SENCORE

TECH NOTE

#156

ATSC VSB Channel Power Measurement and Spectral Displays

This technote provides information on power measurement and spectrum displays. These concepts are then applied to the AT1506 8-VSB Portable analyzer and TMS 1780 Terrestrial Monitoring System.

POWER VS VOLTAGE:

The power of digital communications channels such as VSB or QAM modulated TV channels is usually expressed in dBm or dBmV. dBm is a measure of power as dBmV is a measure of voltage

0 dbmV = 1milliVolt . X(dBmV) = 20*LOG(Y(volts)/.001)
0 dBm = 1milliWatt . X(dBm) = 10*LOG(X(watts)/.001)

In order to convert between dBm and dBmV, the system impedance must be known. (Because a signal with a given fixed power will generate different voltages across different impedances).

In a 75 Ohm system:
0 dBm = +48.75 dBmV
0 dBmV = -48.75 dBm
In a 50 Ohm system:
0 dBm = 47 dBmV
0 dBmV = -47 dBm

MEASURING THE CHANNEL POWER:

The channel power is the average power measured within the 3dB bandwidth of the channel (approximately 5.38MHz for an ATSC 8-VSB channel). The average digital channel power is often measured with a signal level meter, spectrum analyzer, or power meter.
The Sencore AT1506 and the TMS 1780 has built in averaging circuits to accurately measure the average channel power of an ATSC 8-VSB channel.

SPECTRAL DISPLAY:

Viewing the digital channel on the AT1506 spectral display can be confusing because the signal trace crosses a graticule with a level that is much lower than the actual average channel power measurement displayed at the top of the screen. This difference is due to the narrow bandpass filter in the spectral display's signal detector, also known as the resolution-bandwidth (RBW) filter. The spectral display is created by sweeping the RBW filter across the bandwidth of the channel. The noise like qualities of the digital channel cause it to be attenuated by the narrow RBW filter. This attenuation is what causes the difference between the trace level and the

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CHANNEL POWER VS SPECTRAL DISPLAY READING:

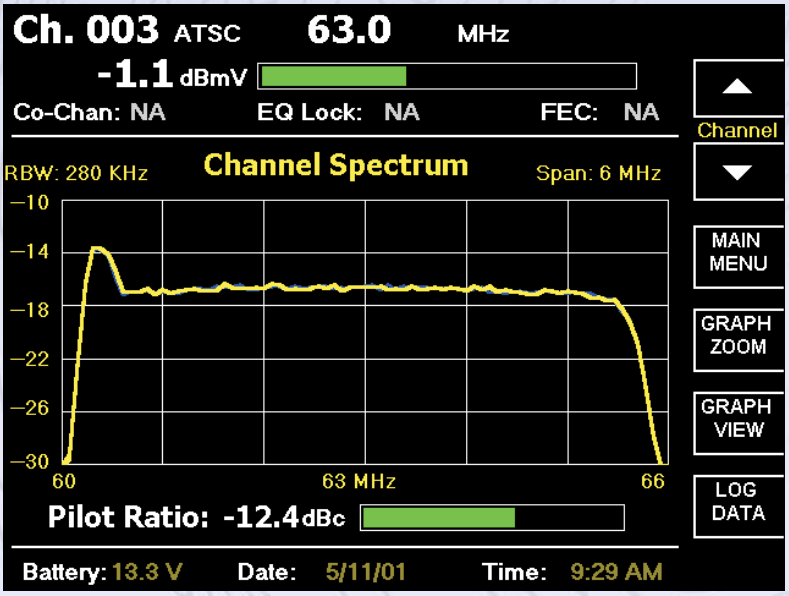
The RBW filter in the AT1506 has a bandwidth of approximately 280KHz. The trace indicates the power measured within the 280KHz bandwidth of the RBW filter, but the displayed channel level indicates the channel power averaged over the entire bandwidth of the channel (5.38MHz). The expected difference between the spectral display's trace level and the indicated channel level can be calculated as follows:

RBW Difference = 10*LOG(.28/5.38) = -12.8dB

Therefore we would expect the signal trace on the spectral display to be at a level approximately 12.8dB lower than the channel level indicated at the top of the screen.
The same calculation can be made with any spectrum analyzer as long as the RBW filter bandwidth is known.

MEASURING THE POWER OF THE PILOT:

The attenuation effect of the RBW filter in the spectral displays can also cause some confusion as to the displayed pilot level. The ATSC standard specifies that the pilot level be ~11.3 dB below the average channel power level. When viewed on the spectral display, the pilot level actually appears to be higher than the signal trace. This is because the sinusoidal narrow-band pilot passes through the RBW filter un-attenuated, whereas the noise-like digital channel power is attenuated as described above.
The pilot will appear 12.8 - 11.3 = 1.5 dB higher than the spectral display trace level.



AT1506 Spectrum display

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