RAY230 & RAY230E Fixed Mount VHF Radio

Owner's Handbook

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PURPOSE

This handbook contains very important information on the installation, operation, and maintenance of your RAY230 US version or RAY230E European version VHF radio. To get the best results in operation and performance, please take the time to read this handbook thoroughly.

RAY230 US Version

Raymarine radios comply with the Federal Communications Commission (FCC) and Industry Canada requirements that regulate marine VHF radio usage for the US and Canada, respectively.

Marine VHF radio users in the US must comply with all applicable FCC rules and regulations, some of which are described here and in Section 7. This information was current at the time this handbook was printed. Up-to-date information, including licensing requirements, can be obtained on the FCC website at:

www.fcc.gov/wtb/marine

FCC NOTICE

This device complies with PART 15 of the FCC Rules. Operation is subject to the conditions that this device does not cause harmful interference. Changes or modifications to this equipment not expressly approved in writing by Raymarine, Incorporated could violate compliance with FCC rules and void the operator's authority to operate the equipment.

Station License

An FCC Ship Radio Station License and Call Sign are not required for most recreational vessels travelling in US waters. However, you must obtain a license if: (1) you are required by law or treaty to carry a radio on your vessel; (2) your vessel travels to foreign ports; (3) you use marine radio equipment on board your vessel **other than** marine VHF radios, any type of Emergency Position Indicating Radio Beacon (EPIRB), any type of radar, GPS or LORAN receivers, depth finders, CB radio, or amateur radio (an amateur license is required). Ships that use MF/HF single side-band radio, satellite communications, or telegraphy must continue to be licensed by the FCC. You can obtain a Station License by completing FCC Form 605 and mailing it with the required fee to:

Federal Communications Commission
1270 Fairfield Road
Gettysburg, PA 17325-7245

Operator License

An Operator License is not required to operate a VHF Marine Radio within US territorial waters. However, a license is required to operate the radio if you dock in a foreign port (including Canada and Mexico) or leave a foreign port to dock in a U.S. port. You can request a Restricted Radiotelephone Operator Permit from the FCC by filing Form 753.

Maritime Mobile Service Identity (MMSI)

A nine-digit Maritime Mobile Service Identity (MMSI) number is required to operate the DSC equipment in this radio. You can request an MMSI number from the FCC when you apply for a Station License. If your vessel does not require a license, you may obtain an MMSI by contacting either BoatUS (www.boatus.com) or MariTEL (www.maritelusa.com).

Once obtained, you can program the MMSI number into your RAY230 using the Menu Operation described in this handbook.

INDUSTRY CANADA

You do not need a license to operate this radio within sovereign waters of Canada or the US. You will need a license to operate this radio outside of Canada or the US. To obtain Industry Canada licensing information, contact the nearest field or regional office, or write:

Industry Canada
Radio Regulatory Branch
Attention: DOSP
300 Slater Street
Ottawa, Ontario
Canada, KIA OC8

The following information about the radio is required to complete the license application:

Industry Canada Type Approval	_____
FCC Type Number	PJ5RAY230
FCC Type Accepted	Part 80
Output Power	1 watt (low) & 25 watts (high)
Modulation	16FE (FM)
Frequency Range	156.025-157.425

RAY230E European Version

The RAY230E is a VHF radiotelephone that includes equipment for Class "D" Digital Selective Calling. It is intended for general communication within the Maritime Mobile Service worldwide and is for use on non-SOLAS vessels.

Compliance Information

The Declaration of Conformity to EC standards for radio equipment appears on page vii.

License

Regulations in some regions require that you obtain an operator license before operating VHF radio equipment. It is your responsibility to determine whether a license is required in your area before operating this equipment.

Maritime Mobile Service Identity (MMSI)

An MMSI number is required to operate the Digital Selective Calling (DSC) equipment in this radio. In some areas, a radio operator license is required before an MMSI number will be issued. You can request an MMSI number from the same agency that issues radio operator licenses in your area. You can then program the MMSI number into your RAY230E using the Menu Operation described in this handbook. If your region does not permit you to program the MMSI number yourself, your distributor can program the number for you.

Automatic Transmission Identification System (ATIS)

Your RAY230E can activate the ATIS feature, if needed. You can request an ATIS number from the same agency that issues radio operator licenses in your area. You can then program the ATIS number into your RAY230E using the Menu Operation described in this handbook. If your region does not permit you to program the ATIS number yourself, you can have your distributor program the number for you. You must only enable this feature when operating the radio in the inland waterways of European countries that require automatic identification transmission.

SAFETY NOTICE

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

Your Raymarine VHF radio generates and radiates radio frequency (RF) electromagnetic energy (EME). This equipment must be installed and operated in accordance with the instructions contained in this handbook. Failure to do so can result in personal injury and/or product malfunction.

Antenna Mounting and EME Exposure

For optimal radio performance and minimal human exposure to radio frequency electromagnetic energy, make sure the antenna is:

- connected to the radio before transmitting
- properly mounted
- located where it will be away from people
- located at least three feet (91 cm) from the Base Station transceiver and Handsets

Adjustments or Repair

Adjustments require specialized service procedures and tools only available to qualified service technicians – there are no user serviceable parts or adjustments. The operator should never remove the cover or attempt to service the equipment.

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

UNITED STATES Raymarine, Incorporated
22 Cotton Road, Unit D
Nashua, NH 03063-4219
Telephone: 603-881-5200
800-539-5539
Fax: 603-864-4756

EUROPE Raymarine Limited
Anchorage Park
Portsmouth, Hampshire
England PO3 5TD
Telephone: +44 (0) 23 9269 3611
Fax: +44 (0) 23 9269 4642

[Declaration of Conformity goes here]

GLOSSARY OF TERMS

All Scan	Scans all channels
ATIS	Automatic Transmission Identification System; used for inland waterways in some European countries
Canadian Channels	Channel designator as defined by the DOC
Carrier Wave	A Radio Frequency on which intelligence is superimposed.
DSC	Digital Selective Calling
Dual Watch	Monitor channel 16 while working on another channel
Duplex	Transmit and receive on different frequencies
ETSI	European Telecommunications Standards Institute
FM	Frequency Modulation
International Channels	Channel designator as defined by the ITU
ITU	International Telecommunications Union
LCD	Liquid Crystal Display
Memory Scan	Scans only user selected memory channels
MMSI	Maritime Mobile Service Identity; a number issued by each country to identify maritime stations.
NOAA	National Oceanographic and Atmospheric Administration
PLL	Phase Locked Loop (a type of frequency synthesizer)
PTT switch	Microphone push-to-talk switch
RF	Radio Frequency
RTCM	Radio Technical Commission for Maritime Services
RX	Receiver
Simplex	Transmit and receive on the same frequency
Squelch	To suppress totally
TX	Transmit
US Channels	Channel designations as defined by the FCC
VCO	Voltage Controlled Oscillator
VHF	Very High Frequency 30MHz to 300MHz
Weather Channels	Channels for routine and emergency weather information broadcast by NOAA

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SECTION 4 TECHNICAL DESCRIPTION

SECTION 1 GENERAL DESCRIPTION

1.1 Introduction

Congratulations on your purchase of Raymarine's RAY230 US version or RAY230E European version fixed-mount marine radiotelephone. In this document, the terms "RAY230/E" or "RAY230/RAY230E" refer to both versions of the radiotelephone.

The RAY230/RAY230E is a microprocessor controlled, digitally synthesized, compact transceiver that provides reliable simplex and semi-duplex (two-frequency) communications. The RAY230/E provides two-way communications on Marine channels and reception on 10 separate weather channels. More importantly, the RAY230/E has built-in full Class D Digital Selective Calling (DSC) for sending and receiving DSC Distress, Urgency and Safety calls.

1.2 Equipment Features

The RAY230/RAY230E is designed and manufactured to provide ease of operation with excellent reliability. The important built-in features of the equipment are listed below.

- Independent, dedicated receiver for the DSC channel (Channel 70)
- Oversized LCD on the Handset
- Waterproof to U.S.C.G. standard CFR-46 for Base Station Transceiver, Cradle and External Speaker
- Waterproof to JIS-7 standard for Handset
- Dedicated DISTRESS key on back of Handset
- All solid-state circuitry for low current drain and maximum reliability
- Series relay protection on input power circuits to prevent reverse polarity damage
- High-performance receiver section with optimum selectivity
- All Scan and Memory Scan features
- Dual/Tri-Watch Monitor modes
- Hailer function
- High-performance receiver section with optimum selectivity
- Distant/local mode

Note: *The External Speaker operates only when the handset is in the cradle (on hook) or when sounding an alert (regardless of whether handset is on hook or off hook).*

Exclusive Features of the RAY230 US Version

- Built-in full class D DSC in accordance with RTCM standard SC-101
- Exclusive circuit that automatically selects 16 or 9 as the Priority Channel when the radio is turned on
- Dedicated key for changing the Priority Channel (16/9)
- Exclusive weather alert feature (when in monitor mode)

Exclusive Features of the RAY230E European Version

- ETSI EN 301 025 compliant Class D
- ATIS
- 10 Private Chanels
- Multi-call operation

SECTION 2 INSTALLATION

2.1 Unpacking and Inspection

Use care when unpacking the unit 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 is necessary to return the unit to the factory.

2.2 Equipment Supplied

The following is a list of materials supplied with the RAY230 and RAY230E:

Description	Part No.
Base Station Transceiver	R49001
Handset with Cradle:	
RAY230 Full Function Handset	E46009
RAY230E Full Function Handset	E46010
RAY230 External Speaker	R49003
Power/Hailer/NMEA Cable	R49004
10m Connection Cable	R49005
Instruction Manual, RAY230	R49006
FCC Instruction	FCC Form 506

2.2.1 Optional Accessories

Description	Part No.
RAY230 Full Function Handset	E46009
RAY230E Full Function Handset	E46010
External Speaker	R49003
Handset Extension Cable	
External Speaker Extension Cable	
Hailer Horn Speaker	M95435

2.3 Planning the Installation

When planning the installation of your RAY230/E, the following conditions should be considered to ensure dependable and trouble-free operation.

- The mounting location of the primary cradle and handset should allow easy access from where the ship is normally navigated.
- The Base Station transceiver and Handset should be located at least 3 feet from the antenna.
- There should be adequate ventilation for the Base Station transceiver.
- A sufficient space should be secured behind the transceiver to allow for proper cable connections to the rear panel connectors.
- The transceiver should be located as near as possible to the power source
- The selected location should be as far apart as possible from any devices that may cause interference such as motors, generators, and other on board electronics.
- The transceiver should be protected from prolonged direct exposure to rain and salt spray. It is always a good practice to protect your valuable electronic equipment from the elements as much as possible.
- Use adequately sized wire for all DC power connections and make sure to solder all in-line connectors or splices.

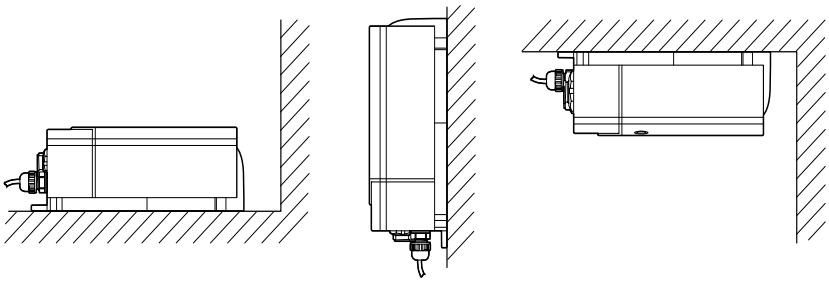
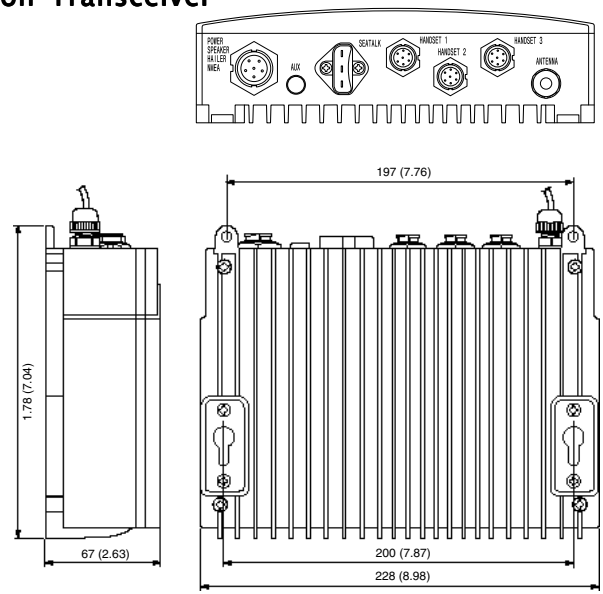
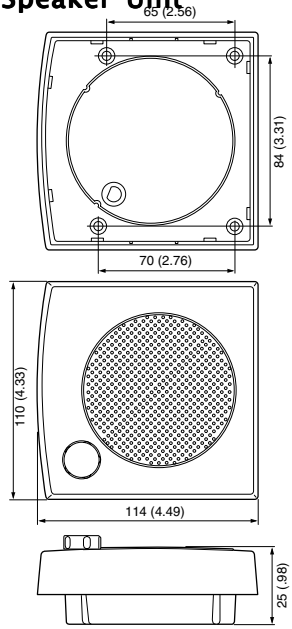


Figure 2-1 Typical Mounting Methods

Base Station Transceiver



External Speaker Unit



Cradle Unit

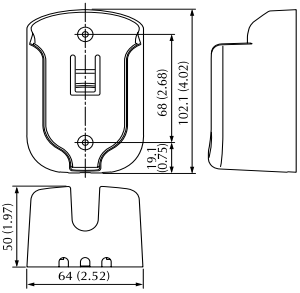


Figure 2-2 Outline and Mounting Dimensions
All dimensions are shown in (inches) and millimeters

2.4 Electrical Connections

2.4.1 DC Power and Hailer/NMEA Cable Connections

The 6-foot long power cable is a multipurpose assembly containing three wire-pairs for connections to DC power, NMEA input, and the Hailer Horn

Wire Color	Function	Connects to
RED	Power +	Ship's 13.2 VDC power
BLACK	Power -	
YELLOW	Hailer +	Hailer Horn speaker
GREEN	Hailer -	
WHITE	NMEA +	Input from position source (GPS,
BLACK	NMEA -	LORAN)

The RED (+) power wire contains a 10 amp in-line fuse.

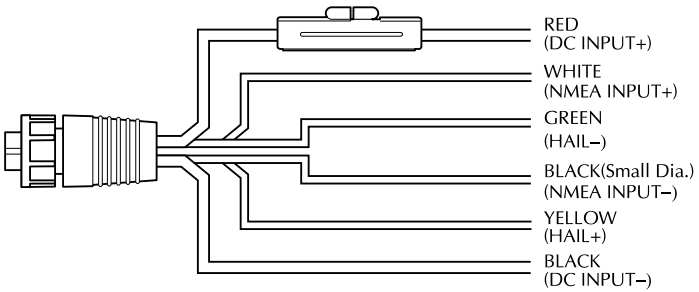


Figure 2-3 Power/Hailer/NMEA Cable and 6-pin Connector

speaker. Connections to the 6-pin connector are as follows:
In most cases the length of the power cable should be adequate enough to reach the DC power source. If additional wire length is required, the cable can be extended by adding more cable as necessary. However, for power cable runs longer than 15 feet, larger wire diameter size should be used to

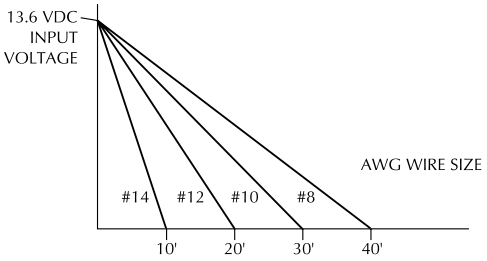


Figure 2-4 Power Cable Length

prevent voltage line loss.
Your RAY230/E radio should be connected to the nearest primary source of ship's DC power. A typical source may be a circuit breaker on the power panel or a fuse block near the unit. When connecting to either of these sources, the circuit breaker or other in-line fuse should be rated at 10 amps.

It is recommended that lugs be used to connect the power cable to the DC supply and the lug connections should be both crimped and soldered. This is very important in order to ensure adequate current draw to the equipment. If an insufficient connection is made to the power source, the unit may not work properly. The connection terminal should be clean, with no sign of corrosion.

The RED (+) wire is connected to the positive terminal of the power source. The BLACK (-) wire is connected to the negative (ground) of the power source. Should the power connections be inadvertently reversed, the unit will not power up but no damage will occur. Simply check the polarity with a VOM (Voltage/Ohm Meter) and reconnect observing correct polarity. If the fuse ever needs replacement, be sure to use the same type and rating.

2.4.2 Hailer Cable Connections

The YELLOW (+) wire and GREEN (-) wire are used for connecting the RAY230/RAY230E to a Hailer Horn speaker. (Refer to Figure 2-3)

Three watts of audio output power are provided for an external 4 ohm speaker. A suitable speaker can be purchased from your local marine dealer. Connect the YELLOW (+) wire and GREEN (-) wire to the speaker observing polarity as it is marked on the speaker. When connected, the external

speaker will function simultaneously with the internal speaker.

2.4.3 NMEA Data

The RAY230/E accepts NMEA 0183 data from a position determining device (GPS, Loran, etc.) to provide the Latitude and Longitude position information that is transmitted during a DSC Distress Call. The NMEA sentences that provide positional data, by order of priority are: GGA, RMC, RMA, and GLL.

Connect the input(s) of the positioning device to the white (NMEA+) and black (NMEA-) wires in the Power/Hailer/NMEA cable.

For example, to connect a Raymarine Heading Sensor to the NMEA input, connect the cables and power supply using a suitable connector block, as shown in the diagram below. If installed, it may be convenient to connect the power to the SeaTalk auxiliary junction box described in the following section.

Note:
All return connections (-) must be tied to a common ground reference.

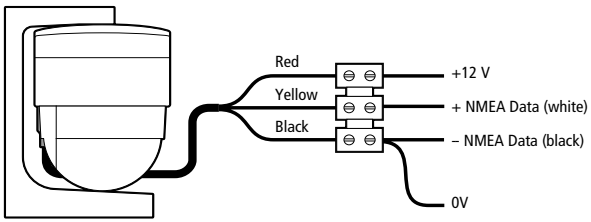


Figure 2-5 Sample GPS Connections

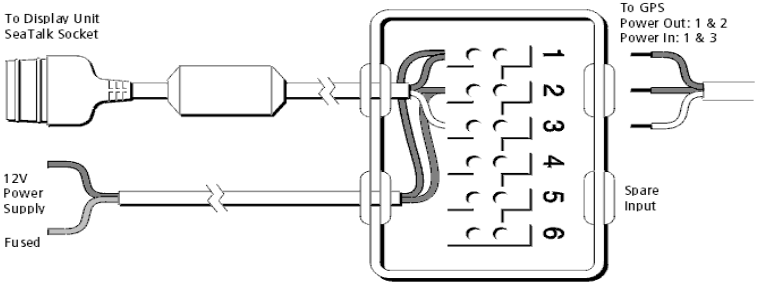
2.4.4 Using the SeaTalk Auxiliary Junction Box

A junction box is used to connect the SeaTalk instrument system to the RAY230. This junction box enables the SeaTalk bus, power and GPS to be connected.

If power is not already available (via another SeaTalk instrument), the junction box can be used to apply power to the SeaTalk bus for other applications. The junction box may also be used for connecting an NMEA GPS system.

The junction box includes:
- SeaTalk cable and connector to attach to display unit
- Power cable to connect to 12 V power (if required)
- Input connections to connect SeaTalk cable from external equipment
- Spare connections for another instrument

The illustration below shows how to connect the junction box.



Cable	Core	Terminal	Function
SeaTalk	Black (screen)	1	0V
	Red	2	+12v
	Yellow	3	SeaTalk
Power	Black (screen)	1	0V
	Red	2	+12V
GPS	Black (screen)	1	0V
	Red	2	+12V
	Yellow	3	SeaTalk

Figure 2-6 SeaTalk Junction Box Connections

2.4.5 Antenna Connections

Your coaxial VHF antenna cable connects to the RAY230/E antenna cable on the rear panel using a PL259 VHF type connector. Your VHF antenna cable can be cut to length but the overall cable length can be critical to performance. If you are uncertain, contact a professional installer or call Raymarine Customer Service. If a longer cable length is required, RG-58 (50 ohm) coaxial cable or equivalent cable can be used for runs up to a maximum of 50 feet. If the distance required is even greater, we recommend using low loss RG-213 or equivalent cable for the entire run to avoid excessive losses in power output.

If the antenna RF connector is likely to be exposed to the marine environment, a protective coating of grease (Dow Corning DC-4 or similar) can be applied to the connector before connecting it to the radio. Any other extensions or adapters in the cable run should also be protected by silicon grease and then wrapped with a waterproofing tape.

2.4.6 Antenna Mounting Suggestions

The best radio in the world is useless without a quality antenna and good location. Mounting the VHF antenna properly is very important because it will directly affect the performance of your VHF radio. A VHF antenna designed for marine vessels should be used.

- Since VHF transmission is essentially line-of-sight, mount the antenna at the highest possible location on the vessel and free of obstruction to obtain maximum range.
- If you must extend the length of the coaxial cable between the antenna and the radio, use a coaxial cable designed for the least amount of power loss over the entire cable length.
- Keep the coaxial cable between the radio and antenna as short as possible but remember to maintain the recommended 3 feet between the radio and antenna.

2.4.7 Grounding

While special grounding is not generally required for VHF radiotelephone installations, it is good marine practice to properly ground all electronic equipment to the ship's ground system. The RAY230/E can be connected to ground by attaching a wire to one of the screws on the unit's rear panel and then to the nearest ship's ground connection point. The recommended wire to be used for such grounding is #10 AWG.

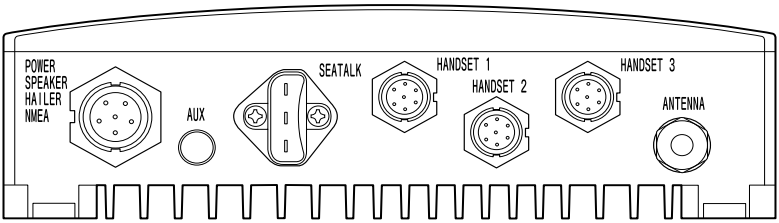


Figure 2-7 Typical Grounding Methods

SECTION 3 OPERATIONS

3.1 Introduction

The RAY230 has the capability to transmit and receive on all available US, Canadian, and International Marine VHF radiotelephone channels. The RAY230E can transmit and receive on all available International and US 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.) Refer to Table 3.5.31, which lists all marine VHF channels available in your RAY230/RAY230E for US, International and Canadian radiotelephone use. Full familiarization of these tables is essential when selecting your channels to ensure proper channel usage.

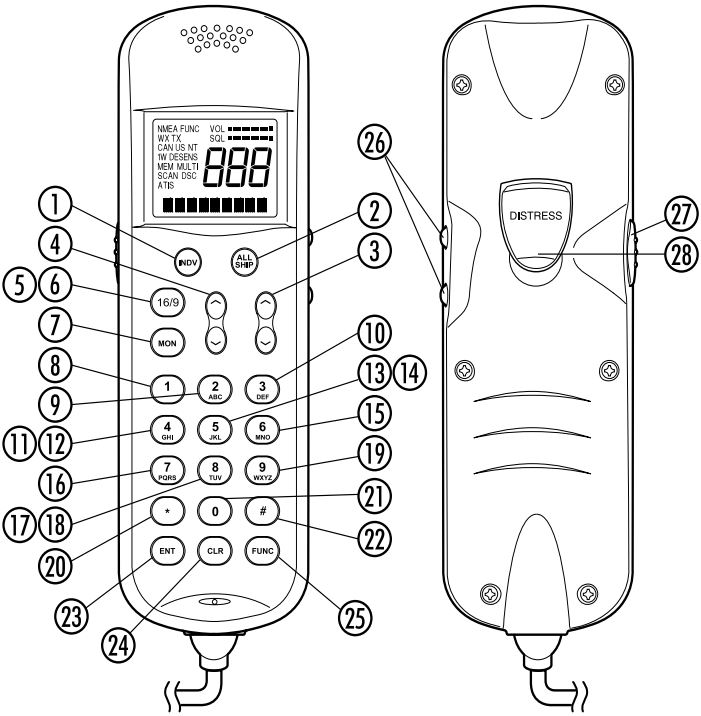


Figure 3-1 Layout of Controls

3.2 Controls and LCD Display

3.2.1 Controls

① INDV key

Switches to the DSC Individual Ships Call mode for initiating ship-to-ship or ship-to-shore calls using a specific MMSI number. Descriptions of subsequent operations appear below in sections 3.5.26.1 and 3.5.26.2.

② ALL SHIP key

Switches to the All Ships Call mode for Safety and Urgency transmissions. Descriptions of subsequent operations appear below in section 3.5.26.5 Transmitting All Ships Call.

③ SQ UP/DOWN (SCROLL) key

Increases or decreases the squelch sensitivity. Pressing the UP ∧ key increases the squelch, while the DOWN ∨ key decreases it. The number of segments in the SQ bar graph on the LCD display will increase or decrease accordingly. This key is also used as a scroll key for changing the channel number and other settings, as described below.

④ VOL UP/DOWN key

Changes the sound volume of the handset. Pressing the UP ∧ key increases the volume, while the DOWN ∨ key causes it to decrease. The number of segments in the VOL bar graph on the LCD display will increase or decrease accordingly.

⑤ 16/9 key (RAY230 US version only)

Switches between the Working Channel and the Priority Channel. Pressing and holding the key for 2 seconds alternates the Priority Channel between channel 9 and channel 16. When the transceiver's main power switch is turned on, this key is also used to power the system ON or OFF.

⑥ 16 key (RAY230E European version only)

Switches between the Working Channel and Channel 16 (the Priority Channel).

⑦ MON/TRI key

Starts the Dual-Watch monitor mode. Pressing the FUNC key followed by the MON/TRI key initiates the Tri-Watch monitor mode.

⑧ 1/MEM key

This key inputs the number 1. When an alphanumeric response is appropriate, this key alternates between entering a 1 and a space. If the channel number indicated on the LCD display is not currently stored in memory, pressing the FUNC key followed by the 1/MEM key enters that channel number into memory. If the currently indicated channel has already been stored, pressing the FUNC key followed by the 1/MEM key deletes that channel from memory.

⑨ 2/SCAN key

This key inputs the number 2. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters A, B, C, then 2. Pressing the FUNC key followed by the 2/SCAN key toggles Scan mode ON or OFF. Scan mode is described below in Section 3.5.21.

⑩ 3/CELL key

This key inputs the number 3. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters D, E, F, then 3. Pressing the FUNC key followed by the 3/CELL key connects the handset with any auxiliary communication equipment with DTMF interface (RAYCOM Cellular, Mini-M, etc.) connected to the AUX port at the rear of the transceiver. See section 3.5.19.

⑪ 4/INT key (RAY230 only)

This key inputs the number 4. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters G, H, I, then 4. Pressing the FUNC key followed by the 4/INT key alternates the frequency groups from US mode to International mode to Canadian mode.

⑫ 4/US key (RAY230E only)

This key inputs the number 4. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters G, H, I, then 4. Pressing the FUNC key followed by the 4/US key alternates the frequency groups between US mode and International mode.

⑬ 5 key (RAY230 only)

This key inputs the number 5. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters J, K, L, then 5.

⑭ 5/PRIV key (RAY230E only)

This key inputs the number 5. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters J, K, L, then 5. Pressing the FUNC key followed by the 5/PRIV key switches to the Private Channel mode. To select the desired Private Channel, press the FUNC key followed by the 5/PRIV key, then input the number key(s) corresponding to the desired channel number and press ENT.

⑮ 6/WX key

This key inputs the number 6. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters M, N, O, then 6. Pressing the FUNC key followed by the 6/WX key alternates between the Working Channel and the Weather Channel. For the RAY230E European model, this operation is valid only in US frequency mode.

⑯ 7/ D/L key

This key inputs the number 7. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters P, Q, R, S, then 7. Pressing the FUNC key followed by the 7/D/L key toggles between full receiver sensitivity (distant mode) and attenuated receiver sensitivity (local mode). Local mode is used in high traffic areas to decrease unwanted reception. While in local mode (receiver is desensitized), the DESENS indicator appears in the LCD display.

⑰ 8 key (RAY230 only)

This key inputs the number 8. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters T, U, V, then 8.

⑱ 8/ M-CALL key (RAY230E only)

This key inputs the number 8. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters T, U, V, then 8. Pressing the FUNC key followed by the 8/M-CALL key starts Multi-Call mode. If the key is pressed during Multi-Call mode, the operation returns to normal mode.

⑲ 9/ 1/25 key

This key inputs the number 9. When an alphanumeric response is appropriate, each press of this key alternately inputs the characters W, X, Y, Z, and then 9. Pressing the FUNC key followed by the 9/1/25 key alternates the transmission power between 1W and 25W.

⑳ */HAIL key

This key inputs an asterisk (*). Pressing the FUNC key followed by the */HAIL key initiates the Hailer mode, which enables a Hailer Horn speaker to be used as a loud speaker or a directional microphone. Pressing this key during Hailer mode returns operation to normal mode.

㉑ 0/IC key

This key inputs the number 0. Pressing the FUNC key followed by the 0/IC key starts Intercom mode, which enables conversation between handsets. Pressing this key during Intercom mode returns operation to normal mode.

㉒ #/FOG key

This key inputs the # character. Pressing the FUNC key followed by the #/FOG key initiates the Fog Alert mode, which enables a Hailer Horn speaker to sound several types of automatic or manual alert tones.

㉓ ENT/MENU key

This key performs the Enter function. It is used to confirm and implement an input action. Pressing the FUNC key followed by the ENT/MENU key initiates the Menu mode. Pressing the key during Menu mode returns the operation to normal mode.

㉔ CLR/LOG key

Depending on when it is used, this key exits the current mode and reverts to the last used mode or normal operation. This key also can be used to clear any alphanumeric inputs one at a time in the order that they were entered. Pressing the FUNC key followed by CLR/LOG key initiates the Digital Selective Calling (DSC) Log. Pressing the key during logging returns operation to normal mode.

㉕ FUNC/DIM key

Initiates the Function mode and activates the FUNC indicator in the LCD display. The next key pressed determines the function selected. (See above key descriptions.) Pressing this key twice starts Dimmer mode, which reduces the brightness of LCD's backlight.

㉖ Channel UP/ DOWN switch

Pressing this switch during normal operation changes the channel number UP or DOWN.

㉗ PTT (Press-to-Talk) switch

Pressing this switch during normal operation places the radio in Transmit mode and displays the TX indicator in the LCD. When the switch is pressed in various function modes, the assigned operation is initiated.

Note: *After 5 minutes of continuously holding the PTT switch, the radio will automatically stop transmitting so that it can receive any incoming messages. To begin transmitting again, release the PTT and depress again.*

㉘ DISTRESS switch

This switch is located under the small door labeled DISTRESS on the back of the handset. Pressing and holding this switch for 4 seconds selects Distress Signal Call mode. Subsequent operations are described in section 3.5.26.7.

3.2.2 LCD Display

The following describes the functional characters on the RAY230/RAY230E Handset's LCD.

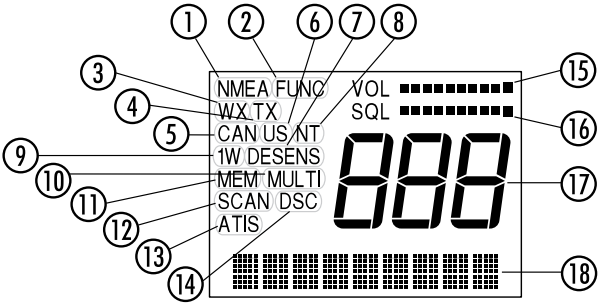


Figure 3-2 LCD Display Layout

① NMEA indicator

Displayed when the radio receives valid SeaTalk or NMEA position data. If the data is invalid or no data is received for a period of time, the indicator disappears.

② FUNC indicator
Displayed when the FUNC key is pressed. Disappears when another key is pressed, or after no other key is pressed for a period of time.

③ WX indicator
Displayed while in Weather Channel or Tri-Watch monitor mode. For the RAY230E, this indicator only appears in the US frequency mode.

④ TX indicator
Displayed while transmitting.

⑤ CAN indicator (RAY230 only)
Displayed when the Canadian frequency group is selected.

⑥ US indicator
Displayed when the US frequency group is selected.

⑦ DESENS indicator
Displayed during the desensitized receiving (local) mode.

⑧ INT indicator
Displayed when the International frequency group is selected.

⑨ 1W indicator
Displayed when the transmission power of 1W is selected with the 9/1/25 key or when a low power channel is selected.

⑩ MULTI indicator (RAY230E only)
Displayed while the channel stored in Multi-Call memory is displayed.

⑪ MEM indicator
Displayed while the channel stored in memory is displayed. This indicator flashes before the start of the memory scan operation.

⑫ SCAN indicator
Displayed during Scan mode. If channels have been stored in memory, this indicator will be flashing before the start of Scan mode.

⑫ MEM indicator
Displayed while the channel stored in memory is displayed. This indicator flashes before the start of the memory scan operation.

⑬ ATIS indicator
Displayed when the ATIS (automatic identification transmission) feature is turned on (via the Menu mode).

⑭ **DSC indicator**
Displayed when in a Digital Selective Calling (DSC) call mode, DSC log, or the DSC menu.

⑮ **VOL indicator (in bar graph)**
Represents the current sound volume level of the handset. A louder volume displays a larger number of segments in the bar graph. This bar graph is not displayed during Menu mode.

⑯ **SQL indicator (in bar graph)**
Represents the current squelch level. A deeper squelch displays a larger number of segments in the bar graph.

⑰ **Three-digit, Seven-segment indicators**
Display the channel number or state of the radio.

⑱ **Nine-digit Dot-matrix display**
Displays alphanumeric messages, modes, and functional status of the radio.

3.3 Radio Functions

3.3.1 RAY230 US Version

1) Selecting the Frequency Mode
Channel selection is available from among three frequency groups: US, International, or Canadian.

2) Receiving the Weather Channels
The RAY230 is programmed to receive 10 NOAA weather channels and will sound an alarm if a Weather Alert is received.

4) Selecting the Priority Channel
Select Channel 16 or Channel 9 as the Priority Channel.

5) Dimmer Operation
Select from four LCD backlight levels, including OFF.

6) Monitor Operation
Select from Dual-Watch or Tri-Watch mode.

7) Scan Operation
Select from All Scan or Memory Scan.

8) Selecting Transmission Power Output
Select either 1W or 25W for the transmission power.

9) Digital Selective Calling (DSC) Operation

Conforms to all class D functionality of a VHF DSC radio in accordance with RTCM SC-101 and ITU 493. These functions include Individual Ships Call, All Ships Call, Distress Call, Group Call, and DSC logging capability.

10) NMEA Receiving Operation

Positional information from external equipment is obtained using the NMEA 0183 interface. Receivable commands are limited to the position commands of GGA, GLL, RMC, and RMA and to the status commands of RMC, APB, GLL, and APA.

11) SeaTalk Operation

Position data from other Raymarine equipment is obtained using the SeaTalk line.

12) Remote Operation

Up to three full function handsets can be connected to the RAY230. Auxiliary handsets can be housed in the cradle, enabling you to listen to radio reception from the external speaker.

13) Intercom Function between Handsets

The Intercom function is available when two or more handsets are connected.

14) Reduced Receiving Sensitivity (Local Mode)

This function decreases receiver sensitivity in high traffic areas to decrease unwanted reception.

15) Hailer Operation

The Hailer Horn speaker can be used as a loud speaker or a directional microphone.

16) Fog Horn Operation

The Hailer Horn speaker can sound several types of fog alerts.

17) Cellular Phone Operation

By connecting an optional RAYCOM Cellular Fixed Wireless Terminal (or other DTMF formatted communications device, such as the Mini-M) to the AUX terminal, the handset can be used as a cellular phone. See section 3.5.19.

3.3.2 RAY230E European Version

1) Selecting the Frequency Mode

Channel selection is available from two frequency groups: US and International. In the US mode, the radio only has access to US channels.

2) Private Channel Operation

Any of the channels from Channel 1 to Channel 10 can be designated as the Private Channel.

3) Multi-call Operation

The Multi-Call function stores in memory up to 8 channels for each of the 2 frequency groups.

4) Weather Channel Access Operation

The RAY230E is programmed to receive 10 NOAA weather channels and will sound an alarm if a Weather Alert is received. This operation is available only in US frequency mode.

5) Channel Memory Operation

Channels that are stored in memory in the same frequency group can be scanned using the Memory Channel Scan function.

6) Priority Channel Operation

Channel 16 is designated as the Priority Channel.

7) Dimmer Operation

Select from four LCD backlight levels, including OFF.

8) Monitor Operation

Select from Dual-Watch or Tri-Watch mode.

9) Scan Operation

Select from All Scan or Memory Scan.

10) Selecting Transmission Power Output

Select either 1W or 25W for the transmission power.

11) Digital Selective Calling (DSC) Operation

This operation conforms to EN 301 025 in accordance with ITU-RM493. These functions include Individual Ships Call, All Ships Call, Distress Call, Group Call, and DSC logging capability.

12) NMEA Receiving Operation

Positional information from external equipment is obtained using the NMEA 0183 interface. Receivable commands are limited to the position commands of GGA, GLL, RMC, and RMA and to the status commands of RMC, APB, GLL, and APA.

13) ATIS Operation

When operating in inland waterways, many European countries require automatic identification transmission, in accordance with ETS300 698. The RAY230E has the capability of activating this ATIS function. This radio is also equipped with "ATIS Killer" to squelch unwanted electrical noise associated with ATIS transmissions.

14) SeaTalk Operation

Position data from other Raymarine equipment is obtained using the SeaTalk line.

15) Remote Operation

Up to three full function handsets can be connected to the RAY230E. Auxiliary handsets can be housed in the cradle, enabling you to listen to radio reception from the external speaker.

16) Intercom Function between Handsets

The Intercom function is available when two or more handsets are connected.

17) Reduced Receiving Sensitivity (Local Mode)

This function decreases receiver sensitivity in high traffic areas to decrease unwanted reception.

18) Hailer Operation

The Hailer Horn can be used as a loud speaker or a directional microphone.

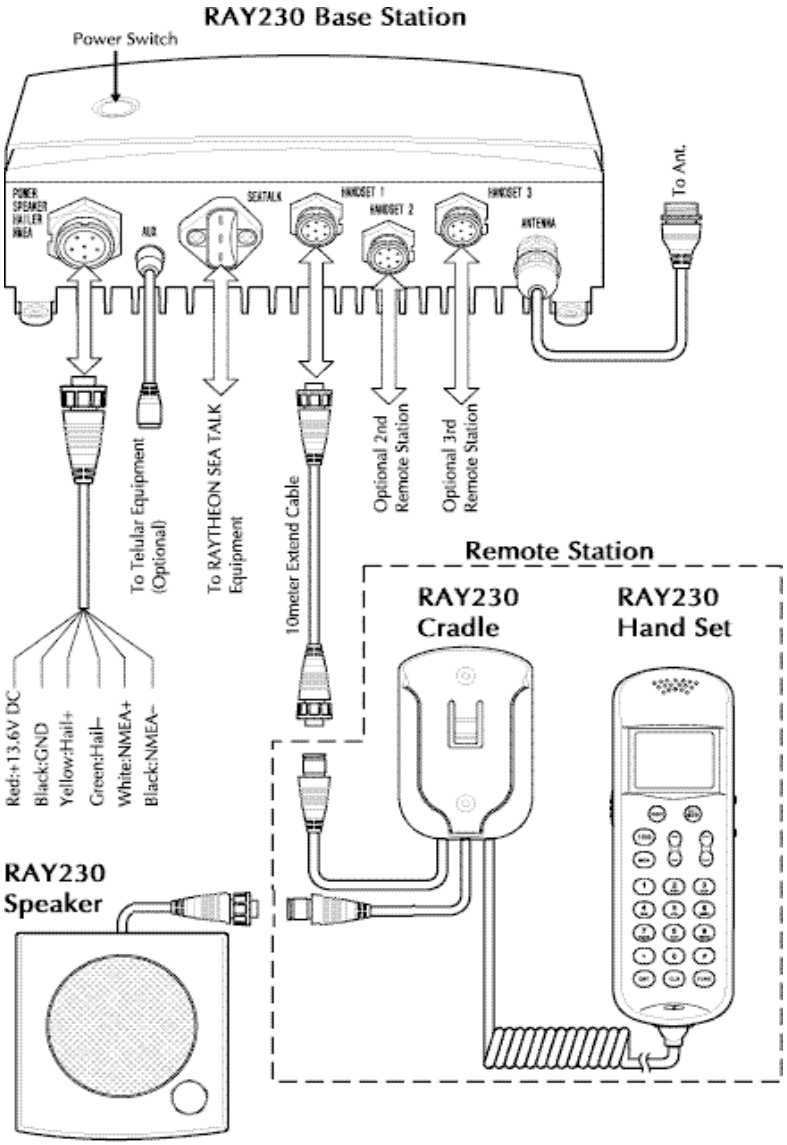
19) Fog Horn Operation

The Hailer Horn speaker can sound several types of manual and auto fog alerts.

20) Cellular Phone Operation

By connecting an optional RAYCOM Cellular Fixed Wireless Terminal (or other DTMF formatted communications device, such as the Mini-M) to the AUX terminal, the handset can be used as a cellular phone. See section 3.5.19.

3.4 Equipment Connections



3.5 Operating Procedures

With the RAY230 and RAY230E, all operations are made on the Handset except turning ON/OFF the main power supply and adjusting the sound volume of the External Speaker.

3.5.1 Turning ON/ OFF the Power Supply

To power on the RAY230/E:

1) Press the main power supply button located on the top of the base station transceiver (main unit). A light illuminates the button when power is ON.
   The main unit and the handset(s) will then be in a standby power condition; the radio circuitry does not yet have power.
2) Press the 16/9 key on any handset. The full system is powered ON.

Note:
If the main power supply switch is OFF, the handsets cannot power the system ON.
If the main power supply switch is ON and multiple handsets are connected, pressing the FUNC and 16/9 key from one handset will fully power ON the system and all handsets.

To power off the RAY230/E:

1) Press the FUNC key followed by the 16/9 key on any handset. The main unit and all handset(s) return to the standby condition.
2) Switch OFF the main power supply. The light illuminating the button goes out. Full system power is OFF.

Note:
If multiple handsets are connected, initiating power OFF from one handset will cause all the handsets (and main unit) to enter the standby condition. Power OFF can be only be initiated from the handset that has priority. See section 3.5.23 below.

3.5.2 Setting the Volume

Setting the Volume on the Handset

The sound volume adjustment for the handset has 11 settings. Pressing and releasing the VOL UP ∧ key increases the volume by one level; pressing and releasing the VOL DOWN ∨ key reduces the volume by one level.

The number of segments in the VOL bar graph on the LCD display will increase or decrease accordingly. If the VOL UP/DOWN keys are pressed and held, the volume levels will automatically change every half-second.

Setting the Volume on the External Speaker

The volume knob on the External Speaker controls its sound volume. Turning the knob clockwise increases the volume; turning it counterclockwise reduces the volume.

Turning the knob fully counterclockwise turns off the volume completely. However, when an alert is received, the tone is sounded at maximum volume regardless of the volume set with the knob.

3.5.3 Setting the Squelch

The squelch adjustment enables you to "quiet" the receiver when no signal is being received. The squelch adjustment for the handset has 11 settings. Pressing and releasing the SQ UP ∧ key increases the squelch by one level; pressing and releasing the SQ DOWN ∨ key decreases it by one level. The number of segments in the SQ bar graph on the LCD display will increase or decrease accordingly. If the SQ UP/DOWN keys are pressed and held, the squelch levels will automatically change every half-second.

3.5.4 Using the Function Key

Most of the keys on the handset control multiple operations. Pressing one of these keys after pressing the FUNC key initiates the operation marked on the label above that key. When the FUNC key is pressed, the FUNC indicator is displayed on the LCD display. If no other key is pressed for 5 seconds, the Function operation is cancelled and the FUNC indicator disappears.

3.5.5 Setting the Frequency Mode (RAY230)

Select the channel frequency group to be used: US, International, or Canadian. Indicators displayed in the LCD identify the active frequency group: US for the US frequency group, INT for the International group, and CAN for the Canadian group.

Pressing the FUNC key followed by the INT key alternates the frequency groups from US mode to International mode to Canadian mode then back to US mode. When the power supply is turned on, the radio is initiated on the last selected Priority Channel (9 or 16) in the frequency group last selected.

When the frequency group is changed, the channel number remains the same as was selected in the previous group, as long as that number is present in the new group. If a channel number is absent in the destination group, the new channel will be the previous number plus 1. When returning to the previous frequency group, the channel returns to its original number if the channel has not been changed. If the channel has been changed, that number is retained when the frequency group is changed.

Example 1
CH15 US ⇒ CH15 INT ⇒ CH15 CAN ⇒ CH15 US
When shifting the frequency group, the channel remains the same because the corresponding channel number exists in the new frequency group.

Example 2
CH2 CAN ⇒ CH3 US ⇒ CH2 INT ⇒ CH2 CAN
No corresponding channel exists in the new frequency group, so the channel is incremented by 1. As long as the channel is not changed further, it returns to its previous number if the frequency group is again changed.

Example 3
CH2 CAN ⇒ CH3 US, then changed to CH5 ⇒ CH5 INT ⇒ CH5 CAN
However, if the channel is changed in the new frequency group, this new number is retained when the frequency group is changed.

3.5.6 Setting the Frequency Mode (RAY 230E)

Select the channel frequency group to be used from either US or International. Indicators displayed in the LCD identify the active frequency group: US for the US frequency group or INT for the International group.

Changing the frequency group
Pressing the FUNC key followed by the INT key alternates the frequency groups from US mode to International mode then back to US mode. When the power supply is turned on, the radio initially operates on Channel 16 in the frequency group last selected.

When the frequency group is changed, the channel number remains the same as was selected in the previous group, as long as that number is present in the new group. If a channel number is absent in the destination group, the new channel will be the previous number plus 1. When returning to the previous frequency group, the channel returns to its original number if the channel has not been changed. If the channel has been changed, that number is retained when the frequency group is changed.

Refer to the examples in section 3.5.5 above, ignoring the references to the Canadian frequency group.

3.5.7 Receiving on the Weather Channels

The Weather Channels consist of Channel 0 through Channel 9. To switch between the Working Channel and the current Weather Channel, press the FUNC key followed by the 6/WX key. While the Weather Channel is active, the WX indicator is appears in the LCD display and the frequency group indicator disappears.

If the channel number is changed while in the Weather mode, the new channel number is stored in memory upon exiting Weather mode. When the power is turned off, the last-used Weather Channel is retained for use when the unit is powered back on.

To exit Weather Mode, press CLR, or FUNC followed by 6/WX.

3.5.8 Selecting the Channel

Two methods are available for selecting the channel: inputting the channel with the numeric keypad then pressing the ENT key or using the Channel UP/DOWN switch on the side of the handset. Both methods are applicable to the three frequency groups on the Working Channel.

Using the Channel UP/DOWN Switch
Pressing the Channel UP ^ switch increments the current channel number by one for each key-click. When the highest channel number is reached, the channel scrolls to the lowest number and increments from there. Pressing the Channel DOWN v switch decrements the current channel number by one for each key-click. When the lowest channel number is reached, the channel scrolls to the highest number and decrements from there. Channel numbers not available in a particular frequency group are skipped.

If the Channel UP/DOWN switch is pressed and held for at least a half second, channels automatically change every 100 milliseconds.

Using the Numeric Keypad
To select a channel, input the desired number on the keypad. For 5 seconds the channel number flashes on the LCD display. If the ENT key is pressed during this 5 second interval, the channel change is implemented. If the 5 seconds elapse without pressing another key, the channel change is implemented anyway. If the CLR key is pressed while the number is flashing, the channel returns to the previous number.

Note: *A leading zero is required for single digit channel numbers.*

3.5.9 Selecting Private Channel (RAY230E)

In the RAY 230E, any of the channels from Channel 1 to Channel 10 can be designated as the Private Channel. To select the Private Channel, press the FUNC key, followed by the 5/PRIV key, then input the channel number on the keypad. For 5 seconds the channel number flashes on the LCD display. If the ENT key is pressed during this flashing phase, the channel change is implemented. If the 5 seconds elapse without pressing another key, the channel change is implemented. If the CLR key is pressed during the flashing phase, the channel returns to the previous number and an error alert tone sounds.

Note:
While using the Private Channel, changing the channel number or pressing the CLR key returns operation to the Working Channel.

3.5.10 Priority Channel for RAY230

In the RAY230 US version, the Priority Channel operates on either Channel 16 or Channel 9. Pressing the 16/9 key during any operation except the Distress Call switches to the Priority Channel. Pressing and holding the 16/9 key for 2 seconds alternates the Priority Channel between Channel 16 and Channel 9.

While using the Priority Channel, pressing the 16/9 key or the CLR key returns operation to the Working Channel.

3.5.11 Priority Channel for RAY230E

In the RAY230E European version, the Priority Channel operates on Channel 16. Pressing the 16 key at any state except the Distress Call shifts operation to the Priority Channel. While using the Priority Channel, pressing the 16 key or the CLR key returns operation to the Working Channel.

3.5.12 Multi-Call Operation (RAY230E only)

The Multi-Call function stores in memory up to 8 channels for quick access for each of the 2 frequency groups. When the frequency group is changed, the radio operates the channels registered in the previous Multi-Call.

Using Multi-Call
To start the Multi-Call operation, press the FUNC key followed by the 8/M-CALL key. The Multi-Call channel used in the previous operation is displayed. Use the Channel UP/DOWN key to increment/decrement through the Multi-Call channels in memory. When exiting Multi-Call, the last-used channel is stored to be used the next time Multi-Call starts.

Changing from the Multi-Call Channel to the Working Channel
During the Multi-Call operation you can return to the Working Channel by again pressing FUNC followed by 8/M-CALL, by pressing the CLR key, or by entering the channel number directly with the ENT key.

Storing the Multi-Call Channel
From the Working Channel mode, select the channel to be stored. Press and release the FUNC key then press and hold the 8/M-CALL key for 3 seconds. The MULTI indicator appears when the registration is complete.

If all 8 Multi-Call channels have already been stored, the registration is terminated and an error alert tone sounds. Also, if you attempt to store as a Multi-Call channel either a Weather Channel, a Private Channel, or Channel 70 for DSC, the registration is terminated and an error alert tone sounds.

Deleting a Channel from Multi-Call
From the Working Channel mode, select the channel to be deleted. Press and release the FUNC key then press and hold the 8/M-CALL key for 3 seconds. The MULTI indicator disappears when the channel has been deleted.

3.5.13 Channel Memory

Channels that are stored in memory in the same group can be scanned using the Memory Channel Scan function. Channels can be stored in memory for each frequency group; when the frequency group is changed, the radio operates according to the channels stored in memory for that group.

Storage in memory of Weather Channels, the Private Channels, or Channel 70 for DSC is disabled. When storage of these channels is attempted, the registration is terminated and an error alert tone sounds.

Storing Channels in Memory
From the Working Channel mode, select the channel to be stored. Press and the FUNC key followed by the 1/MEM key. The MEM indicator appears when the registration is complete.

Deleting Channels from Memory
From the Working Channel mode, select the channel to be deleted. Press and the FUNC key followed by the 1/MEM key. The MEM indicator disappears when the channel is deleted.

3.5.14 Setting Transmission Power Output

The transmission output can be set at either 1W or 25W. When the power supply is switched on, the output is 25W. Pressing the FUNC key followed by the 9/1/25 key alternates the transmission between 25W and 1W. When 1W is selected, the 1W indicator is displayed on the LCD. When 25W is selected the 1W indicator disappears.

This key is also used to override the programmed 1W setting in US mode on Channels 13 and 67. To override, first select the channel. Press and hold PTT and then the 9/1/25 key. While these keys are pressed, the power output is 25W instead of 1W on these two channels.

3.5.15 Reduced Reception Sensitivity (Local Mode)

You can set the RAY230/E to reduce the receiving sensitivity in high traffic areas to decrease unwanted reception. This is also known as local mode.

To start Sensitivity Reduction, press the FUNC key followed by the 7/D/L key. While the desensitize function (local mode) is active, the DESENS indicator appears in the LCD display. To return to full receiver sensitivity (distant mode), again press the FUNC 7/D/L key combination.

3.5.16 LCD Backlight Function

LCD backlight brightness can be set at four different levels. Press the FUNC/DIM key two times to enter Dimmer mode. Each successive click of the FUNC/DIM key alternates the brightness from Off, to Low, to Medium, to High, then back to Off. As the backlight setting is changed, the dot matrix indicator displays the following messages: DIM OFF for the Off setting, DIM LOW for Low, DIM MID for Medium, and DIM HI for High.

When the ENT or CLR keys are pressed or when no other key operation is made for 5 seconds, the current state is accepted and stored in memory, and the backlight setting operation is complete. The next time the power supply is switched on, the state of the backlight is recalled and is applied to all handsets.

3.5.17 Hailer Mode

The Hailer operation enables the unit to use a Hailer Horn as a loudspeaker. To start the Hailer operation, press the FUNC key followed by the */HAIL key. During Hailer mode, **LdH** appears on the 7-segment display. Press the PTT switch to place the unit in loudspeaker mode. The message HAILING appears in the dot matrix display. Release the PTT switch to place the unit in listen mode. LISTEN appears in the dot matrix display.

The VOL UP/DOWN keys adjust the sound volume separately for both loudspeaker and listening modes. When the radio power supply is switched on, the sound volume is the same as was last used. Each handset has its own volume settings.

To cancel the Hailer operation, again press FUNC followed by */HAIL or press the CLR key.

3.5.18 Fog Alert/Siren Mode

The Fog Alert / Siren operation enables the unit to use a Hailer Horn speaker as a fog horn/siren in one of four different modes. To start the Fog Alert operation, press the FUNC key followed by the #/FOG key. During Fog Alert mode, FOG appears on the 7-segment display.

Use the SQ UP ∧ and SQ DOWN ∨ keys to select one of the following modes, then press the ENT key to enable the selection:

Manu. Fog	Pressing the PTT switch sounds a 500 Hz tone.
Auto Fog	Every 115 seconds, the unit sounds a 500 Hz tone for 5 seconds duration.
Siren	Pressing the PTT switch sounds one of 4 siren sounds that are set up in the Menu operation. See sections 3.5.30.4.3.

A message appears on the dot matrix display depending on the mode selected: MANU for Manual Fog, AUTO for Auto Fog, and SIREN for Siren sounds.

When not sounding an alert during one of the Fog Alert / Siren modes, the unit's listening function is operational. The operation mode is flashed on the dot matrix display: ACT when an alert is being sounded (activated) and LIS while in listening mode.

The following table lists the four siren sounds and the procedure for emitting them from the Hailer Horn speaker. See section 3.5.30.4.2 for set up details.

Number	Sound	How to Operate the Siren
1	"Hi-Lo"	Press and release PTT switch to emit continuous sound. Press PTT again to stop.
2	Siren	Press and release PTT switch to emit continuous sound. Press PTT again to stop.
3	Whelp	Press and hold PTT switch to emit sound. Release PTT to stop.
4	Air Horn	Press and hold PTT switch to emit sound. Release PTT to stop.

The VOL UP/DOWN keys adjust the sound volume for both Fog Alert and listening modes. When the radio power supply is switched on, the sound volume is same as was last used. Each handset has its own volume settings.

To cancel the Fog Alert operation, again press FUNC followed by #/FOG or press the CLR key.

3.5.19 Cellular Phone Mode (Optional)

A cellular fixed wireless terminal (such as the RAYCOM Fixed Cellular Wireless Terminal) or other radio communications device with DTMF interface (such as some Inmarsat Mini-M's) can be connected to the RAY230 or RAY230E, using an optional interface to the AUX terminal. One handset is used for cellular phone operation while optional handsets will monitor transmissions on the last selected working or weather channel. When any DSC call is received or a distress call is transmitted, cellular phone operation is interrupted and radio operation is given priority. Channel 70 is always monitored for incoming DSC calls.

Making a call

To make a cellular phone call, remove the handset from the cradle hook and press the FUNC key followed by the 3/CELL key. CEL appears on the 7-segment display. Enter the telephone number to be called with the numeric keypad. The number you just input appears on the dot matrix display. If the phone number exceed 9 digits, the number scrolls and only the last 9 digits are visible.

Press the ENT key to send the call. Make your phone call as usual. When the call is complete, hang the handset on the cradle hook or again press FUNC followed by 3/CELL. The unit returns to normal operation.

Receiving a call
When a cellular phone call is received, an alert tone is sounded and INCOMING CELL CALL is indicated on the dot matrix display. To answer the call, press the FUNC key followed by the 3/CELL key. Any handset can be used to answer an incoming call but when the call is answered, only this handset can be used for cellular phone operation. Other handsets can only be used for radio signal receiving.

3.5.20 Intercom Mode

When more than one handset is installed, Intercom operation enables talking among the stations (handsets). To start Intercom mode, press the FUNC key followed by the 0/IC key. If only one handset is installed, the operation is cancelled and an error alert sounds.

Note:
The station number can be changed to any name up to a length of 9 letters using the Menu operation. For the details, refer to Section 3.5.30 Menu Operation.
Intercom operation is a duplex operation (much like the telephone in your house), so communication can be performed without pressing the PTT switch.
Although any of the handsets can initiate an intercom call, only one handset can perform this function at a time.

Making a Call
Press the FUNC key followed by the 0/IC key to enter Intercom mode. Use the SQ UP ∧ and SQ DOWN ∨ keys to choose the station (handset) to be called: HANDSET 1, HANDSET 2 or HANDSET 3. Then press the ENT key to enter your selection. While calling, CALLING and the handset being called are shown every second on the dot matrix display. When the other station is on the line, the message CALLING turns to CONNECT. If the other station does not respond within one minute, the unit exits Intercom mode.

To exit Intercom mode, hang the handset on the cradle, press the CLR key, or again press FUNC followed by 0/IC.

Receiving a Call When the Handset is on the Cradle
When an Intercom call is received, the external speaker emits a calling tone and CALL FROM with the name of the calling station appear on the dot matrix display once every second. When the handset is removed from the cradle, the calling tone ceases and the message CONNECT appears in the dot matrix display.

Note:
If the handset is not taken out of the cradle within 1 minute after being called, the call is terminated and the dot matrix display is returned to its previous state.

To exit Intercom mode, hang the handset on the cradle, press the CLR key, or again press FUNC followed by 0/IC.

Receiving a Call When the Handset is Off the Cradle
When an Intercom call is received, the handset speaker emits a calling tone and CALL FROM with the name of the calling station appear on the dot matrix display once every second. To answer the call, press the FUNC key followed by the 0/IC key. The calling tone ceases and the message CONNECT appears in the dot matrix display.

Note:
If the call is not answered within 1 minute after being called, the call is terminated and the dot matrix display is returned to its previous state.

To exit Intercom mode, hang the handset on the cradle, press the CLR key, or again press FUNC followed by 0/IC.

3.5.21 Scan Mode

During Scan mode, the RAY230/RAY230E searches through the channels, stops when radio traffic is detected, then resumes scanning after the traffic ceases. Two scan functions are available: All Channel Scan and Memory Channel Scan. The All Channel Scan function searches all channels (except Weather Channels, Private Channels, or Channel 70) within the same frequency group. The Memory Channel Scan searches only the channels stored in memory in the same group.

The scan begins from the channel following the one currently indicated. The scan is suspended when a carrier is detected. Five seconds after the carrier ceases, the scan resumes with the next channel. If the carrier is detected again before 5 seconds elapse, the timer is re-initialized. Press the 2/SCAN key to resume the scan from the next channel. Press and hold 2/SCAN for 3 seconds or press the PTT (Press to Talk) switch to cancel the scan.

Upon reaching Channel 88, the radio scrolls back to Channel 1 and continues the scan. If the scan stops on a channel with traffic and you wish to communicate with the other party, press the PTT switch to cancel the scan and remain on that channel.

Note:
Both Scan functions exclude Channel 70, which is used exclusively for receiving and transmitting Digital Selective Calling (DSC) functions.

Using Memory Scan
This function is available only when at least one channel has been stored in memory. Press the FUNC key followed by the 2/SCAN key. The messages MEM and SCAN flash for 3 seconds on the LCD. A scan of only the channels in memory is initiated when the 3 seconds elapse or when you press the ENT key before the 3 seconds elapse.

Pressing the 2/SCAN key, the CLR key or the PTT switch during the scan cancels Memory Scan.

Note:
No key functions are accepted while transmitting, Multi-calling, or operating on the Weather or Private channels.

Using All Scan
Press the FUNC key followed by the 2/SCAN key The messages MEM and SCAN flash for 3 seconds on the LCD. Before the 3 seconds elapse, press the 2/SCAN key again to begin All Scan If the 3 seconds elapse before you press the 2/SCAN key, the radio will enter Memory Scan.

Pressing the 2/SCAN key, the CLR key or the PTT switch during the scan cancels All Scan.

Note:
No key functions are accepted while transmitting, Multi-calling, or operating on the Weather or Private channels.

3.5.22 Monitor Mode

Monitor operation can be implemented in one of two modes: Dual-Watch or Tri-Watch.

Dual-Watch
In Dual-Watch Mode, the RAY230/RAY230E operates on the Working Channel while constantly monitoring the Priority Channel. The radio locks onto the Priority Channel or the Working Channel whenever it becomes active, then returns to Dual-Watch when there is no activity.

To start Dual-Watch Mode, select the desired Working Channel then press the MON key. The Working Channel is displayed on the 7-segment display and the Priority Channel appears on the right side of the dot matrix display.

To end Dual-Watch mode at the current channel, press the MON key, the CLR key, or the PTT switch. If Dual-Watch mode is initiated at Channel 70, the operation is cancelled and an error alert sounds.

Tri-Watch for US Model RAY230
In Tri-Watch Mode, the RAY230 operates on the Working Channel while constantly monitoring the Priority Channel then the previously selected Weather Channel for severe weather alert broadcasts. When a signal is detected on the Working Channel or Priority Channel, that channel becomes active. When there is no longer any activity on the Working Channel or Priority Channel, the RAY230 returns to Tri-Watch.

If a weather alert broadcast is detected, the RAY230 emits an alert tone and the WX indicator blinks. Tri-Watch mode terminates and the radio switches to the WX channel to monitor the severe weather broadcast.

To start Tri-Watch mode, select the Working Channel then press the FUNC key followed by the MON/TRI key. The Working Channel appears on the 7-segment display, the Priority Channel appears on the rightmost portion of the dot matrix display, and the Weather Channel appears on the leftmost portion of the dot matrix display.

To end Tri-Watch mode at the current channel, press the MON key, the CLR key, or the PTT switch. If Tri-Watch mode is initiated at Channel 70, the operation is cancelled and an error alert tone sounds.

Tri-Watch for European Model RAY230E
In Tri-Watch Mode, the RAY230E operates on the Working Channel while constantly monitoring Channel 16. Then, a third user-selectable channel is monitored: either the previously selected Weather Channel (in US mode) or the last used Multi-Call Channel (in International mode). When a signal is detected on one of the other channels, that channel becomes active. When there is no longer any activity on the active channel, the RAY230E returns to Tri-Watch.

To start Tri-Watch mode, select the Working Channel then press the FUNC key followed by the MON/TRI key. The Working Channel appears on the 7-segment display, Channel 16 appears on the rightmost portion of the dot matrix display, and the Weather Channel or Multi-Call Channel appears on the leftmost portion of the dot matrix display.

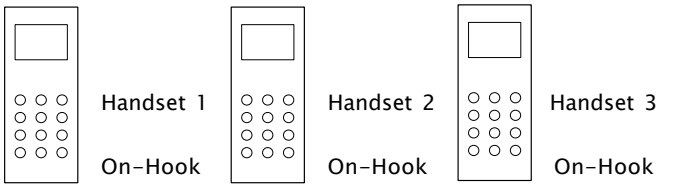
To end Tri-Watch mode at the current channel, press the MON key, the CLR key, or the PTT switch. If Tri-Watch mode is initiated at Channel 70, the operation is cancelled and an error alert tone sounds.

3.5.23 Priority Using Multiple Handsets

If more than one handset has been installed, the station with the highest priority has control of the radio's operation when it is taken off the cradle hook. A handset's priority ranking is determined by its station number, with Handset One having the highest rank and Handset Three having the lowest. Handset One should be located where the ship is normally navigated from, so in the event of an emergency, this handset can take immediate control of the transceiver. The handset name as shown in the dot matrix display can be changed to any name up to a length of 9 letters using the Menu operation. For the details, refer to section 3.5.30 Menu Operation.

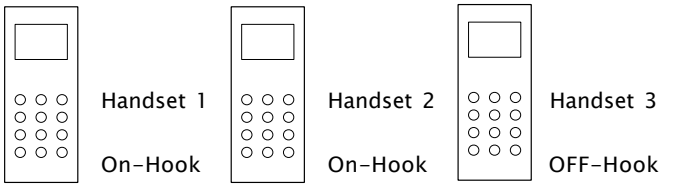
Operation States
Since it has highest priority, key operation is always possible from Handset 1 even while On-Hook. Operation of the other two handsets depends on their On/Off-Hook status.

1) All Handsets On-Hook



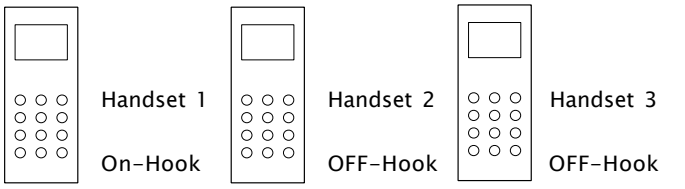
Operation possible Operation disabled Operation disabled

2) All Higher-ranked Handsets On-Hook



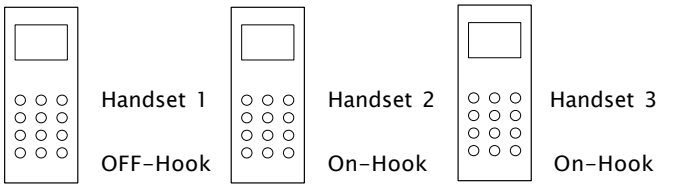
Operation disabled Operation disabled Operation possible

3) Higher-ranked Handset is taken Off-Hook while a lower-ranked Handset is Off-Hook



Operation disabled Operation possible Operation disabled

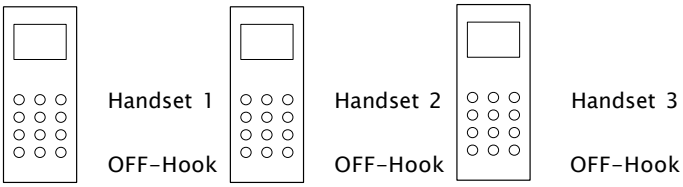
4) Handset 1 is Off-Hook while other stations are On-Hook



Operation possible Operation disabled Operation disabled

5) Handset 1 is Off-Hook while another Handset is Off-Hook

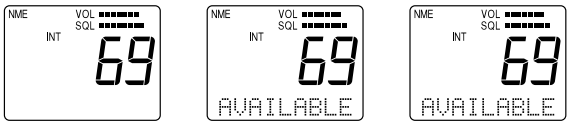
6) All Handsets are Off-Hook



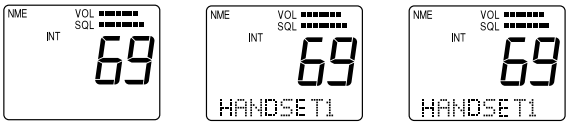
In cases 5 and 6 above, limited operation means the handset can talk on the Intercom, adjust the sound volume, and make a Distress Call.

Handset Display:
The dot matrix display indicates the handset's rank. If Handset 1 has priority, for example, the message AVAILABLE is displayed on the LCD of Handset 1 while HANDSET 1 is displayed on the LCD of the other handsets.

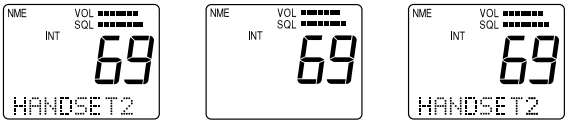
1) If all Handsets are On-Hook



2) If only Handset 1 is Off-Hook



3) If only Handset 2 is Off-Hook.



Handset 1 Handset 2 Handset 3

3.5.24 NMEA Operation

The RAY230/RAY230/E can receive valid position and time information from an external device from an NMEA signal. This information can be broadcast during a DSC call. See section 3.5.26.

Operation at Power Up

At power up, the SeaTalk line is monitored for 1 minute. If a signal is detected, the NMEA line is not monitored. If no signal is detected on the SeaTalk line, the radio is put in monitor mode and switches over to the NMEA line. If no NMEA data is input during the 1 minute monitor time at power up, all the position fields are set to 9's and the time fields are set to 8's. An error alert tone sounds to urge manual entry (see Section 3.5.30.3.2) and the NMEA indicator disappears.

Validating NMEA Data

When an NMEA signal is received, it must be determined whether the data is valid. Receivable commands are limited to the position commands of GGA, GLL, RMC, and RMA and to the status commands of RMC, APB, GLL, and APA. If valid, the data is input and the NMEA indicator is displayed on the LCD.

Operation with Input Data Error

If position data becomes invalid or is not detected, the NMEA indicator flashes and an alert tone of 1-minute duration is sounded at 4 hour intervals to urge manual input of positional data. If no manual input was made during the prior 23.5 hours, all the position data is set to 9's and all the time data to 8's.

3.5.25 SeaTalk Operation

The RAY230/RAY230E can receive SeaTalk position and time information from any SeaTalk capable device. As with NMEA data, if the position information becomes invalid or is not present, you will be prompted to manually input position data.

3.5.26 Digital Selective Calling (DSC)

Digital Selective Calling (DSC) operation includes the following:

1. Transmitting/Receiving an Individual Call
   (including semi-automatic ship to shore phone calls)
2. Receiving a Group Call
3. Transmitting/Receiving an All Ships Call
4. Transmitting/Receiving a Distress Call

With the RAY230 and RAY230E, DSC transmission and reception occurs on Channel 70. Actually, the RAY230/E has a separate receiver exclusively for Channel 70 so that even if receiving under normal operation, the unit can quickly switch over to Channel 70 upon receiving a DSC signal. When the DSC signal is received, the unit performs the corresponding operation. If the radio is transmitting, however, receiving on Channel 70 is disabled.

Transmitting an Individual Call

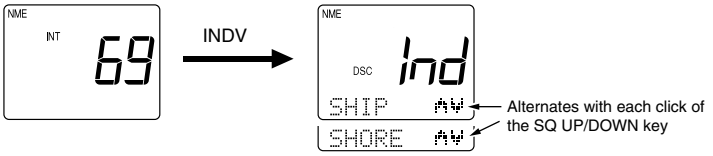
Press the IND key to initiate the call data setup operation. After setting the call data, press the PTT switch to send the call at a transmission output of 1W. The following describes the two types of calling operations: Individual Ship's (ship-to-ship) Call and Shore station (ship-to-shore) Call.

3.5.26.1 Individual Call to another Ship (Ship-to-Ship)

To call another ship, you must select the Working Channel and a specific MMSI number. The MMSI number is selected either manually or from a Phonebook list of preprogrammed numbers specified using the MENU function. To cancel the call, press and hold the CLR key for 4 seconds.

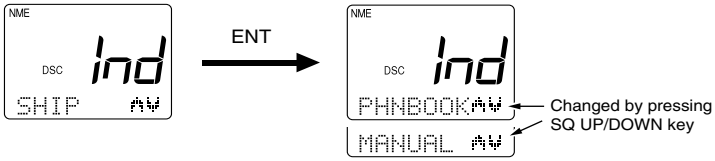
To Make an Individual Call to Ship (ship-to-ship):

1) Press the INDV key. **Ind** appears on the 7-segment display and the DSC indicator is displayed.
Pressing the SQ UP/DOWN key alternates between SHIP and SHORE.

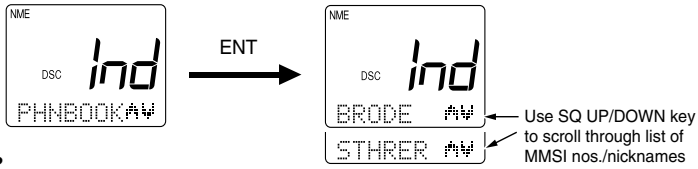


2) Select SHIP and press the ENT key.

3) Scroll with the SQ UP/DOWN keys to select the method for inputting the MMSI number, either from the Phonebook or manually. Press ENT.

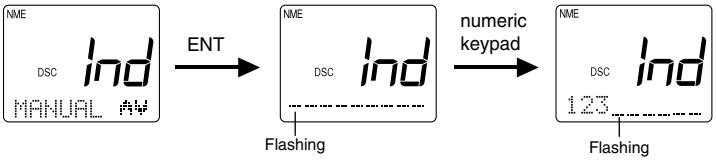


4) Select the MMSI number.
BY PHONEBOOK:
Scroll with the SQ UP/DOWN keys, select the name associated with the desired MMSI number, and press the ENT key. If the MMSI number is not listed in phonebook, the display reverts to manual input.

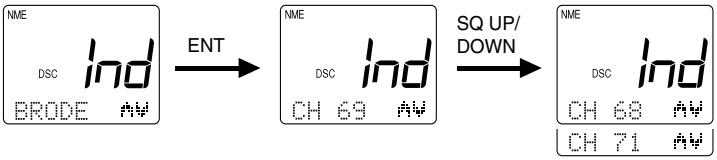


OR

BY MANUAL INPUT:
Input the 9-digit MMSI number with the numeric keypad, then press the ENT key.

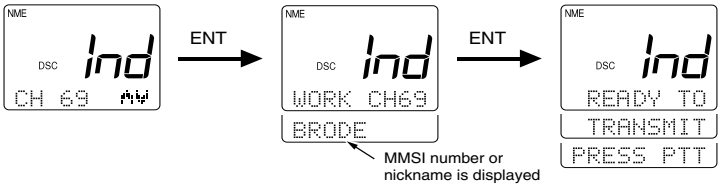


5) Specify the Working Channel with the SQ UP/DOWN keys and press the ENT key.



6) Press the ENT key again. A prompt appears on the display instructing you to press the PTT switch.

7) Press PTT to transmit. If PTT is not pressed within 15 seconds of the prompt appearing, operation returns to the state before the call.

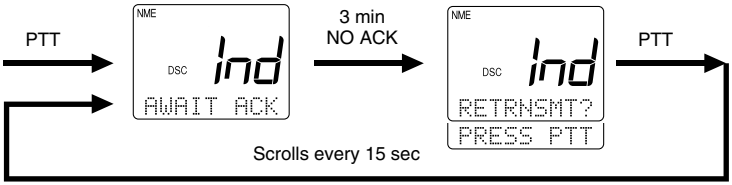


Note: *Only simplex channels (those channels that transmit and receive on the same frequency) can be selected for ship to ship Individual Calls. Pressing the SQ UP/DOWN will scroll you through the simplex channels usable for this operation.*

Response

If a response is received after pressing the PTT switch, a receive-confirmation message is displayed. After 5 seconds have elapsed, the channel is changed to a communication channel and the Individual Ships Call is completed.

If no response is received for 3 minutes after pressing the PTT switch, a prompt to press the PTT switch appears once more. After 15 seconds elapses without pressing the PTT switch following the prompt, operation returns to the state before the call.



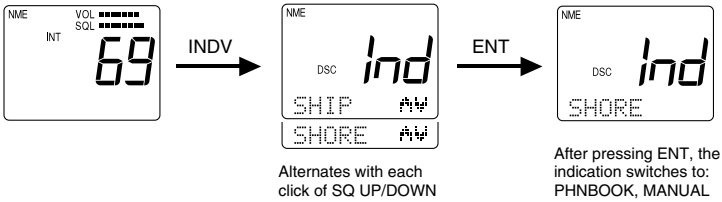
3.5.26.2 Individual Call to Shore Station (Ship-to-Shore)

To call a shore station, you must select the specific MMSI number and, if desired, the telephone number. The MMSI number must be selected from a Phonebook list of preprogrammed numbers specified using the MENU function. The telephone number can be entered manually or preset with the MMSI number in Ship to Shore setup. Channel 16 is automatically assigned for communications.

To cancel the call, press and hold the CLR key for 4 seconds.

To make an Individual Call to Shore Station (ship-to-shore):

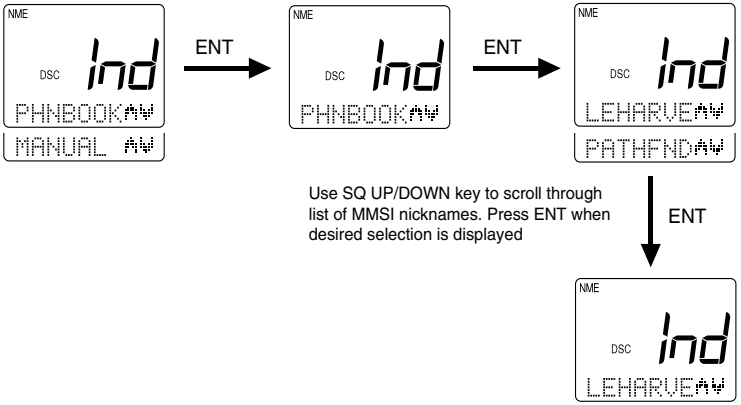
1) Press the INDV key. The Ind appears on the 7-segment display and the DSC indicator is displayed.
   Pressing the SQ UP/DOWN key alternates between SHIP and SHORE.



2) Select SHORE and press the ENT key.

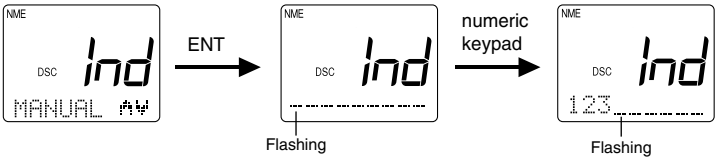
3) Scroll with the SQ UP/DOWN keys to select the method for inputting the MMSI number, either from the phonebook or manually. Press ENT to input your selection.

4) Select the name by MMSI number from the phonebook by scrolling with the SQL UP/DOWN keys, and pressing the ENT key.



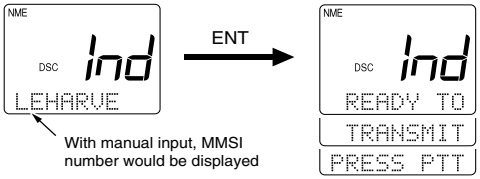
OR

Manually input the phone number with the numeric keypad, then press the ENT key.



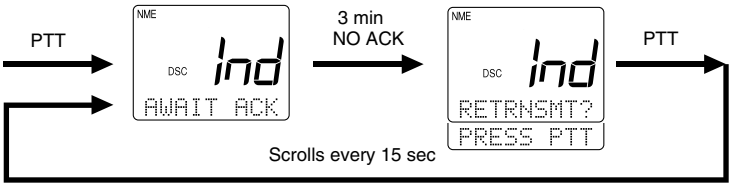
5) Press ENT again. A prompt appears on the display instructing you to press the PTT switch.

6) Press PTT to transmit. If PTT is not pressed within 15 seconds of the prompt appearing, operation returns to the state before the call.



Response
If a response is received after pressing the PTT switch, a receive-confirmation message is displayed. After 5 seconds have elapsed, the channel is shifted to a communication channel and the Individual Call is completed.

If no response is received for 3 minutes after pressing the PTT switch, a prompt to press the PTT switch appears once more. If the PTT switch is not pressed within 15 seconds after the prompt appears, operation returns to the state before the call.



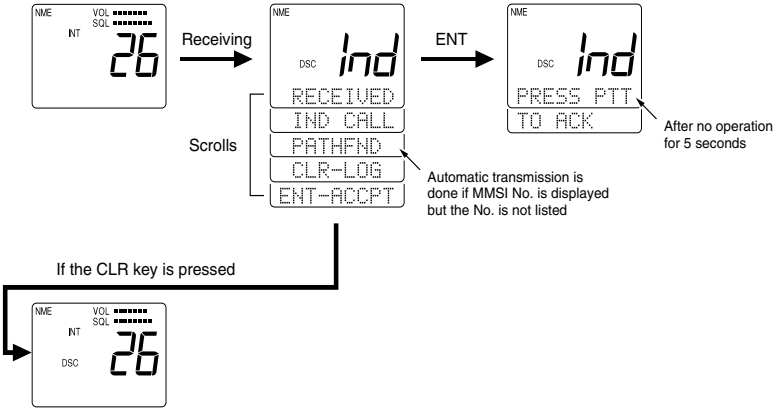
3.5.26.3 Receiving an Individual Call

When an Individual Call is received, the DSC indicator flashes, INd appears on the 7-segment display, and the DSC Received Alert is sounded. On the dot matrix display appears the message RECEIVED IND CALL along with a prompt to press ENT to accept or CLR to log the call. If the MMSI number exists in the list, the associated name is displayed. If no match is found, the actual numeric value of the MMSI is displayed.

Until either the ENT key or the CLR key are pressed, the prompt is flashed at 1-second intervals and is accompanied by an alarm for up to 3 minutes. If neither ENT nor CLR are pressed during these 3 minutes, the radio reverts to the operation mode before receiving the Individual Call. The DSC indicator continues to be flashed on the LCD display until the contents of the log files can be confirmed.

If ENT is pressed, the alarm is turned off, and a new prompt appears on the display, instructing you to press the PTT switch. Press PTT to transmit an acknowledgement (ACK). If PTT is not pressed within 5 seconds of the prompt appearing, the transmission is done automatically. Pressing the PTT switch causes the channel to change to the communication channel.

If the CLR key is pressed, the alarm is turned off and the displays are cleared and the received contents are stored in the Log File. The radio then reverts to the operation mode before receiving the Individual Call. DSC will continue flashing to indicate there is an unread call in the log.



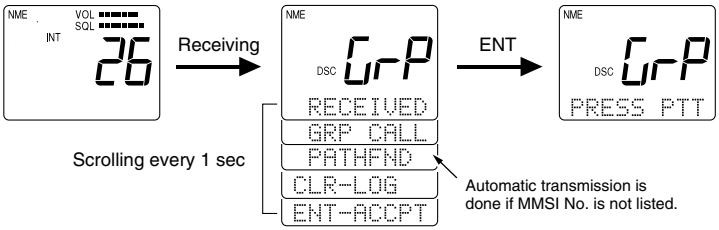
3.5.26.4 Receiving a Group Call

When a Group Call is received, the DSC indicator flashes, INd appears on the 7-segment display, and the DSC Received Alert is sounded. On the dot matrix display appears the message RECEIVED IND CALL, along with a prompt to press ENT to accept or CLR to log the call. If the MMSI number exists in the list, the associated name is displayed. If no match is found, the actual numeric value of the MMSI is displayed.

Until either the ENT key or the CLR key are pressed, the prompt is flashed at 1-second intervals and is accompanied by an alarm for up to 3 minutes. If neither ENT nor CLR are pressed during these 3 minutes, the radio reverts to the operation mode before receiving the Group Call. The DSC indicator continues to be flashed on the LCD display until the contents of the log files can be confirmed.

If ENT is pressed, the alarm is turned off, and a new prompt appears on the display, instructing you to press the PTT switch. Press PTT to transmit. If PTT is not pressed within 5 seconds of the prompt appearing, the transmission is done automatically. Pressing the PTT switch causes the channel to change to the communication channel.

If the CLR key is pressed, the alarm is turned off, the displays are cleared, and the received contents are stored in the Log File. The radio then reverts to the operation mode before receiving the Individual Call. DSC will continue flashing to indicate there is an unread call in the log.



3.5.26.5 Transmitting an All Ships Call

The All Ships Call is classified in two categories: Safety Call and Urgency Call.

To send an All Ships Call

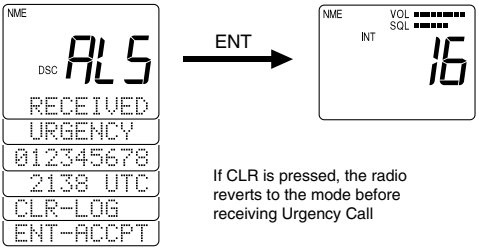
1) Press the ALL SHIP key. The DSC indicator is displayed, and the message SAFETY appears on the dot matrix display.
2) Press the SQ UP/DOWN key. The message URGENCY now appears on the dot matrix display.
3) Make you selection between SAFETY or URGENCY and press the ENT key to submit. The prompt RECONFIRM is displayed.
4) Press the ENT key to confirm. A prompt appears on the display, instructing you to press the PTT switch.
5) Press PTT to transmit the call.

The All Ships Call is made on Channel 16. The transmission power is 1W for a SAFETY Call and 25W for an URGENCY Call.

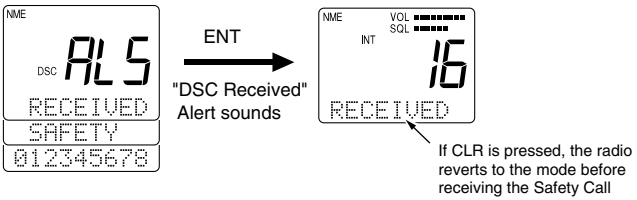
3.5.26.6 Receiving an All Ships Call

When receiving an All Ships Call, the unit's manner of response depends on the type of call received.

When an URGENCY call is received, the DSC Distress alert is sounded. The LCD displays a message that an URGENCY call is being received, along with the sender's MMSI number, and a prompt to press ENT to accept or CLR to log the call. The DSC Distress alert and the displayed message continue until either ENT or CLR is pressed. If ENT is pressed, the radio switches to Channel 16 in 25W mode and the contents of the communication are stored in EEPROM. If CLR is pressed, the radio reverts to the mode before receiving the URGENCY Call and the contents are stored in EEPROM.



When a SAFETY call is received, the DSC Received alert is sounded. The LCD displays a message that an SAFETY call is being received, along with the sender's MMSI number, and a prompt to press ENT to accept or CLR to log the call. The DSC Received alert and the displayed message continue until either ENT or CLR is pressed. If ENT is pressed, the radio switches to Channel 16 in 25W mode and the contents of the communication are stored in memory. If CLR is pressed, the radio reverts to the mode before receiving the SAFETY Call and the contents are stored in memory.

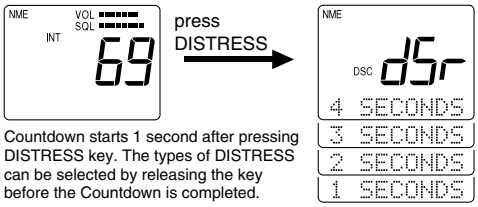


3.5.26.7 Transmitting a Distress Call

Two types of Distress Calls can be made: one that specifies the type of distress and one that does not.

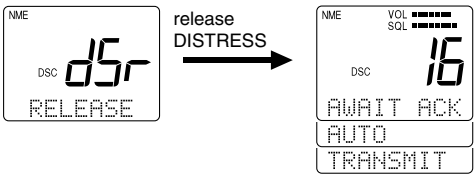
Unspecified Distress Call
To make a Distress Call without specifying type of distress:

1) Open the door labeled DISTRESS on the back of the handset and press and hold the DISTRESS key. The message **dSr** is displayed on the 7-segment LCD and the DSC indicator is displayed. On the dot matrix display, a countdown message appears prompting you to hold the DISTRESS key for 4 seconds.



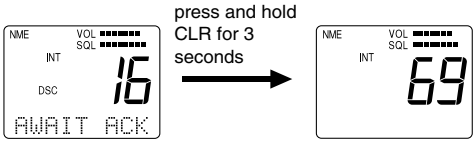
Countdown starts 1 second after pressing DISTRESS key. The types of DISTRESS can be selected by releasing the key before the Countdown is completed.

2) After the countdown has completed, release the DISTRESS key. The unit is switched to channel 16, displays the message AWAIT ACK, and monitors channel 70 for an acknowledgement.

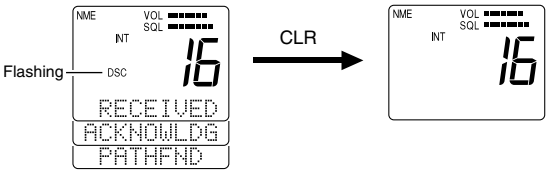


The unit retransmits the DISTRESS call at random intervals of 3.5 to 4.5 minutes, until a response is received or the call is manually cancelled.

To cancel the DISTRESS call, press the CLR key and hold for 3 seconds. The call is cancelled and the unit returns to the state before the call.



When a response is received, the DSC indicator flashes and the DSC Distress alert is sounded. The LCD scrolls a message that the DISTRESS has been acknowledged, along with the sending station's MMSI number. The message and alert are repeated until the CLR key is pressed.



When the CLR key is pressed, the unit exits the DSC mode continues monitoring Channel 16 on high power.

Regardless of the handset state, the DSC Distress alert is sounded at maximum volume on the external speaker.

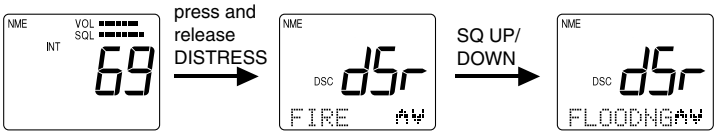
Specified Distress Call

You can assign one of eleven distress types to the call to provide the potential rescuing station additional information if time and circumstances permit. The Nature of the distress call can be selected using the DISTRESS key as outlined below or in the system MENU as outlined in Section 3.5.30.3.1. Below are the messages and their meaning:

Message	Meaning	Message	Meaning
FIRE	fire	ADRIFT	drifting
FLOODNG	flooding	UNDESIG	undesignated
COLLISN	collision	ABNDSHP	abandoning ship
AGROUND	run aground	PIRACY	piracy
LISTING	listing	MANONBD	man overboard
SINKING	sinking		

To make a Distress Call specifying the type of distress:

1) Open the door labeled DISTRESS on the back of the handset and press and release the DISTRESS key on the back of the handset. The message dSr is displayed on the 7-segment LCD and the DSC indicator is displayed. On the dot matrix display, the message FIRE appears.

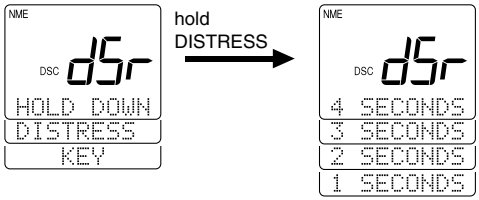


2) If FIRE is the message you wish to attach, press the ENT key.

OR

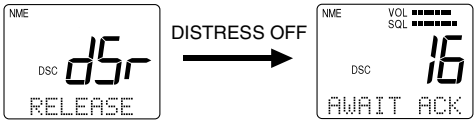
If FIRE is not the message you wish to attach, scroll through the list with the SQ UP/DOWN keys. When the appropriate message is displayed, press the ENT key.

On the dot matrix display, a message appears prompting you to hold the DISTRESS key for 4 seconds. A countdown message is displayed.



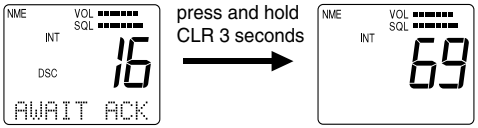
3) Continue to press and hold the DISTRESS key. After 4 seconds have elapsed, the message RELEASE appears, prompting you to release the key.

4) When the prompt appears, release the DISTRESS key. The unit is switched to Channel 16, displays the message AWAIT ACK, and monitors channel 70 for an acknowledgement.



The unit retransmits the DISTRESS call at random intervals of 3.5 to 4.5 minutes, until a response is received or the call is manually cancelled.

To cancel the DISTRESS call, press the CLR key and hold for 3 seconds. The call is cancelled and the unit returns to the state before the call.



When a response is received, the DSC indicator flashes and the DSC Distress alert is sounded. The LCD scrolls a message that the DISTRESS has been acknowledged, along with the sending station's MMSI number. The message and alert are repeated until the CLR key is pressed.

When the CLR key is pressed, the unit exits the DSC mode continues monitoring Channel 16 on high power.

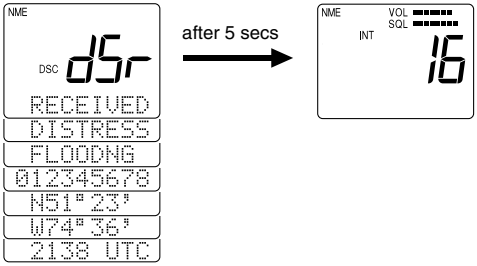
Regardless of the handset state, the DSC Distress alert is sounded at maximum volume on the external speaker.

3.5.26.8 Receiving a Distress Call

When a Distress call is received, the DSC indicator flashes, the message DSr is placed on the 7-segment display, and the DSC Distress alert is sounded. On the dot matrix display are scrolled RECEIVED, DISTRESS, the type of distress, the MMSI number, the transmitting time, the latitude, and longitude of the transmitting station.

The DSC Distress Alert and the displayed message continue until either ENT or CLR is pressed. When ENT or CLR is pressed, the radio switches to channel 16 in 25 W mode and the contents of the communication are stored in memory.

Five seconds after receiving the Distress Call, operation switches to Channel 16. Pressing the CLR key turns off the alert and clears the dot matrix display. The received contents are stored in the Log File.



3.5.27 ATIS Operation (RAY230E only)

The RAY230E European model comes equipped with ATIS capability for inland waterway requirements in Europe. Your dealer or distributor must first activate the ATIS feature before it can be utilized. Once activated, this feature can be enabled or disabled in the system MENU so that the RAY230E can be used in open water or inland waterways. With ATIS enabled, each time the PTT switch is pressed your station ID is transmitted.

3.5.28 Alert Operation

This function emits various sounds to attract the operator's attention for confirming a key operation, warning of an erroneous key operation, or informing of a specific state. The different types of alert sounds are described below.

1) **Key Click**
   This sound is made when a handset key is pressed. In the On-Hook state the sound emits from the external speaker; in the Off-Hook state the sound emits from the handset speaker. The key click volume level is determined by the sound volume setting.

2) **Operation Error Alert**
   This alert sounds when an erroneous key operation is made. In the On-Hook state the sound emits from the external speaker; in the Off-Hook state the sound emits from the handset speaker. The alert tone volume level is determined by the sound volume setting.

3) **DSC Distress Alert**
   This sound is made when receiving a distress call in the DSC receiving mode, receiving an acknowledgment to a transmitted distress signal, or an Urgency signal to All Ships. The alert is output from the external speaker at the maximum sound volume, regardless of the handset volume setting.

4) **DSC Received Alert**
   This sound is made when receiving an Individual Ships Call in DSC receiving mode, a Group Ships Call, or a Safety call to All Ships. In this case the sound is made from the external speaker. The alert is sounded at maximum volume regardless of the volume setting.

5) **DSC Transmission Alert**
This sound is emitted from the external speaker to notify that the DSC code is being sent after transmission is completed. The alert is sounded at maximum volume regardless of the volume setting.

6) **Weather Alert**
This sound is made at the detection of a NOAA Weather Alert. The alert is sounded from the external speaker at maximum volume regardless of the volume setting or handset state.

7) **Cellular Phone Call Sound**
This sound is emitted from the external speaker when a call is received by the optional cellular fixed wireless terminal, if installed. The call volume level is determined by the sound volume setting.

8) **Intercom Call Sound 1**
This sound is made upon receiving a call using the Intercom function, when selected through the Menu operation. If Off-Hook, the sound emits from the handset; if On-Hook, the sound emits from the external speaker at a low volume. The call volume level is determined by the sound volume setting.

9) **Intercom Call Sound 2**
This sound is made upon receiving a call using the Intercom function, when selected through the Menu operation. If Off-Hook, the sound emits from the handset; if On-Hook, the sound emits from the external speaker at a low volume. The call volume level is determined by the sound volume setting.

10) **Intercom Call Sound 3**
This sound is made upon receiving a call using the Intercom function, when selected through the Menu operation. If Off-Hook, the sound emits from the handset; if On-Hook, the sound emits from the external speaker at a low volume. The call volume level is determined by the sound volume setting.

11) **Intercom Call Sound 4**
This sound is made upon receiving a call using the Intercom function, when selected through the Menu operation. If Off-Hook, the sound emits from the handset; if On-Hook, the sound emits from the external speaker at a low volume. The call volume level is determined by the sound volume setting.

12) **Siren 1 ("Hi-Lo" Sound)**
Select this sound option under Siren in the Menu operation. While in Fog/Siren mode, pressing and releasing the PTT switch emits a continuous "Hi-Lo" sound from the Hailer Horn speaker at maximum volume. Pressing PTT again, the Hi-Lo sound stops.

13) **Siren 2 (Siren Sound)**
Select this sound option under Siren in the Menu operation. While in Fog/Siren mode, pressing and releasing the PTT switch emits a continuous siren sound from the Hailer Horn speaker at maximum volume. Pressing PTT again, the siren sound stops.

14) **Siren 3 (Whelp Sound)**
Select this sound option under Fog Siren 1 in the Menu operation. While in Fog/Siren mode, pressing and holding the PTT switch emits a whooping or “whelp” sound from the Hailer Horn speaker at maximum volume. When PTT is released, the whooping sound stops.

15) **Siren 4 (Fog Horn)**
Select this sound option under Fog Siren 1 in the Menu operation. While in Fog/Siren mode, pressing and holding the PTT switch emits an air horn sound from the Hailer Horn speaker at maximum volume. When PTT is released, the air horn stops.

3.5.3 Menu Operation

The menu operation is used for making various settings and confirming the current state. The operation is roughly divided in three functions as follows:

Function	Purpose
1. NAVSTA	Indicates the information input from NMEA or SeaTalk.
2. DSC	To register/modify various settings related to DSC.
3. SETTING	To register the names of stations for Intercom mode, to set the tone of the Fog Siren, and to set the operation mode of ATIS (for RAY230E).

3.5.30.1 Selecting the Menu Operation

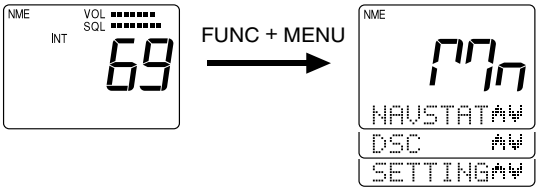
To initiate the Menu function:

1) Press the FUNC key followed by the MENU key. The indication **Mn** is shown on the 7-segment display and NAVSTAT is shown on the dot matrix display.

2) To scroll through these first level menu items, press the SQ UP/DOWN key. The indicators alternate between NAVSTAT, DSC, and SETTING.

3) Select the desired operation and press the ENT key to enter that particular menu item.

To exit the Menu operation, press and hold the CLR key for 3 seconds.



3.5.30.2 NAVSTAT Operation

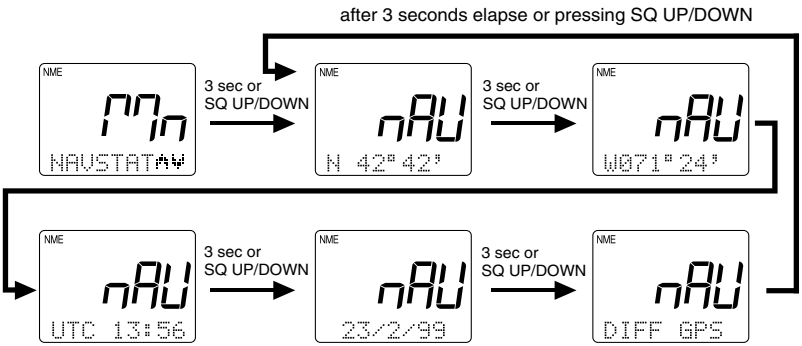
This operation indicates on the LCD display the position information that has been input through NMEA or SeaTalk.

1) Press the FUNC key followed by the MENU key to initiate the Menu operation.

2) Select NAVSTAT and press the ENT key. Scroll through the following five items with the SQ UP/DOWN key, or wait as they are automatically displayed at 3-second intervals in the following order:

   1. Latitude
   2. Longitude
   3. UTC Time
   4. UTC Data (Y/M/D)
   5. Position source (GPS, LORAN, etc.)

This data is for viewing only and can not be altered. Manual position entry is done in the DSC menu as outlined in Section 3.5.30.3.2



To return to the main menu screen, again press FUNC followed by MENU. To exit the Menu operation, press and hold the CLR key for 3 seconds.

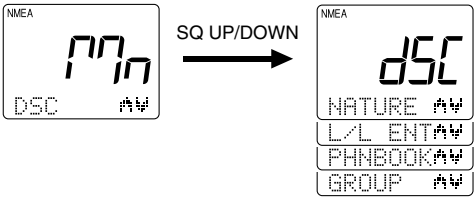
3.5.30.3 DSC Operation

DSC operation includes the manual entry of latitude/longitude, listing of other ship's MMSI numbers for ship-to-ship and ship-to-shore communications, and listing of Group MMSI number.

1) Press the FUNC key followed by the MENU key to initiate the Menu operation.

2) Select NAVSTAT and press the ENT key. The 7-segment display shows **dSC** and the dot matrix display shows L/L ENT.

The DSC Main Menu is made up of NATURE, L/L ENT, PHNBOOK, and GROUP submenus.



3) Press the SQ UP/DOWN key until the desired operation is displayed:

NATURE	Select type of Distress Call
L/L ENT	Manual entry of latitude/longitude
PHNBOOK	Listing of MMSI number
GROUP	Listing of Group MMSI number

4) Press the ENT key to submit.

3.5.30.3.1 Selecting Distress Call Type (NATURE)

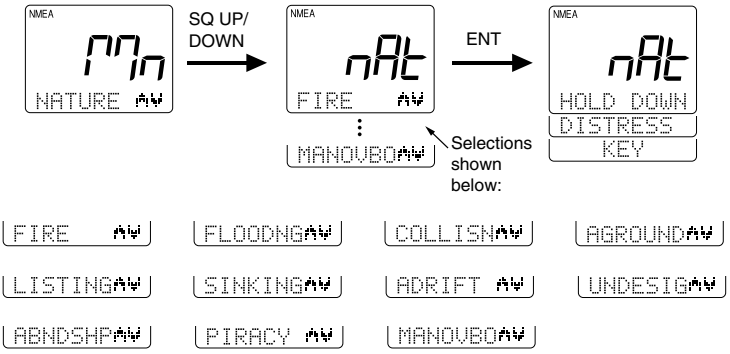
This menu item is used to select the nature of a distress call before the call is sent. The selected information will be sent along with the distress call.

To select the nature of the distress that will be included with the call:

1) As described in section 3.5.30.3 DSC Operation above, select the DSC operation NATURE.

2) Press the ENT key to initiate the process. The 7-segment display shows **nAt** and the dot matrix display shows FIRE.

3) Use the SQ UP/DOWN key to select the type of distress.



3) After selecting the desired distress type, press ENT. You are prompted to press the DISTRESS key.

5) To send the distress call at this time, press and hold the DISTRESS button. Follow the instructions on the display or the steps described in Section 3.5.26.7.

4) To cancel the distress call, press and hold CLR for 3 seconds.

3.5.30.3.2 Manual Entry of Lat/Longitude (L/L ENT)

This operation is used to manually enter the latitude/longitude and UTC time when normal entry of the position information has been disabled.

1) As described in section 3.5.30.3 DSC Operation above, select the DSC operation L/L ENT. The 7-segment display shows **L L**, while the dot matrix display shows the latest latitude data.

2) Press one of the following keys to initiate the corresponding operation:

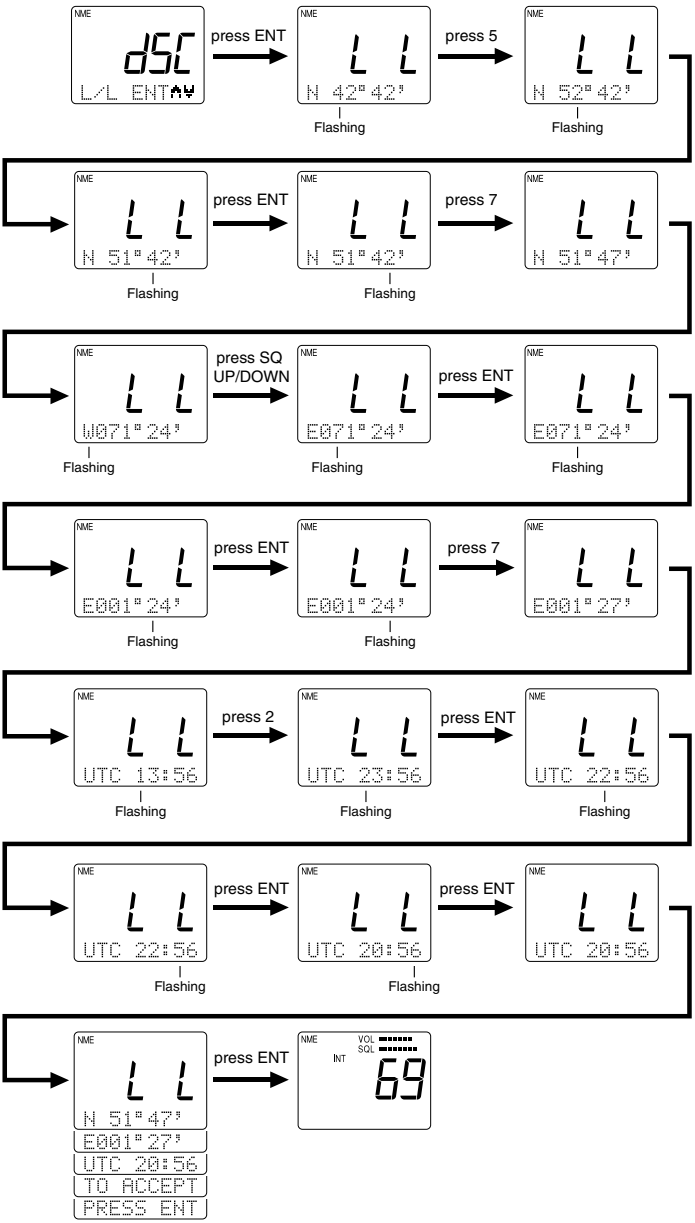
Keys	Action
0 – 9 keys	Changes the flashing numeric value (see step 3), then advances to the next digit's place.
ENT key	Advances the (flashing) subject item to the next one without changing the numeric value. Advances from Latitude, to Longitude, to UTC.
CLR key	Returns to the previous subject item.
SQ UP/ DOWN key	For Latitude, alternates between N and S. For Longitude, alternates between E and W. For UTC, no effect.

3) The subject items can be changed in the following order. Numeric values that can be changed are flashing:

1. Degrees of lat at tens place
2. Degrees of lat at unit's place
3. Minutes of lat at tens place
4. Minutes of lat at unit's place
5. Degrees of lon at hundreds
6. Degrees of lon at tens place
7. Degrees of lon at unit's place
8. Minutes of lon at tens place
9. Minutes of lon at unit's place
10. Hours of UTC at tens place
11. Hours of UTC at unit's place
12. Minutes of UTC at tens place
13. Minutes of UTC at units place

4) After changing the subject item, the display scrolls from latitude to longitude to UTC. To submit the change of the position data as shown in the display, press the ENT key. The unit exits Menu mode and returns to normal operation.

To exit the Menu operation, press and hold the CLR key for 3 seconds. The following illustration shows an example of the operation:

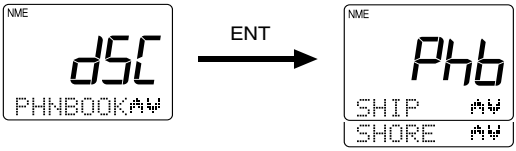

NME
dSC
L/L ENT
press ENT
N 42°42'
Flashing
press 5
N 52°42'
press ENT
N 51°42'
press 7
N 51°47'
press SQ
UP/DOWN
W071°24'
E071°24'
press 2
UTC 13:56
UTC 23:56
UTC 22:56
UTC 20:56
TO ACCEPT
PRESS ENT
VOL
SQL
INT
69

3.5.30.3.3 Modifying the MMSI Number List (PHNBOOK)

This operation is used to modify the "phonebook" lists of MMSI numbers used for DSC Individual Calls. Two lists are available: one for Ship stations and one for Shore stations. Each list enables you to register a maximum of 20 stations. The list for the Ship station allows you to register the MMSI number and nickname of the station, while the list for the Shore station additionally enables you to register the telephone number for semi-automatic ship-to-shore calling.

1) As described in section 3.5.30.3 DSC Operation above, select the DSC operation PHNBOOK.

2) Press the ENT key to initiate the process. The 7-segment display shows **Phb** and the dot matrix display shows SHIP.



3) Use the SQ UP/DOWN key to select between SHIP or SHORE.

4) Press the ENT key to turn to submit your selection.

Modifying the List of Ship Stations

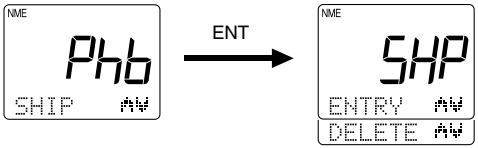
In this operation, a ship is registered (added) to or deleted from the phonebook list for ship stations.

1) When SHIP is displayed, press the ENT key. The 7-segment display shows SHP, while on the dot matrix display shows ENTRY.

2) The ENTRY selection is used to register (add) an item to the list. Press the ENT key to accept.

   The list can hold a maximum of 20 entries. If a list is already full or if the list becomes full during this process, operation returns to the EDIT mode and the indicator PHNBOOK IS FULL is displayed.

3) To delete an item from the list, use the SQ UP/DOWN key to select DELETE and press the ENT key. If no station has yet been registered, the message PHNBOOK IS EMPTY is displayed.



Note:
Pressing and holding the CLR key for 3 seconds during either ENTRY or DELETE returns operation to the mode before the Menu operation began.

Adding Ship Stations to the List
Adding to the phonebook list for ship stations is made in the order: MMSI number and nickname of the station.

1) When the message CONT? Y appears, press the ENT key to submit the registration.

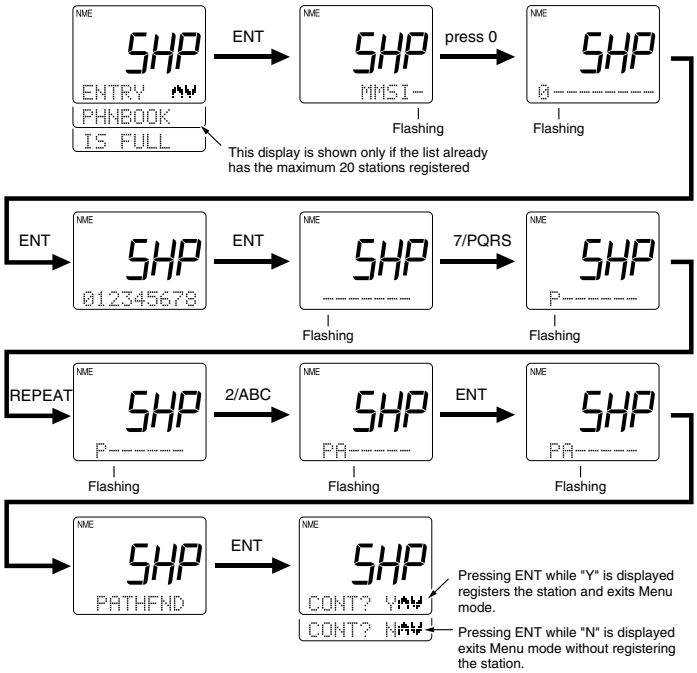
2) To enter the MMSI number, press the corresponding numeric keys (0 through 9). The currently selected location is indicated by a flashing "–" character. Pressing a numeric key enters that value then advances to the next digit's place. To go back by 1 digit, press the CLR key.

3) To enter the nickname, use the numeric keys (0 through 9) to input the associated alpha or numeric value (refer to section 3.2 Controls and LCD Display). The currently selected location is indicated by the flashing "–" character. After inputting the desired letter or numeral, press the ENT key to submit the entry and proceed to the next place.

   To go back by 1 digit, press the CLR key.

   If no nickname is to be registered, press the ENT key for all characters so that they all display a "–".

Note:
*The **0** key will enter only the numeral "0", while the **1** key will alternately enter "1" and "space". The **0** and **1** keys do not have associated alpha characters.*



Deleting Ship Stations from the List

The oldest MMSI number and nickname flashes on the dot matrix display. Press the SQ UP/DOWN key to display all registered stations. To delete the contents indicated, press the ENT key and the message DEL? Y is displayed. Press the ENT key to process the deletion and exit the Menu operation. To exit without deleting, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns operation to the mode before the Menu operation began.

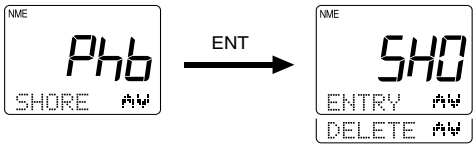
If the list has no stations entered, the message PHNBOOK IS EMPTY HOLD DOWN CLR KEY is displayed. Press and hold the CLR key for 3 seconds to exit Menu mode.

Modifying the List of Shore Stations
In this operation, a shore (coast) station is registered (added) to or deleted from the phonebook list.

1) When SHORE is displayed, press the ENT key. The 7-segment display shows SHO, while on the dot matrix display shows ENTRY.

2) The ENTRY selection is used to register (add) an item to the list. Press the ENT key to accept.
The list can hold a maximum of 20 entries. If a list is already full or if the list becomes full during this process, operation returns to the EDIT mode and the indicator PHNBOOK IS FULL is displayed.

3) To delete an item from the list, use the SQ UP/DOWN key to select DELETE and press the ENT key. If no station has yet been registered, the message PHNBOOK IS EMPTY is displayed.



Note: P*ressing and holding the CLR key for 3 seconds during either ENTRY or DELETE returns operation to the mode before the Menu operation began.*

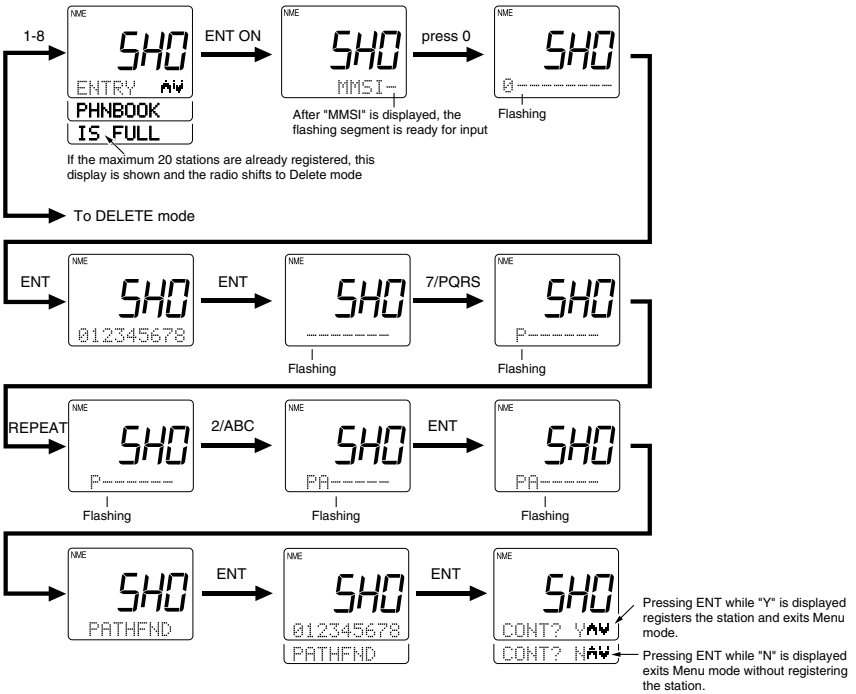
Adding Shore Stations to the List
Adding to the phonebook list for shore stations is made in the order: MMSI number and nickname of the station.

1) When the message CONT? Y appears, press the ENT key to submit the registration.

2) To enter the MMSI number, press the corresponding numeric keys (0 through 9). The currently selected location is indicated by a flashing "–" character. Pressing a numeric key enters that value then advances to the next digit's place. To go back by 1 digit, press the CLR key.

3) To enter the nickname, use the numeric keys (0 through 9) to input their associated alpha or numeric value (refer to section 3.2 Controls and LCD Display). The currently selected location is indicated by a flashing "–" character. After inputting the desired letter or numeral, press the ENT key to submit the entry and proceed to the next place. To go back by 1 digit, press the CLR key.

If no nickname is to be registered, press the ENT key for all characters so that they all display a "–".

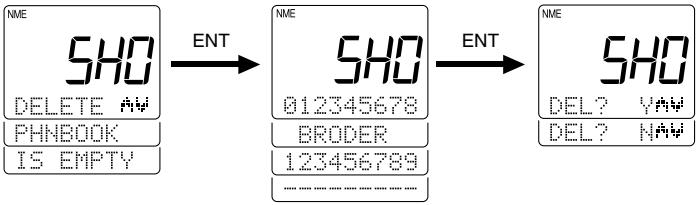


Note:

*The **0** key will enter only the numeral "0", while the **1** key will alternately enter "1" and "space". The **0** and **1** keys do not have associated alpha characters.*

Deleting Shore Stations from the List

The oldest MMSI number and nickname registered flashes on the dot matrix display. Press the SQ UP/DOWN key to display the registered stations. To delete the contents indicated, press the ENT key and the message DEL? Y is displayed. Press the ENT key to process the deletion and exit the Menu operation. To exit without deleting, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



If the phonebook list has no stations entereed, the message PHNBOOK IS EMPTY HOLD DOWN CLR KEY is displayed. Press and hold the CLR key for 3 seconds to exit Menu mode.

3.5.30.3.4 Modifying the MMSI Group Number (GROUP)

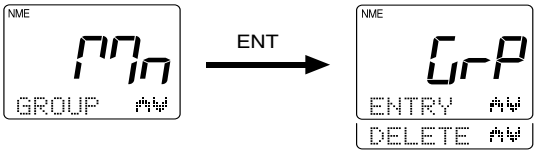
This operation modifies the MMSI number to be used in receiving a Group Digital Selective Call.

1) As described in section 3.5.30.3 DSC Operation above, select the DSC operation GROUP.

2) Press the ENT key to initiate the process. The 7-segment display shows **GrP** and the dot matrix display shows ENTRY.

3) Use the SQ UP/DOWN key to alternate between ENTRY or DELETE.

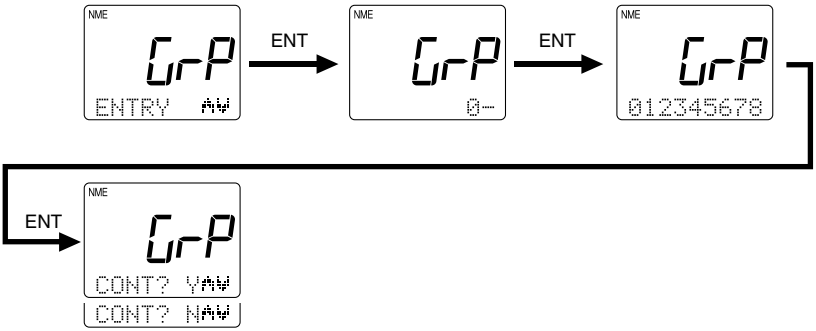
4) Press the ENT key to turn to submit the desired selection.



Adding a Group to the List

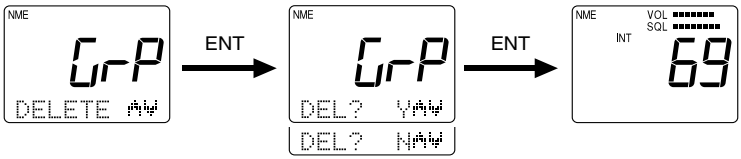
To add a group to the list, select ENTRY then press the ENT key. Use the numeric keys (0 through 9) to input desired group number. The currently selected location is indicated by a flashing "–" character. Pressing a numeric key enters that value then advances to the next place. To go back by 1 digit, press the CLR key.

After the last position has been filled, the message CONT? Y appears. Press ENT to register the group and exit the Menu operation. To exit without registering, press SQ UP/DOWN until DEL? N is displayed. Press the ENT key and operation returns to mode before the Menu operation n.



Deleting a Group from the List

Use the SQ UP/DOWN key to select DELETE. To delete the contents indicated, press the ENT key and the message DEL? Y is displayed. Press the ENT key to process the deletion and exit the Menu operation. To exit without deleting, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



3.5.30.4 Setting Operation (RAY230)

This operation sets the function features of the unit, the name of the Intercom station, the unit's MMSI number, and the call tone/type of the siren.

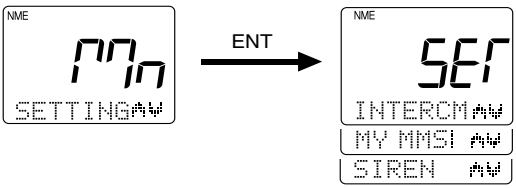
1) Press the FUNC key followed by the MENU key to initiate the Menu mode. **Mn** is shown on the 7-segment display and NAVSTAT appears on the dot matrix display.

2) Press the SQ UP/DOWN key to select SETTING.

3) Press the ENT key. The message SET appears on the 7-segment display and INTERCM appears on the dot matrix display. Pressing the SQ UP/DOWN key alternates between the following:

INTRCM	selects the Intercom setting
MYMMSI	selects the MMSI number for this unit
SIREN	selects the Fog Alert siren setting

4) Select the desired operation and press the ENT key to submit your selection.



To exit the Setting operation, press and hold he CLR key for 3 seconds.

3.5.30.4.1 Intercom Set Up

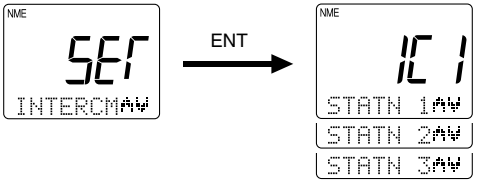
During an Intercom call, the name of the handset being called (or the name of the handset initiating the call) appears in the dot matrix display. Initially, this name is HANDSET 1, HANDSET 2, or HANDSET 3. This identifier name and the alert tone sounded when receiving an Intercom call can be chosen from among four types.

To change the Station name or Intercom tone:

1) Select the INTRCM operation as described above in section 3.5.30.4 Setting Operation (RAY230).

2) Press the ENT key. The 7-segment display shows **IC1** and the dot matrix display indicates STATN 1.

3) Press the SQ UP/DOWN key scroll to STATN 2 and STATN 3. The indication on the 7-segment display changes to **IC2** or **IC3**, respectively.



4) When the desired station name is displayed, press the ENT key to submit.

5) To enter the new station name, use the numeric keys (0 through 9) to input the associated alpha or numeric value (refer to section 3.2 Controls and LCD Display). The currently selected location is indicated by the flashing "–" character. After inputting the desired letter or numeral, press the ENT key to submit the entry and proceed to the next place. To go back by 1 digit, press the CLR key.

6) After entering all the desired characters, press the ENT key. The message RING 1 is now displayed, prompting you to setup the ring tone.

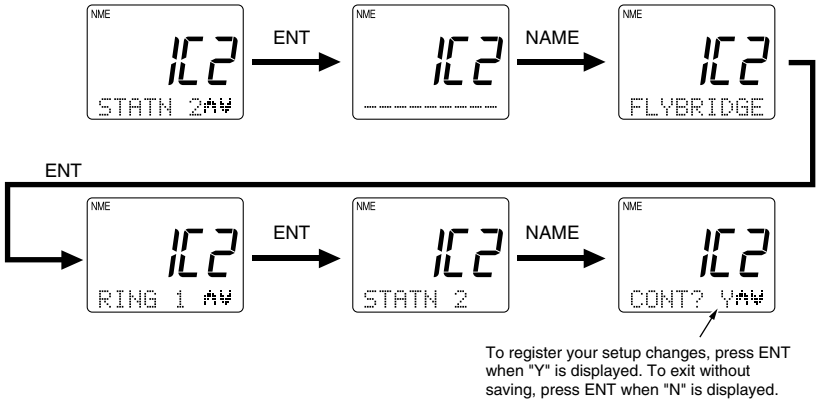
7) To change the tone, press the SQ UP/DOWN key to alternate between RING 2, RING 3, and RING 4. As you scroll, the corresponding call tone sounds from the handset.

8) When you hear the desired call tone, press the ENT key. The contents of your changes are scrolled across the LCD.

9) If the contents are acceptable, press the ENT key to confirm. The message CONT? Y is displayed.

10) Press the ENT key to register the changes.

To exit without making the changes, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



3.5.30.4.2 MMSI Number Set Up

This operation stores the MMSI number required for DSC communications, including distress calls. You can request an MMSI number when you apply for a radio license. If your vessel does not require a license, you may obtain an MMSI by contacting either BoatUS (www.boatus.com) or MariTEL (www.maritelusa.com).

Regulations in some regions do not allow end users to program their own MMSI number. If this unit was purchased to be used in such a region, this function will be disabled and the programming must be done by your distributor.

Note:
This is a one-time operation. Once the MMSI number has been programmed, you will not be able to change it.
Until the MMSI number is programmed, pressing the INDV, ALL SHIP, and DISTRESS buttons will only sound an error alert.

To register the MMSI Number into memory:

1) Select the MY MMSI function as described above in Section 3.5.30.4 Setting Operation (RAY230).

2) Press the ENT key. The 7-segment display shows MS and the dot matrix display scrolls PLEASE PROGRAM MMSI NO.

3) Press ENT. Nine underscore characters appear, which are placeholders for the 9 digits of the MMSI number. The first character place to be input is flashing.

Pressing the following keys initiate the corresponding operation:

Keys	Action
0 - 9 keys	Changes the flashing numeric value, then advances to the next digit's place.
ENT key	Advances the (flashing) subject item to the next one without changing the numeric value. Advances to the next screen after entering the last (ninth) digit.
CLR key	Returns to the previous subject item. Pressing and holding for 3 seconds exits the operation and returns to the mode before the Menu Operation began.

4) Input your MMSI number using the numeric keypad.

5) Press the ENT key. The message ENT - ACCEPT, CLR - EXIT scrolls across the display.

6) Press the ENT key to submit the number. The message ENTER MMSI NO. AGAIN is displayed.

7) Press ENT. The nine underscore placeholders appear once more.

8) Again input the MMSI number with the numeric keypad.

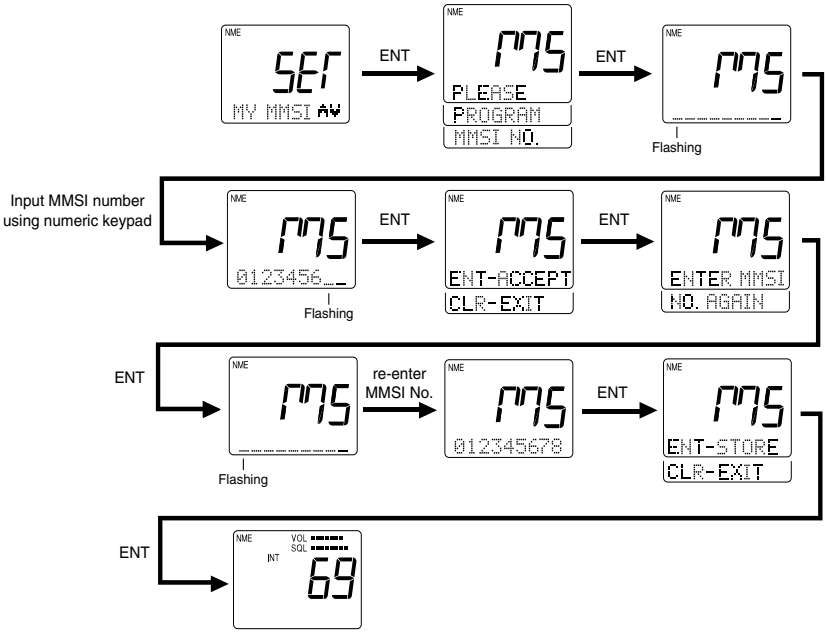
9) Press ENT to submit. If the second MMSI number you input matches the first, the message ENT - ACCEPT, CLR - EXIT is again displayed.

Note: *If the two MMSI numbers don't match, the message MMSI NO. NOT MATCH PRESS ENT scrolls across the display. Press ENT to exit the Menu mode and try again from step 1.*

10) Press ENT to verify. The message ENT - STORE, CLR - EXIT is displayed.

11) Press ENT one last time to register the MMSI number in memory. Operation returns to the mode before the Menu mode began.

To exit without making changes at any time, press and hold CLR for 3 seconds.



3.5.30.4.3 Siren Set Up

This operation changes the tone of the siren that sounds from the Hailer Horn speaker when the SIREN option is selected in Fog/Siren mode, as described in Section 3.5.18.

To select the siren tone:

1) Select the SIREN function as described above in Section 3.5.30.4 Setting Operation (RAY230).

2) Press the ENT key. The 7-segment display shows **Sir**, the dot matrix display indicates CODENC1, and the corresponding call tone sounds from the handset.

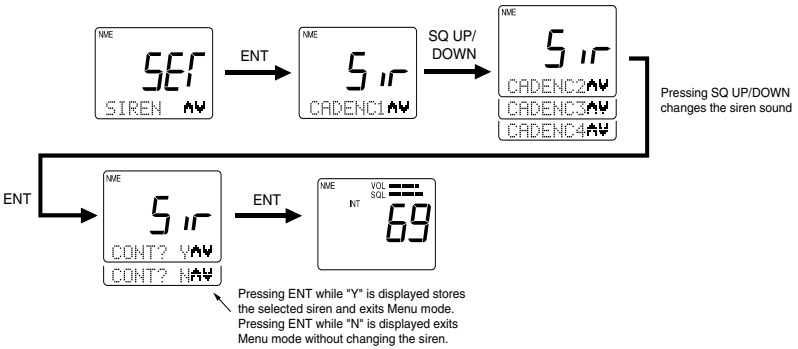
3) To change the tone, press the SQ UP/DOWN key to alternate between CODENC2, CODENC3, and CODENC4. As you scroll, the corresponding siren tone sounds from the handset. The table that follows describes the type of tone emitted and the procedure for sounding the siren while in Fog/Siren mode. **Mn** is shown on the 7-segment display and NAVSTAT appears on the dot matrix display.

Name	Sound	Operating Siren in Fog/Siren Mode
CODENC1	"Hi-Lo"	Press and release PTT switch to emit continous sound. Press PTT again to stop.
CODENC2	Siren	Press and release PTT switch to emit continuous sound. Press PTT again to stop.
CODENC3	Whelp	Press and hold PTT switch to emit sound. Release PTT to stop.
CODENC4	Air Horn	Press and hold PTT switch to emit sound. Release PTT to stop.

4) When the desired call tone is heard, press the ENT key to accept. The message CONT? Y is displayed.

5) Press the ENT key to register the changes.

To exit without making the changes, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



3.5.30.5 Setting Operation (RAY230E)

This operation sets the function features of the RAY230E: the name of the Intercom station, the ATIS ID number and on/off state, the MMSI number, the Tri-Watch function, and the call tone type of the siren.

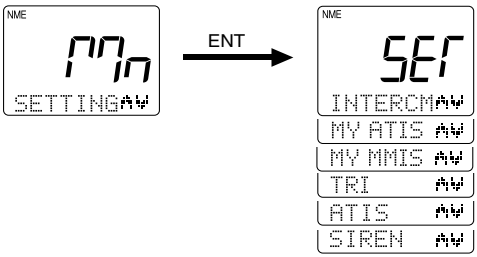
1) Press the FUNC key followed by the MENU key to initiate the Menu mode. **Mn** is shown on the 7-segment display and NAVSTAT appears on the dot matrix display.

2) Press the SQ UP/DOWN key to select SETTING.

3) Press the ENT key. The message SET appears on the 7-segment display and INTERCM appears on the dot matrix display. Pressing the SQ UP/DOWN key alternates between the following:

INTRCM	selects the Intercom setting
MY ATIS	registers the ATIS ID number
MY MMSI	registers the MMSI number
TRI	selects the Tri-Watch operation
ATIS	turns the ATIS function ON or OFF
SIREN	selects the siren setting

4) Select the desired operation and press the ENT key to submit your selection.



3.5.30.5.1 Intercom Set Up

The operation is identical to the Intercom operation described for the RAY230 in section 3.5.30.4.1.

3.5.30.5.2 MY ATIS Set Up

This operation stores the ATIS number required for the Automatic Transmission Identification System used in inland waterways of some European countries. You can request an ATIS number when you apply for a radio license.

Regulations in some regions do not allow end users to program their own ATIS number. If this unit was purchased to be used in such a region, this function will be disabled and the programming must be done by your distributor.

Note:
This is a one-time operation. Once the ATIS number has been programmed, you will not be able to change it.
The ATIS ID number is a ten digit number, beginning with a "9". The MY ATIS set up process has you input only the last 9 digits. The leading "9" is automatically input for you.

To register the ATIS Number into memory:

1) Select the MY ATIS function as described above in Section 3.5.30.5 Setting Operation (RAY230E).

2) Press the ENT key. The 7-segment display shows **AId** and the dot matrix display scrolls PLEASE PROGRAM ATIS ID.

3) Press ENT. Nine underscore characters appear, which are placeholders for the last 9 digits of the ATIS number. The first character place to be input is flashing.

Pressing the following keys initiate the corresponding operation:

Keys	Action
0 – 9 keys	Changes the flashing numeric value, then advances to the next digit's place.
ENT key	Advances the (flashing) subject item to the next one without changing the numeric value. Advances to the next screen after entering the last (ninth) digit.
CLR key	Returns to the previous subject item. Pressing and holding for 3 seconds exits the operation and returns to the mode before the Menu Operation began.

4) Input your ATIS number using the numeric keypad.

5) Press the ENT key. The message ENT - ACCEPT, CLR - EXIT scrolls across the display.

6) Press the ENT key to submit the number. The message ENTER ATIS ID AGAIN is displayed.

7) Press ENT. The nine underscore placeholders appear once more.

8) Again input the ATIS number with the numeric keypad.

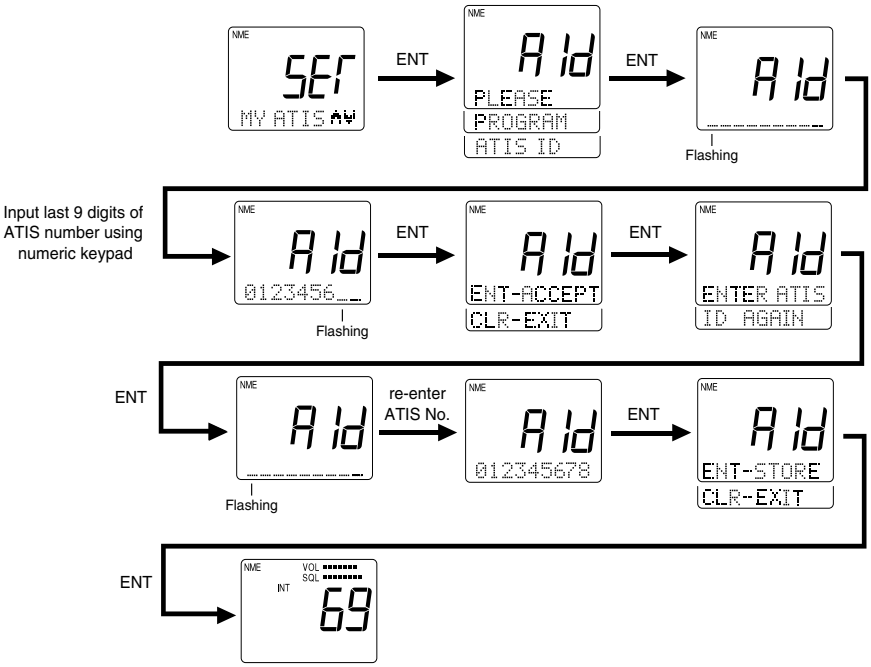
9) Press ENT to submit. If the second ATIS number you input matches the first, the message ENT - ACCEPT, CLR - EXIT is again displayed.

NOTE: *If the two ATIS numbers don't match, the message ATIS ID NOT MATCH PRESS ENT scrolls across the display. Press ENT to exit the Menu mode and try again from step 1.*

10) Press ENT to verify. The message ENT - STORE, CLR - EXIT is displayed.

11) Press ENT one last time to register the ATIS number in memory. Operation returns to the mode before the Menu operation began.

To exit without making changes at any time, press and hold CLR for 3 seconds.


NME
SEr
MY ATIS AV
ENT
NME
AId
PLEASE
PROGRAM
ATIS ID
ENT
NME
AId
Flashing
Input last 9 digits of ATIS number using numeric keypad
NME
AId
0123456__
Flashing
ENT
NME
AId
ENT-ACCEPT
CLR-EXIT
ENT
NME
AId
ENTER ATIS
ID AGAIN
ENT
NME
AId
Flashing
re-enter ATIS No.
NME
AId
012345678
ENT
NME
AId
ENT-STORE
CLR-EXIT
ENT
NME
VOL
SQL
INT
69

3.5.30.5.3 MY MMSI Set Up

The operation is identical to the MMSI set up operation described for the RAY230 in section 3.5.30.4.2 MY MMSI Set Up.

3.5.30.5.4 Tri-Watch Set Up

This operation selects whether the Weather Channel or the Multi-Call Channel is monitored during Tri-Watch state in the US mode.

To change the monitored channel:

1) Per the description in section 3.5.30.8 Setting Operation above, select TRI.

2) Press the ENT key. **TrI** appears on the 7-segment display and TRI WX appears on the dot matrix.

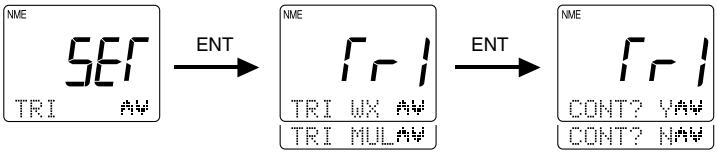
3) Press the SQ UP/DOWN key to toggle between TRI MUL for Multi-Call and TRI WX for Weather Channel.

4) After selecting the desired operation, press the ENT key.

5) If the setting is acceptable, press the ENT key to confirm. The message CONT? Y is displayed.

6) Press the ENT key to register the setting.

To exit without making changes, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



3.5.30.5 ATIS Set Up

This operation determines whether to effect ID transmission of ATIS after the PTT switch is released.

When the ATIS transmission is set to the ON position, the ATIS sound is automatically suppressed by the "ATIS Killer" feature.

To set the ATIS function:

1) Per the description in Section 3.5.30.5 Setting Operation (RAY230E) above, select ATIS.

2) Press the ENT key. The message ATS is shown on the 7-segment display and ATIS OFF appears on the dot matrix.

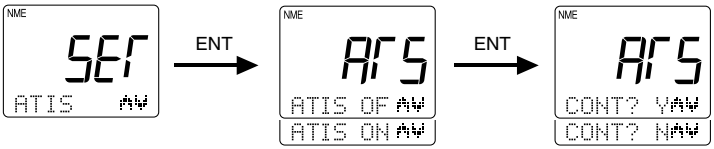
3) Press the SQ UP/DOWN key to toggle between ATIS ON and ATIS OFF.

4) After selecting the desired operation, press the ENT key.

5) If the setting is acceptable, press the ENT key to confirm. The message CONT? Y is displayed.

6) Press the ENT key to register the setting. When ATIS is ON, the ATIS indicator is illuminated on the LCD.

To exit without making changes, press the SQ UP/DOWN key until DEL? N is displayed. Press the ENT key and operation returns to the mode before the Menu operation began.



3.5.30.5.6 Siren Set Up

The operation is identical to the Siren set up operation described for the RAY230 in section 3.5.30.4.2.MY MMSI Set Up.

3.5.31 RAY230/RAY230E Marine Channels

International Mode Frequency Table

Note:

International VHF frequency usage varies from country to country. Insure you are familiar with the channel requirements of the country where you are boating before using any VHF transceiver.

INT(International) Mode					
Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
01	156.050	160.650	Port Operations		YES
02	156.100	160.700	Port Operations		YES
03	156.150	160.750	Port Operations		YES
04	156.200	160.800	Port Operations		YES
05	156.250	160.850	Port Operations		YES
06	156.300	156.300	Intership Safety	YES	
07	156.350	160.950	Port Operations		YES
08	156.400	156.400	Intership	YES	
09	156.450	156.450	Calling	YES	
10	156.500	156.500	Port Operations	YES	
11	156.550	156.550	Port Operations	YES	
12	156.600	156.600	Port Operations	YES	
13 [2]	156.650	156.650	Port Operations	YES	
14	156.700	156.700	Port Operations	YES	
15 [1]		156.750	Port Operations	—	—
16	156.800	156.800	Emergency, Calling	YES	
17 [3]	156.850	156.850	Port Operations	YES	
18	156.900	161.500	Port Operations		YES
19	156.950	161.550	Public Correspondence		YES
20	157.000	161.600	Public Correspondence		YES
21	157.050	161.650	Public Correspondence		YES
22	157.100	161.700	Public Correspondence		YES
23	157.150	161.750	Public Correspondence		YES
24	157.200	161.800	Public Correspondence		YES
25	157.250	161.850	Public Correspondence		YES
26	157.300	161.900	Public Correspondence		YES
27	157.350	161.950	Public Correspondence		YES
28	157.400	162.000	Public Correspondence		YES
60	156.025	160.625	Port Operations		YES
61	156.075	160.675	Port Operations		YES

Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
62	156.125	160.725	Port Operations		YES
63	156.175	160.775	Port Operations		YES
64	156.225	160.825	Port Operations		YES
65	156.275	160.875	Port Operations		YES
66	156.325	160.925	Port Operations		YES
67	156.375	156.375	Intership	YES	
68	156.425	156.425	Port Operations	YES	
69	156.475	156.475	Port Operations	YES	
70 [4]	156.525	156.525	DSC	—	—
71	156.575	156.575	Port Operations	YES	
72	156.625	156.625	Intership	YES	
73	156.675	156.675	Port Operations	YES	
74	156.725	156.725	Port Operations	YES	
75 [1]		156.775	CH16 Guard Band	—	—
76 [1]		156.825	CH16 Guard Band	—	—
77 [3]	156.875	156.875	Intership	YES	
78	156.925	161.525	Public Correspondence		YES
79	156.975	161.575	Public Correspondence		YES
80	157.025	161.625	Public Correspondence		YES
81	157.075	161.675	Public Correspondence		YES
82	157.125	161.725	Public Correspondence		YES
83	157.175	161.775	Public Correspondence		YES
84	157.225	161.825	Public Correspondence		YES
85	157.275	161.875	Public Correspondence		YES
86	157.325	161.925	Public Correspondence		YES
87	157.375	161.975	Public Correspondence		YES
88	157.425	162.025	Port Operations		YES

Notes:

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

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

3 : 1 Watt only.

4 : Channel 70 is used for Digital Selective Calling (DSC) only.

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 Union meeting in Geneva, and are legal for use in International waters only.

Canada Mode Frequency Table for the RAY230

Canada Mode					
Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
01	156.050	156.050	VTS,Port Operation	YES	
02	156.100	156.100	Port Operation	YES	
03 [4]	156.150	156.150	Port Operation	YES	
04	156.200	156.200	Canadian Coast Guard, SAR	YES	
05	156.250	156.250	Port Operation	YES	
06	156.300	156.300	Intership Safety	YES	
07	156.350	156.350	Commercial	YES	
08	156.400	156.400	Commercial	YES	
09	156.450	156.450	Calling	YES	
10	156.500	156.500	Commercial	YES	
11	156.550	156.550	Commercial	YES	
12	156.600	156.600	Port Operation	YES	
13 [2]	156.650	156.650	Navigation, Bridge to Bridge	YES	
14	156.700	156.700	Port Operation	YES	
15 [1]		156.750	Environmental	—	—
16	156.800	156.800	Emergency, Calling	YES	
17 [3]	156.850	156.850	State Controlled	YES	
18	156.900	156.900	Commercial	YES	
19	156.950	156.950	Commercial	YES	
20	157.000	157.000	Port Operation	YES	
21 [4]	157.050	157.050	Coast Guard	YES	
22 [4]	157.100	157.100	Coast Guard	YES	
23 [4]	157.150	157.150	Coast Guard	YES	
24	157.200	161.800	Marine Operator		YES
25	157.250	161.850	Marine Operator		YES
26	157.300	161.900	Marine Operator		YES
27	157.350	161.950	Marine Operator		YES
28	157.400	162.000	Marine Operator		YES
60 [4]	156.025	156.025	Canadian Coast Guard	YES	
61 [4]	156.075	156.075	Canadian Coast Guard	YES	
62 [4]	156.125	156.125	Canadian Coast Guard	YES	
63	156.175	156.175	Canadian Coast Guard	YES	
64 [4]	156.225	156.225	Canadian Coast Guard	YES	
65	156.275	156.275	Port Operation	YES	
66	156.325	156.325	Port Operation	YES	

Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
67 [2]	156.375	156.375	Commercial	YES	
68	156.425	156.425	Boat Operations, Recreational	YES	
69	156.475	156.475	Boat Operations, Recreational	YES	
70 [5]	156.525	156.525	DSC	—	—
71	156.575	156.575	Boat Operations, Recreational	YES	
72	156.625	156.625	Boat Operations, Recreational	YES	
73	156.675	156.675	Port Operation	YES	
74	156.725	156.725	Port Operation	YES	
75 [1]		156.775	CH16 Guard Band	—	—
76 [1]		156.825	CH16 Guard Band	—	—
77 [3]	156.875	156.875	Port Operation	YES	
78	156.925	156.925	Boat Operations, Recreational	YES	
79	156.975	156.975	Commercial	YES	
80	157.025	157.025	Commercial	YES	
81 [4]	157.075	157.075	Coast Guard	YES	
82 [4]	157.125	157.125	Coast Guard	YES	
83	157.175	157.175	Coast Guard	YES	
84	157.225	161.825	Marine Operator		YES
85	157.275	161.875	Marine Operator		YES
86	157.325	161.925	Marine Operator		YES
87	157.375	161.975	Marine Operator		YES
88	157.425	157.425	Commercial	YES	

Notes:

1: Transmitter is automatically disabled on Channel 15, 75 and 76 in Canada mode.

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

3: 1 Watt only.

4: Not for use by general public.
Requires special authorization from the Canadian Coast Guard, or under private land mobile license.

5: Channel 70 is used for Digital Selective Calling (DSC) only.

Important Notice

The Canada mode is not legal for use while operating in U.S. waters.

US Mode Frequency Table

USA Mode					
Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
1	156.050	156.050	VTS/Port Operations	YES	
03 [4]	156.150	156.150	Port Operations	YES	
05	156.250	156.250	Port Operations	YES	
06	156.300	156.300	Intership Safety	YES	
07	156.350	156.350	Commercial	YES	
08	156.400	156.400	Commercial	YES	
09	156.450	156.450	Calling	YES	
10	156.500	156.500	Commercial	YES	
11	156.550	156.550	Commercial	YES	
12	156.600	156.600	Port Operations	YES	
13 [2]	156.650	156.650	Navigation,Bridge to Bridge	YES	
14	156.700	156.700	Port Operations	YES	
15 [1]		156.750	Environmental	—	—
16	156.800	156.800	Emergency, Calling	YES	
17 [3]	156.850	156.850	State Controlled	YES	
18	156.900	156.900	Commercial	YES	
19	156.950	156.950	Commercial	YES	
20	157.000	157.000	Port Operations	YES	
21 [4]	157.050	157.050	Coast Guard	YES	
22 [4]	157.100	157.100	Coast Guard	YES	
23 [4]	157.150	157.150	Coast Guard	YES	
24	157.200	161.800	Marine Operator		YES
25	157.250	161.850	Marine Operator		YES
26	157.300	161.900	Marine Operator		YES
27	157.350	161.950	Marine Operator		YES
28	157.400	162.000	Marine Operator		YES
61 [4]	156.075	156.075	Canadian Coast Guard	YES	
63	156.175	156.175	Canadian Coast Guard	YES	
64 [4]	156.225	156.225	Canadian Coast Guard	YES	
65	156.275	156.275	Port Operations	YES	—
66	156.325	156.325	Port Operations	YES	
67 [2]	156.375	156.375	Commercial	YES	
68	156.425	156.425	Boat Operations,Recreational	YES	
69	156.475	156.475	Boat Operations,Recreational	YES	
70 [5]	156.525	156.525	DSC	—	—

Channel Desig.	Frequency (MHz)		TYPE OF TRAFFIC	Function	
	TX	RX		SHIP TO SHIP	SHIP TO SHORE
71	156.575	156.575	Boat Operations,Recreational	YES	
72	156.625	156.625	Boat Operations,Recreational	YES	
73	156.675	156.675	Port Operations	YES	
74	156.725	156.725	Port Operations	YES	
75 [1]	—	156.775	CH 16 Guard Band	—	—
76 [1]	—	156.825	CH 16 Guard Band	—	—
77 [3]	156.875	156.875	Port Operations	YES	
78	156.925	156.925	Boat Operations,Recreational	YES	
79	156.975	156.975	Commercial	YES	
80	157.025	157.025	Commercial	YES	
81 [4]	157.075	157.075	Coast Guard	YES	
82 [4]	157.125	157.125	Coast Guard	YES	
83	157.175	157.175	Coast Guard	YES	
84	157.225	161.825	Marine Operator		YES
85	157.275	161.875	Marine Operator		YES
86	157.325	161.925	Marine Operator		YES
87	157.375	161.975	Marine Operator		YES
88	157.425	157.425	Commercial	YES	

Weather Channels and Frequencies

CH	RX Frequency	TYPE OF TRAFFIC	FUNCTION-SHIP TO SHORE
0	163.275	NOAA Weather	Receive only
1	162.550	NOAA Weather	Receive only
2	162.400	NOAA Weather	Receive only
3	162.475	NOAA Weather	Receive only
4	162.425	NOAA Weather	Receive only
5	162.450	NOAA Weather	Receive only
6	162.500	NOAA Weather	Receive only
7	162.525	NOAA Weather	Receive only
8	161.650	Canadian Weather	Receive only
9	161.775	Canadian Weather	Receive only

Notes:

1: Transmitter is automatically disabled on Channel 15, 75 and 76 in US mode.

2: 1 Watt initially. User can override to high power by pressing and holding PTT and the 9/1/25 key.

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 used for Digital Selective Calling (DSC) only.

Important Notice

Channel 3, 21, 23, 61, 64, 81, 82 and 83 (shaded) are not for use by the general public in U.S. water.

These frequencies may be used only under authorization by the U.S. Coast Guard, or under private land mobile license.

Section 4 TECHNICAL DESCRIPTION

4.1 Base Station Transceiver

4.1.1 Power Supply Section

This equipment is rated for 13.6 VDC but can operate within a voltage range of 11.6 - 15.6 VDC. In case the input supply voltage exceeds 15.6 VDC, the over-voltage detection circuit (D18, Q27) cuts off the relay (RL1) to the main power supply. Reverse connection of the power supply is protected by a diode (D17) in the relay circuit.

Pressing the Power switch on the main unit turns on the power supply via the relay circuit. This consists of Q26 on the main RF PCB, and Q301, D301, and IC305 on the main control PCB and is switched by Q28, Q30, Q33, and Q34). Only the CPU system is powered on. The RF circuit (Q29, Q30 and Q331) remains off until the power switch is pressed on the handset. At that time, the full system is operational.

4.1.2 Receiver Section

The RAY230/RAY230E is equipped with two receiver units: one for All Channels and another exclusively for Channel 70.

4.1.2.1 Antenna Switching

The RF-signal passes through the low-pass filter to the RF pre-amplifier (Q16) via the antenna switching action of D1 and D2. When receiving a signal, diodes D1 and D2 are non-conductive.

4.1.2.2 Pre-amp, Splitter (binary distribution)

A bifilar wound distribution circuit (L37, R89) is furnished for the RF signal because the radio is equipped with two built-in receivers (All Channels and Channel 70). Since the pre-amplifier is used only to compensate for the losses caused by this circuit, the amplifier is set at a low gain level. A BALUN system assuring low losses is adopted for the distribution circuit.

4.1.2.3 All Channels Receiver

1) RF Amplifier

The RF amplifier consists of the FET amplifier (Q18) and a Band Pass Filter (BPF) having variable bandwidth by variable capacitance diodes (D12-D16). The response is automatically corrected by the control voltage supplied from the CPU to a proper value corresponding to the receive frequency. The BPF is provided with an attenuation characteristic of 15 dB or larger at the detuning point 3 MHz lower than the lower limit of the receive frequency (156 MHz). Then the RF signal, having been mixed with the 1st local oscillator signal by the 1st mixer (Q19) after passing the BPF, is converted to the 1st Intermediate Frequency (IF) signal (21.6 MHz).

Note:

The 1st local oscillator signal generated by a synthesizer has a frequency lower than the desired frequency by 21.6 MHz. The 1st local oscillator signal is fed to the 1st mixer (Q19) after being amplified by the buffer amplifier (Q14).

2) First Intermediate Frequency (1st IF)

The 1st IF signal of 21.6 MHz supplied via the crystal filter (F1) is then amplified by the 1st IF amplifier (Q20).

3) 2nd IF

The 1st IF signal, having been mixed with the 2nd local oscillator signal (21.145 MHz) in the IC (IC7 Mix, Osc, Amp, Limit, Det) for the 2nd IF, is converted into the 2nd IF signal with a frequency of 455 kHz. Further, after subjected to amplification and successive amplitude limitation via the ceramic filter (F2), the signal is demodulated by the Quad detector (quadrature detection) into an audio signal.

4) De-Emphasis

An audio signal is subjected to a correction in the frequency characteristic to -6 dB/oct by the de-emphasis circuit (IC8).

5) Squelch

Within IC 9, high frequency noise outside the voice band from the DISC output of IC 7 is amplified by the noise amplifier and converted into a DC voltage by the detection circuit. Then, this voltage is further amplified by the DC amplifier (IC374B on the control PCB) to a BUSY1 signal, which is

fed to the squelch control port (A/D). The operation level of the squelch is determined by the electronically controlled volume (IC313 on the control PCB) and the set value for the A/D action of the CPU.

4.1.2.4 Channel 70 Receiver

1) High Frequency Amplifier

The front-end part of the Channel 70 receiver consists of the FET amplifier (Q21) and a narrow bandwidth BPF. The BPF has an attenuation characteristic of 15 dB or larger at the detuning point 3 MHz lower than the lower limit of the receive frequency (156 MHz). The amplified RF signal is mixed with the local oscillator signal in the Mixer (Q22) and converted into the 1st IF signal of 16.9 MHz. The 1st local signal, generated by an oscillation circuit (Q24) using the 3rd over tone of the crystal (X3, 46.5417 MHz), has a frequency of 139.625 MHz. The signal is fed to the mixer (Q22) via the buffer amplifier (Q25).

2) 1st IF

The 1st IF signal of 16.9 MHz supplied via the crystal filter (F3) is amplified by the 1st IF amplifier (Q23).

3) 2nd IF

The 1st IF signal is mixed with the 2nd local oscillator signal (16.445 MHz) in the IC (IC9 Mix, Osc, Amp, Limit, Det) for the 2nd IF and is converted into the 2nd IF signal with a frequency of 455 kHz. After further amplification and successive amplitude limitation via the ceramic filter (F4), the signal is demodulated by the Quad detector (quadrature detection) into an audio signal.

4) De-Emphasis

An audio signal is subjected to a correction in its frequency characteristic to a -6dB/oct by the de-emphasis circuit (IC8).

5) Squelch

Within IC9, high-frequency noise outside the voice band from the DISC output of IC 7 is amplified by the noise amplifier and converted into a DC voltage by the detection circuit. Then, this converted voltage is supplied as the BUSY2 signal to the squelch control port (A/D) of the CPU. The threshold level is set with the VR4 on the PCB, free from any external adjustment.

4.1.2.5 WX Alert (Weather Channel)

The tone decoder (IC11) detects the 1050 Hz tone signal from IC7 via IC8, in the Weather Channel mode.

4.1.2.6 ATIS Decode (All Channel Receiver)

The FSK modulated signal of 1200 bps provided in the ETS300-698 is demodulated by the FSK Modem-1 (IC308). Since this signal is offensive to the ear, the AF is muted by the CPU control.

4.1.2.7 DSC Decoding (Channel 70 Receiver)

The DSC signal of 1200 bps is demodulated by the FSK Modem-2 (IC309).

4.1.3 Transmitter Section

4.1.3.1 Instantaneous Deviation Control (IDC) Circuit

After pre-emphasis of 6 dB/oct in the IDC circuit (IC6), the microphone, DSC, and ATIS signals from the control system are supplied to an amplitude-limiting circuit. Then the signals are passed through a fifth-order low-pass filter for splatter prevention and supplied to the VCO. The maximum frequency deviation is set by VR3.

4.1.3.2 Buffer Driver Amplifier

The carrier frequency from the VCO is supplied via the diode switch (D7) to the buffer (Q2). The carrier is then amplified up to about 200mW, and finally boosted to 25W by the RF power amplifier (IC1) at the final stage. The transmitting power is supplied to the antenna via the LPF by operating the ANT switch (D1).

4.1.3.3 Automatic Power Control (APC) Circuit

The transmitting power is sampled and rectified in the detection circuit (D5). Then, this DC voltage is compared with the standard set value of the output at the comparator circuit (IC2). This output controls both the PA and the driver by a two-stage DC amplifier (Q5 and Q6) so that a stable transmitting power can be supplied to the ANT. The switchover of power between 25 W and 1 W is effected with the output changeover switch (Q7). The output is set with VR1 for 1W or VR2 for 25W.

4.1.3.4 ATIS, DSC Encoding

The FSK modulating signal of 1200 bps is produced in the FSK Modem-1 (IC308). The modulation index is: 1.0 for ATIS and 2.0 for DSC.

4.1.4 Phase Lock Loop (PLL) Circuit

The standard PLL frequency of 12.8 MHz is divided by 512 to produce 25 KHz channel spacing by the PLL IC (IC4). The oscillation frequency of the VCO, which has been divided down to 25 kHz just like the standard, is applied to a phase comparator within IC4, producing a pulse output corresponding to the deviation. The output pulse is converted into a DC value through the external charge pump circuit (Q11 and Q12) and a loop filter, which is supplied to the control terminal of the VCO as a frequency control voltage. A part of the output from the VCO is fed back to the PLL IC (f_{in}) via the buffer amplifier (Q13). The loop filter is provided with a time-constant changeover-switch using the IC3 to meet the requirement for high-speed response by accelerating the rise characteristic at the time of transmission/reception changeover and frequency changeover. The detection circuit (IC5) enables the PLL unlocking signal to output without fluttering.

4.1.5 Audio Frequency (AF) Control Section

4.1.5.1 AF Selection

AF signals (RxAF, Fog, Siren, and Hail) are selected by the AF selector (IC310). RxAF and the received Hailer sound are transferred to the cross point switch via the mute circuit (Q302, Q303). The Fog, Siren, and the transmitted Hailer voice signals are transferred via the electronic volume control circuit (IC312, IC313) to the AF amplifier, which develops across a 4 ohm speaker load.

4.1.5.2 Line Selection

The line selector (IC311) selects the microphone, the DSC signal, or the IDC input (modulation input).

4.1.5.3 Speaker Selection

The relay circuit (RL301, Q306) switches over operation to the external speaker.

4.1.5.4 Telephone I/O, Cross-Point Switch

The telephone line driver, receiver, DTMF oscillator, and an 8 x 8 cross-point switch are continued in IC315. The cross-point switch selects and combines the AF signals that correspond to the RAY230/230E's respective operations: handset-VHF, handset-Telephone and handset-Intercom. Connection to a telephone can be made by adding optional communication equipment with a DTMF interface such as RAYCOM Cellular, Mini-M, etc.

4.1.6 Handset I/O

To connect with the handset circuit, an interface unit is provided that is suitable for both audio and digital applications.

4.1.6.1 Audio I/O

A buffer circuit created by the operational amplifier (IC319 - IC321) transmits a low-impedance AF signal between the base station and the handset.

4.1.6.2 Digital I/O

Because of its anti-noise characteristics, photo-couplers (PC304 - PC309) are used to transfer the control data. The received signal data is further subjected to waveform shaping (Q319 - Q321) and processed by the CPU.

4.1.7 NMEA Data Input

The circuit uses a photo-coupler (PC301) as an interface to receive data.

4.1.8 SeaTalk I/O

Both the transmitter and the receiver are furnished with a photo-coupled interface to the +12 VDC power supply circuit.

4.1.9 Write Data Operation

The CPU writes data through the Write terminal (J302). During the write operation, the data port of the CPU is switched to the “write” side by the selector (IC301–IC304). The switch selection is made according to the corresponding operation modes.

4.2 Handset Circuit

4.2.1 Outline

The handset is connected to the cradle to communicate control data for various functions, such as transmission/reception of voice signals on the handset, all key operations, LCD display, lighting by LED, monitor control of the cradle, etc.

4.2.2 Circuit Makeup

The circuit consists of the following components:

- Power supply system circuit
  - Digital system +5V Voltage Regulator (IC701)
  - Analog system +5V Voltage Regulator (IC702)
  - Analog system +9V Voltage Regulator (IC714)
- Single Chip CPU (IC706)
- LCD Display Controller/Driver (IC709)
- LED Driver Circuit (IC710)
- Electronically-controlled Volume (IC716)

4.2.3 Power Supply System

The input voltage of the main supply power is +13.6V. The internal operation voltages for the respective applications are as follows:

- +9V by the voltage regulator (IC714) for LCD lighting
- +5V by the voltage regulator (D5V, IC701) for a digital voltage
- +5V by the voltage regulator (A5V, IC702) for an analog voltage
- +5V (VTH) from emitter follower (Q703) for working bias voltage for the voice signals

4.2.4 CPU

The CPU is an 8-bit, single-chip microcomputer µPD789026 (IC706).

4.2.5 Controller Driver for LCD display

The PCF2113DH/F4 (IC709) is a LCD controller driver used to indicate alphanumeric characters and symbols.

4.2.6 LED Driver Circuit

The TB62715 FN (IC710) makes a 4-stage dimming control for the LEDs (D704–D707) and the LCD backlight, and also turns on/off the keypad LEDs (D708–D720).

4.2.7 Electronically Controlled Volume

The receiver's sound volume on the handset is controlled by the M62429FP (IC706).

4.2.8 Off-Hook Detection Relay

The reed relay ORD213 (RL701) detects the On/Off Hook State of the handset.

4.3 External Speaker Circuit

4.3.1 Outline

The cradle relays signals between and the handset and the rest of the equipment, makes a sound upon receiving a call, and monitors the calling voice signal.

4.3.2 Power Supply System

+13.6 VDC is supplied as the main input source. The following voltages are supplied for the internal components:

- +13.6 VDC for the speaker amplifier
- +5 VDC from the voltage regulator (IC804) for controlling the analog switch
- +2.5 VDC (VTH) for operating bias-voltage for voice signals

4.3.3 Monitor Speaker Amplifier

A 5W/4Ω output TDA1905 (IC802) is used for the speaker amplifier to implement an output of 2W/4Ω.

4.3.4 Sound Volume Control

Sound volume is adjusted by the Volume Controller (VR801).
Upon receiving a DSC (Digital Selective Calling), a sound is produced at the maximum level regardless of the sound volume value set by the volume controller (VR801).

4.4 SPECIFICATIONS

4.4.1 Transmitter

Channels	All available US, International, and Canadian VHF Marine Band
Frequency Stability	+/- 10 PPM (+/- 0.001%) (-20°C to +50°C)
Frequency Range	156.025 to 157.425 MHz
Channel Spacing	25 kHz increments
Power Output	25 W switchable to 1W into 50 ohms at 13.6 VDC
Modulation	Frequency modulated 16F3 (+/-4.5 kHz at 1000 Hz)
Modulation Audio Response	Shall not vary +1/-3dB from true 6dB pre-emphasis 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	Less than -40 dB below audio
Audio Distortion	Less than 10 % at 1 kHz for 3 kHz deviation
Spurious & Hamonic	Attenuated at least 43+10 log Po (below rated radiated carrier Emissions power) per FCC Rules Part 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, International, and Canadian 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°C
Usable Sensitivity	0.35 µV for 12 dB (SINAD)
Squelch Sensitivity	0.2 µV or better
Threshold	1.0 µ full squelch
Adjacent CH Rejection	70 dB
Spurious Image Rejection	70 dB
Intermodulation Rejection	70 dB
Audio Output	2 watts or more at 10% or less distortion into 4 ohm load (internal)
Hum & Noise in Audio	Less than -40 dB

4.4.3 Operating Requirements

Input Voltage	13.6 VDC +/- 15% (11.6 to 15.6 VDC)
Current Required	Less than 6 amps at 25 watts
Transmit	Less than 2 amps at 1 watt
Operating Temperature	-20°C to +50°C
Duty Cycle	Continuous, 80% receive, 20% transmit (max 10 min, @25°C)
Humidity	100% at 50°C for 8 hours

4.4.4 Radio Dimensions

Base Station Transceiver

Height	2.63 inches (67 mm)
Width	8.98 inches (228 mm)
Depth	7.04inches (179 mm)
Weight	Approx. 4 lbs (1.87 kg)

Hand Set

Height	6.81 inches (173 mm)
Width	2.2 inches (56 mm)
Depth	1.1 inches (28 mm)
Weight	Approx. 0.30 lbs (138 g)

Cradle

Height	1.97 inches (50 mm)
Width	2.52 inches (64 mm)
Length	4.02 inches (102.1 mm)
Weight	Approx. 0.15 lbs (70 g) (without cables)

External Speaker

Height	4.53 inches (115 mm)
Width	4.33 inches (110 mm)
Depth	1.57 inches (40 mm)
Weight	Approx. 0.75 lbs (340 g)

SECTION 5 MAINTENANCE

5.1 General

The purpose of this section is to provide servicing instructions to the service technician.

The RAY230 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 Raymarine (US)

Technical Support: **1-800-539-5539 ext. 2444, or**
1-603-881-5200 ext. 2444

You can reach our Technical Support Department Monday to Friday 8:15 AM to 5:00 PM Eastern Standard Time. Our Technical Support Specialists are available to answer installation, operation, and troubleshooting questions about your Raymarine unit. Our Technical Support Department can also be reached via the Internet.

Questions can be addressed directly to:
techsupport@raymarine.com

Or visit the Raymarine World Wide Web site:
www.raymarine.com

Accessories and Parts: **1-800-539-5539 ext. 2333, or**
1-603-881-5200 ext. 2333

Many Raymarine accessory items and parts are available through your authorized Raymarine dealer. However if you are in need of an item not available through your retailer feel free to contact our Customer Service department Monday to Friday 8:15 AM to 5:00 PM Eastern Standard Time. If you are uncertain about what item to choose for your Raymarine unit please contact our Technical Support Department Prior to placing your order at 1-800-539-5539 ext. 2065.

Product Repair and Service
In the unlikely event your Raymarine unit should develop a problem please contact the Raymarine dealer from where the unit was purchased. Your Raymarine dealer is best equipped to handle your service needs. Service may also obtained by returning your unit to Raymarine's Product Repair Center at the address below.

Raymarine, Inc.
Product Repair Center
22 Cotton Road, Unit D
Nashua, NH 03063-4219

5.1.2 How to Contact Raymarine (Europe)

In Europe, Raymarine support, service and accessories may be obtained from your authorized dealer, or contact:

Raymarine Limited
Anchorage Park
Portsmouth, Hampshire
England PO3 5TD
Tel +44 (0) 23 9269 3611
Fax +44 (0) 23 9269 4642

Or visit Raymarine World Wide Website:
www.raymarine.com

Technical Support Tel +44 (0) 23 9269 3611
Fax +44 (0) 23 9269 4642
The Technical Services Department handles inquiries concerning installation, operation, fault diagnosis and repair.

For the technical help desk, contact:
techsupport@raymarine.com

Accessories and Parts
Raymarine accessory items and parts are available through your authorized Raymarine dealer. Please refer to the lists of component part numbers and optional accessories in Section 2.2 of this handbook and have the Raymarine part number ready when speaking with your dealer. If you are uncertain about what item to choose for your Raymarine unit, please contact our Customer Services Department prior to placing your order.

Worldwide Support
Please contact the authorized distributor in the country. A list of worldwide distributors os supplied with your unit.

5.2 Preventative Maintenance

The RAY230/RAY230E has been constructed to be virtually maintenance free. Your attention to a few basic points should assure many years of service.

1) Although the unit is waterproof, always keep the unit as dry as possible.
2) Clean the exterior of the unit with a tissue or soft non-abrasive cloth.

CAUTION
Do not use solvents or other chemicals for cleaning this equipment.

3) Inspect the radio case and antenna for any physical damage.

5.3 Alignment

This transceiver is completely aligned at the factory and does not require any adjustments at installation. However it is considered good practice to verify that none of the adjustments have changed or been disturbed.

The test equipment listed below is used for the test set up. This test setup is used either in part or in total during the following adjustment.

Test Equipment
The test equipment required:

1. DC Power Supply (20V, 10A) set at 13.2 VDC
2. RF Power Meter (40W, 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 (DC Voltmeter)
7. Oscilloscope (any oscilloscope accurate for audio signal tracing)
8. SINAD Meter
9. Distortion Meter

5.3.1 PLL Frequency Adjustment (Transmitter, All Channel Receiver)

1) Connect the power supply (13.2V, 10A) to the DC Power Line.
2) Connect the RF Power Meter and a Frequency Counter through the coupler.
3) Turn the radio "ON" and select Channel 16 (156.800 MHz).
4) Press PTT on the Handset and read the indication on the Frequency Counter.
5) Adjust trimmer capacitor (TC1) on the RF PCB (see Fig 5-2) for the desired frequency (156.800 MHz) +/- 100 MHz.

5.3.2 Local Oscillator Adjustment (Channel 70 Receiver)

1) Connect a Frequency Counter to TP1 on the RF PCB and GND.
2) Set the radio on Channel 16 and adjust trimmer capacitor (TC2) on the RF PCB for the desired frequency (139.625 MHz) +/- 100Hz.

5.3.3 Modulation Adjustment (Transmitter)

1) Connect an FM Linear Detector through the coupler.
2) Connect the Audio Oscillator to the IDC input (pin 15 of J2) as shown in Fig 5-3.
3) Set the AF OSC output to 0 dBm (0.77 Vrms) at 1 kHz.
4) Press PTT and adjust VR3 on the RF PCB to the maximum modulation of 4.5 kHz +/-100 Hz.5.3.4

5.3. Output Power Adjustment (Transmitter)

1) Connect the RF Power meter.
2) Set the radio on CH 16 (156.800 MHz) .
3) Transmit and adjust the RF power output by VR1 (Low) and VR2 (High) on the RF PCB as follows.

Sequence	RF Power	Adjust Point	Target Power
1	Low	VR1	0.9W +/- 0.05W (limit 1W)
2	High	VR2	24W +/-0.5W (limit 25W)

5.3.5 RF Sensitivity Adjustment (All Channel Receiver)

1) Connect a RF Signal Generator (SG) to the antenna connector and a SINAD meter to the AF out 1 (pin 10 of J2).
2) Set up the SG at 1 kHz+/-3 kHz deviation and adjust L16, L18-L22 on the RF PCB as follows.

Caution: Do not tune L17.

Sequence	Condition	Adjust Point	Target Level
1	CH16 (156.800 MHz) SG output: 10uv	L16, L18-L22	Maximum SINAD
2	CH60 (156.025 MHz) SG output: 0.6uv	L16, L18-L22	Over 12dB SINAD
3	WX0 (163.275 MHz) SG output: 0.6uv	L16, L18-L22	Over 12dB SINAD

3) After alignment, check at Channel 60 and Weather Channel 0 for 12dB SINAD minimum with 0.35 uV output from SG.

5.3.6 RF Sensitivity Adjustment (CH 70 Receiver)

1) Set up the SG to CH70 (156.525 MHz) at 1 kHz +/-3 kHz deviation.
2) Connect the SINAD Meter to the AFout2 (pin 16 of J2) on the RF PCB.
3) Adjust L25-L29 on the RF PCB to get the best SINAD (over 12 dB SINAD) when SG output is .06uV.
4) Check using 0.35 uV SG input level for 12dB SINAD minimum per spec.

5.3.7 Weather Alert Decoder Adjustment

1) Connect the SG to the antenna connector.
2) Set up CH WX1 (162.550 MHz) with 1050 Hz +/-3 kHz deviation.
3) Connect the DC Volt Meter to TP2 on the RF PCB.
4) With VR5 fully clockwise, turn counter-clockwise and note its position when TP2 voltage changes from 5.0 VDC to 0 VDC.
   Continue to turn VR5 CCW until TP2 voltage changes from 0 VDC to 5 VDC.
   The final setting for VR5 is for 0 VDC between these two points.

5.4 Troubleshooting Guide

The following table provides a general troubleshooting chart for the a technician to isolate circuit failures within specific functional areas of the VHF radio.

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 RAY230/E can be found in Section 6.

Item No.	Symptom	Possible Cause
1	Unit does not turn on and Main Switch LED off during Standby mode	a.10 amp fuse in power line open b. Check Power SW and Relay (RL1) c. Check SW circuit as follows 1) Q26 input voltage: 0.7V -ON 2) +5v line: IC306 out at CPU PCB 3) R166: open 4) D18: shorted. Defective/device: Power Switch, D17-18, Q26-27 Relay (RL1), R166, IC305-7
2	Unit does not turn on and LCD off during Working mode	a.Defective handset cable and connector. b. Check handset as follows. 1) +B line: +13V Q708 Keyscan output 2) +5v line: IC701 output c. Defective/device: CPU (IC708), Reset IC (IC707), Q701, Q704-6, Q708 Photo Coupler (PC701) d. Check CPU PCB as follows: 1) RXD data input at Q319-321 e.Defective/device: CPU (IC305), Q319-321 Photo Coupler (PC305, 307, 309)
3	No sound with AF signal applied to AF1 output (pin 10 of J2)	a.Check RF PCB as follows: 1) RF on/off: +5V at pin 12 of J1 2) Q29 input

Item No.	Symptom	Possible Cause
		3) B+ line: +13V 4) R5v line: +5V at Q33 output 5) COM8v line: +8v at IC12 output 6 DISC out at pin 4 of J2 b. Defective/device: 2nd IF IC (IC7), Disc (Z1), De-emph IC (IC8), IC12-13, Q30, Q33-34, D19
4	No sound with AF signal applied to Main unit out	a.Check CPU PCB as follows : 1) +5vA line 2) AF level: pin 3 of IC310 3) AF level: Q302 and Q303 output 4) AF level: cross-point SW at pins 7, 8, 17 of IC315 5) AF level: Buff amp at pin 1 of IC319-321 b. Defective/device: CPU (IC305), IC310, IC315, IC319-321, Q302-304, Flex cable and connector
5	No sound with AF signal applied to SP box	a.Check +5V regulator of IC804 b. Check AF level on PCB as follows: 1) VR801 out pin 2 of J802 2) Analog SW out at pins 2, 6 of IC801 3) PA out at pin 1 of IC802, C817 c. Defective/devices: IC801 - 804, VR801, C817
6	No sound with AF signal applied to Handset	a.Check handset PCB as follows: 1) +9V line: IC714 output 2) +5V line: IC702 output 3) +2.5V Vref: Q703 output, VTH output 4) AF leveL: pin 7 of IC704 5) AF level: pin 2 of IC711 6) AF level: pin 2 of IC706

Item No.		Symptom Possible Cause
7	No receiver (All Channel Receiver) Or low sensitivity	a.Check RF PCB as follows: 1) +R8v line: Q30 output 2) BPF control voltage (Vcp): pin 12 of J2, pin 7 of IC8, CH16: 2V, WX0: 4.8V 3) VCO frequency: f-21.6 MHz 4) VCO output level: 775 mV typ. 5) Mixer input: G2 of Q19 6) 1st IF output: Q20 7) 21.145 MHz Xtal OSC b. Defective/device: ANT SW diode: D1-2 BPF tracking: Vcp PLL circuit Q14, Q16-20, Q30, D9, D11-16
8	SQ circuit inoperative	a.Check SQ circuit on RF PCB and CPU PCB as follows: 1) Busy1 noise output: pin8 of J2, pin14 of IC7 2) DC amp out: pin7 of IC314, pin97 of IC305 3) SQ VOL IC output: pin6 of J2, pin10 of IC13 b. Defective/device: IC7, IC312-314, CPU (IC305)
9	PLL inoperative	a.Check at DC power source: 1) +6v line: IC14 output 2) +5v line: IC13 output 3) VCO B+ (5.3V): (Q8 output) b. Check 12.8 MHz Xtal OSC (X1) c.Check T/R SW voltage (VCO T/R): RX : 0V TX: 5V (pin 13 of J2)

		d. Check VCO control voltage at TP3: 1.5V - 5.5V e.Check PLL fin level at pin 8 of IC4, 245mV min f. Defective/device: IC3-IC5, CPU (IC305), IC13-14, Q8-13, VCO
10	No transmit (TX)	a.Defective PTT switch on Handset (S727) b. Check PTT control circuit: 1) TXD data at Q705, pin 27 of IC 706 2) PTT signal at PC304, PC306, PC308 3) RXD data at Q319-320 c.Check T8v line: Q31 output d. Check PLL signal:5V at Q32 input, IC305 pin79 e.Check PLL unlock: IC5 pin3, unlock=51 f. Check PLL circuit: See Item 9 g.Defective/device 1) Handset: IC708, Q701, Q705-707 PC701, PTT Sw 2) CPU PCB: IC305, PC304-309 Q316-321, D307-312 3) RF PCB: Q31-32, PLL circuit
11	Low power output (TX)	a.Check ANT cable and connector b. Check DC line current: 25W 6.5A c.Check LPF and Antenna switch d. Check PA input power: 250mW typ. e.Check power control circuit: 1) VR1-Low and VR2-High 2) APC output voltage at pin 2 of PA 3) H/L select: Q7 input (H-0V) f. Defective/device: VR1-2, Q1-2, Q5-7, D1-6, IC1-2 Antenna cable with c n

12	Poor or no modulation (TX)	a. Check IDC inp level at pin 15 of J2 +/- 3 kHz dev: 155 mV typ. b. Check IDC output and VR3 c. Check handset mic line ouput: +/- 3 kHz dev: 155 mV typ. d. Check cross-point SW (IC315) and analog SW (IC311) on CPU PCB e. Check VCOf. Defective/device 1) Handset: Mic, IC704-705, C717 2) CPU PCB: IC311, IC315, IC319-321 CPU (IC305) 3) RF PCB: IC6, VR3, VCO
13	Hailer inoperative	a. Check Relay: RL301 Make: Talk, Break: Listen b. Check Hailer Speaker and wiring c. Check AF PA output: 10W at 4 ohm d. Check AF level cross-point (IC315) output to AF PA input

SECTION 6 PARTS LIST AND DRAWINGS

6.1 Parts Location List

Description		Q'ty	Symbol
RF PCB Assembly			
Capacitor			
Ceramic Chip Capacitor	0.5pF / 50V	7	C111, 127, 171, 180, 200, 201, 207
Ceramic Chip Capacitor	1pF / 50V	4	C18, 113, 128 , 181
Ceramic Chip Capacitor	1.5pF / 50V	1	C177
Ceramic Chip Capacitor	2pF / 50V	8	C48, 122, 130, 137, 81, 109, 120, 123
Ceramic Chip Capacitor	4pF / 50V	1	C208
Ceramic Chip Capacitor	5pF / 50V	7	C102, 114, 131, 172, 173, 183, 194
Ceramic Chip Capacitor	6pF / 50V	4	C139, 186, 199, 209
Ceramic Chip Capacitor	7pF / 50V	8	C112, 121, 124, 138, 170, 179, 182, 206
Ceramic Chip Capacitor	8pF / 50V	6	C80, 101, 110, 129, 176, 202
Ceramic Chip Capacitor	10pF / 50V	1	C82
Ceramic Chip Capacitor	12pF / 50V	2	C76, 136
Ceramic Chip Capacitor	15pF / 50V	1	C31
Ceramic Chip Capacitor	18pF / 50V	2	C26, 187
Ceramic Chip Capacitor	22pF / 50V	3	C15, 17, 25
Ceramic Chip Capacitor	27pF / 50V	1	C16
Ceramic Chip Capacitor	33pF / 50V	5	C64, 65, 185, 196, 203
Ceramic Chip Capacitor	47pF / 50V	5	C34, 140, 145, 188, 195
Ceramic Chip Capacitor	56pF / 50 V	3	C146, 210, 211
Ceramic Chip Capacitor	100pF / 50V	12	C47, 69, 70, 75, 91, 103, 153, 218, 247, 248, 249, 256
Ceramic Chip Capacitor	220pF / 50V	5	C88, 149, 150, 214, 215
Ceramic Chip Capacitor	390pF / 50V	1	C97
Ceramic Chip Capacitor	470pF / 50V	3	C85, 253, 255
Ceramic Chip Capacitor	1000pF / 50V	79	C14, 19, 20, 21, 23, 24, 27, 28, 29, 30, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 45, 46, 49, 50, 51, 52, 60, 61, 67, 72, 74, 77, 78, 79, 83, 95, 99, 104, 105, 106, 107, 108, 116, 117, 118, 119, 125, 126, 132, 133, 134, 135, 144, 174, 178, 184, 191, 197, 198, 204, 205, 232, 235, 241,

Description		Q'ty	Symbol
			242, 243, 244, 245, 246, 250, 251, 252, 254, 257, 258, 259, 260, 261, 262
Ceramic Chip Capacitor	1500pF / 50V	2	C93, 94
Ceramic Chip Capacitor	2200pF / 50V	6	C159, 223, 228, 229, 230, 231
Ceramic Chip Capacitor	3300pF / 50V	2	C160, 224
Ceramic Chip Capacitor	4700pF / 50V	2	C86, 96
Ceramic Chip Capacitor	0.01uF / 50V	16	C53, 56, 68, 73, 84, 115, 141, 142, 143, 152, 166, 189, 190, 192, 193, 217
Ceramic Chip Capacitor	0.1uF / 16V	24	C43, 44, 63, 66, 71, 98, 147, 148, 154, 156, 158, 161, 163, 175, 212, 213, 219, 221, 222, 225, 227, 236, 239, 263
Ceramic Chip Capacitor	1uF / 6.3V	10	C87, 89, 90, 92, 100, 151, 162, 216, 226, 240
Ceramic Chip Capacitor	0.1uF / 100V	3	C1, 3, 5
Ceramic Chip Capacitor	1000pF / 630V	3	C2, 4, 6
Ceramic Chip Capacitor	33pF / 200V	1	C10
Ceramic Chip Capacitor	15pF / 200V	3	C7, 11, 13
Ceramic Chip Capacitor	33pF / 200V	3	C8, 9, 10
Chip Tantalum Electrolytic Capacitor	0.22uF / 35V	1	C165
Chip Tantalum Electrolytic Capacitor	0.47uF / 25V	2	C157, 164
Chip Tantalum Electrolytic Capacitor	2.2uF / 16V	1	C58
Chip Tantalum Electrolytic Capacitor	4.7uF / 16V	3	C62, 155, 220
Chip Tantalum Electrolytic Capacitor	10uF / 16V	2	C54, 55
Chip Alminum Electrolytic Capacitor	10uF / 16V	2	C237, 238
Chip Alminum Electrolytic Capacitor	22uF / 35V	2	C22, 167
Chip Alminum Electrolytic Capacitor	47uF / 16V	1	C168
Alminum Electrolytic Capacitor	470uF / 25V	1	C233
Alminum Electrolytic Capacitor	470uF / 25V	1	C234
Filim Chip capacitor	0.047uF / 16V	2	C57, 169
Filim Chip capacitor	0.1uF / 16V	1	C59
Diode			
Zener Diode (16V, Rank Z)	02DZ16-Z	1	D18
Diode	1SS301	3	D3, 17, 19
Diode	1SS345	1	D5
Diode	1SS368	2	D6, 10
Diode	1SS371	3	D7, 8, 11
Diode	1SV273	6	D9, 12, 13, 14, 15, 16
Diode	MA716	1	D4

Description		Q'ty	Symbol
Pin Diode	MI308	1	D2
Pin Diode	MI402	1	D1
IC			
IC	LMC567	1	IC11
IC	M57710-A	1	IC1
IC	MB15A02	1	IC4
IC	NJM3403AV	1	IC6
IC	TA31136FN	2	IC7, 9
IC	TA75S01F	2	IC2, 10
IC	TA75W01FU	1	IC8
IC	TA7808F	1	IC12
IC	TA78L05F	1	IC13
IC	TC7W02FU	1	IC5
IC	TC7W66FU	1	IC3
IC	TK11360M	1	IC14
Resistor			
Chip Resistor	2.2W, 1/16W	1	R87
Chip Resistor	22W, 1/16W	6	R97, 106, 132, 138, 170, 171
Chip Resistor	56W, 1/16W	1	R131
Chip Resistor	68W, 1/16W	1	R32
Chip Resistor	100W, 1/16W	10	R2, 12, 13, 26, 31, 33, 61, 84, 117, 158
Chip Resistor	15W, 1/16W	1	R83
Chip Resistor	220W, 1/16W	3	R43, 44, 49, 54, 56, 62, 111, 112, 113, 143, 144, 145, 151, 154
Chip Resistor	330W , 1/16W	2	R9, 89
Chip Resistor	470W , 1/16W	2	R11, 107
Chip Resistor	560W, 1/16W	2	R86, 150
Chip Resistor	680W, 1/16W	1	R55
Chip Resistor	750W, 1/16W	1	R39
Chip Resistor	1kW, 1/16W	8	R17, 25, 27, 64, 81, 125, 139, 147
Chip Resistor	1.3kW, 1/16W	2	R118, 159
Chip Resistor	1.5kW , 1/16W	4	R10, 96, 105, 126
Chip Resistor	1.8kW, 1/16W	1	R137
Chip Resistor	2.2kW, 1/16W	5	R6, 36, 38, 41, 168
Chip Resistor	2.7kW, 1/16W	7	R152, 30, 37, 88, 116, 157, 165
Chip Resistor	3.9kW, 1/16W	2	R59, 80
Chip Resistor	4.7kW , 1/16W	7	R15, 29, 40, 52, 58, 146, 148
Chip Resistor	5.1kW, 1/16W	1	R68
Chip Resistor	5.6kW, 1/16W	3	R28, 108, 140

Description		Q'ty	Symbol
Chip Resistor	6.2kW, 1/16W	2	R20, 169
Chip Resistor	8.2kW, 1/16W	1	R72
Chip Resistor	10kW, 1/16W	12	R21, 22, 34, 42, 45, 48, 60, 82, 109, 141, 149, 161
Chip Resistor	15kW, 1/16W	3	R120, 136, 162
Chip Resistor	22kW, 1/16W	11	R19, 46, 47, 65, 66, 67, 94, 123, 124, 129, 153
Chip Resistor	27kW, 1/16W	1	R104
Chip Resistor	33kW, 1/16W	3	R71, 74, 172
Chip Resistor	36kW, 1/16W	1	R75
Chip Resistor	39kW, 1/16W	3	R70, 77, 78
Chip Resistor	47kW, 1/16W	13	R35, 50, 51, 76, 85, 101, 103, 110, 115, 133, 135, 142, 167
Chip Resistor	56kW, 1/16W	2	R95, 130
Chip Resistor	100kW , 1/16W	2	R14, 57, 63, 90, 91, 98, 99, 100, 119, 121, 128, 156, 163
Chip Resistor	150kW, 1/16W	2	R114, 155
Chip Resistor	220kW, 1/16W	6	R18, 23, 73, 79, 92, 127
Chip Resistor	270kW, 1/16W	2	R122, 164
Chip Resistor	470kW, 1/16W	2	R24, 53
Chip Resistor	1MW, 1/16W	1	R160
Chip Resistor	120kW, 1/16W	1	R69
Chip Resistor	1.5MW, 1/16W	2	R102, 134
Chip Resistor	10W, 1/10W	1	R8
Chip Resistor	15W, 1/10W	1	R5
Chip Resistor	33W, 1/10W	1	R7
Chip Resistor	47W, 1/10W	1	R166
Chip Resistor	330W, 1/10W	1	R4
Chip Resistor	10kW, 1/10W	1	R1
Chip Resistor	150W, 1/8W	1	R3

Handset PCB

IC

TA78L05F	2	IC701, 702
NJM2070M (T1)	1	IC703
NJM3404AV	1	IC704
BA3308FV	1	IC705
M62429FP	1	IC706
RN5VD45A	1	IC707
uPD789026	1	IC708
PCF2113D	1	IC709

Description		Q'ty	Symbol
TB62715FN		1	IC710
TC7S66FU		1	IC711
TA78L09F		1	IC714
Transistor			
Transistor 2SA1586-GR		1	Q705
Transistor 2SB1188		1	Q713
Transistor 2SC4116-GR		1	Q703
Transistor DTC144EUA		8	Q704, 706, 707, 708, 709, 710, 711, 712
Transistor FMG2A		2	Q701, 702
Diode			
Diode 1SS368		1	D702
LED FR1101F-TR		4	D704, 705, 706, 707
LED HSMS-C190		13	D708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720
Capacitor			
Ceramic Chip Capacitor	22pF / 50V	2	C712, 713
Ceramic Chip Capacitor	470pF / 50V	2	C735, 736
Ceramic Chip Capacitor	680pF / 50V	1	C738
Ceramic Chip Capacitor	1000pF / 50V	15	C734, 739, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753
Ceramic Chip Capacitor	3900pF / 50V	1	C737
Ceramic Chip Capacitor	4700pF / 50V	1	C726
Ceramic Chip Capacitor	0.1uF / 16V	10	C703, 705, 707, 709, 714, 715, 716, 731, 733, 740
Ceramic Chip Capacitor	1uF / 6.3V	9	C701, 718, 721, 723, 725, 727, 728, 729, 730
Chip Tantalum Electrorytic Capacitor	2.2uF / 16V	1	C719
Chip Tantalum Electrorytic Capacitor	4.7uF / 16V	8	C704, 706, 708, 710, 711, 717, 720, 724
Chip Tantalum Electrorytic Capacitor	10uF / 16V	2	C702, 722
Chip Tantalum Electrorytic Capacitor	220uF / 6.3V	1	C732
Resistor			
Chip Resistor	1W, 1/16W	1	R730
Chip Resistor	10W, 1/16W	3	R732, 733, 734
Chip Resistor	100W, 1/16W	1	R717
Chip Resistor	150W, 1/16W	1	R752

Description		Q'ty	Symbol
Chip Resistor	220W, 1/16W	1	R751
Chip Resistor	330W, 1/16W	1	R755
Chip Resistor	470W, 1/16W	1	R716
Chip Resistor	560W, 1/16W	1	R720
Chip Resistor	620W, 1/16W	1	R736
Chip Resistor	1kW, 1/16W	1	R739
Chip Resistor	1.5kW, 1/16W	1	R756
Chip Resistor	2.2kW, 1/16W	3	R721, 731, 754
Chip Resistor	3.3kW, 1/16W	1	R729
Chip Resistor	5.1kW, 1/16W	1	R728
Chip Resistor	8.2kW, 1/16W	1	R757
Chip Resistor	10kW, 1/16W	9	R712, 718, 726, 737, 740, 743, 744, 749, 750
Chip Resistor	15kW, 1/16W	2	R719, 753
Chip Resistor	22kW, 1/16W	9	R702, 711, 722, 723, 724, 727, 746, 747, 748
Chip Resistor	33kW, 1/16W	1	R715
Chip Resistor	36kW, 1/16W	2	R703, 713
Chip Resistor	47kW, 1/16W	3	R725, 741, 745
Chip Resistor	51kW, 1/16W	1	R738
Chip Resistor	1MW, 1/16W	1	R714
Chip Resistor	10W, 1/10W	1	R735
Miscellaneous			
Chip Resistor	0W, 1/16W	1	JP1
Chip Resistor	0W, 1/16W	1	JP3
Tactile Switch		4	SW716, 721, 726, 727
Receiver/32W		1	SP701
Microphone		1	MIC701
Photo Coupler TLP112A		1	PC701
Lead Relay ORD213		1	RL701
LCD LM-5276B		1	LCD701
Crystal OSC (4.9152MHz)		1	XTL701
9Pin Connector		1	J701

I/O PCB

Capacitor			
Ceramic Chip Capacitor	10000pF / 50V	2	C512, 513
Ceramic Chip Capacitor	2200pF / 50V	15	C501, 502, 504, 505, 507, 509,

Description		Q'ty	Symbol
			511, 514, 515, 516, 517, 518, 519, 520, 521
Ceramic Chip Capacitor	0.1uF / 16V	4	C503, 506, 508, 510
Diode			
LED BR3822K		2	D501, 502
Resistor			
Chip Resistor	470W , 1/16W	1	R501
Miscellaneous			
Push Switch		1	SW501
Circular Connector 6pin		1	J501
Sea Talk Connector		1	J502
Circular Connector 8pin		3	J503, 504, 505
Connector 3pin		1	J506
Connector 4pin		1	J507
Connector 26pin		1	J508
FFC 26pin		1	W509

CTRL Assembly PCB

IC			
24LC16BT-I/SN		1	IC322
M30800FCFP		1	IC305
M62363FP		1	IC313
MSM7512BGS-VK		2	IC308, 309
NJM3403AV		1	IC312
NJM3404AV		3	IC319, 320, 321
RN5VD45A		1	IC307
TA75S01		1	IC326
TA7805F		1	IC306
TB31303AF		1	IC315
TC74HC390AF		1	IC324
TC74HC4051AF		1	IC310
TC74HC4053AF		1	IC311
TC75W51FU		1	IC314
TC7S04F		1	IC318
TC7W241FU		1	IC317
TC7W53FU		4	IC301, 302, 303, 304
TDA1519A		1	IC316
Transistor			
Transistor 2SA1204		1	Q305

Description		Q'ty	Symbol
Transistor 2SA1586-GR		1	Q310
Transistor 2SC4116-GR		10	Q304, 308, 314, 315, 323, 324, 326, 327, 328, 329
Transistor DTA115TUA		2	Q302, 303
Transistor DTA144EUA		2	Q322, 325
Transistor DTC144EUA		10	Q301, 307, 309, 311, 312, 313, 316, 317, 318, 330
Transistor DTD114EK		1	Q306
Transistor UMG6N		3	Q319, 320, 321
Diode			
Zener Diode (16V, Rank Y)		1	D302
Diode 1SS301		1	D301
Diode 1SS302		1	D306
Diode 1SS368		10	D303, 304, 305, 307, 308, 309, 310, 311, 312, 313
Diode 1SS372		1	D314
Capacitor			
Ceramic Chip Capacitor	15pF / 50V	2	C311, 312
Ceramic Chip Capacitor	33pF / 50V	2	C340, 341
Ceramic Chip Capacitor	100pF / 50V	4	C301, 302, 303, 319
Ceramic Chip Capacitor	220pF / 50V	1	C353
Ceramic Chip Capacitor	1000pF / 50V	12	C304, 327, 331, 359, 361, 362, 370, 371, 372, 373, 376, 422
Ceramic Chip Capacitor	1500pF / 50V	1	C348
Ceramic Chip Capacitor	2200pF / 50V	3	C379, 384, 389
Ceramic Chip Capacitor	0.01uF / 50V	15	C325, 328, 329, 335, 360, 377, 395, 396, 397, 399, 405, 411, 416, 417, 418
Ceramic Chip Capacitor	0.022uF / 25V	4	C314, 320, 346, 398
Ceramic Chip Capacitor	0.047uF / 16V	3	C413, 414, 415
Ceramic Chip Capacitor	0.1uF / 16V	19	C305, 306, 308, 316, 317, 321, 322, 323, 332, 334, 339, 352, 354, 356, 374, 375, 394, 412, 424
Ceramic Chip Capacitor	1uF / 6.3V	26	C324, 326, 330, 342, 343, 347, 349, 350, 351, 357, 358, 364, 366, 367, 368, 369, 380, 381, 382, 385, 286, 387, 390, 391, 392, 423
Chip Tantalum Electrorytic Capacitor	1uF / 16V	2	C337, 406
Chip Tantalum Electrorytic Capacitor	4.7uF / 16V	4	C333, 336, 338, 355
Chip Tantalum Electrorytic Capacitor	10uF / 16V	13	C309, 310, 313, 315, 318, 344,

Description		Q'ty	Symbol
			345, 363, 383, 388, 393, 407, 378
Chip Alminum Electrolytic Capacitor	22uF / 35V	1	C307
Chip Alminum Electrolytic Capacitor	47uF / 16V	2	C365, 402
Chip Alminum Electrolytic Capacitor	100uF / 10V	1	C408
Stacked Metallized Film Chip capacitor	0.015uF / 16V	2	C403, 404
Stacked Metallized Film Chip capacitor	0.022uF / 16V	2	C409, 410
Resistor			
Resistor	0W, 1/16W	1	R316
Resistor	10W, 1/16W	1	R386
Resistor	22W, 1/16W	2	R317, 321
Resistor	47W, 1/16W	1	R369
Resistor	68W, 1/16W	3	R389, 401, 413
Resistor	100W, 1/16W	9	R301, 302, 303, 304, 305, 306, 307, 308, 374
Resistor	220W, 1/16W	4	R311, 398, 410, 422
Resistor	270W, 1/16W	1	R441
Resistor	330W, 1/16W	3	R375, 383, 402
Resistor	390W, 1/16W	2	R356, 382
Resistor	470W, 1/16W	3	R388, 400, 412
Resistor	560W, 1/16W	3	R387, 399, 411
Resistor	1kW, 1/16W	3	R337, 352, 364
Resistor	1.5kW, 1/16W	1	R439
Resistor	2.2kW, 1/16W	4	R376, 379, 385, 446
Resistor	3.3kW, 1/16W	2	R354, 423
Resistor	4.7kW, 1/16W	2	R363, 372
Resistor	5.1kW, 1/16W	1	R315
Resistor	8.2kW, 1/16W	2	R434, 437
Resistor	10kW, 1/16W	29	R319, 323, 325, 328, 329, 340, 348, 350, 360, 361, 373, 384, 391, 396, 397, 403, 408, 409, 415, 420, 421, 425, 426, 427, 428, 433, 442, 443, 453
Resistor	12kW, 1/16W	4	R378, 395, 407, 419
Resistor	15kW, 1/16W	11	R353, 377, 394, 406, 418, 448, 449, 450, 451, 465, 466
Resistor	20kW, 1/16W	1	R444
Resistor	22kW, 1/16W	13	R345, 347, 365, 380, 392, 393, 404, 405, 416, 417, 431, 432, 454
Resistor	27kW, 1/16W	3	R355, 371, 445
Resistor	33kW, 1/16W	4	R318, 359, 366, 452
Resistor	36kW, 1/16W	2	R346, 468

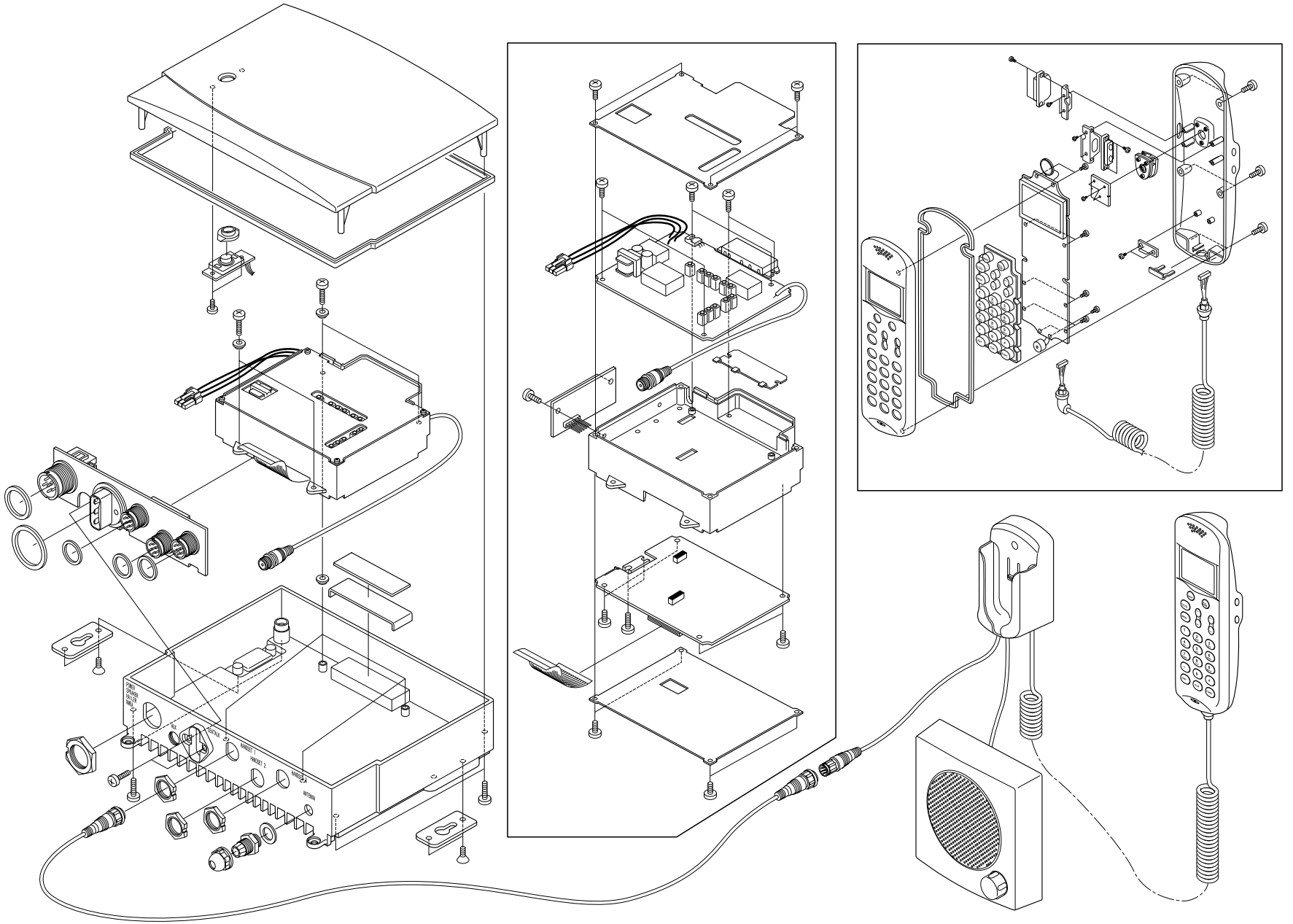
Description		Q'ty	Symbol
Resistor	39kW, 1/16W	1	R381
Resistor	47kW, 1/16W	8	R309, 310, 314, 324, 327, 435, 436, 438
Resistor	56kW, 1/16W	1	R447
Resistor	68kW, 1/16W	1	R349
Resistor	100kW, 1/16W	14	R320, 322, 338, 339, 341, 342, 344, 351, 368, 370, 424, 462, 463, 464
Resistor	220kW, 1/16W	11	R330, 331, 332, 333, 334, 335, 336, 343, 429, 430, 467
Resistor	470kW, 1/16W	2	R362, 440
Resistor	100kW, 1/16W (Rank F 1%)	1	R312
Resistor	47kW, 1/16W (Rank F 1%)	1	R313
Resistor	22W, 1/10W	1	R357
Resistor	27W, 1/10W	1	R358
Miscellaneous			
6 Pin Connector		1	J301
10 Pin Connector		1	J302
20 Pin Connector		1	J303
16 Pin Connector		1	J304
26 Pin Connector		1	J305
Photo Coupler TLP112A		1	PC301
Photo Coupler TLP181		1	PC302, 303
Photo Coupler PS2701-1		6	PC304, 305, 306, 307, 308, 309
Relay G5V-2		1	RL301
3.579545MHz Crystal OSC		2	XTL301, 302
18.432MHz Crystal OSC		1	XTL303

VCO PCB

Transistor			
Transistor	IMB5A	1	Q901
Transistor	2SK508-K53	2	Q902, 903
Transistor	2SC4226-R24	1	Q904
Diode			
Diode	1SV283	4	D901, 902, 903, 904

Description		Q'ty	Symbol
Capacitor			
Capacitor	1pF / 50V	2	C908, 918
Capacitor	2pF / 50V	1	C904
Capacitor	4pF / 50V	2	C903, 914
Capacitor	0.5pF / 50V	1	C901
Capacitor	5pF / 50V	1	C913
Capacitor	10pF / 50V	4	C906, 907, 920, 921
Capacitor	13pF / 50V	2	C902, 905
Capacitor	15pF / 50V	3	C915, 916, 917
Capacitor	18pF / 50V	1	C912
Capacitor	1000pF / 50V	5	C909, 910, 911, 919, 922
Resistor			
Resistor	100W, 1/16W	1	R908
Resistor	470W, 1/16W	1	R904
Resistor	560W, 1/16W	1	R906
Resistor	2.2kW, 1/16W	1	R901
Resistor	47kW, 1/16W	2	R903, 905
Resistor	100kW, 1/16W	1	R902
Resistor	220kW, 1/16W	1	R907
Miscellaneous			
E2-0.35-1.6-8TL		2	L902, 905
Chip Indctor (2.2uH)		2	L903, 906
Chip Indctor (4.7uH)		2	L901, 904
Chip Inductor 68nH		1	L907

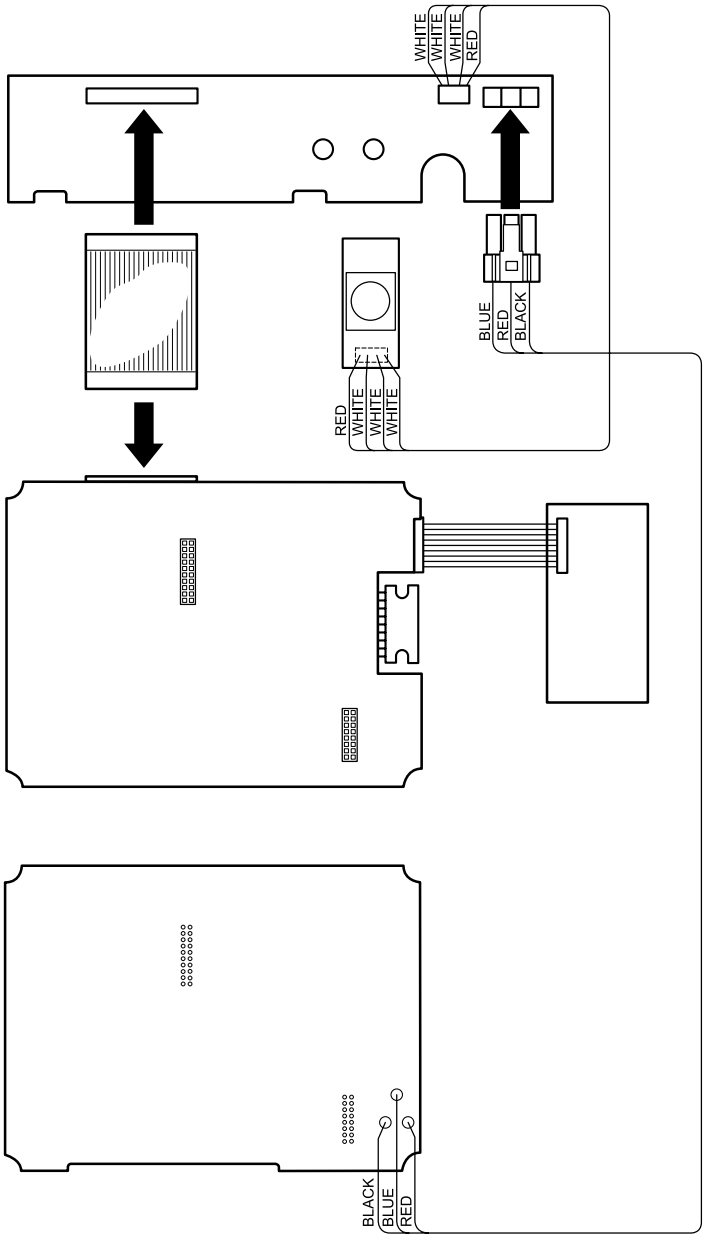
6.2 RAY230 ASSEMBLY DRAWING

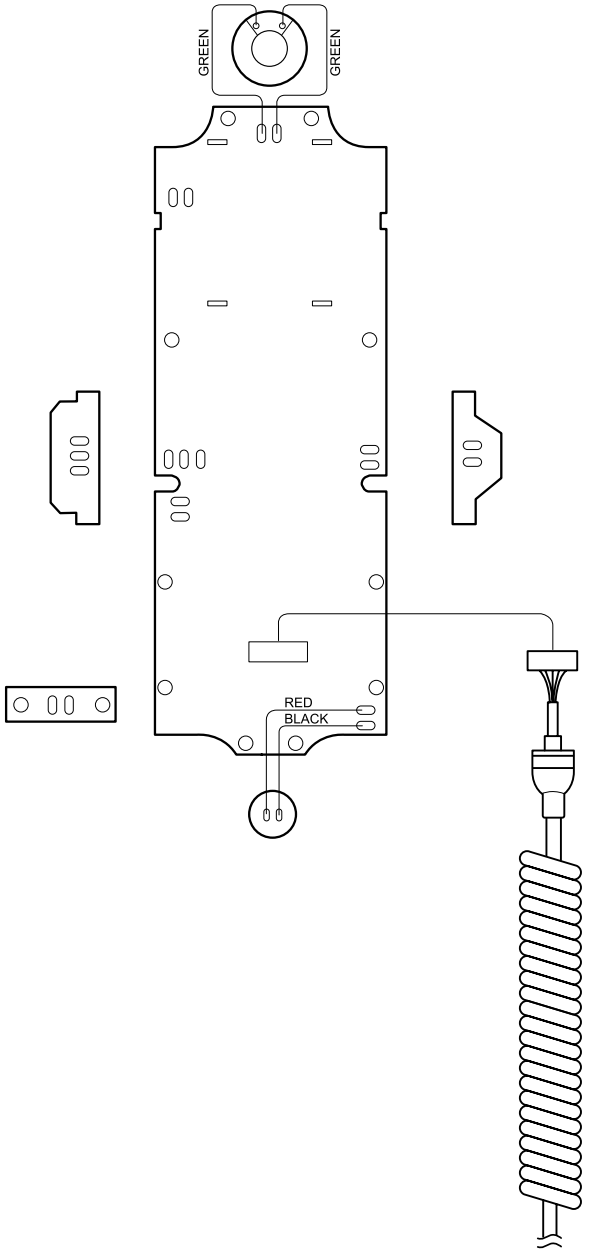


6.3 BLOCK DIAGRAM

6.4 RAY230 PCB LAYOUT

6.5 RAY230 WIRING DIAGRAM





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 can obtain a station license and call sign by completing FCC Form 605 and mailing it with the required fee to the FCC, Marine Ship Service, 1270 Fairfield Road, Gettysburg, PA 17325-7245.

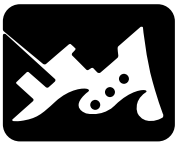
- You need a radio operator license to operate a VHF Marine Radio only if you plan to dock in a foreign port or leave a foreign port to dock in a U.S. port.

- 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.

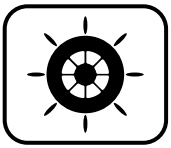
- If you carry more than six passengers for hire, your vessel must be certified as a passenger-carrying vessel by the FCC and the Coast Guard.

USAGE GUIDE


Emergency

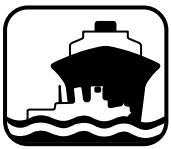

Calling


Monitoring


Intership Safety

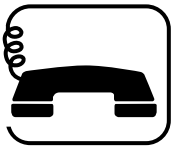
U.S. Coast Guard

Navigation


Port Operation


Noncommercial

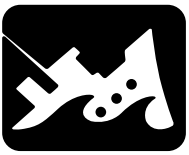

Commercial


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 another channel

Caution
Every ship at sea is to 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

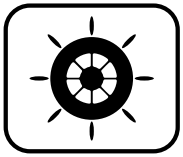
Monitoring

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

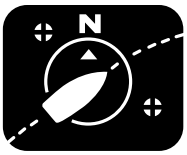
Channel: 22

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

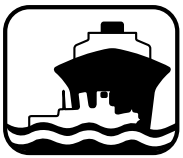
Vessels: Any

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

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 vessels traffic service on the Great Lakes, St. Lawrence Seaway and designated major ports.

Non commercial (Boat Operations)

Channels: 19, 68, 69, 71, 72, 78

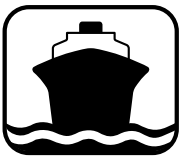
Vessels: Recreational boats and any others not used primarily for commercial transport.

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

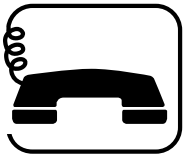
Use: Communications pertaining to the purpose for which the vessel is used

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

Channel 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.

PHONETIC ALPHABET:

To help make call letters more clearly understood, and to assist in spelling out similar sounding or unfamiliar words, radiotelephone users employ the international phonetic alphabet.

Phonetic Alphabet:

A - ALPHA
B - BRAVO
C - CHARLIE
D - DELTA
E - ECHO
F - FOX-TROT
G - GOLF
H - HOTEL
I - INDIA
J - JULIET
K - KILO
L - LIMA
M - MIKE
N - NOVEMBER
O - OSCAR
P - PAPA
Q - QUEBEC
R - ROMEO
S - SIERRA
T - TANGO
U - UNIFORM
V - VICTOR
W - WHISKEY
X - X-RAY
Y - YANKEE
Z - ZULU