160.650	41	158.050	158.050	162.650
02	156.100	156.100	160.700	42	158.100	158.100	162.700
03	156.150	156.150	160.750	43	158.150	158.150	162.750
04	156.200	156.200	160.800	44	158.200	158.200	162.800
05	156.250	156.250	160.850	45	158.250	158.250	162.850
06	156.300	156.300	160.900	46	158.300	158.300	162.900
07	156.350	156.350	160.950	47	158.350	158.350	162.950
08	156.400	156.400	161.000	48	158.400	158.400	163.000
09	156.450	156.450	161.050	49	158.450	158.450	163.050
10	156.500	156.500	161.100	50	158.500	158.500	163.100
11	156.550	156.550	161.150	51	158.550	158.550	163.150
12	156.600	156.600	161.200	52	158.600	158.600	163.200
13	156.650	156.650	161.250	53	158.650	158.650	163.250
14	156.700	156.700	161.300	54	158.700	158.700	163.300
15	156.750	156.750	161.350	55	158.750	158.750	163.350
16	156.800	156.800	161.400	56	158.800	158.800	163.400
17	156.850	156.850	161.450	57	158.850	158.850	163.450
18	156.900	156.900	161.500	58	158.900	158.900	163.500
19	156.950	156.950	161.550	59	158.950	158.950	163.550
20	157.000	157.000	161.600	60	156.025	156.025	160.625
21	157.050	157.050	161.650	61	156.075	156.075	160.675
22	157.100	157.100	161.700	62	156.125	156.125	160.725
23	157.150	157.150	161.750	63	156.175	156.175	160.775
24	157.200	157.200	161.800	64	156.225	156.225	160.825
25	157.250	157.250	161.850	65	156.275	156.275	160.875
26	157.300	157.300	161.900	66	156.325	156.325	160.925
27	157.350	157.350	161.950	67	156.375	156.375	160.975
28	157.400	157.400	162.000	68	156.425	156.425	161.025
29	157.450	157.450	162.050	69	156.475	156.475	161.075
30	157.500	157.500	162.100	70	156.525	156.525	161.125
31	157.550	157.550	162.150	71	156.575	156.575	161.175
32	157.600	157.600	162.200	72	156.625	156.625	161.225
33	157.650	157.650	162.250	73	156.675	156.675	161.275
34	157.700	157.700	162.300	74	156.725	156.725	161.325
35	157.750	157.750	162.350	75	GUARD	156.775	161.375
36	157.800	157.800	162.400	76	GUARD	156.825	161.425
37	157.850	157.850	162.450	77	156.875	156.875	161.475
38	157.900	157.900	162.500	78	156.925	156.925	161.525
39	157.950	157.950	162.550	79	156.975	156.975	161.575

C. TO DESIGNATE A SPECIAL CHANNEL AS THE PRIORITY CHANNEL:

Select the special channel list using the LIST key. Then push RADIO 9.

EXAMPLE: If special channel 30 is programmed (enabled) and it is desired to make it the priority channel, first push LIST to access the special channel list. Select Channel 30 by pressing 3, 0, ENT. Finally, push RADIO 9 to set channel 30 as the priority channel.

B. ADDING A SPECIAL CHANNEL:

The following steps should be performed in numerical order to enable each special channel desired. To avoid unpredictable results, do not push keys other than those described below during the programming process. If you suspect a problem, simply repeat part A above. The unit will not be damaged if you make a programming mistake.

1. CHANNEL SELECTION: Use the UP and DN keys or numeric entry keys to select the desired special channel number. Initially, new channels are set to simplex, receive only. As an example, if you first select channel 100, the display shows 100A. The receiver will operate on 158.025 MHz.

NOTE: If the channel was previously enabled, the SPL annunciator will also be on. See paragraph C below for removing or changing the operating parameters of a special channel.

2. TRANSMIT/RECEIVE ONLY SELECTION: If the special channel is to be enabled for transmission, push the microphone PTT switch once. (Note that the unit will not transmit while being programmed.) The TX indicator will turn on to indicate that the special channel will be capable of transmission. Additional pushes of the PTT switch will toggle the channel between transmit enabled or receive only capability.

3. TRANSMIT POWER LEVEL: (This step should be skipped if transmission is not to be allowed on the special channel.) Normally, the unit will transmit at 25 or 1 watt power level. If you desire only the 1 watt level, push RADIO 4 keys and the 1W indicator will come on. Repeating RADIO 4 will toggle the 1W selection on and off.

4. SIMPLEX/DUPLEX SELECTION: The default setting is simplex with identical transmit and receive frequencies. The "A" following the channel number on the display is lit to show simplex operation. If duplex operation is desired, push the "16" key once. The "A" following the channel number will extinguish to indicate that the special channel will duplex. For example, special channel 100 (duplex) will receive on 162.625 MHz and transmit on 158.025 MHz assuming that transmission was enabled. If transmission was not enabled, channel 100 (duplex) will receive on 162.625 MHz but will not transmit. Each time the "16" key is pushed, the simplex/duplex selection is toggled.

5. LOCKING IN A SPECIAL CHANNEL: After completing steps 1 through 4 above, push RADIO 7 to lock in the special channel. The SPL annunciator will come on indicating that the special channel is locked in. If the SPL annunciator does NOT come on, you already have ten special channels and must remove one special channel before adding a new one. See paragraph C below for removing or modifying a special channel.

3.10 REVIEWING THE CALL LOGS

Press the DSC key and press 1 to review the call logs. Press 1 to review distress calls. Press 2 to review other calls. The last 40 calls in each category are stored. It is possible to respond to nondistress calls. It is possible to relay a distress call.

3.11 SETTING THE TIME

Press the DSC key and then press 2 to get the DSC program menu. Press 4 for time and enter the time and date as prompted.

3.12 INPUTTING POSITION DATA

Press the DSC key and then press 2 to get the DSC program menu. Press 3 for position and enter the current position and time of fix as prompted. NOTE: If the latest position data is more than 4 hours old an alarm tone will sound and any key entry other than DISTRESS or 16 will cause this menu to be displayed automatically.

3.13 PROGRAMMING THE NAVIGATION INTERFACE

Press the DSC key and then press 2 to get the DSC program menu. Press 5 and then indicate whether an NMEA compatible navigation receiver is installed.

3.14 PROGRAMMING THE DSC ID (MMSI)

Press the DSC key and then press 2 to get the DSC program menu. Press 6 and then enter the individual DSC ID (MMSI) and group ID as prompted. NOTE!! It is not possible to transmit a DSC call until this is done and an error message will be displayed at powerup. The DSC ID can only be programmed twice without a special access code not generally available to end users.

3.15 PROGRAMMING OPTIONS

Press the DSC key and the press 2 to get the DSC program menu. Press 7 to get a menu which allows you to program the alarm timeout for routine calls (default 5 minutes), disabling of alarms for incoming polling and ship's position calls (defaults to disabled), and default DSC channel (default Channel 70).

3.16 PROGRAMMING DSC DIRECTORY

Press the DSC key and then press 2 to get the DSC program menu. Press 1 to get to the directory of DSC ID's. Use the UP and DN keys to scroll through the pages labeled A-F and use the numeric keys (1-8) to select an entry to reprogram. You will be prompted for the name and number. When entering names use the UP and DN keys to cycle through the letters shown on each alphanumeric key. Press ENT when finished. The LIST key is used as a backspace in these entries.

3.5.2.1 ROUTINE INDIVIDUAL DSC CALL

A routine individual call is used to address another station, either ship or coast. Typically such calls are made on Channel 70 and indicate an alternate working channel. If most calls are transmitted on a calling channel other than 70 the default channel can be changed. To transmit a routine individual DSC call, press 3 from the primary DSC menu. Select a receiving station as described in Section 3.6. Select a working channel and transmit the call as described in Section 3.8.

3.5.2.2 ROUTINE INDIVIDUAL DSC CALL WITH ALTERNATE CALLING CHANNEL

This is similar to Section 3.5.2.1 except that the call need not be transmitted on the default calling channel (Channel 70). To transmit such a DSC call press 4 from the primary DSC menu. In response to the prompt select a calling channel using the UP and DN arrow keys and/or the numeric keys. Select a receiving station as described in Section 3.6. Select a working channel as described in Section 3.8.

3.5.2.3 DISTRESS RELAY CALLS

Normally, DSC distress calls are handled by coast stations. In some cases, however, a coast station may not receive a DSC call, a ship in distress may not be equipped with DSC or the ship in distress may be unable to make a call. If this is the case, a distress relay call can be used to report another vessel in distress. To transmit a distress relay call press 5 from the primary DSC menu. Press 1 to transmit to all ships and 2 to transmit an individual call (normally a nearby coast station). If an individual call is desired, select a receiving station as described in Section 3.6. Transmit the call as described in Section 3.8. It is also possible to initiate a distress relay while reviewing the distress call log. This method is preferable if the call was received via DSC as the DSC ID and position will be transferred automatically.

3.5.2.4 ALL SHIPS CALLS

To call all ships within radio range use an all ships call. Most frequently this is used by coast stations to initiate navigational warnings, weather reports and similar matters of interest to all mariners. To transmit an all ships DSC call, press 6 from the primary DSC menu. Select a priority category at the prompt. Select a receiving station as described in Section 3.5. Select a working channel and transmit the call as described in Section 3.8.

3.5.2.5 AUTOMATIC TELEPHONE CALLS

DSC can be used to set up a telephone call through an appropriately equipped cost station. To initiate a phone call, press 7 from the primary DSC menu.

3.4.15 SCAN LIST REVIEW

To enter the scan list review mode press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 4 to toggle the mode. The mode will be displayed for 2 seconds and then the display will return to the normal radio mode. When in scan list review mode the UP and DN keys can be used to scan through the scan list. Exit scan list review mode by pressing ENT or entering a channel.

3.4.16 PRIORITY/DUAL SCAN MODE PROGRAMMING

To program the priority and dual scan mode mode (guard vs. normal) press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 3 to toggle the mode. The mode will be displayed for 2 seconds and then the display will return to the normal radio mode. In guard mode priority scan and dual watch will receive on the priority channel whenever it is active. In normal mode the receiver stops on the first active channel until it becomes inactive.

3.4.17 SCAN HANG TIME PROGRAMMING

To modify the scan hang time (time the receiver stays on channel after it becomes inactive) press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 6 to program the hang time. The SQL annunciator and the currently programmed hang time will be displayed. Use the UP and DN keys to adjust the hang time. To exit, press the ENT key or enter a channel. (Or wait for time out in approximately 2 seconds) The display will return to the normal radio mode.

3.4.18 ADJUSTING THE BACKLIGHTING LEVEL

To adjust the backlighting press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 5 and hold down to cycle through the brightness levels. When the 5 key is released the display returns to the normal radio mode. If the backlighting is extinguished the first keypress will be used to restore backlighting. This first keypress will be otherwise ignored.

3.4.19 KEY BEEP CONTROL

To toggle the key beep on or off press the RADIO key. This will cause the RADIO menu to appear. Press 1 to go to the secondary radio menu. Press 7 to toggle the beep control setting. The setting status will be displayed for 2 seconds and then the display will return to the normal radio mode. In the "beep on" mode, an audible tone will be heard whenever a key is pressed.

3.4.2 ON-OFF/VOLUME CONTROL

To INCREASE the loudspeaker volume level, rotate the control CLOCKWISE. To DECREASE the loudspeaker volume level, rotate the control COUNTERCLOCKWISE. Rotating the control fully COUNTERCLOCKWISE will turn the main power OFF.

3.4.3 SQUELCH CONTROL

To adjust the squelch threshold level, press the SQL key. The SQUELCH annunciator will flash. While the SQUELCH annunciator is flashing the UP and DN keys will adjust the SQUELCH threshold level. The SQUELCH threshold level is indicated on the display.

3.4.4 CHANNEL LIST SELECTION

To cycle through the channel lists (US, International, Weather, Canada and [when enabled] Special) press the LIST key until the desired annunciator (US, INT, WX, SPL, CAN) shows on the display.

3.4.5 EMERGENCY CHANNEL SELECTION

To cause the radiotelephone to immediately switch to the International Emergency Channel (16) press the 16 key. NOTE: If the radiotelephone is already displaying 16, the 16 key will select the PRIORITY channel.

3.4.6 TRANSMITTER POWER CONTROL

To toggle the output power between the 1 and 25 watt power levels press the RADIO key. This will cause the RADIO menu to appear. Press 4 to toggle the power level. Note that the 1W annunciator is displayed when the low power level is selected. Also note that the menu will show 4 = 1W when the radio is in the 25 watt power mode and the menu will show 4 = 25W when the radio is in the 1 watt power mode.

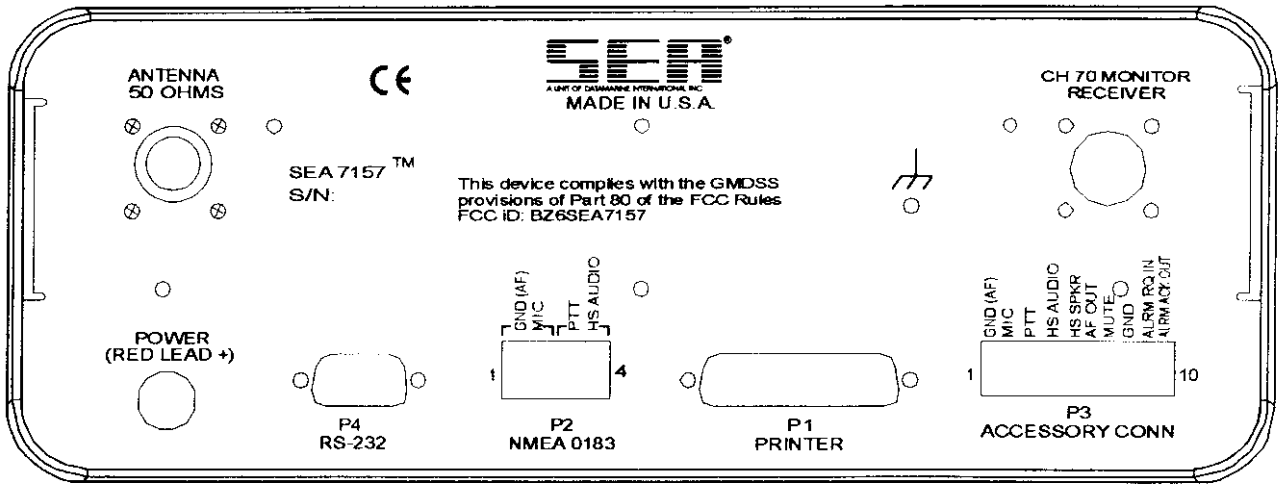
3.4.7 DUAL WATCH

To turn on dual watch press the RADIO key. This will cause the RADIO menu to appear. Press 2 to start the Dual Watch scan. The DW annunciator will appear. The display returns to the normal radio mode. To stop the dual watch scan, press ENT or enter a channel number.

3.4.8 SEARCH

To activate search mode press the RADIO key. This will cause the RADIO menu to appear. Press 3 to start search scan. The SCH annunciator will appear. The display returns to the normal radio mode. Press the UP key to skip an active channel. Hold UP for one second to lock out a channel. To stop the search scan press ENT or enter a channel number.

(D:\7157-rear.CDR Imp 7/13/98)



Not to scale

SEA 7157
Rear View
Figure 2.2

2.6 SEA 7157 VHF DIGITAL SELECTIVE CALLING CONTROLLER

The VHF Digital Selective Calling Controller incorporated into the SEA 7157 VHF Radiotelephone has been designed to comply with all FCC regulations given in 47 CFR 80.1101(b), 47 CFR 80.1101(c)(2) as well as 47 CFR 80.225. This encompasses compliance with the following documents which are included for reference:

80.1101(b)(1)	IMO Resolution A.694(17)
80.1101(b)(2)	ITU-T Recommendation E.161
80.1101(b)(3)	ITU-T Recommendation Q.11
80.1101(b)(4)	IEC Publication 92-101
80.1101(b)(5)	IEC Publication 533
80.1101(b)(6)	IEC Publication 945
80.1101(c)(2)(i)	IMO Resolution A.609(15)
80.1101(c)(2)(ii)	ITU-R Recommendation 493-4
80.225(a)	ITU-R Recommendation 493 Class A

HUM AND NOISE:	50 dB (EIA)
FREQUENCY DEVIATION:	5 KHz max. peak
CARRIER FREQUENCY STABILITY:	±5 ppm, -30 to +60 C (FCC, EIA)
TRANSMITTER ATTACK TIME:	≤ 100 milliseconds (EIA)

2.3 RECEIVER

FREQUENCY RANGE:	Simplex 155-159 MHz Semi-duplex 159.6-163.6 MHz
INTERMEDIATE FREQUENCIES:	45 MHz, 10.9 MHz, 455 KHz
SENSITIVITY:	≤ 0.3 uv for 12 dB SINAD
AUDIO FREQUENCY RESPONSE:	Within +1,-3 dB of 6 dB per octave deemphasis from 300-3000 Hz (EIA)
AUDIO OUTPUT:	4 W at less than 10% distortion into external 4 ohm load. 2 W internal
HUM AND NOISE:	Unsquelched -45 dB (EIA) Squelched -55 dB (EIA)
ADJACENT CHANNEL SELECTIVITY:	-80 dB @ 25 KHz -85 dB @ ≥ 50 KHz (EIA)
INTERMODULATION REJECTION:	-80 dB (EIA)
SPURIOUS EMISSION, RADIATION:	Complies with FCC, and EIA
SQUELCH SENSITIVITY:	Threshold: .2 uv max. (EIA) Tight: max 10 dB above reference sensitivity (EIA)
RECEIVER ATTACK TIME:	Less than 100 msec (EIA)
RECEIVER CLOSING TIME:	100 msec typical 250 msec max
SCAN RATE:	Max 10 channels/second
MODULATION ACCEPTANCE:	6 KHz minimum (EIA) 7 KHz typical

IMPORTANT

NOTICE TO INSTALLERS

NOTE: The safe compass distance for this equipment (As defined in Paragraph 29 of IEC Publication 92-101, Third Edition):

SEA 7157G VHF FM TRANSCEIVER/DSC CONTROLLER = 2.0 meters
