An Efficient 2 Meter Antenna Disguised as a TV Satellite Dish

This vertically polarized horizontal slot antenna, cut into the reflector of a TV dish, might be the ultimate stealth antenna.

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I've long wondered if it would be practical to hide an efficient 2 meter base-station antenna in a TV satellite dish. My homeowners covenants, conditions, and restrictions (CC&R) committee couldn't force me take it down.[1] But would all the metal in the TV dish compromise a 2 meter antenna? Finally, it struck me: don't fight the metal, take advantage of it, by cutting a half-wavelength-long slot antenna into the TV dish 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. They're common in TV broadcasting, the skin of aircraft, and in radar, microwave, and cell phone applications. This TV dish (see Figure 1) slot is the complement to a dipole. It is also a great way to learn about slot antennas.

Figure 1 — Note the low visibility of the slot in my modified satellite TV dish.

The Slot Antenna

A slot behaves like a dipole. Both have roughly 2 dBi gain perpendicular to the antenna and they are omni-directional on axis. I found that a slot is easy to work with. I was delighted to find that this one displays good agreement with theory. The width of a slot — like the conductor diameter of a wire dipole — determines its bandwidth. My first slot was arbitrarily ½ inch in width, but all smaller widths I subsequently tried also worked well. The one described here is a single jigsaw blade cut. I reasoned that the thinner the slot, the less neighbors would notice it. Figure 2 graphs its very adequate bandwidth — less than 1.5 to 1 SWR over the entire 2 meter band.

The horizontal dish slot is correct for vertically polarized 2 meter repeaters.

There are differences between a slot dipole and a wire dipole. The horizontal slot is vertically polarized because of the RF currents flowing in the entire surface around the slot. The horizontal dish slot is correct for vertically polarized 2 meter repeaters.

Dish Size and Slot Size

The common 22 × 32-inch SlimLine DIRECTV® dish, or equivalent, is a good choice. It has a large enough surface area. My *Antennas* textbook suggests that classical slot behavior is achieved for a surface larger than ½ λ by ¾ λ.[2] This made me wonder if even a SlimLine dish would be too small, but tests suggested otherwise. This slot behaves classically. I welcome reader comments on their experiences.

There isn't enough room for a straight slot in a SlimLine DIRECTV dish — the ends must droop in order for the slot to fit. This only slightly "softens" the gain and directivity. Figure 3 shows the comparison between wire equivalents of the slot, and of a dipole. I used wire equivalents for the simulations because *EZNEC* is not suitable for slots.

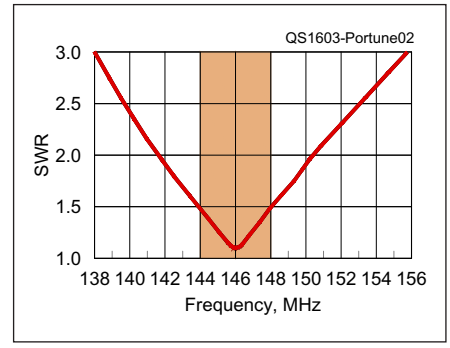

Figure 2 — Bandwidth of a single-saw-blade-cut TV dish slot antenna.

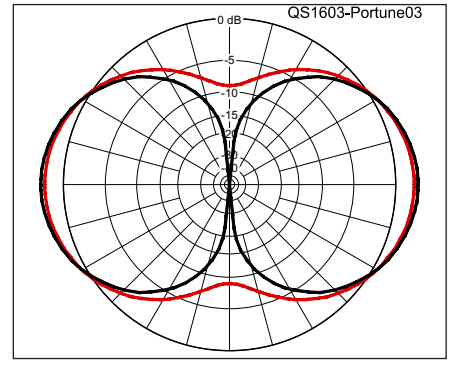

Figure 3 — Elevation radiation patterns for a vertical wire simulation of the bent slot (red) and a straight slot (black). The peak gains are 1.9 dBi and 2.1 dBi, respectively.

Cutting the Slot

To cut the slot, remove the reflector from the mount and LNB assembly. Mark a straight 24-inch horizontal line and two 7.5-inch drooped ends (39 inches total) on the back. Position them as shown in Figure 4. Exact position is not critical. Make a single jigsaw cut with a 21 tpi HSS metal-cutting blade. File the edges smooth and apply clear plastic spray paint to prevent

Figure 4 — A horizontal slot antenna, with drooping ends, cut into the reflector of a Slim-Line DIRECTV satellite dish.

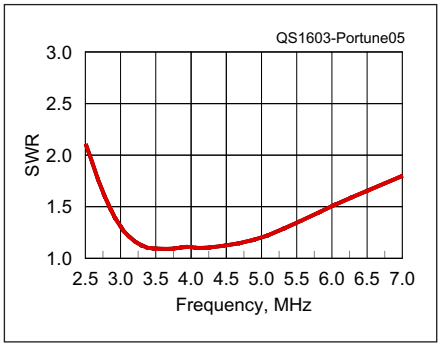

Figure 5 — SWR for a feed point approximately 4.5 inches from the end of the slot.

Figure 6 — The coax feed line includes a six-turn coiled-coax choke balun and attaches 4.5 inches from the slot end.

rust. Do not cover the slot. The neighbors won't notice the slot at this width.

My 40-inch-long cut is a little too long. I did this intentionally to cause the slot to tune 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 (a hardware store item). If the short is large compared to the slot (roughly 1.5 × 1.5 inches) capacitive coupling makes it unnecessary to remove the paint from the dish.

For a good path to 2 meter repeaters, mount the dish at least at roof height, as you would any 2 meter antenna.

For stability, the dish needs a rigid plastic brace across the slot (back center). I used 3 inches of 0.5-inch square nylon bar stock attached with 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 side directly across, though not in the middle. Coax feed for a slot is done off-center. A center-fed wire dipole impedance is Z_{dipole}=72 Ω, increasing off-center toward the ends. Conversely, the slot dipole impedance is high in the middle (Z_{slot}=493 Ω), and decreases toward the ends. My *Antennas* textbook estimates the 50 Ω points at roughly 0.05 λ from either end. [The wire dipole and slot dipole are complementary structures. Their center-fed impedances are related by $(376.7)^2=4Z_{dipole}Z_{slot}$ and their electric and magnetic fields, and thus polarizations, are swapped. — *Ed.*] Using my MFJ-259B antenna analyzer, I easily found the match near the textbook estimate.

I initially used an easy-to-move feed-line attachment fixture and found that the feed point location is not touchy (see Figure 5). You needn't duplicate my movable fixture — just directly make a permanent attachment as in Figure 6.

The match is good anywhere from 3 to 6 inches from an end. Be sure to use a 1:1 current choke balun. The one shown is 6 turns of RG-58 coax secured with UV-stabilized Ty-Rap® cable ties. I used clear silicon adhesive to attach the choke to the back of the dish.

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 directivity, you might want to point your slotted dish at the repeater(s). However, it's omnidirectional in elevation, so you can tilt it upward as if it were receiving TV satellite signals. For a good path to 2 meter repeaters, mount the dish at least at roof height, as you would any 2 meter antenna.

Dual operation may not be practical because 2 meter transmissions might interfere with TV reception. I have not tested this, and welcome reader comments. I prefer separate dishes, on opposite sides of my house.

Finishing the Dish

I left the TV 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 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 the channel chatter.

Notes

[1]US 47 CFR 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." **https://www.fcc.gov/guides/over-air-reception-devices-rule**.

[2]J. Kraus, *Antennas*, 3rd Edition, Chapter 9, p. 305.

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