Want a Good Microwave Antenna? Drink More Coffee!

Looking for a highly effective microwave horn antenna? Look no farther than your pantry! Food cans (empty, of course) can be just the right size to give you lots of gain—just watch out how much YOU gain by emptying the cans!

It was about 12 years ago and I was looking for the right-sized feed for a 3456-MHz dish antenna I was building. I did the calculations, then went into the kitchen cupboard with a ruler, measuring cans, and said, "Uhhh Dear, can we have the stewed asparagus for dinner?" Hey, the can was the right size!

Believe it or not, plain old run-of-the-mill coffee cans (see Photo), soup cans, etc., can be just the right size to serve as excellent microwave horns antennas (see last month's "Antennas, etc." column for more on horn antennas in general). How do you calculate the correct size that you'll need? One of the most useful articles I've ever seen is from the May, 1976, issue of *Ham Radio* magazine. Norm Foot, WA9HUV, put together a family of charts and curves for cylindrical feed horn antennas. Going into his charts, you could come up with the optimum diameter feedhorn for any frequency. I highly suggest digging up a copy of this article if you can find a friend with a collection of *Ham Radio* magazines. Or if you are patient, a complete set of *Ham Radio* will soon be available on CD from CQ Communications. For the moment, I'm just going to stick with what we can do with 3-pound and 1-pound coffee cans.

Photo. 1200-MHz and 2300-MHz horn antennas made from coffee cans. Your next feedhorn may be as close as your kitchen pantry.

1296 MHz— Lots of Coffee

You can turn a coffee can into a quick and simple horn antenna with 8.5 dBi gain for 1296 MHz. Its bandwidth is very broad and this horn can be used as is from 1100 MHz to 1500 MHz. It works great in SSB, CW, FM, ATV, satellite, and even SETI (Search for Extra-Terrestrial Intelligence) applications.

Take an empty 3-pound coffee can and drill a hole for the coax connection along the solder seam 4 1/2 inches from the bottom (see Figure 1 for other dimensions). Now mount a Type "N," BNC, or SMA connector in your hole. Inside, solder the probe to the coax connector (the probe is the actual antenna element, generally cut to 1/4-wavelength at your proposed operating frequency). You want the probe to be sort of thick; #16 copper wire, 1/8-inch copper or brass tubing, and 1/4-inch-wide strips of .032-inch sheet brass have all been used and have all worked well.

One is good, so two is better, right? Yep, in this case. The probe is pretty close to the opening of the 3-pound coffee can,

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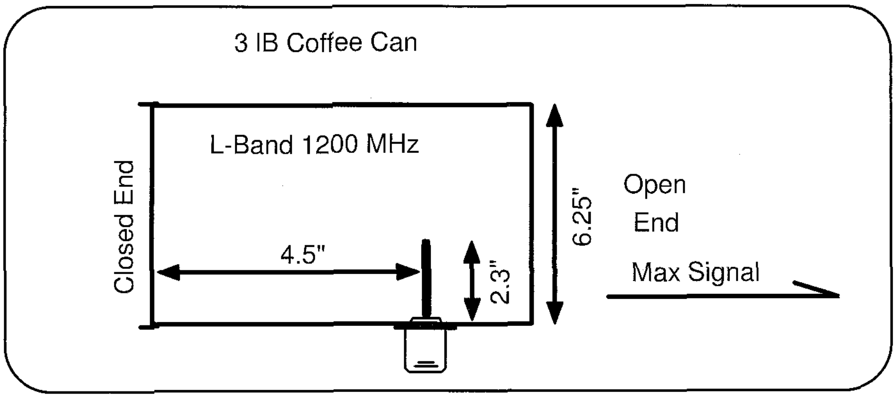

Figure 1. Dimensions for a 1200-MHz horn antenna made from a 3-pound coffee can.

adding a second 3-pound coffee can will improve the gain from 8.5 to 10.5 dBi (see Figure 2).

Just cut the bottom out of the can (I'll assume the top has already been removed and the contents have already been consumed), so you just have a steel tube. Attach the second can to the first and extend the horn. You don't have to completely solder the gap between the cans. I've found that a couple of spot solder points work fine. I've also used that aluminum wallboard tape with good results, and have even used duct tape once or twice. The super glues I tried didn't work well at all.

Now, I know exactly what you're thinking (I tried it over 15 years ago). If one can is good, and two are better, let's go for three! Without going into waveguide theory, I can tell you that it won't work. When I tried using three cans, overall gain dropped to only 7 dBi.

I have taped these to poles and stuck them up in the air for "rover" contacts. I nailed one to a rafter in my roof, pointed it at a local 1200-MHz repeater and used it for several years. And a dozen years ago, W5DBY in Ft. Worth, Texas, worked a station near Miami, Florida, on 1296-MHz SSB. For many years, this 1,100-mile QSO was the U.S. 1296-MHz tropo record. And yes, W5DBY was using a 3-pound coffee can duct taped to his tribander for this record QSO.

2.3- and 2.4-GHz Horns

In Figure 3, you'll see a 3-pound coffee can configured as a 2.3-GHz horn. The antenna runs about 10.2 dBi gain on 2304 MHz, and, while I haven't measured the gain on 2400 MHz, the results should be similar. You *don't* want to put a second can on this version and extend its length. I tried it, the pattern was horrible.

A 1-pound coffee can also make a pretty good antenna on this band (see Figure 4). Gain is between 6.5 and 6.8 dBi, and I've been using a set of these 1-pound can antennas for five years now on 2.4-GHz spread spectrum.

Cans and Dishes

While simple and practical antennas in their own right, these coffee can antennas really shine when they're mounted at the focus of a dish. A single 3-pound coffee can feed makes a great 1200-MHz dish feed for SSB, CW, ATV, or AMSAT Mode L. The single 1-pound coffee can feed works best as a 2.3-GHz or 2.4-GHz dish feed. Just what you need for AMSAT Mode S.

The orientation of the probe determines polarization of the antenna. When the probe is vertical, then the antenna is vertically polarized. Mount the probe horizontally and the antenna is horizontally polarized.

Radomes

Having had various cans in the air for nearly 20 years, I can tell you from personal experience that these cans make ideal nesting sites for the local avian population. So some sort of radome, or cover, is a good idea if you're mounting it outside. The plastic lids that originally came with the coffee cans are only good for a few months, they then break down from exposure to ultraviolet light.

A plug of about 1-inch thick Styrofoam works well, as does some of the bird netting available at many hardware stores. Whatever you use to cover the opening, keep it thin. Something thick, like glass or even Plexiglas, will be lossy.

If you're permanently mounting the can outside, I strongly suggest painting it with one of the spray epoxy paints. It will last years longer and the light gray colors will draw less attention to your antenna.

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CW = 10-dB Gain

If I can make only one suggestion to new No-Code Techs, it would be to learn enough code to a least recognize your own callsign before getting too active on the higher bands. The number varies a bit, but basically it takes 10 times as much power to make an SSB QSO than it does to make a CW QSO. So 1 watt of CW goes about as far as 10 watts of SSB. Ya like FM? You're going to need *40* watts of 5-kHz-wide FM to go as far as a 1-watt CW signal. Now just imagine how far 1500 watts of CW can go!

CW gets through when nothing else will. When UHF and microwave stations are trying to get hooked up, they typically start on CW. When signals are heard, the signal is tuned in a bit better, the antenna is peaked, and the call is returned on CW. If the signal is still pretty weak, make sure you keep transmitting back for 30 seconds or so. This gives the

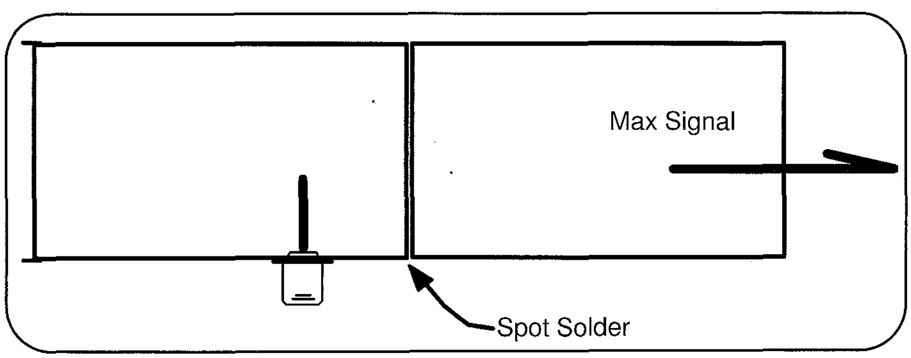

Figure 2. Extended 1200-MHz horn antenna. This is made with two 3-pound coffee cans (drink up!) soldered or taped together.

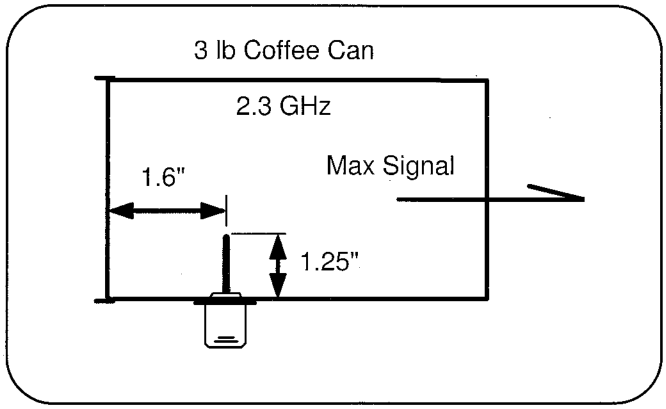

Figure 3. A 3-pound coffee can set up for 2.3 and 2.4 GHz use.

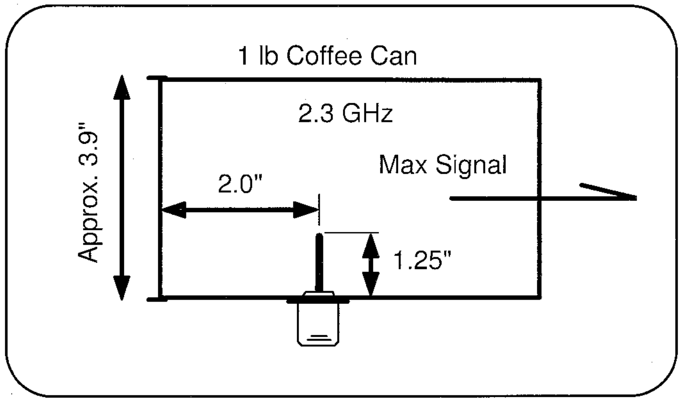

Figure 4. Here's how to set up a 1-pound coffee can for 2.3 and 2.4 GHz. This can be helpful if using 3-pound cans makes you too jumpy!

other station a chance to peak up his or her antenna on your signal. If signals are now solid copy, of course flip over to SSB; if not, you can probably finish off the QSO on CW.

Now I realize that many of you can be afraid of those long CW QSOs. On the higher bands, though, we're not going to be chatting about gardening tips or our bypass surgery. It's just going to be your call, their call, and the numbers in the signal report. Hey, if you're going out portable for a contest group, or to give someone a new grid/state/county, you only have to recognize their call and your own. This is far easier than copying five minutes of text. Just remember, knowing those 10 letters or so in CW is worth an extra 10 dB!

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ATV Interference on UHF Bands

There has been some interesting but erroneous information published recently regarding the interference potential of ATV signals on the UHF bands (see "Reader Feedback," September, 1999, *CQ VHF*), particularly ATV signals centered on 434.000 MHz. The writer cited his credentials as an ARRL Technical Advisor and a member of his local coordinating council's technical committee. Well, I'm also a member of my local coordinating council's technical committee (Texas VHF FM Society), a member of the ARRL Spectrum Management Committee, and was, until quite recently, a Video Applications Engineer for Tektronix. And I feel the need to set the record straight.

The actual power in the video sidebands is highly dependent on the video content. These sidebands peak 27 to 25 dB below the video carrier on commercial broadcasts, not the "more than 40 dB down" figure that has been commonly quoted. And since hams tend to, shall we say, push the modulation limits, 20 to 25 dB below the video carrier is really more typical of an amateur ATV signal at 2 MHz from the carrier frequency. Even these numbers are not truly representative of the interference potential of NTSC video signals (the standard for TV in the U.S.). When monitored on an SSB re-ceiver, the video signals come out as a series of pulsing carriers every 15 kHz. So the RF energy is condensed into carriers, not uniformly spread out as a spectrum analyzer might suggest. Allowing for the modest beam antennas most ATVers use, and the typical 150-watt amps, this gives a 434-MHz ATV signal the same interference potential as a pulsing 10-watt CW signal into an omnidirectional antenna.

The use of vestigial sideband (VSB) filters would limit the bandwidth of the ATV signal and greatly reduce this problem, but simple VSB filters cannot be used on the cheaper ATV transmitters. One side of the ATV signal goes through the filter, and the other side of the signal is blocked or reflected back by the filter. This means the ATV transmitter is operating into a high SWR and video linearity suffers, i.e., a pretty bad picture comes out. There are several technical solutions to this problem, such as filtering the video at an earlier stage, using absorptive rather than reflective filters, better transmitter stages, etc., but these would increase the price of the cheaper ATV units and are rarely used.

The next problem is finding out who is tearing up a UHF band with an uncoordinated ATV signal. It's a bigger problem that one might first think. First, you've got to rig up an ATV station just to see his face or read his call card! Plus, you'll need 20 to 30 dB more signal to read his call card than the signal level that will open the squelch on a repeater or heterodyne an SSB/CW QSO. In the past, these uncoordinated ATV stations have torn up hundreds of square miles and been very difficult to find.

Interference from ATV signals were a common problem and numerous complaints have been filed with coordinating bodies in my area. Fortunately these complaints have fallen off as NTSC AM ATV falls in popularity. The new FM ATV video systems have a 17- to 23-dB advantage over AM ATV. This means the new 2-watt FM ATV system goes farther than an old 100-watt AM ATV station! (To give you some idea of how popular AM video is among professionals: can you name a communications satellite that transmits AM video back to Earth? Unless you work in the satellite TV business, chances are you can't. It's one satellite, it's in geostationary orbit over India, and it transmits PAL—the European standard—not NTSC, AM video.)

Aim High!

That's about it for this month. Remember, our microwave frequencies are extremely valuable to commercial interests, and, unless more of us start using them on a regular basis, we'll be in danger of losing them.

—73 de WA5VJB