Receiving Digital Television

Frederick Vobbe - October 26, 2018

Introduction

The change in June 2009 from analog to digital came with some frustration to home viewers. Just like the difference from your analog cellphone to digital, the digital device requires a constant stream of "good" bits of information. Drop a few bits, and you lose the picture.

In the analog days a TV signal could be fuzzy, or have ghosts in the picture, yet people were happy with what they got. With digital, low signal and reflections often cause problems with reception, typically called "the blue screen effect" as the signal would just freeze and die.

If you are on the edge of reception the picture may pixelate or stutter. In 99% of the cases a review of the antenna system can fix your problem.

Myths

First, if you remember the ads on TV and Radio saying that all you needed to receive a signal is a pair of rabbit ears and converter, that is, (pardon the expression), bologna!

We don't recommend using any kind of inside antenna; rabbit ears, flat panels, pancake, or the spooky voo-doo antennas that look cool.

We don't recommend TV antennas in attics as the nearby wiring, duct work, and snow on the roof can drastically cut down one the signal quality.

- **TV antenna theory has not changed in well over 8 decades**!
- **You can not change the science of antenna physics.**

The way people received TV in the 50s and 60s is still a tried and true method. The best antenna for local use is a simple Yagi for VHF, and a Screen Reflector for UHF.

There is no such thing as a "digital antenna", or an "HD antenna". Those words are used to make you think you need a new antenna when perhaps you don't.

Many antenna manufacturers will make bold claims by saying their antennas will reach up to XX miles. This number is usually a best guess based on an ideal antenna system of 75' above ground, with RG-11 quad-shield coax, in an un-obstructed view of the transmission site. TV frequencies are UHF or VHF and are *line of site*. This means there is nothing between your antenna and the TV station's transmission antenna.

Truths

Television stations transmit a digital signal for a specific service area. This service area is known as a protected contour, which means no other station can use this spectrum, nor may an unlicensed device operate on the transmission channel. If you are in this "service area", you should be able to get the signal with NO problem, however…

The physics of antenna design have not changed since the dawning of transmission. Antennas must be comparable with the channels being received.

An antenna must be directional, pointed AT THE STATION, and the gain of the antenna, (minus any preamplifier or booster), should be 6dB. The sides of the antenna should attenuate by 12 to 24 dB. And the back of the antenna should attenuate between 15 and 27 dB.

If an antenna does not work, it's not the signal strength. TV stations can't boost their signals to overcome a deficiency in your antenna. You can be getting a good signal level, but reflections or noise may compromise the reception.

Boosters and Amplifiers sound good on the surface; however, they boost not only a station's signal, but the noise and multipath as well, usually causing more problems than they solve.

The national standard for the correct TV antenna to us is an outdoor mounted antenna, at least 30 – 40 feet above ground. The antenna leads down to the set should be a type approved for use with the antenna and set. Usually it's RG-6 or RG-11 (low loss), with properly installed "F" connectors and grounding block.

Voo Doo Antennas

Yes, you can get a modern, small antenna, and it possibly *may* work, but what results it gives you is by amplifiers and tuners to overcome the losses by the antenna not being tuned to the correct frequencies. Many of the manufacturer claims of superiority are embellished at best, and after years of selling them, (and disappointed consumers), the item will disappear and be replaced with something of even more incredible claims.

Users are disappointed, and when complaining about the product the seller will often claim it's the TV stations fault for bad signal. If a station had a bad signal there would be hundreds of thousands of people complaining, and the station would be out of business in a few months. Don't Get Fooled!

A good antenna doesn't have to be high up, (unless you want to receive distant stations). For local reception you need only get the antenna up, outdoors in free space, and point it in the direction of the station.

Types of Antennas

The television spectrum is broken into three different bands;

- VHF Low – 54 to 88 MHz – Channels 2 to 6
- VHF High – 174 to 216 MHz – Channels 7 to 13
- UHF – 470 to 608 MHz – Channels 14 to 36.
    - UHF channels 70 through 83 were reallocated in 1982 to cellular and mobile phone service.
    - UHF channels 52 through 69 in the United States have been reassigned on June 12, 2009, to Homeland Security.
    - Effective September 1, 2018 the FCC Repack shifted TV frequencies. Channels 38 through 51 will be reassigned to mobile internet. All stations > 38 must move to channel 38 and below in one of 10 phases.

Bigger antennas typically have better gain, or reach. However, height plays into the distance as well. A small antenna at 15' outside in Findlay would do well to receive WFND and perhaps WBGU and other local stations. But if you expect to get Toledo or Fort Wayne, you need height and a better gain antenna.

REMO Electronics Outdoor TV Antenna BAS-1105-P ($30)

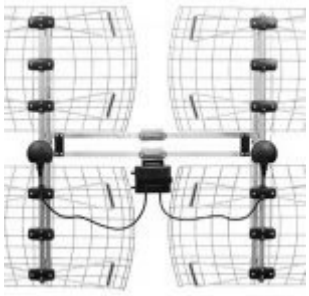
A small UHF antenna such as the Remo BAS-1105 would do a very good job of local reception. The antenna has around 6dB gain, weighs less than 1 pound, and comes with a connector for standard 75-ohm coax

It's a Russian made antenna, made from aluminum, and can mount on a pipe up to 1.5" in diameter. Find it on Amazon and other retailers.

REMO model BAS-1133 ($35.00)

The bigger UHF version is the Remo BAS-1133. This would be used for regional TV viewing. The antenna has around 9 to 11dB gain and is more directional. The weight is still under 1 pound and comes with a connector for standard 75-ohm coax. A variation of this antenna features a booster, (which is not recommended). This is also a Russia made antenna, very sturdy and can mount on a 1 to 1.5" pole.

Don't forget the grounding kit!



Antennas Direct 8 Element Bowtie ($120)

A big UHF antenna is the Antenna Direct 8, which is sold on-line. It features a screen reflector, with 8 bow-tie dipoles phased into one feed. This antenna has incredible gain of 10-14dB depending on UHF channel. It also has a beam angle is 24.5 degree making the antenna less susceptible to receiving interference where it's not pointed. Quality comes at a cost of nearly $120, but if you put this up at 35-55' in the air, I would not be surprised at 55-75-mile reception. Available on-line from various retailers, or direct from the manufacturer & distributor.

Stellar Model 30-2475 VHF ($40)

For VHF reception the Stellar model 30-2475 is not a bad choice for local reception. The length is 60.5", and it weighs 2 pounds. It claims between 9 to 12dB gain of a signal on channels 7 to 13. They are available from various locations, including MCM Electronics in Ohio. This antenna is designed for local reception. If you want a further reach it's best to step up to the 30-2476 which has more gain.

Stellar Model 30-2476 VHF ($60)

The Stellar 30-2476 VHF is larger/longer at 82.7". Weight is not too much more than the 30-2475. It has a gain of 10 to 14dB on channels 7 to 13.

If you live in Findlay, this antenna, mounted up at least 30' in the air with an unobstructed field of view would probably get WLIO in Lima, WTOL (11) and WTVG (13) in Toledo, and possibly WMFD (12) in Mansfield, OH, or WINM (12) in Angola, IN, depending on where you point the antenna, and where you live.

Rotors

A rotor is preferred in any installation, unless you want to watch only ONE station, and you position the antenna toward that station.

Picking up a digital transmission "off the side" or the back of an antenna is not recommended because of the time-lag from side to side.

Getting two of the same antennas and pointing them in different directions is also not recommended. The reason is no matter how hard you try, both antennas will see all the stations you're trying to receive, and the two received signals will confuse the digital decoder in the TV set.

Yes, you could do this with analog, and you *might* be able to do it with some digital stations. But it's a roll of the dice if you will have success or not, or you'll be angry by the signal cutting in and out randomly. Digital reception must be a steady, uninterrupted stream of data not compromised by reflections and noise.

The rotor should be installed on the antenna mast where it allows the antenna to be rotated without catching the antenna on a tree or something within near vicinity of the antenna. Leave just enough loop of coax cable so your antenna may turn freely and does not tighten against the support.

The antenna "tip" should be at least 10' from any object, especially metal. It should be well away from power wires.

Use good rotor cable, and a good rotor. The cheaper the rotor, the more likely you'll have to replace it in one or two years. A good rotor will be between $200 and $500, but a good rotor should last longer than antennas, usually 30 years.

Always ground the mounting pipes, tower, and rotor.

Boosters

Boosters are used to amplify or increase a weak signal. However, when not installed right they can hurt your reception, or at the least make it frustrating.

The problem is a booster also amplifies noise and other signals which are not desired. For example, if you are using a powerful booster to pick up a weak station, and a police car goes by your house and transmits, the signal from the TV station may disappear due to the amplifier reacting to a strong signal. This is because the booster becomes overloaded.

Boosters should only be used when the situation merits, and never to amplify a small or low mounted antenna. You should always buy a GOOD booster, and not a cheap booster which can overload easily.

If there is a cellphone tower within 2 miles of you, or if your antenna points at a station and there is a cellular site in the path within the first 5 miles, you might want to invest in an LTE Filter. They are inexpensive, easy to install, and will keep transmissions from 600 MHz and up from causing interference.

Combiners

Combiners take the signals from a UHF and a VHF antenna and combine them to a single cable going down to the TV set. They are usually placed between the UHF and VHF antennas.

Always use a good quality combiner rated for outdoor use, and if possible, get one with an FM Band Trap. The trap eliminates FM signals, (88-108MHz), which could overload a TV or booster.

When using a combiner, both the VHF and UHF antennas should be pointed in the same direction.

Stacking

Stacking is where you place two, (or more), of the same antennas together to get more gain. When one is placed on top of another, the gain increases.

However, when placed side by side, (at least 1 wavelength apart), not only does the gain go up, but width of the beam becomes sharper. This can be helpful to overcome interference, or to separate two stations on the same channel.

The cable from each antenna to the combiner must be *exactly* the same length. If one cable is 2′ 6″ long, and the other is 2′ 7″ long, you will get phase delay in the signal causing it to cut out.

Cable

Always use a good quality RG-6 coaxial cable, and for longer runs greater than 75′. Or use RG-11 quad shield for runs greater than 75′. This cable is available from several sources online, or at your local home improvement store.

For the RG-6 coax use PPC EX6XLPlus connectors indoor, PPC EX6WPlus for outdoor use.

For RG-11 coax, and either indoor or outdoor installations, use the PPC EX11N716WS waterproof connector.

Both connectors require a stripper and crimper for the specific cable and connector. Better yet, call an installer who is certified for the job.

Grounding

Always ground your antenna system. This is not only to protect the equipment but protect you as well. Lightning will seek the most convenient path to ground.

Unless you have properly grounded your antenna system, there is potential for lightning to enter your house! **MYTH**: No grounding an antenna keeps lightning away because grounding attacts the lightning.

It's hard to describe grounding when there are so many ways to install an antenna, but the proven method is by what is called a three-point system. The antenna coax lead is grounded just below the rotor on the tower or support. The wires are then grounded before they transition into the home. Then the wires are grounded just before they enter the home. When grounding at the transitions at ground level, use an 8' ground rod, or attach the ground to an outside water pipe. (Never ground to the gas pipe or electrical services post meter).

Use (1) 10' or 12' ground rod at the base of the tower or pole, at least 24" before the wire goes into the house. Use "solid" wire from the ground block to ground rod. #10 copper is the *minimum* size to use. #4 to #8 is the best.

Grounds should go down, and not up. Think of it as how water would flow, from top to bottom. A ground going up it resistance to discharge. Ground going down presents a pathway for discharge.

Use only (1) ground rod unless you have multiple towers. A single tower with (2) or more rods, (unless spaced 15' from each other), causes impedance resistance to the lightning, thus the charge may get past the block.

ALWAYS waterproof ALL connections with Scotch brand *Super 88* electrical tape. Water will corrode the cable and cause signal loss.

Author: Frederick Vobbe

Chief Engineer and Director of Engineering for Block Communications Inc. 48 year veteran of broadcasting, Licensed amateur radio and radio-telephone. Interests include antenna design, high power transmission, DIY audio, and classic gear from the 60s and 70s.

Use the ***RabbitEars*** search map for more accurate results: https://rabbitears.info/searchmap.php

---