Efficient 2 meter Disguise Antenna Made From a TV Satellite Dish

This horizontal “slot” antenna, cut into the reflector of a TV dish, is both the master of disguise and high in performance.

By John Portune W6NBC

47 C.F.R. Section 1.4000, October 1996, “prohibits restrictions that impair… antennas used to receive video… including… satellite dishes less than one meter (39 in.) in diameter”. (FCC Web Site)

I’ve long wondered, is it practical to hide an efficient 2 meter base-station antenna in a TV satellite dish? My CC&R committee couldn’t make me take it down. But what about all the metal in the TV dish? Wouldn’t that compromise a 2 meter antenna? Finally it struck me, don’t fight the metal; take advantage of it. Cut a “slot” antenna into the TV dish’s reflector.

A slot antenna is a narrow rectangular opening in a large conductive surface, such as a TV satellite dish. Slot antennas are familiar in the commercial radio world, but not to hams. They’re common in TV broadcasting, the skin of aircraft and in radar, microwave and cell phone applications. This disguised TV dish slot is equal to a J-pole (Figures 1 and 2) and is also a great way to learn about slot antennas.

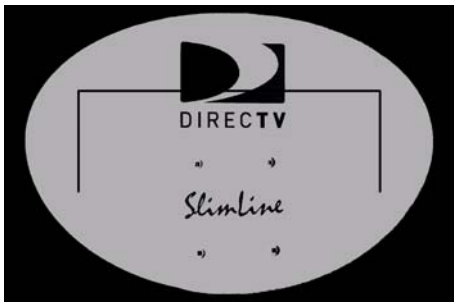

Figure 1: Representation of a horizontal slot antenna cut into the reflector of a SlimLine DIRECTV satellite dish.

Figure 2: My modified TV satellite dish.
Note low visibility of the uncovered slot.

The Slot Antenna

My learning curve first showed me, as the literature says, that a slot behaves much like a dipole. Both have roughly 2 dBi gain, perpendicular to the antenna and they are omni-directional on axis. Also I quickly found that a slot is docile and easy to work with. I was delighted to find that this one displays close agreement to theory. It's a classic 38 in.

The width of a slot, I further learned, determines its bandwidth. Its analogous to the conductor diameter of a dipole. My first slot was arbitrarily ½ in. All small widths I subsequently tried worked well too. This one is a single jig-saw-blade cut. I reasoned that the thinner the slot, the less the neighbors would notice it. Figure 3 graphs its very adequate bandwidth – less than a 1.5 to 1 SWR over the entire 2 meter band.

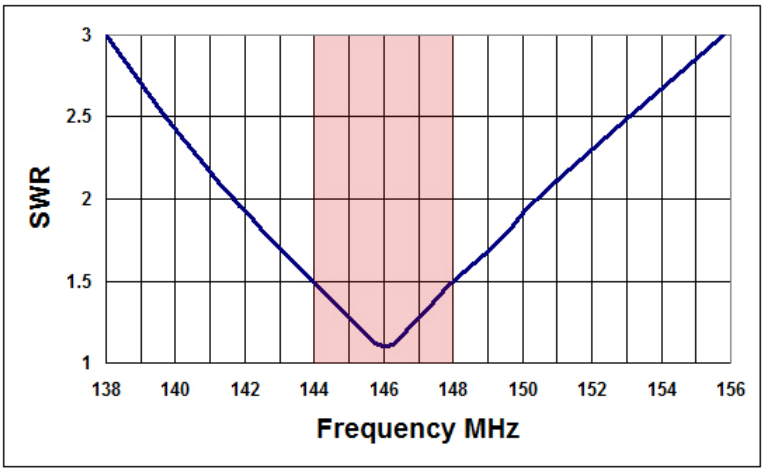

Figure 3: Bandwidth of my
single-saw-blade-cut TV dish slot antenna

A slot, however, isn't exactly a dipole, there are differences. Here, one difference is very convenient. A horizontal slot is surprisingly, vertically polarized. The RF currents flowing in the entire surface around the slot, cause a 90 degree rotation of the E and H fields. Hence, a horizontal dish slot is correct for vertically polarized 2 meter repeaters.

Dish Size and Slot Size

At first, I considered an 18 in. round or 18 x 20 in. elliptical dish. However, the common 22 x 32 SlimLine DIRECTV dish, or equivalent, is better. It has a larger surface area. Kraus (Antennas, Ch 9, p. 305, 3rd Edition) suggests that classical slot behavior is achieved for a surface larger than ½ λ by ¾ λ. This did make me wonder if even a SlimLine dish would be too small. Subsequent tests suggested otherwise. This slot behaves classically. I welcome reader comments, though.

However, in a SlimLine DIRECTV dish, the slot can't be straight; the ends must "droop." But again like a dipole, this only slightly "softens" the gain and directivity. Figure 4 shows the comparison, using dipoles for the simulations. EZNEC is "iffy" for slots.

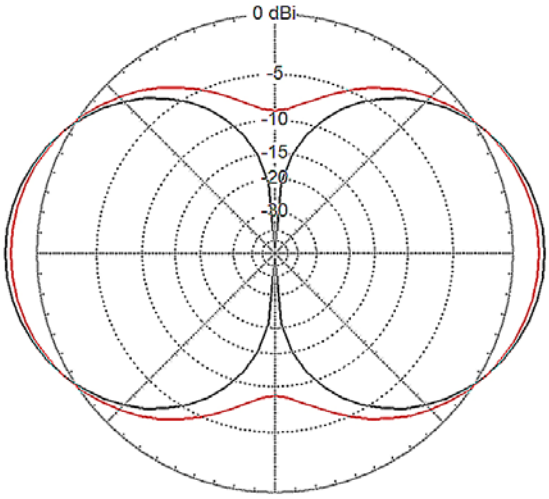

Figure 4: Elevation radiation patterns (dipole simulated) of my bent slot (red) vs. a straight slot (black). Gains: 1.9 dBi and 2.1 dBi respectively

Cutting the Slot

To cut the slot, remove the reflector from the mount and LNB assembly. Mark a straight 24 in. horizontal line and two 7½ in. drooped ends (39 in. total) on the back, positioning them as in Figures 1 and 2. Exact position is not critical. Make a single jig cut with a 21 tpi HSS metal-cutting blade. File the edges smooth and apply clear plastic spray paint for rust prevention. Do not bother to cover the slot. The neighbors won't notice left open at this width.

This 40 in. is a little too long. I did this intentionally to cause the slot to tune up a little low in frequency. A too-short slot would have been difficult to lengthen with the dish in location. It's much easier and just as effective to "short" a slot end with heavy aluminum tape. Hardware stores usually sell heavy aluminum tape in the same department as duct tape. If the short is large compared to the slot (roughly 1½ in. by 1½ in.), capacitive coupling makes it unnecessary to remove the paint from the dish.

For stability, the dish needs a rigid plastic brace across the slot (back center). I used 3 inches of ½ in. square nylon bar stock attached by

four 6-32 brass screws. The plastic handle of an old paint brush, for example, would also be fine.

Feeding and Matching

Attach the feed coax braid to one side of the slot and the center conductor to the other directly across, though not in the middle. Coax feed for a slot is best done off-center. The reason is this. A dipole's free-space impedance is low in the middle (72Ω), ***increasing*** toward the ends. A slot's free-space impedance is conversely high in the middle (493Ω), and ***decreases*** toward the ends. Kraus, (Antennas, Ch 9, 3rd Edition) estimates 50Ω points roughly 1/20 λ from either end. With my MFJ-259B antenna analyzer, I easily found the match near his estimate.

Then, because all antennas are affected by location, during my learning curve, I used an easy-to-move feed-line-attachment fixture. With it I found that feed point location is not touchy. See Figure 5. You needn't duplicate my movable fixture. It will be fine to directly make a permanent attachment. See Figure 6.

Figure 5: Feed point SWR near the end of the slot.
4.5 in. is a good compromise for most dish locations

As you can see, the match is good anywhere 3 to 6 inches from an end. 4 ½ in. works well for most final dish locations (Figure 6). Be sure, though, to use a 1:1 current balun. The one shown is six turns

of RG-58 coax, secured with UV-stabilized ty-wraps. I used clear silicon adhesive to attach the balun to the back of the dish.

Figure 6: Coax attachment, 4½ in. from end.
Note six turn coiled-coax 1:1 choke balun.

Using the Dish

After seeing my dish, my ham friends asked if one dish could be used for both 2 meter activity and TV reception. Possibly, but recalling that the slot has azimuth gain, you might want to point your slotted dish at the repeater(s). However, it's omni-directional in elevation, so you can tilt it upward as if it were receiving TV satellite signals. For a good wave angle to the repeaters, mount it at least at roof height as you would any 2 meter antenna.

Another reason dual operation may not be practical is that 2 meter transmissions might interfere with TV reception. I have not tested this, so I welcome reader comments. I prefer separated dishes, on opposite sides of my house. That way my neighbors don't notice the aiming difference.

Finishing the Dish

Lastly, I left the LNB assembly as is. The arm is perpendicular to the slot and the whole assembly is likely not resonant. With a little effort, though, a false non-metallic feed assembly could be fabricated. I did not consider the effort worthwhile.

With one of these neighbor-disguised dishes, next time you're talking on your local repeater you can say, "I'm coming to you through my TV satellite dish." That should spice up channel chatter.

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