

Marine HF SSB Installation and Grounding

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Marine HF Installation Considerations

- This document is meant to be an overview of Marine HF radio installation
- For detailed installation instructions beyond the scope of this document, we recommend that you follow ABYC (American Boat and Yacht Council) guidelines.
- Further information is available at www.abycinc.org



Marine HF Installation Considerations

- NMEA also provides additional installation instructions and guidelines
- These instructions are meant to be a superset of the ABYC guidelines in regards to marine electronics installation
- Go to www.nmea.org for more information



Marine HF SSB Physical Installation

- Install in well ventilated areas
- Make sure controls are easy to get to in an emergency or bad weather
- Make sure display is angled for easy viewing
- Keep radio at compass-safe distance
- Make sure it is audible in critical areas on the boat
- Think about 3rd party product interconnection
- Avoid exposure to sea spray

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Marine HF SSB Tuner (AT 140) Physical Mounting

- Install in well ventilated areas
- Tuners are designed to resist moisture, but not a great idea to expose to frequent splashing water
- Ensure one of the water drains is facing downward
- Mount as close to antenna feed point as practical



Marine HF SSB Power Considerations

- Icom HF SSB's typically draw 30 amps on TX
- The cabling provided with the radio is sufficient for the supplied run length (10 feet)
- 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 HF SSB 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 SSB HF's spec
@ 13.6 V ± 15%

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Marine HF SSB Power Considerations

- Using the previous table and the formula V = IR, on a 25 foot run of 8 gauge wire, you can expect about .5 volt drop at 30 amps
- 13.6 +/- 15% is the tolerance of Icom HF 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 30 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 HF SSB 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. 6 gauge may be a better choice in this case.
- Icom suggests avoiding any run beyond 20 feet, and even for that, supply 6 gauge wire.



Marine HF SSB Antenna Selection

- Whips of 16’ or longer are generally used on power boats (Sailboats will generally use either whips or insulated backstays)
- There is a minimum length of whip that you can used, depending on the lowest frequency you wish to use:

The Lowest Frequency	Required Antenna Element Length
1.6 MHz band	7 M; 23.0 feet or longer
4 MHz band	3 m; 9.8 feet or longer

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Marine HF SSB Antenna Selection

Avoid multiples of half wavelength for antenna element lengths, since tuning becomes difficult.

L: Antenna element length to be avoided (m)

F: Operating frequency (MHz)

N: Natural number (n = 1,2,3, …)

Formula: $L = (300/f) * (1/2) * n$

Example at 16 MHz avoid the following lengths

$L = (300/16) \times (1/2) \times n = 9.4, 18.8 \ldots$

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Sample Marine HF SSB Whip Antennas

Shakespeare 27.6’ 5390

Shakespeare 23’ 5310-R

Digital 16’ 544-SSW

Digital 24’ 534-SSW



Marine HF SSB Backstay Antennas

Alexander-
Roberts Backstay
Insulator

Gam / McKim
Split Lead
Antenna

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Marine HF SSB Antenna Installation

- Marine HF Whip antennas should be mounted with at much spacing as possible from other antennas. Allow at least 3 feet or more from a VHF antenna
- Icom HF SSB's put out 150 watts. That amount of power can really get into shipboard electronics. Take care with antenna placement

Sample HF SSB Whip Antenna Mounts

- Mounts can typically these can be nylon or stainless steel. We always recommend stainless for its durability.
- Rail mounts can come either with a ratchet or fixed. Surface mounts can be flange, ratchet or lift-n-lay.

Rail Mounts

Surface Mounts

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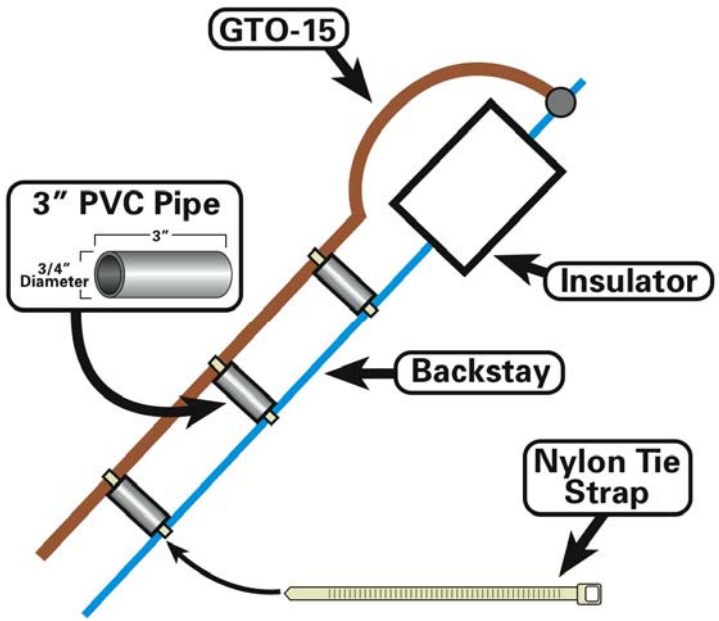
Marine HF SSB Feed-line Installation

- The line between tuner & antenna should be short. Remember, it is now part of the antenna also!
- Use reasonably heavy gauge, high voltage wire like GTO-15

Marine HF SSB Feed-line Installation

If you are going to run the feed-line alongside a stay or other metal, stand it off a few inches. Example:



Note:
Materials should be marine grade

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Marine HF SSB Antenna Coax Considerations

- HF Antenna Coax feed can be any almost any length to feed tuner
- Avoid adding extra “jumpers” (multiply by .5 db the number of cable junctions)
- Solder on PL-259 Connectors preferred

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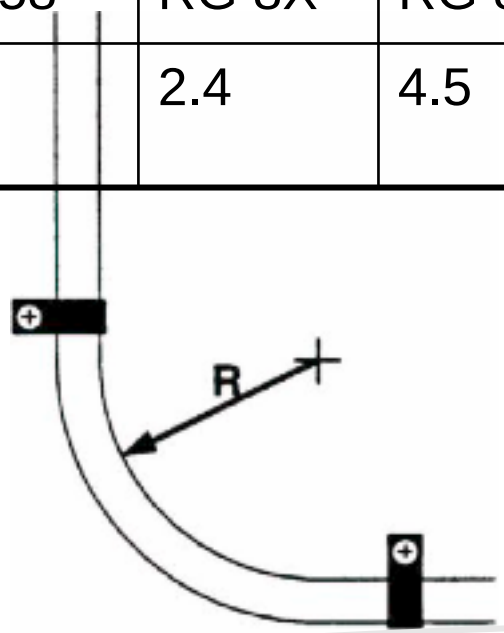
Marine HF SSB Antenna Coax Considerations

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



Take care not to exceed bend radius or your feed line will become less efficient. Better quality cable has more liberal bend radius limits.

Marine HF SSB Antenna Coax Considerations

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

Higher quality cable provides less loss. We generally recommend at least RG 8/U

RG58	RG 8X	RG 8/U	RG 213	LMR240	LMR400
3.0	2.5	1.3	1.3	1.7	.9



Marine HF SSB General Grounding Considerations

There are four significant kinds of grounding systems on most vessels

- DC Ground
- AC Ground
- Lightning Ground
- RF Ground

We will only discuss DC and RF Ground

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Marine HF SSB DC Grounding Considerations

- For our HF SSB's, always run a ground return wire the same gauge as the hot lead.
- Do not rely on a metal hull or superstructure to conduct the return.
- Run the return to the battery or distribution panel *rated to handle the current without significant IR drop!*
- Ensure if possible that the battery ground touches the water at ONE point only to help reduce stray galvanic currents.

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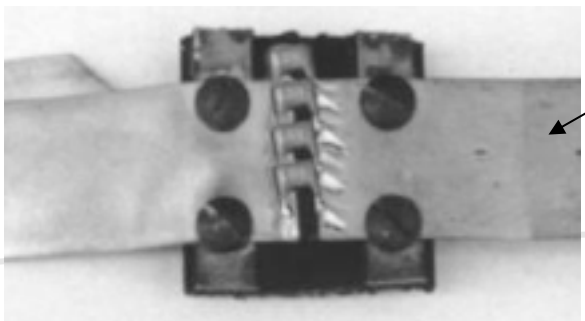
Marine HF SSB RF Ground Strap Considerations

- Use a 2” metal strap to connect Tuner AND SSB to ground point. It is best to make an individual run for each device. Avoid 1/4 Wave Lengths
- Use a DC Block as pictured in example. The helps prevent galvanic currents as we only need to pass RF. Capacitors are .15μf



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Marine HF SSB RF Ground Point Considerations

- A ground shoe such as those made by Guest (Dynaplate) or Newmar should be fitted
- Other mount points like a lead keel will work as well
- Dimensions of 6-8 inches wide and a length of 16-18 inches should be sufficient. This can be two separate shoes if the curvature of the vessel does not allow for one large plate.
- Should be mounted in such a way that it does not come out of the water when healing or planing

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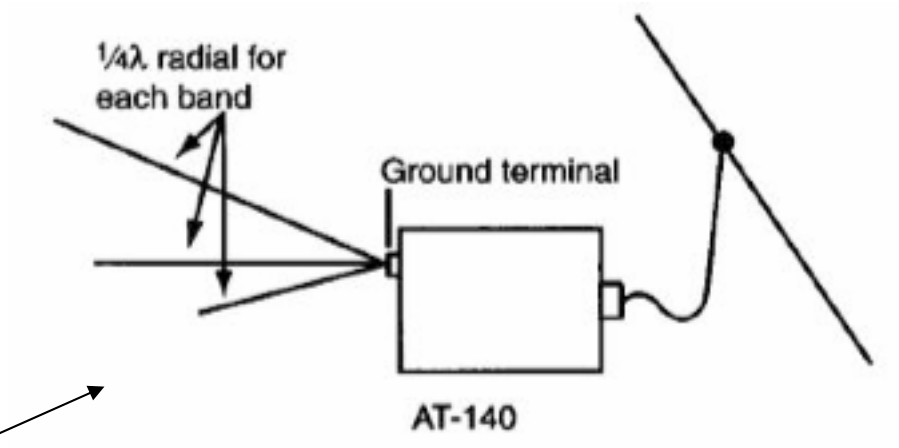
Marine HF SSB RF Radial Considerations

We do recommend radials be run, particularly if the ground point is in fresh water



Twin Lead



Marine HF SSB Calculating Radial Lengths

L: Counterpoise length for the operating frequency (m)

F: Operating frequency (MHz)

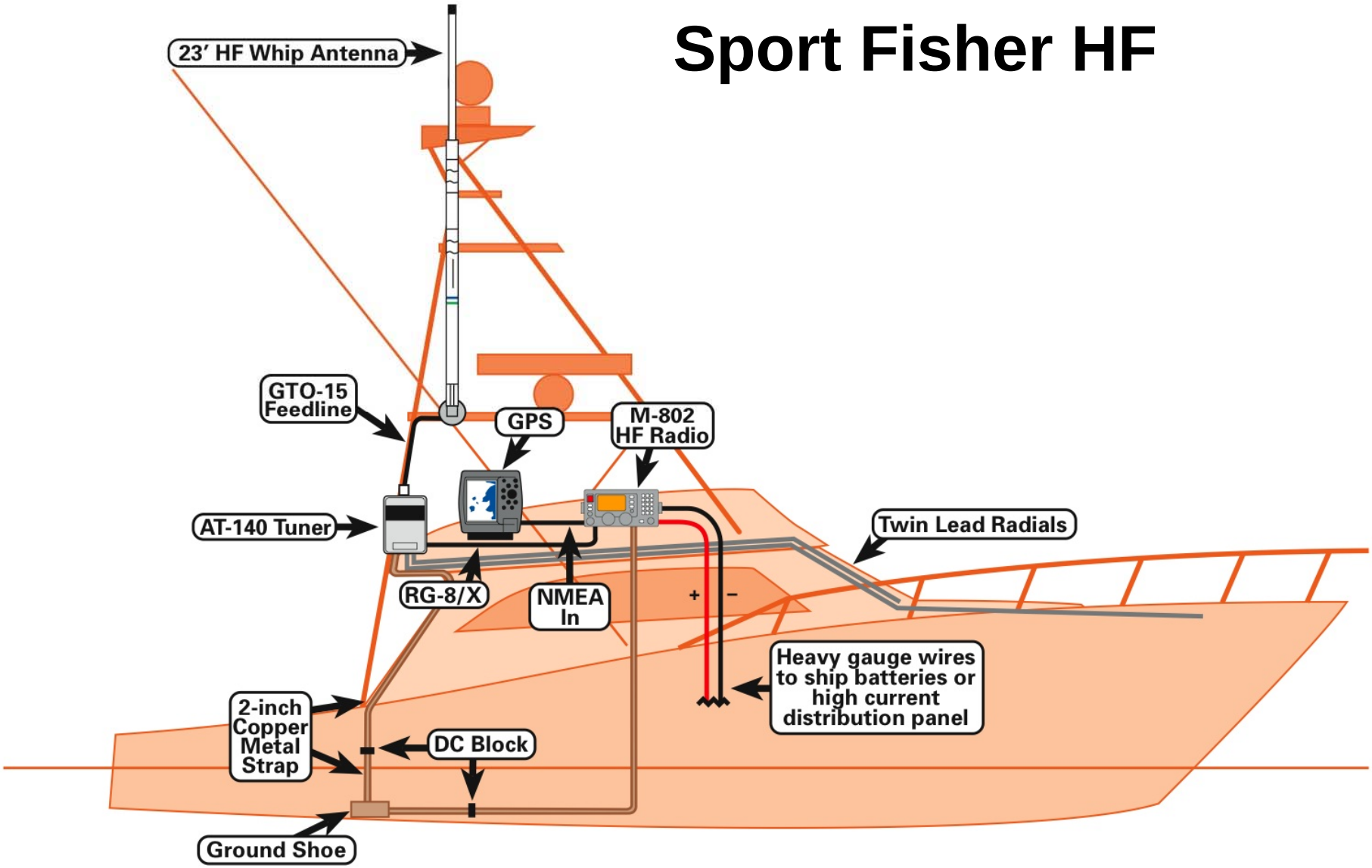
$L = (300/f) \times (1/4)$

Example: At an operating frequency of 16 MHz, use a counterpoise with the following length:

$L = (300/16) \times (1/4) = 4.7$ (m)

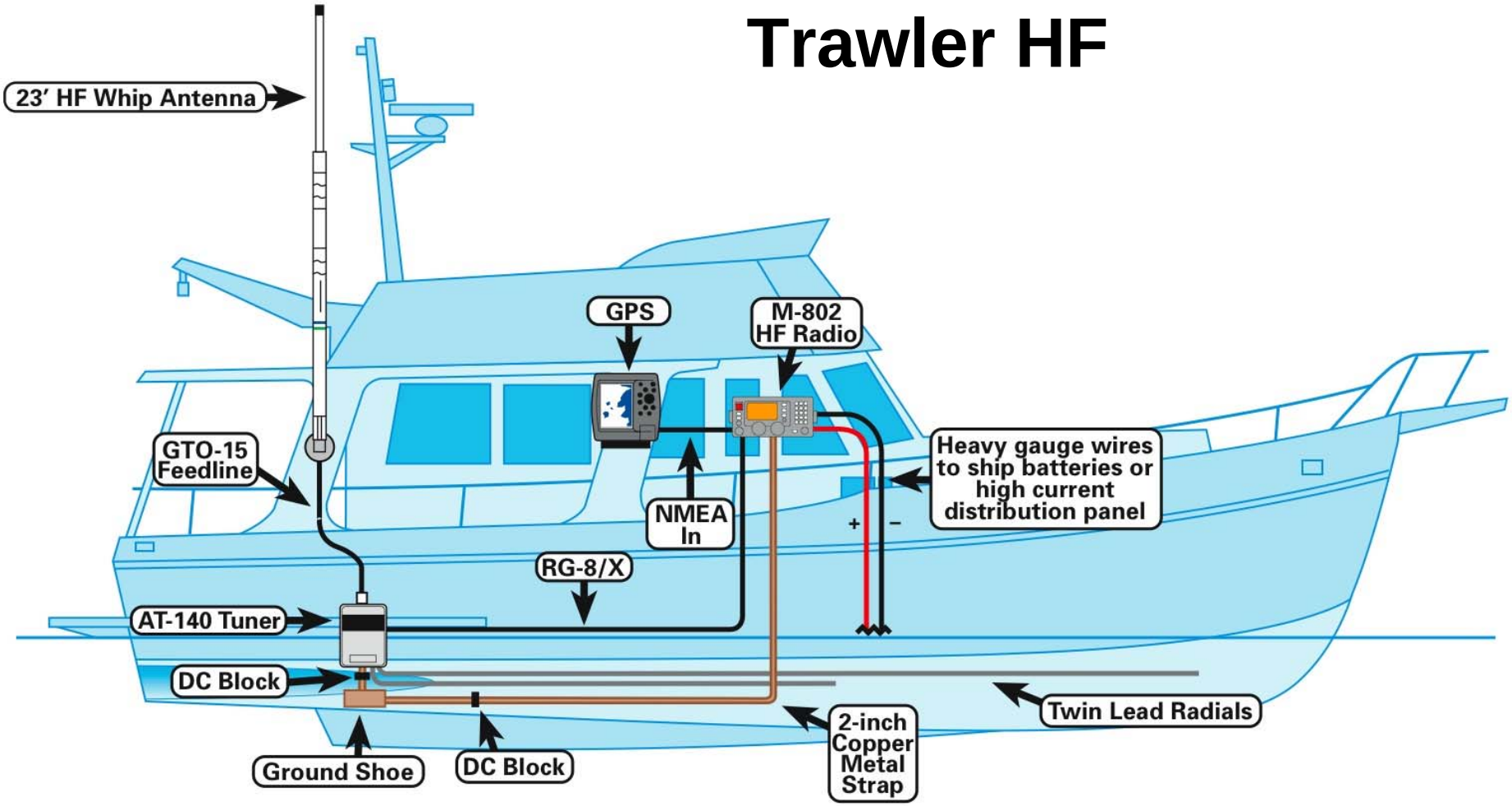


Sport Fisher HF





Trawler HF



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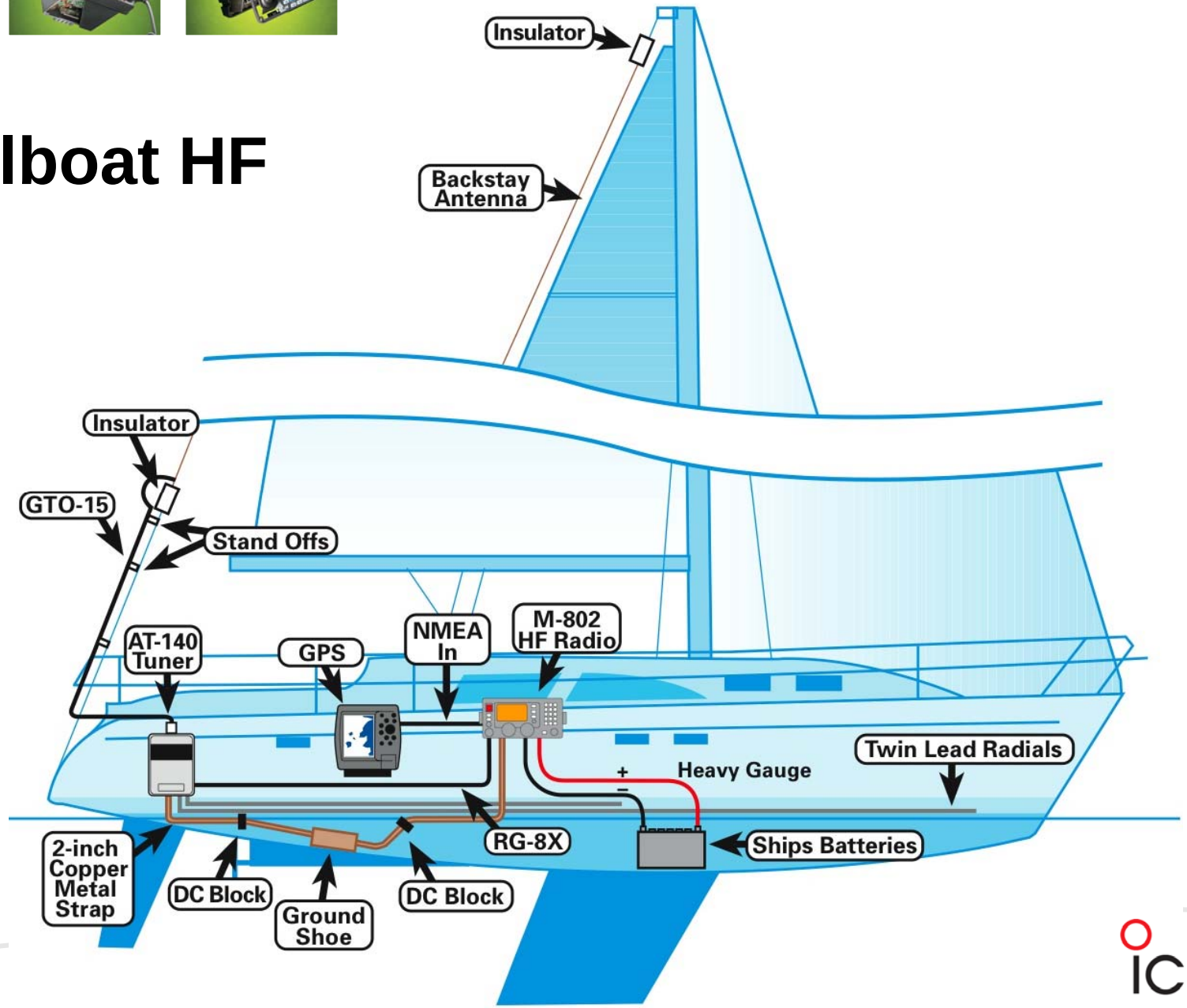
Sailboat HF



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Marine HF SSB 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 HF SSB 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 HF SSB On-Board Potential 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 HF SSB 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!



Marine HF SSB 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 HF SSB 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 HF SSB On-Board EMI Resolution

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



Marine HF SSB 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 HF SSB 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 HF SSB 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.



Thanks for choosing Icom!