by Kent Britain, WA5VJB

A Cheap And EZ HDTV Antenna Project

Here's an inexpensive way of helping along that new Digital TV converter you just got with the government HD converter coupon you requested. And the good news is that this antenna (**Photo A**) is not limited to just DTV, but will also work well with the UHF low-power analog and translator stations which are not covered by the new laws (see "Countdown to Digital Television" elsewhere in this issue for more on the topic).

Haven't gotten a converter yet? First make sure you pay a quick visit to www.dtv2009.gov, fill out the on-line form, and in a few weeks you'll get your coupon for $40 toward the purchase of a converter. Not connected to the Internet? Then you can call 1-888-DTV-2009 (1-888-388-2009) and apply for a mail-in form. The HDTV coupons work like credit cards and are tracked by address, so you can apply for your parents, grandparents, great aunt, etc. Just use their address to help them get ready for the switch over.

As I mentioned last time, when choosing your converter you really want a model that has an antenna bypass switch. The cheapest converters usually don't. And that automatic antenna switch is worth a few extra bucks. As with your VCR, when you turn off the VCR, it connects the cable or TV antenna back to the TV set. Many of the low-cost HDTV converters saved a few pennies by leaving off the antenna switch, but remember, *not all the analog stations are going off the air*. Stations running 10 kW ERP or less are not required to go off the air. And, while the government plans to auction off TV Channels 53 to 68, not all of those channels will be going off the air. Many of the low-power and translator TV stations get to stay on until the new owner actually starts to use the frequency. And that may be a *long* time in some parts of the country.

Theory

Yagi-type antennas are limited in how wide a frequency range they will cover, so I'm pulling several tricks on this one. At the low end of the band, we have the driven element and the longer reflector. Down at 470 MHz for TV Channel 14, this is basically a two-element Yagi. The directors are pretty short at TV Channel 14 and are helping a little bit, but not much. Up at 700

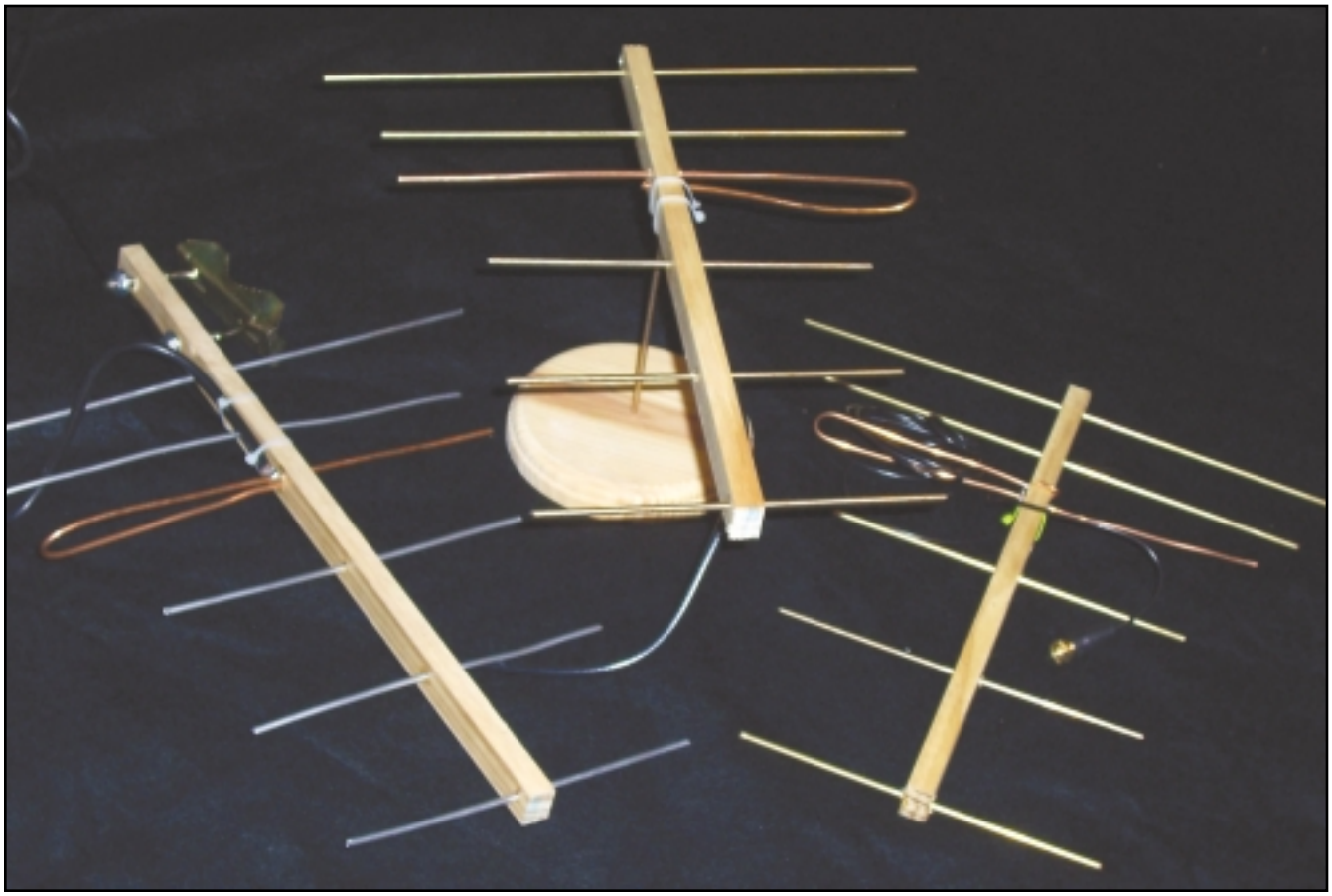

Photo A. Easy-to-build HDTV antennas.

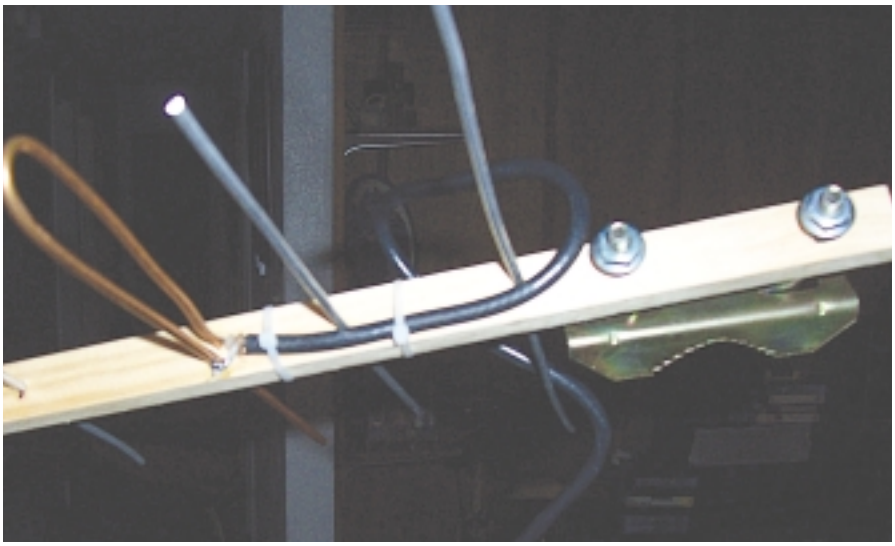

Photo B. Close up of the coax connection.

MHz for TV Channel 58, the reflector is too long, and too far back, so I've added the second reflector element, which is tuned to the higher end of the band.

The three directors are now doing their job and really helping the gain of the Yagi. This means the antenna has more gain at the UHF channels in the 50s than it does in the teens, but this works out just fine. As you go up in frequency the signal has more path loss and the walls of the house have more loss. And even the coax itself has more loss as you go up in frequency so the extra gain is put to a good use. **Figure 1** is the pattern of this Yagi at 476 MHz for the low end of the band, and **Figure 2** is the pattern at 700 MHz.

Construction

Figure 3 shows the lengths and spacings for the elements. The elements can be made from almost any rod material about 1/8 inch in diameter. You can use #10 to #12 copper wire, aluminum ground rod wire, tubing from a hobby store, or, my favorite, bronze welding rod as element material. Desperate? Clothes hanger wire can even be used, but find some rod or wire made out of brass or copper for the driven element (it's kind of hard to solder coax to iron wire).

With an antenna this broad, element diameter is not as critical as it would be for single-frequency Yagis. For the boom I used 1/2-inch wide wood. Wood dowel also works. I know several of you will also ask about PVC pipe. Personally, I don't like it, and it will look pretty ugly on the TV set, but, yeah, it works. Just paint it black or something!

Again, I want to stress that the driven element needs to be made from copper or brass so you can solder the coax more easily. The element spacing is designed to allow the driven element to directly drive 72 Ohm coax (**Photo B**). Now you can use that old RG-59 or RG-6 jumper with only one good end. Dimensions for the driven element are given in **Figure 4**.

Use

For one version I made a small pedestal to get it up off the shelf a bit since

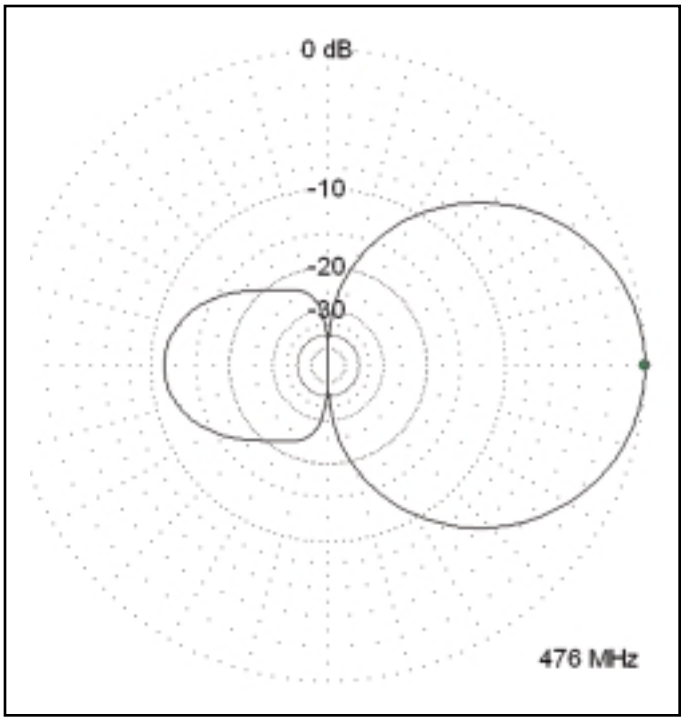

Figure 1. EZ HDTV pattern on UHF TV Channel 14.

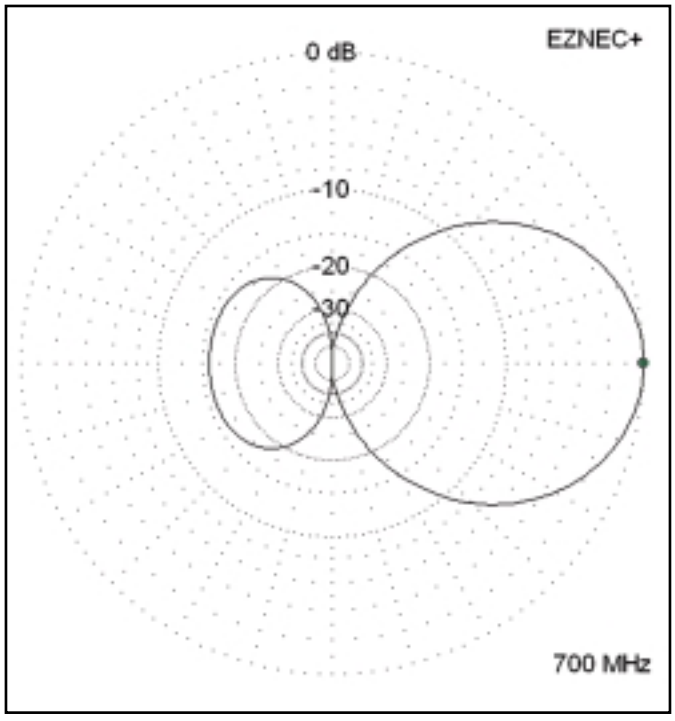

Figure 2. EZ HDTV pattern on UHF TV Channel 52.

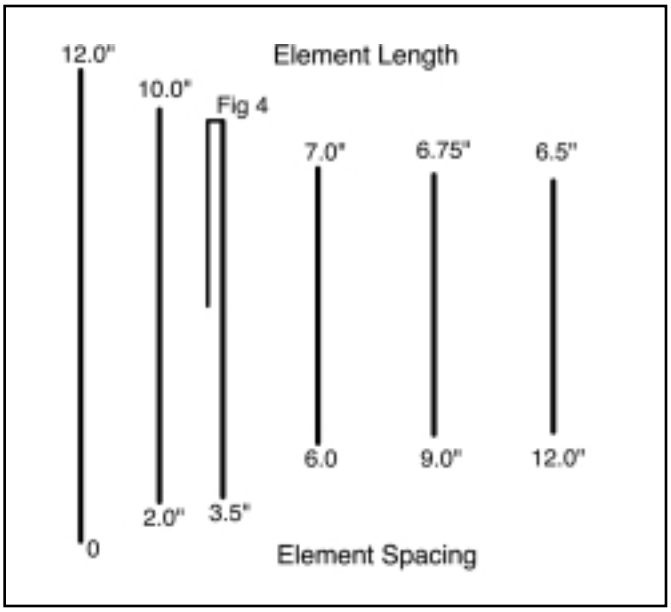

Figure 3. Element lengths and spacings.

metal a few inches from the elements can detune the antenna. For another version I made the boom several inches longer and drilled holes for a U-bolt so I could attach it to a mast. But I must confess that mine is really in the attic sitting on a cardboard box. The box got the antenna a foot higher and away from some electrical wires. Again, remember to point the end with the shorter elements toward the TV transmitters.

Figure 5 is a spectrum analyzer plot of one of the prototype's coverage of the UHF TV band in the Dallas, Texas, area. It shows us virtually "channeled out." At last count only two channels do not have a signal, so the band is pretty busy. **Figure 6** is a plot of a local UHF analog TV signal. On the left side is the Video carrier; the noisy area is the video signal and over on the right is the Audio carrier. Down and almost in the noise is the Croma carrier. Kind of weak isn't it? Now you know why the picture fades back to black and white when the TV signal is weak—the TV loses the color signal.

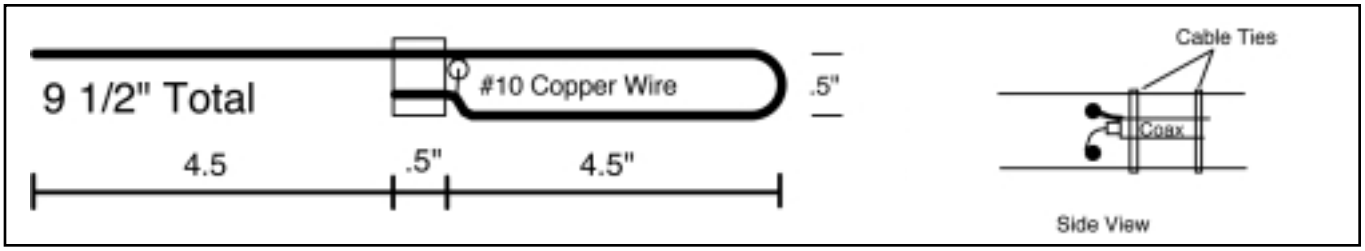

Figure 4. Driven element dimensions.

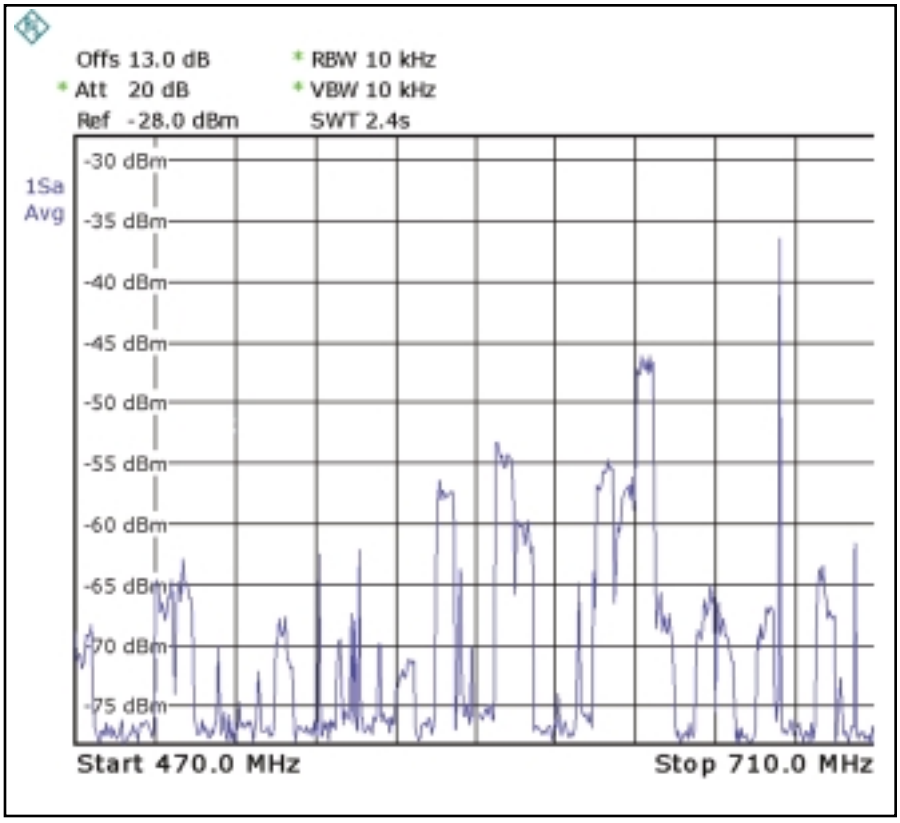

Figure 5. Dallas area UHF TV band.

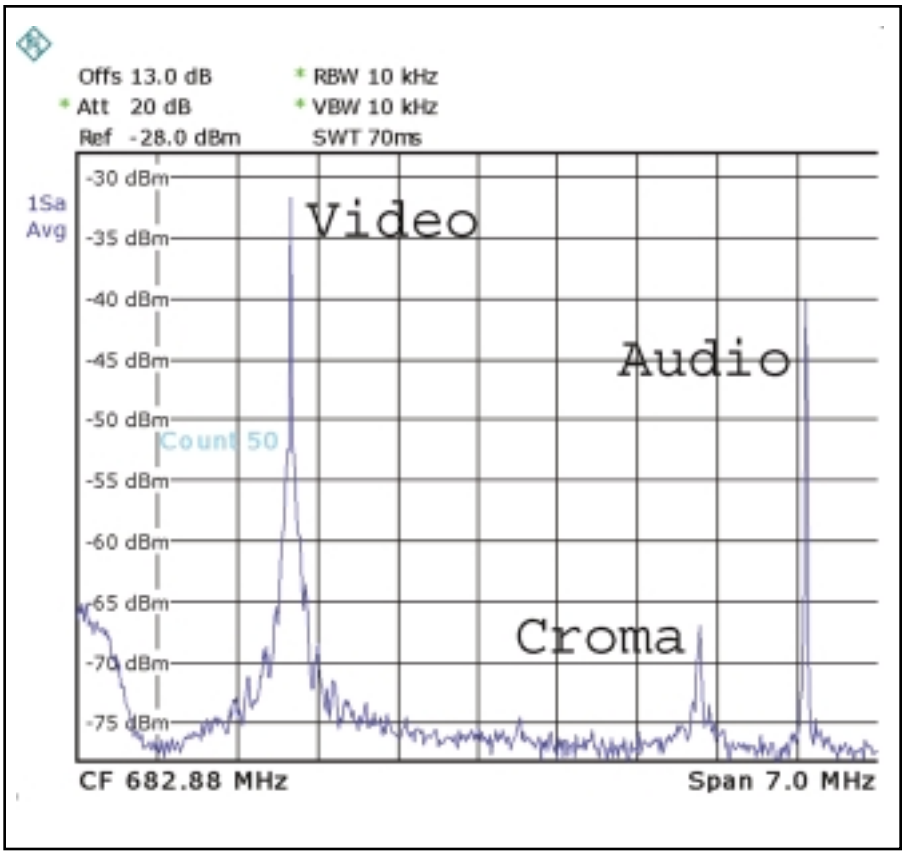

Figure 6. Spectrum analyzer plot of an analog TV signal.

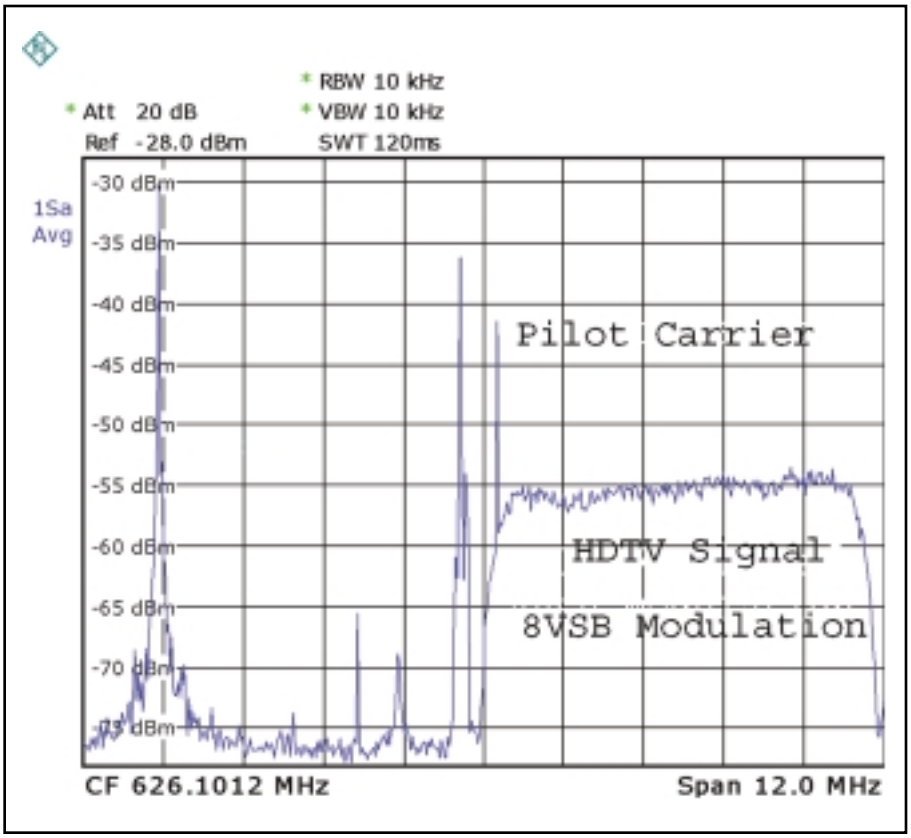

Figure 7. Side-by-side analog NTSC and digital 8VSB.

In **Figure 7** you see the HDTV signal which uses 8VSB modulation (again, refer to the "Countdown…" feature for more information and explanations of unfamiliar terms). In the industry this waveform is affectionately called a "Bart's Head" since it looks like Bart Simpson's hair. You can clearly make out the Pilot carrier. This reference carrier for your 8VSB demodulation chip is exactly 309,441 Hz, or 309.441 kHz above the bottom of the channel. This carrier is specified to never have a frequency error exceeding 3 Hz, so they make great calibration standards for wideband receivers and even spectrum analyzers. Just put your ICOM R-7000 or similar radio in SSB mode and zero beat the carrier. As an example, TV Channel 14 is assigned 470 to 476 MHz. The Pilot carrier for HDTV Channel 14 would be 470.309411 MHz, and usually with less than 1 Hz of error.

There are several mathematical ways of measuring NTSC and 8VSB power, but the 8VSB transmitters are running 14 to 17 dB less power. That means the digital transmitters only need 2 or 4 percent of the power to get the same coverage as an analog signal requires—that makes a big difference in the station's power bill at the end of the month. I saw one VHF HD 8VSB transmitter covering an entire major population center, and it just plugged in the wall.

At the moment I don't know how those in charge plan to transition channel numbers. In this area analog TV Channel 8 uses Channel 9 for its digital signal, but TV Channel 2 uses Channel 43 for its digital signal. Over 95 percent of the digital stations are on UHF, but there is no rhyme or reason to the channel allocated for the analog's digital signal. Your HDTV or TV converter figures all this out, but there are few channel lists. However, for a list of available TV channels in your area, and recommended antennas, visit www.AntennaWebb.org.

Until Next Time

As always, we appreciate your questions and suggestions for column topics. Just drop me an email at wa5vjb@cq-vhf.com or you can visit www.wa5vjb.com for other antenna projects. You, our readers, provide some of the best topics for columns. ■