

HF/VHF/UHF from a Sport Boat

Planning and ingenuity result in a dream marine mobile setup.

John Turner, KG6ODI

Our family loves the ocean, so when we purchased our new Sea Ray (which we keep in a slip in San Diego Bay), I was eager to design and install HF, VHF, and UHF

ham radio capabilities to give us a fully equipped marine mobile station to enjoy when we spend weekends and vacations on the boat.

Installing ham equipment on a fiberglass boat presents many challenges, including working in a harsh, wet environment, grounding issues, RF noise, RF interference affecting other electronics on the boat, antenna mounting issues, and generally making everything fit nicely within limited space. My goal was to add complete HF, VHF, and UHF ham radio capabilities without affecting the aesthetics of the boat.

What's On Board

The Sea Ray installation uses an Icom IC-7100 radio, which provides HF, VHF, and UHF capabilities, with a separate transceiver and control head that can be used anywhere on the boat, supported by an Icom AH-4 remote HF tuner. At the helm, there's a Yaesu FTM-400 VHF and UHF radio mounted in a waterproof "glove box." In addition to working on HF, 2 meters, and 70 centimeters, the FTM-400 and IC-7100 also receive marine HF, VHF, FRS, GMRS, etc. A Uniden SDS100 handheld digital trunking scanner monitors harbor police, lifeguards, aircraft, and other services. An Icom IC-M400BB VHF marine radio with a remote-controlled microphone provides traditional marine VHF ship-to-shore capability.

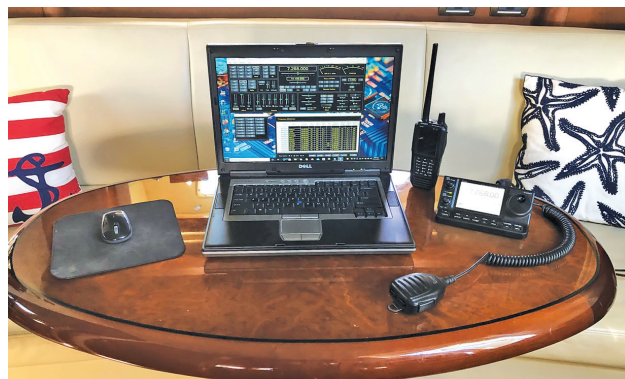


John Turner's, KG6ODI, journey with his boat includes designing and installing a radio setup to meet many needs.

Antenna Considerations

Because the Sea Ray is a sport boat, a typical 23-foot marine HF vertical antenna was not an option. I decided against a screwdriver antenna, because the salty marine environment would likely, in time, degrade the antenna's electrical and mechanical parts. Plus, screwdriver antennas are a bit bulky and may be too obtrusive with the aesthetics of the boat.

After a lot of consideration and research, I opted to go with MFJ hamstick-style antennas that could easily be screwed on and changed with a custom mount/mast fabricated to fit on a standard marine stainless-steel antenna ratchet mount on the side arch of the boat.



The Icom IC-7100 can be used anywhere on the boat.

Although the hamstick antennas are, for the most part, resonant for the selected band, I did have that Icom AH-4 remote tuner. The MFJ hamsticks can be used over the entire band — or in many cases, on another band (with the tuner) — without further mechanical or standing wave ratio (SWR) adjustment.

For the VHF and UHF ham bands, I selected the Comet CA-2X4SR VHF and UHF wideband antenna, which offers an SWR of less than 1.5:1 for all the ham frequencies, as well as 2:1 or less at 140 – 160/435 – 465 MHz with a gain of 3.8/6.2 dBi.

The HF antenna is mounted on the topside of the boat roof/arch with a standard marine ratchet mount. The antenna is connected to the Icom AH-4 tuner. The tuner, located in the side panel of the boat, is connected to the Icom IC-7100 transceiver's separate base unit inside the cabin of the boat.

With my son's help, we modified a Shakespeare Marine antenna extension and fabricated a custom mast/mount that would screw on to a standard stainless-steel marine ratchet mount that the MFJ hamsticks screw on to, supporting various MFJ hamstick antennas for 80, 40, 20, 15, and 6 meters.

Because the remote tuner could not be mounted at the base of the HF antenna as it is normally configured (the sidewall arch on the boat was not big enough inside to hold the tuner), the AH-4 had to be mounted about 36 inches away from the antenna base. Because there is a bit of a misconfiguration between the Icom tuner (it's normally configured to work with an end-fed wire or a direct connection to the antenna, and the hamstick is normally used with a base-mount 50 Ω coax connection), we used shielded RG-8/U coax with a specified minimum breakdown voltage of 2800 V dc to connect the custom hamstick mount to the tuner. In the design stage, there was some concern about connecting the antenna in this manner, but after some trial and error, it ended up working very well.

SWR and tuning, via the Icom tuner, worked great and clamp-on chokes did a good job of controlling stray RF. For HF grounding, braided copper wire connects to the boat's lightning/electrical ground system (which grounds out to the motors, railing, etc.). I have always found that using a generous number of clamp-on chokes on antennas, power, audio, and other connecting wiring works great in mitigating stray RF, especially in unique installs like this one.

For VHF/UHF on the Yaesu FTM-400 and Icom IC-7100 we used two Comet CA-2X4SR antennas. The antennas were mounted on the roof, accessed by temporarily removing the ceiling lights inside. Custom

mounts had to be fabricated to mount the antennas vertically on the slanted roof. With the fiberglass roof of the boat not providing any ground plane for the VHF and UHF antennas, 125 feet of insulated #14 copper wire radials were run in all the open areas inside the roof and support pillars to provide a ground plane/counterpoise for the antennas, as well as to connect to the boat's common RF ground. It worked very well, with no noticeable problems with SWR or stray RF, and provided great access to all the local San Diego and southern California repeaters we normally access.

Cabling, Power, Accessories, and Connectivity

The coaxial cables, counterpoise wires, and copper braided ground wire (for the HF radio and Icom AH-4 tuner) all terminate inside the helm-side service panel. Because the Icom and Yaesu ham radios are not specifically built for a ruggedized, wet marine environment, the transceiver units were installed in a dry cabinet located in the back salon of the boat.



The radio cabinet is home to handhelds, accessories, and other necessities.



The Yaesu FTM-400 VHF and UHF radio mounted in a waterproof "glove box."



The hamstick-style antennas for VHF and UHF, custom mounted on the roof of the boat.

Coaxial cables, separation connecting cables for the radio to base, the tuner control cable, the copper braided ground wire, and other wires pass through gray plastic tubing to the radios in the cabinet.

Also in the radio cabinet is an auxiliary 30 A 12 V dc power supply, a 2 F filter capacitor, a USB hub, and other handheld radios and accessories.

The Icom IC-7100 control head connects to the base transceiver via RJ45 connectors/Cat6 cable and can be used anywhere in the boat cabin or cockpit. The IC-7100 with a remote control head was a great choice for HF, VHF, and UHF, as the unit can be used at the helm or in the cockpit of the boat on nice days, and in inclement weather it stays in the dry cabin. It's also nice that with the extended RJ45/Cat6 cable the radio can be used at the cabin dining table in the boat or in the front berth for late-night contacts.

After using the Yaesu FTM-400 at the helm for a few weeks, we learned the radio does not have enough audio output (the Yaesu specs say 8 W audio) when used with our West Marine external 6-inch speakers. We added a two-channel Pyle 90 W audio amplifier so we could crank up the volume and hear the FTM-400 when the boat was under way with a lot of engine and wind noise. We also interfaced the Pyle amplifier to the Uniden SDS100 scanner, providing plenty of loud audio output in the noisy marine environment.

Cabin electronics include a Verizon MiFi 5G hotspot and wireless router that offers very fast broadband for streaming video from the various streaming services, as well as high-speed internet and web connectivity for our personal devices. The hotspot also allows, for example,

the boat's navigation displays to mirror our laptop and iPhone screens, and allow the Icom IC-7100 remote control, weather, internet weather radar, marine tracking, and other applications to be displayed at the helm or any of the four TVs on the boat.

It's also cool that, using the 5G wireless high-speed connectivity and *Parallels* remote access software, I have access to my work and home computers, as well as my home location's radio control computer that's connected to my ham radios and scanners at home, with the ability to listen to and operate them remotely from the boat.

The boat install required some creativity in building custom antenna mounts, creating counterpoises, grounding, wiring, and making sure the system would not affect other electronics on the boat. With a lot of up-front planning and hard work on the installation, we were very happy with the results. After all, having the Pacific Ocean as a ground plane is a pretty good environment for getting the most from 100 W on HF.



 The Pang Jin transmitter survived a shipwreck on the way to the 1939 New York World's Fair, and it's still functional with the crystal that let sailors call for help. Access the digital edition of *QST* (www.arri.org/qst) to hear Stan Wood, WA4NFY, share this fascinating tale, along with more details about the transmitter.

All photos by the author.

John Turner, KG6ODI, graduated from the Communications Electronics program at GASC Technology Center in Flint, Michigan, in 1972. His career started in the manufacturing and computer industry. John and his wife, Patty, moved to San Diego, California, in 1981, founding a company that developed and sold telecommunications products. He sold his company in 2003 to make time for family and hobbies, including ham radio, desert off-roading, and boating. Now that his kids are grown up, John returned to manufacturing as a Sales Program Manager in the electronic manufacturing services industry. He can be reached at john@turnersandiego.com.

For updates to this article, see the *QST* Feedback page at www.arri.org/feedback.

