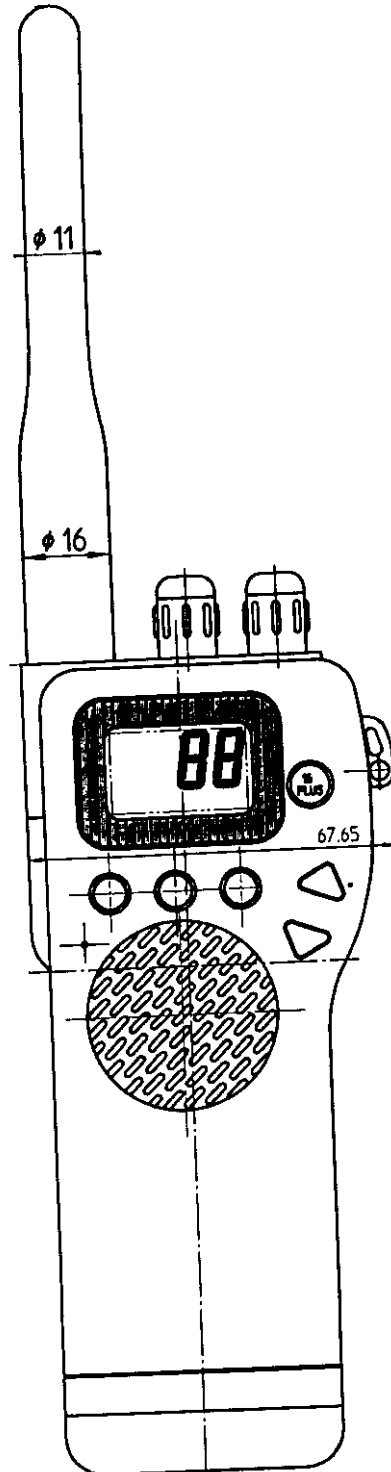


ALIGNMENT & CIRCUIT DESCRIPTION
SEE SECTION 4

Raytheon Electronics

VHF502

VHF HANDHELD RADIO
OPERATION MANUAL



PURPOSE

This manual contains very important information on the installation, operation, and maintenance of your new equipment. To get the best results in operation and performance, please take the time to read this manual thoroughly.

*****IMPORTANT NOTICE*****

This device is only an aid to navigation. Its performance can be affected by many factors including equipment failure or defect, environmental conditions, and improper handling or use. It is the user's responsibility to exercise common prudence and navigational judgment, and this device should not be relied upon as a substitute for such prudence and judgment.

Raytheon products are supported by a network of authorized Service Representatives. For product information you may contact the following regional centers:

UNITED STATES..... Raytheon Marine Electronics **
676 Island Pond Road
Manchester, NH 03109
Telephone: (603) 647-7530

**** AUTHORIZED FACTORY SERVICE and
REPLACEMENT PARTS DISTRIBUTION CENTER**

EUROPE..... Raytheon Marine Europe
Anchorage Park
Portsmouth, Hampshire
PO3 5TD
England
Telephone: 44- (01) 705-69-3611

NOTE:

This device complies with Part 15 of the FCC Rules. Operation is subject to the conditions that this device does not cause harmful interference.

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GLOSSARY OF TERMS

VHF.....	Very High Frequency (30 MHz to 300 MHz)
FM.....	Frequency Modulation.
MODULATION.....	To vary a carrier wave.
CARRIER WAVE.....	A radio frequency on which intelligence is superimposed.
DUAL WATCH.....	Monitors channel 16 while working on another channel.
USA CHANNELS.....	Channel designations as defined by the FCC.
INTERNATIONAL CHANNELS.....	Channel designations as defined by the International Telecommunication Union.
CANADIAN CHANNELS.....	Channel designations as defined by the Canadian Govt.
WEATHER CHANNELS.....	Channels for routine and emergency weather information broadcast by NOAA.
SIMPLEX.....	Transmit and receive on the same frequency.
DUPLEX.....	Transmit and receive on different frequencies.
SQUELCH.....	To suppress totally.
LCD.....	Liquid Crystal Display.
TX.....	Transmit.
RX.....	Receive.
RF.....	Radio Frequency.
CPU.....	Control Processor Unit.
PLL.....	Phase Locked Loop (A type of Frequency Synthesizer).
VCO.....	Voltage Controlled Oscillator.
PTT.....	Microphone Push-To-Talk switch.

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

Congratulations on your purchase of Raytheon VHF502 handheld marine radiotelephone. The VHF502 is a CPU-controlled, digitally synthesized, compact handheld transceiver, that provides reliable simplex and duplex (two-frequency) communications between ships at sea and from ships at sea to public or private shore stations. The VHF502 provides two-way communications on all U.S., International, and Canadian channel Marine band frequencies, plus reception on 10 separate weather channels.

This manual describes the physical and functional characteristics of the radiotelephone.

1.2 EQUIPMENT FEATURES

The VHF502 is designed and manufactured to provide ease of operation with excellent reliability. Some important built-in features of this radio are listed below:

- Totally submersible industrial design.
- All solid-state circuitry for low current drain (longer battery life) and maximum reliability.
- High-performance receiver section with optimum selectivity.
- Access to all available U.S., International, and Canadian VHF Marine band channels.
- Exclusive circuit that automatically selects 16 PLUS (priority) channel when the radio is turned on.
- Exclusive weather alert feature (when in Monitor Mode).
- Memory channels can be programmed for Memory Scan and Memory operations.
- Selected channel number is always shown on the digital LCD display.
- Aluminum die cast housing to prevent interference of offending RF.
- "Quick" 16 PLUS, for instant selection of the emergency calling channel CH16, or an alternate priority channel.
- Easy direct mode access to 10 weather channels WX 0 through WX 9.

SECTION 2

INSTALLATION

2.1 UNPACKING AND INSPECTION

Use care when unpacking the your new VHF502 from the shipping carton to prevent damage to the contents. It is also good practice to save the carton and the interior packing material. The original packing material should be used in the unlikely event it becomes necessary to return the unit for service.

2.2 EQUIPMENT SUPPLIED

The following is a list of the standard equipment included with your VHF502.

Description	Part No.
VHF502 Radiotelephone	
Instruction Manual	
Wall Charger 110VAC	
NiCad Battery Pack	
Battery Charger Bracket	
AA Battery Holder	
Rubber Helical Antenna	
Leatherette Carrying Case	
Belt Clip w/Screws	
Wrist Strap	G624700-9
NiCad Battery Safety Message	G263695-1

Table 2-1 Equipment Supplied

2.2.1 Optional Accessories

Description	Part No.
Universal Drop-In Charger (12VDC, 110VAC, 220 VAC)	
12V Cigarette Lighter Adapter	M99-134
High Gain Antenna	M56809
Leather Holster/Carrying Case	M56810
Soft Carrying Case	M56811

Table 2-2 Optional Accessories

These optional accessories may be ordered by calling our Customer Service Department directly at (603) 647-7530 ext.2333 Monday through Friday 8:30 am-5:00 pm E.S.T.

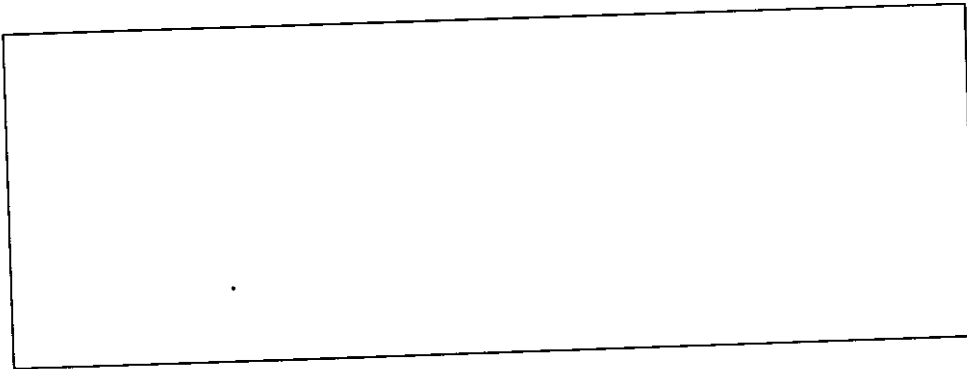
2.3 ASSEMBLY

2.3.1 AA Battery Holder

Your radio was shipped from the factory with the AA battery holder attached. Removal of this battery holder is as follows:

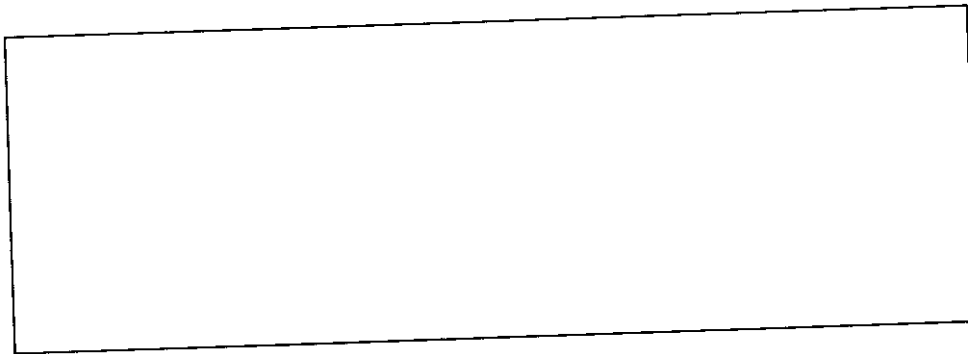
- 1) Using a coin or screwdriver, turn the screw at the base of the AA battery holder counterclockwise. This will allow you to remove the holder from the radio.

AA Battery Holder Removal



- 2) There are no batteries installed in the AA battery holder from the factory. To install batteries, carefully follow the battery insertion diagram found on the door of the battery holder.

Installation of AA Batteries



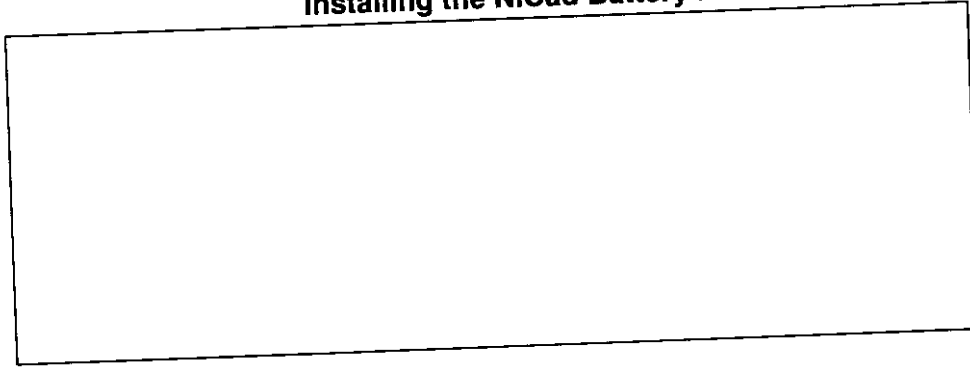
AA BATTERY HOLDER USAGE

- Always carefully note the correct installation of batteries into the battery holder.
- Only use Alkaline or NiCad AA batteries in the AA battery holder.
- You may wish to use the AA battery holder as a "backup" battery pack, for use should your NiCad pack become discharged at an inconvenient time.
- If rechargeable alkalines or NiCads are used, they must be removed from the AA battery holder to be recharged. The AA battery holder cannot be used with the desktop/wall charger included with your radio.
- Always note the safety, handling, and storage instructions that is included with AA batteries you may purchase. Especially when storing batteries inside the AA battery holder for extended periods of time, or emergency use.

2.3.2 NiCad Battery Pack

Although some voltage may be measured on the NiCad battery pack initially, it must be fully charged before normal use. Remove the battery pack from the poly bag, and attach it to the radio housing. Using a coin or screwdriver, turn the screw at the base of the NiCad battery pack clockwise to secure the battery to the radio housing.

Installing the NiCad Battery Pack

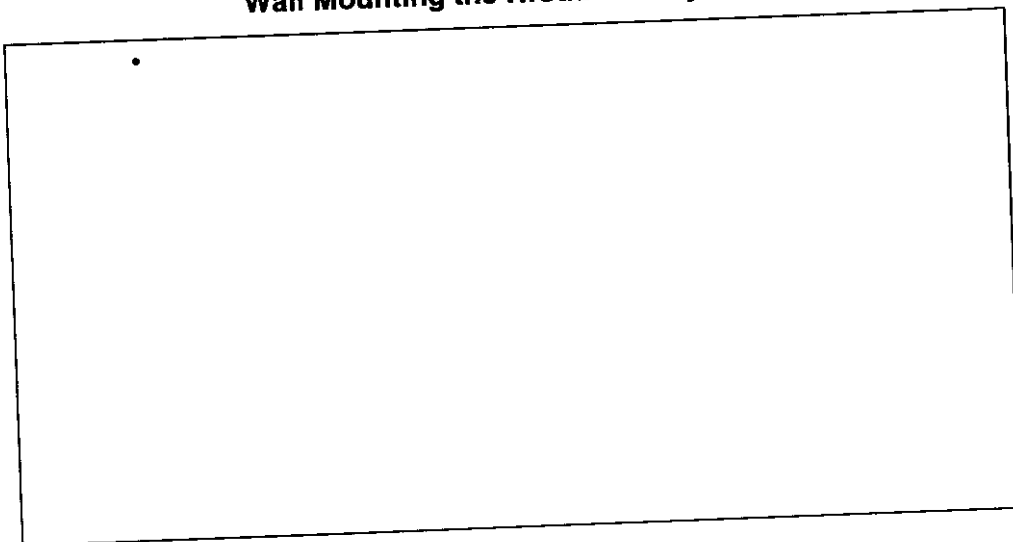


2.3.3 NiCad Battery Charger

The NiCad battery charger can be used as a desktop charger, or can be wall mounted in a convenient location. To attach the battery charger to a wall or other vertical surface:

- 1) Remove the two screws from the base of the charger.
- 2) Remove the wall mounting plate, and attach it to the wall using the screws provided.
- 3) Reassemble the charger by sliding the charger body down into the wall mounting plate.
- 4) Replace the two screws in to the base of the wall mounted charger.

Wall Mounting the NiCad Battery Charger

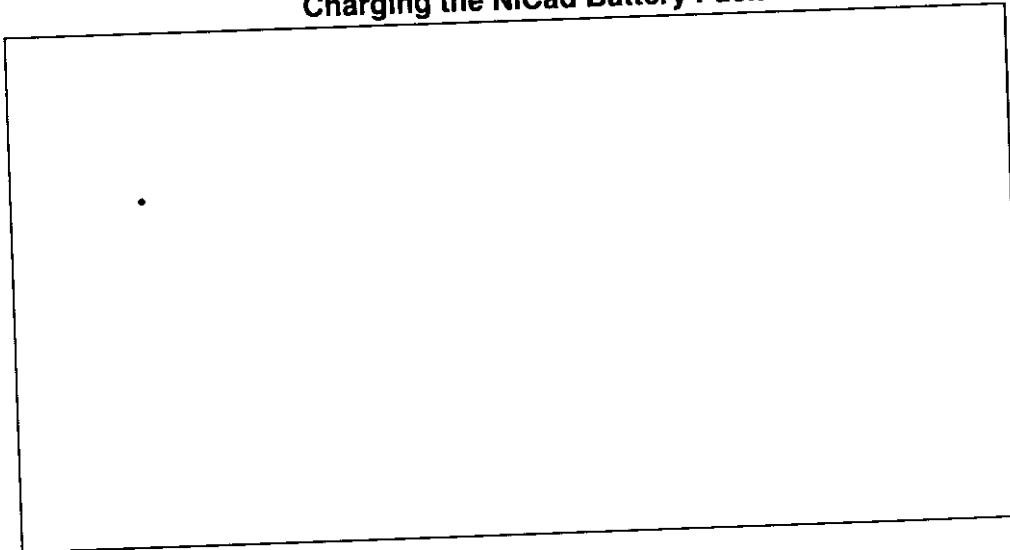


2.3.4 Charging the NiCad Battery Pack

Although some voltage may be measured on the NiCad battery pack initially, it must be fully charged before normal use.

- 1) Insert the radio with the battery pack attached into the battery charger.
- 2) Connect the AC wall adapter into a standard 110VAC wall outlet, and insert the molded plug into the connector on the side of the NiCad battery charger. The "CHARGE" indicator on the front of the charger will illuminate when the it is receiving voltage from the AC adapter.
- 3) A typical time to recharge the battery pack can be up to 15 hours. Normal operating time will be an average of 6 to 8 hours on a fully charged battery. To conserve battery life, use the low (1W) power setting when using the radio for primarily short range communications.

Charging the NiCad Battery Pack



2.3.5 Getting the most out of your Nicad Battery Pack

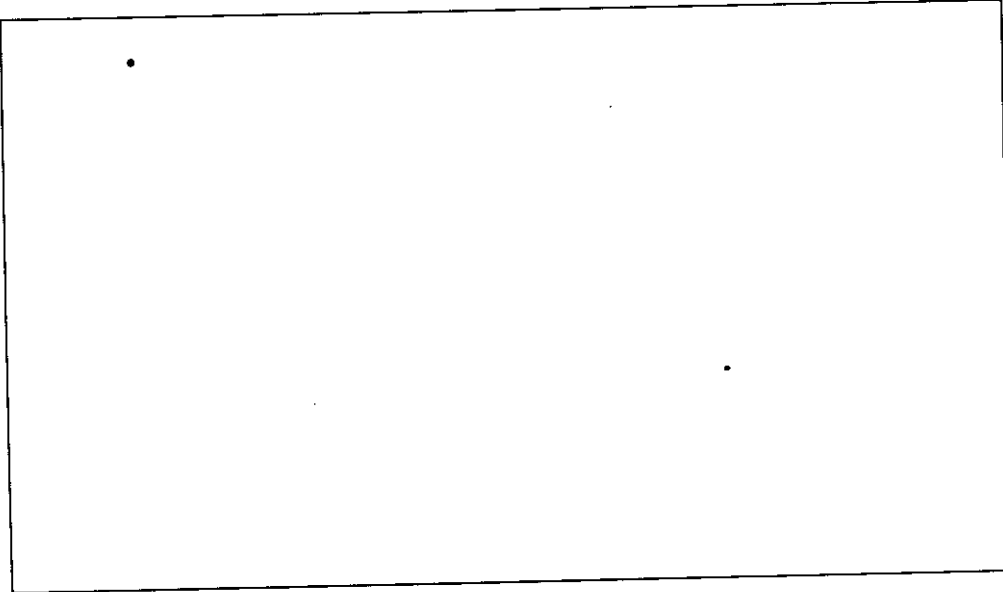
To extend the life of your NiCad Battery Pack and maintain its best performance during the use of your radio, follow the guidelines listed below.

- To recharge the radio's battery pack safely, always use only the AC adapter that comes with your radio or an equivalent replacement.
- The radio should always be turned OFF while recharging the battery pack.
- Avoid short charging cycles. In general, the battery should only be recharged when fully discharged. The optional Universal Drop-in Charger (M56791C) features a discharge key and a rapid recharge for fully automatic discharge/recharge battery cycles.
- Avoid high ambient temperatures (over 110° F) while recharging the battery pack.
- When the battery pack becomes warm to the touch, it is fully charged and should be removed from the charger.
- If the radio is to be stored for an extended period of time, remove the battery pack to avoid possible damage and/or resultant battery failure.
- When it is determined that the battery is no longer useful, it should be disposed of properly.

2.3.6 Attaching the Antenna

Securely fasten the rubber helical antenna to the TNC type connector on the top of the radio.

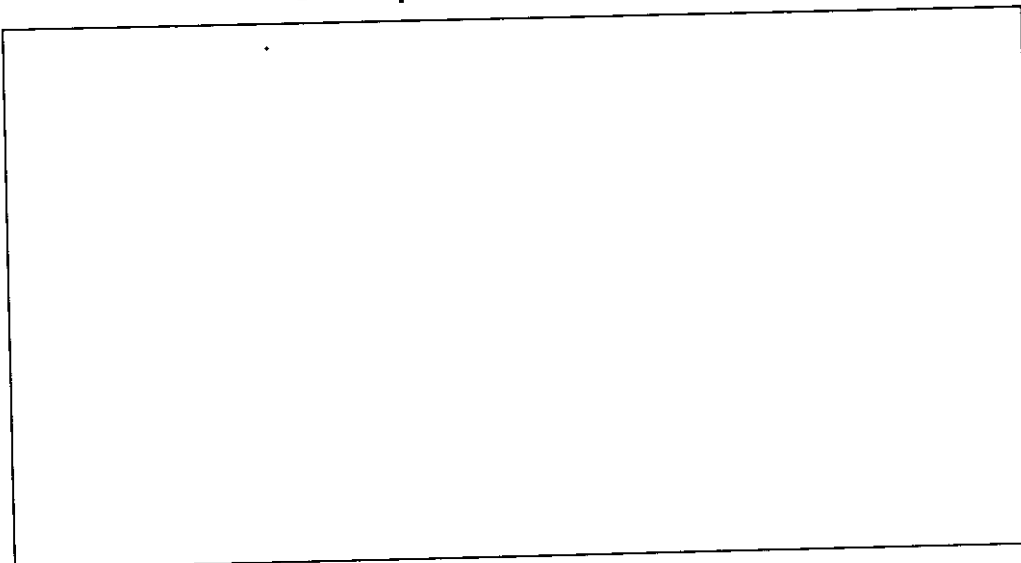
Attaching the Antenna



2.3.7 Attaching the Belt Clip and Wrist Strap

- 1) Put the radio into the supplied leatherette carrying case if desired.
- 2) Remove the belt clip and hardware from the packing materials. Using the two screws provided attach the belt clip to the rear housing of the radio.
- 3) Attach the wrist strap by looping it through the mounting hole.

Belt Clip and Wrist Strap Installation



2.3.8 VHF502 Dimensions

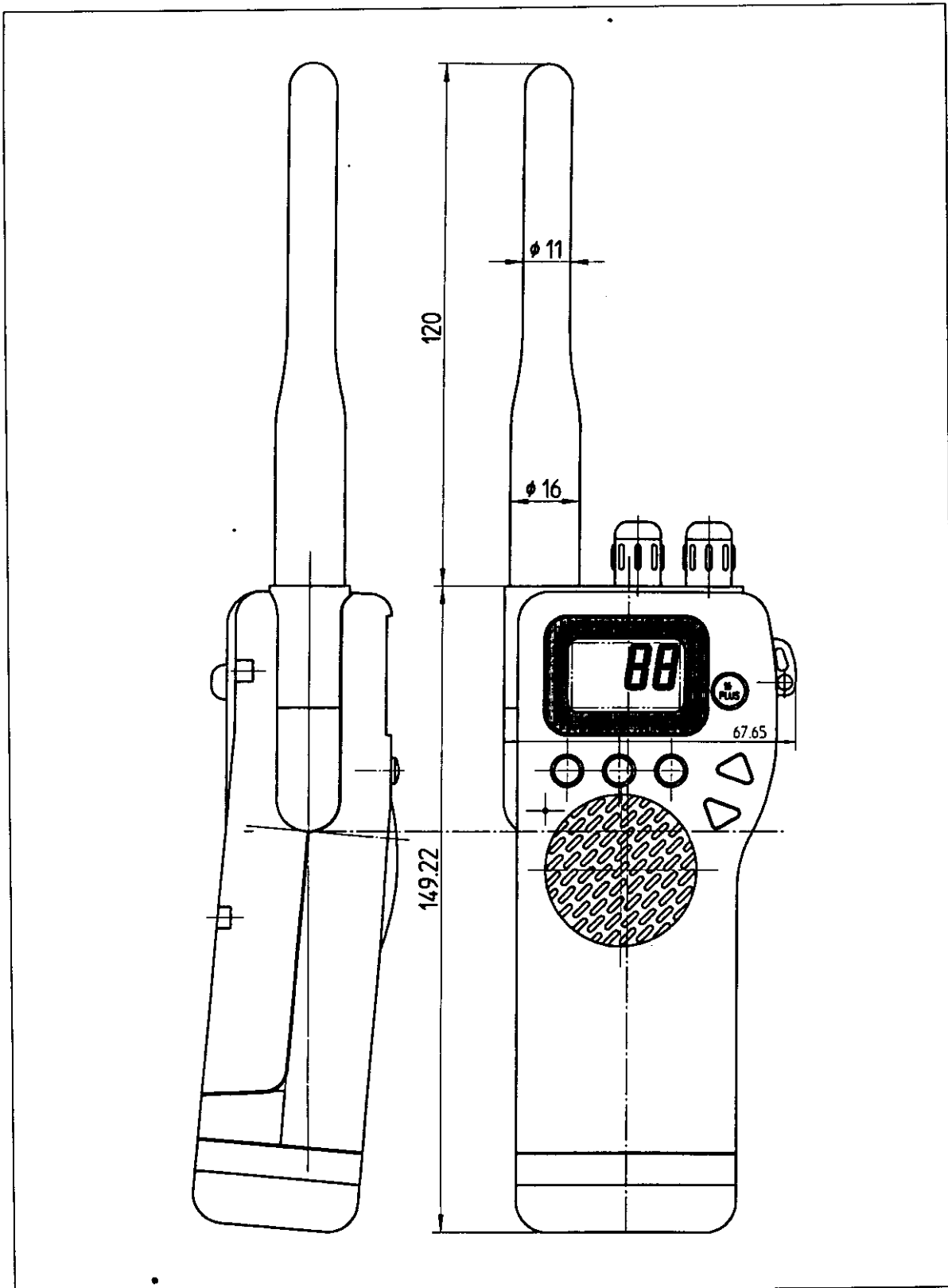


Fig. 2-1 OUTLINE DIMENSIONS

SECTION 3

OPERATIONS

3.1 INTRODUCTION

Your VHF502 has the capability to transmit on all legally available Marine VHF radiotelephone channels. There are channels that are FCC approved but may only be used by authorized stations for specific purposes, depending on the type of vessel (commercial or non-commercial). Carefully review section 3.3.8 which lists all of the marine VHF channels available in your VHF502 for U.S., International, and Canadian radiotelephone use. Full familiarization with this table is essential when selecting your channels. The U.S. channels are those channels authorized for use in the U.S. by the FCC. The international frequencies were agreed upon by the attending countries at the 1968 International Telecommunication Union meeting in Geneva and are in active use around the world.

3.2 CONTROLS AND LCD DISPLAY

Refer to Figure 3-1 for familiarization with the controls and display modes.

3.2.1 Controls

- 1) **VOLUME Control (On/Off)**
Turns the radio On and controls the Volume of the audio output from the speaker.
- 2) **SQUELCH Control**
Allows the user to "quiet" the receiver when no signals are being received.
- 3) **PTT (Push-To-Talk) Switch**
When pressed puts the radio into the transmit mode, and "TX" is displayed on the LCD.
- 4) **SCAN / MEM Key**
 - When pressed, puts the radio into the All scan or Memory scan mode. In this mode, the radio scans through the channels, stopping when radio traffic is detected, then resumes scanning after the traffic ceases. If the scanning has stopped on a particular channel, and you wish to continue, press the SCAN key again to continue scanning.
 - This key is used to program channels into memory, or to clear channels from memory. The radio will beep to confirm when channels are being stored into memory.
- 5) **WX / INT Key**
 - When pressed, selects the Weather mode. "WX" is displayed on the LCD along with a weather channel number (0 - 9). Use the \wedge / ∇ channel keys to select your local NOAA weather channel. In the WX mode, the transmitter is disabled.
 - Press and hold for 1 second, to change from U.S. mode to INT (international) or CA (Canada) mode. The U.S. mode is the default operating mode.

IMPORTANT NOTE

The INT and ÇA modes are not legal for use while operating in US waters.

6) MON / TX Key

- When pressed, selects the Monitor (Dual Watch) mode and **"MON"** appears on the LCD. In this mode, the radio will monitor the currently selected working channel and the priority channel (16plus).
- While in the Monitor (Dual Watch) mode, press the MEM key to activate the Tri-Watch mode. In the Tri-Watch mode, the last used weather channel is also monitored for severe weather alert broadcasts.
- When pressed, and held for 1 second, a beep will be heard and the transmit output power setting alternately changes between 5 and 1 Watt.

7) 16PLUS Key

This key is used to instantly select the priority channel (16plus). CH16 is the default priority channel from the factory. However an alternate channel can be programmed as the priority channel if desired.

8) ^/▼ Channel Keys

The up and down arrow keys are used to change the currently selected channel. The channel number is increased or decreased once with each keypress or if held, will continue scrolling through the channels until released.

3.2.2 LCD Display

A number of indicators appear on the LCD display in different locations. The following list describes each indicator and when it will appear.

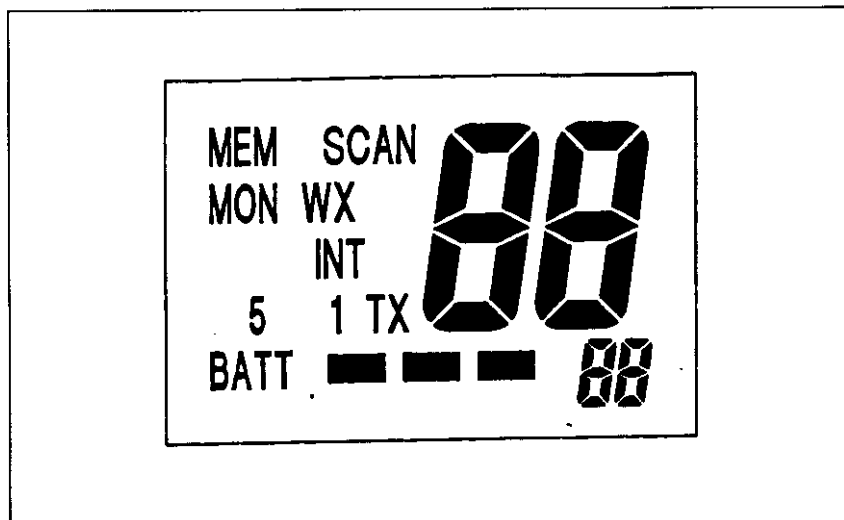


Fig. 3-2 LCD DISPLAY

- ① **MEM** (Memory) : will be displayed when the current channel is a memory channel, and in Memory Scan mode.
- ② **SCAN** (All Scan/Memory Scan) : will be displayed when the radio is in the All Scan or Memory Scan mode.
- ③ **MON** (Monitor) : will be displayed when the radio is in the Monitor mode.
- ④ **WX** (Weather) : will be displayed when a weather channel is selected. The “WX” indicator will blink when a severe weather alert tone is received (in Monitor mode).
- ⑤ **INT** (International) : will be displayed when International channels are programmed for use.
- ⑥ **5 / 1** : will be displayed to indicate the current TX power setting.
- ⑦ **TX** (Transmit) : will be displayed on the LCD when the Push-To-Talk (PTT) switch on the radio is engaged and the transmitter circuits are providing RF signals to the antenna.
- ⑧ **BATT** : is always shown on the display along with the battery voltage bar indicators to provide a battery level status. The “BATT” indicator will blink when the battery voltage is low, and the battery needs charging. If a low battery condition is detected during transmission, “LO” will be shown and the radio will stop transmitting. The battery level is shown on the LCD as follows:

Battery condition	LCD Indicator
Fully charged	BATT — — —
Normal operation	BATT — —
Needs charging	BATT —

- ⑨ **LARGE CHANNEL #** : displays the channel number currently in use.
- ⑩ **SMALL CHANNEL #** : displays the channel number of the priority channel in Monitor mode.

Other indicators shown in the Small Channel segment area:

- L** : indicates Key Lock mode.
- C** : indicates Canada mode.
- P** : indicates Priority mode.

3.3 OPERATING PROCEDURES

Specific operating procedures for the 502 are presented in this section. General information regarding correct marine channel usage may be found in the Appendix section. Refer to the Control section 3.2.1 beginning on page 9 for a thorough description of all 502 functions.

3.3.1 Turning the Power On

- 1) Rotate the ON/OFF/Volume control clockwise to turn the radio on. Continue rotating the knob clockwise and set it at approximately the midpoint of it's range.
- 2) Rotate the SQUELCH control fully counterclockwise. (Background noise will be heard.)
- 3) Set the VOLUME control to the desired listening level.
- 4) Rotate the SQUELCH control slowly clockwise until the background noise in the speaker ceases.
- 5) When the power is initially turned on, the priority channel (16plus) will be selected. Press the $\blacktriangle/\blacktriangledown$ channel keys to select the desired working channel. Refer to section 3.3.8 on

pages __ - __ for the available VHF Marine channels and their frequencies.

To Select A Weather Channel

- 1) Press the WX key, then the ▲/▼ channel keys to select your local NOAA weather channel (0 to 9). When the WX mode is selected, the transmitter is inhibited.

To Transmit

- 1) To select or change the transmitter output power, press and hold the TX key for 1 second. There are three output power settings; 5 Watts, and 1 Watt. The appropriate power setting depends on the distance the message is to be transmitted, transmitting conditions, and desired battery life.
- 2) Press the Push-To Talk (PTT) switch and speak into the microphone using a clear normal voice.

NOTES:

- Initial communication contacts are usually made over channel 16 as all ships and shore stations monitor this channel, then a shift to a working channel will be necessary.
- In certain US harbors and on certain channels, the FCC requires the power to be limited to 1 watt. On these "required" channels, the radio automatically selects the 1 watt power output setting when the channel is selected.
- The VHF502 is designed to meet the new FCC Rules Part 80.203, which states, if the Push-To Talk (PTT) switch is pressed for over five minutes continuously, the transmitter will disengage. If this occurs, audible beeps will sound continuously until the PTT switch is released. Upon release of the PTT switch, normal radio operation will resume.

3.3.2 The 16PLUS (priority) Channel

The 16plus priority channel has been preset to CH16 prior to shipment from the factory. However, an alternate working channel can be selected as the priority channel if desired, using the procedure below.

- 1) Press the ▲/▼ channel keys to select the desired channel.
- 2) Press and hold the 16plus key for three seconds. An audible beep tone will confirm that the selected channel is stored in memory as the new priority channel.
- 3) To reprogram CH16 as the 16plus channel, repeat steps 1 and 2 for CH16. WX channels cannot be programmed as the priority channel.

3.3.3 Memory Key Functions

The MEM key is used to program channels into memory for Memory Scan and Memory functions, and for the Memory Recall function.

- **To program a channel into memory**, select the channel to be stored using the ▲/▼ channel keys. Press and hold the MEM key for about 1 seconds. The **MEM** indicator will

appear on the display, and a beep tone will confirm that the channel has been stored to memory. There is no limit to how many channels can be stored to memory.

- **To clear a channel from memory**, select the channel to be cleared using the $\blacktriangle/\blacktriangledown$ channel keys. Press and hold the MEM key for about 1 second. The **MEM** indicator will no longer be shown on the display and a beep tone will confirm that the channel has been erased from memory.
- **To review the memorized channels** (Memory Recall), press the MEM key twice. The channels that have been stored into memory will be displayed in sequence on the LCD for review.

3.3.4 Memory Reset

To clear all channels from memory, and reset the 16plus key to its factory default channel (CH16), hold the MEM key down while turning the radio ON.

3.3.5 All Scan and Memory Scan Modes

1) All Scan

Press the SCAN/MEM key, to activate the All Scan mode. The **SCAN** indicator will appear on the display and the VHF502 will sequentially scan all of the channels in the selected frequency mode (U.S., INT, or Canada).

- If a signal is received, the scanning will stop until the station clears. After 5 seconds, scanning will resume. If the scanning has stopped on a received signal, press the SCAN key again to continue. To cancel the SCAN mode, press the SCAN key.
- If the scanning has stopped on a channel with traffic, and you wish to communicate with the other party, press the PTT switch to cancel the SCAN mode and remain on that channel.

2) Memory Scan

- To scan only the channels that have been stored to memory, press the MEM key and then press the SCAN key while "**MEM**" is blinking (within 2 seconds).

3.3.6 Monitor Mode

The monitor mode consists of the Dual Watch and Tri-Watch functions.

1) Dual Watch Mode

To start the Dual Watch mode, select the desired working channel and press the MON key. The **MON** indicator will appear on the display, and the working channel and the 16plus (priority) channel will be monitored. In the Dual Watch mode, the current channel being monitored will be shown in the large LCD channel segments, and the channel in standby mode will be shown in the small LCD channel segments.

2) Tri-Watch mode

To start the Tri-Watch mode, you must first be in the Dual Watch mode, then press the

MEM key. In addition to the two channels already being monitored, the last used **WX** channel will also be monitored for severe weather alert broadcasts.

- If a weather alert broadcast is detected, the VHF502 will emit an alarm and the **WX** indicator will begin to blink. The Tri-Watch mode will then be canceled and the radio will switch to the **WX** channel to monitor the severe weather broadcast.

3.3.7 VHF502 Marine Channels and Their Usage

- **Caution :** Operation on channels not designated for use by your classification of craft, or in International or Canadian frequency mode while operating in US territorial waters is a violation of FCC Rules and Regulations and may result in severe penalties.

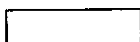
USA Mode Frequency Table for the VHF502 VHF Radiotelephone

USA Mode			Function		
CH	Freq. (MHz)		Type of Traffic	Ship to	Ship To
	TX	RX		Ship	Shore
01	156.050	156.050	VTS, Port Operations	✓	
03 ₄	156.150	156.150	Port Operations	✓	
05	156.250	156.250	Port Operations	✓	
06	156.300	156.300	Intership Safety	✓	
07	156.350	156.350	Commercial	✓	
08	156.400	156.400	Commercial	✓	
09	156.450	156.450	Calling	✓	
10	156.500	156.500	Commercial	✓	
11	156.550	156.550	Commercial	✓	
12	156.600	156.600	Port Operations	✓	
13 ₂	156.650	156.650	Navigation, Bridge to Bridge	✓	
14	156.700	156.700	Port Operations	✓	
15 ₁	-	156.750	Environmental	-	-
16	156.800	156.800	Emergency, Calling	✓	
17 ₃	156.850	156.850	State Controlled	✓	
18	156.900	156.900	Commercial	✓	
19	156.950	156.950	Commercial	✓	
20	157.000	157.000	Port Operations	✓	
21 ₄	157.050	157.050	Coast Guard	✓	
22 ₄	157.100	157.100	Coast Guard	✓	
23 ₄	157.150	157.150	Coast Guard	✓	
24	157.200	161.800	Marine Operator		✓
25	157.250	161.850	Marine Operator		✓
26	157.300	161.900	Marine Operator		✓
27	157.350	161.950	Marine Operator		✓
28	157.400	162.000	Marine Operator		✓
61 ₄	156.075	156.075	Canadian Coast Guard	✓	
63	156.175	156.175	Canadian Coast Guard	✓	
64 ₄	156.225	156.225	Canadian Coast Guard	✓	
65	156.275	156.275	Port Operations	✓	
66	156.325	156.325	Port Operations	✓	
67 ₂	156.375	156.375	Commercial	✓	
68	156.425	156.425	Boat Operations, Recreational	✓	
69	156.475	156.475	Boat Operations, Recreational	✓	
70 ₅	-	156.525	Digital Selective Calling	-	-
71	156.575	156.575	Boat Operations, Recreational	✓	
72	156.625	156.625	Boat Operations, Recreational	✓	
73	156.675	156.675	Port Operations	✓	
74	156.725	156.725	Port Operations	✓	
75 ₁	-	156.775	CH16 Guard Band	-	-
76 ₁	-	156.825	CH16 Guard Band	-	-
77 ₃	156.875	156.875	Port Operations	✓	
78	156.925	156.925	Boat Operations, Recreational	✓	
79	156.975	156.975	Commercial	✓	
80	157.025	157.025	Commercial	✓	
81	157.075	157.075	Coast Guard	✓	
82	157.125	157.125	Coast Guard	✓	
83	157.175	157.175	Coast Guard	✓	
84	157.225	161.825	Marine Operator		✓
85	157.275	161.875	Marine Operator		✓
86	157.325	161.925	Marine Operator		✓
87	157.375	161.975	Marine Operator		✓
88	157.425	157.425	Commercial	✓	

Notes:

- 1 : Transmitter is automatically disabled on channels 15, 75, and 76 in USA mode.
- 2 : 1 Watt initially. User can override to high power setting via front panel controls.
- 3 : 1 Watt only.
- 4 : Not for use by general public. Requires special authorization from the U.S. Coast Guard, or under private land mobile license.
- 5 : Channel 70 is now used for Digital Selective Calling only, therefore transmission is disabled on channel 70 in this radio.

****IMPORTANT NOTICE****

 *SHADING

Channels 3, 21, 23, 61, 64, 81, 82, and 83, (shaded) are not for use by the general public in U.S. waters. These frequencies may be used only under authorization by the U.S. Coast Guard, or under private land mobile license.

International Mode Frequency Table for the VHF502 VHF Radiotelephone

INT (International) Mode				Function	
CH	Freq. (MHz)		Type of Traffic	Ship to	Ship To
	TX	RX		Ship	Shore
01	156.050	160.650	VTS, Port Operations		✓
02	156.100	160.700	Port Operations		✓
03	156.150	160.750	Port Operations		✓
04	156.200	160.800	Port Operations		✓
05	156.250	160.850	Port Operations		✓
06	156.300	156.300	Inter-ship Safety	✓	
07	156.350	160.950	Commercial		✓
08	156.400	156.400	Commercial	✓	
09	156.450	156.450	Calling	✓	
10	156.500	156.500	Commercial	✓	
11	156.550	156.550	Commercial	✓	
12	156.600	156.600	Port Operations	✓	
13 ₂	156.650	156.650	Navigation, Bridge to Bridge	✓	
14	156.700	156.700	Port Operations	✓	
15 ₁	-	156.750	Environmental	-	-
16	156.800	156.800	Emergency, Calling	✓	
17 ₃	156.850	156.850	State Controlled	✓	
18	156.900	161.500	Commercial		✓
19	156.950	161.550	Commercial		✓
20	157.000	161.600	Port Operations		✓
21	157.050	161.650	Coast Guard		✓
22	157.100	161.700	Coast Guard		✓
23	157.150	161.750	Coast Guard		✓
24	157.200	161.800	Marine Operator		✓
25	157.250	161.850	Marine Operator		✓
26	157.300	161.900	Marine Operator		✓
27	157.350	161.950	Marine Operator		✓
28	157.400	162.000	Marine Operator		✓
60	156.025	160.625	Canadian Coast Guard		✓
61	156.075	160.675	Canadian Coast Guard		✓
62	156.125	160.725	Canadian Coast Guard		✓
63	156.175	160.775	Canadian Coast Guard		✓
64	156.225	160.825	Port Operations		✓
65	156.275	160.875	Port Operations		✓
66	156.325	160.925	Port Operations		✓
67 ₂	156.375	156.375	Commercial	✓	
68	156.425	156.425	Boat Operations, Recreational	✓	
69	156.475	156.475	Boat Operations, Recreational	✓	
70 ₄	-	156.525	Digital Selective Calling Only	-	-
71 ₁	156.575	156.575	Boat Operations, Recreational	✓	
72	156.625	156.625	Boat Operations, Recreational	✓	
73	156.675	156.675	Port Operations	✓	
74	156.725	156.725	Port Operations	✓	
75 ₁	-	156.775	CH16 Guard Band	-	-
76 ₁	-	156.825	CH16 Guard Band	-	-
77 ₃	156.875	156.875	Port Operations	✓	
78	156.925	161.525	Boat Operations, Recreational		✓
79	156.975	161.575	Commercial		✓
80	157.025	161.625	Commercial		✓
81	157.075	161.675	Coast Guard		✓
82	157.125	161.725	Coast Guard		✓
83	157.175	161.775	Coast Guard		✓
84	157.225	161.825	Marine Operator		✓
85	157.275	161.875	Marine Operator		✓
86	157.325	161.925	Marine Operator		✓
87	157.375	161.975	Marine Operator		✓
88	157.425	162.025	Commercial		✓

Notes:

1 : Transmitter is automatically disabled on channels 15, 75, and 76 in INT mode.

2 : 1 Watt initially. User can override to high power setting via front panel controls.

3 : 1 Watt only.

4 : Channel 70 is now used for Digital Selective Calling only, therefore transmission is disabled on channel 70 in this radio.

IMPORTANT NOTICE

The INT mode is not legal for use while operating in U.S. waters. The TX/RX frequencies available in the INT mode were agreed upon by the attending countries at the 1968 ITU - International Telecommunication Conference. International Telecommunication are legal for use in International waters only.

Uni

SECTION 4

TECHNICAL DESCRIPTION

4.1 GENERAL

The VHF502 can be considered as consisting of two major sections.

- The Control Section (consisting of the front panel controls, LCD display, and CPU).
- The Transmitter/Receiver / PLL Section.

4.2 THE CONTROL SECTION

The heart of the control section is the CPU, which is IC203 located on the CPU PCB. The CPU controls all of the following items :

- Controls the Squelch circuit by detecting a busy signal from the 2nd IF circuit IC5 on the Main PCB.
- Generates a beep tone when a key is activated on the keyboard.
- Mutes the transmitter modulation circuit when receiving.
- Controls the output power of the transmitter High/Low.
- Controls the dividing ratio N of the PLL circuit.
- Switches ON/Off the transmitter power.
- Mutes AF audio.
- Detects a weather alert signal (when in Monitor Mode).
- Controls the LCD display.

4.3 THE TRANSMITTER/RECEIVER/PLL SECTIONS

In reading through the following circuit descriptions, it may be helpful to refer to Figure 4-1 Block Diagram of the TX/RX/PLL circuits.

4.3.1 PLL (Phase Lock Loop) Circuit

The PLL circuit is oscillating the standard frequency with the PLL IC (IC4) and 12.8MHz crystal filter XTL1. This is divided into 1/512 in the IC4 to make 25KHz reference frequency. RF output from VCO unit (VCO1) will be input to PLL IC (IC4) pin8 via buffer amplifier Q6. The dividing ratio data stored in the CPU IC203 will be output to pin10 and clock signal will be output to pin9 of the PLL IC (IC4). And when the chip enable signal is input to pin11 of PLL IC (IC4) the dividing ratio data will be latched to the PLL IC (IC4). The phase of the frequency which is a input frequency to the PLL IC (IC4) divided by the CPU stored dividing radio and the 25KHz reference frequency is compared correlated to control voltage. That is input to the pin of VCO unit (VCO1).

4.3.2 Transmitter Circuit

1) Microphone Amplifier Circuit

Voice signal from the microphone goes through pre-emphasis circuit consisting of C227, R217 and operational amplifier IC202 - A. The amplified signal is limited by the IC202-B and adjusted in the RV201. Then it goes through the active 4-stage LPF consisting of IC102-C,D etc., and modulated in the VCO unit (VCO1).

2) High Frequency Power Amplifier Circuit

RF signal from the VCO unit (VCO1) goes through the 10dB attenuator consisting of R12 - 14 and will be amplified by Q2. Output from Q2 will amplify drive power necessary for the Q1. FET power module (IC1) will be amplified and the RF signal will be output to the antenna switching circuit. RF output from the FET power module (IC1) can be changed by changing the voltage of IC1 pin 2.

3) APC Circuit

Diode D3 is monitoring a part of the FET power module's (IC1) output. The monitoring signal will be output to IC1 via switching transistor Q3 and displays the "TX ON" on the LCD. Voltage of monitoring signal will be compared and amplified between the set standard voltage and IC2. Then the output voltage goes through buffer amplifier transistor Q4 and will be connected to the pin 2 of FET power module (IC1) and make it a APC control loop. Output power can be changed by controlling transistors Q19 with the CPU IC101 to change the set standard voltage.

4.3.3 Receiver Circuit

1) Antenna Switching Circuit

Signal received at the antenna connector J3 goes to high frequency amplifier circuit via the 3 stage low pass filter consisting of coils L1-3.

2) High Frequency Amplifier Circuit

RF signal goes to the 1st mixer circuit through 2-stage BPF (consisting of coil L9, 10 and L11, 12), and will be high frequency amplified by Q5 and then 2-stage BPF (consisting of L14, 15 and L16, 17). The 1st image spurious frequency will be rejected to the adequate level in the 4-stage BPF inside the high frequency amplifier circuit.

3) 1st Mixer Intermediate Frequency Amplifier Circuit

A Transister mixer type in this radio. The 1st IF signal from the mixer circuit goes to the 2nd mixer circuit through 1-stage crystal filter (FIL1) and amplified in Q8 of the 1st IF amplifier circuit.

4) 2nd Intermediate Frequency Circuit

The 1st IF signal is added to IC5 and converted to 2nd IF signal. The 2nd IF signal goes through FIL2 and amplified in the IC5 and then through discriminator FIL3 and the demodulated AF signal is output from IC5.

5) Low Frequency Circuit

The AF signal demodulated in the IC5 goes through the de-emphasis circuit consisting of R58 and C77 and will be amplified in the Q9. A 2-stage HPF consisting of Q10, C79, R61, C80 and R60 is used to reject AF signal below 300Hz. The AF signal from the HPF goes

through variable resistor RV2 and is input to the speaker amplifier circuit IC6 and amplified to the set output level.

6) Audio Muting Circuit .

The Q14 to mute the audio is controlled by input of squelch's BUSY signal and the mute output of the CPU IC203.

7) WX Alert Detection

The tone selector IC201 detects the 1050Hz alert tone if it is contained in the re-modulated AF and the WX alert tone will be output from the speaker.

4.4 SPECIFICATIONS

4.4.1 Transmitter

Channels	All available US,INT, Canada VHF Marine band
Frequency Stability	± 10 PPM (0.001%) from -20°C to $+50^{\circ}\text{C}$
Frequency Range	156.025 to 157.425 MHz
Channel Spacing	25 KHz increments
Power Output	Switchable 5W, 1W into 50 Ohms at 6.0 VDC
Modulation	Frequency Modulated (16K0G3E)
Modulation Audio	Shall not vary $+1, -3$ dB from true 6 dB/Oct pre-emphasis response from 300 to 2500 Hz, reference 1000 Hz. Audio frequencies 3-20 KHz shall be attenuated (at 1 KHz by 60 log f/3 dB. Above 20 KHz by 50 dB)
FM Hum & Noise	Level greater than 40 dB below audio
Audio Distortion	Less than 10% at 1 KHz for 3 KHz deviation
Spurious & Harmonic	Attenuated at least $43 + 10 \log P_o$ (below rated radiated carrier power) per FCC Rules Parts 2 & 80
Antenna Impedance	50 Ohms
Transmitter Protection	Shall survive open or short circuit of antenna system without damage (10 min. test)

4.4.2 Receiver

Channels	All available US,INT, Canada VHF Marine band
Frequency Range	156.025 to 163.275 MHz in 25 KHz increments
Frequency Stability	± 10 PPM (0.001%) from -20°C to $+50^{\circ}\text{C}$
Usable Sensitivity	0.3 μV for 12 dB (SINAD); 0.5 μV for 20 dB quieting
Squelch Sensitivity threshold	0.3 μV or better
Tight squelch sensitivity	0.5 μV to 1.0 μV

Modulation Acceptance	Less than ± 7.0 KHz
Adjacent Channel Rejection	Greater than 70 dB
Spurious Image Rejection	Greater than 70 dB
Intermodulation Rejection	Greater than 60 dB
Audio Output	0.4 Watt or more at 10% or less distortion into 4 Ohm load
Hum & Noise in Audio	Less than -40 dB

4.4.3 Operating Requirements

Input Voltage	6.0 VDC NiCad rechargeable battery
Battery Capacity	600mA/H
Current Required	
Transmit	Less than 2.0 amps at 5 W; and 1.0 amp at 1W
Receiving (squelched)	Less than 40mA; 150mA at 0.3 Watt audio output (1 KHz)
Operating Temperature	-20°C to +50°C
Duty Cycle	Continuous, 80% receive, 20% transmit (max. 10 min. @25)
Humidity	100% at +50°C for 8 hours

4.4.4 Radio Dimensions

Height (radio body w/batt.)	149.2 mm
Width	63.3 mm
Depth	38.0 mm
Weight	Approx. 0.5kg. (1 lb)

NOTE:
**The VHF502 VHF FM Radiotelephone meets all applicable sections of
 FCC Rules Parts 2, 15 and 80.**

SECTION 5

MAINTENANCE

5.1 GENERAL

The purpose of this section is to provide servicing instructions for the service technician. The VHF502 is designed to provide long periods of trouble-free operation. It is recognized, however, that environmental and other factors may result in a need for occasional service.

5.1.1 How to contact Raytheon

Technical Support: 1-800-539-5539 extension 2445 or (603) 647-7530 extension 2445

You may reach our Technical Support Department Monday thru Friday, from 8:15am to 5:00pm Eastern Standard Time. Our Technical Support Specialists are available to answer installation, operation, and trouble-shooting questions about your Raytheon unit. Our Technical Support Department may also be reached via the Internet.

- Questions may be addressed directly to:
rnc_tech_Raytheon@raymarine.com.
- Or visit Raytheon at the Raytheon Electronics World Wide Web site:
www.raymarine.com
- Our Fax Number is 603 634 4756

Accessories and Parts 1-800-539-5539 extension 2120 or (603) 647 7530 ext. 2120

Many Raytheon accessory items and parts are available through your authorized Raytheon dealer. However if you are in need of an item not available through your retailer feel free to contact our Customer Service department Monday thru Friday from 8:15am to 5:00pm Eastern Standard Time. Please refer to the Optional Accessory list in this manual (Page 3), and have the Raytheon part number ready when calling to place an order. If you are uncertain about what item to choose, please contact our Technical Support Department (1-800-539-5539 ext. 2065) prior to placing your order.

Product Repair and Service

In the unlikely event your Raytheon unit should develop a problem please return your unit to our Product Repair Center. Please make certain to complete and mail the warranty registration card from the front of this manual. If you have not mailed your warranty card please include a copy of your original purchase receipt to verify your warranty status. Please return your unit to the following address:

Raytheon Product Repair Center
676 Island Pond Road
Manchester NH 03109-5420

Please make sure to fill out completely the Service Information Card found in the back of this manual and return this card with your Raytheon unit. A postcard acknowledging we have received your unit will be mailed to you upon arrival at our Product Repair Center. We will do everything possible to return your unit as quickly as possible. To inquire about the status of your unit our Product Repair Center may be reached by calling 1-800-539-5539 extension 2118. Please keep a record of the serial number of your unit and have this number ready when you call.

How To Contact Raytheon (Europe)

In Europe, Raytheon Support, Service and Accessories may be obtained by contacting:

Raytheon Marine Europe Limited
Anchorage Park, Portsmouth
PO3 5TD, England
ATT. Service Department
Phone (01705) 693611
Fax (01705) 694642

5.2 PREVENTATIVE MAINTENANCE

The VHF502 has been constructed to be virtually maintenance free. Your attention to a few basic points should assure many years of service.

- Although the unit is waterproof, always keep the unit as dry as reasonably possible.
- Clean the exterior of the unit with a tissue or soft non-abrasive cloth. Do not use solvents or other chemicals.
- Inspect the radio case, battery pack, and antenna for any physical damage.
- Check the antenna connector for any dirt or corrosion.

NOTE:

The following alignment procedures have been provided in this manual to aid FCC licensed technicians and service personnel only.

5.3 ALIGNMENTS AND SERVICE

This transceiver is completely aligned at the factory and does not require any adjustments at installation.

The test equipments listed are used for the test setup shown in Fig. 5-1. This test setup is used either in part or in total during the following adjustments.

TEST EQUIPMENT

1. DC Power Supply (0-20 V variable, 3A max.) set at 7.2 VDC
2. RF Power Meter (10 W, 50 ohm, 150-200 MHz)
3. RF Signal Generator (50 ohm Output, 150-200 MHz)

4. FM Linear Detector (FMLD) or Deviation Monitor 150-200 MHz
5. Frequency Counter
6. Digital Voltmeter
7. Oscilloscope (any oscilloscope accurate for audio signal tracing)
8. SINAD Meter
9. Distortion Meter
10. Toggle Switch (for use as a PTT twitch)
11. Coaxial Switch for TX/RX Antenna switching

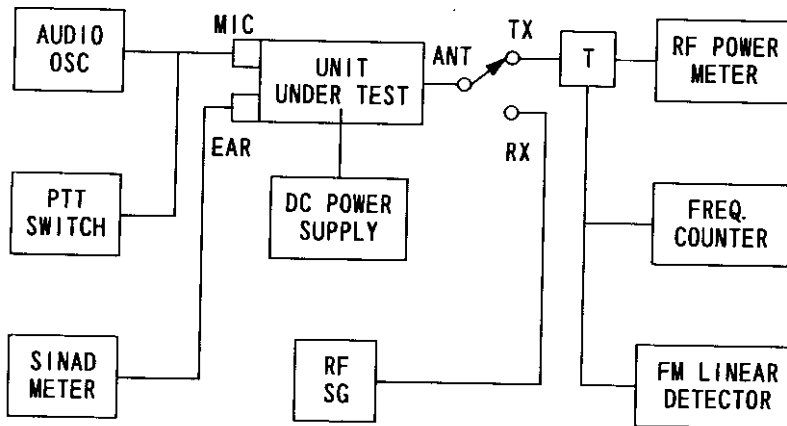


Figure 5-1

5.3.1 PLL Adjustment (TRANSMITTER/RECEIVER)

- 1) Connect the power supply (6.0V, 3A) to the power line and the PTT switch to the microphone terminal.
- 2) Connect a digital voltmeter or high impedance tester (positive lead to VCO pin2, negative to ground) and check as shown in Table 5-1. (See Fig. 5-2.)

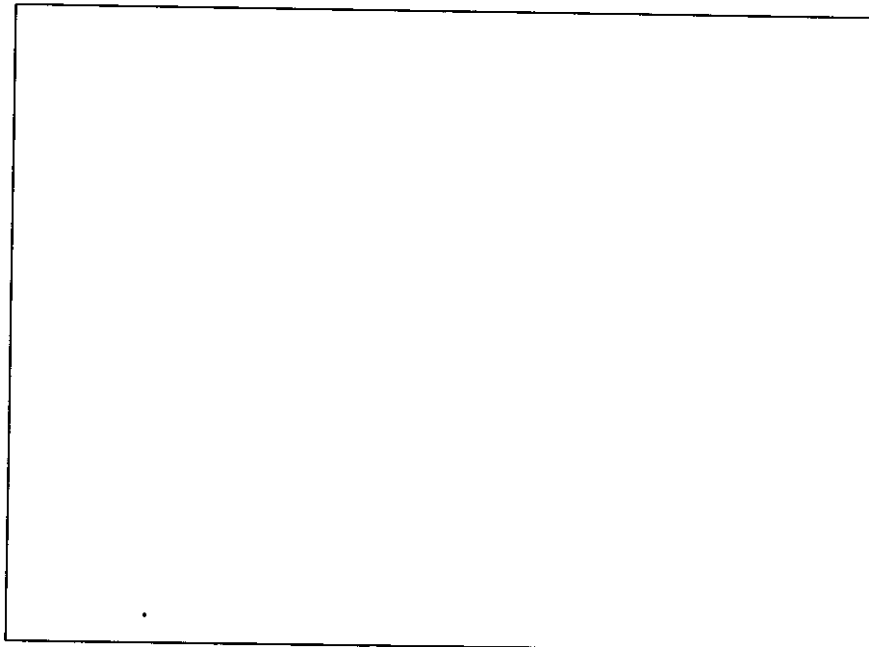


Figure 5-2

Sequence	Item	Condition	Adj. point	Adj. volt
1	TX	TX CH16 USA		Approx. 2.3Vdc
2	RX	RX CH16 USA		Approx. 1.8Vdc
3	RX	RX CH88 USA		less than 4.2Vdc

Table 5-1

5.3.2 Frequency Adjustment (TRANSMITTER)

- 1) Connect the coupler output to a frequency counter, set the radio on CH16 (156.800 MHz), key to transmit, and read the indication on the frequency counter.
- 2) Adjust trimmer capacitor CV1 on the RF PCB for the desired frequency (156.800 MHz) on the frequency counter.

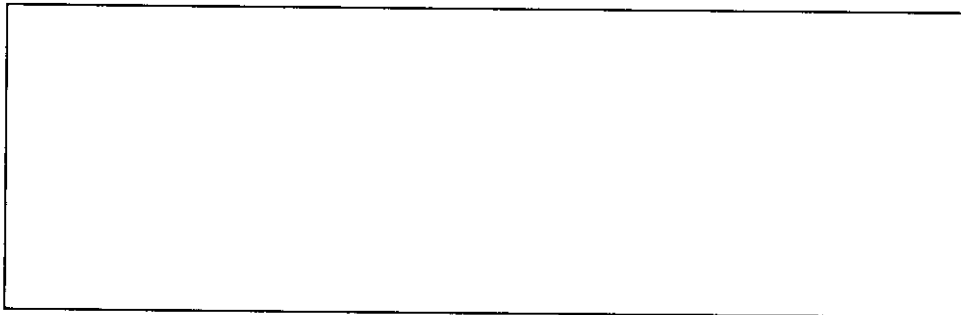


Figure 5-3

5.3.3 Modulation Adjustment (TRANSMITTER)

- 1) Connect the coupler output to an FM linear detector. Connect an audio oscillator to the microphone connector and key to transmit.
- 2) Set the audio oscillator output to -25 dBm, 300Hz and adjust RV101 on the CPU PCB for a deviation of 4.5 KHz +/- 300 Hz. (See Fig. 5-4.)
- 3) Set the audio oscillator output to -43 dBm, 1 KHz and read the deviation meter (2.5KHz - 3KHz)

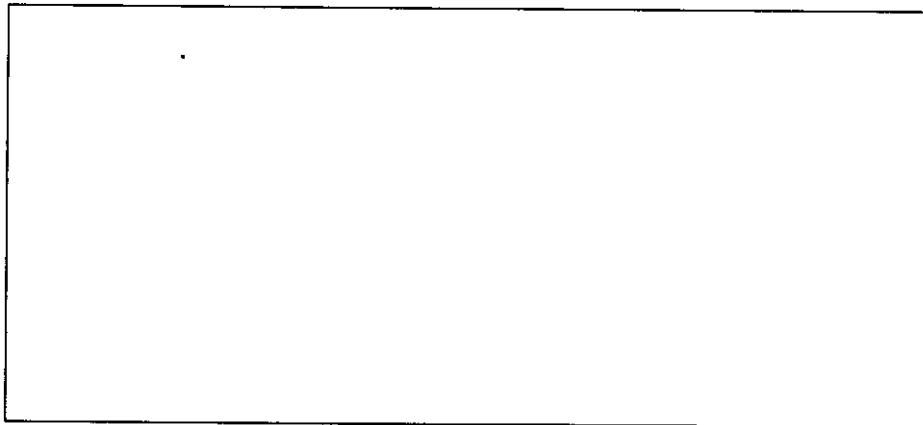


Figure 5-4

5.3.4 Power Output Adjustment (TRANSMITTER)

- 1) Connect an RF power meter to the antenna connector. Key to transmit and adjust RV1 for the low power on the RF PCB as shown in Table 5-2. (See Fig. 5-5.) The high power will be adjusted automatically.

Sequence	Condition	Adj. Point	Target power
1	6.0 Vdc H/L	LRV1 low power	0.9W +/- 0.05W (limit 1.0W)
2	6.0 Vdc H/L :H	check	5W (Po 0.5W)

Table 5-2

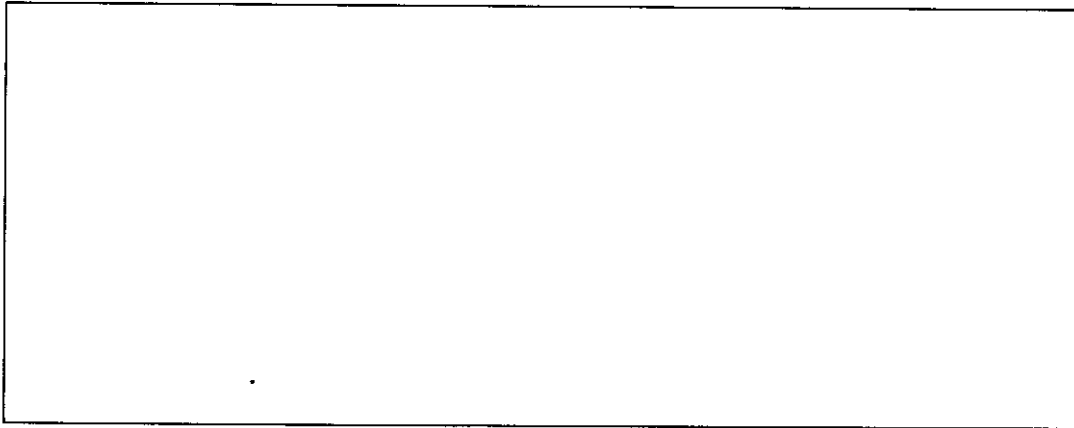


Figure 5-5

5.3.5 Weather Alert Frequency Adjustment (RECEIVER)

- 1) Connect an RF signal generator to the antenna connector. Set the RF signal generator as follows:

Frequency : 162.550 MHz with no modulation
Output level : 60 dB

- 2) Select the weather channel WX1.
- 3) Connect a frequency counter to TP1 on the CPU PCB and adjust RV102 to obtain 2100 Hz ± 10 Hz on the frequency counter. (See Fig. 5-6.)

5.4 TROUBLESHOOTING GUIDE

Table 5-4 provides a general troubleshooting chart for use by a technician to isolate circuitry to specific functional within VHF radio.

The first step in attempting to clear a problem associated with the general operation of this radio is to perform a MASTER RESET. This can be done by simply holding down the 16 PLUS key while turning the radio on. This should be performed anytime a component or PCB within a radio is replaced. This function will clear the memory of the 502 and return it to the original factory settings, 16 PLUS will automatically be reprogrammed to channel 16.

NOTE:

Micro-components within the radio are generally not field replaceable, therefore, repairs to the radio typically go down to the PC board level only. A replacement parts list for the VHF502 can be found in Section 6.

<u>Item</u>	<u>Symptom</u>	<u>Possible Cause</u>
1	Unit does not turn on.	<ul style="list-style-type: none"> a. Defective power switch. b. Check the battery voltage. c. Check the connector connection. d. Defective regulator IC7.
2	NO sound from speaker	<ul style="list-style-type: none"> a. Defective speaker (SP101). b. Defective IC6 and/or assoc. components(C97, etc) c. Defective speaker ON control circuit (Q12,IC203). d. Defective volume control. e. Defective mute circuitry (Q14).
3.	Squelch circuit inop	<ul style="list-style-type: none"> a. Check squelch control. b. Defective IC5 and/or associated circuitry between pins 7 and 9.
4.	No receive (RX)	<ul style="list-style-type: none"> a. Defective regulator IC7. b. Defective Q16 (RX+B). c. Check IC5 audio output voltage at pin 9. d. Defective audio signal buffer Q9,Q10. e. Check XTL2 output for 21.145 MHz signal. f. Check 21.6 MHz output of X'tal filters FIL1. g. Check 21.6 MHz output of first IF amplifier Q8. h. Check 455 KHz signal form ceramic filter FIL2. i. Failure of VCO circuit (VCO1, IC4, Q6 and/or other associated circuitry). j. Defective CPU.
5.	Low receiver sensitivity	<ul style="list-style-type: none"> a. Check antenna and connector for possible corrosion or bad connection. b. BPF, Q5 and/or associated circuitry. c. Output of Q18 and/or associated circuitry. d. Output of VCO1 Pin 3.
6	CPU inoperative	<ul style="list-style-type: none"> a. Turn off the power once, and try again. b. Check CPU clock frequencies (pins 70 and 71 of IC203). c. If clock frequency is not present, check for +5 Vdc line.
7	Display malfunction	<ul style="list-style-type: none"> a. check the interconnection to the LCD display. b. Inoperative CPU.

Table 5-3 TROUBLESHOOTING CHART

<u>Item</u>	<u>Symptom</u>	<u>Possible Cause</u>
8	No transmit (TX)	<ul style="list-style-type: none"> a. Defective PTT switch.

		<ul style="list-style-type: none"> b. Defective regulator IC7. c. Defective Q15 (TX+B). d. Check power transmit circuit (Q1, Q2, and/or IC1) e. Failure of VCO circuit (VCO1) or PLL IC4. f. Check PLL control voltage for 2.3 V at Pin 2 of VCO1 on channel 16. g. Failure of TX mute circuit (IC2 and/or associated circuit). h. Failure of talk detection circuit (D3).
9	Low RF power output	<ul style="list-style-type: none"> a. Check RF power output from IC1 pin 4.. If it checks good, then check the triple Pi type network components (C1 - C4 and L1 - L4) and antenna switching diode (D1). If not good, then check the voltage level outputs of the drive amplifiers Q1 and Q2 as well as the associated circuitry. b. Check power control circuit (IC2 and/or associated circuitry)
10	Poor or no modulation	<ul style="list-style-type: none"> a. Defective microphone or microphone connection. b. Defective IC202 and/or its associated components.
11	Deviation of transmit frequency	<ul style="list-style-type: none"> a. Check VCO output frequency at pin 8 of PLL IC3, PLL phase detector output at pin 16, 15 of PLL IC3 and associated circuitry. b. Check 12.8 MHz crystal (XTL1).
12	PLL output frequency or level	<ul style="list-style-type: none"> a. Check frequency of 12.8 MHz crystal (XTL1). b. Check the frequency output at pin 8 of IC 3 and verify the transmit frequency.

Table 5-4 TROUBLESHOOTING CHART (Continued)

SECTION 6

PARTS LIST AND DRAWINGS

6.1 PARTS LOCATION LIST

MAIN CIRCUIT BOARD

Symbol	Q'ty	Parts No.	Description
C1,3,28	3	C1608CH1H180JT	Chip capacitor 18p
C12,17	2	C1608CH1H220JT	Chip capacitor 22p
C13	1	C1608CH1H270JT	Chip capacitor 27p
C2	1	C1608CH1H390JT	Chip capacitor 39p
C20,57	2	C1608CH1H330JT	Chip capacitor 33p
C21,24,64,72,73,88,105,106,107,115,116	11	C1608JF1E104ZT	Chip capacitor 0.1uF
C23,37,62,78,79,80	6	C1608JB1H103KT	Chip capacitor 0.01uF
C25,68,76,81,92,93,95,110	8	C1608JF1A105Z	Chip capacitor 1u/10V
C26,38,84	3	SK-1C105M-RA	Chip Tantalum 1uF/16V
C27,70	2	C1608JB1H222KT	Chip capacitor 2200p
C4,8,10,11,14,15,16,18,19,29,30,31,32,33, 34,35,36,39,43,44,45,49,50,52,54,55,56,60, 61, 67,71,85,91,108,109	35	C1608JF1H102ZT	Chip capacitor 1000p
C40	1	C1608CH1H1R5CT	Chip capacitor 1.5pF
C46	1	C1608CH1H010CT	Chip capacitor 1p
C5,6,41,42,47,48	6	C1608CH1H130JT	Chip capacitor 13pF
C51	1	C1608CH1H0R5CT	Chip capacitor 0.5pF
C53,63,111,112	4	C1608CH1H101JT	Chip capacitor 100p
C58,66,87	3	C1608CH1H560JT	Chip capacitor 56p
C7	1	C1608CH1H030CT	Chip capacitor 3p
C74	1	C1608CH1H910JT	Chip capacitor 91p
C77	1	C1608JF1C224Z	Chip capacitor 0.22uF
C82	1	SK4-1A336M-RC	Chip Tantalum 33uF/10V
C86	1	C1608CH1H470JT	Chip capacitor 47p
C89,90	2	C1608CH1H221JT	Chip capacitor 220p
C9,22,59,65,75,83,94,99,100,113	10	SK3-1A475M-RA	Chip Tantalum 4.7uF
C96	1	C1608CH1H100DT	Chip capacitor 10p
C97	1	RE3-6V221M	Capacitor 220uF/6.3V
C98	1	SK3-1A106M-RB	Chip Tantalum 10uF/10V
C117	1	C1608CH1H150JT	Chip capacitor 15p
C118	1	C1608JB1H472KT	Chip capacitor 4700p
CV1	1	TZC03P200A110	Trimmer Chip Capacitor 20p

Symbol	Q'ty	Parts No.	Description
D1,2	2	1SS135	Antenna SW Diode
D3	1	1SS383	Chip Diode
D4,5	2	DAN202K-T146	Chip Diode
FIL1	1	21U15A	21.6MHz Crystal Filter
FIL2	1	CDBM455C24	455KHz Ceramic Filter
FIL3	1	CDBC455CX24	Disc 455KHz
JP1	1	52559-2290	Connector 22P
JP2	1	1L-S-2P-S2T2-EF	Connector 2P
JP3	1	1L-S-5P-S2T2-EF	Connector 5P
L1,2,4	3	E2-0.4-2.0-7TL	Chip Coil 0.4 ϕ 7t
L3	1	E2-0.4-2.0-5TL	Chip Coil 0.4 ϕ 5t
L5	1	LK2125-6R8K-T	Chip Inductor 6.8uH
L6,7	2	E2-0.35-1.6-6TL	Chip Coil 0.35 ϕ 6t
L8,13,18,19	4	LK2125-1R0K-T	Chip Inductor 1.0uH
L9,11,14,16	4	E2-0.35-1.6-8TL	Chip Coil 0.35 ϕ 8t
L10,12,15,17	4	E2-0.3-1.0-5TR	Chip Coil 0.3 ϕ 5t
Q1	1	2SC3357	Transistor
Q11	1	2SB1188	Transistor
Q12	1	DTC144EUA	Digital Transistor NPN
Q14	1	2SC4851	Transistor
Q15,16	2	2SA1298-Y-T(IY)	Transistor
Q19	1	DTC114EKA-T146(24)	Digital Transistor NPN
Q2,5,6,8,13,18	6	2SC4226	Transistor
Q3,4,7,9,10,17	6	2SC4116	General Transistor
R1	1	CR1/8-151JV	Chip Resistor 150 1/8W
R11,28,58	3	CR1/16-333JV	Chip Resistor 33k 1/16W
R12,14	2	CR1/16-121JV	Chip Resistor 120 1/16W
R13	1	CR1/16-510JV	Chip Resistor 51 1/16W
R15,19	2	CR1/16-682JV	Chip Resistor 6.8k 1/16W
R16,27,41	3	CR1/16-222JV	Chip Resistor 2.2k 1/16W
R17,62,68,73,80,85	6	CR1/16-332JV	Chip Resistor 3.3k 1/16W
R2,4	2	CR1/16-431JV	Chip Resistor 430 1/16W

Symbol	Q'ty	Parts No.	Description
R20,22,24,45,56,74,75,78,81	9	CR1/16-103JV	Chip Resistor 10k 1/16W
R21,40,46,50,67,83	6	CR1/16-104JV	Chip Resistor 100k 1/16W
R23	1	CR1/16-334JV	Chip Resistor 330k 1/16W
R25	1	CR1/16-162JV	Chip Resistor 1.6k 1/16W
R3	1	CR1/16-120JV	Chip Resistor 12 1/16W
R30	1	CR1/16-151JV	Chip Resistor 150 1/16W
R34	1	CR1/16-563JV	Chip Resistor 56k 1/16W
R35	1	CR1/16-820JV	Chip Resistor 82 1/16W
R42,43,44	3	CR1/16-473JV	Chip Resistor 47k 1/16W
R49,59	2	CR1/16-221JV	Chip Resistor 220 1/16W
R5,9	2	CR1/10-100JV	Chip Resistor 10 1/10W
R53	1	CR1/16-824JV	Chip Resistor 820k 1/16W
R54	1	CR1/16-152JV	Chip Resistor 1.5k 1/16W
R55	1	CR1/16-681JV	Chip Resistor 680 1/16W
R57,60,79	3	CR1/16-224JV	Chip Resistor 220k 1/16W
R6,18,33,47,48,52,63,86	8	CR1/16-102JV	Chip Resistor 1k 1/16W
R61	1	CR1/16-183JV	Chip Resistor 18k 1/16W
R66,87	2	CR1/16-154JV	Chip Resistor 150k 1/16W
R69	1	CR1/16-223JV	Chip Resistor 22k 1/16W
R7,10,29,31,32,36,37,38,39,51,72	11	CR1/16-101JV	Chip Resistor 100 1/16W
R70,71	2	CR1/16-562JV	Chip Resistor 5.6k 1/16W
R76	1	CR1/16-472JV	Chip Resistor 4.7k 1/16W
R8	1	CR1/16-471JV	Chip Resistor 470 1/16W
R84	1	CR1/16-331JV	Chip Resistor 330 1/16W
IC1	1	M68731H	PA Module
IC2	1	TA75S54F	OP AMP
IC3	1	TK11255BM	5.5V series regulator
IC4	1	MB1505PFG-BND	PLL IC
IC5	1	TA31136FN	IF IC
IC6	1	TA7368F	Spk AMP
IC7	1	TK11240B	4V series regulator
VCO1	1	MVR-149T/R	VCO

Symbol	Q'ty	Parts No.	Description
RV1	1	MVR32HXBR-N-202	Chip Pot 2K 3.0mm
RV2	1	TP96N97N	VOL(10K)A
RV3	1	TP96N97	SQ(10K)B
XTL1	1	12.8MHz (UM-1)	12.8MHz Crystal OSC
XTL2	1	21.145 MHz (UM-1)	21.145MHz Crystal OSC

CPU CIRCUIT BOARD

Symbol	Q'ty	Parts No.	Description
C252	1	C1608JF1E474ZT	Chip capacitor 0.47uF
C218	1	C1608CH1H271J	Chip capacitor 270p
C219	1	C1608JB1H222K	Chip capacitor 2200p
C220	1	C1608CH1H681J	Chip capacitor 680p
C221	1	C1608CH1H821K	Chip capacitor 820p
C222,224	2	C1608JF1A105Z	Chip capacitor 1uF
C226,227,229	3	C1608JB1H103K	Chip capacitor 0.01uF
C228	1	C1608JF1H473Z	Chip capacitor 0.047uF
C231,232,233,234,235,236,237,238,242, 243,244,246,247,248,249	15	C1608JB1H102K	Chip capacitor 1000p
C239,240,241,245	4	C1608CH1H101J	Chip capacitor 100 pF
C253	1	SK-1V224M-RA	Chip Tantalum 0.22uF/35V
C217,254	2	SK3-1A475M-RA	Chip Tantalum 4.7uF
C255	1	C1608JB1H223K	Chip capacitor 0.022uF
C208,225,230,250,251	5	C1608JF1E104Z	Chip capacitor 0.1uF
D201	1	02CZ8.2Y	Zener Diode 8.2V
D202,203	2	BR1101F	Chip LED SMT
JP203	1	52559-2290	Connector 22P
LCD201	1	NCA6300	LCD
Q201	1	2SA1298	Transistor
Q202,205	2	DTC144EE	Digital Transistor NPN
Q203	1	2SA1586-GR-T(SG)	Transistor
Q204	1	2SC4851	Transistor
R201,229,230,231,232,233,234,246,248, 249,254	11	CR1/16-472JV	Chip Resistor 4.7K 1/16W

Symbol	Q'ty	Parts No.	Description
R203	1	CR1/16-224JV	Chip Resistor 220K 1/16W
R223	1	CR1/16-562JV	Chip Resistor 5.6K 1/16W
R224	1	CR1/16-682JV	Chip Resistor 6.8K 1/16W
R214	1	CR1/16-123JV	Chip Resistor 12K 1/16W
R213,216,217	3	CR1/16-272JV	Chip Resistor 2.7K 1/16W
R219,220,238,239,252,256	6	CR1/16-103JV	Chip Resistor 10K 1/16W
R221	1	CR1/16-101JV	Chip Resistor 100 1/16W
R222	1	CR1/16-102JV	Chip Resistor 1K 1/16W
R211,214,225,240,241,242,243,247	8	CR1/16-104JV	Chip Resistor 100K 1/16W
R226	1	CR1/16-62.0KFV	Chip Resistor 62K 1/16W
R227	1	CR1/16-69.8KFV	Chip Resistor 69.8K 1/16W
R228	1	CR1/16-561JV	Chip Resistor 560 1/16W
R202	1	CR1/16-362JV	Chip Resistor 3.6k 1/16W
R212,215,218	3	CR1/16-473JV	Chip Resistor 47K 1/16W
R253	1	CR1/16-332JV	Chip Resistor 3.3K 1/16W
R236,237	2	CR1/16-333JV	Chip Resistor 33K 1/16W
R204,205,206,207	4	CR1/16-683JV	Chip Resistor 68K 1/16W
R245	1	CR1/16-121JV	Chip Resistor 120 1/16W
R250,251	2	CR1/16-221JV	Chip Resistor 220 1/16W
R255	1	CR1/8-470JV	Chip Resistor 47 1/8W
R244	1	CR1/16-153JV	Chip Resistor 15K 1/16W
R209	1	CR1/16-753JV	Chip Resistor 75K 1/16W
S201,202,204	3	SOP-112HST	Tact Switch
S203,205,206	3	SKHMPW	Tact Switch
IC201	1	LMC567C	Tone detect
IC202	1	NJM3403	OPAMP
IC203	1	uPD753036GK	CPU 4 bit
IC204	1	93LC46X-CT	EEPROM
RV201	1	MVR32HXBR-N-203	Chip Pot 20K 3.0mm
RV202	1	MVR34KXBR-N-103	Chip Pot 10K 3.0mm
X201	1	PBRC4.19B	4.19MHz Crystal

MAIN CIRCUIT BOARD

Symbol	Q'ty	Parts No.	Description
C1,3,28	3	C1608CH1H180JT	Chip capacitor 18p
C12,17	2	C1608CH1H220JT	Chip capacitor 22p
C13	1	C1608CH1H270JT	Chip capacitor 27p
C2	1	C1608CH1H390JT	Chip capacitor 39p
C20,57	2	C1608CH1H330JT	Chip capacitor 33p
C21,24,64,72,73,88,105,106,107,115,116	11	C1608JF1E104ZT	Chip capacitor 0.1uF
C23,37,62,78,79,80	6	C1608JB1H103KT	Chip capacitor 0.01uF
C25,68,76,81,92,93,95,110	8	C1608JF1A105Z	Chip capacitor 1u/10V
C26,38,84	3	SK-1C105M-RA	Chip Tantalum 1uF/16V
C27,70	2	C1608JB1H222KT	Chip capacitor 2200p
C4,8,10,11,14,15,16,18,19,29,30,31,32,33, 34,35,36,39,43,44,45,49,50,52,54,55,56,60, 61, 67,71,85,91,108,109	35	C1608JF1H102ZT	Chip capacitor 1000p
C40	1	C1608CH1H1R5CT	Chip capacitor 1.5pF
C46	1	C1608CH1H010CT	Chip capacitor 1p
C5,6,41,42,47,48	6	C1608CH1H130JT	Chip capacitor 13pF
C51	1	C1608CH1H0R5CT	Chip capacitor 0.5pF
C53,63,111,112	4	C1608CH1H101JT	Chip capacitor 100p
C58,66,87	3	C1608CH1H560JT	Chip capacitor 56p
C7	1	C1608CH1H030CT	Chip capacitor 3p
C74	1	C1608CH1H910JT	Chip capacitor 91p
C77	1	C1608JF1C224Z	Chip capacitor 0.22uF
C82	1	SK4-1A336M-RC	Chip Tantalum 33uF/10V
C86	1	C1608CH1H470JT	Chip capacitor 47p
C89,90	2	C1608CH1H221JT	Chip capacitor 220p
C9,22,59,65,75,83,94,99,100,113	10	SK3-1A475M-RA	Chip Tantalum 4.7uF
C96	1	C1608CH1H100DT	Chip capacitor 10p
C97	1	RE3-6V221M	Capacitor 220uF/6.3V
C98	1	SK3-1A106M-RB	Chip Tantalum 10uF/10V
C117	1	C1608CH1H150JT	Chip capacitor 15p
C118	1	C1608JB1H472KT	Chip capacitor 4700p
CV1	1	TZC03P200A110	Trimmer Chip Capacitor 20p

Symbol	Q'ty	Parts No.	Description
D1,2	2	1SS135	Antenna SW Diode
D3	1	1SS383	Chip Diode
D4,5	2	DAN202K-T146	Chip Diode
FIL1	1	21U15A	21.6MHz Crystal Filter
FIL2	1	CDBM455C24	455KHz Ceramic Filter
FIL3	1	CDBC455CX24	Disc 455KHz
JP1	1	52559-2290	Connector 22P
JP2	1	1L-S-2P-S2T2-EF	Connector 2P
JP3	1	1L-S-5P-S2T2-EF	Connector 5P
L1,2,4	3	E2-0.4-2.0-7TL	Chip Coil 0.4 ϕ 7t
L3	1	E2-0.4-2.0-5TL	Chip Coil 0.4 ϕ 5t
L5	1	LK2125-6R8K-T	Chip Inductor 6.8uH
L6,7	2	E2-0.35-1.6-6TL	Chip Coil 0.35 ϕ 6t
L8,13,18,19	4	LK2125-1R0K-T	Chip Inductor 1.0uH
L9,11,14,16	4	E2-0.35-1.6-8TL	Chip Coil 0.35 ϕ 8t
L10,12,15,17	4	E2-0.3-1.0-5TR	Chip Coil 0.3 ϕ 5t
Q1	1	2SC3357	Transistor
Q11	1	2SB1188	Transistor
Q12	1	DTC144EUA	Digital Transistor NPN
Q14	1	2SC4851	Transistor
Q15,16	2	2SA1298-Y-T(IY)	Transistor
Q19	1	DTC114EKA-T146(24)	Digital Transistor NPN
Q2,5,6,8,13,18	6	2SC4226	Transistor
Q3,4,7,9,10,17	6	2SC4116	General Transistor
R1	1	CR1/8-151JV	Chip Resistor 150 1/8W
R11,28,58	3	CR1/16-333JV	Chip Resistor 33k 1/16W
R12,14	2	CR1/16-121JV	Chip Resistor 120 1/16W
R13	1	CR1/16-510JV	Chip Resistor 51 1/16W
R15,19	2	CR1/16-682JV	Chip Resistor 6.8k 1/16W
R16,27,41	3	CR1/16-222JV	Chip Resistor 2.2k 1/16W
R17,62,68,73,80,85	6	CR1/16-332JV	Chip Resistor 3.3k 1/16W
R2,4	2	CR1/16-431JV	Chip Resistor 430 1/16W

Symbol	Q'ty	Parts No.	Description
R20,22,24,45,56,74,75,78,81	9	CR1/16-103JV	Chip Resistor 10k 1/16W
R21,40,46,50,67,83	6	CR1/16-104JV	Chip Resistor 100k 1/16W
R23	1	CR1/16-334JV	Chip Resistor 330k 1/16W
R25	1	CR1/16-162JV	Chip Resistor 1.6k 1/16W
R3	1	CR1/16-120JV	Chip Resistor 12 1/16W
R30	1	CR1/16-151JV	Chip Resistor 150 1/16W
R34	1	CR1/16-563JV	Chip Resistor 56k 1/16W
R35	1	CR1/16-820JV	Chip Resistor 82 1/16W
R42,43,44	3	CR1/16-473JV	Chip Resistor 47k 1/16W
R49,59	2	CR1/16-221JV	Chip Resistor 220 1/16W
R5,9	2	CR1/10-100JV	Chip Resistor 10 1/10W
R53	1	CR1/16-824JV	Chip Resistor 820k 1/16W
R54	1	CR1/16-152JV	Chip Resistor 1.5k 1/16W
R55	1	CR1/16-681JV	Chip Resistor 680 1/16W
R57,60,79	3	CR1/16-224JV	Chip Resistor 220k 1/16W
R6,18,33,47,48,52,63,86	8	CR1/16-102JV	Chip Resistor 1k 1/16W
R61	1	CR1/16-183JV	Chip Resistor 18k 1/16W
R66,87	2	CR1/16-154JV	Chip Resistor 150k 1/16W
R69	1	CR1/16-223JV	Chip Resistor 22k 1/16W
R7,10,29,31,32,36,37,38,39,51,72	11	CR1/16-101JV	Chip Resistor 100 1/16W
R70,71	2	CR1/16-562JV	Chip Resistor 5.6k 1/16W
R76	1	CR1/16-472JV	Chip Resistor 4.7k 1/16W
R8	1	CR1/16-471JV	Chip Resistor 470 1/16W
R84	1	CR1/16-331JV	Chip Resistor 330 1/16W
IC1	1	M68731H	PA Module
IC2	1	TA75S54F	OP AMP
IC3	1	TK11255BM	5.5V series regulator
IC4	1	MB1505PFG-BND	PLL IC
IC5	1	TA31136FN	IF IC
IC6	1	TA7368F	Spk AMP
IC7	1	TK11240B	4V series regulator
VCO1	1	MVR-149T/R	VCO

Symbol	Q'ty	Parts No.	Description
RV1	1	MVR32HXBR-N-202	Chip Pot 2K 3.0mm
RV2	1	TP96N97N	VOL(10K)A
RV3	1	TP96N97	SQ(10K)B
XTL1	1	12.8MHz (UM-1)	12.8MHz Crystal OSC
XTL2	1	21.145 MHz (UM-1)	21.145MHz Crystal OSC

CPU CIRCUIT BOARD

Symbol	Q'ty	Parts No.	Description
C252	1	C1608JF1E474ZT	Chip capacitor 0.47uF
C218	1	C1608CH1H271J	Chip capacitor 270p
C219	1	C1608JB1H222K	Chip capacitor 2200p
C220	1	C1608CH1H681J	Chip capacitor 680p
C221	1	C1608CH1H821K	Chip capacitor 820p
C222,224	2	C1608JF1A105Z	Chip capacitor 1uF
C226,227,229	3	C1608JB1H103K	Chip capacitor 0.01uF
C228	1	C1608JF1H473Z	Chip capacitor 0.047uF
C231,232,233,234,235,236,237,238,242, 243,244,246,247,248,249	15	C1608JB1H102K	Chip capacitor 1000p
C239,240,241,245	4	C1608CH1H101J	Chip capacitor 100 pF
C253	1	SK-1V224M-RA	Chip Tantalum 0.22uF/35V
C217,254	2	SK3-1A475M-RA	Chip Tantalum 4.7uF
C255	1	C1608JB1H223K	Chip capacitor 0.022uF
C208,225,230,250,251	5	C1608JF1E104Z	Chip capacitor 0.1uF
D201	1	02CZ8.2Y	Zener Diode 8.2V
D202,203	2	BR1101F	Chip LED SMT
JP203	1	52559-2290	Connector 22P
LCD201	1	NCA6300	LCD
Q201	1	2SA1298	Transistor
Q202,205	2	DTC144EE	Digital Transistor NPN
Q203	1	2SA1586-GR-T(SG)	Transistor
Q204	1	2SC4851	Transistor
R201,229,230,231,232,233,234,246,248, 249,254	11	CR1/16-472JV	Chip Resistor 4.7K 1/16W

Symbol	Q'ty	Parts No.	Description
R203	1	CR1/16-224JV	Chip Resistor 220K 1/16W
R223	1	CR1/16-562JV	Chip Resistor 5.6K 1/16W
R224	1	CR1/16-682JV	Chip Resistor 6.8K 1/16W
R214	1	CR1/16-123JV	Chip Resistor 12K 1/16W
R213,216,217	3	CR1/16-272JV	Chip Resistor 2.7K 1/16W
R219,220,238,239,252,256	6	CR1/16-103JV	Chip Resistor 10K 1/16W
R221	1	CR1/16-101JV	Chip Resistor 100 1/16W
R222	1	CR1/16-102JV	Chip Resistor 1K 1/16W
R211,214,225,240,241,242,243,247	8	CR1/16-104JV	Chip Resistor 100K 1/16W
R226	1	CR1/16-62.0KFV	Chip Resistor 62K 1/16W
R227	1	CR1/16-69.8KFV	Chip Resistor 69.8K 1/16W
R228	1	CR1/16-561JV	Chip Resistor 560 1/16W
R202	1	CR1/16-362JV	Chip Resistor 3.6k 1/16W
R212,215,218	3	CR1/16-473JV	Chip Resistor 47K 1/16W
R253	1	CR1/16-332JV	Chip Resistor 3.3K 1/16W
R236,237	2	CR1/16-333JV	Chip Resistor 33K 1/16W
R204,205,206,207	4	CR1/16-683JV	Chip Resistor 68K 1/16W
R245	1	CR1/16-121JV	Chip Resistor 120 1/16W
R250,251	2	CR1/16-221JV	Chip Resistor 220 1/16W
R255	1	CR1/8-470JV	Chip Resistor 47 1/8W
R244	1	CR1/16-153JV	Chip Resistor 15K 1/16W
R209	1	CR1/16-753JV	Chip Resistor 75K 1/16W
S201,202,204	3	SOP-112HST	Tact Switch
S203,205,206	3	SKHMPW	Tact Switch
IC201	1	LMC567C	Tone detect
IC202	1	NJM3403	OPAMP
IC203	1	uPD753036GK	CPU 4 bit
IC204	1	93LC46X-CT	EEPROM
RV201	1	MVR32HXBR-N-203	Chip Pot 20K 3.0mm
RV202	1	MVR34KXBR-N-103	Chip Pot 10K 3.0mm
X201	1	PBRC4.19B	4.19MHz Crystal

SECTION 7

APPENDIX

7.1 VHF MARINE CHANNEL USAGE GUIDE AND LICENSING REQUIREMENTS

Most of the information found in this section is reprinted in whole or in part from FCC Information Bulletin No. 2 REVISED EDITION February 1991 and FCC Fact Sheet PR-5000 March 1990.

REMEMBER:

- Maintain a radio watch on Channel 16. Channel 16 is used for distress and safety purposes only.
- Use VHF Channel 70 only for Digital Selective Calling (DSC). It may be used for general-purpose calling using DSC. Your cooperation in not using Channel 70 for general intership communications is necessary to prevent interference.
- Your VHF transceiver has a high-low power switch. Use low power whenever feasible. Unnecessary high-power operations can interfere with other important communications.
- Always use your radio call sign at the beginning and end of each transmission.
- Be sure only qualified persons operate your radio. You are responsible for control of your radio. Know the rules.
- Limit calls to other vessels to 30 seconds. If you receive no reply, wait 2 minutes; then try again. Keep communications brief and avoid chit-chat.
- Never transmit false distress messages, and never use profanity on the air.

OTHER REMINDERS:

You need a radio operator license to operate VHF Marine Radio only if you plan to dock in a foreign port or leave a foreign port to dock in a U.S. port.

- Your radio license is not transferable. If you sell your boat, request the FCC to cancel your station license.

If you replace your radio, you do not need to change your license unless the new radio operates on another frequency band. If you install equipment to operate on another frequency band, apply for modification of your license.

- If you carry more than six passengers for hire, your vessel must be certified as a passenger-carrying vessel by the FCC and the Coast Guard.

Licensing Requirements for Hand Held Portable VHF Marine Transceivers 10 Watts Power or Less

VHF Marine hand held transceivers can be operated and licensed as follows:

- a) **Associated Ship Unit:** A hand held VHF Marine transceiver can be operated under an existing valid ship station license under the following conditions only:
 - i) Except for safety purposes, the hand held transceivers must be used only to communicate with the ship station with which it is associated. Such associated ship units **MAY NOT** be operated from shore.
 - ii) The transmitting power is limited to **ONE WATT** only.
 - iii) The hand held transceiver must be identified by the call sign of the ship station along with its associated unit designator.
- b) **Portable Ship Station:** The Commission may grant a station license permitting operation of a portable ship station aboard different vessels of the United States. Each application (FCC Form 506-Application for a Ship Radio Station License) for a portable ship station license must include a showing that:
 - i) The station will be operated aboard a vessel.
 - ii) A station license for portable equipment is necessary to eliminate separate applications to operate a ship station aboard different vessels.
- c) **Marine Utility Station:** A utility station in the maritime mobile service consists of one or more hand held transceiver units licensed under a single authorization. Each unit is capable of operating while being hand carried by an individual. There are two types of stations authorized:
 - i) **Marine Utility Coast** – when transmitters are located on land; may communicate directly to vessels only.
 - ii) **Marine Utility Coast/Ship** – transmitters from land may communicate with vessels or when aboard a vessel, may communicate with other vessels or coast stations.

NOTE: A Marine Utility Ship license will not be authorized.

The station operates under the rules applicable to a private coast station when the unit are on land and under the rules applicable to a ship station when the unit (s) are aboard a vessel. FCC Form 503, application for Land Radio Station License is used when applying for a marine utility License.

USAGE GUIDE



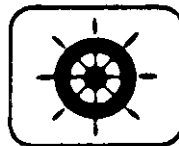
Emergency



Calling



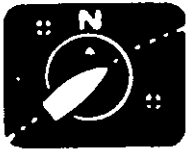
Monitoring



Intership Safety



U. S. Coast Guard



Navigation



Port Operations



Noncommercial



Commercial



Marine Operator



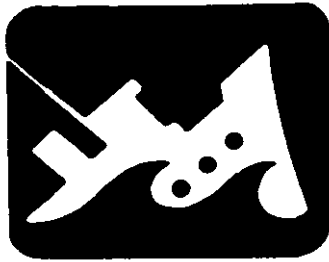
State Control



Environmental



Weather



Emergency

Channel 16

If :

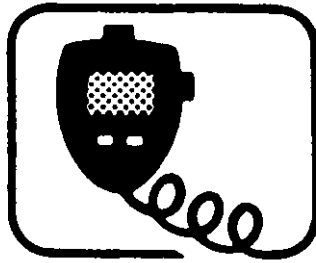
- Your ship is sinking, or on fire
- Someone has been lost overboard
- There exists grave and imminent danger

Use this distress procedure:

- Select Channel 16
- Say "Mayday, Mayday, Mayday."
- Give call sign and boat name
- Give location of boat
- Describe emergency
- If no answer, repeat; then try and other channel

Caution:

Every ship at sea is obliged to give absolute priority to radio communications relating to ships in distress – it is vital that false distress calls or messages not be broadcast.



Calling

Channel 16 & Working Channel

If – you wish to establish communications with another station

And – you know which working channel the station is monitoring

Then – initiate the call directly on that working channel

If – you wish to establish communications with another station

And – you do not know what working channel the station may be monitoring

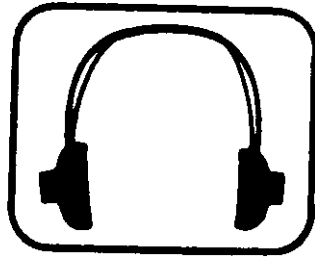
Then – initiate the call on channel 16. After contact is made switch to a working channel.

NOTE: Due to congestion on channel 16 caused by frequent hailing of other vessels, the FCC has approved channel 9 as a second hailing channel.

Avoid excessive calling and radio checks

Always monitor before transmitting

Never interrupt emergency communications



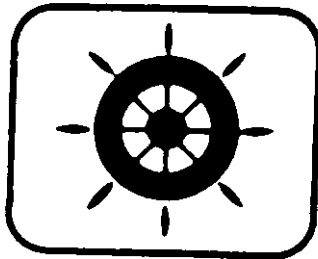
Monitoring

Channel 16 & Working Channel

When – your VHF station is turned on and it is not being used to exchange communications

You Must – monitor channel 16

As an operating convenience, many stations employ a second receiver so that they can monitor a working channel and channel 16 simultaneously.



Intership Safety

Channel: 6

Vessels: Any

Use: Communicating navigational and weather warnings to other ships

Communicating with U.S. Coast Guard stations or other vessels during search and rescue operations

Between: Ship-to-ship only

Comments: Do not use for routine communications. This is a safety channel.



U.S. Coast Guard

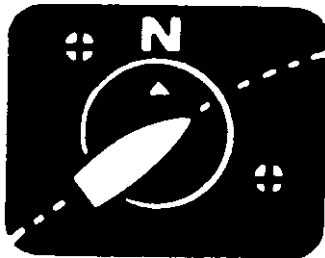
Channel: 22

Vessels: Any

Use: Working channel for exchange of communications with stations of the U.S. Coast Guard

Between: Ship to U.S. Coast Guard ship, coast to aircraft stations

Comments: U.S. Coast Guard does not regularly monitor this channel. Establish contact on channel 16 and shift to channel 22 as directed.



Navigation

Channel: 13

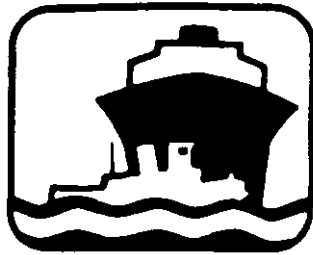
Vessels: Any

Use: Safety communications pertaining to the maneuvering of vessels or the directing of vessel movements

Primarily ship-to-ship and secondarily ship-to-coast

This is commonly called the Bridge-to-Bridge channel. Large vessels and towboats depend on this channel for their safe navigation. Railway or highway bridges which open for ship navigation often operate on this channel.

Bridge-to-Bridge stations must reduce power to one watt for routine operations.



Port Operations

Channels: 5, 12, 14, 20, 65, 66, 73, 74, [77]

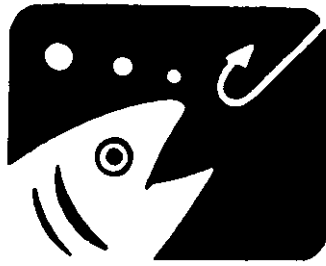
Vessels: Any

Use: Messages relating to the operational handling, movement and safety of vessels in or near ports, locks and waterways

Between: Ship-to-ship or ship-to-coast

Comments: Channel 77 is limited to communications to and from commercial pilots concerning the movement and docking of vessels.

Note: Channels 11, 12, 13 and 14 are used for vessel traffic service on the Great Lakes, St. Lawrence Seaway and designated major ports.



Non Commercial (Boat Operations)

Channels: 9, 68, 69, 71, 72, 78

Vessels: Recreational boats and any others not used primarily for commercial transport.

Use: Communications pertaining to the needs of the vessel (i.e., fishing, rendezvous, maneuvers, berthing, scheduling of repairs, provisioning, etc.)

Between: Ship-to-ship or ship to limited coast stations

Comments: Channel 72 may not be used for ship to coast communications. Channel 9 is shared with Commercial users.

If you regularly monitor one of these channels with a second receiver, please notify frequently-called stations of this practice. Help reduce congestion on channel 16.



Commercial

Channels: 7, 8, 9, 10, 11, 18, 19, 67, 79, 80, [88]

Vessels: Those used primarily for commercial transport of persons or goods, or engaged in servicing other vessels

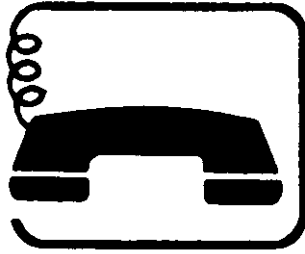
Use: Communications pertaining to the purpose for which the vessel is used

Between: Commercial transport vessels (ship-to-ship) or between commercial transport vessels and limited coast stations

Channels 8, 67 and 88 may not be used for ship-to-coast communications

Recreational boats are not permitted to use these channels

Channel 88 not available on Great Lakes and St. Lawrence Seaway.



Marine Operator

Channels: 24, 25, 26, 27, 28, 84, 85, 86, 87, 88

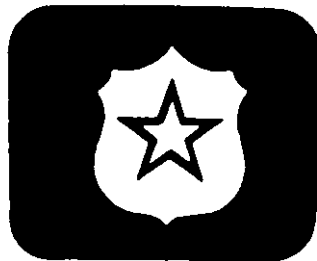
Vessels: Any

Use: To place a telephone call to any location in the world or to a vessel outside of your transmitting range

Between: Vessels and public coast stations

Comments: Contact the marine operator on the channel assigned to your navigating area. If unable to determine this channel, use channel 16.

Be patient. Do not interrupt calls in progress. Avoid excessive calling if the operator does not answer – give the operator a chance to reply.



State Control

Channel: 17

Vessels: State and local government

Use: Coordination, regulation and control of boating activities and the rendering of assistance to vessels.

Between: Ship and coast stations associated with state and local governments.



Environmental

Channel: 15

Vessels: Any (receive only)

Use: Broadcast of information concerning the environmental conditions in which vessels operate-weather, sea conditions, time signals, notices to mariner, hazards to navigation

Between: One-way broadcast from coast to ship stations

Note: Currently used for Class C EPIRB emergency signals.



Weather

Channels: WX1, WX2, WX3

Vessels: Any

Use: Continuous weather information from NOAA (National Oceanic and Atmospheric Administration)

Between: One-way broadcast from NOAA to any interested parties

Comments: Receive only. You are not allowed to transmit on these frequencies.