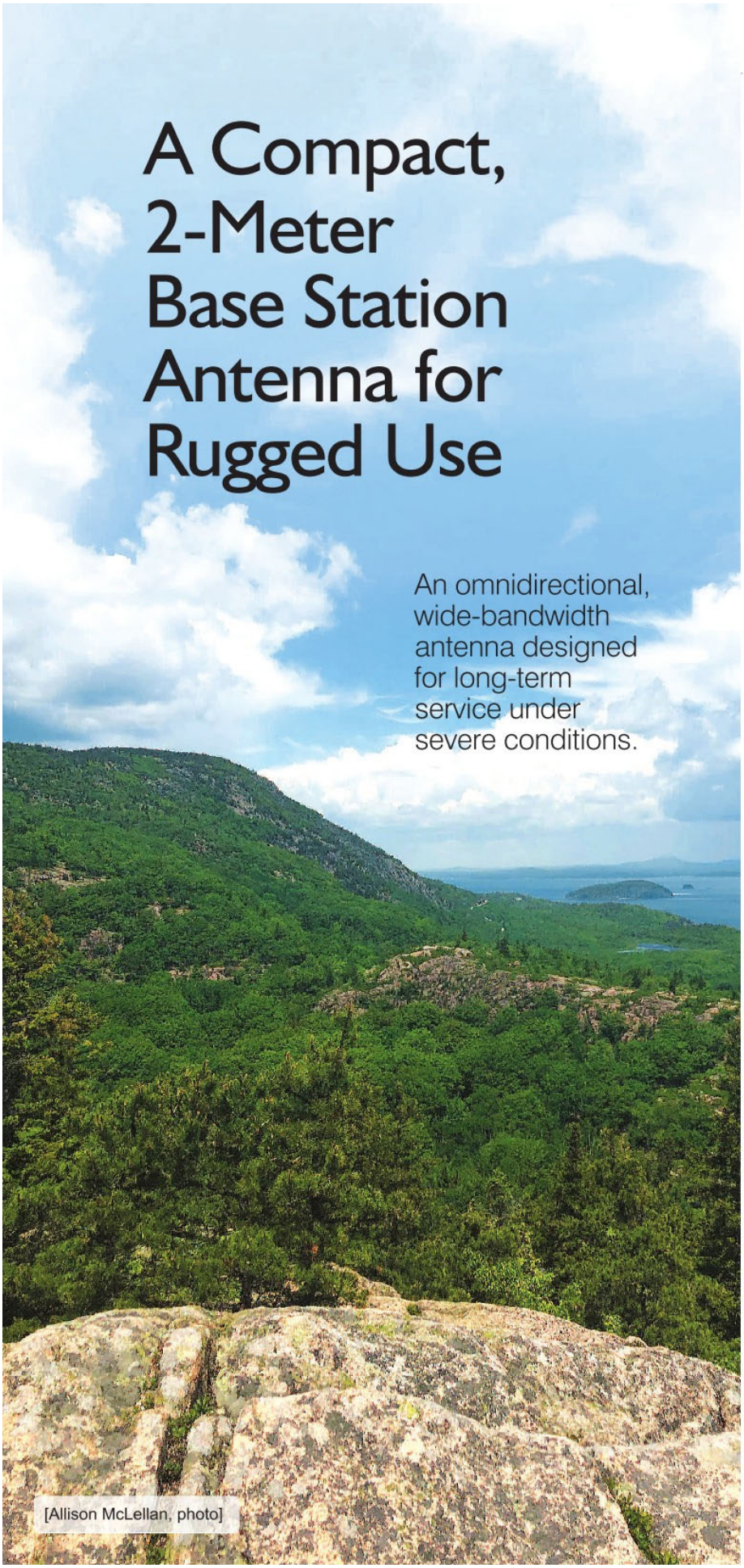
A Compact, 2-Meter Base Station Antenna for Rugged Use

An omnidirectional, wide-bandwidth antenna designed for long-term service under severe conditions.



[Allison McLellan, photo]

John Portune, W6NBC

It is not unusual for a repeater station antenna to be located on a remote hilltop where high winds and severe weather conditions must be endured. Access to such areas for maintenance or repair is generally difficult, so long-term, reliable operation is a must. This requires a much sturdier design than an equivalent home station antenna.

My rugged base station antenna is a 2-meter omnidirectional vertical made from thick-wall aluminum Schedule 40 pipe for durability, longevity, and wide bandwidth. At less than 25 inches tall, it is only 40 percent of the height of a 2-meter **J**-pole antenna. The prototype has been trouble-free for over 2 years.

Design

The antenna is a half-wavelength ($\lambda/2$) "fat" dipole, electrically shortened by adding ¼-inch diameter aluminum capacity loading rods at the top and bottom, as shown in the lead photo below. The dipole elements are aluminum Schedule 40 pipe, 1.05 inches in diameter with a ⅛-inch-thick wall. Figure 1 details the design.

This antenna is very durable, suitable for repeater use or where the location calls for a long unattended life. [John Portune, W6NBC, photo]

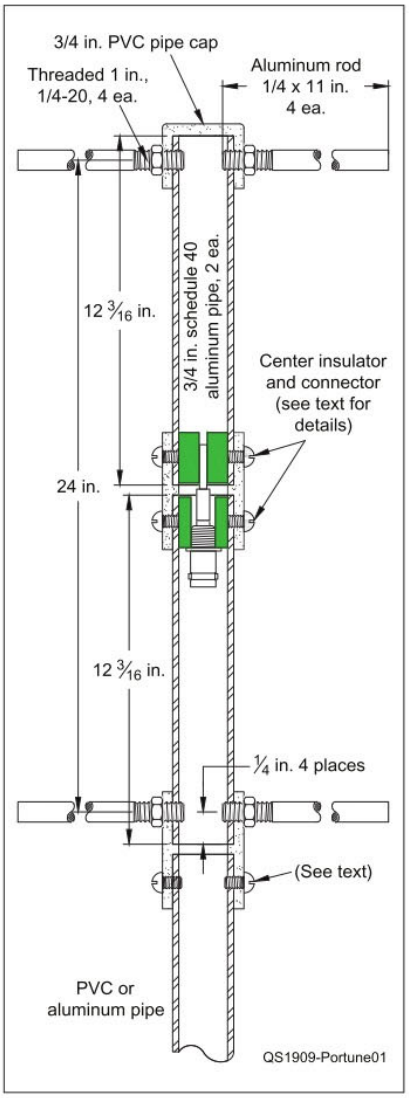


Figure 1 — Mechanical drawing of the rugged 2-meter antenna.

Figure 2 shows the antenna's low SWR from 140 – 150 MHz, as measured with a Comet CA-500 antenna analyzer. The large diameter of the pipe is responsible for an SWR below 1.2:1 over the entire 2-meter band. Figure 3 shows *EZNEC Pro-4* radiation patterns for the antenna 10 feet above average soil. The *EZNEC* file is available at **arrl.org/qst-in-depth**.

Materials and Tools

For this project, Schedule 40 pipe is preferable to 1-inch OD tubing because it fits common PVC pipe fittings, which are used for both the base and the feed-point insulators. The thicker walls of Schedule 40 pipe allow for more threads to engage the screws and threaded loading rods. I bought ¼-inch aluminum rod for the antenna's loading elements and used an ordinary ¼-20 thread cutting die to cut 1 inch of threads at one end of each rod. You will also need several inches of ¾-inch diameter aluminum round bar to form the feed point of the antenna.

If you don't already have a set of taps and dies, an inexpensive set should be adequate for working with aluminum. Note that the ⅜-32 tap may have to be purchased separately, because that size is not included with most inexpensive sets. Also, when tapping aluminum, it can be "grabby," so back the tap out often and use a special purpose lubricant such as Tap Magic or even kerosene (i.e., charcoal lighter). The proper drill sizes for tapping are available online.

Construction

PVC pipe couplings may vary in length, so select longer ones if possible. Clearance holes for the rods and screws are drilled appropriately in the coupling ends, as shown in Figure 1. The pipe is drilled and tapped with ¼-20 threaded holes for the loading rods and 10-24 threaded holes for the screws. The screws at the bottom of the center PVC insulator and the bottom PVC mounting coupling (on the right in Figure 1) are actually rotated 90 degrees around the pipe, compared to the way shown. This provides a positive connection between the antenna tubes and two aluminum slugs that are cut from ¾-inch aluminum rod. The slugs help in assembling the antenna. The feed coax runs coaxially up through the antenna tube to a BNC bulkhead connector in the bottom slug.

Remove the center pin from a banana plug and solder it to the back terminal of the BNC bulkhead connector. Drill and tap ⅜-32 threads on the center axis of the bottom slug to accept the bulkhead connector. Drill a 5/32-inch hole through on the center axis of the top slug to act as the receptacle for the banana plug center pin. Fabricate a plastic washer, roughly ⅛ inch thick, to fit over the banana plug pin to keep the aluminum slugs separate.

Begin assembling the feed point by attaching the coax to the BNC connector. Pass this assembly up through the bottom pipe to the feed

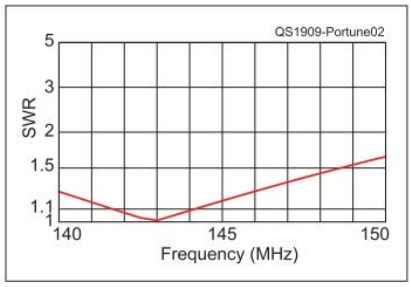


Figure 2 — SWR sweep from 140 MHz to 150 MHz.

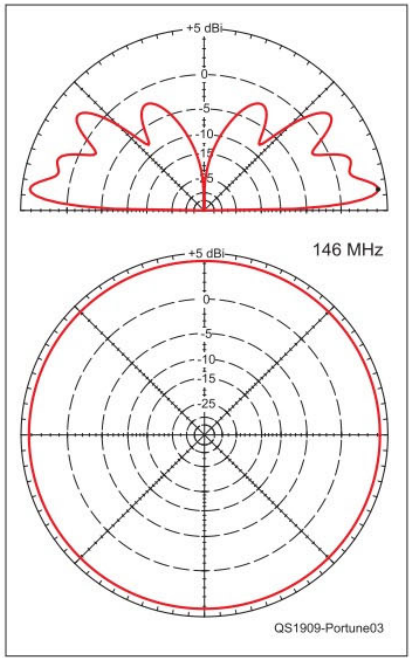


Figure 3 — Elevation and azimuth radiation patterns.

> *"It is advisable to initially cut the threaded rods long and trim them to length at the antenna's working location."*

point. Install and lightly tighten the side screws. Next, place the top slug and plastic insulator on the banana plug pin and then insert this assembly into the center insulator. Finally, install the top screws and tighten all screws.

You may use a coax pigtail for a simpler center feed point, instead of the aluminum slugs and BNC connector. To make the pigtail, separate and fan out the coax center conductor and shield into two separate conductors. Apply heat-shrink tubing and crimp-on ring terminals for 10-32 lugs. Drill a ¾-inch hole through the side of the center insulator, including some of the ends of the antenna tubes, to permit the pigtail wires to exit and connect to the 10-24 screws at the ends of the aluminum tubes. With this alternate method, it is advisable to weatherproof the entire assembly. Large diameter heat-shrink tubing is ideal.

Tuning

Roughly 1.5 MHz of frequency adjustment is afforded by adjusting the threaded rod ends in or out. Move all rods by the same amount. Greater frequency change is affected by changing the length of the rods. It is advisable to initially cut the rods long and to trim them to length with the antenna in its working location, if required. The antenna has a 2 dB bandwidth of 7.3 MHz, which is sufficient for the entire 2-meter band.

Should you desire to use this design on a different band, the lengths of the Schedule 40 pipe and rods can be inversely scaled to frequency. For a big change, you may also want to scale the rod and tuning diameters, although I have successfully built a 6-meter version and a 220 MHz version with the same tubing and rod sizes.

Mounting

A length of the same ¾-inch schedule 40 aluminum pipe can be used as a mast, inserted directly into the base insulator. Schedule 80 PVC pipe (the gray type) may also be used as a short mast, as shown in the lead photo. Otherwise, a short aluminum pipe nipple in the bottom of the antenna and a mast-to-mast clamp can be used. You can provide an exit hole for the coax in the side of the mast or simply run the coax out the bottom of the mast.

A balun is recommended. For 2 meters, if a PVC mast is used, the balun can be simply six turns of the feed coax wrapped around the mast, secured by tie wraps. A 1:1 ferrite choke balun is also suitable.

John Portune, W6NBC, is an ARRL member and frequent contributor to *QST*. He has been licensed for 53 years and has held an Amateur Extra-class license since 1972. John has a BS in physics and also holds FCC Commercial General Radiotelephone Operator and FCC Radiotelegraph licenses. He retired as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California. You can reach John at **jportune@aol.com** or through his website at **www.w6nbc.com**.

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

New Products

SOTABEAMS WOLFWAVE Advanced Audio Processor

WOLFWAVE is an audio processing system that includes sophisticated band-pass filtering, noise reduction, and even age-related hearing correction. WOLFWAVE also uses a low-distortion audio test generator to create one or two tones for transmitter testing. Another novel feature is an experimental CW regenerator that gives noise-free CW reception.

WOLFWAVE features a bright OLED spectrum display and on-screen help, all powered by the latest ARM low-power processor with a 20-bit codec. There are separate audio outputs for headphones and a loudspeaker.

WOLFWAVE firmware is upgradable so users will always benefit from the latest developments. Visit **www.sotabeams.co.uk/wolfwave-advanced-audio-processor** for more details.

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47 | See our Video Overview of the **HF Signals** µBITX 80-10 Meter QRP Transceiver.