Low-Cost Easy-to-Build Antenna

For 146/440 MHz.

by Bob Witmer W3RW and Ed Clegg W3LOY

This easy-to-build antenna provides improved performance in range on both bands over the standard antenna ("rubber duck") currently supplied with the dual-band, hand-held transceiver. In addition, at less than 2 feet tall, it's space-efficient for mobile operation.

The Challenges

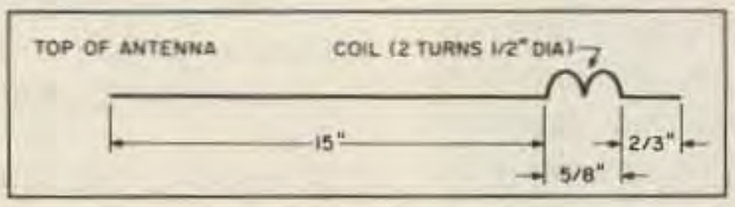
The recent popularity of compact dual-band 146/440 MHz FM transceivers has created an antenna problem for those owners who desire improved performance over the standard antenna. Improved performance antennas are available separately for both bands, but you have to change antennas when you change bands. This is hardly convenient.

We discovered, quite by accident, that this antenna, originally designed just for gain performance over a quarter-wave on 440 MHz, had dual-band capability.

How It Works

The antenna works in different modes on each of the bands. On 146 MHz, the performance is virtually identical to a quarter-wave whip. At this frequency, depending on the ground plane configuration, the performance can be significantly superior to the rubber duckie antenna, even within a small fraction of a dB of a conventional quarter-wave located in the same ground plane environment. The SWR characteristics and bandwidth also behave similarly to a quarter-wave monopole.

The real virtues of this antenna appear in the 440 MHz application. Many have been surprised to find that they were able to get some measure of performance when they operated on 440 MHz with a conventional 146 MHz whip. The fact is that a 146 MHz whip looks like a ¾-wave whip when used at 440 MHz. It presents a very acceptable SWR to the rig. Any piece of wire will radiate to some degree, in some direction. And there's the rub—*some* direction. Most of the radiation from a ¾-wave vertical whip over a ground plane is directed up into the sky! It will send a nice signal at about 48 degrees above the horizon. That's not where we want our signal to go most of the time!



Dimensions for the dual-band antenna.

The easy-to-build antenna, while occupying essentially the same space as the 146 MHz vertical whip, behaves quite differently on 440 MHz than the above sky-warmer. The secret is in the current distribution resulting from the addition of the "curly-Q" inductor inserted into the lower part of the whip. Because of the resulting current distribution, the antenna behaves similarly to the classical ⅝-wave vertical, which not only provides several dB of gain over a quarter-wave whip, but also directs its radiation along the horizon where we want it to go. (For a copy of the current distribution plots and MININEC radiation simulations for this antenna, send an SASE to the authors at *146 Forest Trail Dr., Lansdale PA 19446*).

The curly-Q inductor not only establishes the ideal current distribution, but also performs the impedance matching required to make a highly reactive, high impedance ⅝-wave whip look like the 35–60Ω resistive load we want to match to our 50Ω rigs!

Construction

The antenna is simple to build. Actual dimensions vary slightly, depending on the application, but in any case appear to be non-critical. Forming the base loading coil is the hardest part of construction. When constructing my mobile antenna, I worked with a stainless steel whip and formed it as such. It was difficult. I used 18-gauge Copperweld wire to construct the antenna for my 146/440 MHz handheld. It was considerably easier to form!

The easiest way to start construction of a mobile antenna is to obtain a quarter-wave VHF commercial high-band mobile antenna uncut for the operating frequency. This should provide you with all the material you need. Simply measure the antenna for the location of the loading coil, form the loading coil, and mount the antenna on the mounting base. Construction of a hand-held version is similar. Use any conductor material which will give you the desired size and structural integrity.

When selecting the material for your dual-band antenna, remember that you have to attach it to the antenna connector on your handheld. When I used 18-gauge Copperweld wire, I chose a BNC connector with a screw stud, left over from a broken 2 meter rubber duck. I formed a loop in the bottom of the antenna, and attached the connector and screw stud with a matching nut.

Adjustment

The next step is to trim the antenna for optimum 2 meter band operation. 440 MHz SWR usually does not appear to need adjustment since observed SWRs have not been higher than 2:1.

Performance

Mobile performance of my magnet-mounted version on 2 meters is indistinguishable from that of a regular quarter-wave whip. 440 MHz performance approaches that of a commercial "5 dB gain" antenna.

Performance of the portable version, which I have used on my 146/440 MHz handheld, shows a noticeable improvement on both bands over the standard antenna supplied with the rig.

On a 35-mile path with 3 Watts, 440 MHz operation proved superior to that with 30 Watts into the 2 meter whip, and gave barely detectable difference when compared with an expensive commercial vertical collinear!

SWR was not measured on the handheld. Complexities associated with antenna SWR on handhelds precluded such measurement. I have used this antenna with my HT, however, for quite some time, with no troubles.

Summary

This low-cost antenna is space-efficient and easy to build. It gives you greater range and versatility over the antenna supplied with your handheld transceiver.

For information on the availability of a commercial grade Clegg dual-band antenna, contact *Viatek, Inc., 350 Main St. E., Allentown PA 18106. Phone (215) 395-7222.* 73