Welcome to AntennaSelect™ Volume 11 – June 2014

Welcome to Volume 11 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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Galvanizing Antenna Pylons – A hot story !

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Top mounted antennas are made of steel. They can be as short as 20 feet long (6.1 meters) and up to 60 feet (18.3 meters) or more. These antenna pylons are between 12 (30.5 cm) and 20 inches (51 cm) in diameter. Untreated steel can start to rust as soon as it is exposed to water or high humidity.

Galvanizing is a process to apply a zinc coating to all surfaces of the antenna pylon. There are a number of steps needed to properly Galvanize the pylon.

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After the antenna pylon is done in manufacturing, the pylon is trucked to a Galvanizing plant. The first step is to immerse the pylon in a tank that has a caustic solution. This removes dirt, paint and grease from the surfaces of the pylon. The pylon is then rinsed off. The pylon is immersed in a second tank to remove off mill scale. Mill scale is a thin bluish-black film form during the steel fabrication. If it is not removed it will begin to break loose after being exposed to the elements. An acid bath is used to remove the scale. The pylon is then rinsed off.

At this point the pylon is given a close up inspection to see if the pylon is clean and all mill scale has been removed. Small spots of scale that remain can be sandblasted off. Next the pylon is coated with a flux that is allowed to dry. This protects the bare steel from oxidizing and helps the galvanizing zinc bath wetting and adhering to the steel.

The pylon is ready for galvanizing. A large tank holding a solution of molten almost pure zinc (98.5 to 99.995% pure) is heated up to between 840 to 850 degrees Fahrenheit. The pylon is slowly lowered into the tank. The pylon is kept in the tank until all of it has reached the ambient temperature of the zinc solution. The now shiny pylon is raised from the tank slowly allowing the excess zinc to drain back in the tank. The pylon can be cooled by air or it can be cooled in a quench tank.

If there was proper prep and cleaning of the pylon, a durable 4 mil thick coat of zinc should be on all surfaces. Now comes the fun part. A number of tapped holes on the pylon will be partly plugged with zinc. The holes will need to be cleaned out before the pylon is ready to ship back to us. Depending on how many holes there are it can be a time consuming process.

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How long before the antenna pylon will show any signs of rust ? With a properly galvanized pylon with a 4 mil thick coating, the life can be as little as 25 years in a hot humid environment or over 50 years in a rural fairly arid climate. With galvanizing when the zinc coating gets down to 5 to 10% of its original thickness, that becomes the effective service life of the antenna pylon.

June is a popular wedding month – Wedding Cakes

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At Micronetixx we supply Wedding Cakes on some of our antennas. We do not have an oven, so baking them is out of the question for us. The type of wedding cake we make is to allow top mounted pylon antennas to be stacked on top of each other or be used as part of a bury section. The wedding cake is between 12 and 36 inches high and has enough room to allow a transmission line to be routed through it and into the bottom end of the top mounted antenna.

The picture to the left shows a close up of a wedding cake that is part of a bury section. The antenna is mounted on top the wedding cake and is bolted in place. The transmission line comes in at a 45 degree angle and attaches to an EIA flange on the bottom of the antenna.

This design used solid steel rods for the legs of the wedding cake. Gussets are welded under each leg for additional strength.

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The picture to the right shows a section of a wedding cake used to support a small UHF top mount antenna. In the lower left side of the picture part of the EIA input flange is visible. This design used thick plate steel for the legs. Gussets were added to the bottom of the UHF antenna pylon for additional strength.

There is enough vertical room in this wedding cake to clear a 3-1/8” EIA transmission line and elbow. There are several designs that could have been used. The wedding cake could be part of the bottom antenna pylon, be a separate section or be integrated into the top antenna pylon. All three methods have excellent mechanical strength.

When the wedding cake is designed there are two design goals that have to be met. The first is the mechanical strength to withstand high loads imposed when there is severe wind conditions. The second goal is to ensure that the coaxial components will fit inside the wedding cake. Then there has to be enough room to tighten each bolt on the input flange and any components like elbows.

On the next page we will look at a wedding cake to allow a pair of VHF pylons to work together as a single antenna or as two independent single antennas. There are two transmission lines coming up to the tower from a power splitter mounted in the transmitter building. This system operates as a main antenna or a backup antenna system.

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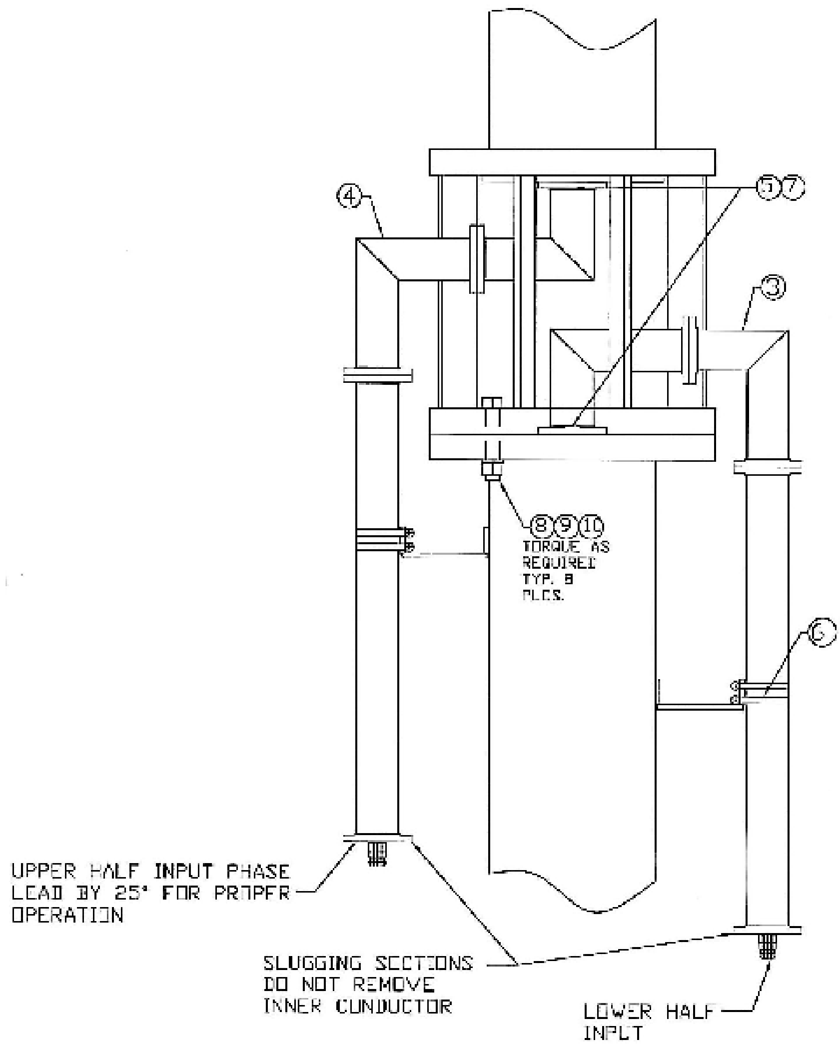

This is a drawing of the dual feed system wedding cake. There were three design goals that had to be met here. The first and most important is mechanical strength. The second is having enough room inside the wedding cake to install the EIA flanged components inside. The third was the length of the wedding cake to ensure proper spacing between the slots of both halves of the antennas, as this affects the elevation pattern when run as a single antenna array.

Passive Intermodulation (PIM) – Part 1

What is Passive Intermodulation or PIM ? Passive intermodulation (PIM) occurs as the result of a non-linearity being experienced by two or more signals. There are many types of non-linear conditions that can cause PIM.

Over the next few issues of AntennaSelect, we will look at the spectral mixing products from PIM and some of the causes of PIM. As more RF emissions are added to multi-user sites, the opportunities for PIM generation increase. Lets look at some spectral plots first.

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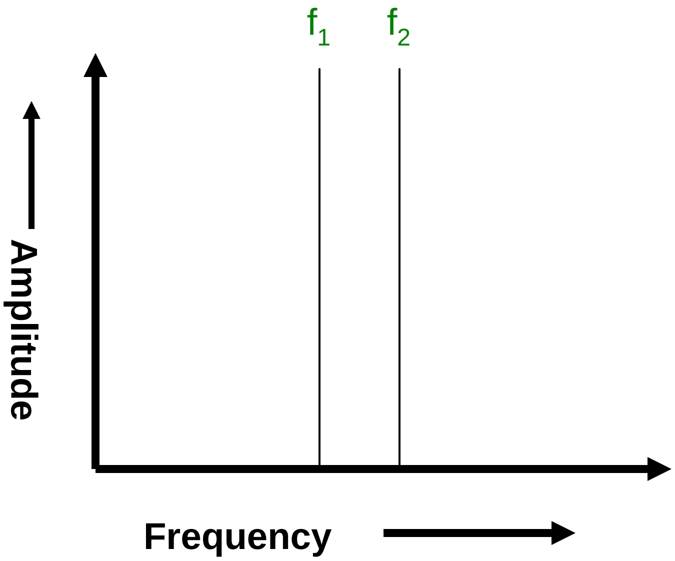
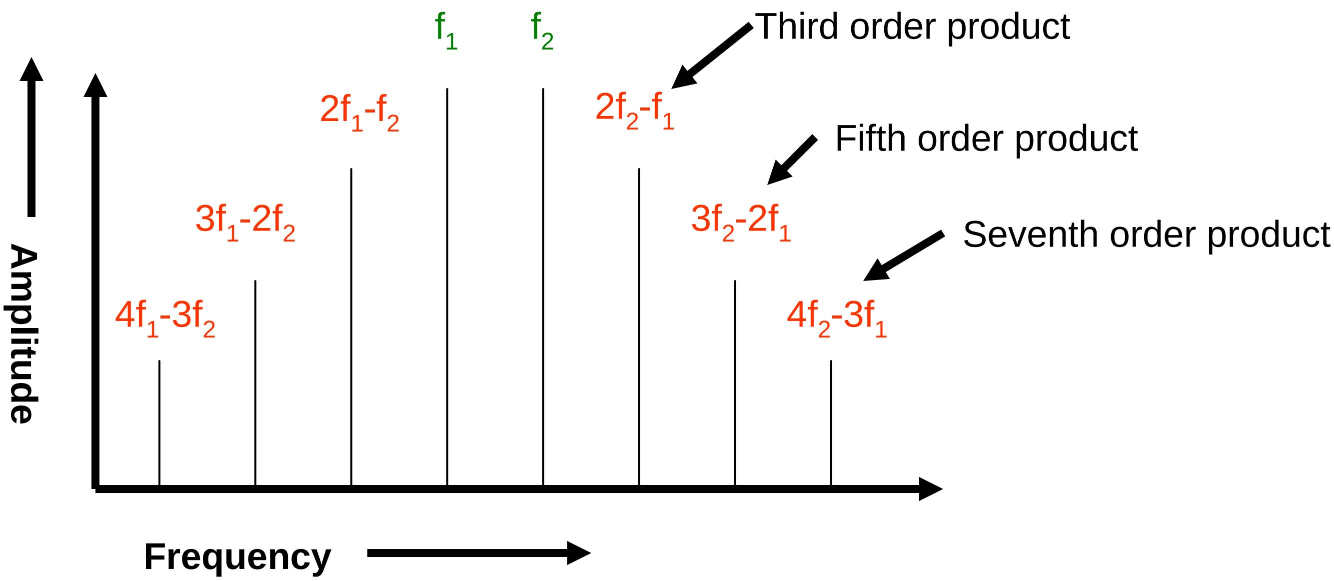


The graph to the left shows two signals (f_1 and f_2) that have no impairments, or intermodulation products. For this example we will set f_1 at 101.5 MHz and f_2 at 102.5 MHz.



The graph above shows the PIM products created when f_1 and f_2 are subjected to a non-linearity. The first PIM product on either side of the two desired signals is called a third order mixing product, the second signal is a fifth order mixing product. Note: The mixing products shown on the graph are not drawn to any particular scale.

The third order mixing products are at 100.5 MHz and 103.5 MHz, while the fifth order products are at 99.5 MHz and 104.5 MHz. The seventh order products are at 98.5 MHz and 105.5 MHz. If we were wanting to pick up a station at any of the frequencies where a PIM product is at we would have interference. If there is more than two signals being transmitted, we would expect to see many more PIM products, blocking reception on many more stations.

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Now that we have an idea of what the spectral layout of some typical PIM products are, lets take a look at some of the causes of PIM. They include:

- Corrosion of surfaces and joints
- Damage in coaxial components and connectors
- Ferromagnetic metals
- Changes in weather
- Poor RF bonding of metallic objects
- Introduction of new RF emissions in a transmitter site

Of the causes of PIM, the most common problems found at transmitter sites is corrosion and poor bonding of metallic objects. A side mounted FM or TV transmitting antenna radiates a lot of RF power into the support structure just feet away. What may appear to be DC grounded can in fact be an active parasitic at RF as a capacitive or inductive element. A corroded bolt when excited by RF can act like a diode. We will explore this in more detail next month.

Over the next few issues of AntennaSelect we will discuss some issues at transmitter sites and how to reduce the chance of PIM generation. Our last article in the series will show a picture of one of the worst possible ways to ensure PIM is generated. To those of you with a lot of RF experience you won’t believe your eyes.

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

MICRONETIXX COMMUNICATIONS
1 Gendron Drive Lewiston ME 04240 U.S.A.
V 207-786-2000 www.micronetixxantennas.com