Marine Communications Course

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FOREWORD

Communication at sea is of vital importance to ensure the safety of all who use our oceans. The ability to call for help when needed is the most important function of a VHF or SSB radio. The contents of this course will enable you to use a VHF radio and introduce you to the correct operational procedures and common radio terminology. This book should be kept on board your boat at all times as a quick reference guide, and all crew members should be taught to operate a VHF radio in the event of an emergency.

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INTRODUCTION

Today, radio communications are a central and essential part of life at sea. A VHF radio is the absolute minimum a prudent skipper should have on board, even on local waters. Once a mariner ventures further offshore then the inventory of communications equipment grows to include SSB/HF radio, Satellite communication, EPIRBs SARTs etc.

Commercial vessels and vessels that have to comply with their Flag State's regulations will be required to carry specific equipment including possibly Global Maritime Distress and Safety System (GMDSS). This applies to all cargo ships of 300 gross tons, and all passenger ships regardless of size, on International voyages.

There are a number of purposes for good communications while at sea. These range from Safety, which has absolute priority, to operational and business communications, both ship to shore and ship to ship. Familiarity with and correct use of, the various items of equipment is essential and in some instances compulsory.

This course aims to outline the various types of communications equipment, regulations concerning their use correct use, of radio equipment and the correct procedures for emergency radio communications.

BASIC RADIO THEORY

Transmitter, receiver, transceiver, antenna
A radio set consists of a transmitter and receiver combined in one instrument, usually called a transceiver. The transmitter is the part that can send out a radio signal and the receiver is the part that can receive a radio signal from another transmitter elsewhere. When you speak into the microphone the sounds of your voice are converted by the transmitter into radio waves, or signals, which are then sent out from the transmitter through an antenna. A receiver can pick up these radio signals through its antenna and convert them back into sounds which are heard coming from the radio speaker. When a radio station transmits a signal, it can be received on any other radio receiver if it is tuned to the same frequency as the transmitter, and it is within range of the transmitter.

Frequency
Radio transmitters send out their signal on a precise frequency and only a receiver tuned exactly to the same frequency will receive that signal. The frequency selected is usually indicated on the radio by a pointer against a printed scale or by a digital readout. In order to find the frequencies used by a specific station, a publication listing radio stations will have to be consulted. More sophisticated radio receivers may allow entry into a memory of frequencies of regularly used stations, so that by just pressing a numbered button the radio receiver automatically switches to the desired frequency. If the radio has this facility you can also switch from one frequency to another by simply pressing the correctly numbered button.

Radio waves/wavelength
Radio signals travel from a transmitter to a receiver in waves. Just as a pebble dropped on the surface of a lake forms concentric waves moving outwards from the point of entry, so do radio waves (invisible) move outward at constant velocity from an antenna in concentric circles.

Radio waves are electromagnetically propagated at the antenna (by the reversal of electrical current). As the rate of reversals is changed, so too is the length of the waves. Because all radio waves travel at the same speed (the speed of light) a transmitter that generates more waves per second produces shorter waves. Conversely one producing fewer waves per second produces longer waves. Thus the higher the frequency the shorter the waves and the lower the frequency the longer the waves.

Radio waves are described by the frequency with which these waves occur per second, in other words by the number of waves per second. The technical term used is a Hertz, named after Dr. Heinrich Hertz, a 19th. Century German physicist. 1 hertz (1Hz) means one wave per second, 1 kilohertz (1kHz) means 1,000 waves per second and 1 megahertz (1MHz) means 1,000,000 waves per second.

Radio Frequency Bands

Various radio frequencies are divided into bands:

BAND	BAND	FREQUENCY
VLF	Very Low Frequency	3 kHz to 30 kHz
LF	Low Frequency	30 kHz to 300 kHz
MF	Medium Frequency	300 kHz to 3000 kHz (3 MHz)
HF	High Frequency	3 MHz to 30 MHz
VHF	Very High Frequency	30 MHz to 300 MHz
UHF	Ultra High Frequency	300 MHz to 3000 MHz (3 GHz)

SHF	Super High Frequency	3 GHz to 30 HGz
EHF	Extremely High Frequency	30 HGz to 300 GHz

Three different frequency bands are reserved solely for marine communications.

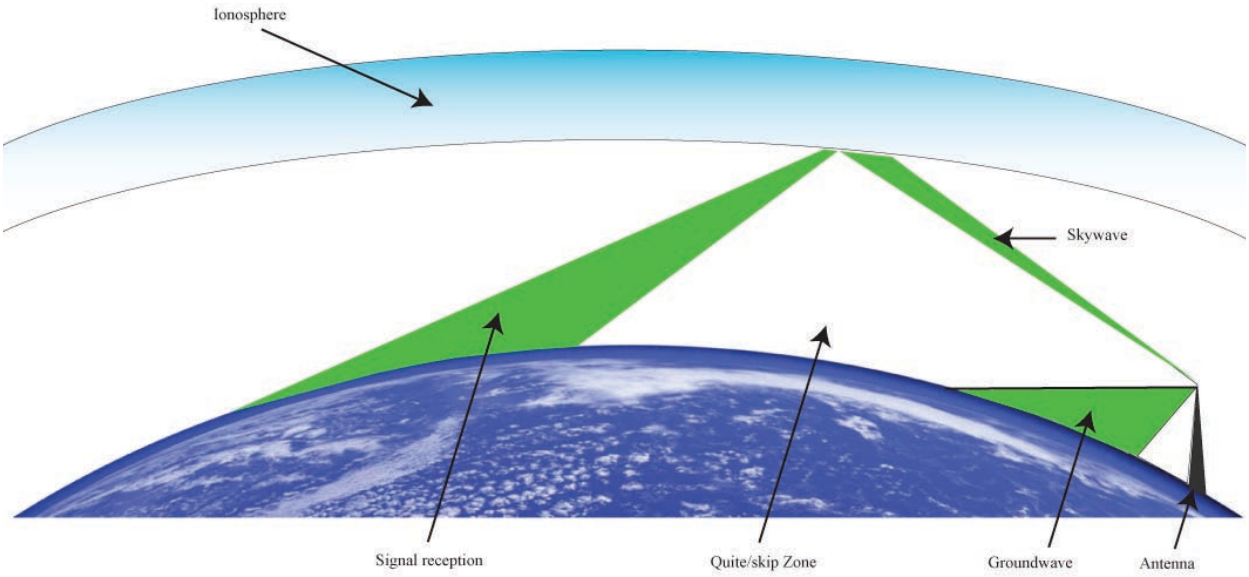
These are:

- HF (high frequency) from 4 to 25 MHz giving a range up to about 10,000 miles
- MF (medium frequency) from 1.6 to 4.2 MHz with a range of about 1000 miles
- VHF from 156 to 174 MHz with a maximum range of roughly 40 to 50 miles.

Propagation simplified

Propagation is the way a radio wave moves from one place to another. The main factor which determines the path taken by a radio wave is its frequency. Basically Low and Medium frequencies will travel a path following the curvature of the earth and are known as ground waves and therefore range is determined by Transmitter power. Higher frequencies will be reflected back from the ionosphere in the form of sky waves. Very High Frequencies and above become space waves which are not reflected back to earth.

Sky waves make long distance radio communications possible. The transmitter sends a radio wave up to the ionosphere which "bounces back" at an angle and returns to earth. The area between the transmitter and the return area is known as the skip zone. Skip distance is the shortest distance beyond the ground wave at which communication is possible, this is the point where the sky wave first comes to earth.



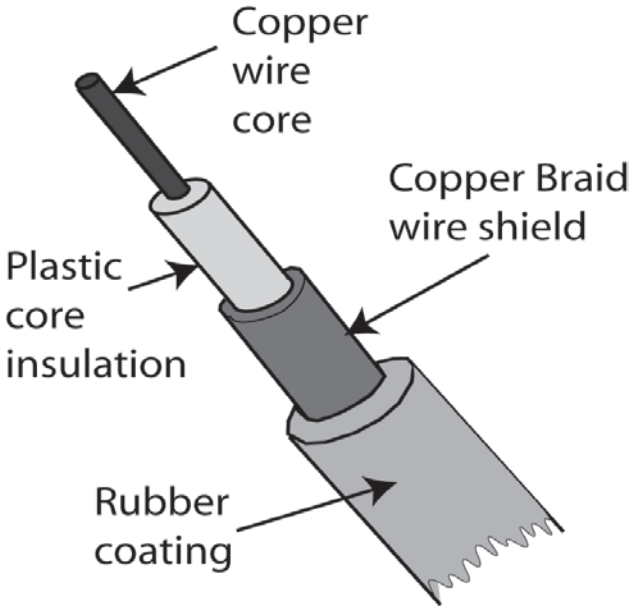
Propagation of radio waves.

SUBSIDIARY EQUIPMENT

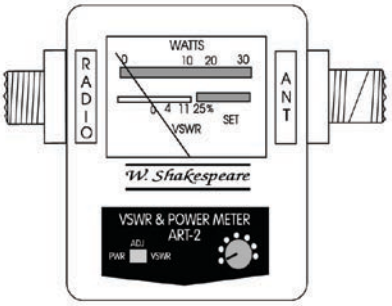
Antennas
The antenna requirements vary with each type of communications system and are discussed in the appropriate section.

Lightening
Modern radio transceivers are vulnerable to atmospheric electricity and may be damaged by lightening even without being hit directly. The electrostatic field surrounding an aerial in the vicinity of an electrical storm may cause severe damage to the radio. In these conditions, disconnect the aerial connection from the radio set and earth the cable, if possible.

Aerial cable
The cable used to connect the aerial to the radio is a special type of two wire cable called 'co-axial' cable. It is very important that only the correct grade of co-ax cable is used and it is of equal importance that the outside insulating sheath remains unbroken. If the cable insulation is damaged, water will penetrate to the wire causing corrosion which will reduce the power output from the aerial. The damaged cable should be replaced, not 'repaired' with insulating tape.



"Through deck" connectors will also lead to power loss if not kept corrosion free. It is usually preferable to pass the aerial cable through a raised watertight gland at the deck and make the connection inside he boat if possible. Cables exiting the mast base should be protected from physical damage from feet, winch handles, halyard falls and so on.



SWR Meter
A special meter, called a standing wave ratio meter (SWR meter), can be used to quickly check the transmitter power output and to determine how much of the power generated by the transmitter is actually being radiated from the aerial.

Batteries
Power is usually supplied to a fixed radio by a 12 volt, or 24 volt, rechargeable lead acid battery similar to a car or truck battery. The battery is normally charged by the boat's engine or by an independent generator. Transportable or hand-held radios use small internal rechargeable or replaceable dry cell batteries.

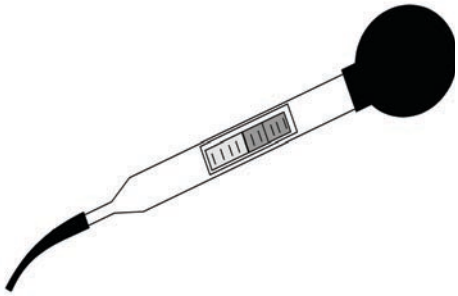
Battery Maintenance
A VHF transmitter will not deliver full power unless the battery is fully charged. Lead acid batteries with removable cell covers can have their state of charge checked using an hydrometer.

- A specific gravity of 1.250 or more indicates the battery is fully charged.
- A specific gravity of 1.150 or less indicates the battery is discharged.

Cells should be topped up with distilled water to about 6mm or 1/4 inch above the top of their plates if required. Batteries that are sealed can be checked with a voltmeter connected across the terminals. The battery should not be on charge while this test is carried out. A reading of 12.6 volts or more indicates the (12v) battery is charged.

Batteries should be kept clean and dry. The battery terminal connections should be tight, clean and covered with petroleum jelly to protect them from corrosion.

The wiring to the radio should be of sufficient cross sectional area to avoid a drop in voltage while transmitting.



Hydrometer

Safety
Be careful when working with batteries. The liquid in a lead acid battery is sulfuric acid, which is highly corrosive; wear protective gloves and eye protection when handling an hydrometer.

Hydrometers are made of thin walled glass and should be handled carefully.

Batteries are heavy, make sure they are held down securely in an acid resistant (e.g. lead lined) enclosure in the boat and be especially careful of your back when lifting heavy batteries. A battery under charge gives off explosive hydrogen gas.

Microphone

Hand Microphone

A radio transmitter has a microphone into which you speak whilst transmitting. On the microphone is a switch called the 'press to transmit' switch (PTT) which does exactly what its name suggests. This switch, when pressed, switches off the receiver section of the radio and switches on the transmitting section, thus allowing your message to be transmitted. You cannot transmit and listen at the same time when using a VHF radio of this type because when you are transmitting the receiver is switched off and when you are listening the transmitter is switched off. Two types of microphone are available. A 'telephone handset' and a 'fist mike'. A telephone handset looks exactly like a normal telephone except that it has its PTT switch somewhere in the middle of the handle between the earpiece and the mouthpiece. The fist mike is smaller being designed to fit in the palm of the hand and has its PTT switch somewhere on its side or top. Hand held portable VHF radios usually have the microphone built into the case.

COMMON RADIO TERMS

Simplex operation
Both stations use the same frequency and therefore the transceiver only allows the operator to either speak **or** listen but not both at the same time. This is known as simplex operation. Most VHF and SSB frequencies are simplex.

Semi Duplex operation
Semi duplex requires two frequencies but the station transmitting on one cannot at the same time receive on the other. VHF equipment is made that allows this facility on certain channels (mainly public correspondence channels). Simplex sets can use semi duplex public correspondence channels by pressing the PTT switch to speak and letting it go to listen in the normal fashion

Duplex operation
Each station transmits on its own frequency and at the same time receives on the other stations' transmitting frequency, similar to an ordinary domestic telephone on which you can both speak and listen at the same time.

For duplex operation to work, two frequencies are required for each channel/station instead of one. The transceiver is more expensive and two aerials, or a special duplex filter, are also required, making the whole set-up more expensive and difficult to install. With Single Side Band (SSB) this is standard for a number of frequencies, but for VHF, whereas it may seem attractive to have a duplex system it is not really of any real advantage and therefore not readily available.

REGULATIONS / LICENSING REQUIREMENTS

Certificates of Competency

Under international law, every radio installation must be licensed and every operator must have a Certificate of Competency in Radiotelephony. In the USA the Federal Communications Commission (FCC) will issue a VHF operators' license (Operators Permit) upon payment of a fee but there is no test of competence or exam, as there is in most other parts of the world. Any operator on commercial vessels must have a VHF license as does anyone operating an SSB also.

General Regulations

1. Every radio installation (Station) must be licensed and the license displayed.

2. Every radio installation must be operated by a qualified operator or under the supervision of a qualified operator.

3. The master is responsible for all radio messages sent.

4. Stations must obey instructions from Coast Radio (i.e. Coast Guard Radio) stations.

5. Stations must identify themselves when transmitting, by using the station's name or call sign.

6. Before transmitting a station must first listen to make sure that its transmission will not interfere with communications already in progress.

7. Channel 16 is the international VHF distress frequency, and 2182, 4125, 6215, 8291, 12290 and 16420 kHz are the international SSB frequencies. They are used for distress, urgency and traffic safety.

8. Channel 16 and 2182 are also used for the initial calls and replies required to establish communications between stations but as soon as contact has been established both stations must transfer immediately to an appropriate working channel/frequency.

9. To facilitate reception of Distress calls, all transmissions on Channel 16/2182 should be kept to an absolute minimum.

10. Swearing and profanity is forbidden and any and all information gained by hearing or interception must be kept secret and can not be used for personal benefit.

11. All ships fitted with VHF radios must keep the maximum watch possible on Channel 16. On vessels with SSB radios, 2182 no longer needs to be monitored.

12. An entry must be made in the ship's official log book of:
    a) the times when, and the reasons why, listening to Channel 16 was discontinued,
    b) all communications relating to Distress, Urgency and Safety traffic received or transmitted on the ship's radios.

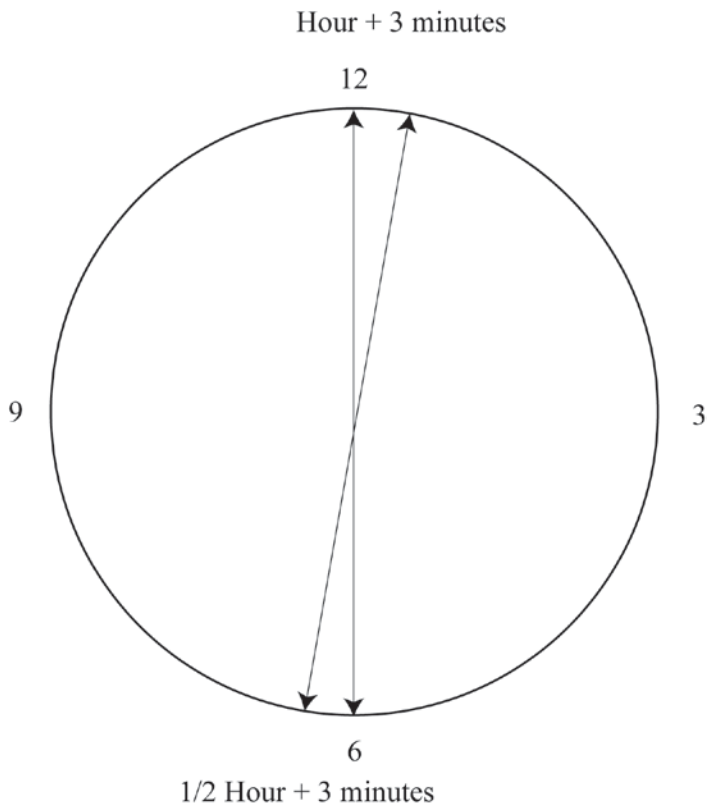
13. On the marine VHF band, channels are designated for communications between ships and coast radio stations, ships and port radio stations and between ships. Ships equipped with VHF radios must be able to send and receive on:
    Channel 16 (Distress, Urgency, Safety and calling) and
    Channel 6 (the primary International intership channel)

14. SSB band frequencies are designated for communications between ships and coast radio stations, ships and port radio stations and between ships. Ships equipped with SSB radios must be able to send and receive on:

Frequency 2182 (Distress, Urgency, Safety and calling) and
Frequency 2670 for communication with the United States Coastguard (USCG)
Other designated frequencies depending upon the capacity of the radio.

Silence Period

In order for a station in distress with a weak signal to be heard, all stations must maintain a twice hourly "silence period" for three minutes on the hour and on the half hour. This no longer applies to VHF but it still is a requirement for SSB radio operations.

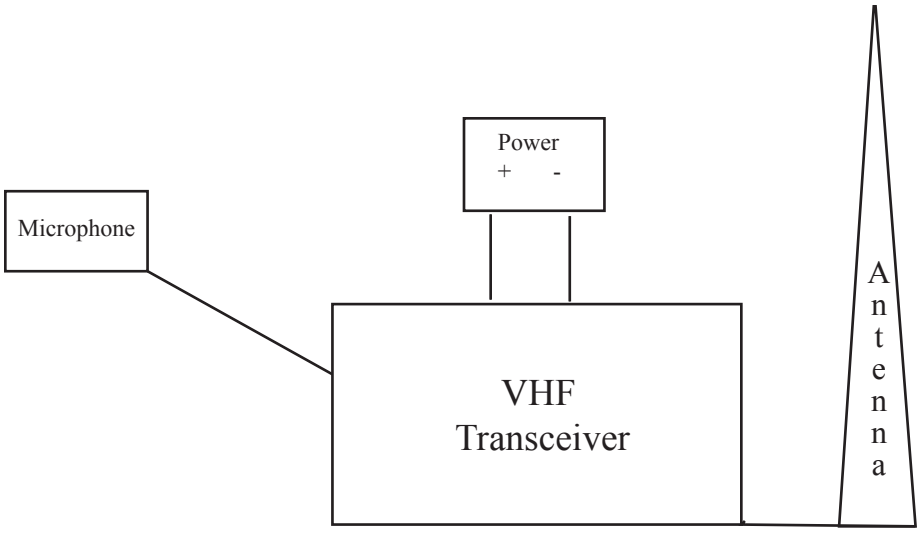


VHF RADIO EQUIPMENT

VHF radio may be used efficiently for communications between vessels at sea and between a vessel at sea and shore based services. A VHF radio is still arguably the single most important piece of safety equipment carried and it is also affordable.

VHF
VHF stands for Very High Frequency, that is the frequency band within which the short range marine radio transmitter and receiver is designed to work.

Why VHF?
VHF's range might seem short but coverage is very good due to the amount of shore based radio stations and to the amount of commercial shipping and pleasure boats. VHF is also cheap to purchase and install and easy to operate. It is not prone to interference from external electrical equipment and (nearly) always receives a good clear signal or no signal at all. It does not require much electrical power to operate and is therefore suitable for hand held sets with rechargeable batteries. Aerials for VHF radios are simple to install and inexpensive.



Typical VHF Set up

Channels
VHF radio transceivers for marine use operate between 156 MHz and 174 MHz and within this range there are 57 frequencies each of which is used, by international agreement, for a specific purpose. It would be far too difficult to memorize each specific frequency and to make this unnecessary, each frequency has been given a simple one or two figure number, called a 'channel'. For example 156.8 MHz, the international distress, safety and calling frequency is simply called '**Channel 16'**.

To select a specific frequency on a modern VHF radio all that is required is to turn a knob or press the number on a keypad which corresponds to the channel you require.
Although there are 57 international channels they are not numbered from 1 to 57. Channel numbers start at 01 and finish at 88, there are no channel numbers between 29 and 59. Each channel is allocated for a specific purpose.

Typical modern VHF transceivers

VHF sets
There are so many different VHF sets available that it is not practical to explain how each individual model is operated but essentially the functions of the controls on all types are similar. The model shown is typical of a modern fixed VHF transceiver which has all the international channels and the facility to fit private channels, if required.

On / Off / Volume
The set is switched on and off by turning the on/ off knob; this knob usually controls the volume of sound from the speaker as well. Note that adjusting the volume control only increases or decreases the sound coming from the speaker, it *does not* increase or decrease the power output from the transmitter.

Squelch
The 'squelch' control increases or decreases the sensitivity of the receiver. In practice the set is switched on and the squelch control is adjusted until continuous loud background noise is heard. The squelch control is then turned back slightly until the background noise disappears; at this setting the receiver is tuned to its maximum sensitivity allowing it to pick up all signals within range.

Channel (CH)
The rotary knob marked 'CH' is turned to select the required channel. As a safety feature most modern sets automatically select channel 16, the Distress and Safety channel, when first switched on. The channel selected is indicated by the number (16 in the figure) displayed in the window of the set. When it is desired to use another channel the knob is turned until the number of the required channel is seen in the window. Some sets use digital keypads, similar to the keypad on a calculator, to select the required channel.

DIM
For night time use the display can be lit by pressing the dim button. On some sets the brightness of the lighting can be controlled as required.

Dual Watch (DW)
Channel 16 is the Distress, Safety and Calling channel so it makes sense to listen to this channel at all times; in fact it is a legal requirement for commercial shipping to do so. However it is often desirable to be able to listen in to another channel at the same time; for example perhaps you may wish to listen to 22a in order to hear a marine weather advisory. A dual watch facility allows you to listen to both channel 16 and any one other channel at the same time. To use dual watch select the channel you wish to listen to, say channel 22a, and then press the DW button. The receiver will then switch momentarily from channel 22a to channel 16 and back to 22a again and will repeat this cycle continuously until the dual watch is switched off. If the receiver detects a signal on Ch 16 it will lock on to that channel when in dual watch mode. Some sets are sold which can scan through all channels, this is actually illegal and is of no real practical use anyway.

1/25
The maximum power output from a VHF set allowed by law is 25 Watts. A lot of the time a much lower output is quite sufficient, as for example when talking to another boat which is close by. Virtually all fixed VHF sets can (in theory) transmit at the legal maximum power of 25 Watts and most sets also have a switch which reduces the power output to 1 Watt for close range communications.

The number showing which channel is in use indicate which power option has been selected. 'HI' indicates 25 Watts and 'LO' indicates 1 Watt. Simply pushing the button marked 1/25 changes the power output. Note that this only affects the power output when transmitting and has no effect on the set's ability to receive signals.

USA / International / Canada
Selects the mode for the area in which the vessel is operating. The channel allocations vary in the 3 areas.

16
Most sets have a facility to go directly to channel 16, the Distress and Safety channel, quickly in an emergency. Pressing the button marked '16' automatically selects channel 16, high power.

Transmit (Tx)
Tx is 'shorthand' for transmit. When you are transmitting some sets show a little red light to confirm that the set is transmitting. ('Rx' is shorthand for receive.)

Microphone (MIC)
The lead from the microphone cable is plugged in to the socket marked 'MIC'.

Aerial socket
Somewhere on the back of the set is a socket into which the aerial lead is connected. On no account press the transmit button on a radio without an aerial connected because serious, or irreparable, damage to the transmitter may result if you do.

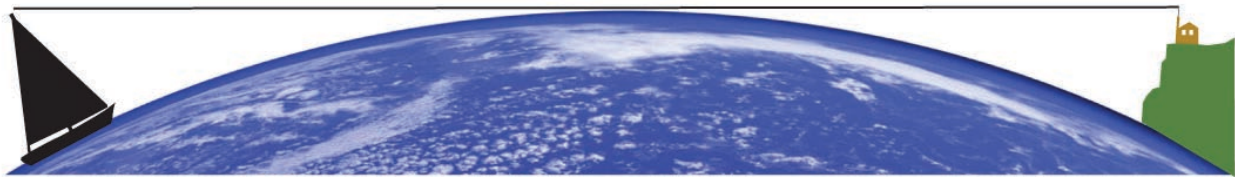
Hand held VHF radios
Small hand held portable VHF transceivers are readily available and their operation is similar to that of the fixed set explained above. Hand held radios have a self contained, rechargeable battery and an aerial connected directly to the top of the set. The maximum power output is normally between 3 to 5 watts; more power would make no difference to the possible range of the set due to the low aerial height. If you wish to extend the range of a hand held it is possible to make up an adapter cable to connect the hand held to a fixed aerial mounted as high up as possible. Most hand held radios have the full range of channels, various different methods being used to select them. The microphone is usually incorporated in the body of the set and sometimes the battery pack is removable allowing a fully charged spare to be carried. Some sets have provision for an external microphone to be fitted.

Nowadays most hand held radios are waterproof. Chargers suitable for mains and 12 volt should be supplied with the set; never let the batteries remain flat for any length of time or they may not recharge. A hand held is useful on a small boat and makes an ideal back up for the larger boat. In the case of an emergency a hand held radio will allow communications from the life raft or dinghy. The regulations and licensing requirements for hand held radios are the same as for fixed sets, remember it is the ship that is licensed, not the radio.

Hand held radios must not be used to transmit from elsewhere other than on the boat.

Range

Essentially the maximum range of a VHF signal is 'line of sight'. VHF radio waves travel in a straight line but the surface of the earth is curved, therefore the maximum range between two VHF transceivers will depend on the height of the transmitting aerial and the height of the receiving aerial. The higher the aerial the greater the range which is why coast radio stations put their aerials on top of hills.



Due to earth's curvature the sailing boat, with the higher aerial, has a greater VHF radio range than a motor boat.

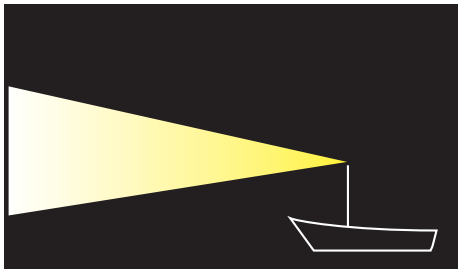
Range versus aerial heights

The approximate ranges which may be expected are as follows:

Receiving aerial height, Feet	Range, Miles	Transmitting aerial height, Feet
10	8	10
10	10	20
10	14	50
20	12	20
30	15	30
50	20	50
60	42	500

Aerials

If you could see the radio signal being radiated from an aerial it might look something like the beam from a torch, the beam starting out as a point of light and increasing in width the further it moves away from the aerial. As the power input is the same anywhere along this beam it can be seen that the signal strength becomes weaker as the distance from the aerial increases. Therefore a point must be reached after which the signal will be too weak to be of any use, irrespective of the height of the aerial.



High gain aerials

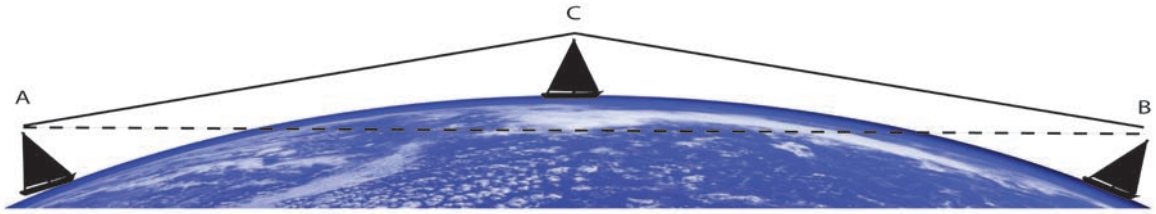
A spotlight has its beam compressed to make the light shine further. In much the same way an aerial can be designed so that it compresses the radio signal thus sending it further. This type of aerial is called a high gain aerial but, because the beam is narrow, the aerial must remain reasonably upright. A high gain aerial is therefore only really suitable for a motor boat rather than a sailing boat which will operate at an appreciable angle of heel most of the time.

Unity gain aerials

Aerials for sailing boats are usually 'unity gain' types, in other words they are designed without any gain. Sailing boats have the advantage of a high mast on which to mount their aerials and gain range in

this way; the wide angle of the signal from an aerial without any gain reduces the risk of broken, or interrupted transmissions.

Relaying messages
It may sometimes be possible to relay messages through a station between you and the station you wish to talk to.



A and B cannot talk to each other but they can relay their message through C

VHF Channel Allocations

Channels
Each channel is allocated for a specific purpose:
- International Distress, Safety and Calling. (Channel 16)
- Ship to Ship. (Channel 06 is the primary inter-ship channel.)
- Ship to Port. (12,14)
- Ship to Coast Radio Station. (24 - 28)
- Digital selective calling for distress and safety, i.e. automatic distress alarm (70)
- U S Coast Guard (22A) The A indicates a US channel, not International.

Note that all VHF transceivers must, by law, have both Ch 16 and Ch 06 fitted.
Lists of channels used by all stations are given in Admiralty Lists of Radio Signals, Vol. 1 (ALRS Vol. 1) and in the Reeds Nautical Almanac, or on Channel Assignment Charts.

Some **International** channels (in order of priority) which may be used for the different services are:

Ship to Coast Stations
26, 27, 25, 24, 23, 28, 04, 01, 03, 02, 07, 05, 84, 87, 86, 83, 85
Ship to Port Stations
12, 14, 11, 09, 68, 71.
Ship to Ship
06, 08, 72, 77, 10, 13, 09, 73, 69, 15, 17.

Digital Selective Calling (DSC)
In 1992 a worldwide system intended to co-ordinate search and rescue communications came into being. This system is called 'Global Maritime Distress and Safety System' or GMDSS for short. Channel 70 is to be used exclusively for digital selective calling for distress and safety purposes. Radiotelephone operations on channel 70 are strictly forbidden.

Channel 16
Channel 16 is reserved for Distress, Urgency and Safety messages, the precise meanings of which are described later. Ch 16 is also used as a calling channel. Because every station should keep a continuous watch on Ch 16 it follows that any station you wish to contact will hear you if you call them on Ch 16. As soon as contact is established you will both change to an appropriate working channel to continue the conversation. The absolute minimum time possible must be spent transmitting on Ch 16, in order to leave Ch 16 clear for its designated purpose. The *maximum time allowed on channel 16 is 60 seconds*, apart from Distress Urgency or Safety traffic. You can of course, by prior agreement,

arrange to call another station on a working channel in order not to take up time on Ch 16, and wherever possible this should be done.

Yachts and small boats are not required by law to listen at all times to Ch 16 but should do so whenever possible so that they will be aware of any distress situation and, of course, in order to hear any station trying to contact them. There are 57 internationally allocated channels. Each one of these channels is reserved for one or more specific purposes. It is not necessary to know all of the channels off by heart, but you must memorize a few off them. **You should know that every VHF radio must have both Channel 16 and Channel 6 and possibly Channel 13.**

Channel 13
Channel 13 is a 'bridge to bridge' channel used for communications between shipping relating to safety of navigation. All commercial vessels are required by international law to monitor a separate radio tuned to Channel 13 when in coastal waters. Ships greater than 20 meters or 65 feet must maintain a listening watch on this channel in US waters.

Ship to Coast Radio Station
Ship to Coast Radio channels are used for a boat to talk to a shore based radio station, such as the Miami Marine Operator. Coast Radio Stations have been set up at various strategic places around our coast so that they can control communications and broadcast messages such as safety information, navigation warnings, gale warnings and weather forecasts. Coast Radio stations are also intended to link ships and boats into the telephone network ashore ('link calls'). Channel 16 is monitored continuously by Coast Radio stations as well as their working channels.

Ship to Port Station
Channels are allocated for radio traffic between a ship and harbor or port authority and might be used, for example, when requesting a pilot or when seeking permission from the Harbor Master to enter a port.

Ship to Ship
Ship to ship channels are for one ship, or boat to talk to another ship or boat. Every VHF radio must have the primary intership channel 06.

Weather Channels
In the U.S. WX 1 – WX8 are "receive only" channels and are operated by the National Oceanagraphic and Atmospheric Administration (NOAA) and broadcast a continuous weather synopsis. The channels are geographical in coverage and designed to minimize interference with each other.

Channel 22A
Channel 22A is used by the U.S. Coast Guard solely for safety communications with ships, yachts, fishing vessels etc.

Digital Selective Calling (DSC) on Channel 70.
In 1992 a worldwide system intended to co-ordinate search and rescue communications came into being. This system is called 'Global Maritime Distress and Safety System' or GMDSS for short.

GMDSS contains provision for VHF sets to have Digital Selective Calling (DSC) equipment incorporated, or added on, allowing the radio operator to send distress alerts in an automatic digital form which will be picked up by Coast Radio Stations and ships keeping an automatic watch on Ch 70.

Channel 70 is reserved for Digital Selective Calling and must not on any account be used for speech transmissions.

You must, wherever possible, use the correct channel but if for example you received no reply to a distress message sent on channel 16 it would be proper (and sensible) to try any other channel on which you think you may be heard. (You will not be heard on channel 70)

Listen before transmitting to ensure that the channel you intend to use is not in use.

Maximum time on Ch 16 = 60 seconds (except for Distress, Urgency and Safety traffic).

Radio check, **Maximum time 10 seconds**.

UNITED STATES VHF CHANNEL ALLOCATIONS AND FREQUENCIES

Ch	Transmit	Receive	Use
01A	156.050	156.050	Port Operations and Commercial. VTS in selected areas.
05A	156.250	156.250	Port Operations. VTS in Seattle
06	156.300	156.300	lntership Safety
07A	156.350	156.350	Commercial
08	156.400	156.400	Commercial (lntership only)
09	156.450	156.450	Boater Calling. Commercial and Non-Commercial.
10	156.500	156.500	Commercial
11	156.550	156.550	Commercial. VTS in selected areas.
12	156.600	156.600	Port Operations. VTS in selected areas.
13	156.650	156.650	Intership Navigation Safety. (Ships > 20 meter must maintain a listening watch on this channel in US waters.)
14	156.700	156.700	Port Operations. VTS in selected areas.
15	—	156.750	Environmental (Receive only). Used by Class C EPIRBs.
16	156.800	156.800	International Distress. Safety and Calling.
17	156.850	156.850	State Control
18A	156.900	156.900	Commercial
19A	156.950	156.950	Commercial
20	157.000	161.600	Port Operations (duplex)
20A	157 .000	157.000	Port Operations
21A	157.050	157.050	U.S. Government only
22A	157.100	157.100	U.S. Coast Guard
23A	157.150	157.150	U.S. Government only
24	157.200	161 .800	Public Correspondence (Marine Operator)
25	157.250	161.850	Public Correspondence (Marine Operator)
26	157.300	161.900	Public Correspondence (Marine Operator)
27	157.350	161.950	Public Correspondence (Marine Operator)
28	157.400	162.000	Public Correspondence (Marine Operator)
63A	156.175	156.175	Port Operations and Commercial. VTS in selected areas.
65A	156.275	156.275	Port Operations
66A	156.325	156.325	Port Operations
67	156.375	156.375	Commercial (lntership only)
68	156.425	156.425	Non-Commercial
69	156.475	156.475	Non-Commercial
70	156.525	156.525	Digital Selective Calling (voice not allowed)
71	156.575	156.575	Non-Commercial
72	156.625	156.625	Non-Commercial (lntership only)
73	156.675	156.675	Port Operations
74	156.725	156.725	Port Operations
77	156.875	156.875	Port Operations (lntership only)
78A	156.925	156.925	Non-Commercial
79A	156.975	156.975	Commercial
80A	157.025	157.025	Commercial
81A	157.075	157.075	U.S. Govt. only - Environmental protection operations.
82A	157.125	157.125	U.S. Government only
83A	157.175	157.175	U.S. Coast Guard only
84	157.225	161.825	Public Correspondence (Marine Operator)
85	157.275	161.875	Public Correspondence (Marine Operator)
86	157.325	161 .925	Public Correspondence (Marine Operator)
87	157.375	161 .975	Public Correspondence (Marine Operator)
88	157.425	162.025	Public Correspondence in selected areas only.
88A	157.425	157.425	Commercial (Intership only)

SINGLE SIDE BAND / HIGH FREQUENCY RADIO EQUIPMENT

Introduction
Vessels intending to voyage further offshore than the range offered by VHF will require additional communications resources. One solution is the short wave radio receiver for weather forecasts and / or a Single Side Band (SSB)/HF transceiver for communications.

Weather information
Weather information for offshore voyages is provided for the East Coast of the USA, Atlantic and Caribbean from the U S Coast Guard Portsmouth Va.

These forecasts are delivered by "Metallic Mike/Perfect Paul", a synthesized voice at the following times:

Forecast Area	*Time UTC (Universal Time Co-ordinates)	Frequencies KHz
Offshore	0330,0500,0930	4426 / 6501 / 8764
	1130,1600, 2200 2330	6501 / 8764 / 13089
High Seas	0500	4426 / 6501 / 8764
	1130	6501 / 8764 / 13089
	1730	8764 / 13089 / 17314
	2330	6501 / 8764 / 13089

*UTC, or Universal Time Co-ordinates, was previously GMT, or Greenwich Meantime.

Time signals
For accurate UTC time signals tune in on one of the following frequencies:

5000 / 10000 / 15000 / 20000 / 25000 KHz

SSB/HF/MF
HF stands for High Frequency, MF is Medium Frequency, these are the frequency bands within which the medium/ long range marine radio transmitter and receiver is designed to work. These transceivers are generally known as SSB, Single Side Band, which is the part of the radio wave used. (Upper Side Band)

Why SSB/HF?
For long range communications and/or to comply with GMDSS when traveling in areas A2, A3 and A4 appropriate SSB/MF/HF radio transceivers will be required. (A2 MF, and A3 & 4 HF). See later GMDSS section for more details. However SSB equipment is more expensive, more cumbersome, more complicated to install and to use than VHF. The choice of antenna, too, will affect the performance. In addition power consumption is greater and the tuner has to be well grounded.

Equipment
There are a number of makes of SSB radios on the market, however unlike VHF the SSB is a system and not just a transceiver. The most important criteria for selection are; a set that covers the appropriate bands, the most ppropriate antenna, tuner unit and correct ground system. Only then will power output affect performance.

Antenna
Two types of antenna are commonly used with an SSB transceiver and the type of vessel will often dictate the preferred type.

Backstay/wire Antenna
Mainly used on sailboats with insulators or can be rigged as a triatic stay.

Whip Antenna
Free standing and used normally on vessels without mast stays.

Antenna Tuning Unit (ATU)
Because each band requires a different antenna length an antenna tuner unit is installed to match the antenna to every frequency.

Grounding System
The antenna must be correctly grounded in order to work properly. This usually takes the form of a 2 – 3 inch copper strip connected from the ATU and run the shortest distance possible to an external plate under the waterline (or to a stringer in the case of a metal vessel).

Frequencies/Channels

The choice of what frequencies to have, will be dictated by the area of coverage required and whether the vessel is to be GMDSS compliant.

The following, 2182, 4125, 6215, 8291, 12290 and 16420 kHz are the international SSB distress and calling frequencies.

They are used for initial calling and for Distress, Urgency and Safety traffic.
On the marine SSB bands, frequencies are designated for communications between ships and coast radio stations, ships and port radio stations and between ships. Ships equipped with SSB radios must be able to send and receive on:
Frequency 2182 (Distress, Urgency, Safety and calling) and
Frequency 2670 for communication with the United States Coastguard (USCG)

Other designated frequencies depending upon the capacity of the radio.

In addition for those sets that are GMDSS compliant they must be able to send and receive DSC on:
Frequencies 2187.5, 4207.5 6312, 8414.5, 12577,16804.5 kHz. These frequencies are reserved exclusively for DSC distress, urgency and safety messages.

Controls

Microphone
As with VHF the microphone screws into the socket and can be either a fist or telephone type.

Power Switch
The set is switched on and by a push button.

Speaker off
Allows use of a telephone type microphone.

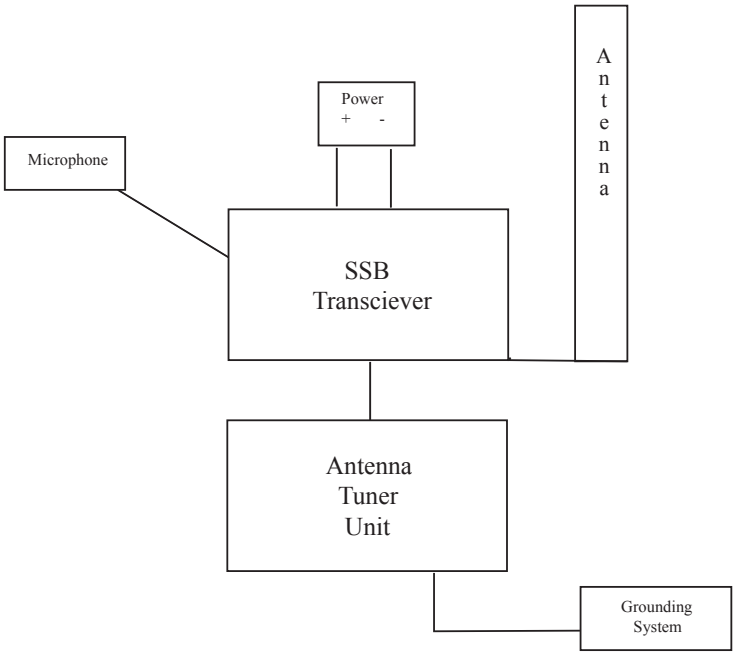
Dim
Brightness of the display can be controlled.

Volume
Controls the volume of sound from the speaker, but has NO effect on the transmit power output.

Group Channel Selector
Allows groups of channels to be selected.

Antenna Tuner
Fully automatic tuning when used with the appropriate Tuner Unit. The set automatically tunes the antenna once the PTT button is pressed.

Channel Selector
Accesses preset channels.



Typical SSB System

Function Switch
Allows dual function of some of the other controls.

Clarifier
Allows the receive frequency to be adjusted +/- for use when a transmit signal is not exactly on frequency.

Keypad Controls
For entering frequency/channel data.

Squelch
This decreases the receiver sensitivity by filtering background static.

Noise Blanker
Filters out ancillary equipment interference.

AGC (Automatic Gain Control)
Allows the reception of weak signals by filtering out strong signals on adjacent frequencies.

Mode
Changes the mode.

Tx Frequency
Shows the frequency being transmitted.

2182
Automatically selects 2182 kHz.

Alarm Switch
Automatically transmits a two tone alarm signal when used in conjunction with the Tx button.

Single Sideband / HF radio

RADIO PROCEDURES

Correct radio procedure has been developed in order to reduce to the absolute minimum the amount of time used during communications. One of the ways this is accomplished is by using an internationally agreed format, thus cutting out all unnecessary words and reducing the risk of misunderstandings which require extra time to clarify.

DO NOT use phrases like "are you receiving me" or "are you there". If the station being called is not there or not receiving your signal, it certainly will not reply. Always finish each individual transmission with the word 'OVER' which indicates that the station transmitting is now ready to receive a reply.

When you have finished working with the other station finish your final transmission with the word 'OUT'. **NEVER say "OVER AND OUT"**.

PROCEDURE WORDS

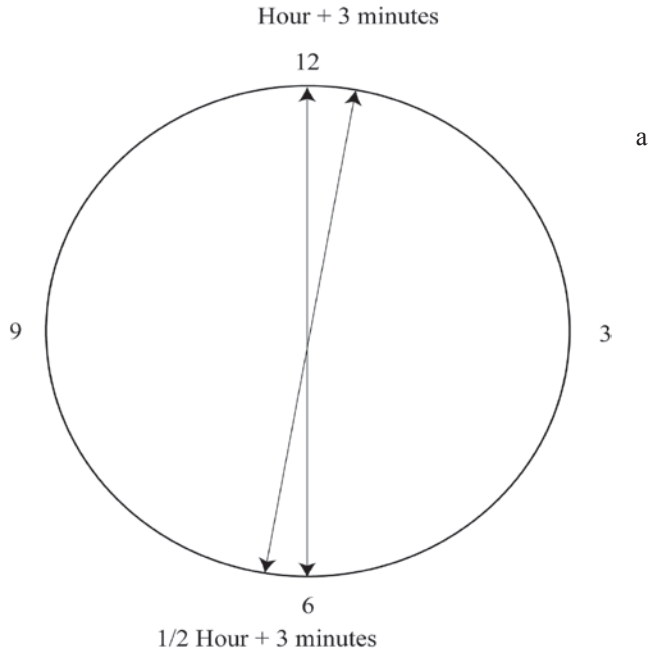
Procedure words are single words which are used to define a specific and unambiguous meaning. They are used internationally for the sake of brevity and clarity.

ALL AFTER	Everything that follows word or phrase indicated
ALL BEFORE	Everything before word or phrase indicated
CORRECT	Confirms that station has correctly repeated message.
CORRECTION	I have made an error (followed by I SAY AGAIN …..)
IN FIGURES	The following figures are to be written as figures (i.e. '2')
IN LETTERS	The following numerals are to be written in letters (i.e. 'two')
I SAY AGAIN	I repeat (e.g. important words). Used with the pro-words WORD AFTER, WORD BEFORE, ALL AFTER, ALL BEFORE.
I SPELL	I will spell the last word using the phonetic alphabet
OVER	Invitation to reply
OUT	End of working (*NEVER SAY "OVER AND OUT"*)
RADIO CHECK	Please tell me the strength and clarity of my transmission
READ BACK	Receiving station will now repeat the message received
RECEIVED	Receipt acknowledged (*NOT* '*ROGER'*)
SAY AGAIN	Repeat your message
STATION CALLING	Used when a station is uncertain of the identity of the station calling
TRAFFIC	Radio / telephone communications
THIS IS	This transmission is from the station whose name follows
WRONG	The message has been read back incorrectly

WAIT….MINUTES — If a station is unable to accept traffic immediately it will indicate how long before it can accept traffic.

NOTHING HEARD — When there is no reply from a station being called.

Silence Period
In order for a boat in distress with perhaps a weak signal to be heard, all stations must maintain twice hourly "silence period" for three minutes on the hour and on the half hour. This does not to apply to VHF but it still is a requirement for SSB radio operations.



The Phonetic Alphabet
Sometimes it will be necessary to spell words, call signs, etc. In order to avoid confusion the following phonetic alphabet has been adopted internationally and must be used. If it is necessary to spell a word the spelling is preceded by the words "I spell". When giving numbers say each individual digit.
For example: "..and I expect to arrive at Miami, - I spell: Mike India Alpha Mike India, (Miami) , - at One Five Zero Zero tomorrow afternoon". (1500)

The phonetic alphabet is given below and must be learnt off by heart.

Letter	Word to use	Letter	Word to use
A	**Alfa**	**N**	**November**
B	**Bravo**	**O**	**Oscar**
C	**Charlie**	**P**	**Papa**
D	**Delta**	**Q**	**Quebec**
E	**Echo**	**R**	**Romeo**
F	**Foxtrot**	**S**	**Sierra**
G	**Golf**	**T**	**Tango**
H	**Hotel**	**U**	**Uniform**
I	**India**	**V**	**Victor**
J	**Juliet**	**W**	**Whiskey**
K	**Kilo**	**X**	**X-ray**
L	**Lima**	**Y**	**Yankee**
M	**Mike**	**Z**	**Zulu**

Figure	Spoken as
0	Zero
1	Wun
2	Too
3	Three
4	Fo-wer
5	Fifer
6	Six
7	Seven
8	Ait
9	**Niner**

Numbers are more or less pronounced normally with the exception of the number '9' which is pronounced "NINER". The reason for this is to distinguish between 'nine' and 'five' which, under bad conditions, can sound similar over the radiotelephone.
You must learn the phonetic alphabet off by heart.

Using VHF
Remember always that VHF design means that whilst you are using the channel no one else within a large radius can use the same channel so always try to keep your traffic or message as brief as possible.

- Switch the radio on.
- Select the required channel and adjust squelch control.
- Listen, to ensure channel is not in use.
- Engage brain before opening mouth.
- Press the PTT switch.
- Speak clearly into the microphone.
- Keep your message as brief as possible.
- Finish your message with the word "OVER".
- Release the PTT switch and wait for a reply.

Procedure Cards

A procedure card, similar to the one shown below, explaining how to use the VHF radio in an emergency should be placed directly beside the radio on board. In an emergency the person who is left to work the radio may not understand how it is operated.

TO USE RADIO WHEN IN DISTRESS

- **TURN RADIO ON**
- **SELECT CHANNEL 16**
- **PRESS TRANSMIT SWITCH ON MICROPHONE**
- **SAY:**

"MAYDAY, MAYDAY, MAYDAY
THIS IS
'NAME OF BOAT', 'NAME OF BOAT', 'NAME OF BOAT'

MAYDAY
'NAME OF BOAT'

POSITION
NATURE OF EMERGENCY;
NUMBER OF PEOPLE ON BOARD;
ASSISTANCE REQUIRED;
OVER"

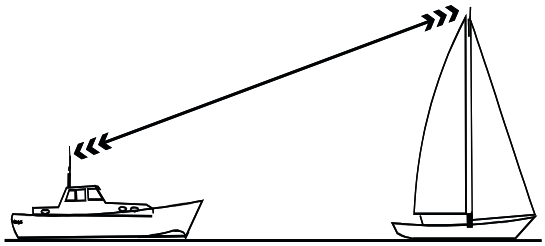
- **RELEASE TRANSMIT SWITCH;**
- **LISTEN FOR REPLY**
- **REPEAT IF NO REPLY AFTER 1 MINUTE**

Ship to Ship calls

In order to establish contact with another ship, or boat, contact is made initially on Ch 16 (unless a working channel has been previously agreed upon). As soon as contact has been established both stations will immediately change to an appropriate agreed working channel, such as a ship to ship channel in this case.

First listen to ensure that no other station is transmitting then press the microphone switch and the initial call to establish contact then proceeds. In the following example a yacht called 'Celtic Mist' wishes to talk to a motor boat called 'Warriore'. The call begins with the name of the boat being called followed by the words "this is" followed by the name of the calling boat given twice. The calling boat then nominates an appropriate working channel, Ch 09, 68,69,71,72,&78A, and finishes with the word 'over'.

"WARRIOR
THIS IS
CELTIC MIST , CELTIC MIST
CHANNEL 09,
OVER"



'Elaine' replies on channel 16 and agrees to use channel 09:

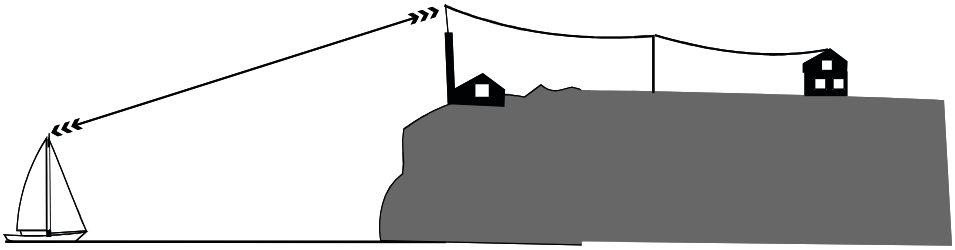
"CELTIC MIST
THIS IS
WARRIOR
CHANNEL 09
OVER."

Both boats now switch their radios to channel 09 to continue their message.

If reception conditions are bad for any reason, the names of the calling and called boats may be repeated not more than three times. It is not usually necessary to repeat the names of each boat three times unless reception conditions are bad. The person on board Warrior will normally recognize the name of their own boat quickly but might have difficulty catching the name of the calling boat with which they may not be familiar; for this reason the name of the calling boat can be repeated not more than three times. If a boat has a particularly odd or difficult name it may be better to use the boat's call sign rather than her name.
Should no reply be received to the initial call wait three minutes before repeating the call again.

Link Calls

A link call is simply a telephone call made by linking the VHF signal into the normal telephone system through a Coast Radio Station. Therefore a link call can be made to a telephone subscriber anywhere in the world, provided the calling station is within range of a Coast Radio Station. Most countries have a comprehensive VHF Coast Radio station network and a boat in these waters should have no difficulty in setting up a link call. The yacht 'Warrior', whose call sign is WTC 4705, wishes to make a link call through Miami Marine Operator. The boat has checked that Miami's working channel is Ch 26 and she therefore switches to Ch 26, listens to make sure no one else is using the channel and then establishes contact with Miami. The call would proceed as follows:



"MIAMI MARINE OPERATOR
THIS IS
WHISKEY TANGO CHARLIE 4705, WHISKEY TANGO CHARLIE 4705
'WARRIOR'

ONE LINK CALL PLEASE
OVER."

The marine operator will reply and ask for the details of the phone number 'Warrior' requires, payment for the call (usually set up prior to sailing) and any other relevant information. 'Warrior ' would then be asked to 'stand by' (remain listening on Ch 26) until the operator has reached the number required.

If reception conditions are not good, due for example to engine noise or sea conditions, the name of the station being called and the call sign of the calling station would each be repeated not more than three times.

Link calls can also be made from a telephone subscriber ashore to a boat by dialing 1-800-SEACALL and asking for a "ship's radio telephone call", giving the name of the ship, its approximate location and the name of the person you wish to talk to.

Traffic Lists

Traffic Lists are lists of the names/call signs of vessels for which there is a telephone call waiting. If you hear your boat's name or call sign in the traffic list wait until the traffic list is finished and then call the Coast Radio station on its working channel (after first listening to make sure the channel is clear). The call would be as follows:

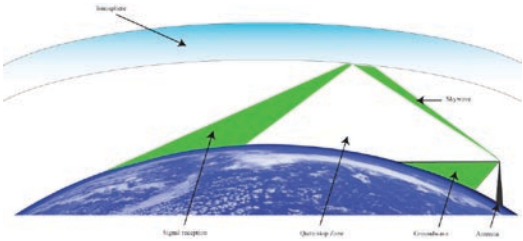
"MIAMI MARINE OPERATOR
THIS IS
WHISKEY TANGO CHARLIE 4705, WHISKEY TANGO CHARLIE 4705
YOU HAVE TRAFFIC FOR ME, OVER."

The marine operator would reply and ask you to stay listening on the working channel until they make the connection to the telephone subscriber who wishes to contact you.

Using HF/SSB

To use SSB effectively an understanding is required not only of the system but also the concept of propagation.

Very briefly, each time a frequency is selected the tuner unit must be re-tuned to that frequency. With an automatic tuner this will not present a problem, but with a manual unit some moments will be needed to tune.



See previous diagram of propogation of radio waves.

The adjustment of the various controls will also affect the performance on both transmit and receive.

- Switch the radio on.
- Select the required frequency.
- Listen, to ensure channel is not in use.
- Press PTT switch momentarily to activate ATU.
- Engage brain before opening mouth.
- Press the PTT switch.
- Speak clearly into the microphone.
- Keep your message as brief as possible.

- Finish your message with the word “OVER”.
- Release the PTT switch and wait for a reply.

Ranges of Radio Signals

The distance a signal will be effective depends on a number of things, atmospheric conditions, season, time, of day/night, frequency selected and the height and density of the various layers in the ionosphere.

As a guide only the following distances for various bands are given, these are approximate and may vary considerably de,pending on any of the factors mentioned in the above paragraph.

Band MHz	Day Time Range Min - Max	Night Time Range Min - Max	Comments
2	100 - 150	200 - 300	If in VHF range this must be used
4	150 - 250	200 - 1500	
6	250 – 500	500 - 2000	
8	250 -1500	1000 - 2500	
12	1000 - 2000	2000 - 4000	
16	2000+	3000+	
22	3000+	4000+	

EMERGENCY RADIO COMMUNICATIONS
DISTRESS, URGENCY AND SAFETY PROCEDURES

DISTRESS (MAYDAY)
A Distress signal is the most important transmission that can be made and as such takes precedence and has priority over all other radio transmissions. Nothing is allowed to interfere with a Distress message. Because of the importance given to a Distress message it is defined clearly and this definition must be understood.

DISTRESS: “THE DISTRESS SIGNAL INDICATES THAT A SHIP, AIRCRAFT, OR VEHICLE IS THREATENED BY GRAVE AND IMMINENT DANGER AND REQUESTS IMMEDIATE ASSISTANCE.”

The key words are GRAVE **AND** IMMINENT. If these two conditions are not simultaneously fulfilled the situation does not justify the sending of a distress message. The skipper, or person in charge, decides whether a situation is both grave and imminent.

Under International Radio Regulations 1982, (amended in 1985) the use of the word Mayday is strictly limited to situations where the ….ship, aircraft or other vehicle is threatened by grave and imminent danger...; there is no mention of a *person*. In order to include a person in the definition an International Conference on Safety of Life at Sea held in 1979 redefined Distress to include a person. Since 1991 it has been accepted practice to use Mayday in cases of man overboard. To date, the International Telecommunications Union have not accepted this definition.

The **Distress signal** is the spoken word **“MAYDAY”**
(Mayday comes from the French “m’aidez”, which means “help me”)

The distress call:

MAYDAY, MAYDAY, MAYDAY

THIS IS

"WARRIOR", "WARRIOR", "WARRIOR"

followed immediately by the Distress Message:

MAYDAY

"WARRIOR",

POSITION IN LATITUDE AND LONGITUDE
OR
DISTANCE AND BEARING FROM A KNOWN POINT

NATURE OF DISTRESS AND ASSISTANCE REQUIRED

ANY OTHER USEFUL INFORMATION

OVER

The distress procedure is in two sections:

A Distress call is transmitted on VHF Channel 16, using high power (25 watts) or 2182,4125, 6215 etc. on SSB. Your position should be given first, as accurately as possible, either in latitude and longitude or as a bearing and distance FROM a known feature. For example "position 2 miles East from Port Everglades". A position as a bearing and distance from a place might mean that someone nearby will realize they are close to you faster than if they have to first plot the latitude and longitude on a chart.

The nature of the distress is given next so that the rescue services know what assistance is most appropriate for the circumstances. The number of people on board is the next most important piece of information so that the rescuers will know how many people to search for in the event of the crew being unable to remain together. If there is sufficient time, give any other information that may be relevant. Finally finish with the word "over".

Acknowledgment of receipt of distress call:
Ships, which receive a Distress message from a station in their immediate vicinity, must acknowledge receipt of this message immediately. However, in our coastal waters it is likely that a distress message will be picked up by a Coast Radio Station and for this reason wait a short time before acknowledging receipt of the Distress message. It is reasonable to assume that anyone in a distress situation may have very little time to spare sending distress signals so it is vital that a distress message be acknowledged as soon as possible to allow the sender time to save himself. It could happen that for some reason you may be the only one to hear the distress message and if this is the case you must then acknowledge receipt.

If you hear a distress call
- *Write down the position*, name of boat and nature of distress at once.
- Wait a few moments, if no other station responds to the distress call,
- Acknowledge receipt of distress call yourself.

A distress call is acknowledged as follows:

Distress signal once only **"MAYDAY"**

Name of station in distress 3 times	**"WARRIOR", "WARRIOR", "WARRIOR",**
	THIS IS
Name of station acknowledgin receipt	**MY BOAT, MY BOAT, MY BOAT**
	RECEIVED MAYDAY"

The key words to remember here are **RECEIVED MAYDAY.** If you have to acknowledge receipt of a distress message you must, as quickly as possible, let the vessel in distress know your present position and how long it will be before you can reach her. You may also have to relay the distress message; how to do this will be explained later on.

Control of distress traffic.
Most distress situations will require on-going communications and to avoid confusion the distress traffic will be controlled either by the station in distress or by a Coast Radio Station. Distress traffic has absolute priority over all other messages. Stations not involved in the distress communications must not transmit on the channel being used for distress working or interfere with the distress traffic in any way.

Imposing Radio silence
A station may be unaware that a distress situation exists and may attempt to transmit on the channel being used for distress working. In this case radio silence will be imposed on the interfering station by the controlling station using the words **'SEELONCE MAYDAY'** followed by the name of the controlling station. *Only the controlling station may use this expression.*

"MAYDAY"

SEELONCE MAYDAY, SEELONCE MAYDAY, SEELONCE MAYDAY.

THIS IS COASTGUARD MIAMI, COASTGUARD MIAMI

OUT"

A station other than the controlling station may impose radio silence if it feels that this is essential by using the expression **'SEELONCE DISTRESS'**, followed by its own name in a similar form as shown in the example above.

Note that all transmissions made by stations involved with an on-going distress situation start with the word **'MAYDAY'** spoken *once only*.

Restricted radio working may resume
If the controlling station feels that complete radio silence on the distress frequency is no longer necessary it may allow *important* traffic to resume. It will make this known by using the word **'PRUDONCE'.**

Canceling Radio silence
When the distress situation is over or when radio silence is no longer considered necessary the controlling station will use the words **'SEELONCE FEENEE**' as follows:

"MAYDAY - ALL STATIONS, ALL STATIONS, ALL STATIONS - THIS IS
NAME of station sending the message, TIME of the message,
NAME of the station that was in distress
SEELONCE FEENEE"
You should continue to listen to distress traffic until you are sure you cannot be of assistance in any way.

Mayday Relay
Transmission of a Distress Message by a ship not itself in Distress

If you hear a Distress call which no other station has heard you must first acknowledge receipt and then send a 'Mayday Relay' in the hope that a Coast Radio station will pick up your signal. If you see a distress signal of any form, flares etc. you should broadcast a "Mayday Relay" in the format set out below. In essence you will become the radio "go between", relaying messages between the vessel in distress and the Coast Radio Station and vice versa.
You may also have to send a distress message on behalf of a ship in distress which cannot, for some reason, send a distress message herself.

It is very important that you learn the correct procedure for a Mayday Relay *because a mistake could well generate confusion as to exactly who is in Distress or even start a second search and rescue situation*.

Mayday Relay Call:

MAYDAY RELAY, MAYDAY RELAY, MAYDAY RELAY,

THIS IS,

"MYBOAT", "MY BOAT", "MY BOAT"

Repeat the distress message sent by the station in distress:

THE FOLLOWING DISTRESS MESSAGE WAS RECEIVED FROM "name of boat in distress"

AT "time" HRS

MESSAGE BEGINS" ----------"

MESSAGE ENDS

On seeing a
distress signal

MAYDAY RELAY, MAYDAY RELAY, MAYDAY RELAY,

THIS IS,

"MY BOAT", "MY BOAT", "MY BOAT",

MY POSITION IS,

TYPE OF DISTRESS SIGNAL SEEN
TIME DISTRESS SIGNAL WAS SEEN

POSITION OF DISTRESS SIGNAL SEEN OR BEARING FROM YOUR POSITION'

ANY OTHER USEFUL INFORMATION,

OVER.

False Alarms
Some people seem to take pleasure in sending hoax distress calls.
Except in the case of distress, the use of the Distress signal is absolutely forbidden. The master of the ship can be prosecuted for misuse of the Distress signal.

SUMMARY

THE DISTRESS SIGNAL IS THE SPOKEN WORD "MAYDAY"

DISTRESS signal may be sent when there is GRAVE AND IMMINENT DANGER

Learn how to send a Distress call and message:

"MAYDAY, MAYDAY, MAYDAY"

THIS IS

"MY BOAT", "MY BOAT", "MY BOAT"

MAYDAY,

"MYBOAT",

POSITION,

NATURE OF DISTRESS AND ASSISTANCE REQUIRED,

ANY OTHER USEFUL INFORMATION,

OVER.

Learn how you would acknowledge receipt of a Distress message:

"MAYDAY

NAME of station in distress repeated 3 times,

THIS IS

"MY BOAT", "MY BOAT", "MY BOAT"

RECEIVED

MAYDAY"

RADIO SILENCE IS IMPOSED BY:

CONTROLLING STATION	"SEELONCE MAYDAY"
ANY OTHER STATION	"SEELONCE DISTRESS"
RESTRICTED WORKING MAY RESUME	"PRU-DONCE"
NORMAL WORKING MAY RESUME	"SEELONCE FEENEE"

Learn how to send a Mayday Relay:

MAYDAY RELAY, MAYDAY RELAY, MAYDAY RELAY,
THIS IS

"MY BOAT", "MY BOAT", "MY BOAT"

THE FOLLOWING DISTRESS MESSAGE WAS RECEIVED FROM "name of boat in distress"
AT time HRS

MESSAGE BEGINS "repeat message"
MESSAGE ENDS

OVER

URGENCY (PAN PAN)

An Urgency message takes precedence and priority over all other radio communications except Distress. It is therefore the second most important message that can be transmitted.

The URGENCY PRIORITY for an Alert and the URGENCY SIGNAL indicates that a VERY URGENT MESSAGE follows concerning the SAFETY of a BOAT or the SAFETY of a PERSON.

The **Urgency Signal** consists of the words **"PAN-PAN".**
The signal shall be said THREE times in an Urgency Call.

The use of the URGENCY PRIORITY for an alert and the use of the URGENCY SIGNAL shall be used only on the authority of the Master or person responsible for the ship.

The Urgency call Message is normally sent on the distress frequencies.
However, the Urgency **MESSAGE** may be sent on a **working frequency** in case of a long message or medical message or for a repeat of a message in areas of heavy radio traffic.

PAN-PAN, PAN-PAN, PAN-PAN,

ALL STATIONS, ALL STATIONS, ALL STATIONS,

THIS IS

"MY BOAT", "MY BOAT", "MY BOAT",

MY BOAT
POSITION

NATURE OF URGENCY AND ASSISTANCE REQUIRED,
ANY FURTHER RELEVANT INFORMATION,

OVER.

Medical Emergency
If you require urgent medical advice and/or assistance use the Urgency call with the addition of the word "MEDICO".

(i.e. "**PAN-PAN MEDICO, PAN-PAN MEDICO, PAN-PAN MEDICO**", etc.)
This will alert the Coast Radio Station that you require medical advice and they will immediately start to arrange telephone contact with a doctor at the hospital on duty. As medical advice is liable to be lengthy you will be asked to change to a working channel/frequency in order to leave the calling channel/frequency clear.

SAFETY (SECURITE)
The **safety signal** is "**SECURITE" (pronounced "say-cure-e-tay")**

The safety call is normally only used by a Coast Radio Station and it warns that a message of importance to shipping is about to follow. The message may be regarding a navigational hazard or a gale warning for example. The Safety signal will be transmitted on the calling channel/frequency but the message will usually be sent on a working channel/ frequency, which the Coast Radio Station will announce.

An example of a safety call might be:

"SECURITE, SECURITE, SECURITE,

ALL STATIONS, ALL STATIONS, ALL STATIONS,

THIS IS U.S. COASTGUARD MIAMI, US COASTGUARD MIAMI,
U.S. COASTGUARD MIAMI,

FOR REPETITION OF NAVIGATION WARNING LISTEN
CHANNEL 22A/2670KHz".

If you wish to hear the navigation warning switch to channel 22A/2670KHz, the navigation warning will be transmitted after a minute or so.

You should listen to Securite messages until you are sure that they do not concern you and you should of course not interfere with these messages by transmitting on the same channel while they are in progress.

Mobile Telephones
It should be stressed here that a mobile phone is *not* as good as a VHF radio with regard to distress messages because:

- A distress message transmitted on channel 16 will be heard by all ships and Coast Radio stations in the vicinity, a phone call will not.
- VHF coverage around the world is extremely good, mobile phone coverage at sea is not continuous.
- Coast Guard Radio stations will act immediately on hearing a Mayday; a telephone call will have to be re-routed to the search and rescue authorities.
  Search and Rescue helicopters and surface vessels can use VHF transmissions to help locate the vessel in distress but the equipment does not work with mobile phones.

GMDSS

Global Maritime Distress and Safety System (GMDSS)
GMDSS was introduced by the International Maritime Organization (IMO) as a world wide system of automated distress and safety communications at sea in 1988, by amendments to the International Convention for the Safety of Life at Sea (SOLAS).

From February 1st, 1999 all cargo vessels of 300 GRT or more and all passenger ships carrying 12 passengers or more on international voyages must comply with the GMDSS regulations. However in view of the number of nations involved and technical difficulties arising from the equipment required, there has been delays in the implementation.

The US has started to implement the system, and since February 1st, 1999, does not require a listening watch on 2182 kHz for GMDSS vessels. Listening watch is required on VHF channel 16 until 2005.

Although the regulations do not apply to most leisure craft it is important to have a basic understanding of the system and voluntarily carry selected systems with GMDSS capability.

In simple terms the objectives of GMDSS are to improve the effectiveness of a distress call and to increase the chance of a distress call being received anywhere in the world. GMDSS will also improve the transmission of urgency and safety communications. The improvement in communications is made possible using modern radio technology to integrate communications between ships, land stations and satellites.
The equipment which must be carried aboard ship to comply with the GMDSS requirements depends not only upon the size or type of ship but also upon the area(s) in which the ship will operate.

GMDSS Areas
There are 4 designated sea areas:

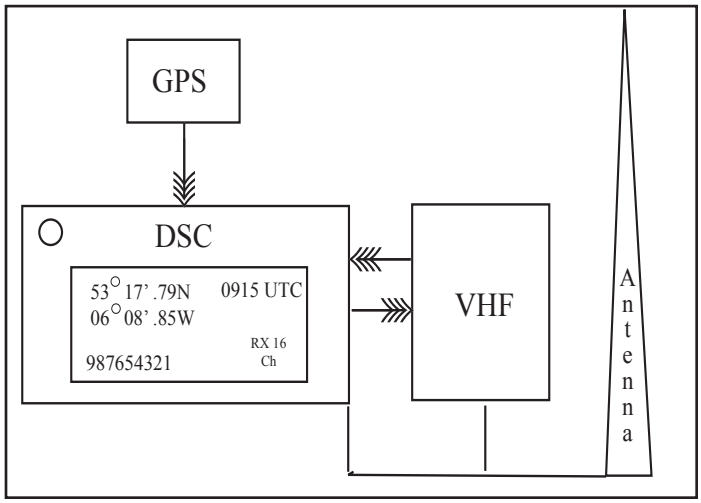
A1 an area within radiotelephone coverage of at least one VHF Coast Radio Station in which continuous Digital Selective Calling (DSC) alerting is available. (Approximately 20 to 40 miles from a coast radio station.)

A2 an area within radiotelephone coverage of at least one MF Coast Radio Station in which continuous DSC alerting is available. (Approximately 100 to 150 miles from a coast radio station.)

A3 an area excluding A1 and A2 within the coverage of a geostationary INMARSAT satellite in which continuous alerting is available. (Between 70°N to 70°S.)

A4 all areas outside areas A1, A2, A3. Essentially these are the polar regions where geostationary satellite coverage is not available.

Digital Selective Calling (DSC)
At the heart of the new system is what is termed a Digital Selective Calling controller or 'DSC controller' for short. The DSC controller is a 'black box'. Depending on the type of radio and the legal specification required by individual countries, it will either be connected to a transceiver, or be included within the transceiver. The DSC is activated by the press of a button and automatically sends information in digital form through the selected channel/frequency. The controller itself also receives digital signals addressed to it.



When a license is issued for a DSC installation a 9 digit number called a MMSI (Maritime Mobile

Service Identity) is allocated to the station, this number is unique to the station just like a telephone number and must be programmed into the controller.

The DSC controller therefore knows *who* it is and, if connected to an electronic navigation aid such as GPS or Loran, will also know *where* it is. If GPS is not connected the controller allows a manual input of position when required.

'Digital'
Digital signals are quicker and more efficient than voice signals; for example a full digital distress signal might take, typically, about half a second to transmit as opposed to perhaps 20 to 30 seconds for the same signal sent by voice.

'Selective'
The system is selective because the sender can select who will receive the signal.

DSC Ship to Ship/shore
If another vessel's MMSI number is known the vessel can be called direct, the call will activate a buzzer on the ship being called, just like a telephone. A number (6) of books of MMSI numbers will need to be carried. Once the initial "Routine" call is acknowledged the communications then continue on by voice on an appropriate working channel/ frequency.
In the event of the need to call an unknown vessel for navigational purposes then a DSC Alert, Safety alert, addressed to "All ships" will need to be made.
To establish contact with an unknown vessel, if within coastal waters, the initial call should be made on Ch 13, the compulsorily monitored Bridge to Bridge channel. In the event that does not work, address the call to those stations within the area ie a radius of 6 miles.

DSC Alert
All that is required to send a Distress message (Distress Alert) from a station equipped with DSC controller is to lift a flap and press a big red distress button for 5 seconds. The distress message containing the vessel's MMSI number, position, (if the controller is connected to a GPS or Loran receiver), description, and time of the message is automatically sent 5 times and will be received automatically by any Coast Radio Station or Coast Guard Radio station and all ships within range. If no GPS is connected the position must be entered manually.

The Coast Radio Station DSC controller will acknowledge receipt of the Distress Alert and the DSC controller will then automatically switch the radio on the vessel in distress to channel 16/2182. The vessel in distress will, after acknowledgment of the distress alert, immediately transmit a full Distress call and message by voice on Ch 16/2182 etc. and all communications relating to the distress will continue by voice on Ch 16/2182.

If the call is not acknowledged by a Coast Radio Station any other vessel must acknowledge; in the event of no acknowledgment the DSC controller will continue to send the Distress Alert every 3.5 to 4.5 minutes until an acknowledgment is received. If time allows, further details, such as the nature of the distress, can be entered into the DSC controller before sending the Distress Alert.

Distress Alert Relays, Urgency Alert and Safety Alert messages can also be transmitted automatically by the DSC controller initially and then by voice on the appropriate channel/frequency.

Under GMDSS regulations every complying vessel must have at least 2 independent and separate methods of transmitting distress alerts, each using a different radio communications service. Another method is through the INMARSAT satellite system and EPIRBs. This is discussed later in more detail.

GMDSS – Current status
The cancellation of the watchkeeping requirement on 2182 KHz has not had such a great impact as that which will happen when VHF16 is no longer monitored on 1 February 2005. Under the present international VHF system all ships as well as certain Coast Radio/Coast Guard stations are requested, where practicable, to maintain a continuous watch on channel 16 until this date. Leisure craft are also requested to listen to channel 16 whenever possible. Therefore, a vessel transmitting a Distress message on channel 16 relies on being within VHF range of either a Coast Radio station

or another ship listening to Channel 16.

When GMDSS is fully operational, ships, Coast Radio Stations and Coast Guards will no longer maintain a watch on channel 16 as this function will be carried out by the DSC controller on channel 70. A voice message on channel 70 will not alert the DSC controller and so will not raise the alarm. One way for a vessel not equipped with DSC equipment to alert a Coast Radio Station would be to transmit a Mayday on the nearest Coast Radio Station's working channel, or on the Bridge to Bridge Ch 13.

Recent reports suggest that DSC is causing serious problems for Search and Rescue Authorities. Figures suggest that more than 96% of DSC Alert transmissions are false alarms and that the amount of false alarms received is increasing each year. False Alerts are alerts sent in error, not hoax calls. The sending of alerts by mistake has been attributed to equipment which is difficult to use and on procedural problems.

A recent report suggests that many DSC units are turned off aboard merchant ships in order to cut out the '..... annoying and distracting DSC alerts'.

The US Coast Guard is so concerned at the amount of false alerts that in September 1998 it announced the closure of their regional MF DSC stations. It has subsequently begun to introduce slowly MF and HF DSC capabilities as equipment and procedural improvements reduce the number of false alerts.

The World Radio Conference has decided to allow channel 16 to continue to be used for Calling and the International Maritime Organization has 'recommended' shipping to continue to keep a listening watch on Ch 16 until 1st February 2005. The IMO has also requested governments to encourage *all* craft to fit DSC radios by 2005. However many countries will stop watch keeping on 16 as soon as possible.

GMDSS Certificates

An operator's certificate, called the Short Range Certificate, will only be required if a DSC controller is fitted.

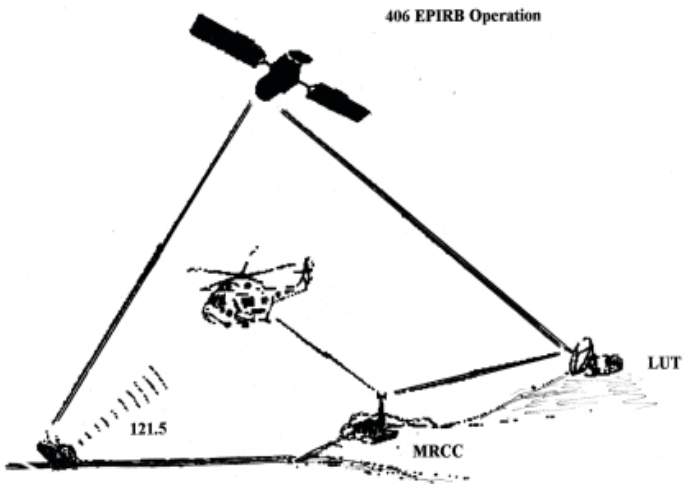
Existing VHF certificates (Restricted Certificates of Competency in Radiotelephony) will remain valid for non DSC VHF radios.

A GOC (General Operators Certificate) is required for GMDSS complying vessel radio operators, and each vessel must have a second operator also with a certificate. However if the vessel operates only in Area A1 an ROC (Restricted Operators Certificate) will be required.

EMERGENCY POSITION INDICATING RADIO BEACON (EPIRB)
&
SEARCH AND RESCUE TRANSPONDERS (SARTS)

EPIRBS

These operate via SARSAT/ COSPAS (American/Canadian/French SARSAT/ Russia COSPAS) on 406 MHz and include a signal on 121.5/243.0 MHz which the Search and Rescue authorities can use to home in on. Older EPIRBS that operate on 121.5 MHz only (Civil aircraft distress frequency) may still be found, but they have created many false alarms and are being phased out.



EPIRB

The SARSAT/ COSPAS system employs Polar orbiting satellites evenly spaced East -West around the earth, which provide total global coverage, supplemented by geostationary satellites, relying on "Doppler shift" for positional information. The satellites communicate with a network of earth stations known as Local User Terminals (LUTs) who can pass distress alerts and location data to Rescue Coordination Centers (RCCs) via Mission Control Centers (MCCs).

By using several satellites in displaced orbital planes the system provides a complete world wide distress alert monitoring facility with an average notification time of 90 minutes.

When activated, the EPIRB will transmit a distress signal containing the identity of the ship or aircraft which is relayed by the orbiting satellite back to an earth station. The LUT uses doppler shift measurement techniques to compute the position of the beacon and then alerts the appropriate RCC. A distress message can be relayed from under one minute to one and a half hours, dependent mainly on the latitude. The nearer the equator the greater the potential time lag. On 406 MHz the average position accuracy is from 3-5 km (Although in one actual distress the position was only 70 yards (64m) out).

121.5 MHz is used as a homing frequency, primarily by Search and Rescure (SAR) units, but SARSAT/ COSPAS can also compute a position from this. However, accuracy on this frequency is reduced to 12-20 km. Once a shore terminal is alerted by a signal via satellite, a SAR operation is commenced. SAR and rescue units use the 121.5MHz signal to home in on the distress. Surface craft can use 3cm radar to home in on SART transmissions. Hand held radios are used for on scene communications.

INMARSAT

These operate on L-Band (1.6 GHz) employing geostationary satellites, with positional information coming from an integrated GPS system. With INMARSAT, IAT (Initial Alerting Time) on average is 2 minutes (potentially up to 5 minutes) with advertised accuracy of 100m, although in practice it is usually in the order of 3-5 m.
Complies for use by ships sailing in areas Al, A2 and A3.

Operation

When activated, the EPIRB will transmit a distress signal containing the identity (MMSI No) of the ship or aircraft which is relayed by the orbiting satellite back to an earth station (LUT). The LUT uses doppler shift measurement techniques to compute the position of the beacon and then alerts the appropriate RCC.
An EPIRB must be:

1. Installed in an easily accessible position
2. Ready to be released manually and capable of being carried by one person into a survival craft and being operated manually.
3. Capable of floating free in the event of the ship sinking, and automatically transmitting when afloat. The EPIRB should be fitted in a float free position on board ship, well away from any hazards which may prevent its release.

Testing

The EPIRB should be removed from its stowage and tested once every month. Follow the manufacturers instructions carefully, most require pressing a TEST button for a few seconds, an indicator light will flash indicating a successful test, release the TEST button.

The EPIRB battery has a life of 5 years, and the expiry date should be clearly marked on the EPIRB. Operating life is typically 48 hours. Usually a *Hydrostatic Release mechanism has a life of 2 years, and should be replaced when required. The expiry date should be clearly marked on the mechanism. The bracket also has an expiry date of 8 years after purchase.

Having been activated either manually or automatically the EPIRB requires no further input from the operator.

*Liferafts should have a hydrostatic release attached to them for automatic deployment in the event of a sudden sinking. The hydrostatic release unit is mounted between the liferaft and the cradle which holds it. If you do not have a chance to manually deploy the liferaft when the ship is sinking, at a depth of 10-15' the Hydrostatic Release Unit will allow the raft to inflate and float free automatically.

Hydrostatic Release attached to the liferaft

SART

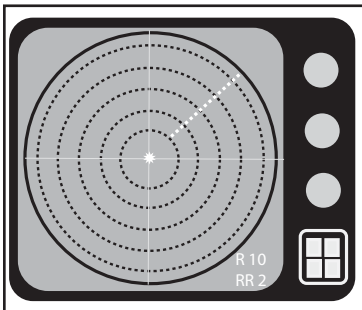
One SART is compulsory for vessels over 24 meters (80 feet) and less than 50m or 500 grt; vessels over this size must now carry at least two SARTs, one each side of the vessel, located so that they can be rapidly placed in a survival craft. Alternatively one transponder can be carried in each survival craft, the SART being carried in lieu of a radar reflector in a liferaft.

The SART is a location aid, operating on a radar frequency (9GHz) with only a short range, 5 miles at 6 feet high. Once activated the SART will "paint" a marker on the screen of any vessel's operating radar display as an easily recognized series of 12 dots. When the SART is about1 mile away the markers become arcs and finally concentric circles.

Many of the available SARTs include visual and/or audible warning when illuminated by radar. They should be positioned as high up as possible for maximum detection.

A ship's radar will transmit a stream of high power pulses on a fixed frequency between 9.2 GHz and 9.5 GHz. It will collect the echoes received on the same frequency using a display known as a Plan Position Indicator (PPI) which shows the ship itself at the center of the screen, with the echoes dotted around it. Echoes further from the center of the screen are thus further from the ship, and the relative or true bearing of each echo can be easily seen.

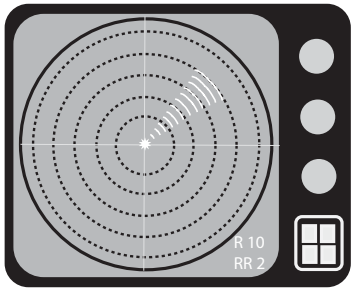
The duration of operation of the SART is 96 hours in standby condition, followed by a minimum of 8 hours of transmission while being continuously interrogated.



SART POSITION IS THE 12th DOT
NEAREST CENTRE OF RADAR.
DOT SPACING IS .64 MILES

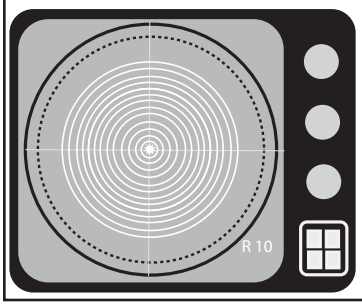
SART 2 MILES FROM RADAR

RADAR RANGE = 10 MILES
RANGE RINGS = 2 MILES



SART 1 MILE FROM RADAR

RADAR RANGE = 10 MILES
RANGE RINGS = 2 MILES



SART 0.2 MILES FROM RADAR

RADAR RANGE = 10 MILES
RANGE RINGS = 2 MILES

SART
Search And Rescue
Transponder
3 cm radar band

Testing
Regular testing should be carried out.
Locate the SART within the line of sight of an operating radar. Insert the test probe carefully into the 3mm diameter hole in the center of the activation switch, taking care not to damage the security label. Pushing the test probe into the hole, activates the test cycle, the red LED will be "On" continuously and the buzzer will sound every two seconds. The SART will signal on the radar. To switch off SART, insert the probe through the small hole at rear of switch and push firmly until switch clicks off.
Note: Only test for a few seconds as a live distress call may be received by other vessels in range.

Battery
The battery should be changed 5 years from the date shown on the label.

SATELLITE COMMUNICATIONS

Introduction

INMARSAT (the International Maritime Satellite Organization) is a consortium of about 80 member states which provides a system of global satellite communications. Initially provided for maritime use it has now expanded to cover aircraft and vehicles traveling anywhere within four Regions. These are as follows:

Atlantic Ocean Region -East (AORE)
Atlantic Ocean Region -West (AORW)
Indian Ocean Region (IOR)
Pacific Ocean Region (POR).

The area of coverage is from 70˚ N to 70˚ S.

The System comprises 3 parts as follows:

1. 4 Satellites in geostationary orbit about 20,000 miles high, one above each region, over the equator. These are each backed up by a standby satellite. The satellites are maintained and operated by INMARSAT Headquarters in London through its Satellite Control Center (SCC).

2. On the ground in each ocean region there is a Network Coordination Station (NCS) which monitors its satellite and all its traffic and also monitors the Land Earth Stations (LES) (or Coast Earth Stations) linked to that satellite. There are 34 LES which provide access to and from the satellites and the telecommunications networks.

3. The users of the system are Mobile Earth Stations (MES) (or Ship Earth Stations) which communicate with shore based subscribers, via a selected satellite and LES.

INMARSAT SERVICES

In order to comply with GMDSS requirements a system must support Enhanced Group Calling (ECG) for the receipt of Marine Safety Information (MSI)

Inmarsat A

Introduced in 1982, Inmarsat A was the first system available for users. It allows 2 way telephone, fax, email and telex as well as High Speed Data transfer. An analogue system complies with GMDSS.
Expensive call charges and requires a large heavy stabilized antenna.

Inmarsat B

The successor to A, is the digital version, and with better technology has reduced the call charges by half. Requires a large heavy stabilized antenna, and is not yet ECG compatible and therefore not GMDSS compliant.

Inmarsat C

Introduced in 1991, Inmarsat C allows only data transmission. Low power consumption, call cost rate and small fixed antenna make the system ideal for all vessels. However the data transmission speed is slow which increases call costs. It is GMDSS compliant.

Inmarsat E

This is the EPIRB system discussed in Section 11.

Inmarsat M

Designed to provide a voice system and also fax and data compatible, Inmarsat M is not GMDSS compliant. Lower call charges than A, still requires a steerable antenna but smaller than that for the A and B system. A further development of this system is the Mini M which provides voice, fax and data compatibility and the equipment is compact. The system is not GMDSS compliant and the antenna though smaller needs to be stabilized.