Welcome to AntennaSelect™ Volume 21 – August 2015

Welcome to Volume 21 of our newsletter, AntennaSelect™. Each month 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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Moving to high band ? The batwing antenna - improved

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Most high band TV stations use batwing style antennas. It is a design old enough to collect social security. Many of the antennas now in service are over 40 years old. As stations on now on high band look at replacing their current antennas and stations moving to high band, the batwing antenna is worth taking a look at.

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In the title of the article is the word improved. That's right Micronetixx has taught the batwing a few tricks. But first let's go over some of the basics of the design.

The batwing antenna has four elements per bay. The elements are fed in quadrature to each other. On each opposing pair of elements, one side is fed with the center conductor of the feed line attached to the element On the opposing element the ground of the feed line is connected to the element.

Batwing elements are grounded to the support pylon at both ends of the elements, providing excellent lightning protection.

The rectangular area between the inside edge of the element and the support pylon is excited with RF energy, which makes the element radiate. The impedance of the antenna is set by the distance of the support pylon to the inside edge of the element. The typical impedance is 75 to 77 Ohms. The feed harness for the antenna pictured has not been installed yet.

Let's look at an off the shelf batwing antenna. For a high-band model the element is built to resonate about 5% lower in frequency than channel 7 (174 to 180 MHz). Inter bay spacing of the elements is set for a Wavelength at channel 7 as well.

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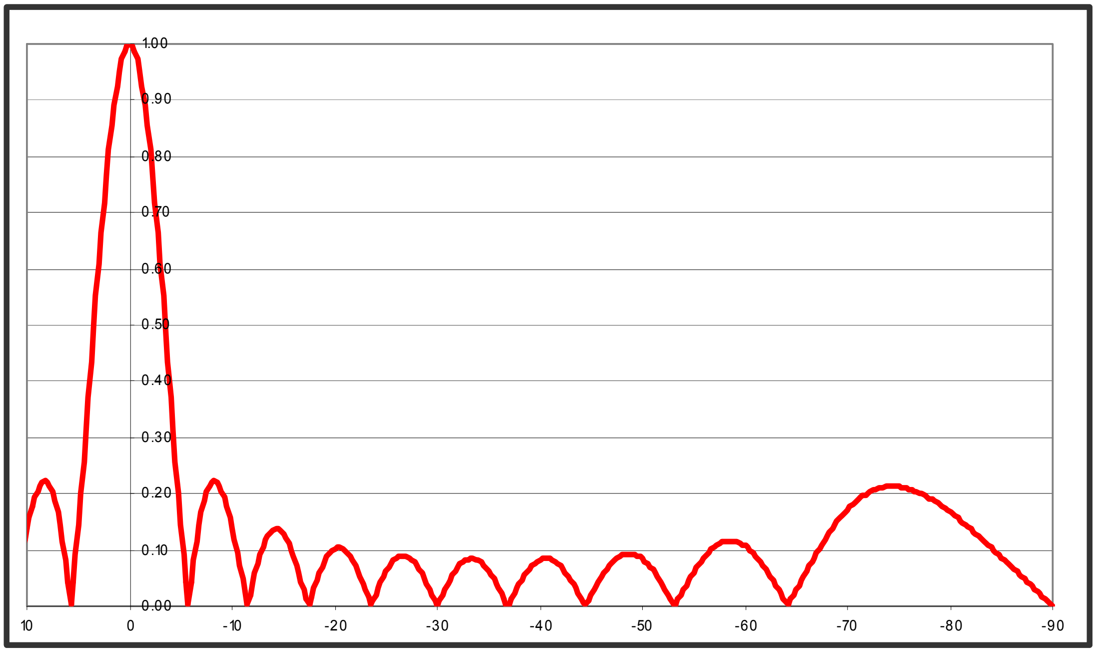
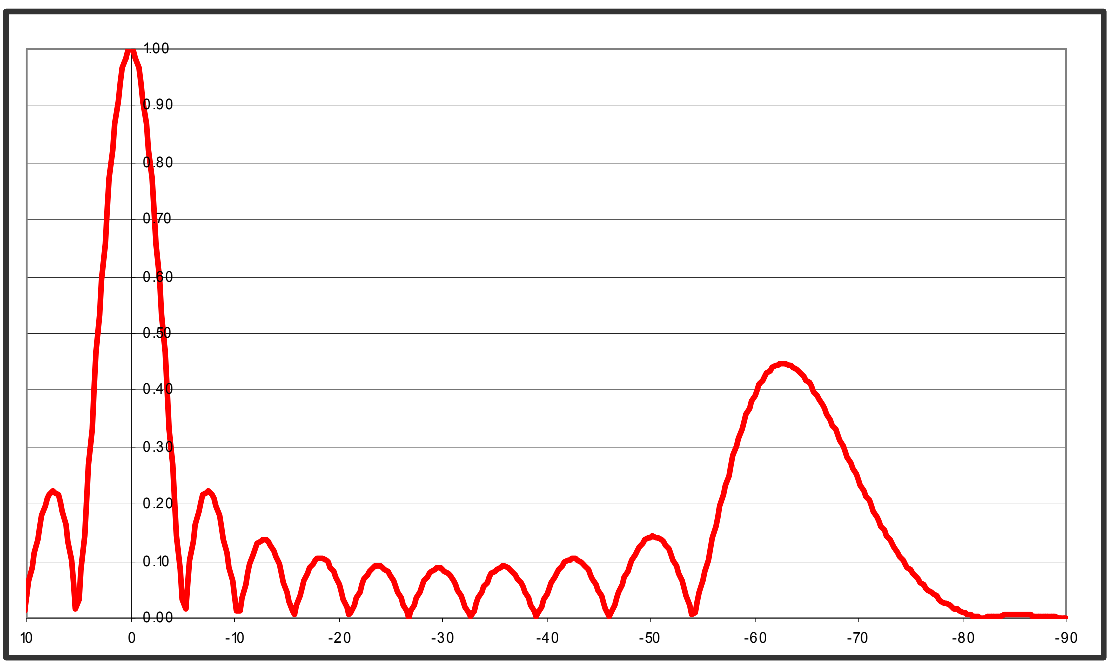
The batwing antenna does a good job of covering channel 7 (174 to 180 MHz) to channel 13 (210 to 216 MHz). At channel 7 the elevation pattern of a 10 bay batwing antenna would look like the plot below. We did not add any beam tilt or null fill.



The plot below is the same 10 bay antenna, operating at channel 11. The spacing at channel 11 (198 – 204 MHz) is more than the 1λ spacing used at channel 7



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The gain of the batwing at channel 7 is about 10.5 (10.21 dB, while the gain at channel 11 is about 9.5 (9.77 dB). The increased spacing between bays and the formation of the large grazing lobes decreases the array gain.

An improved batwing antenna

So how do you improve a 60 year old technology ? Let's look at a case where a channel 10 and 12 want to share a common antenna. The antenna need to have a gain of 9 to 10 to make ERP with the transmitter they intend to use. Power handling is not an issue with the batwing design as the size of the feed system, and power divider rating is the limiting factor.

We could sell this pair of stations an off the shelf channel 7 to 13 design. This antenna would be 62-1/2 feet (19.1 meters) long.

Since the antenna would only be used on channel 10 and 12, we can scale the antenna for those two channels. The batwing elements would be built to resonate slightly below channel 10. For spacing, we would space the bays at 1λ on channel 12. The spacing at channel 10 would be less, about 0.94λ or 339 electrical degrees. The gain at both channels would be close to 10.5. The main beam on both channels is nearly identical as well. With the closer bay to bay spacing the new antenna is 7-1/4 feet (2.21 meters) shorter than the off the shelf antenna design. On the next page is a elevation plot of the 360 degree spaced pattern at channel 12, and the 339 degree spaced pattern at channel 10. The main beams are very close, with the channel 10 being slightly broader below -2 degrees of depression angle. The high angle grazing lobe decreases to about 6% of field on channel 10 due to the wave fronts not adding up in half wave increments.

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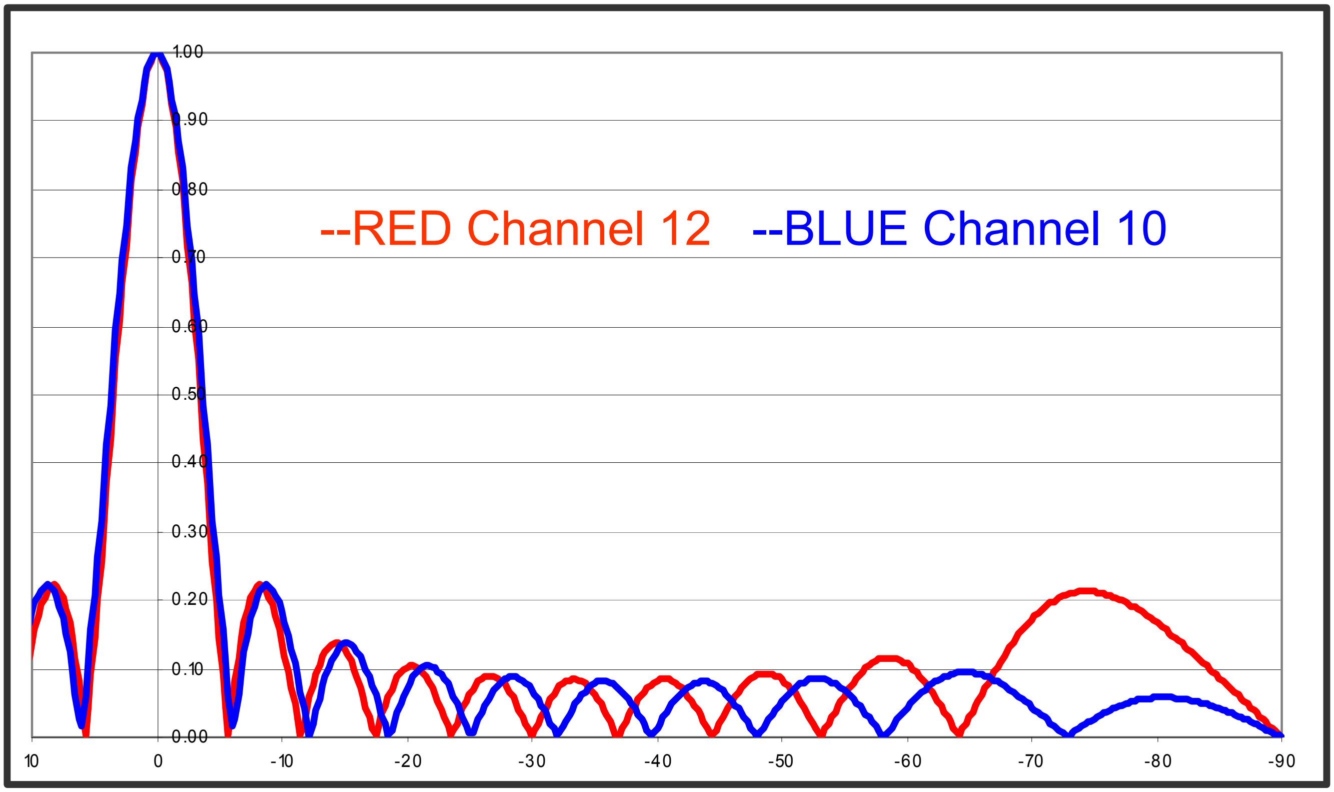

Now let's shorten up the antenna even more. We will space the antenna at 7/8λ (or 315 degrees) on channel 12. The spacing will reduce to 0.82λ (296 degrees) on channel 10. This antenna will be 13-7/8 feet (4.22 meters) shorter than the stock channel 7 to 13 design. The elevation gain has dropped slightly to about10 (10.00 dB) on channel 12 and 9.6 (9.82 dB) on channel 10. The off the shelf 10 bay bat wing had a gain of about 9.7 (9.86 dB) on channel 10.

The main beams are almost identical, with the channel 10 being a percent or two wider. Besides being a much shorter and lighter antenna, the high angle grazing lobes are gone. The antenna produces less than 10% of field from -25 to -90 degree depression angles. If you site is located on a short tower, your RFR footprint will be up to 15 dB lower. The elevation patterns for this antenna are on the next page

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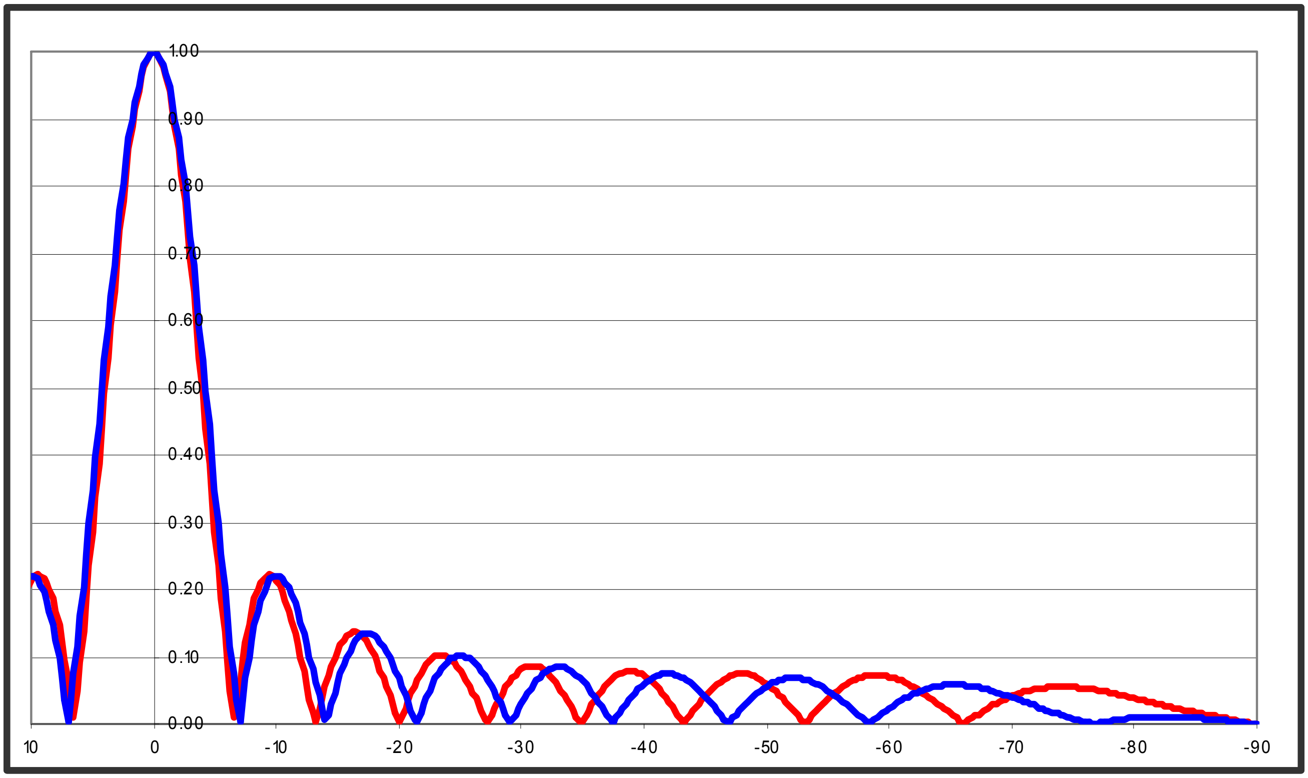

So now you know that an old antenna technology can be taught new tricks. The scaled batwing is shorter and lighter, and has excellent elevation patterns. If you are contemplating a move to VHF or want an upgrade from your decades old antenna, give us a call. We design a system that will optimize your coverage..

LPFM antennas and PIM

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Some LPFM operators are going to use cell towers as their transmitting site. Buried in some site contracts is language that if the LPFM station creates PIM or Passive Intermodulation, it must cease operation until the source can be fixed. Fixing the problem can cost more than the entire station in some cases. So here are a few ideas to minimize the chance that your new station will cause PIM.

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The first item to look at is the mechanical design of the antenna. The antenna elements should be well bonded to each other. At Micronetixx, we fabricate both of our FML and FMP series of antennas with stainless steel. The elements are welded in place to the mounting bracket, which is also stainless steel. All elements are at DC ground. Some competitors designs have elements that bolt together. Any corrosion in those junctions down the road can cause PIM to generate. Antennas that are built out of Aluminum and are not properly surface treated can cause problems as soon as 6 months. Untreated Aluminum will pit, which makes the perfect PIM generator. A properly built aluminum antenna will be given a Class 1-A chromate treatment

The next area to look at is the bonding of mounting system for the antenna. For most LPFM's mounting on a cell tower, an outrigged pole will be used. This pole is placed 3 to 4 feet off from the leg of the cell tower. The outrigged pole should have a grounding cable installed to the tower. This helps prevent PIM and also lessens the chance of damage with a lightning strike. The transmission line should also have a ground clip that connects to the outrigged pole. A second grounding clip should be installed bonding the transmission line to the tower.

Then there is the elevation pattern of the antenna itself. The antenna will in many cases have other antennas above or below it. To minimize radiation going directly above or below the LPFM antenna, a two bay half wave spaced antenna is recommended. The two bay elevation pattern cancels about 99% of the radiated field + and – 90 degrees from the antenna. Since there is much less radiation hitting other antennas and tower components, there is also a much greater chance PIM will not be generated. The two bay elevation pattern is on the next page.

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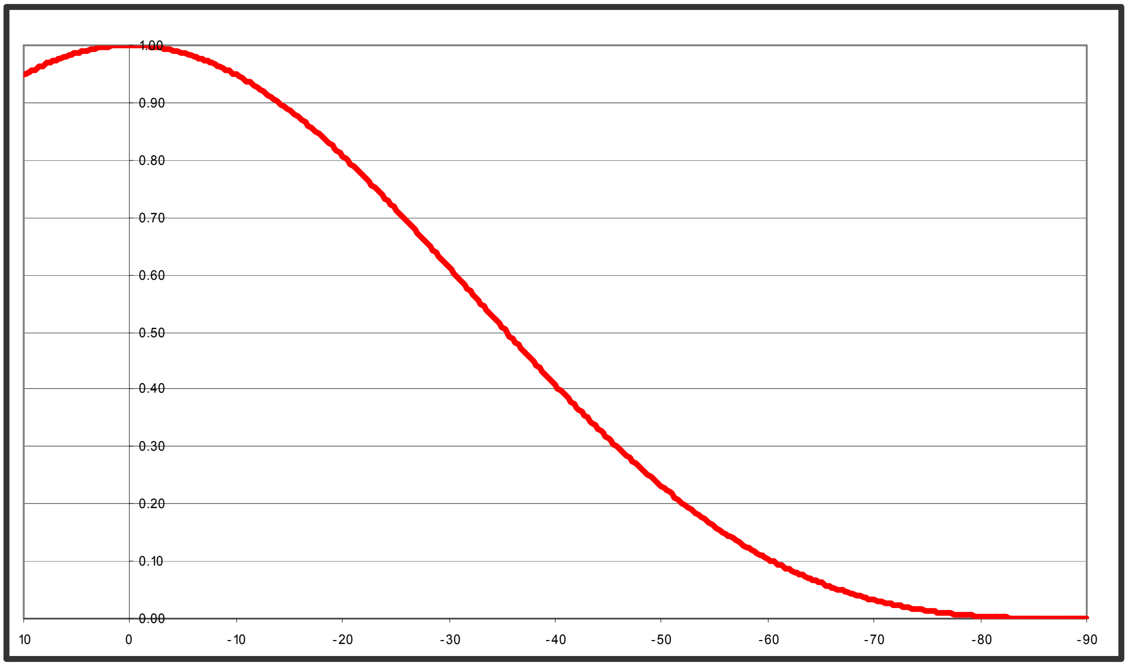

The suppression of this pattern is so good at high depression angles that the radiated power is only 45 mW at those angles. That is almost 40 dB of suppression ! Between good bonding of the antenna and using an all stainless steel antenna welded design, PIM generation is not likely to happen. If questions come up about mounting your new Micronetixx LPFM antenna, please let us know. We are happy to help out.

In the October issue of AntennaSelect we will discuss some additional tricks for High Band DTV transmission. We will also give you an update about some of the high power microwave projects we are doing. If there are subjects you would like us to cover, just drop us a note.

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

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