To A Neighbor's Rescue: Now She Can See Her DTV

A Primer on Digital Signal Reception in The New TV World Part 1 of a Two Part Series

by Phil Karras, KE3FL
< http://cs.yrex.com/ke3fl >

The question continues to be asked: Do I really need a "digital antenna" to receive digital TV (DTV)?

No, you don't. First, there is no such thing as a *digital antenna.* Second, my experience shows that old TV antennas designed for the predigital analog era can work fine in many cases.

I've tested antennas that were not made for TV and even these can be used to receive the current DTV signals. In fact, some of these non-TV antennas worked far better than I expected.

I am a firm believer in the *try it* method and love to experiment with *this, that or the other thing.* Whenever I have a new idea, I jot it down so I can try it when I have the opportunity.

Receiving, 101

Let's start with the basics of receiving any kind of radio-frequency (RF) signal, focusing on DTV. For DTV in the VHF/UHF range we're interested in line-of-sight (los) signals. *(NOTE: los is not LOS, which is used for Loss Of Signal. – Ed.)*

The Basics:

The questions to consider when trying to receive Over The Air (OTA) DTV are:

- Where are stations located that I can expect to receive? What directions are the signals coming from? Visit: < http://bit.ly/k7TsAC >.
- How far away are they? How strong are the transmitters? Is more gain needed in my receiving antenna? Visit: < http://bit.ly/k7TsAC >. *(Your DTV or converter box has a signal strength measuring function. Look for it in the device's MENU. –Ed.)*
- What frequencies are the local stations using? Is a different antenna needed for any of the stations? Visit: < http://bit.ly/mIs3jR >.
- What is between the stations and the antenna? Should the antenna be higher or should it be moved? If moved, which way? Visit: < http://bit.ly/k7TsAC >.

Visiting these URLs, notice I reference < www.TVFool.com > for addressing most of the questions. Be aware that it uses the same theoretical evaluation the FCC came up with to determine what you should be able to receive.

"On June 12, 2009, full-power TV stations across the U.S. were mandated by the FCC to have completed an historic transition from analog to digital broadcast. During the past two years, DTV viewers have settled-in to clear, free-access reception . . . or have they?"

It is usually overly optimistic. The only true way to find out what you can and cannot receive is to *put up an antenna and try it.*

Getting Started

Your first step should be to do whatever is easiest. Do you already have an antenna up from the analog era? Try it with your DTV converter or digital TV.

If you were able to get all your analog TV stations using a set of rabbit ears, then try those.

If the older antenna used a 300-ohm, twin-lead feed line, then go to the local hardware store or RadioShack to get a 300- to 75-ohm impedance transformer.

You can first simply connect the 300-ohm, twin-lead to the TV and see what happens. I noticed that when I did this, the TV (and converter box) had no problems with it. I did it by removing the innards from a 300- to 75-Ohm impedance transformer and soldered the leads directly to the 75-ohm F-connector. *(To see an F-connector, visit: < http://bit.ly/ldjkty >. – Ed.)*

We're not transmitting here so we don't really need an impedance transformer to keep the transmitter happy — a receiver is far more forgiving. In my case, I found that this worked so well that I left the transformer out.

'How Strong Are the Transmitters?'

The power allowed to transmit has been reduced and while, the 8VSB digital signals require 16 dB less energy for the same coverage and, in theory . . . have exactly the same coverage as the higher power NTSC signals, it has been shown in numerous online forums and in articles already published in *Popular*

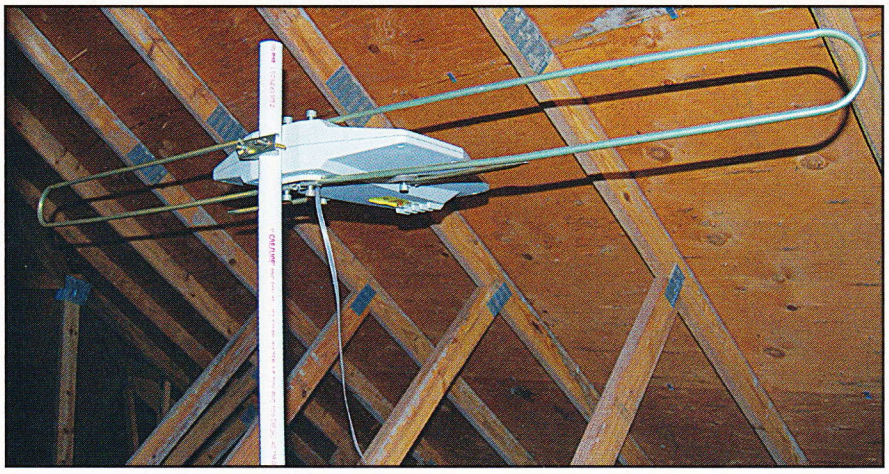

Photo A: Archer antenna mounted.

Communications, that the theory used is overly optimistic. My experience bears this out, as well.

In our case, OTA DTV viewers have to take that into consideration. Since this was not done by test engineers in the field under various weather conditions prior to the changeover, we're stuck with picking up the slack with the higher-cost, high-gain antennas or RF amplifiers — or both.

The use of high-gain directional antennas may be able to bring some stations back, but I cannot tell you that you will be able to receive all the stations you once enjoyed when TV used analog signals.

Also, an RF amplifier is used for countering the losses in the coax, splitter, combiner, connections and going from the antenna to your TV or multiple TVs.

It is *not* for making a weak station strong enough for the TV to receive. An RF amplifier can only amplify what is on the input port. It *cannot* put a signal on the output port it does not have on the input port.

So, the job of the antenna is to get enough signal from all stations wanted before we use an amplifier. You may or may not need an amplifier to counter losses in coax and signal splitters. The way to tell is to measure signal levels at the antenna.

If you have good signals there, then there will be a way to get that level of signal to your TV. If not, then more work needs to be done with the antenna before considering the need for an amplifier.

My experience has shown that in some situations there will be no way to receive all of the stations once enjoyed.

A good reference can be found in the June 2010 *Popular Communications* article by Bruce A. Conti: *The Future Is Fuzzy For Free TV.* He followed it in September with: *Broadband Vs. Broadcasters: The Debate Heats Up.*

"DTV continues to get poor reception reports," he writes. "This technology was not really well worked out before being made *prime time* anyway. I think TV as we knew it is really gone."

It seems to me that the *fringe area* has moved closer to the transmitters for DTV. Also, many who were considered to be in the extreme fringe area are now left out in the *no-receive-zone.* Conti provided examples of what some viewers have had to do to get the OTA analog stations they used to watch.

'What Frequencies Are the Local Stations Using?'

This may seem strange to those who have dealt with National Television System Committee (NTSC) TV for so long, because the channel number was synonymous with the frequency range for a transmitter.

This is no longer the case. The FCC has allowed stations to change frequencies and yet keep the old channel numbers as identifiers. The frequencies of some of your favorite stations may have changed. In my area, the Washington NBC station, Channel 4, went from the Channel 4 TV frequencies to the UHF Channel 48 frequencies.

After the change was completed, all stations were allowed to go back to their old frequencies. Many chose not to, *but* even if they did *not* return to their former channel and frequencies, they are still allowed to identify with their *old* channel numbers!

So in my area, Channel 4 is using Channel 48 frequencies but still identifies as Channel 4 and so the channel identifier may no longer have anything to do with the actual frequencies being used.

How is one to know? Search online resources < www.TVFool.com > and < www.wikipedia.org > to find the channel designation and the actual channel associated with that designation.

Then, if needed, you can find the frequency range on a page on the < www.wikipedia.org > site.

'What is Between the Stations I Want To Receive and My Antenna?'

Here, again, things may have changed. When some stations changed frequencies for the DTV tests they ran, they may have also changed the location of their transmitting antenna — and sometimes even the *smallest* location change of either the transmitting or receiving antenna can cause LOS.

Again, < www.TVFool.com > is a good reference. Remember, though, it uses the same overly optimistic theory to generate tables for your location as the FCC. These are the *best* you can expect and, in all likelihood, you may not be able to get all of the "green" (most likely-to-be-received) stations.

"An indoor 'set-top' antenna is probably sufficient to pick up these channels." as *TVFool.com* classifies them. Another disadvantage is that we no longer have a reservoir of people who know the answers to these questions for reception in your area.

In the past, we were able to ask the local TV repair shop person, radio retail employee or even a neighbor or two. Today there are few if any TV repair shops to be found and radio retailers in general are *not* the answer folks they may once have been.

If you look around at your neighbors' houses, you may be hard pressed to see an outside TV antenna, unless it's very old and likely no longer used.

You'll find all sorts of dish antennas for various satellite services, while other neighbors have nothing visible, which probably means they have cable or other wire or fiber.

Help Thy Neighbor . . .

I was planning to use my TV reception as the main example for this article, but a friend of mine needed to get Channel 13

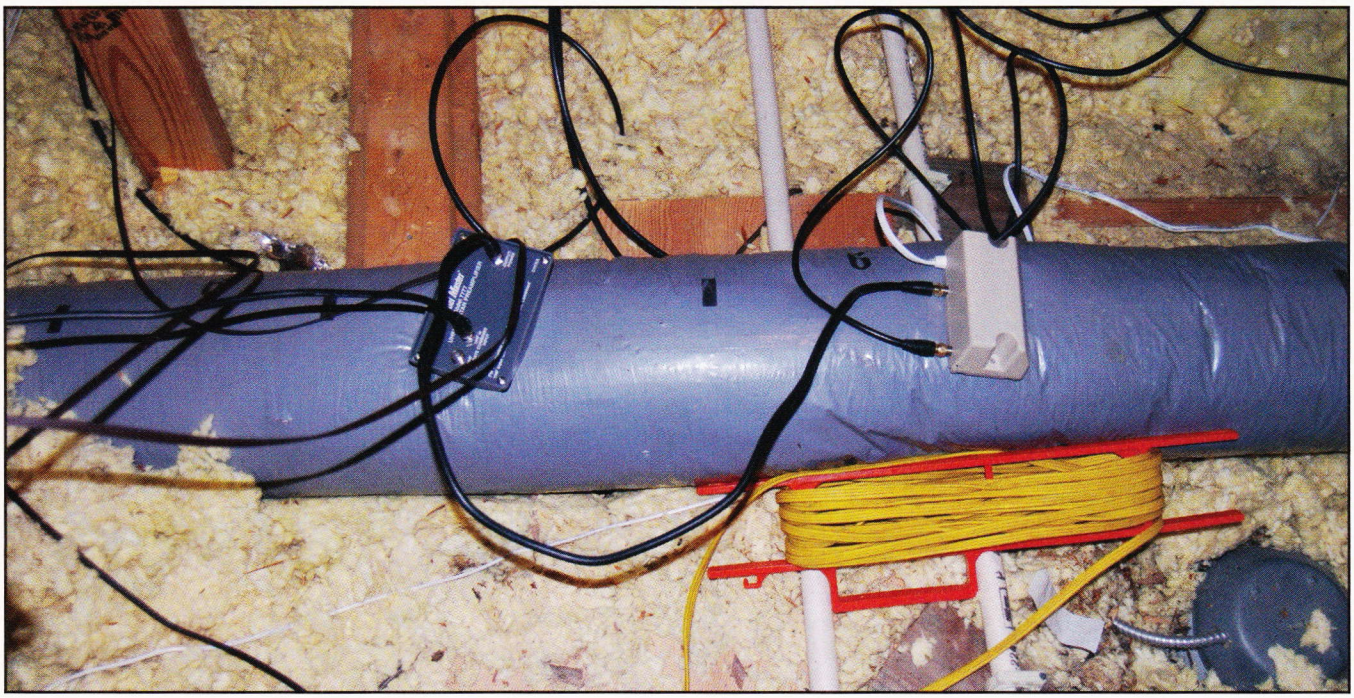

Photo B: New high-gain TV amplifier.

and her case was much more interesting than mine — as was the solution.

Her TV problems were many. She lives in the same town as me and the same initial theoretical data from < www.TVFool.com > was used to see what she should be able to get and what the actual frequencies of the identified channels are.

Since we live in the same ZIP Code, the online evaluation sites all predict we *should* be able to receive the same stations. The problem: We are not in the same geographical situation. I live east of the Mount Airy Ridge in Maryland. She lives almost on top of it. She told me that even with the old analog TV she could get only a few Baltimore stations and the one Hagerstown station, which are in opposite directions for her antenna.

While the saying, *location, location, location* is important for realtors, it is even more important for line-of-sight — *los* — RF signals.

Where is the transmitter's antenna located? Where is the best location for my antenna to receive it? What height do I need to get over whatever is in the way?

Or, where do I have to move the antenna to get around whatever is in the way? And, as long as you can go high enough or wide enough, property lines allowing, you *should* be able to get over or around the problems, but don't count on it.

Again, < www.TVFool.com > simply gives you the best information it can about

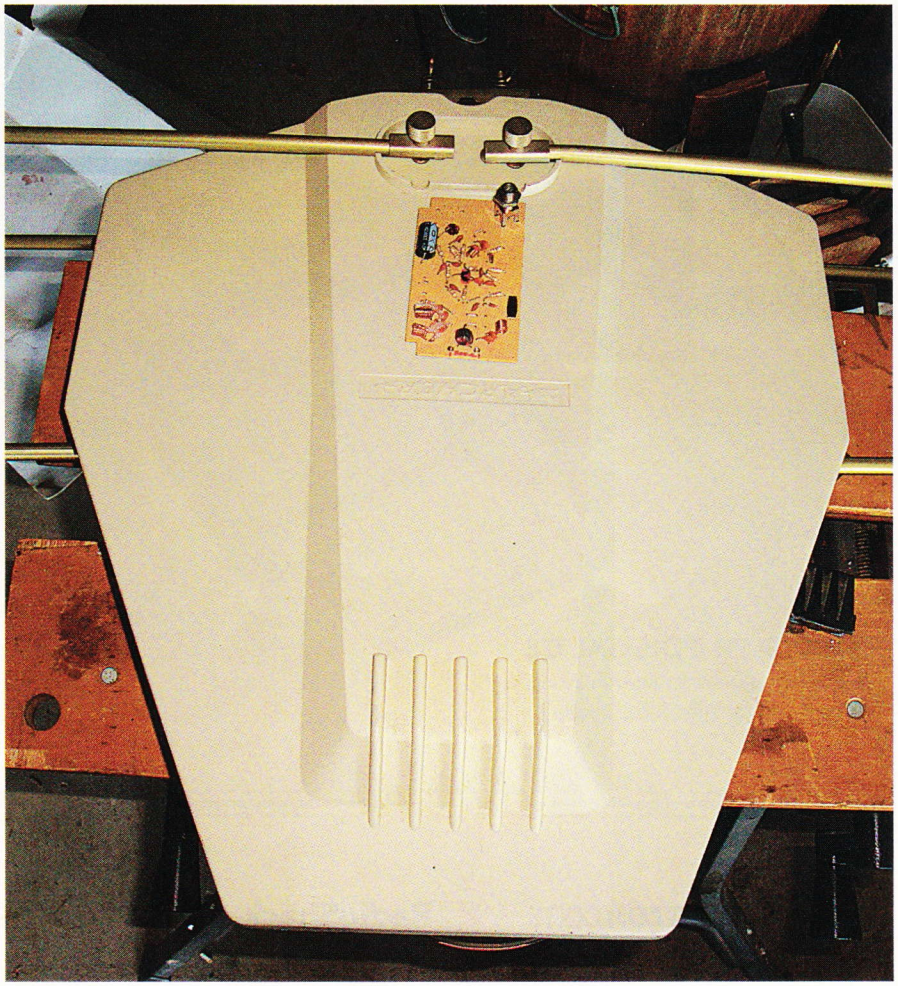

Photo C: Archer antenna and removed amplifier board.

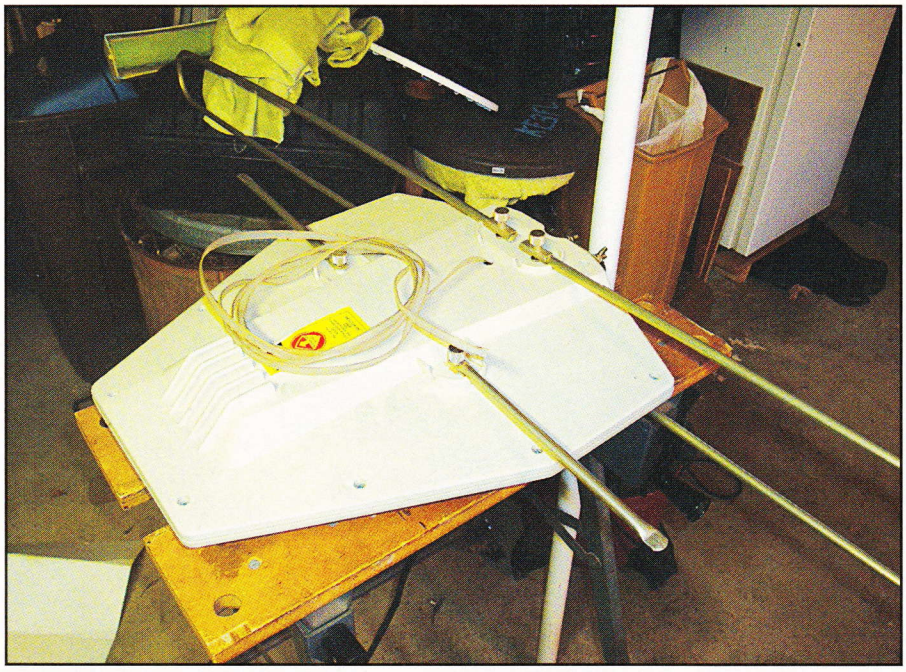

Photo D: Archer antenna with twin-lead added.

your situation. It does point out that a signal is — as far as they know — *los,* one or two edges before you receive it.

The basic initial data from *TVFool.com* shows Mount Airy residents should probably be able to get 20 channels with nothing more than a *set-top* antenna. The stations ZIP Code 21771 *should* be able to receive are: 2, 4, 5, 7, 9, 11, 13, 14, 20, 22, 22*, 24, 26, 32, 45, 50, 54, 62, 66 and 67. That's 19 "stations."

Baltimore: 2, 11, 13, 24, 45, 54, 67

Washington: 4, 5, 7, 9, 14, 20, 26, 32, 50, 62

Others: 22, 22*: (125 and 305 degrees True, 62:237d T) (167 T is Washington)

My Friend's Situation

My friend was able to get only the old analog channels 11 and 13 from Baltimore and 25 from Hagerstown. Her digital reception was at least Channel 13 but when the trees had all their leaves, her reception went to zero stations received.

I tested with the portable TV and its included extendable antenna to get a base line, both in one of the upstairs bedrooms with only one wall south and east, and in the attic. Nothing was received.

Yet we both live in 21771. *Well, so much for theory.* That means none of the "green" stations were actually receivable with just a simple portable indoor antenna.

Looking at the situation, I noticed her antenna was in the attic. It was an old Archer VHF/UHF antenna attached to a rotator, which could not rotate due to the physical constraints **(Photo A).**

There was also a power supply for the built-in antenna RF amplifier and an amplified splitter as well. The system was installed with good quality RG-59 coax throughout the house to the two TVs, the master bedroom (upstairs) and the living room (downstairs).

The amplifiers were needed to overcome the coax loss even with the old analog TV signals. This did not bode well for the newer DTV lower power signals at all, especially with the initial tests coming up completely empty, with not even a few stations of the *not worth watching* level.

Seeking Solutions

The first thing I did was to buy a newer higher-gain RF amplifier — a Channel Master Model 7777, 26-dB UHF, 23-dB VHF **(Photo B)**, and a new high-gain UHF TV antenna.

I installed these and removed the older system and she was now able to get some of the Washington TV stations — 4, 5, 20 and 62 — which she had never gotten before. But Baltimore Channel 13 was still lost.

I did not use an FM trap *(unless the amplifier already has one built in, but I don't believe it does)* and the results speak for themselves. As you test, don't be surprised if you end up with FM radio interference.

Photo E: The two antennas connected.

In looking the situation over, I next noticed that even from her attic her antenna was pointing into the middle of all the trees between her and Baltimore.

To the west she was apparently high enough to have *los* with the Hagerstown Channel 25 antenna, which is likely also on top of a mountain east of Hagerstown.

The *view* to the south toward Washington was a bit more complex. Her house is on the ridge, but between her and the Washington stations are more ridges and more trees.

Apparently, the added gain of the antenna helped with this situation. But what was the problem with Baltimore? What gave me hope was that just after the conversion, she was still able to get Channel 13. It was not perfect, but it was mostly watchable until the summer bloom. Her real problem occurred when the leaves were fully out on the trees to the east of her. These apparently blocked enough of the signal to cause its complete loss.

More Study Needed

At this point, I did a little more research and found that Channel 13 is still on its 210-216 MHz band and so was not a UHF station. Baltimore Channel 11 is also on its ~200-MHz frequency, so her older VHF/UHF antenna should still be able to get both.

I took her old antenna home with me and modified it by first removing the internal amplifier and then adding twin-lead feedline to bring about 6 feet of feed-line out of the antenna. My idea was to just experiment with attaching the two antennas together using the twin lead and then attach this combination directly to the new RF amplifier **(Photos C and D).**

A source at *Popular Communications* said the frequencies used by Channels 11 and 13 are the second harmonics of FM broadcast transmitters and that I would probably need an FM filter and also need to combine the antennas using a signal combiner.

Well, the losses of using a combiner would be 3.5 dB per antenna. I didn't have one to test with and I'm not sure I could afford to lose 50+ percent of the available signal to begin with. So, I tested with what I had. There was no loss of any station being received from the high-gain antenna, which was only picking up Washington, DC stations anyway.

The added antenna simply picked up the missing Channel 13 and a few other Baltimore stations. The stations well-received now were: Channels 2, 4, 5, 11, 13, 20, 45, 54, 62.

Channels 24, 27, 32, 66 are *in and out* as my friend says. This means:

Baltimore: 2, 11, 13, [24], 45, 54
Washington: 4, 5, 20, [32], 62, [66]
Others: [27]

Overcoming Knotty Issues

I ran into a small problem when attempting to attach the older antenna — still in excellent condition and with my modifications — to the new antenna. I noticed I could loosen the screws of the active element but I could not tighten them enough.

When I did try to tighten the screw, the head cut right through the twin-lead wire. This meant two things: There were unattached internal nuts. The wire needed to be protected.

The new high-gain antenna was taken down and taken apart. Washers were fabricated out of rectangular pieces of aluminum from a pie-tin to protect the twin-lead wire. These were then put under the UHF dipole elements and then everything was tightened down.

The UHF antenna was placed back on its pole and the Archer antenna was attached to the PVC pipe that I had brought along (**Photo E**).

Once I faced the Archer antenna's VHF elements to the east toward Baltimore, and plugged the amplifier back in, we had solid reception of both channels 11 and 13. I didn't even have to play with the length of the twin-lead between the two antennas.

The Bottom Line

My friend now has more channels than ever before due to having two antennas — one with much better gain, and both pointed in the desired directions — and with the use of a higher gain amplifier to keep the signal strength up even through a splitter and more than 100 feet of RG-59 coax.

Note that I was testing ideas by the *seat of my pants* here and because of the lack of, time, effort, analysis and a combiner, I really do not know why this all ended up working as well as it does.

My ideas are:

- The antennas are for different bands, UHF for one and VHF for the other.
- The signals are 90 degrees from each other so the antennas are pointed in somewhat different directions, but they are not as far different as I expected.
- Perhaps this is the telling reason the new UHF antenna was only receiving Washington stations even when pointed more east than south and the VHF antenna was *never* able to receive Washington stations.

Perhaps each antenna had nothing to add — more likely, subtract — from what the other was receiving well. While the fact is there are far more ways for the signals to combine to cause worse reception than better reception, I am a firm believer in the *give-it-a-try* method.

If something like this doesn't work for you *(and because of the above truth it may not)* buying a combiner (with 3.5-dB loss per antenna) and/or properly phasing the antenna array will be required.

I may have been lucky with my *seat-of-the-pants* analysis and tests for my friend, and you can, of course, try it this way since it will *not* cost more to try this way first and then add the time and effort and perhaps more money to properly phase the antennas.

So, go get that new or better antenna, new or better amplifier (don't forget to get one with the FM filter/blocker if you have strong FM stations nearby) and better coax.

If most of the run can be done with twin-lead, you might want to try using that.

Always: Safety First!

Please be careful if you're on the roof or a ladder, and please watch out for any overhead electrical wires. Put your antenna far enough away from them to be sure there is no contact — no matter what, *ever.*

Next month: *In Part II, find out how Philip Karras, KE3FL, used a VHF/UHV splitter/combiner with only a 0.5-dB insertion loss to get all the DTV signals back at his location. Stay tuned. – Ed.*