Marine HF SSB Counterpoise
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The function of a counterpoise is as the word implies, to provide a reference for the antenna to work against. Imagine that you are in the water and you try to push then pull your boat, it is likely that you will move with the boat moving very little. Now you are on a dock and you find that you can push your boat with you moving very little. Your transmitter does something similar. It pushes and pulls electrons in and out of your antenna. It gets those electrons from the counterpoise then pushes them back into the counterpoise. If your counterpoise has a good connection to Earth as the dock does, the voltage at your counterpoise will change very little while your antenna's voltage will change in response to the current supplied by your transmitter.

A counterpoise does not have to be connected to Earth for it to work. Take the example above, but now you are on a ship instead of a dock. You find that you can push and pull your boat just like when you were connected to the Earth. The reason is the ship's momentum is so much larger than your boat's.

From this discussion you can see that there might be different kinds of counterpoises. Here are some of them:

1. Direct to Earth. Uses a direct electrical connection to Earth connecting to metal that is in contact with sea water. Example: DynaPlate.
2. Capacitive to Earth. Uses large surface area along the inside hull below the water line. If the capacitance is large enough it is virtually the same as Direct to Earth. Note that RF currents are AC currents and capacitors conduct AC current. Example: (a) Connection to fiberglass encapsulated lead keel. (b) Copper screen embedded in fiberglass hull.
3. Bulk. Connection to large metal objects on the boat. As with the example of pushing and pulling your boat while standing on a ship, the “Bulk” of the conductive area provides a source and sink for the electrons that your transmitter is moving in and out of your antenna. It is important to note that only the surface area is used, it is not the mass of the object that is important. Examples: (a) Connection to engine, metal fuel and water tanks. (b) Vast amount of coper foil or screen not in close proximity to sea water.
4. Resonant. This counterpoise uses a specific length of conductor for each frequency band that you intend to operate on. They are all connected at one end to the turner ground terminal and radiate outward along the length of your boat.

For the first three types, the bigger the better. In practice most installations operate in all of these modes to some extent, but there will most likely be a dominate mode.

Here are the disadvantages if each type:

1. Direct to Earth. Requires significant amount of existing under water metal or installation of Dynaplate. May introduce opportunity for electrolysis. May not function well in fresh water. Electrolysis issue can be eliminated by using series DC blocking capacitors.
2. Capacitive to Earth. Requires large amount of conductive surface, difficult to install. May not function as well in fresh water.
3. Bulk. Existing metal often not enough. If not enough existing bulk, will require addition of coper foil or screen.
4. Resonant. Works only on specific frequency bands. Will radiate RF energy into equipment on board.

Here are the advantages if each type:

1. Direct to Earth. Simple, if your vessel has metallic ruder post, through hulls or external keel.
2. Capacitive. Electrolysis not an issue. If enough conductive area, then will operate in Bulk mode as well.
3. Bulk. Uses existing metal on board. No exposed metal to sea water. Works as well in fresh water.
4. Resonant. Limited amount of foil or wire needed for installation – less than Capacitive or Bulk. Works as well in fresh water.

Tips on constructing a counterpoise:

1. Avoid using standard circular wire for the counterpoise and for any interconnection of the counterpoise. Use copper strap or foil that is at least 2" wide. When you must use standard wire keep it as short as possible.
2. Using a mix of Direct and Capacitive if structures are available.
3. If not using a Resonate counterpoise, connect you transceiver chassis to the counterpoise with copper strap.
4. Make sure all connection surfaces are clean and bare metal. Use corrosion block on connections
5. Connect copper strap to your common DC negative grounding point along with your radio's negative supply wire. If you don't have a common DC grounding point I suggest you construct one. Otherwise use the battery negative terminal.
6. Avoid connecting counterpoise to electrical devices that can cause radio frequency interference like refrigeration, generator, inverter, charger and watermaker. May be connected at the boat common DC grounding point.
7. Avoid connecting the counterpoise directly to equipment that may be sensitive to radio frequency energy like navigation or other communications equipment and auto pilot. Ideally the only connection will be connected at the boat common DC grounding point.

For Direct to Earth:

1. Connect copper strap to underwater metal. If you have a metal ruder post, use it by connecting a short piece of flexible #10 wire to it and to the copper strap. Other opportunities are external propeller shaft strut, bronze through-hulls and external metal keel.
2. If electrolysis is a concern you can use capacitors in series. This will block any DC currents but will conduct radio frequency currents. At any point you can cut the copper strap and solder a few 0.1 micro farad ceramic or mica capacitors across the cut. See Note on electrolysis below.
3. If you have an encapsulated metal keel connect to it. You may have to drill through some fiberglass to get to it. Then use a lag bolt or other method to connect it to the copper foil.

For Capacitive to Earth:

1. Check to see if your boat has factory installed copper screen or foil.
2. The goal is to maximize the surface area and minimize the distance to water. Use wide foil or screen on the hull surface below the water line.
3. If you have an encapsulated metal keel connect to it. You may have to drill through some fiberglass to get to it. Then use a lag bolt or other method to connect it to the copper foil.

For Bulk:
Use copper strap to connect engines, tanks and other large metal structures.

For Resonant:
I don't recommend using it. The KISS SSB counterpoise is one device that claims to be a set different length wires. Studies have shown that this device is a poor counterpoise and is resonant in only one

band near 10mhz, due to folding and packaging of conductors in close proximity.

Note on electrolysis:
While this is not a problem in the short term for testing, there is a chance that you may introduce an electrolysis issue when connecting RF ground underwater metal such as rudder post. If you are not sure that the metal and radio ground are at the same DC potential or if your metal is somehow isolated from DC ground (battery negative) then you should add capacitors in series with the connection to block any DC current that might flow.

For the capacitors use about 5 .1uf to uf, all in parallel and place them inline with the conductor going to the post -- does not matter where in the conductor path you place them.
Here is a link where you might order the caps: http://www.digikey.com/product-detail/en/RDER72E224K8K1C11B/490-4818-ND/1656243

My vessel is an example where I believe there is not the need for blocking DC to the rudder post. The post is not isolated as it is grounded to the engine block via steering and engine control cables. RF ground and engine are at same potential since the RF ground is connected to engine block at ground bus bar near engine where all DC negative supply wires are connected as well as bonding for lightning and boat side of shore power ground isolator. Some folks believe that RF and DC grounds should not be connected, as indicated above I don't agree, turns out that in ICOM tuners the FR ground is common to DC ground within the tuner. My strategy is to force that which cannot be easily isolated to same potential with good conductors and common grounding point. This also allows use of structures such as engine, keel and metal fuel tanks to be used as part of RF ground.