

Marine SSB and Offshore Communications 2016

Practical techniques to make it all work

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Outline

- Race Rules and Requirements
- VHF Radios
 - Coax, Antennas, Installation
 - AIS- Receive only and Class B Transponder
- SSB
 - Motivation: Why carry one?
 - SSB Basics
 - SSB System Installation and Resources
- Iridium Phone Systems

Race Rules and Requirements

- **RULE 4.10** A permanently installed 25watt VHF radio with a masthead mounted antenna of at least 15" in length. The radio must be VHF with Global Positioning System (GPS) and Digital Selective Calling (DSC) capability, connected to or with an internal GPS, with an MMSI number registered to the vessel.
- **RULE 4.11** Waterproof handheld VHF radio with integrated DSC/GPS capability.
- **RULE 4.34** A second emergency VHF antenna shall be provided to allow the 25-watt VHF radio to be operated in the event of a dismasting.
- **RULE 4.35** Equipment to communicate your position to the Race Committee at least once a day by means to be designated in the Communications Plan. This will likely include reporting position by anyone of the following means satellite phone, text [SMS], e-mail, or by single sideband [SSB] voice via an assigned Communications Vessel. Though an SSB radio transceiver is not required, it is highly recommended as a means of communicating and sharing with the fleet.
- **RULE 4.45** Automatic Identification System (AIS) receiver with a data display that indicates a minimum of range and bearing to an approaching target is required. Though not required, an AIS Class B Transponder is recommended. Radar is also recommended.
- **RULE 4.46** A 406 MHz EPIRB Is required. PLB does not count, but good idea.

VHF Radios

- The VHF radio is your **first and best tool** for communicating, safety, and for getting assistance at sea. It is **ESSENTIAL** that it be installed and work **PROPERLY!!** This means a quality unit, with a GOOD 3dB masthead antenna, using low loss coax with properly installed and waterproofed connectors. A proper backup antenna, easily mounted to a rail or other structure with good coax cable is both required and necessary.

VHF Radio for the SSS TransPac

- Modern VHF radios do a lot more than just allow you to talk to your buddies. They offer AIS receiver and display capabilities, weather channels, DSC calling, some have GPS antennas and displays, loudhailer capability, remote operating positions, waterproofing, and alarms of various sorts.
- For those who just want to know what to buy, I recommend a **Standard Horizon GX2200**. Other manufacturers offer good units also. This unit offers IPX7 immersion rating, full VHF channels and features, a remote operating handheld with AIS, AIS receiver, display, and alarms, DSC calling, internal GPS antenna and provision for external unit, loudhailer, GPS display, AIS output, and a ton of other features. In 40 years of using Standard Horizon VHF radios I have NEVER had a failure.

VHF Antennas and Coax

- VHF radios are fairly simple to install. The result is almost **ENTIRELY dependent** on the coaxial cable, connector, and antenna installation. These **MUST** be chosen and installed properly.
- VHF frequencies for voice communication run from 156.05 to 157.425 MHz. AIS and weather frequencies are at about 162 MHz. These frequencies are far beyond what ham-fisted wiring techniques will allow. The RF signals **MUST** be plumbed through low loss 50 ohm coaxial cable with UHF connectors properly **SOLDERED** onto the cable and completely waterproofed.
- Coaxial cables exhibit loss of signal power (both for transmit and receive) which depends on cable type, size, and length.
- The universally specified connector for a VHF radio is the venerable UHF connector. The piece which fits on the coax is the PL-259. It is highly recommended that this be either silver or gold plated, with teflon insulator. Typical price is \$2 to \$5. The PL-259 installs directly on RG/8U, RG/213, and LMR-400 coaxes, which are 0.405" in diameter. For smaller coaxes, adaptors which screw into the PL-259 are necessary. For RG/58, the adaptor is a UG/175. For RG/8X or LMR-240, the adaptor is a UG/176. **The shield and center conductor must be SOLDERED correctly to the body in order to reduce losses and to provide a waterproof connector.**

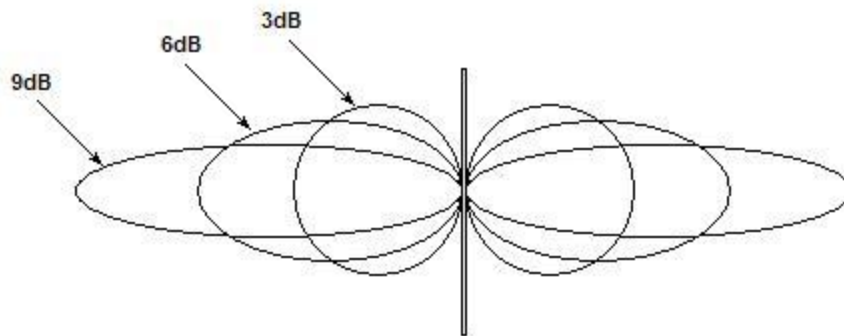
Coax Cable

- Coax MUST have tinned conductors, and a robust jacket suitable for outdoor marine use. It MUST be rated as 50 Ohm, and have a total loss in the path to the antenna of better than -3dB (50% power loss). Hopefully MUCH less loss. The loss applies for both transmit and receive signals.
- Common choices are RG/58, RG/8X, RG/8U, and RG213. Ancor brand coax is suitable. There are very low loss cables used in the microwave industry which are also suitable, such as Times Microwave LMR-240UF and LMR-400UF. The UF stands for Ultraflex, which is appropriate for boat usage. The LMR cables have restrictions on bending radius, and are a little less robust than the RG type cables.

Coax Type	Diameter (inches)	Adaptor for UHF PL-259 Connector	Power Loss (db) In 60 feet	Power thru (%)
RG/58C	0.195"	UG/175	-4.18 dB	38.2%
RG/8X	0.242"	UG/176	-2.552 dB	55.6%
RG/8U	0.405"	None	-1.459 dB	71.4%
RG/213	0.405"	None	-1.63 dB	68.8%
LMR-240UF	0.240"	UG/176	-1.859 dB	65.2%
LMR-400UF	0.405"	None	-0.93 dB	80.7%

Antennas

- VHF antennas come in three common flavors: 3dB, 6dB, and 9dB. These numbers refer to the vertical shape of the distribution of radiated power. 3 db has a broad, almost spherical radiation pattern, while 9 db has a pattern with most of the energy nearly in the horizontal plane. **Sailboats heel, so the 3db antenna is appropriate.** Powerboats and catamarans can use 6 or 9 dB antennas.
- For the VHF radio, the appropriate antenna is a 3dB base loaded whip antenna, such as the Shakespeare 5215 or Metz Manta-6 mounted at the masthead.



Antenna Radiation Pattern



Shakespeare 5215

AIS

- **AIS is a vessel tracking system** in which large ships, fishing vessels, tugs, etc, automatically broadcast many details about their identities, positions, course and speed and so on on one or both of two dedicated VHF frequencies. Any boat with a VHF radio designed for AIS reception can pick up these signals and display them on a suitable chartplotter, computer, or dedicated display. Alarms can be set when there is a potential for a collision.
- **Commercial vessels use a Class A AIS transponder**, which broadcasts more information, at a 25 watt power level. Any **recreational vessel may use a Class B transponder**, which broadcasts less information at a low power level of 2 watts. **The transponder is programmed with the vessels MMSI number**, and generally cannot be reprogrammed easily.
- A transponder system usually also receives AIS broadcasts from other vessels and outputs it as an **NMEA 0183 data stream at 34800 Baud**.
- If using a masthead antenna and an AIS capable VHF radio such as the Standard Horizon GX2200, ships can be tracked at considerable distances. Having the ship's name, MMSI number, speed, course, position, and Closest Point of Approach makes it easy to call them on the same VHF and negotiate a safe transit for both vessels.
- Confusion sometimes arises when a boat with an AIS capable VHF radio desires to add a Class B transponder.

Adding an AIS Class B Transponder

- Most Class B transponders require the use of a **dedicated GPS antenna**, separate from any other system. It also requires a VHF antenna which is designed for the AIS frequencies, which lie at the edge of the VHF band such as the Shakespeare 5215-AIS.
- The installation of the GPS unit is pretty simple. It needs a clear view of the sky and should not be blasted by the radar.
- The AIS antenna installation is a little more tricky. It **MUST** be installed using the same considerations of coax, connectors, loss, and so on as the masthead communication antenna. Confusion arises when people start asking if they can use the same masthead antenna as the VHF radio. The simple answer is **NO! A Class B transponder needs a separate antenna**, as it is constantly transmitting your boat's position, COG, SOG, etc, and cannot share the communication VHF's antenna. Some manufacturers apparently provide an integrated Class B transponder and VHF designed to use a single antenna, but personally I do not view this as a necessarily good thing. Having separate antennas works well and increases redundancy. So where to put the AIS antenna??
- Class B transponders have low power, and because the vessels you most want to have see generally have their antennas high above the water, there is little need to try to put the AIS antenna high on the mast. With a fiberglass extension (4' and 8' are common), a height of say, 10' above the water is easily obtained.
- Using the masthead VHF radio as the detection system for AIS targets, ships may be seen at ranges easily of 15 to 22 miles. With a Class B antenna at only 10' above the waterline, ships can see the sailboat at ranges of 8 to 18 miles. These are approximate, of course, but illustrate one solution to the dilemma of siting two active VHF antennas on a small boat.

AIS Detection Ranges

Range for ship to detect sailboat with 10' Class B Antenna

Height of sailboat AIS antenna (feet)	Height of Ship Antenna (feet)	Range of detection (miles)
10	10	8
10	30	12
10	50	14
10	100	18

Range for sailboat to detect ship with 35' masthead VHF antenna

Height of sailboat AIS antenna (feet)	Height of Ship Antenna (feet)	Range of detection (miles)
35	25	15
35	50	18
35	75	20
35	100	22

SSB

What is SSB?

- SSB refers to a technology for communicating over long distances using **radio transmissions in the 2 to 30 MegaHertz frequency range.**
- The term **“SSB”** comes from **“Single Sideband”**, a modulation technique which allows better utilization of available bandwidth. This is the norm for voice communications in the lower frequency bands.

Why have an SSB on Board?

- First-timers to the TransPac often are very averse to having an SSB onboard. They cite power issues, cost, installation difficulties, and claim that Iridium is “just as good”.
- Race veterans will generally be VERY positive about the benefits and pleasure that having an SSB brings to the racer, especially on the return trip. It is FUN!!
- Iridium phones are wonderful tools for directed, one-on-one communication. They allow quick email access, and 24/7 calls to loved ones ashore or a doctor, etc. They CANNOT do what SSB does.

SSB Myths and Values

- Although an SSB can draw as much as 25 amps when transmitting at high power, **the actual energy used in most log-ins/chats during the race is only a few amp-hours.** They can also be used at lower power levels (150/60/20 watts).
- Used ICOM SSB radios show up all the time on Ebay for reasonable \$\$.
- Installation is pretty routine if a KISS counterpoise is used as a ground. There are alternatives to a backstay/insulator antenna, such as a standalone whip antenna or a wire/spectra hoistable antenna.
- An SSB allows a level of real-time sharing of the adventure of a singlehanded ocean passage that greatly enhances the experience, and promotes friendship and long term relationships with the fellow competitors. It also helps keep you grounded.
- An SSB allows roundtable chats, access to nets, and advice about boat problems which cannot be done with Iridium. It can also be used to receive weather faxes, GRIBS, forecasts, get time checks, and to operate on Winlink or Ham nets (if you get a ham license) or listen to the BBC or other strange whispers over the airwaves at night.

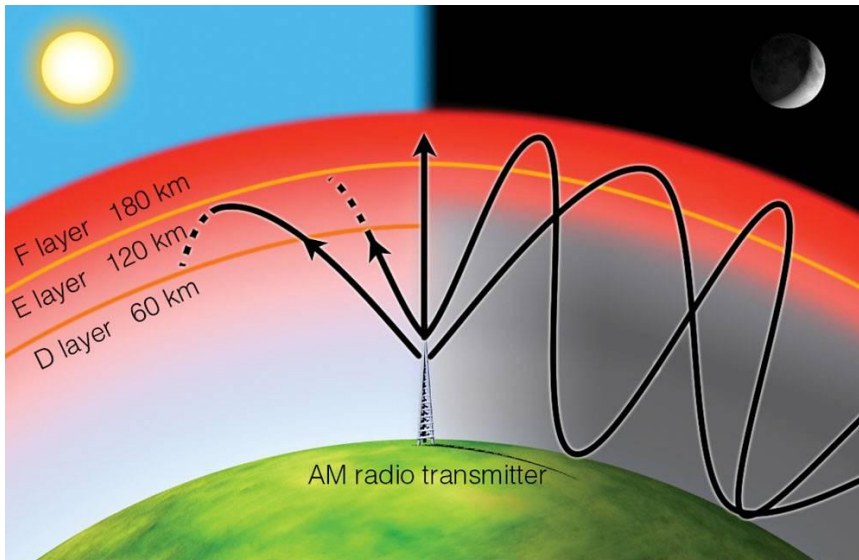
What is the difference between Marine SSB and Ham Radio?

- **Marine SSB and Ham Radio use an essentially identical technology base in the 2-30 MHz spectrum.** The main differences are in the frequency allocations, operating modes, and user interface.
- **Ham radio allows the use of any frequency within a designated set of bands,** and the radios are capable of continuous tuning within those bands. The radios are generally sophisticated and complex to operate, but allow the operator to optimize the connection.
- **Marine SSB is a channelized service, similar in concept to the VHF marine radio.** A marine SSB has very few controls, and is intended to communicate on only a discrete, well documented set of frequencies within the designated bands. Although intended to be simple to operate, the controls are often non-intuitive and annoying to use. Marine SSBs are usually somewhat hardened for use in a marine environment.

The Ionosphere

- High frequency **radio waves** (e.g. VHF) **propagate in straight lines** from the antenna. Due to curvature of the earth, the range is short, typically 20 to 200 miles).
- Radio waves in the HF range (2-30 MHz) can **reflect off a layer of ionized particles in the upper atmosphere** called the **ionosphere**, and bounce back to earth, dramatically increasing the distance traveled around the circumference of the earth. This effect depends on time of day, frequency, and the effects of the solar wind on the ionosphere. This is called “skip” propagation.
- Picking the right frequency band for a time of day and intended communication distance is a learned skill, but there are PC programs which can be helpful.
- An antenna with a high radiation angle (up from the horizon) will not bounce well from the ionosphere, limiting the communication range and signal power at the receiving site.

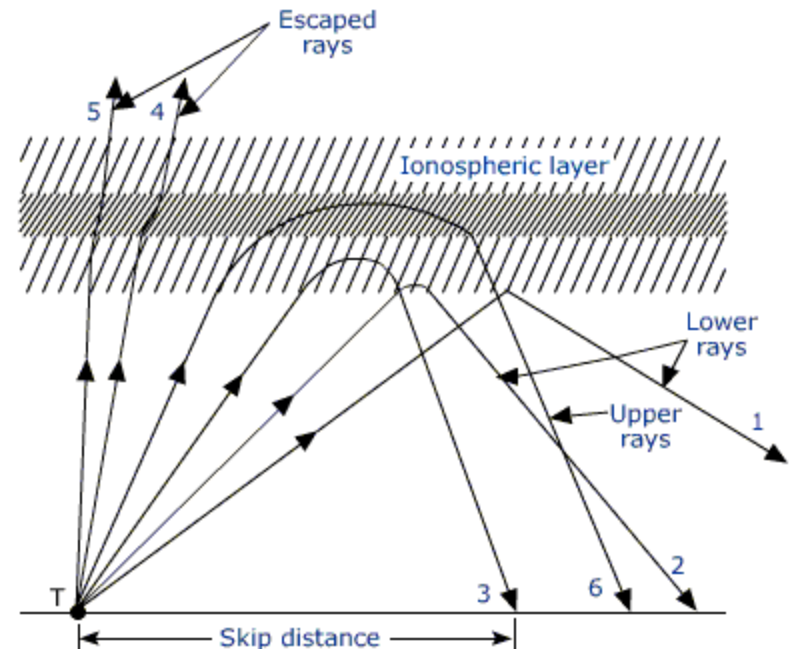
Ionosphere- Skip Propagation



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A high radiation angle from the antenna lets the transmitted radio waves escape into space instead of being refracted back to earth. This is an effect of a poor counterpoise or ground plane.

The bending effect of the ionosphere Depends on the time of day and the Height of the layer (D,E, F) above Earth. Also on the solar wind from sunspots.



Marine SSB Frequencies

- Different frequencies can cover different ranges, at different times of the day. Here are some general characteristics of the Marine SSB Bands:
- 2 MHz 200-400 miles
- 4 MHz 400-600 miles
- 6 MHz 600-1,200 miles
- 8 MHz 800-1,600 miles
- 12 MHz 1,200-2,400 miles
- 16 MHz 1,600-3,200 miles
- 22 MHz 2,200-4,000 miles plus
- 26 MHz unpredictable during our solar cycle minimum
- Generally the bands lower than 8 MHz propagate well at night, and those above 8 MHz propagate well in the daytime. This is a rough rule of thumb.
- The 4,6, and 8 MHz bands will be the ones primarily used in the SSS TransPac. 12 MHz may be useful for Wx FAX. Exact frequencies to be used in the race will be covered at the skipper's meeting.

From Latitude 38's "Idiots Guide to Marine SSB

<http://www.latitude38.com/features/SSB.html#.Ux-JWc7vh1M>

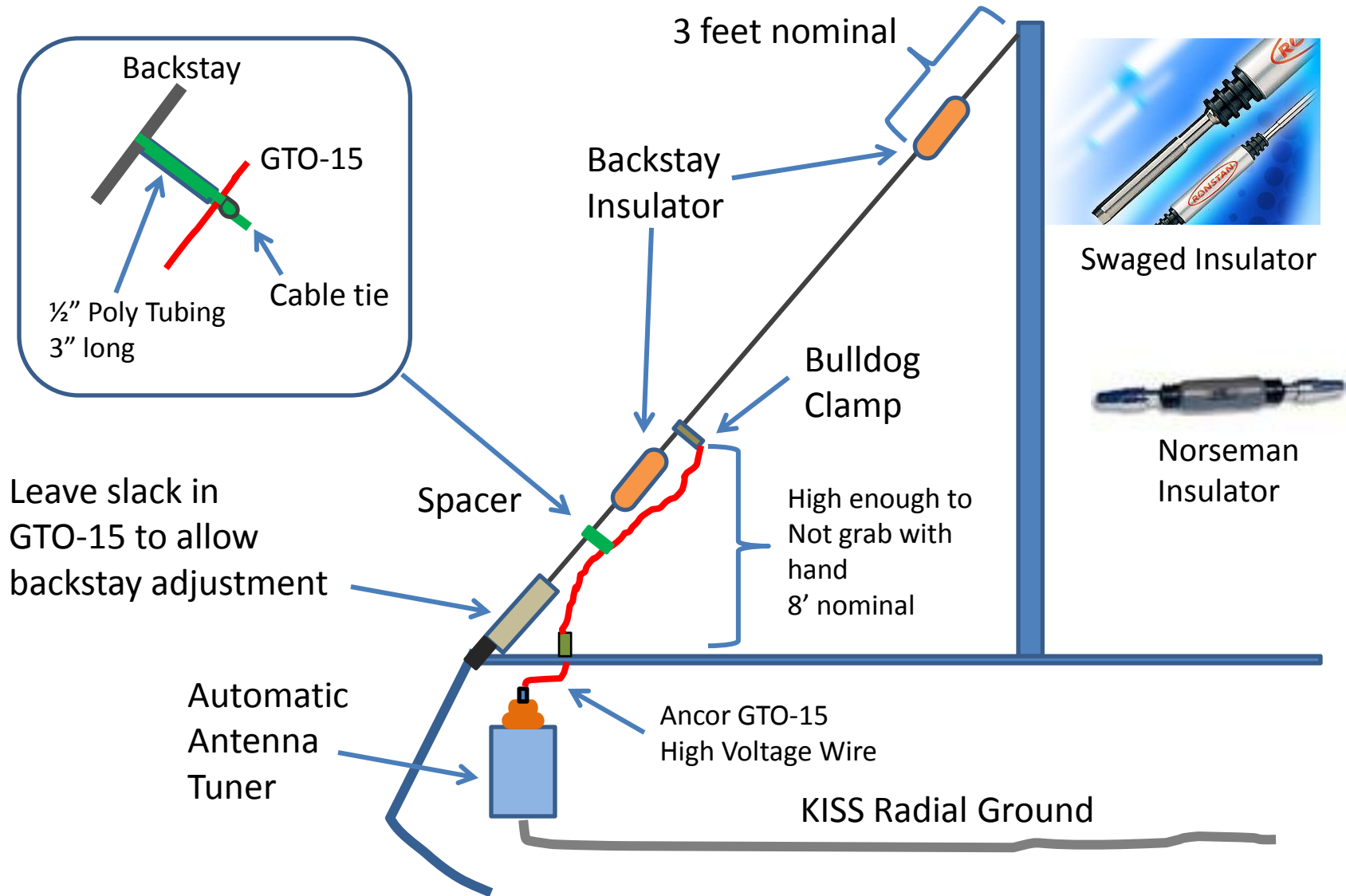
A Marine SSB System

- A good HAM or Marine SSB installation in a boat has the following parts:
 - ❖ An Antenna
 - ❖ An Antenna Tuner
 - ❖ A Ground System or “counterpoise”
 - ❖ A Line Isolator
 - ❖ A Lightning Arrestor
 - ❖ Coax Cable
 - ❖ An SWR Meter
 - ❖ A Transceiver
 - ❖ A Power Supply
 - ❖ Optionally, it may have a Pactor Modem, run by a computer

Antennas

- The **Antenna** converts the electrical signals generated in the Transceiver into travelling electromagnetic waves which then propagate through space to allow communication.
- **Antennas must be resonant** at the frequency of operation in order to generate radio waves of any significant amplitude. This is accomplished with an antenna tuner, unless the antenna is a specially designed narrow band one.
- Antennas on a boat are **VERTICAL DIPOLE** antennas, which necessitates a **COUNTERPOISE** or **GROUNDING SYSTEM** to simulate the missing half of the dipole. The quality of this grounding system determines antenna *efficiency* and *radiation angle*.
- Marine SSB antennas are usually non-resonant whips or insulated backstays, which generally need to be at least 23 feet long to allow the TUNER to make them resonant at all operating frequencies. Some antennas, such as short rail mount verticals, contain inductors and capacitors to make them resonant in a small set of frequency bands. They do not usually need a tuner, but suffer from poor efficiency and non-optimum radiation angle.

Insulated Backstay Antenna System



Antenna Connection

Solder GTO-15 to Ancor #8 Battery Lug with electronic grade solder. Fill the lug entirely with solder.

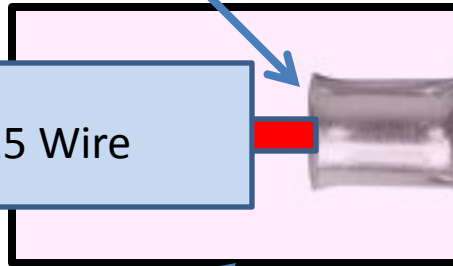
Use Stainless Steel Bulldog Clamp to attach to wire backstay.

Ancor GTO-15 Wire

Use Adhesive Lined Heat Shrink Tubing to seal

Use Lug with hole To match Bulldog Clamp

Use wire seal to bring GTO-15 through the deck.



Alternative Antennas

- There are alternatives to the Backstay with insulators, which is the Gold Standard. The alternatives shown here are workable and if executed well can be quite good.
- One method is a **standalone whip antenna**, driven at the base. The typical minimum length of such a system is 23' to tune over the 2-30 MHz range. Commercial products such as made by Shakespeare. Some simple models can be found for as little as \$160. They must be supported at both the base and with insulated struts perhaps 4 to 6 feet above the base.
- Another option is to use a **GAM Split lead antenna**, which slides over a backstay without insulators. These seem to run around \$450 at Defender. I have never tried one, but the claim is they work.
- A trick which should work well is to insert a piece of **14AWG wire (preferably GTO-15) into the center of a piece of bare spectra** (perhaps ¼" diameter. the spectra would have eyes spliced at each end and the wire would enter through the side and terminate at least 3 feet from the end, with a waterproof heat shrink protecting from water intrusion. The spectra/wire is then secured at the deck, possibly on one side of the transom, and hoisted on the spare Main Halyard. The GTO-15 goes through a gland to the antenna tuner.

Emergency SSB Antennas

- If the rig comes down, there is still hope to communicate via SSB. There are several possible ways to build an antenna.
- If some sort of jury rig can be established, such as a boom or spinnaker pole, a piece of wire running from the tuner over the top of the “mast” and then down to the bow (ending up a few feet above deck- use a nylon pennant to secure) will probably load up and work ok.
- A kite can be used to lift a halyard off the deck. I might use #18 wire for lightness, but use whatever you have. If you make it longer it will tend to be better.
- In years past, Outbacker and Hustler made small (8 feet or less) antennas for Marine and Ham SSB that were inductively loaded with coils in the base and a variety of odd bits at the top. These antennas might be still available (EBay??). They were small and light, but the short height means that their radiation angle was high, thus making them not very efficient. They were designed to be resonant and have 50 ohms impedance, so running a coax direct to them would be possible.
- Carrying some spare wire, terminals, an extra GTO-15 lead from the tuner to the backstay, a reasonable length of RG/58 (30'??) with PL-259 connectors on each end, a deck mount VHF antenna (required) would be a good idea.

Transceivers

- A **Transceiver** is the actual SSB radio.
- Some **HAM transceivers can be modified** to allow use on the Marine SSB frequency channels. **It is technically illegal** to operate like this, but if all you have is a HAM SSB, then it is a usable option. To avoid a nasty encounter with the FCC, **be SURE (!!!) that the radio is tuned to EXACTLY the channel frequency** and that you are using the appropriate sideband (upper or lower). Don't be sloppy.

Transceivers

- There are a variety of Marine SSBs on the market. Although some are probably workable, long experience by thousands of users has shown that **ICOM Marine SSBs are the gold standard**. Of these, there are 4 that Sailmail recommends: the old ICOM 700PRO, ICOM 710, ICOM 710RT, and the newer ICOM 802. These radios are very robust , reliable, powerful, and easy to get repaired (unlikely to be necessary).

ICOM Marine SSB



ICOM 700PRO



ICOM 710 RT



ICOM 710

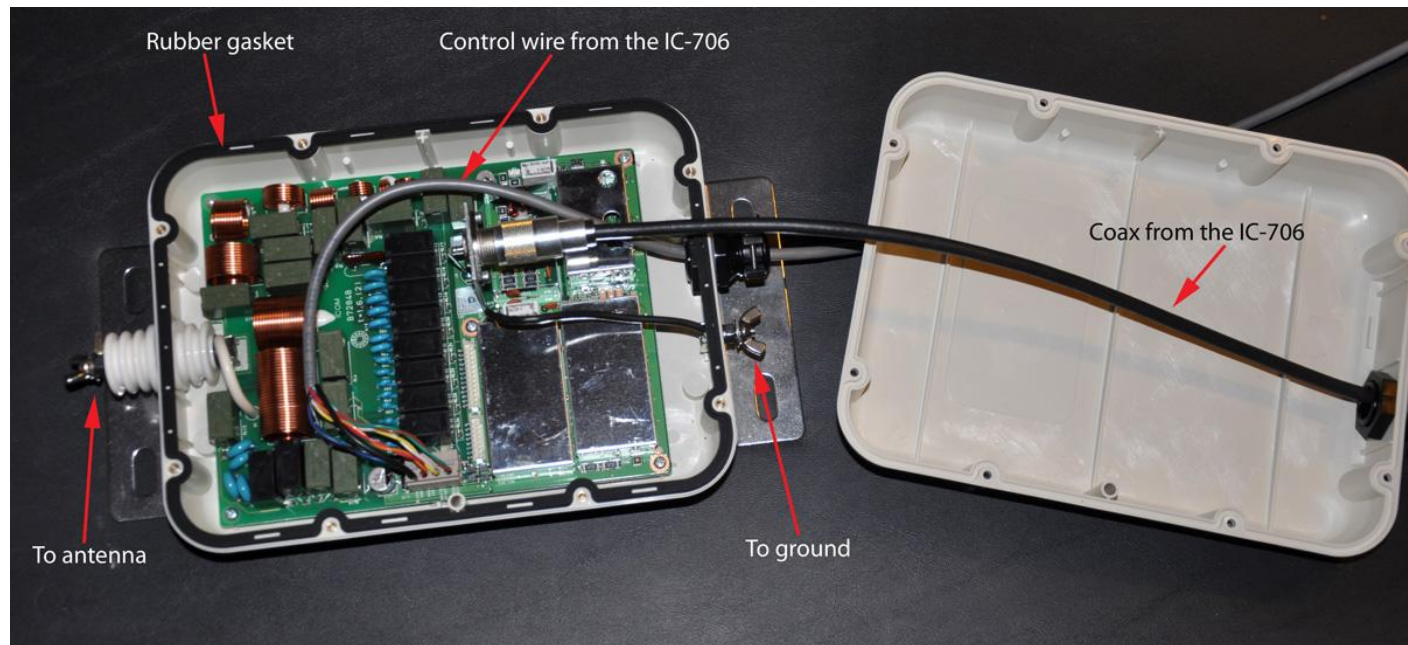


ICOM 802

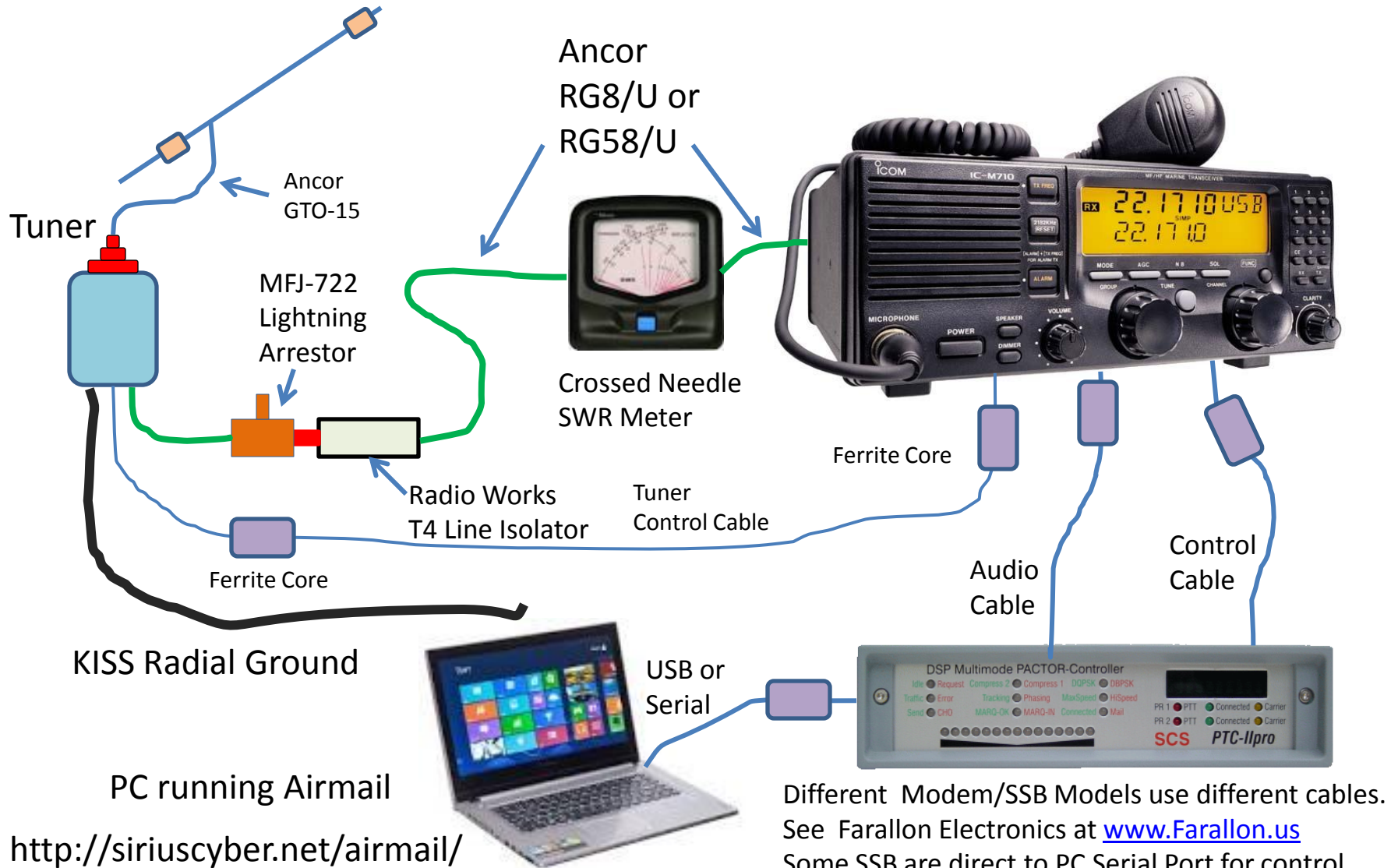
Antenna Tuner

The **Automatic Antenna Tuner** switches coils and capacitors in a network between the coax from the transceiver and the insulated backstay antenna to resonate it and to adjust the electrical impedance to be 50 ohms, maximizing power transfer and antenna efficiency.

It should be sited as close to the transom as practical, with a direct and, if possible, vertical lead to the antenna.



The Complete SSB System



Coax Cable

- Coax Cable is the “pipe” that is used to transfer RF energy from one place to another. Coaxial Cable has an inner wire strand surrounded by polyethylene insulator and an outer braided shield wire, all inside a tough insulating jacket. Due to the AC nature of RF, a balanced signal propagating in the coax does not (nominally) radiate radio waves outside the coax.
- A coax cable has a “characteristic impedance” which for this application will be 50 ohms. This number is an AC parameter, and relates the voltages and currents travelling in the coax at a point in space and time. It cannot be measured with an ohm-meter.
- An RF transmission line system MUST use appropriate connectors (UHF type for this application), properly attached to the cable. Random wires spliced onto a coax are a disaster, and can cause a system to behave poorly or not at all.
- Coax suitable for the Marine SSB includes RG8/U, RG58/U, RG213. I don't like foam core RG/8-X coax personally, but many people find it fine. NEVER use RG-59 (it is 75 ohm impedance). Ancor makes a very good line of coaxial cable for marine use, with tinned wires and a good jacket.



Coax Connectors

- There are a variety of connectors used to properly terminate and interconnect coaxial cables. Names of a few are: UHF, BNC, TNC, N, SMA, mini UHF. The standard for HF radio use is the good old UHF connector. The male connector to be installed on a cable is designated as a PL259 connector.



There are screw-in adaptors to accommodate Different coaxial cables:

Use only the shell and the center for RG8/U and RG213.

Use UG175 adaptor for RG-58 coax.

Use UG176 adaptor for RG-8X foam coax



UG175

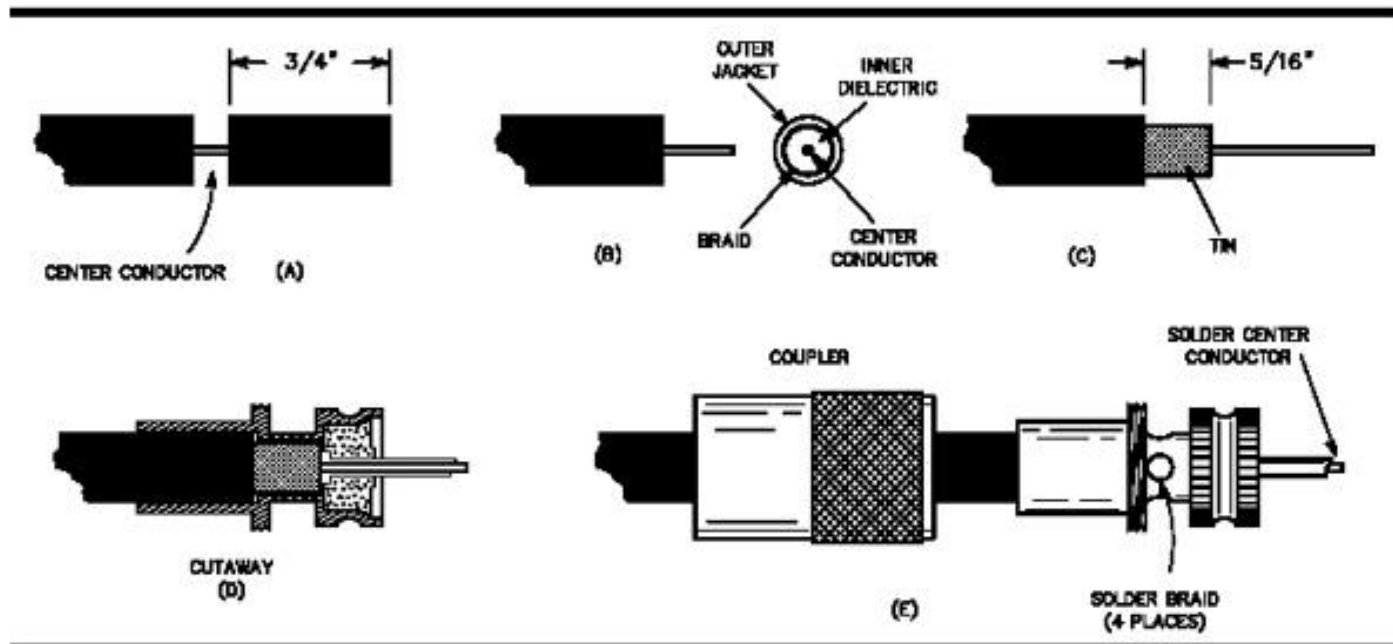


UG176

A good source of PL259 connectors and adaptors is Ham Radio Outlet. Use gold or silver plated connectors with teflon insert such as # PL-259ST-HRO (\$2.69).

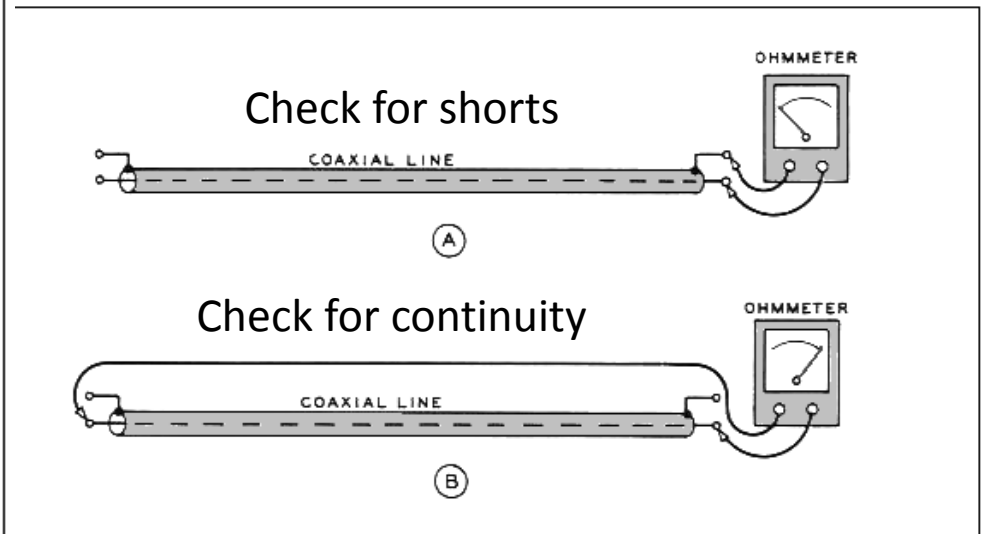
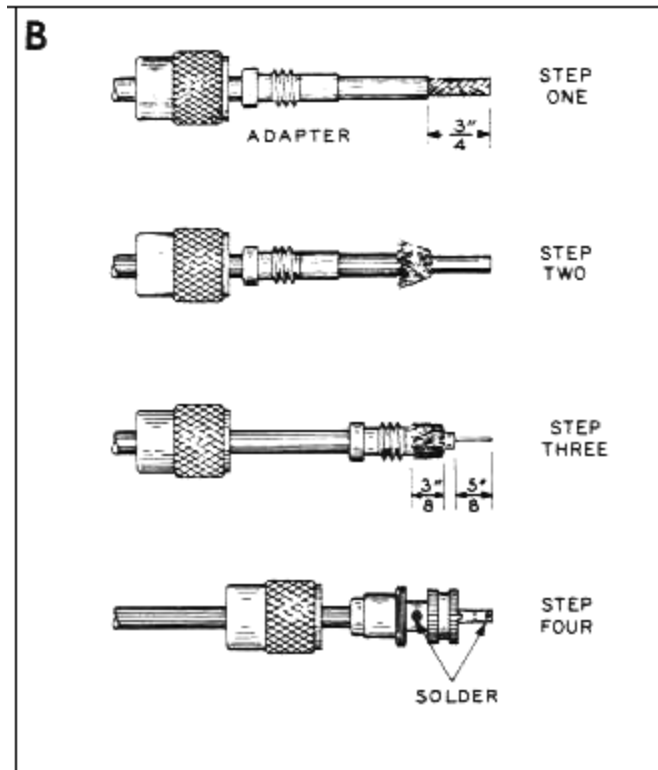
Installing a PL259 Connector on RG-8 or RG-213

Before step D, tin the braid. Before soldering through the holes in step E, coat a small amount of radio solder flux on the braid and the hole walls.. Use a very hot, clean, tinned soldering iron to solder the braid in each of the holes to the shell. Do not move connector after soldering until cool. After the connector is cool, use Adhesive Lined Heat Shrink Tubing to seal the cable to the center part of the connector.



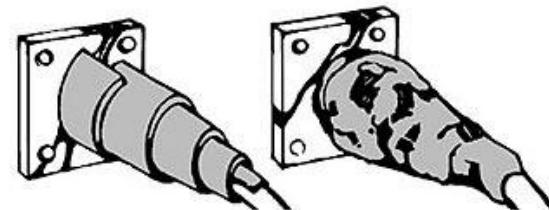
Installing a PL259 Connector on RG-58/U

As before, in step 3 add a small amount of radio solder flux to the braid and the shell. Use a **very hot**, clean, tinned soldering iron to solder the braid to the shell through the holes and also the center pin. Do not move the assembly until cool! Use Adhesive Lined Heat Shrink Tubing to seal the coax to the connector. Check continuity of the assembled cable as shown below with an ohm-meter.



Waterproofing a Coax Connector

- Coax connectors in the wet parts of the boat must be sealed.
- Use “STUF” (Ham Radio Outlet, \$11.95 /tube) to fill connector. Assemble connector to female fitting and wipe off excess STUF. Clean carefully.
- Wrap the connectors with a layer of electrical tape, and then a layer of clay-like Coax-Seal (HRO Universal Coax-Seal, \$3.99). Mold to cover connectors. There should be nothing showing except metal outside the Coax Seal.
- Wrap assembly with self amalgamating rubber tape, overlapping remaining metal surfaces and work with fingers to make a smooth cover.



Waterproofing connectors- another look

Sealing Coaxial Connectors - the **ULTIMATE SEAL**



From www.radioworks.com

KISS Radial Ground System

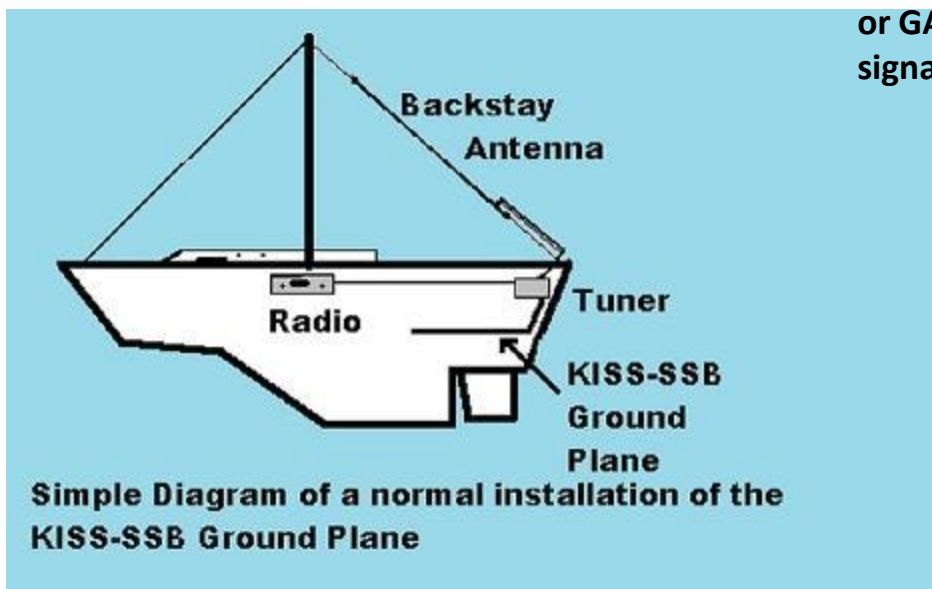
- The part of an SSB system most people struggle with is the “ground” or “counterpoise”. This element primarily determines the ability of the SSB antenna to generate low radiation angle signals and for the tuner to provide a good match to the coax cable from the SSB. A bad ground system causes lots of RF in the boat, making the autopilot and other electronics go nuts.
- Rather than the masses of copper foil and arcane grounding schemes proposed in the past, **the KISS Radial Ground** system has been used to very good effect by racers in previous TransPacs. It is simple, easy to install, and relatively inexpensive. It should be tried first before adding lots of foil, etc, inside the boat. The current price is \$149 from <http://www.kiss-ssb.com/>.

KISS Radial Ground System



It comprises of a four foot lead that attaches to the "ground / counterpoise lug" on your tuner and then you just stretch out the remaining 10 feet of 1" diameter tubing that encloses the array of specific lengths of radiating copper wires. It is just that simple, run it along the hull, behind a cushion, in the cabinets, in the lazarett, etc. If you can not run it straight it is just fine to make sweeping turns, even a sweeping U-Turn is OK. The perfectly measured lengths of copper and marine sealed coils act as an exact mirror image of your radiating backstay, whip, or GAM antenna, this is what bounces your radiated signal wave off your antenna.

From KISS website.



<http://www.kiss-ssb.com/>

Lightning Arrestor

- A **Lightning Arrestor** is a device which prevents high voltage pulses from nearby lightning strikes from blowing up your expensive SSB system. It is cheap insurance!! The MFJ-722 is a reasonable choice. There are many types available. Price is \$35 at Ham Radio Outlet.



Install between tuner and line isolator. Male-Female connectors makes this easy. If a boat ground (keel, engine, thru-hulls, etc) is available, connect the Ground terminal to that with a short piece of # 8 AWG wire.

Line Isolator

- A **Line Isolator** is an important component which prevents reflected power (indicating a mismatched antenna) from re-entering the coaxial cable to the SSB. This reflected power is primarily responsible for most of the troubles with autopilots and so on. The Isolator you need is the T4 model, sold by Radio Works (www.radioworks.com). \$48.



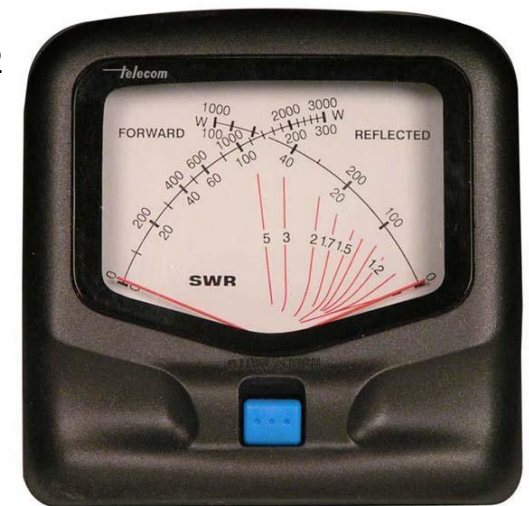
SWR Meter

- An SWR Meter measures Transmitted and Reflected RF Power and also the Standing Wave Ratio, an excellent indicator of antenna and tuner proper operation. An SWR meter is an essential tool for insuring optimum performance and troubleshooting RF feedback and poor performance. The Crossed Needle SWR meter is probably the best for a boat. An SWR less than 2.0 to 1 is usually acceptable.



Palstar PM2000AM
\$180
Has REMOTE Head

MFJ-822
\$60



These are two suitable units I have used. Many more at Ham Radio outlet. Frequency range 1.8-30 MHz, Power to 300 Watts are minimum specs

Ham Radio Outlet (www.hamradio.com)
2210 Livingston Street, Oakland
(next to West Marine). Phone 510-534-5757

Ferrite Chokes

Ferrite Chokes are a hollow cylinder of a high permeability ferrite material which adds significant inductance to a wire or cable wrapped around it. They can be obtained in snap-on form, allowing easy installation on a pre-made cable. They make it energetically unfavorable for undesired RF energy to travel down installed cable or wire. They may be used on any wire or cable which conducts or receives spurious RF energy, such as PC interconnections, SSB control lines, or autopilot wiring.

Use the Proper Ferrites!



MFJ-700B4 (at Ham Radio Outlet)
4 PACK FERRITE CHOKES FOR RG213 SIZE
CABLE \$13.95



<http://www.mouser.com/ProductDetail/Fair-Rite/0431164181/?qs=KmhVpTOE4SbzMQqE%2fOkzw%3d%3d>

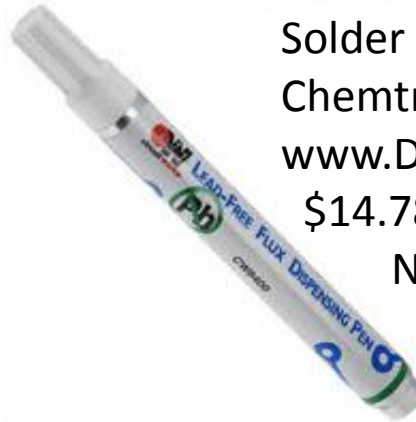
Manufacturer:	Fair-Rite
Manufacturer Part #:	0431164181
Frequency Range:	Lower & Broadband Frequencies 1-300 MHz (31 material)
Description:	31 ROUND CABLE CORE ASSEMBLY

Taken from: SHTP_Communications_Paul_Elliott_2012.pdf

Odds and Ends, Bits and Pieces



UHF F-F
Adaptor



Solder Flux Pen
Chemtronics CW8400 or similar
www.Digikey.com Part# CD8400-ND
\$14.78
NO ACID FLUX!!!!



UHF M-M
Adaptor



Multicore Electronic Solder
60/40 grade
www.Digikey.com #82-105-ND
\$19.25



UHF M-F
Right Angle
Adaptor



BNC Male-
UHF Female
Adaptor

Adaptors at [HAM Radio Outlet](#)

Power Supply for SSB

- **An SSB DEMANDS a clean source of “12 volt” power.** The installation must be capable of supplying 30 amps as directly from the battery as possible, with minimal voltage drop. A voltage at the SSB of less than 12 volts will cause big problems, often commented on by others as “flutter”.
- **Use a heavy gauge wire** for both conductors from the battery. AWG 8 is the lightest that should be used. Be sure to add a circuit breaker (40 amps is ok) at the battery end. There are often fuses in each leg of the wire to the power connector of the SSB supplied by the manufacturer. Leave these in place and carry spares.
- Extreme issues with RF in the boat may be helped by wiring several 0.1 uF ceramic disc capacitors (50 volt working voltage minimum) across the power connections as close to the radio as possible, and between the radio and any ferrite cores.
- Putting several **snap-on ferrite beads** on each power lead close to the SSB itself is a good idea to help prevent any issues with RF in the boat.
- An electrically noisy alternator can make it impossible to hear weak stations or run email traffic. It is wise to charge batteries just before running the SSB at check-in or when using email, and operate with the engine off. Keep an eye on the voltage.
- **Run the SSB at reduced power level when feasible.** ICOM 710 has three power levels. I find the 60 watt level (number 2- the middle one) works for most occasions. If you are having a hard time getting through, you can bump it up; it will just use more power.

SCS Pactor Modem

- A Pactor Modem is a device which takes a digital data stream generated by the Sailmail or Airmail program and converts it into a set of rapid phase, frequency, and amplitude shifted signals which can be transmitted by the SSB.
- The modem also controls transmission by using a handshaking error detection and correction protocol with the shore station to insure error free operation.
- Pactor modems are highly sophisticated, amazing devices. They are made by SCS, represented in the USA by Farallon Electronics, a local firm.
<http://www.farallon.us>)
- Farallon Electronics will sell appropriate cable sets to interconnect almost any SSB with the modem and the computer. If you have an older modem, ask them about upgrading to at least Pactor III. It makes a big difference! This is a firmware upgrade done via the Airmail program with a purchased upgrade key.



PTC-IIIusb Pactor 3 Modem
\$1,148.00

Sailmail/Airmail program

- Airmail and Sailmail are free programs which run under Windows. They are essentially identical, with modifications to allow use with the Winlink HAM email system or Sailmail, respectively. They are designed to both operate under the same icon, with a user choice of the HAM or SAILMAIL system.
- They operate like an email client (Outlook, Thunderbird, etc), with a mailbox, text editor, and so on, but they also interface with the Pactor Modem (SCS), and also Iridium and the web directly. They control the frequency of the SSB radio from drop down menus. This is essential for easy operation, and having an SSB that allows this control is really a must. Those SSBs described above do so.
- You download and install the programs from the Sailmail website (www.sailmail.com) and the Airmail website (<http://siriuscyber.net/airmail/>). Detailed instructions are given in the Sailmail Primer on that website. The programs must be configured for the type of controller, SSB, and the serial ports used to access them. There are baud rates, and a bunch of other fiddly parameters to set, but the Sailmail Primer does a good job of walking you through this.

Sailmail/Airmail user screens

Terminal

File Edit View Control Mode Help

W70DN 7103.5(p3)

```

2015/09/01 02:14:33 No answer from W6IM
2015/09/01 02:15:13 Calling w70DN on 7103.5(p3) kHz
< id > de ki6fso
2015/09/01 02:15:22 Call canceled
2015/09/01 02:15:26 Calling w70DN on 7103.5(p3) kHz
< id > de ki6fso
2015/09/01 02:15:44 No answer from w70DN
2015/09/01 02:15:53 PTC-IIusb modem released
2016/03/08 20:18:45 PTC-IIusb modem initialized OK
< Modem serial#: 010000AE2BACE67 >
< Professional (Pactor-3) firmware ver: 4.0, P-3 license OK >
    
```

Tx Data: 0/0 bytes Rx Data:

Propagation

From our location: Lat: 37°47'N Lon: 122°16'W Grid: CM87us

To station location: Lat: 44°56'N Lon: 123°03'W Grid: CN84lw

Parameters: Freq(khz): 03593.0,03593.0#,07069.5,07103.5,07103.5#

Sunspots: 114 SFI: 158 Date: 2016/03/08

W70DN, Salem, OR: Distance= 430 NM at 356°T

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
3593.0	56	86	95	99	100	100	100	100	100	100	100	99	99	99	100	86	39							1
7069.5	96	97	98	99	100	100	92	88	85	85	84	77	64	75	94	100	99	97	94	49	18	17	47	92
7103.5	96	97	98	99	100	100	92	88	85	85	84	77	64	75	94	100	99	97	94	49	18	17	47	92

- W70DN
- KB6BT
- KA7HRC
- W7B0
- K7DAV
- W7J
- K7EK
- N7YRT
- VE7SCC
- VE7AXY
- VE6GPS
- KK5AN
- K5AEA

AirMail

File Edit View Message Tools Modules Window Help

Message Index

Message ID	From	To	Via	Subject	Size
1617_KI6FSO	Dave Wyman	HAM.HF....	Re: Welcome Back!	406	
1616_KI6FSO	QTH	HAM.HF....	POSITION REPORT	351	
1615_KI6FSO	pacseanet@g...	HAM.HF....	SV Frolic KI6FSO - safe arri...	520	
1614_KI6FSO	susan	HAM.HF....	Re: re marina village	492	
1598_KI6FSO	steve m	HAM.HF....	landfall late today	413	
1597_KI6FSO	steve	HAM.HF....	Fw: inReach message from...	1324	
1596_KI6FSO	joan fish	HAM.HF....	Re: Fw: inReach message f...	1654	
1595_KI6FSO	Simin	HAM.HF....	Re: //WL2K R/ Re: no email?	881	
1594_KI6FSO	susan	HAM.HF....	Re: re marina village	989	
1593_KI6FSO	joan fish	HAM.HF....	Re: Fw: inReach message f...	742	
1592_KI6FSO	query@saildo...	HAM.HF....	Saildocs Request	284	
1591_KI6FSO	QTH	HAM.HF....	POSITION REPORT	371	

1616_KI6FSO.msg

From: KI6FSO Post Via: HAM.HF.K6IXA

To: QTH

Cc:

Subject: POSITION REPORT

TIME: 2014/09/04 01:11

LATITUDE: 37-47.12N

LONGITUDE: 122-16.07W

COMMENT: made it to Alameda 0100 PDT, 3 Sep. What a trip!

Windows taskbar showing system tray with 96% battery, 12:23 PM 3/8/2016, and 246 Messages, 1 Selected.

Sailmail/Airmail Saildocs GRIB file Wizard

AirMail - [Cat Tree]

File View Message Tools Modules Window Help

Catalogs

- Saildocs
 - Grib Files
 - Atlantic
 - Buoy data
 - Caribbean
 - Coastal
 - Fax schedules
 - Fleet Code
 - Great Lakes
 - Gulf of Mexico
 - High Seas
 - Indian Ocean
 - Marine Interp Msg
 - Med
 - Metarea
 - Misc
 - Offshore
 - Pacific
 - Satellites
 - Tropical
 - WL2K

GFS Grib Parameters

Grib Boundary: North Lat: 40N, South Lat: 36N, West Lon: 132W, East Lon: 122W

Forecast Times: every 6 hrs for 3 days

Parameters:

- PRMSL
- WIND
- HGT500
- SFCTMP
- TMP500
- WAVES
- RAIN

Data grid: delta-Lat: 0.5, delta-Lon: 0.5

Maxsea (-dLat)

Moving Forecast: Speed: 0.0, Course: 30

Approx size: 7KB

Model: GFS Request GFS: 40°00'N-35°30'N, 132°00'W-122°00'W (0.5x0.5 deg) Approx size: 7KB

Request from Saildocs

- Request (to be sent once)
- Subscribe for 14 days, to be sent every 24 hours at 00:00 UTC

02:26:31 utc

96% 6:26 PM 3/8/2016

Saildocs

- Saildocs is an email-based document-retrieval system for the delivery of text-based Internet documents either on request or by subscription. Saildocs can deliver web pages (including text weather forecasts, and provides subscriptions for automatic delivery. Additionally Saildocs provides custom grib weather-data files per request from data downloaded from NOAA/NCEP and other sources.
- This is a free service, and of GREAT use to sailors, as the GRIB and other requested weather info is public domain, and can be accessed on SSB or HAM radios with a Pactor Modem, or via the email client of an Iridium phone system. It is also allowed to use this information during the race. The Airmail program has a built in GRIB viewer, and most chartplotters and navigation programs (OpenCPN) can also display the weather info in a useful manner.
- Get information at <http://www.saildocs.com/>

Sources

- Ham Radio Outlet (www.hamradio.com), 2210 Livingston Street, Oakland Phone 510-534-5757
- Digikey (everything electronics related) www.digikey.com
- Newark Electronics (all electronics) www.newark.com
- Radio Works (Line Isolators, connectors, coax seal, etc) www.radioworks.com
- Frys Electronics (for the stuff you can't live without)
- Ancor (excellent wire and cable for the marine world, Svendsen's has it) www.ancorproducts.com/en
- Blue Pelican Marine (a consignment store at Grand Marina- fabulous place for gear)
<http://www.bluepelicanmarine.com/>
- Farallon Electronics (everything PACTOR, local) <http://www.farallon.us/>
- Sailmail (www.sailmail.com)
- Airmail (<http://siriuscyber.net/airmail/>)
- Saildocs <http://www.saildocs.com/>
- McMaster Carr (simply the BEST source for hardware, good tools, metals, anything really)
www.mcmaster.com
- KISS Radial Ground System (<http://www.kiss-ssb.com>)
- FCC Marine SSB Licensing: http://wireless.fcc.gov/services/index.htm?job=licensing&id=ship_stations
- USCG Marine SSB Channels listing <http://www.navcen.uscg.gov/doc/rtchan.txt>
- **EBAY!!!**

Technical papers and resources

- SCS Pactor Modem cable reference:
<http://www.farallon.us/webstore/PTC%20modem%20cable%20ref.pdf>
- Farallon Electronics Radio Installation Guide <http://www.farallon.us/webstore/Pcup%20SSB.pdf>
- Latitude 38 idiots Guide to SSB <http://www.latitude38.com/features/SSB.html#.Ux-JWc7vh1M>
- Brian Boschma on SSB <http://sfbaysss.org/resource/doc/Brian-Boschma-SSB-Seminar-2010.pdf>
- SHTP Communications by Paul Elliot
http://sfbaysss.org/resource/doc/SHTP_Communications_Paul_Elliott_2012.pdf
- Gordon West on SSB Grounding (pre KISS system)
http://sfbaysss.org/resource/doc/SeawaterGroundingFor_HF_Radios_byGordonWest.pdf
- ICOM America Download Database; a ton of manuals and information
<http://icomamerica.com/en/downloads/Default.aspx>
- Eric Steinberg SSB SHTP Presentation http://sfbaysss.org/resource/doc/Eric_Steinberg_SSB.pdf
- Sailmail Primer in PDF form. This is the bible of SSB email and WxFAX. Lots of specific advice.
<http://www.sailmail.com/sailmail%20website.pdf>
- Sailmail Website- a treasure trove of useful information and how-to-do it.
<http://www.sailmail.com/>
- Winlink 2000 HAM email system (a free alternative to Sailmail for HAMs): <http://www.winlink.org/>
- Jim Corenman's Airmail web page: <http://siriuscyber.net/airmail/>

Final Thoughts

- **A marine SSB adds a HUGE amount to any ocean passage.** It allows you to have the warmth of human contact and to share your adventures in real time. It offers the potential for help in emergencies from other sailors, and advice for technical problems and the lovelorn. You can get weather information and send and receive email.
- **The laws of physics, not good intentions, control the outcome of any SSB installation.** An installation is not rocket science, but it takes good components, time, care, and allows for **no shortcuts**. The skills needed, although not familiar to many, are not extreme and can be learned.
- **Put an SWR meter in the system.** Then you KNOW what is going on (or what ISN'T going on...).
- **READ THE DAMN MANUALS AND PRACTICE BEFORE DEPARTURE!!!** You will get better as the voyage progresses, but trying to fix the system or figure it out when seasick on day 2 is dumb. Use it before you depart!!!!
- **Ask questions** from others who know more. They will be glad to help.
- Prepare frequencies of WX fax, broadcasts, schedules, etc.

Iridium Satellite Communications

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Chief Technical Officer
OCENS

Jeff@ocens.com

206.878.8270

Notes added by **Michael Jefferson**

Iridium Phones



9555



9575



9505/9505a

Current Iridium phones.

Discontinued 9505/9505a are still around and work fine but accessories are running out of stock.

9575 Rugged and includes SOS as well as GPS for position tracking solutions

Both 9555 / 9575 have direct USB data connections

9505/a adapters



Antenna Adapter



Data Adapter



USB / Serial Adapter



Sidekick Wi-Fi adapter



9500 / 9505 / 9505a require additional adapters for data connections.

The Sidekick is highly recommended with this for easy and reliable data connections

9575 Extreme



AC, DC chargers, External Antenna, Data Connector Adaptor
Newest Iridium Phone, environmentally hardened

External Antenna Options



An external antenna is highly recommended
For a larger sailboat installation.

Data

- Connecting to computer via USB

- (What is required)

- Driver installation
- Modem setup
- Com ports
- Lack of firewall

- Connecting via OCENS Sidekick



Connecting most satellite phones requires non trivial software configuration.

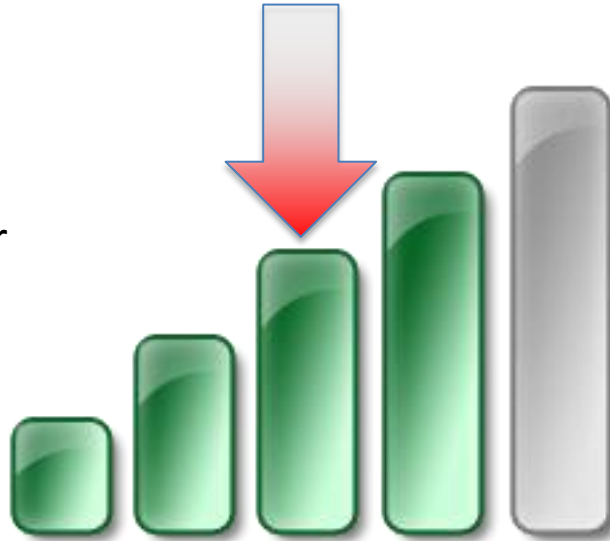
Using an OCENS Sidekick device greatly simplifies this by creating a Wi-Fi hotspot. It also firewalls all background data that would otherwise slow the connection.

Data

Requires GOOD signal strength –more than voice*.

Must have 3 bars or better.

*Voice will work as low as 1 bar



Radar can interfere with Iridium. Suggest putting radar in Standby when communicating via Iridium Phone, especially DATA mode. Site Iridium external antenna well out of plane of radar emissions.

Typical Rental Package from OCENS



Iridium 9555

AC Charger

Optional Accessories

DC Charger

Antenna Adapter

Marine Antenna

Antenna Cable

USB Data Cable

Airtime 120 minutes = \$162

*Sidekick rentals available

Monthly Rental packages **start**
at \$179. Airtime extra.

www.ocens.com/rentals

Reserve as soon as possible, by April 30 to avoid price increase.
Availability is limited.

Services From OCENS

- WeatherNet
 - GRIB Explorer
 - MetMapper
- GRIB Explorer for iPad
- SpotCast
- OCENSMail
- OneMail
- OneMessage

Final Thoughts on Iridium

- Iridium with an external antenna is a great way to do email, get grips, call home, and generally get in touch with people on shore.
- Email is generally very fast and takes at worst a few minutes, and can work 24 hours a day at any time. You probably will need an email provider such as OCENS.
- Satellites are in polar orbit, so come and go over the horizon in less than about 20 minutes. This can lead to occasional drops in calls or email for a few minutes.
- Radar will interfere with Iridium reception, so I turn it to Standby when using it.
- **Iridium is NOT interchangeable with SSB**, and cannot do what SSB does. Nor can SSB do what Iridium does as easily as Iridium does it. I have both, use both a lot, and would not wish to go to sea without either.
- **Buying Airtime is a real PITA!!!** The source providers (not OCENS) play some real games with the pricing structures which are hard to avoid and painful to accept. If you use the service constantly, this is less of a problem. If you use it only on longer trips several times a year, you are going to feel badly used, as minutes expire, and the pricing/minute duration schedules are very badly set up for intermittent use. For example, if you want a small number of minutes to last a year or two, you cannot get them. The lifetime of the minutes generally increases with the number of minutes purchased. If you do not need many minutes, you probably will have to buy them at inflated cost just before you need them. It is very annoying!