Application Note
AN-50
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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, $f_{usb} = f_{lo} + f_{if}$ and also $f_{lsb} = f_{lo} - f_{if}$ 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 NOTHING ! It still works.

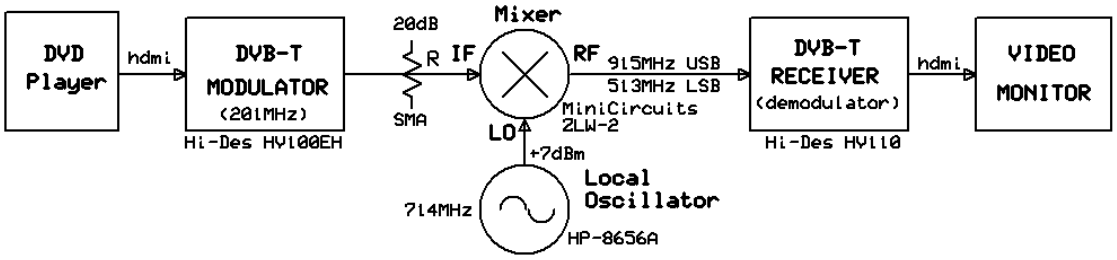

Fig. 1 Test set for mixer/LO tests of DVB-T

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 915 MHz on 33 cm band. I also then trained the receiver to receive normally on 513 MHz. I then reprogrammed the HV-100 modulator to put out a normal DVB-T signal on Ch 11 (201 MHz). With a local oscillator set to 714 MHz, the USB product was 915 MHz, while the LSB product (with inverted DVB-T signal) was on 513 MHz. Connecting the

HV-110 receiver to the mixer output, I was able to successfully receive both the 915 and 513 MHz signals. This thus proved that inverting the sideband polarity of the DVB-T signal had no effect.

Frequency Offset: With this 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 of the HP signal generator, I found that I could move the LO up or down about ± 550 kHz 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. 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 worse. 200 Hz deviation caused pixelization and anything higher, the receiver failed. The following table shows the degradation of a DVB-T signal's signal to noise ratio (S/N) with increasing FM deviation with a 1 kHz test tone. (the test DVB-T signal was QPSK, 1080P, 6Mbps, 1/2 FEC, 1/16 guard). Bottom Line -- DVB-T can not tolerate much FM or phase noise.

Deviation	S/N
none	23 dB
100 Hz	23 dB
200 Hz	20 dB
300 Hz	14 dB
400 Hz	11 dB
500 Hz	9 dB
600 Hz	8 dB
700 Hz	0 dB (i.e. no picture)