



# How Well Does High VHF Work for DTV?

This month I'll tackle a topic I've been thinking about for some time—what will happen on Feb. 18, 2009, when viewers used to receiving their favorite DTV station on UHF with its 1,000 kW ERP find it's changed to a VHF channel at much lower power? In my travels across the country with laptop, USB ATSC tuner and whip antenna, I usually find it more difficult to receive VHF DTV than UHF DTV, although most of the VHF DTV stations are operating with relatively low power.

Recently, while I was in San Francisco during the independent demonstration of viability for the Open Mobile Video Coalition for mobile TV I had an opportunity to check out reception of a high-power VHF DTV station, which had much better results. This led me to look at the VHF power levels in the latest FCC DTV Table of Allotments. After the transition, 25 percent of all full service DTV stations will be on Channels 7-13.

Planning Factor	Symbol	Low VHF	High VHF	UHF
Geometric mean frequency (MHz)	F	69	194	615
Dipole factor (dBm-dBu)	K <sub>d</sub>	-111.8	-120.8	-130.8
Dipole factor adjustment	K <sub>a</sub>	none	none	see text
Thermal noise (dBm)	N <sub>t</sub>	-106.2	-106.2	-106.2
Antenna Gain (dBd)	G	4	6	10
Downlead line loss (dB)	L	1	2	4
System noise figure (dB)	N <sub>s</sub>	10	10	7
Required Carrier to Noise ratio (dB)	C/N	15	15	15

Fig. 1: Planning factors for DTV reception (OET Bulletin 69, Table 3)

### THE MATH APPROACH

The DTV planning factors use receiver noise figure, antenna gain, line loss, and other factors to determine the minimum field strength required for ATSC DTV reception (see Fig. 1). The difference between high VHF and cen-

ter-of-band UHF is only 5 dB. This doesn't mean increasing power by 5 dB will allow a UHF DTV station to match a VHF DTV station's coverage.

Free space path loss varies with frequency. On a 35 mile path at 183 MHz, the path loss will be 112.7 dB. At

605 MHz, for the same distance the path loss increases to 123.1 dB, a difference of 10.4 dB. Add the 5 dB difference in the field strength required and we see a high VHF DTV station should be able to achieve the same coverage, assuming no additional losses, as a UHF station with 15.4 dB less power. In other words, all things being equal, a VHF station on Channel 8 with 28.8 kW ERP should be able to match the coverage of a 1,000 kW UHF DTV station on Channel 36, based on free space path loss and DTV planning factors alone. While this approach does not consider other losses, VHF losses due to foliage and obstructions are less than at UHF.

The DTV planning factors for high VHF are based on the use of a receiving antenna with 6 dB of gain 30 feet above ground and a line loss of 2 dB. UHF DTV planning factors are based on an antenna with 10 dB gain for UHF reception, which is partially offset by 4 dB of down lead loss. The planning factors use a 7 dB noise figure for UHF and a 10 dB system noise figure for high VHF. Between the antenna system, which provides a 6 dB advantage and the tuner noise figure difference, which adds 3 dB, UHF gains a 9 dB receive system advantage, almost offsetting the difference in path loss in our example.

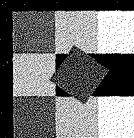
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I've noticed newer tuners show the same noise figure (6 dB for the Microtune MT2131) for VHF and UHF, which should improve VHF DTV reception.

## POWER MATTERS

Does real world experience jive with my number? Based on responses to a question about DTV reception at distances greater than 35 miles that I asked readers of my RF Report e-mail newsletter, the answer seems to be yes, especially if outdoor antennas are used. My experience has been mixed.

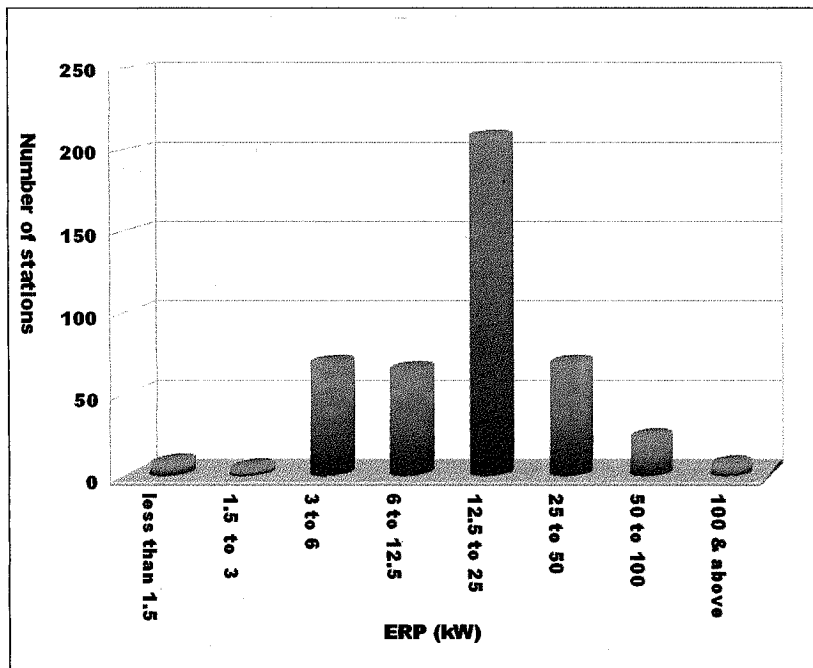


Fig. 2: High-VHF effective radiated power

As mentioned earlier, in San Francisco and San Jose, I had good luck receiving KNTV DTV on Channel 12 when reception of UHF stations at the same site was difficult or impossible. KNTV operates with more than 100 kW ERP. Lower power VHF DTV stations in other markets were more difficult to receive. I had good luck receiving many UHF DTV stations with a simple whip antenna at the airport in Honolulu, but Channel 8, while detected, couldn't be decoded. According to CDBS (the FCC's consolidated database system), that station is operating with only 7.2 kW ERP.

In Miami, near the Miami-Dade/Broward County line, not far from the main antenna farm, DTV laptop reception of WSVN (DTV Channel 8) and WPLG (DTV Channel 9) was possible when there was a clear view of the towers. However, reception from UHF DTV stations transmitting from the same antenna farm was easier and more reliable. CDBS shows WSVN-DT and WPLG-DT with ERP of 14.4 kW and 15.8 kW, respectively.

Miami DTV viewers should have easier reception after the transition when WSVN and WPLG return to their analog channels with higher power and higher antennas. The latest post-transition DTV Table of Allotments shows WSVN-DT at 145 kW on Channel 7 and WPLG-DT at 30 kW on Channel 10.

## POWER LEVELS POST-TRANSITION

Let's look at how these power levels compare with others around the country, using the data in FCC-08-72A2.xls, an attachment to FCC-08-72, the FCC Memorandum Opinion and Order on Reconsideration in the DTV Table of Allotments Proceeding. The spreadsheet, released March 6,

2008, is available on the FCC Web site at [www.fcc.gov/dtv/](http://www.fcc.gov/dtv/).

Only 40 stations will be left on low-VHF channels post-transition, so I'm focusing on the 452 stations on high-VHF channels. Fig. 2 shows the number of stations operating in eight power ranges. Only six high-VHF stations have been allotted 100 kW or more. In addition to the stations in California and Florida mentioned earlier, Nevada, Oklahoma, Oregon and Texas have one station with 100 kW or higher power station.

Only 98 stations have been allotted powers above 25 kW, while 145 have power less than 12.5 kW. Most allotments are at power levels between 12.5 kW and 25 kW.

Is a high-VHF power level below 25 kW sufficient? If outdoor antennas with sufficient gain and sufficient height are used for reception, perhaps. For indoor reception, it may not be sufficient unless the population to be served is concentrated close to the antenna. While RF at high-VHF frequencies has less attenuation due to foliage and buildings, once inside a building, VHF RF will be competing with

noise from computers, TV displays, fluorescent lighting and various motors. Indoor antennas for VHF frequencies are bigger. At best, indoor viewers are likely to have an antenna with gain (before any preamplifier) equal to a dipole at VHF (rabbit ears). Worst case, they may be trying to receive VHF on a UHF-only antenna. Adding a preamplifier may help, but it will also amplify the electrical noise inside the house.

## PROVIDING A STRONGER SIGNAL

The same techniques I've suggested for improving UHF signal strength can be used at VHF. The cost to add circular polarization to a VHF station at relatively low power is much less than for UHF station with 1,000 kW ERP. Adding electrical or mechanical beam tilt to put the main beam of the antenna below the radio horizon offers a way to provide a stronger signal over a nearby community while protecting more distant VHF stations.

Beyond these tips, consider applying for additional power when the FCC lifts the freeze on DTV coverage expansion. If the extra power causes interference to other stations, it may be worth contacting them if the interference can be resolved by increasing power. Of course, that could lead to other interference cases requiring more stations to increase power. As the freeze is expected to be lifted in August, it would be a good idea to start investigating the interference landscape soon if you're concerned about VHF coverage. With more than two-thirds of all high-VHF DTV stations allotted power below 25 kW, it might be worth the effort!

Comments and questions are welcome. E-mail me at [dlung@transmitter.com](mailto:dlung@transmitter.com).

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