

## Grounding (Counterpoise)

Good grounding or counterpoise techniques are absolutely necessary for maximum single sideband range. Half your antenna is your radio frequency ground, so don't skimp here! The radiating portion of your antenna needs to see a mirror image of itself before it will send out your SSB signal. This mirror image, called a counterpoise, is created by using metal surface and seawater as your radio frequency ground plane.

Your marine single sideband system will not perform satisfactorily if you don't have a good counterpoise system. Poor counterpoise (ground) equals poor range. This is especially true on lower frequencies where large RF grounds (counterpoise) are required for good range.

If you make direct contact with the seawater, you may be able to reduce the amount of ground foil that must be run from your radio and the automatic tuner. If your through-hulls are metal and are all bonded with a green wire per ABYC (American Boat & Yacht Council) standards, find a couple of in-water bronze through-hulls, and run the foil directly to them for an effective seawater ground. But make sure that bronze through-hull is already part of your bonding system with a telltale green wire attached to it and going off to other underwater metals. Never ground to a bronze through-hull that has been specifically left isolated and ungrounded.

Use a wire brush to clean up the neck of the through-hull, and then use a hose clamp to affix the copper foil to that through-hull. Bunch the foil up a few times to provide a good solid connection where it won't easily rip.

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**TIP!**

If there are several bonded underwater through-hulls near your automatic antenna tuner, your grounding will be easier. You might only need 50 feet of ground foil to complete the entire process! Direct contact with seawater improves any RF ground system.

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Same thing for a powerboat—but you'll need more ground foil because your automatic antenna tuner is probably mounted up top on the flying bridge. In this case, you will need to follow a wire run channel from the top of the flying bridge down below decks, and down to the bilge area where you can make connection to underwater through-hulls. You could even use a metal tube that may already be in place as part of your ground foil run.



*Use 3-inch wide, 3-mil copper foil to ensure a good sea water ground.*

Why foil? Round wires create inductive reactance at radio frequencies, and are not effective as a good grounding conveyance. Use 2 or 3 inch wide, 3 mil copper foil (available at most marine electronic stores) to achieve a good seawater ground.

Your counterpoise system needs to begin directly below your antenna feed-point if at all possible. When you use an antenna coupler, we will consider this as the "feedpoint."

An ideal counterpoise for all frequency single side band work should consist of up to 100 square feet of metal surface area directly below the feedpoint. While this may sound like an impossible number of square feet to achieve, consider the following large surface RF ground planes (counterpoise) already available to you:

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|------------------------|--|
| Tanks                  | Stainless steel tuna towers/stanchions |
| Propeller and shaft    | Chain plates                           |
| Encapsulated lead keel | Engine block                           |
| Bonded through-hulls   |  |

You can develop your own large surface area RF ground plane (counterpoise) system by fiberglassing into your hull copper screen or 2-3 inch wide copper foil strips. It's too bad they didn't build in the ground plane when they laid up the hull, isn't it?

It will probably take you about a day and a half and a hundred feet of copper foil to create a good capacity ground plane below the water line. You will be running copper foil inside your hull for a capacitive ground to the seawater. No, the foil does not go on the outside of the hull! The fact that the ground foil is close to the seawater makes all the difference on transmit and receive range. While it might be an effort to get all this foil below the water line, it will really make the difference when you press down on your microphone key.

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### **Did You Know?**

Your bonding of underwater metals that are already tied in with a common ground wire will not affect your corrosion control system. If your present underwater metals are not all bonded together, you may wish to lay out a RF ground system (counterpoise) independent of an actual connection to the seawater but that's not really necessary.

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These other copper foil leads go directly to the antenna tuner. The tuner will have a ground terminal to which the foil is attached. Do not reduce

the size of the foil as you approach the tuner or the radio. Also, do not convert the foil to wire as you approach the tuner or the radio. Fold the foil back on itself and drill a hole for the mounting stud.

Your RF ground system (counterpoise) does not actually need to contact the seawater to be effective. Even though an encapsulate lead keel doesn't actually touch the seawater, it makes a capacitive ground by being next to the seawater, if you run wide copper foil to it.

You may either double bolt the foil to an exposed keel bolt, or actually tap directly into the lead keel with a bolt going through the copper foil and into the lead.

In attaching to through-hulls, remember, it will improve performance if you run foil between each through-hull. Stainless steel hose clamps are the best way to "pick up" these underwater metals. Water tanks, copper hydraulic lines, etc.; can also be connected with foil using hose clamps.

I know, I know, trying to get a good RF ground (counterpoise) system is a bit difficult—especially if you can't get at your keel bolt. If this is the case, then drill into the keel and pull up some lead. Any sailboat system that doesn't use a poured keel is losing a tremendous amount of potential in obtaining a super signal. Only if your keel is made of lead shot poured in fiberglass would you not elect to use it. In any other case, where there is a large amount of surface area below the water line, such as a lead keel, by all means use it in your RF ground plane counterpoise. It will save you many hours of trying to run more copper foil and screen below decks.

Good RF grounding (counterpoise) techniques will also enhance your overall protection from a lightning strike. Lightning protection and good RF grounding all have a common denominator—a large amount of surface area below the water line.

Again, I would like to mention that running wire—even battery cable—is not effective as an RF ground (counterpoise) at radio frequencies. Although, wire looks like a good DC ground, it looks invisible at most

radio frequencies. Use foil, and only foil. Even aluminum foil will work in a pinch. You can even use aluminum air conditioning foil with sticky on the back as counterpoise. Wires won't work so forget about using them.

The more counterpoise, the better your signal. Ever wonder why supertankers always have the loudest signals on the band? They are only using 100-watt equipment, and a standard 23-foot antenna, but their signal literally bounces off of their gigantic counterpoise.

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**TIP!**

Again, RF grounding IS the key to single sideband super range. It's one of the few components of the installation you can control.

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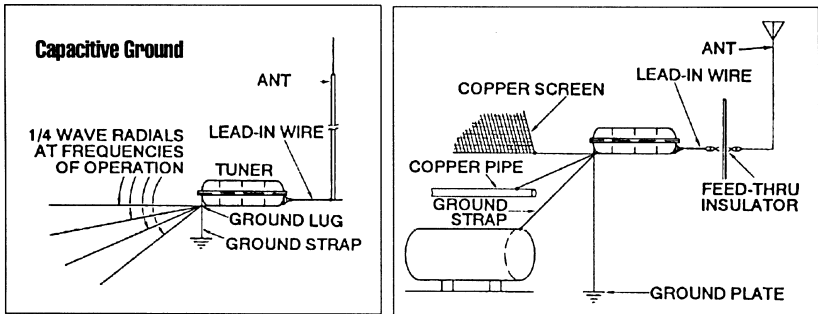
Once the copper is in place, you can just about forget it. It will do the work for you. We recommend applying a thin coat of paint or resin over the copper to keep the salt water from tarnishing it. While green copper works just as well as bright, shiny copper, it's a much more sanitary installation to keep it isolated from the elements. It also prevents tearing or other damage to the system.

If you have soldered all copper joints, you won't need to check for continuity. However, you may wish to clean up copper connections at through-hull fittings every couple of years. Since these connections are made with hose clamps, there is the possibility that the contacts may get corroded after a few years in the bilge. A steel brush should bring both the copper and the through-hull fitting up to a nice shiny surface, and you can make your connection again.

The periodic inspection of your copper ground system, you can be assured that your signal will stay loud and clear.

## ◆ *Ground System Review*

- (1) The automatic tuner must be connected to a good electrical ground. A good ground prevents shocks, interference and numerous other problems. One example of a good ground is the nearest metal member on a metal vessel. For best results, use metal strap or foil. Make the length as short as possible.
- (2) Good ground systems on wood or fiberglass boats are more difficult to install. For best results, use strap or foil connected to the keel, tanks, or other large metal objects.



If you have no way of contacting the seawater, you could install a counterpoise for each band of frequencies used above 4 MHz, as shown in the figure. This would be a last resort!

Ground plates? We save the underwater ground plate as an absolute last resort for a single-sideband antenna system that is working off of an automatic antenna tuner. Ground plates provide terrific contact to the seawater, and also have good connection points to attach the foil. The porous ground plates don't achieve any better ground than if you were to come up with your own copper plate, but they do provide a superior means for mounting them through the hull. Using a ground plate as a RF ground may cause interference with other on board electronics using the same ground plate as a DC ground.

The automatic antenna tuner performs best with a direct seawater ground connection. Whether it be through your bonded underwater through-hulls, or to a dedicated ground plate, the direct connection is one great way to minimize hours spent in the bilge developing a good-ground system.

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**TIP!**

A capacitive ground system, made up of copper strips run around the hull below the water line, or individual copper strips at one-quarter wavelength sections, is one way to achieve a good ground, but may take several days to lay into the hull and keep dry. Why not go for the direct seawater contact, and establish your single-sideband ground connection in hours instead of days!

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◆ *Typical Installation*

The following figure shows a typical installation. Any radio communications system operating with a whip antenna or long wire antenna (insulated back stay) must have an adequate ground connection, otherwise the overall efficiency of the radio installation is degraded especially at low frequencies.

The 50 ohm output impedance of the transceiver makes it necessary to employ antennas of the trapped or externally matched type. The use of an antenna coupler in conjunction with a whip antenna or long wire antenna (insulated back stay) allows an efficient installation which will cover all HF marine bands.

Of course, those of you with aluminum hull vessels, your RF groundplane (counterpoise) is your hull, and you'll probably have the loudest signal anywhere in the world. No further RF grounding is necessary.