Multibanding the Fracvert Half-wave

Here's a wire vertical with surprising performance on 40–10 m.

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In the search for a simple, high performance, multiband HF antenna, the choices are pretty limited. Topping the list is the G5RV, a dipole with a radiating ladderline section on some bands. I've never been crazy about the power pattern on this antenna and, given the fact that it needs a tuner, it struck me that other tuner options beyond a droopy longwire must be around.

Of course, the solution is often under your nose. Having spent considerable research efforts on fractal antennas, I decided to play with a very simple one. Fractal antennas are shaped antennas that are "bent" in some self-similar way. Each time you do a scale of bending, it's called an iteration. The effect is to produce something akin to linear loading, but on many scales of size. Fractal loading has proved an efficient way of making smaller antennas.

But another effect caused by fractal bending is phasing—and gain. The simplest example is when the bending is done on just one scale—effectively, a stub. Applying a three-sided box stub in the middle of a dipole yields a Cohen dipole, an echelon antenna optimized for performance using shaped antenna and fractal ideas. It is high-gain: over 4 dB when compared to a regular dipole. The tradeoff for this example is size, though. The Cohen dipole is one wave in its biggest dimension.

My Fracvert Half-wave is half a Cohen dipole, fitted as a monopole. It is a "try me" antenna: As a first-iteration fractal it was designed to get hams to think about the fractal possibilities. For those who prefer something more familiar than fractal geometry, its stub and echelon nature are adequate reasons for playing with it. And if those don't work, then the performance will. Gentlemen's bet: After you try this antenna, you will wonder what to do with your G5RV and dipoles and longwires. I can guarantee you that with 35 feet of height and a footprint of 35 feet for the radials, you will be extremely pleased with the results of your effort.

What does the antenna look like? It's a wire vertical with a dogleg. I show it in **Fig. 1** over eight radials cut for 20 m. For lengths in waves and feet, I've prepared **Table 1**. The antenna has a half wave of height on 20 m. It has full bandwidth and a flat VSWR on 20 m as shown in **Fig. 2** (all modeling done with NEC4), so if you scale the dimensions for 40 m, for example, you will get the same specifications.

Its gain was modeled over perfect ground with NEC4 (see **Fig. 3**), where ideally it shows over 4 dB gain over a quarter-wave vertical. It has gain over a half-wave vertical, too. But unlike the quarter- and half-wave verticals,

FracVert Dimensions for 20 m (14.15 MHz)

Section	Length (waves)	Length (feet)
Feed Section (vertical)	0.17	11.8
Horizontal Section	0.25	17.4
Top Section (vertical)	0.33	23.6

Table 1. *Fracvert dimensions for 20 m (14.15 MHz). All radials are 1/4-wave. All wires are #12 copper.*

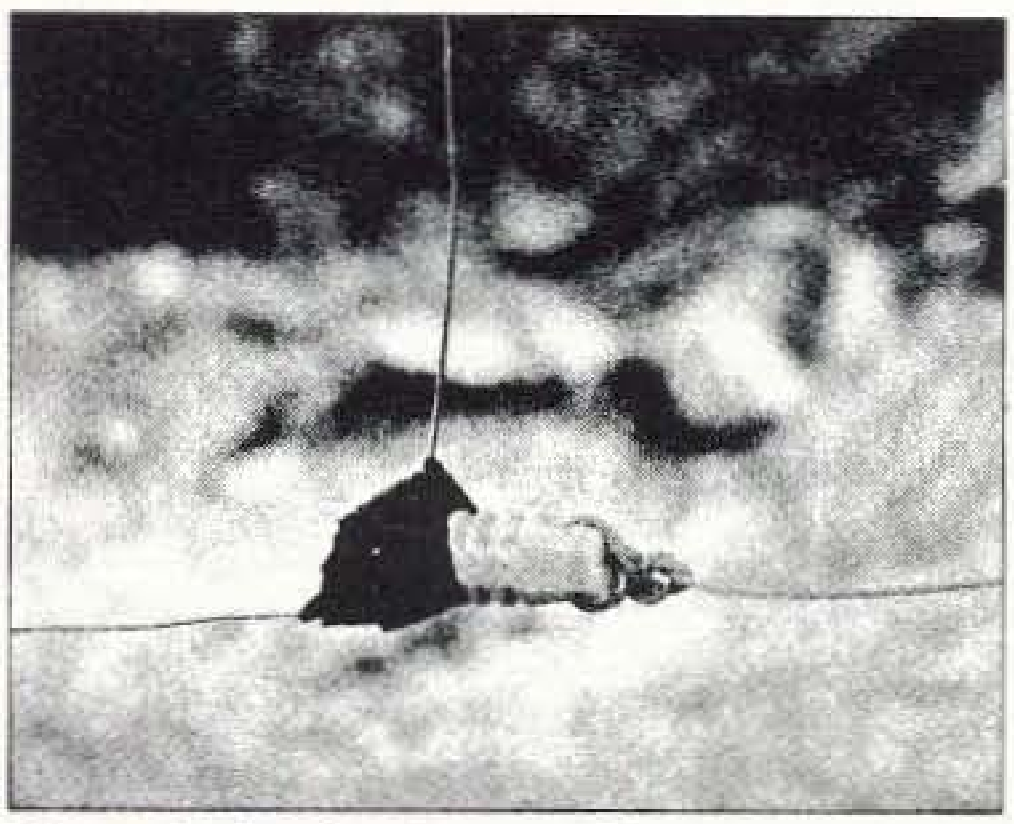

Photo A. Anchoring an elbow.

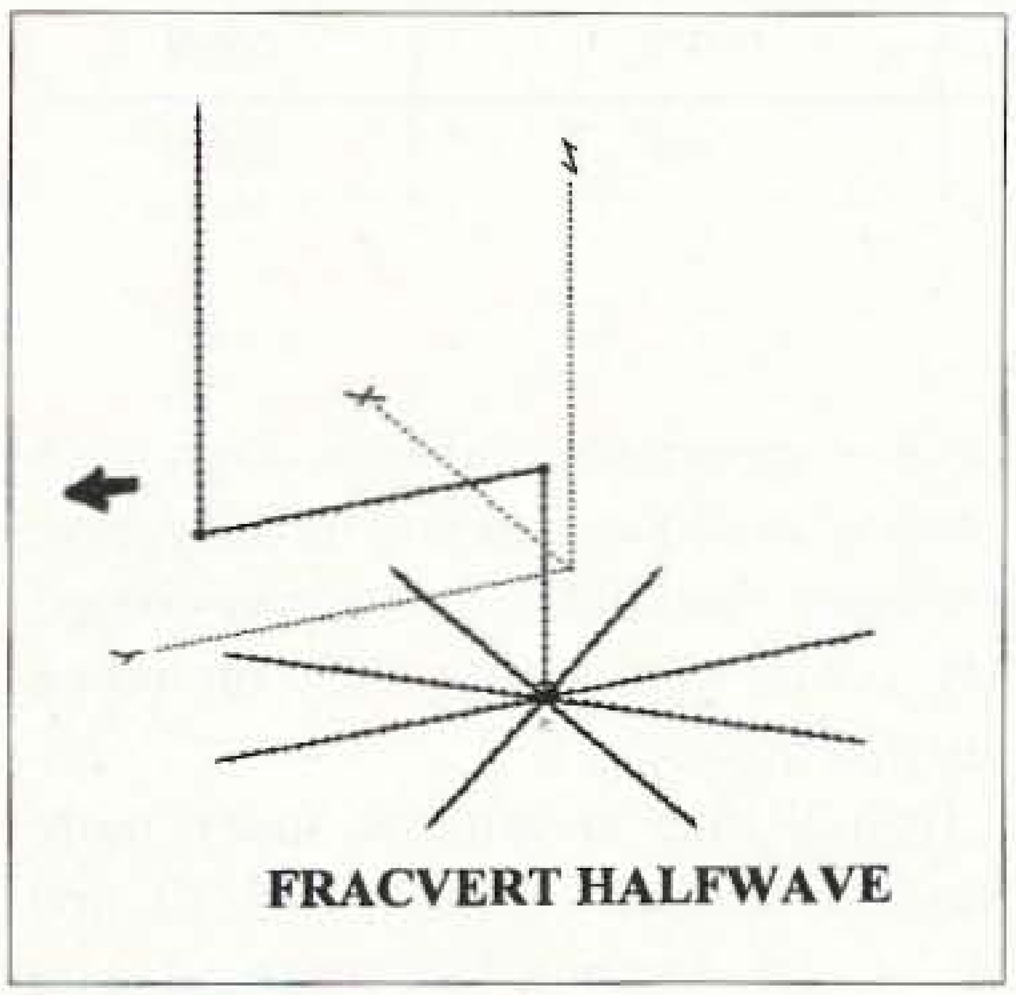

Fig. 1. The Fracvert Half-wave.

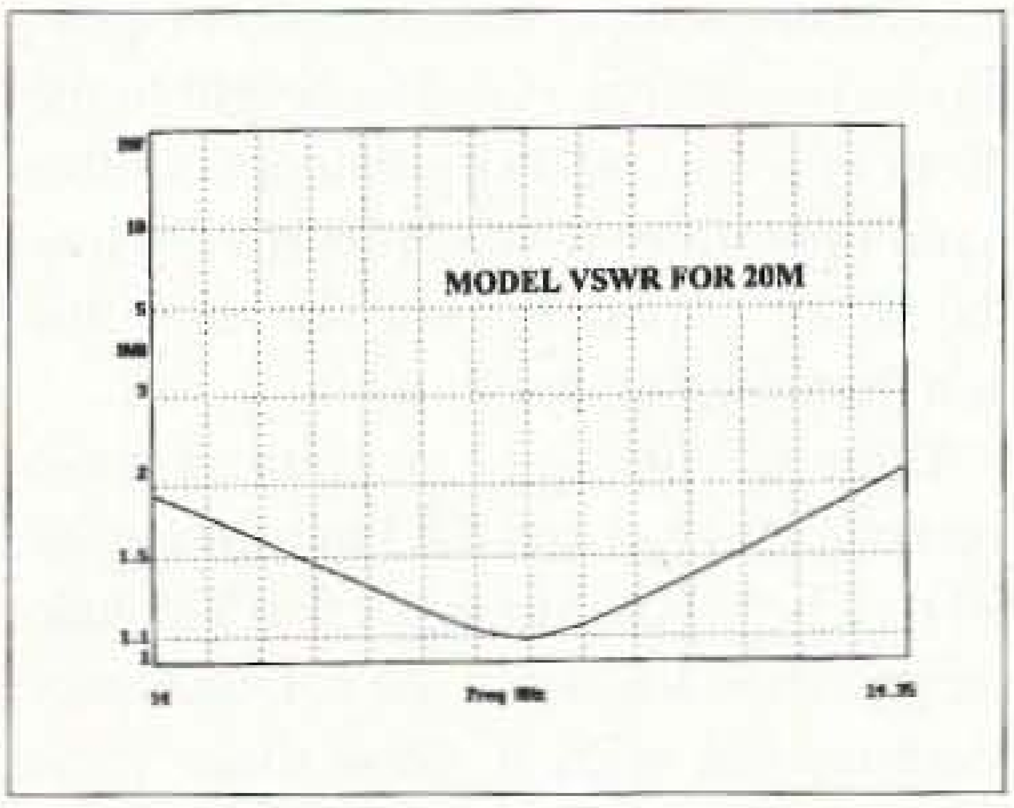

Fig. 2. Model VSWR for 20 m.

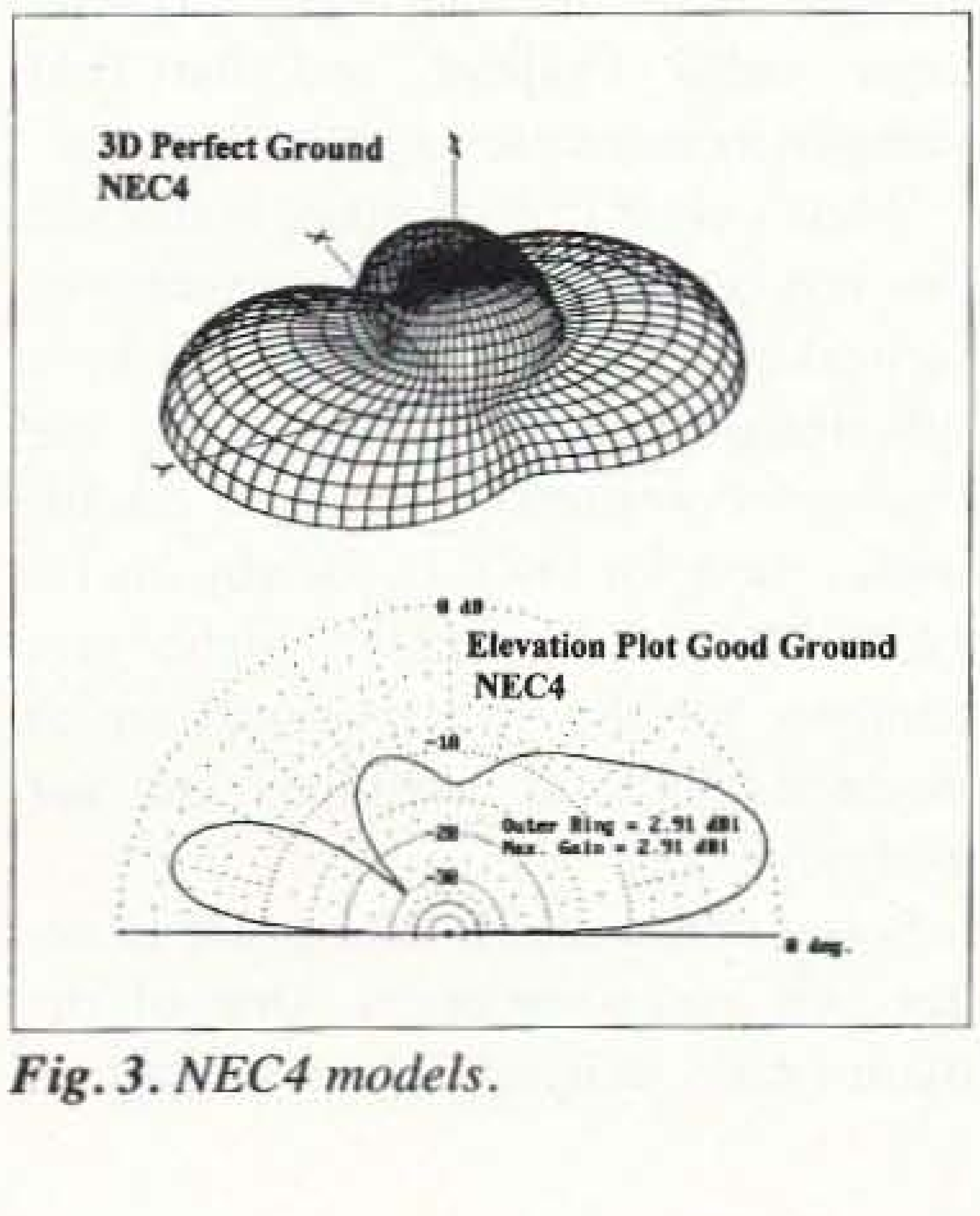

Fig. 3. NEC4 models.

Same Height Vertical Comparison

	Fracvert Half-Wave (20 m)		1/4-Wave Vertical (40 m)	
Band	Field Strength (dBi)	Az. Pattern	Field Strength (dBi)	Az. Pattern
40	-0.3	omni	-0.4	omni
30	0.1	Bi/omni	0	omni
20	2.9	Bi	0.7	omni
17	1.7	Bi	-0.5	omni
15	3.8	Bi (rotated)	3.5	omni
12	3.5	Bi (rotated)	4.3	omni
10	4.6	Bi	4.7	omni

***Table 2.** Same height vertical comparison.*

this antenna's pattern is bidirectional like that of a dipole. Over real ground with good conductivity, the modeled pattern is a slightly asymmetric and bidirectional, also shown in **Fig. 3**, favoring the direction of the dogleg. View the Fracvert Half-wave as a very simple, resonant, coil-less, high gain vertical on 20 m and you already have a winner. And did someone say cheap? My costs were under $15, including ferrite chokes.

Brandishing an antenna tuner, more fun is to be had. On 30, 17, 15, 12, and 10 m, the antenna has practical gain over a quarter-wave vertical cut for those wavelengths. But as this is not a good comparison, I chose a 40 m quarter-wave vertical, equal in height to the 20 m Fracvert, and simulated its multiband operation. If you want to measure the better of two 35-foot verticals, this is a meaningful comparison.

Table 2 compares the quarter-wave vertical for 40 m and the Fracvert cut for 20 m. These field strengths don't include the insertion loss from the antenna tuner loading, but with a good tuner these losses will be minor and comparable for each of the two antennas. Note that I had to place the 40 m vertical over a much larger radial footprint, and the field strengths include losses over good ground.

What's clear from the data is that the Fracvert beats loading up a conventional vertical of the same height, often by a substantial margin. Furthermore, the Fracvert consistently has low takeoff angles (best for DX). Especially on 15, 12, and 10 m is this true; the higher gain numbers for the 40 m vertical are at moderate to high elevations and not useful for DX.

Some construction details are in order. All are no-brainers. One of the main issues at hand is how to support the two "elbows." I did this by passing the wire through an insulator and anchoring the other end, as shown in **Photo A**. Another one is how to orient the antenna. On 20 m, the maximum gain is in the same direction (outgoing; see the arrow in **Fig. 1**) as the stub. On 15 and 12 m, it's at a right angle to it. I've indicated this as "rotated" in **Table 2**.

There are no tricks on feed attachment. Just make a radial harness and solder to the braid, and solder the center connector to the dogleg at the bottom of the feed section. Special note: Choke the coax with ferrite or a line isolator just to make sure that the coax doesn't radiate. The antenna is certainly unbalanced when not in use on 20 m, so a choke is imperative.

An intriguing possibility is true 80–10 operation for the Fracvert Half-wave. If the antenna is cut for 40 m and you have the 70 or so feet of height, then the antenna will work on all these bands.

The performance has been excellent with this antenna. I use it on 40–10 m as my default antenna these days (when not experimenting with others). In fact, I occasionally throw up its mate, with this second dogleg pointed 90 degrees off to get more coverage. I kick in the antenna tuner to match for all bands except 20 m, where the 1.2 VSWR is so good I just take the tuner out of line. My experience is that I typically beat tribanders at 35–45 feet with ease in the direction favored by the Fracvert Half-wave.

Of course, I'm not the only one who uses a Fracvert Half-wave. TT8JWM put up a Fracvert on 20 m last year and was "*very* impressed." About 100 hams so far have used them and sent me glowing E-mail. The antenna may be available commercially later (its patent is pending), but for now all hams are welcome to make their own and experiment with the multiband capabilities. 73

QRX

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meeting, ARRL President Rod Stafford W6ROD observed, "The debate was at times contentious and the result was not unanimous. Some board members preferred greater simplification; others were uncomfortable with some of the changes being proposed. However, every board member, without exception, left the meeting knowing that each of his or her colleagues did what they believe is best for the future of amateur radio."

Members are urged to contact their ARRL directors to comment on this proposal.

Forwarded from a Cornell (University) ARC Newsgroup bulletin by Shaun Gartenberg KB2JNW, via WA2YYX.

We'd Choose a Somewhat *Stronger* Word

On the night of 14 October 1996, the aircraft carrier *USS Theodore Roosevelt* and the cruiser *USS Leyte Gulf* were engaged in predeployment drills and tests off the Atlantic Coast. The *Roosevelt* was testing its Challenge Athena communications system, which was getting interference from the ship's radar system. At the same time, the *Roosevelt* was also testing its propulsion systems and conducting electric power shifts—which caused communications gear to cease operations at times. Part of the propulsion system tests included putting the engines astern for long periods of time.

The *Leyte Gulf* was trailing the *Roosevelt* at a range of about 4,000 yards, and had not been informed of the tests being conducted on the *Roosevelt*. Because the communications systems on the *Roosevelt* were not able to be used, the two ships were using flashing light to exchange messages—a method used in yesterday's navy, but apparently a lost art today. It took 25 minutes for one message to be received and passed on to the bridge. Flashing-light messages are sent using Morse code, and the text of the message that was received was garbled.

At 2:44 A.M., the *Roosevelt* went to "Emergency Back Full" on its engines and was going astern at 17 knots. At 2:49 a signalman aboard the *Roosevelt* started to send a message that said, "My engines are astern." The *Leyte Gulf* had not been told of this maneuver and the officer of the deck was confused by the movement. After recognizing the danger that was approaching, the *Leyte Gulf* also went to "Emergency Back Full" on its engines, but it was too late to avoid a collision. The *Roosevelt* and *Leyte Gulf* collided at 2:52 A.M. The result? *Over $10,000,000 in damage* to the two ships. Fortunately, there were no deaths or serious injuries involved.

The Board of Inquiry results stated that 25 minutes to deliver one message by flashing light using Morse code was "unsatisfactory."

TNX Jack R. Main W4YCZ. This appeared in the May 1998 issue of the *W8KEA Midland ARC* newsletter, Judy Engel KB8WEE, editor, but we got it from the *ARNS Bulletin*, June 1998 issue. 73