

Marine VHF Installation, Use and Advanced Features

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The Essence of Marine VHF Radios

- A primary safety tool for almost all marine vessels
- Designed to provide near line of site communications for marine traffic
- Relatively simple technology helps keep the equipment inexpensive and reliable.
- Radios can be versatile, providing optional features such as intercom and hailer without interfering with the radios core mission.
- Radios are manufactured to be small enough to mount almost anywhere in a vessel. Handheld units are available also.



Marine VHF Commercial/Recreational

There are significant requirements for commercial vessels when it comes the use of VHF radio. This presentation discusses primarily the needs of recreational or “voluntary” vessels.

Ships that are NOT “voluntary” include:

•Cargo Ships over 300 gross tons navigating the open sea

•Ships certified by the USCG to carry more than six passengers for hire in the open sea or tide waters of the US

•Power-driven ships over 65 feet 7 inches on navigable waterways

•And a few others…

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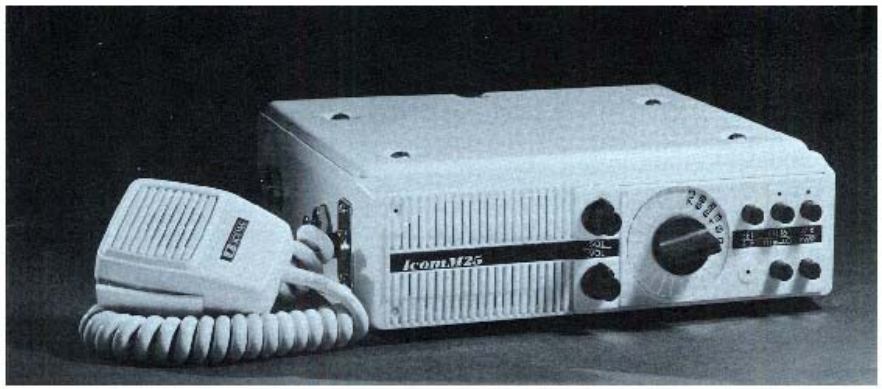
Marine VHF Past

Icom M25 Circa 1970's

Sold for around $500!



Someone out there still probably thinks this is the best radio ever made…



Marine VHF Presents

Icom M422

Sells around $250!

Built-in DSC meets RTCM SC-101

Digital Selective Calling Features

Position Request and Position Report with External GPS Receiver

New public address (PA) and RX speaker functions

Submersible (1m depth for 30 minutes.)

And much more…

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Marine VHF Physical Installation Considerations

- Install in well ventilated areas
- Make sure controls are easy to get to in an emergency or bad weather
- Keep radio at compass safe distance
- Think about antenna connection
- Make sure it is audible in critical areas on boat
- Think about 3rd party product interconnection

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Marine VHF Installation Power Considerations

- Icom VHF's typically draw 6 amps on TX
- The cabling provided with the radio is sufficient for the supplied run length
- ABYC E011 provides more detailed standards for ship electrical systems. See: www.abycinc.org/standards/purpose.cfm#E11
- Use larger gauge wire for longer runs. More on this on the next few pages



Marine VHF Installation Power Considerations

AWG	Diameter	Diameter	Square	Resistance	Resistance
	mm	inch	mm2	ohm/km	ohm/1000feet
13	1,80	0,0720	2,6	6,76	
12	2,05	0.081	3,3	5.4	1.7
10	2.59	0.102	5.26	3.4	1.0
8	3.25	0.128	8..296	2.2	0.67
6	4.115	0.165	13.298	1.5	0.47
4	5.189	0.2043	21.15	0.8	0.24
2	6.543	0.2576	33.62	0.5	0.15
1	7.348	0.2893	42.41	0.4	0.12
0	8.252	0.325	53.49	0.31	0.096
00	9.266	0.365	67.43	0.25	0.077
000	10.40	0.4096	85.01	0.2	0.062
0000	11.684	0.460	107.219	0.16	0.049

Icom VHF's spec
@ 13.8 V ± 15%

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Marine VHF Power Considerations

- Using the previous table and the formula V = IR, on a 50 foot run of 12 gauge wire, you can expect about .5 volt drop at 6 amps
- 13.8 +/- 15% is the tolerance of Icom VHF radios
- Our radios will run at full specifications as low as 11.6 volts
- So for example, assume we are starting with a battery voltage with 13.6 volts on it. Under transmit, if the radio is drawing 6 amps, there will be a .5 volt drop, thus delivering 13.1 volts to the radio under load. Well within specification

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Marine VHF Power Considerations

- However, with the engine off, battery voltage may settle to a nominal voltage of around 12 volts (depending on state of charge).
- Drop .5 volts and the power available is now only 11.5 volts at the radio, below specification. 10 or 8 gauge may be a better choice in this case.



Marine VHF Antenna Selection

There are all types antennas for different needs. Sometimes bigger is not always better!

A few questions can really help in determining antenna type:

- What type of boat
- What type of boating is intended
- Antenna budget
- Need to “match” with other antennas

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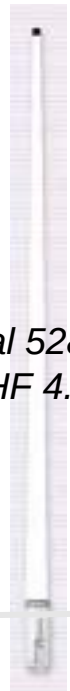
Marine VHF Antenna Selection for Smaller Boats

Small vessels like bass boats, center console fishing boats or any vessel where size is critical

Shakespeare 5240-R 3' VHF 3dB

Shakespeare 5240-R 4' VHF 3dB

Digital 528VW 4' VHF 4.5dB



GAM SS-2 35" VHF 6db



Marine VHF Antenna Selection for Larger Boats

Large vessels like sport fishing boats and trawlers

Shakespeare 5309-R 23' VHF 9dB

Shakespeare 5225-FLT 8' VHF 6dB

Digital 529VW 8' VHF 6dB

Digital 721VW 21' VHF 10dB



Marine VHF Antenna Sailboat Selection

Sailboats…

Shakespeare 5215-C-X 3' VHF 3dB

Shakespeare 4015 3' VHF 3dB

Digital 22VW 3' VHF 3dB

GAM SS-2 35" VHF 6db



Marine VHF Antenna Installation

Marine VHF antennas should be mounted with at least 3 foot spacing between other antennas

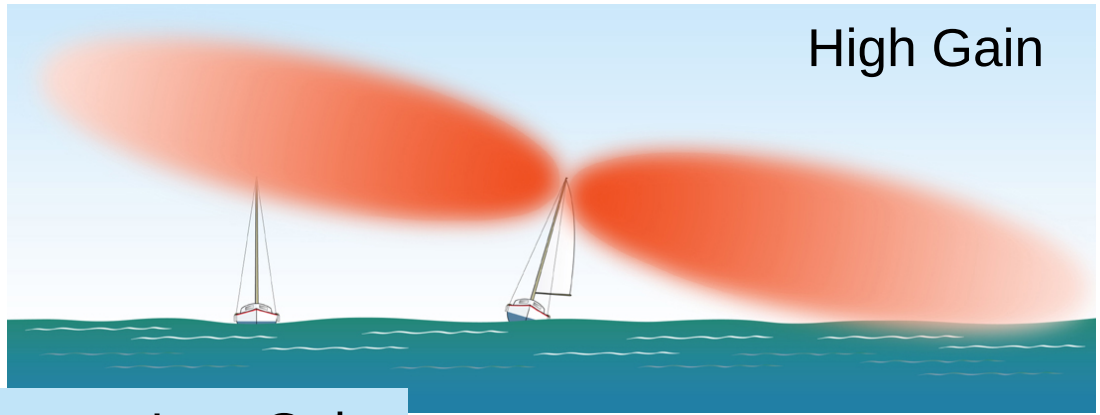
Higher is almost always better

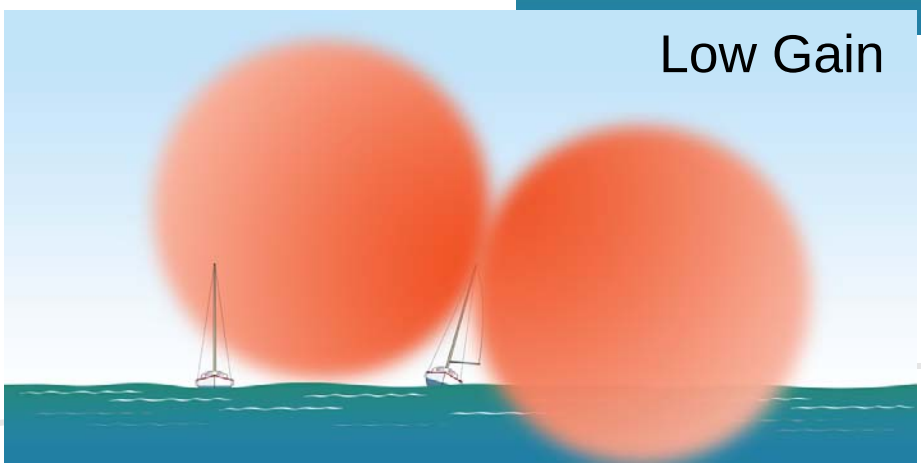
Make sure the antenna is at least three feet from the radio

Be careful with high gain antennas with a boat that heels significantly

Marine VHF Antenna Installation

Effects of heeling on reception







Marine VHF Antenna Coax Considerations

VHF Antenna cable can be cut (but no shorter than three feet)

Avoid adding extra “jumpers” (multiply by .5 db the number of cable junctions)

Solder on PL-259 Connectors preferred

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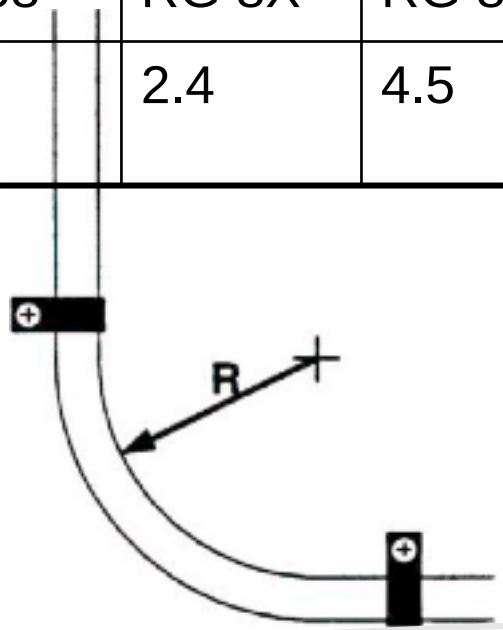
Marine VHF Antenna Coax Considerations

Minimum Bend Radius (inches)

RG58	RG 8X	RG 8/U	RG 213	LMR240	LMR400
2.0	2.4	4.5	5.0	.75	1.0





Marine VHF Antenna Coax Considerations

Coaxial Cable Loss Characteristics (50 Ohm, 160 MHz)
Signal Loss per 100 feet (dB)

RG58	RG 8X	RG 8/U	RG 213	LMR240	LMR400
5.0	4.0	2.6	2.6	3.1	1.6



Marine VHF Antenna Mount Considerations

Rail Mounts

Surface Mounts

Mast Mounts









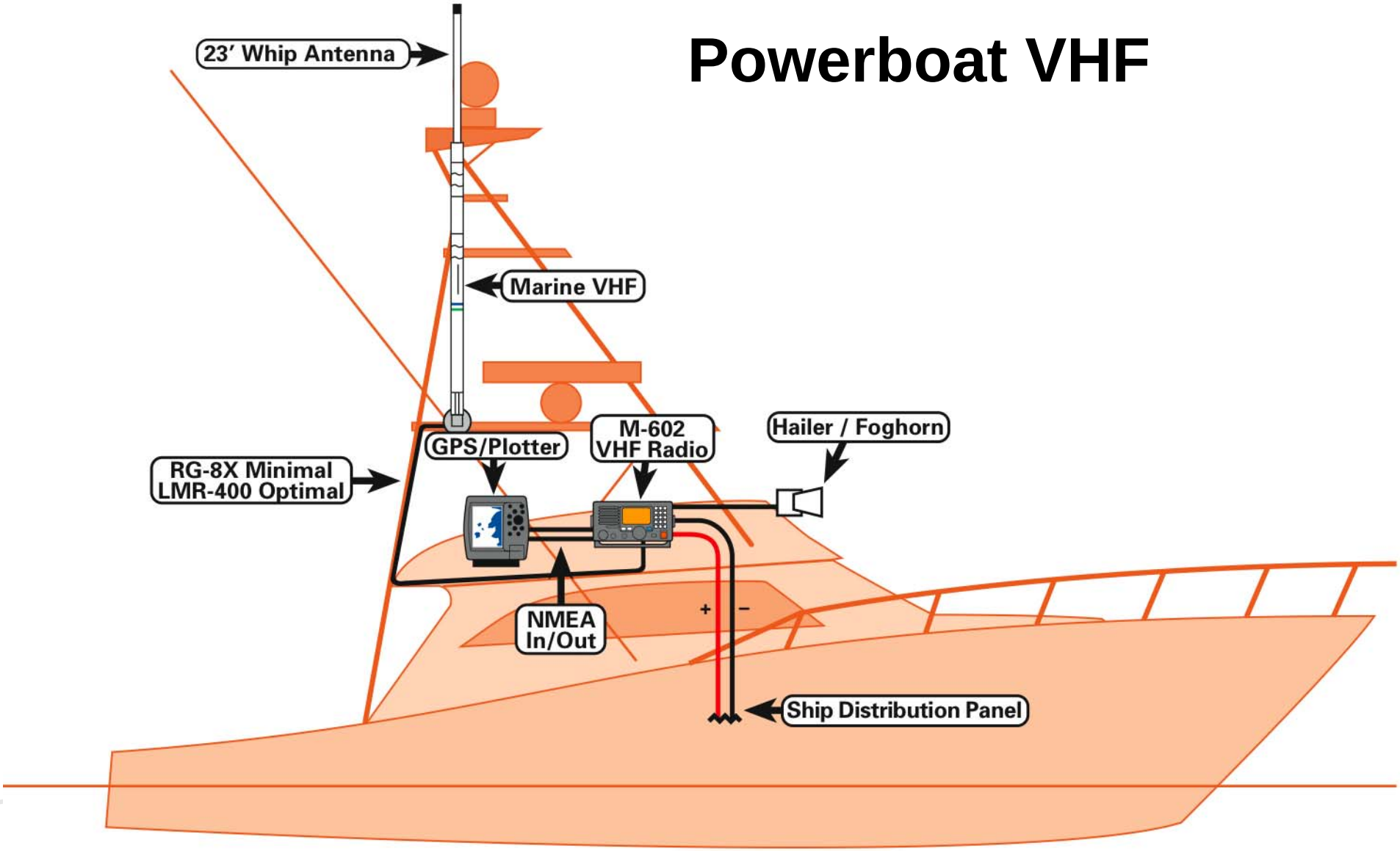
Marine VHF Grounding Considerations

Grounding is not generally an issue with marine VHF radios (certainly not like SSB radios)

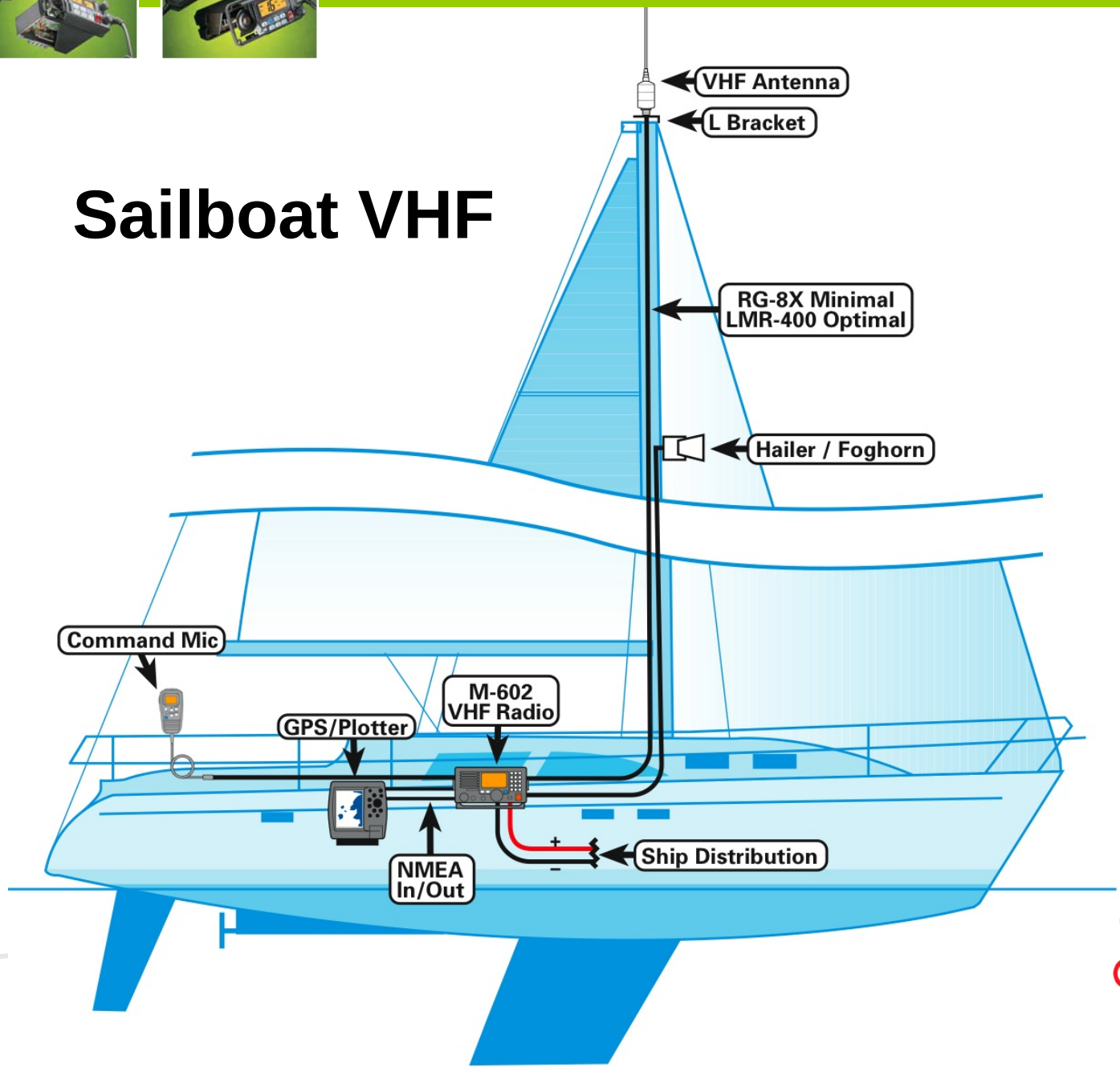
Most marine antennas are also “self ground” or have built in counterpoise



Powerboat VHF



Sailboat VHF



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Marine VHF Range

Rough guide to communications distance:

- Boat to boat 10-15 Miles
- Boat to shore 25 Miles

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Marine VHF Range

More precisely:

Distance (Nautical Miles)= 1.23 * Square Root of Height of Antenna in Feet Above Water

Don’t forget to include both stations in these calculations



Marine VHF Interference

During or after installation, you may notice extraneous noise on receive (or on your transmissions to other vessels). Interference is any extraneous noise that is or appears to be on channel that interferes with the operators ability to communicate. This come from:

- Devices on-board the vessel
- Devices on other vessels

And…



Marine VHF Interference

- Atmospheric conditions
- RF adjacent channel

Over the next few pages, we will concentrate our discussion on how to identify the source of on-board interference and how to eliminate it



Marine VHF On-Board Interference Sources

Navigation Equipment	Engine Tachometers
Autopilots	Battery Chargers
Engine Alternator	Television and Ant. Amps
Depth Sounders	INMARSAT
Networked Equip.	Stepper Motors
Computer Driven Equip.	Fans
DC Motors	Air Conditioners
Inverters	AC Generators
Fluorescent Lamps/Dim	Engine Ignition

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Marine VHF On-Board Interference Source Identification

- Turn off all equipment on vessel except affected device
- Turn on, one by one, each piece of equipment
- Repeat until source of interference is found
- NOTE! Some interference may not occur until the offending devices are warmed up!

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Marine VHF On-Board Interference Source Identification

When noise has been isolated to a particular piece of equipment check to see if:

- Noise is coming from equipment (over the air)
- Noise is being conducted through cables

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Marine VHF On-Board Interference Source Identification

- To verify how the interference is entering the HF radio, disconnect the antenna. If the noise is still present, then the noise is coming in through the power leads, or other connections. If the noise disappears, then the noise is coming in through the antenna.
- How the interference is propagated will make a difference in what tools you use to solve the issue



Marine VHF On-Board EMI Resolution

- Shielded Cables
- Twisted Cables
- Grounding
- Filters
- Clip-On Ferrites
- Relocating Cable Runs
- Relocating Equipment Displays
- Relocating Antennas



Marine VHF On-Board EMI Resolution

Shielded Cables

Installation of shielded cables in the equipment that is CAUSING EMI interference may reduce or eliminate the transmission of EMI. Shields must be connected to the RF ground system. Shield connection should be made at the end closest to the transmitted signal. The other end should remain unconnected.

Twisted Cables

This is a “easy thing to try”. Twisting the power wires together on the affected HF may help reduce some interference.



Marine VHF On-Board EMI Resolution

Grounding

Grounding other equipment display cases and the cases of all the peripheral modules in the system may need to be performed. A #8 gauge wire, but not smaller than #12 gauge should be used for grounding.

Filters

Available filter types include alternator filters, noise filters and capacitors. The filters may be installed at the noise source or on leads entering the affected device.

Ferrites

Ferrite core toroids and split ferrites may be used to reduce conducted and radiated EMI from a noise generator.

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Marine VHF On-Board EMI Resolution

Relocating Cable Runs

In certain installations, it may be necessary to relocate the routing of cables to reduce the coupling of signals from the interfering source cables into another device.

Relocating Equipment Displays

May be necessary to relocate the equipment display to reduce the coupling of signals from the interfering source into the affected device.

Relocating Antennas

May be necessary to relocate antennas to reduce the coupling of signals from the interfering source into the affected device.

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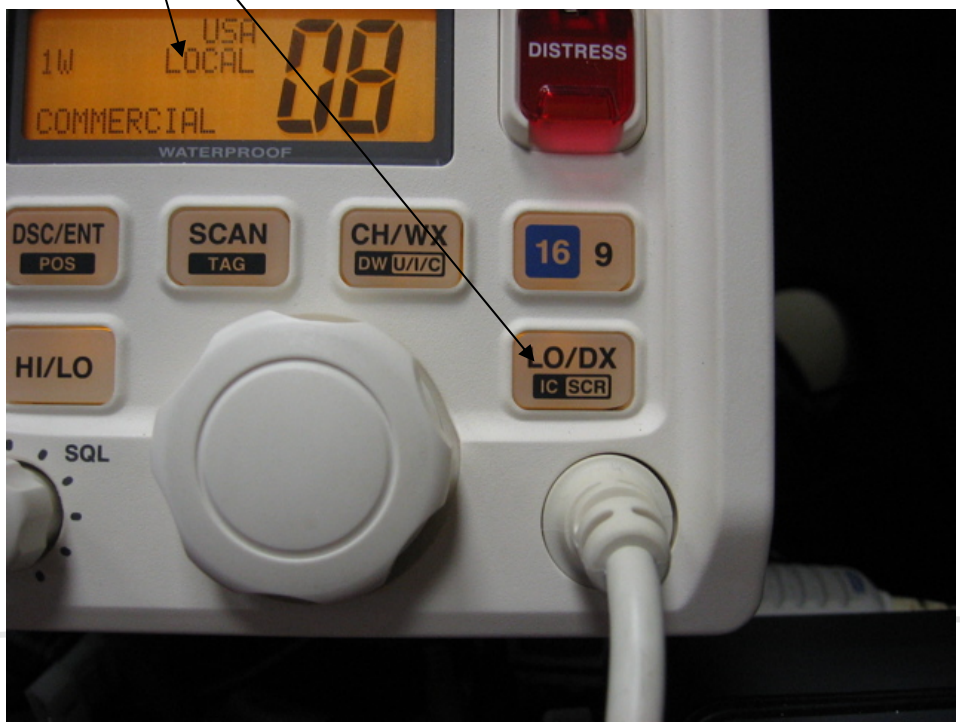
Marine VHF Adjacent Channel Interference Resolution

Use your attenuator!

- "LO/DX" Switch on 422, 502 and 504
- "F6" (LO/DX) on 602



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Marine VHF Protocol

Emergency Call Procedure for Voice is: “Mayday” three times followed by identity (usually boats name) three times

- Emergency channel (for voice) is 16

Normal Calling Procedure is: “Knotical, Knotical This is Dolphin Dolphin Over”

- Channel 9 has been designated as a supplementary calling channel for recreational boaters



INTERNATIONAL MARITIME ORGANIZATION

GMDSS

GMDSS stands for Global Maritime Distress and Safety System. It is a world wide system for dealing with distress situations at sea.

The system uses three principal elements:

- DSC (Digital Selective Calling) on VHF and SSB radios
- EPIRPB's using Cospas -Sarsat Satellite system
- Satellite communications using Inmarsat

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Rescue 21

Rescue 21 is the US Coast Guards effort to update its antiquated NDRS system

Rescue 21 helps the Coast Guard meet the demands of GMDSS

When Rescue 21 is fully implemented, the USCG will be monitoring channel 70 full time for DSC traffic

Implementation date of 2006



DSC

DSC (Digital Selective Calling) gives VHF Marine (or HF SSB) radios the capability to transmit digital signals to another radio station or stations



DSC Classes

DSC equipped radios come in these primary classes, A, B, D and SC 101.

Icom manufactures radios that cover two of these classes, Class “D” and “SC 101”

Our M504 and M602 meets the requirements of Class “D”

The rest of our radios including the 302, 422 and 502 are SC101

More information concerning this can be found at http://www.navcen.uscg.gov/marcomms/gmdss/dsc.htm



DSC Mandates

Recreational craft are voluntary users of radio, which mean that the user can select any class of DSC radio they would like, or not bother at all.



DSC MMSI Numbers

Nine-digit Maritime Mobile Service Identity number

Uniquely identifies:

- Individual vessel
- Group of vessels
- Coast Stations

The MMSI is broadcast digitally in an initial DSC contact and is used in the same way a telephone number is used.

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DSC MMSI Numbers

A complete MMSI consists of a national code (MID) and an individual identity codes

	US Recreational Boat	US Coast Station
Shore Station Code	NA	00
MID	367	367
Individual station identity	123456	1234
Complete MMSI number	367123456	003671234



Acquiring an MMSI number

In the US, contact:

BoatU.S

www.boatus.com/mmsi

Maritel

888-Maritel (627-4835)

Sea Tow

www.seatow.com

DSC Partner Equipment

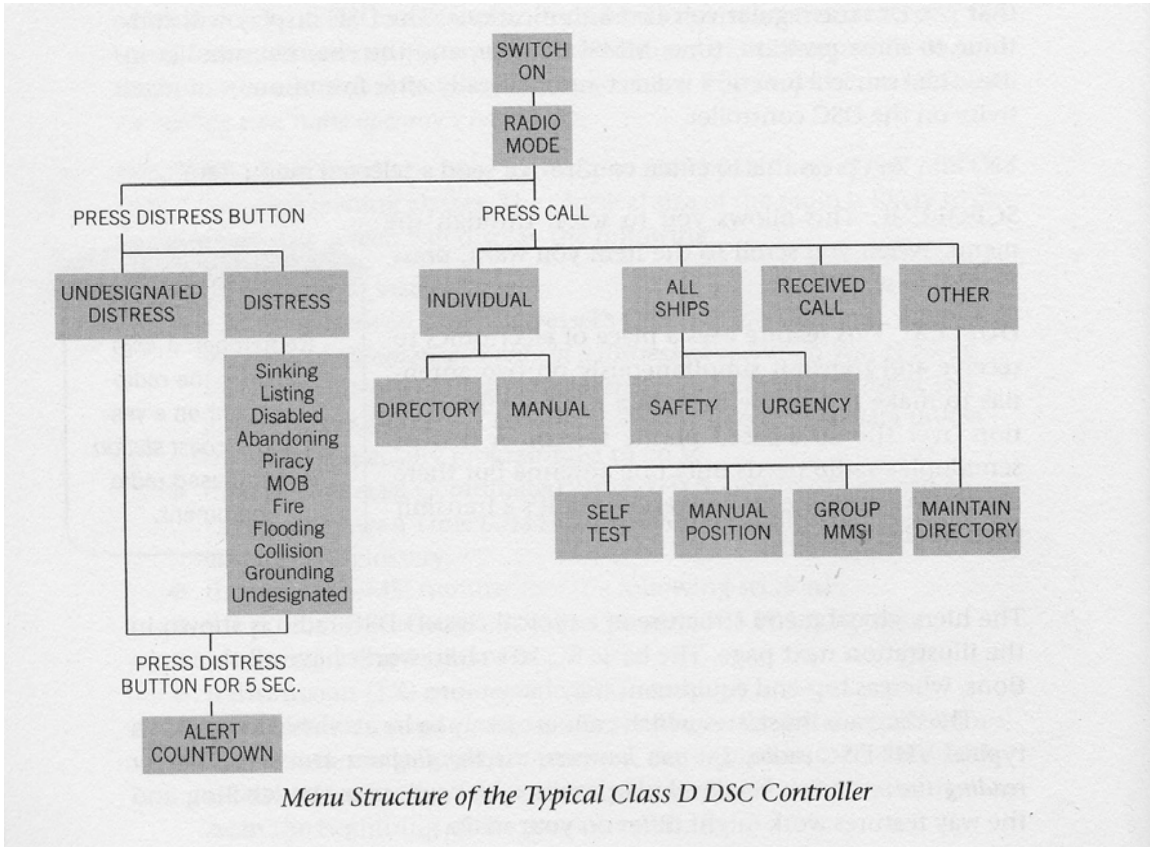
To get the most from DSC, our radio should be hooked to a GPS, GPS and Plotter or GPS/Plotter Unit.



DSC Calls

DSC Equipped radios can make a variety of calls as demonstrated on the next slide

DSC Call Tree



Menu Structure of the Typical Class D DSC Controller

From: A Boater's Guide to VHF and GMDSS



DSC Calls

All DSC Calls take place on Channel 70.

Depending on the nature of the call and the users response, the called radio will automatically switch to a working channel for follow-up voice conversation.

DSC Emergency Call

With our radios, lifting the plastic cover and pressing the distress button for 5 seconds will send a DSC Emergency Call.



DSC Emergency Call Procedure

Once you have transmitted a distress alert on CH70, use the same voice procedure as distress alerts without DSC

DSC is simply a digital notification

Once a DSC distress acknowledgement is received, the radio will auto tune to CH16



DSC Individual Call

Icom radios can call a individual vessel or coast station using DSC individual call

Initiate the call from the menu (and select working channel)

After a call is made, the called vessel must respond “Able to Comply” or “Unable to Comply”

If they respond “Able”, the called vessels radios will tune automatically to the working channel



DSC Group Call

Some Icom radios can call groups of stations

To setup a group call you must select a group number and program this number into the MMSI call list of all radio in the group.

Call is initiated through menu similar to individual call



DSC All Ships and Position Polling

DSC also has the capability of calling “All Ships” and doing Position Requests.

“All Ships” is used to alert vessels in the area to an urgency or safety situation. Avoid using it simply when you do not know the MMSI number of a vessel

Position Request is useful when you want to know the location of a friend’s vessel

A Geographical Call is meant for all units in a geographical area



Thank you for your time!

Sources used include NMEA Installation Standard for Marine Electronic Equipment Used on Moderate Sized Vessels Rev 1.1 and "A Boaters Guide to VHF and GMDSS" by Sue Fletcher as well as many others.