Welcome to AntennaSelect™ Volume 23 – December 2015

Welcome to Volume 23 of our newsletter, AntennaSelect™. Bi-monthly, we will be giving you an "under the radome" look at antenna and RF technology. If there are subjects you would like to see covered, please let us know what you would like to see by emailing us at: info@micronetixx.com

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LPFM – Exploring Vertical FM Whip Antennas

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Over the past year we have been getting questions about vertical whip LPFM transmitting antennas. The stations asking about them had for the most part already bought one. Those who had were, for the most part, not happy with the coverage area of their LPFM station. The inexpensive price of the whip compared to other antenna solutions was the main driver in the purchase decision. Let's take a look at some of the issues that vertical whip antennas users face.

First the whip is a vertically polarized-only antenna. If the listener is using a vertically polarized antenna, the LPFM signal should be at its

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Maximum in theory. LPFM's do face a few problems. With an antenna height of 30 meters or less in most cases, the chance for Faraday rotation of the signal at the listeners' location can easily materialize. The signal may arrive horizontally polarized, which can cause up to a 20 dB reduction in received signal level when using a vertically polarized receive antenna. With a 100 Watt ERP station, that cross-polarization attenuation equates to an ERP of only 1 Watt.

Next consider the reception in a car. Many cars have antennas embedded in the rear window. They are horizontally polarized and they are directive as well. The same cross-polarization losses take place in that scenario. Cars that use a rear mounted whip antenna usually mounted at a 45 degree angle fare much better, with only 3 to 6 dB of loss relative to a dipole.

The avid LPFM listener who goes out and buys an outdoor FM antenna is no better off. Cross-polarization losses of up to 20 dB can occur in this case as well. (Editors note: If you had not heard, Antennacraft, maker of the popular FM6 antenna was shut down as part of Radio Shack's bankruptcy plan earlier this year. Popular retailers of the antenna are now out of stock).

Now let's discuss the transmission end of the LPFM station. The whip does do a great job at being an omni-directional, vertically polarized transmitting antenna. To do that job the antenna needs to be mounted on top of a pole with nothing else nearby. A wavelength separation (120 inches/3.04 meters) at 98 MHz is a minimum. If the whip antenna is going to be mounted on the side of a tower, that same distance applies. With vertical polarization, the tower will cause a lot more azimuth pattern distortion. Since the antenna now electrically "sees" the tower it is electrically coupled to, it can detune quickly from its free field V.S.W.R. profiles. Towers with larger faces will exacerbate this problem further.

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One question came up about stacking whip antennas to increase gain. It is possible, however there are a number of concerns. First the antennas would have to be properly spaced. Then the length of the feeder transmission lines would need to be calculated using the velocity factor of the lines, in order to ensure proper relative phasing. If the whip antenna is frequency adjustable, the free space adjustment might well be suboptimal antenna performance-wise for the specific mounting configuration. Mitigating this issue may require extensive test and adjustment time on site.

For LPFM stations, going with an omni-directional circularly-polarized antenna is the way to go. With C/P almost listeners will get a better signal using a wide array of receive antenna solutions. The C/P antenna is going to be more expensive than a whip and will need a slightly higher-power transmitter for the same ERP. At the end of the day, with the 100 Watt ERP limitation, LPFM'ers need to squeeze out every Watt they can. A Micronetixx LPFM antenna will do just that. Our decades of antenna experience can be put to work for you – just give us a call.

Group Delay in DTV Transmitting Antennas

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One of the most overlooked parameters when evaluating complete transmission systems, including antennas, is the Group Delay, (sometimes referred to as Envelope Delay), signature. When a signal from a broadcast transmitter is routed through components in the system such as transmission lines, filters, switches and finally to the antenna for transmission, these components in the signal path can alter the characteristics of the transmitted signal. If the alteration is severe, (especially for digital signals, where excessive bit error rates can occur), disruptions in service or degradations in the quality of that

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service can result. One of these critical parameters is the rate of change of phase shift as a function of frequency within a channel. This is the specific definition of **Group Delay**.

Traditionally, Group Delay is evaluated for cavity filters, since filters are capable of storing, (and hence delaying), the signal envelopes for different amounts of time within the channel, as a function of each specific frequency, evaluated across the channel.

Mathematically, Group Delay is defined as:

$$\tau_g = -(1/360) * d\phi/df$$

Where $d\phi/df$ is the derivative of the transmission phase, (in degrees), with respect to the frequency in Hertz, (usually evaluated over the operating frequency band). Within a DTV channel bandwidth, the implications for broadcasters could be substantial, depending on the Group Delay characteristics of the entire transmission path, including the antenna, since the phase characteristics of the digitally encoded baseband signal over the channel are crucial. One of the extremely important parameters that we test with great care for every digital television antenna manufactured at Micronetixx, are its complete transmission Group Delay characteristics.

In many cases, if the radiation moment magnitude of a particular radiating element of an antenna is small per excitation voltage cycle, the element, and the complete antenna system will exhibit high stored energy per cycle, (also defined as the "Q" of the antenna system). If the energy stored in the electric and magnetic fields in and around the antenna is delayed, (due to that energy storage), for different lengths of time at different frequencies across the channel, unacceptable Group Delay is encountered. In other words, if the time delay due to this stored energy is different at different frequencies within a channel, then an abnormally high Group Delay parameter can result. At Micronetixx, we measure and ensure that the Group Delay characteristics of every

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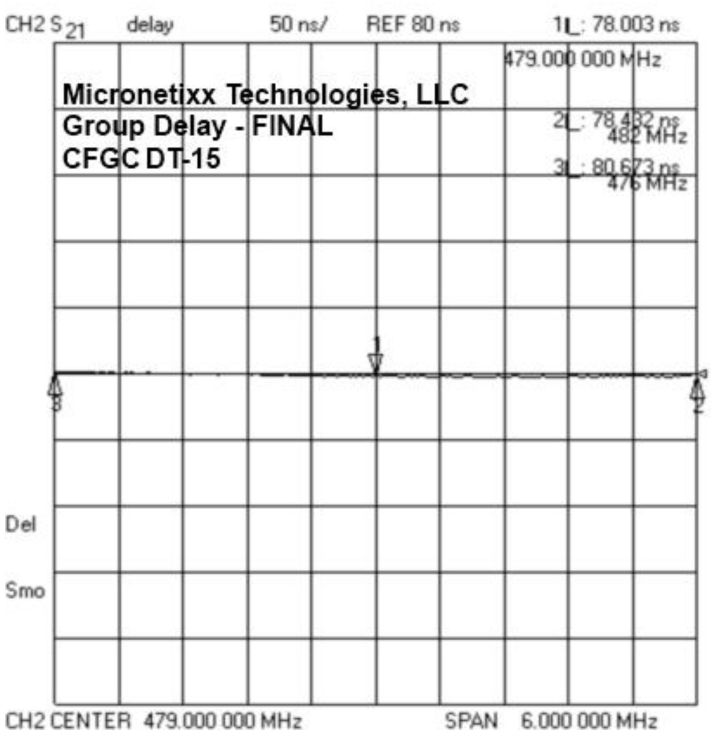
DTV antenna that we manufacture will not affect an otherwise beautifully transmitted television signal.

We use patented very low Q coupling structures in our antennas, with all elements at DC ground. This ensures that there is very low stored energy, (resulting in frequency-sensitive envelope delays in-channel), in any of the elements at any place in the operational band.

At Micronetixx, we measure and ensure that the Group Delay characteristics of every DTV antenna that we manufacture will not affect an otherwise beautifully transmitted television signal. While ATSC 3.0 and other possible advanced modulation systems are being developed, minimizing Group Delay will be even more important.

Here are a few plots of the measured Group Delay of antennas we have built:



S_{21} or Group Delay of a 6 bay UHF slot antenna. This antenna is elliptically polarized, and has a peak differential delay of only 2.5 nS across the channel. Our E/P antennas are fed in true quadrature phase, with all elements being DC grounded for optimal protection from lightning.

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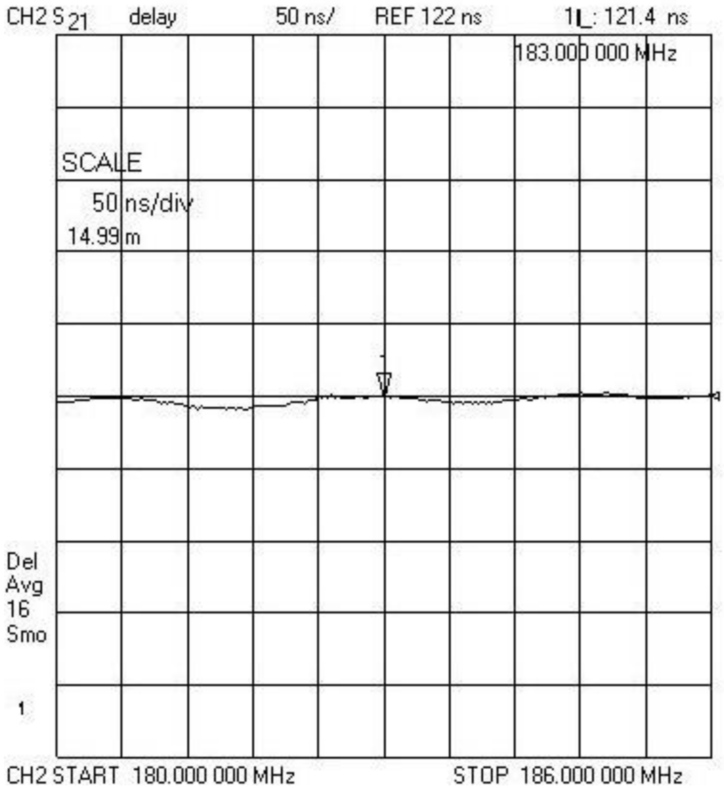
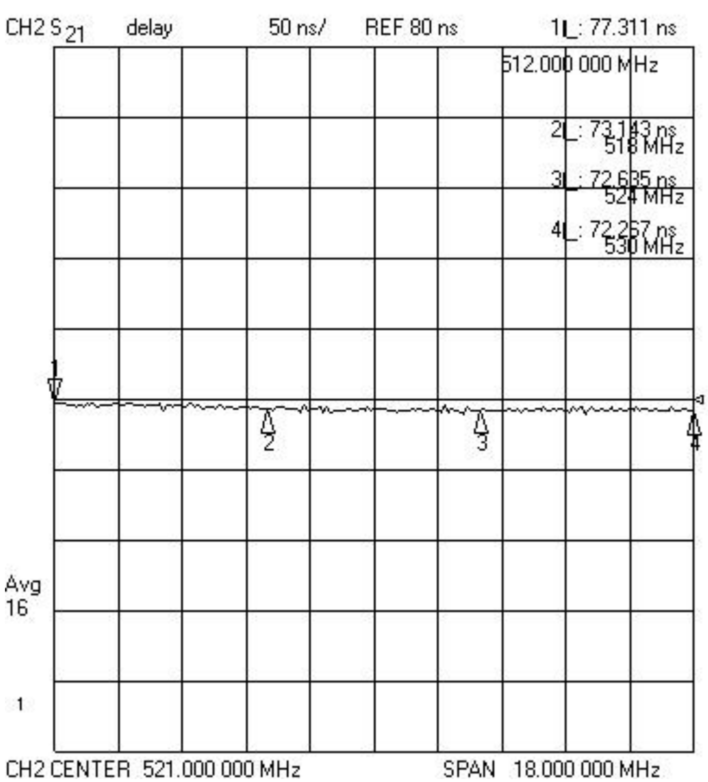


The plot above is for a top mounted high-band VHF elliptically polarized antenna. Even with the large pylon diameter, differential group delay is no more than 8.5 nS over the channel.



This plot is for a three channel wide UHF slot antenna, using our SFN™ slot technology. Even with the wide bandwidth of the antenna, our low Q coupling system functions in a very linear manner across all three channels. The differential group delay across any one channel is under 3 nS.

Spectrum Auction – DTV Antenna "What-ifs"

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The spectrum auction is just around the corner. Many stations will either need or want to upgrade their DTV antennas. With crowded towers and tighter packing of stations a good probability, more creative solutions will be needed. That's were we come in. We build high quality DTV and FM antennas.

We do not offer standard catalog solutions. Many of the antennas we build are designed specifically for each Broadcaster's specific requirements. Have a tight space issue on a tower?
A 12 bay antenna will not fit? Well we can supply an 11 bay model, with the precise null fill and beam tilt needed.

Contemplating a move to high band VHF or replacing the 35 year old RCA antenna? We can supply specially-spaced and scaled batwing antennas, to save you both money and potential load issues on the tower.

Have a short tower and face ground level RFR problems? Our unique, (Patented), SFN™ Technology produces up to 25 dB less radiation on the ground.

We love talking antennas and coming up with innovative solutions. Give us a call and tell us the problems you are facing. We are likely the company that can provide the best solution for you.

Be on the lookout for the next volume of AntennaSelect™ coming out in February

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