Application Note AN-50b

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Is DVB-T Sideband Sensitive ?

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Application Note, AN-36, in 2017, has previously discussed the basics of what is required to operate at microwave frequencies with DVB-T. We can purchase from Hi-Des in Taiwan, both modulators and receivers that will work up to the 13cm (2.4 GHz) band. Above there in frequency, we need to then start using mixers and local oscillators to up/down convert. So, one question arises right away -- *"What happens when sidebands are inverted ?"*

When using a mixer and LO, the resultant output contains two mixing product signals,

$$f_{usb} = f_{lo} + f_{if} \quad \& \quad f_{lsb} = f_{lo} - f_{if}$$

The polarity of the RF sidebands remains the same as the IF for the plus (+) mixer product. But the polarity of the sidebands is reversed for the minus (-) mixer product. When running single sideband voice, this makes a big difference. Inverting the sidebands results in un-intelligible speech. *What does it do to a DVB-T, digital TV signal ? ? ?*

The Quick Answer is ---- YES ! DVB-T is sensitive to inverted sideband. *

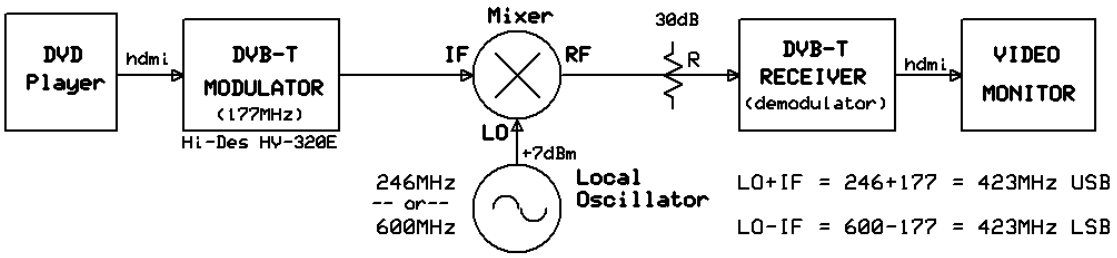

Fig. 1 Test set for mixer/LO tests of DVB-T sidebands

** note - This conclusion is contrary to what I originally published in the first version of this AN-50 in Sept. 2019.*

To experimentally determine this, I set up a controlled experiment. See above Fig. 1. I started with a DVB-T receiver which had already been trained to receive normally, Channel 57, 423 MHz on the 70 cm band. I then programmed the HV-320E modulator to

put out a normal DVB-T signal on hi-band VHF, Channel 7, 177 MHz. With a local oscillator set to 246 MHz, the USB product was 423 MHz. Then switching the LO to 600 MHz, again put a signal on 423 MHz, but this time with an inverted sideband, LSB.

I then used these signals to test several different DVB-T receivers. The receivers tested were Hi-Des models HV-110, HV-120A & HV-122; GT-Media model V7-Pro; and Pantesat model HD-99-T2. Also tested were USB TV tuner dongles. The HV-110, HV-120, V7-Pro and HD-99 all worked perfectly with either sideband.

But the HV-122 and USB dongles refused to decode the inverted sideband.

Thus the conclusion is: Yes, DVB-T is Sideband Sensitive.

Pete, WB2DVS, had purchased the HV-122, which I tested, for use with a 10 GHz transverter which in fact used an LO which inverted the polarity of the received DVB-T signal and he found that he was unable to receive any of the other Boulder ATV ham's 10 GHz, DVB-T signals. Pete contacted customer support at Hi-Des and they confirmed for him that *"Yes, in fact, the HV-122 will not decode inverted sideband signals."*

Further research on the subject by Bill, AB0MY, and Don, N0YE, looked into using USB TV Tuner dongles as potential receivers for microwave, DVB-T, experiments. They also found the dongles would not decode inverted sideband signals. They were using the free computer program, VLC, to run their dongles. They did find in the Advanced Options menu of VLC a line labeled "Spectrum Inversion" which should handle this situation. However changing this setting, it still refused to work with their dongles.

DVB-T SENSITIVITY to Frequency Error and Phase Noise:

Frequency Offset: With this same LO/mixer test set, it was then a simple matter to determine the sensitivity of a DVB-T receiver to having a signal with the center frequency offset from the correct frequency. Adjusting the LO frequency I found that I could move the LO up or down about ± 1/2 MHz and the receiver would retain lock. Thus, a DVB-T signal with Doppler shift up to this amount should still work.

Phase Noise: The next test was also simple to perform. What happens with phase noise? I was able to simulate this by turning on the FM modulation of the HP signal generator used as the LO. What I found was the DVB-T receiver was very sensitive to small amounts of FM deviation of the center frequency. With a 1 kHz test tone, the receiver worked only up to about 600 Hz deviation. With a lower 400 Hz test tone, it was even worse. 200 Hz deviation caused pixelization and anything higher, the receiver failed.