ARRL Periodicals Archive – Search Results
A membership benefit of ARRL and the ARRL Technical Information Service

ARRL Members: You may print a copy for personal use. Any other use of the information requires permission (see Copyright/Reprint Notice below).

Need a higher quality reprint or scan? Some of the scans contained within the periodical archive were produced with older imaging technology. If you require a higher quality reprint or scan, please contact the ARRL Technical Information Service for assistance. Photocopies are $3 for ARRL members, $5 for nonmembers. For members, TIS can send the photocopies immediately and include an invoice. Nonmembers must prepay. Details are available at www.arrl.org/tis or email photocopy@arrl.org.

QST on CD-ROM: Annual CD-ROMs are available for recent publication years. For details and ordering information, visit www.arrl.org/qst.

Non-Members: Get access to the ARRL Periodicals Archive when you join ARRL today at www.arrl.org/join. For a complete list of membership benefits, visit www.arrl.org/benefits.

QST Issue: May 1990
Title: Closer Look at Horizontal Loop Antennas, A
Author: Doug DeMaw, W1FB

Click Here to Report a Problem with this File

A Closer Look at Horizontal Loop Antennas

Multiband horizontal loops perform differently on each HF band. This article provides information about the E- and H-plane characteristics of a 160-meter square loop for use from 160-10 meters.

By Doug DeMaw, W1FB
ARRL Contributing Editor
PO Box 250
Luther, MI 49656

Various amateurs have written about horizontal loops. Many have praised their performance, but what about patterns and radiation angles for multiband operation? I want to discuss these points and provide graphic illustrations of what you can expect from a loop of modest height. The radiation patterns were generated by Harold Johnson, W4ZCB, by means of his IBM® computer and the MININEC antenna-evaluation program. On-the-air performance of my loop verifies the computer data he provided.

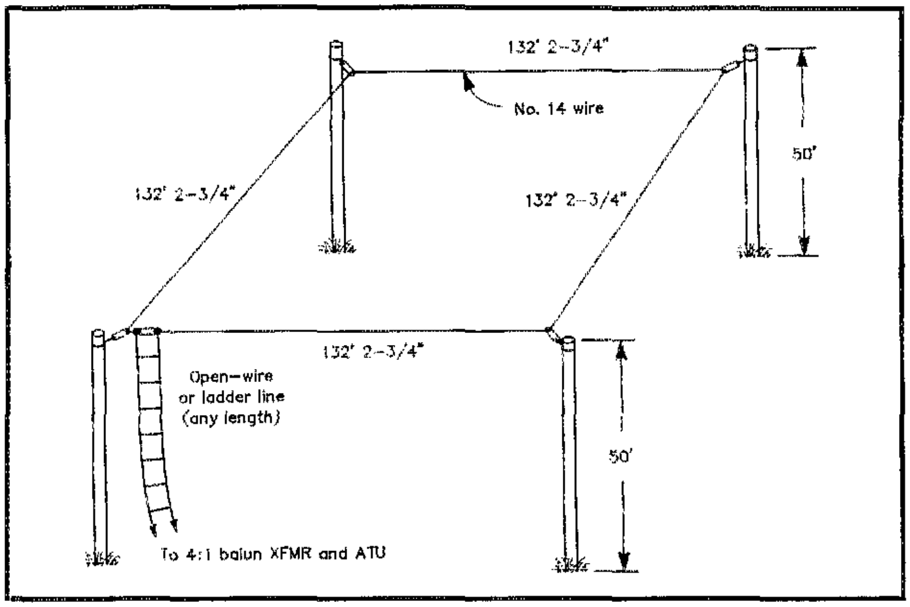


Fig 1—Details of the W1FB full-wave 1.9-MHz loop. The four cedar support poles are 50 feet high. The antenna contains 529 feet of stranded no.14 copper wire. Each pole has a pulley and halyard. The feeder may be any length of open-wire or ladder line from 300 to 600 ohms. A 4:1 balun transformer and 10 feet of RG-8 coax connect the balanced feeders to a Transmatch at the ham-shack end of the 450-ohm ladder line used at W1FB.

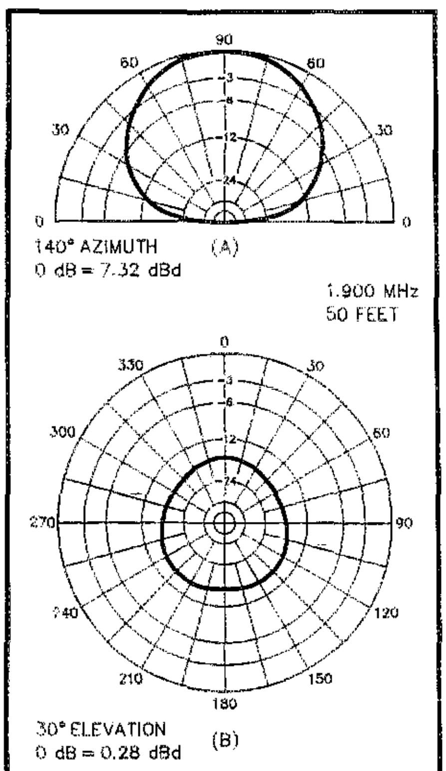


Fig 2—E- and H-plane patterns for the loop at 1.9 MHz.

Details of the W1FB Loop

After using vertical and tilted Δ, square and rectangular loops for many years, I decided to erect a 160-meter loop, cut for 1.9 MHz, parallel to ground. I was skeptical about horizontal-loop performance when the antenna is less than a half wavelength above ground at the lowest operating frequency. At best, it should be a "cloud warmer" with its straight-up radiation. Fortunately, I prefer this type of radiator for local work on 160 and 75 meters, so the experiment seemed worthwhile.

I had been using a square, tilted 160-meter loop until the change was made to a completely horizontal loop in mid 1989. The original loop was 50 feet above ground at two corners, then sloped to a

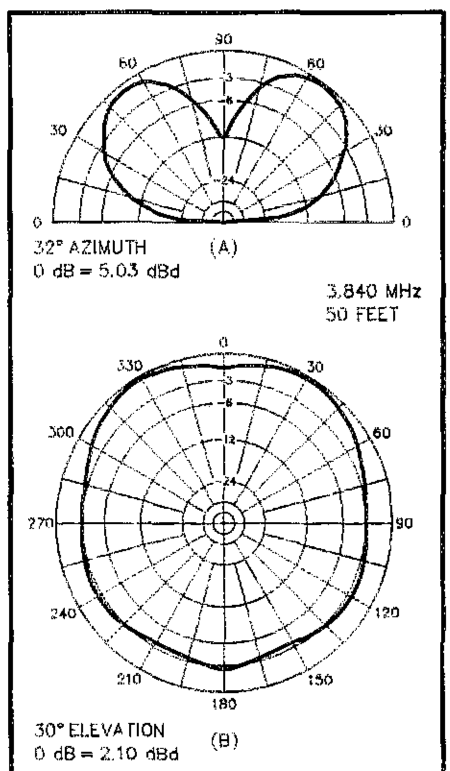


Fig 3—E- and H-plane patterns for operation at 3.84 MHz.

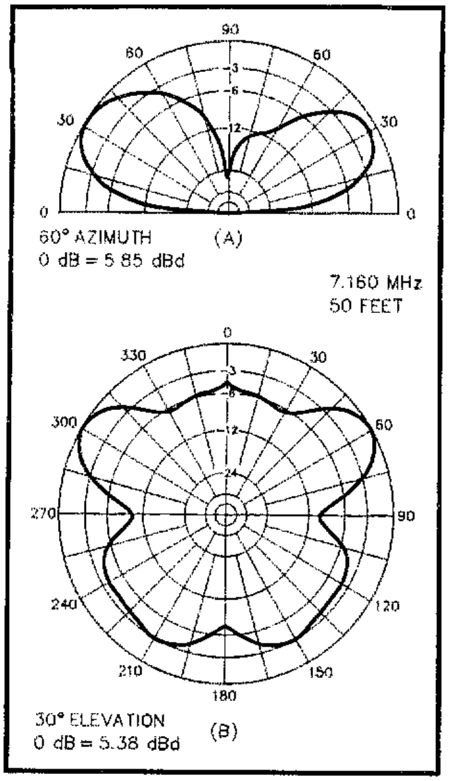


Fig 4—E- and H-plane patterns for operation at 7.16 MHz.

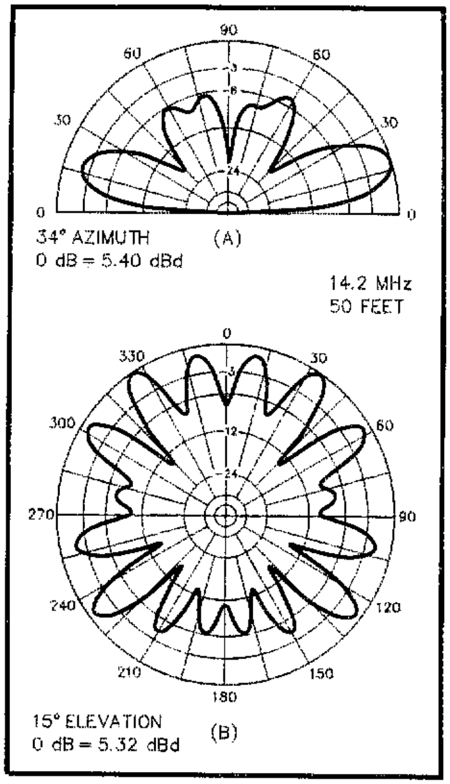


Fig 5—E- and H-plane patterns for operation at 14.2 MHz.

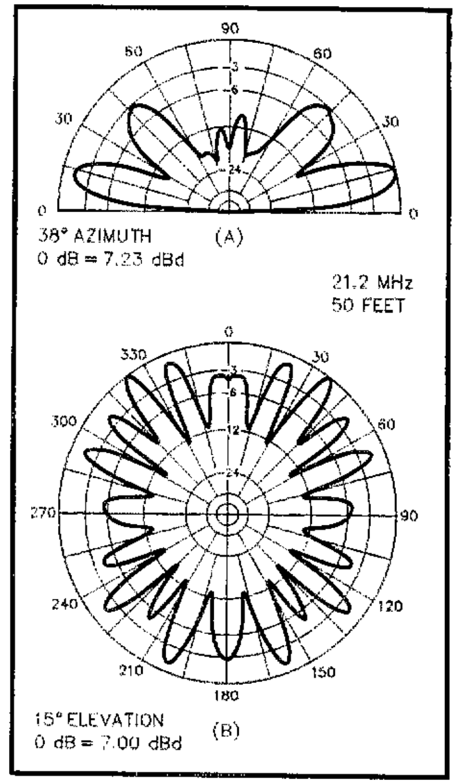


Fig 6—E- and H-plane patterns for operation at 21.2 MHz.

height of 6 feet at the far side of the antenna. I used corner feed at 50 feet by means of 450-ohm ladder line. A 4:1 balun transformer (just outside the ham shack window) and 10 feet of RG-8 coax cable was used to connect the balanced feeder to my Transmatch. I still use that feed system. Multiband performance was entirely acceptable, especially from 40 through 10 meters. I could work DX easily, and stateside signal reports were good. Performance on 160 and 75 meters beyond 800-1000 miles was not outstanding. Closer in, it was excellent.

Fig 1 shows the present loop system. Upon raising the far corners of the radiator to 50 feet, I was heartened to find that my signal from Michigan became consistently 10 dB better at W4ZCB in North Carolina on 160 and 75 meters. The same is true for my weekly schedule with N8HLE/1 in Connecticut on 80 meters. The system now produces 20, 15 and 10-meter performance that is on par with, and sometimes better than, that of my commercial triband Yagi at 55 feet. Large loops exhibit increasing gain as the operating frequency in MHz is raised (with reference to a dipole). I recently compared this loop with a two-element, half-size 40-meter Yagi of commercial design. Signals on 7 MHz from European DX stations were the same with the loop and the 55-foot-high 40-meter Yagi. Futhermore, background noise was substantially lower when I used the loop for these comparisons (loops are known for being less responsive to man-made noise than are other types of antennas). My loop is dimensioned from L(ft) = 1005/f(MHz), which yields an overall wire length of 529 feet for 1.9 MHz. A full-wave loop for 3.9 MHz requires 257.7 feet of wire.

Loop Radiation Patterns

Fig 2 shows what we should expect from a 160-meter loop that is only 50 feet (1/10th wavelength) above ground. The radiation pattern is omnidirectional and the radiation is practically straight up (high angle). This provides excellent performance out to 1000 miles on 1.9 MHz. My signal compares favorably to those from stations of comparable output power that use inverted-V antennas 50 or 60 feet above ground (Michigan stations). At times my loop is superior to the inverted Vs, depending upon band conditions.

Fig 3 illustrates the E- and H-plane patterns for the 160-meter loop at 3.84 MHz. Radiation is still omnidirectional, but the radiation angle has become lower; this increases the antenna effectiveness for working distant stations.

A dramatic improvement in the antenna patterns is shown in Fig 4. Here we can see that at 7.16 MHz the lobes are considerably lower than they are on 75 meters. Great for DX work! Although the directivity is essentially omnidirectional, you can see that lobes have formed an "inkblot" pattern. Radiation has increased off the course of the loop. The broader lobes are on the side where the feed line is attached.

Switch to Fig 5 and note the increased

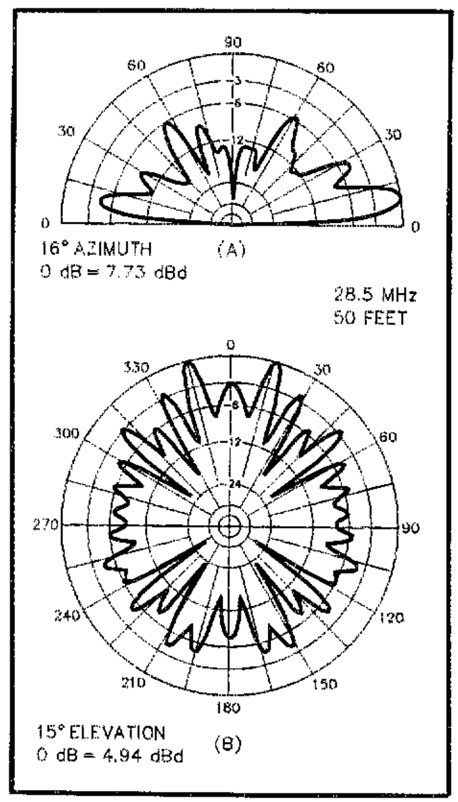


Fig 7—E- and H-plane patterns for operation at 28.5 MHz.

(continued on page 35)

test operation: W1XX/3 from western Pennsylvania. Although we had equipment for all bands, we brought the '736 along as a backup rig. Murphy made it necessary to use the '736 on 220 MHz, along with a 400-W amplifier and a pair of Boomer antennas (no external preamplifier). Although most operators agreed that the receiver was very quiet (some ran the audio gain near maximum), it was very sensitive and stood up to strong signals from other mountaintop operations. We worked 51 grid squares on 220 MHz during that operation, including some contacts of more than 600 miles. During another VHF contest, Clarke Greene, K1JX, used the review transceiver for a QRP portable expedition (see sidebar).

An additional capability Yaesu has added to the FT-736 is that of fast-scan-television (FSTV) operation. With an optional external TV camera/audio interface, you can work FSTV on the 1.2-GHz band. I didn't try this (we didn't purchase the interface), but it appears to be simple and interesting.

The '736 does have one annoying characteristic: The receiver must be retuned when you change modes between SSB and CW. Although this may seem like a minor point, I often found myself switching to CW to work distant stations after calling in vain on SSB. Every time I switched to CW, I had to tune in the station again.

I enjoyed having the FT-736 in my station. It's great having everything in one compact package, but it's not without compromises. The receiver and transmitter work well, although it would be nice to have 25 W available on 6 meters to drive my amplifier to full output. I found the transceiver easy to use (because I used only the basic functions). With the combination of a sensitive receiver and narrow filter, this is the best radio I've used on FM. It's ideal for satellite operation, and the satellite features don't intrude on normal operation.

The '736 is an expensive radio compared to other VHF rigs, but even with a couple of optional band modules, it's in the same price range as today's full-featured MF/HF transceivers. Who should buy one? If all you're looking for is an FM rig, you should probably look elsewhere. If you're just interested in SSB and CW DXing from a home station, consider also the HF transceiver/transverter route. If you use a lot of bands and modes and/or are into satellites, this rig should be a serious contender for your radio dollars.

Thanks to Clarke Greene, K1JX, and Mike Owen, W9IP, for contributing to this review.

Price class: FT-736R, $1570; 6-meter band module, $265; 220-MHz band module, $290; 1.2-GHz band module, $530; keyer, $20; dc cable, $10; FSTV interface, $150; voice synthesizer, $40; CTCSS encoder/decoder, $55. Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90701.

A Closer Look at Horizontal Loop Antennas

(continued from page 29)

low-angle radiation of the loop at 14.2 MHz. There is substantial high-angle radiation, useful for close-in communications on 20 meters. DX performance is excellent because of the low-angle radiation component. The loop remains omnidirectional, but note the numerous small lobes that have developed.

Fig 6 shows what happens when the antenna is operated at 21.2 MHz. Again we have excellent low-angle performance along with a high-angle component for short-skip work. Omnidirectionality remains, but the pattern is now split into countless small energy lobes.

Finally, we examine the antenna patterns for operation at 28.5 MHz (Fig 7). You can see that we now have high, medium and low angles of radiation. This makes the loop an outstanding antenna for all types of 10-meter communication. The system is still an omnidirectional one, and has many major lobes that form a 360-degree pattern. The gain notations (in dBd, gain in decibels referenced to a half-wave dipole) on the illustrations show that antenna gain increases with operating frequency. At 10 meters, the loop is on a par, in some respects, with a 3-element 10-meter Yagi.

Some Closing Comments

I have kept the narrative short in order to provide page space for the many illustrations. The point is that, if you have space for one, you can use a horizontal loop as a multiband antenna. You need not tailor it for 160 meters. A 75- or 40-meter full-wave loop will usually fit into a city lot. The higher you erect it above ground, the better its performance will be. But, don't give up the notion of a loop if you can't get it high above ground. Height extends the useful working distance of a loop, but many loops at low heights still permit good DX results at the higher end of the HF spectrum. The improvement in noise rejection during receive may be sufficiently rewarding to justify putting up a large piece of wire. This is especially true if you live in a noisy neighborhood.

One word of caution: Wire that has thick polyvinyl insulation (such as no. 14 electrical wire) causes the antenna resonance to be somewhat lower than the formula dictates. Apparently, the propagation factor of the wire, when used in a closed loop, causes this phenomenon. I have not observed this condition when using ordinary enameled wire.

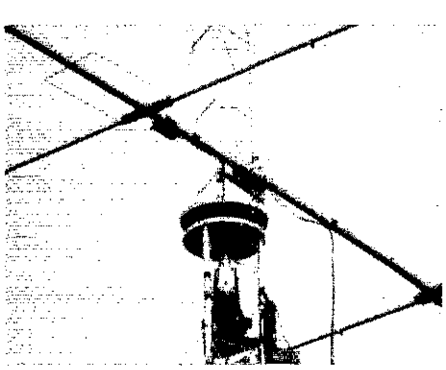
I wish to express my thanks to Harold Johnson, W4ZCB, for his help in making this article possible.

New Products

ROTATING TOWER SYSTEMS FOR ROHN 25 TOWERS

☐ Rotating Tower Systems, Inc, has increased its product line by introducing a new rotating joint and guy-wire bracket for adding tower-rotation capability to Rohn 25 towers. A rotating tower allows the installation of stacked monobanders, tribanders, or VHF/UHF arrays, and installation of rotatable antennas at optimum height. All bearing surfaces are completely protected from the weather, and use standard automotive grease fittings to make lubrication easy.

Sold as complete systems, the rotating tower kits include one galvanized-steel rotating joint with a self-aligning bearing; one, two or three rotating guy-wire brackets; and all necessary installation hardware (nuts and bolts, ¼-inch threaded rods to fix the rotating joint during erection and servicing, an extension that allows mounting a gin pole far enough from the tower to clear the rotating joint and guy-wire bracket [and which can later be used as a side-mounted antenna bracket], etc). The rotating joint's vertical load capacity is more than 3000 lb, and the bearing is designed for easy replacement.



Price class: rotating joint and one guy bracket, $1330; joint plus two brackets, $1860; joint plus three brackets, $2290. Shipping is by truck, COD, FOB Prosper, Texas. Rotating Tower Systems also manufactures similar products for Rohn 45 and 55 towers. For more information, contact Rotating Tower Systems, Box 44, Prosper, TX 75078, tel 214-347-2560.—*Rus Healy, NJ2L*