TECHNICAL BULLETIN

N. 4 December 2016

This month:

FM ANTENNA ARRAYS

This month we are considering the possible choice of the right antenna and the right array for FM Broadcast.
This choice depends on many considerations because every situation can be different and can require different systems.

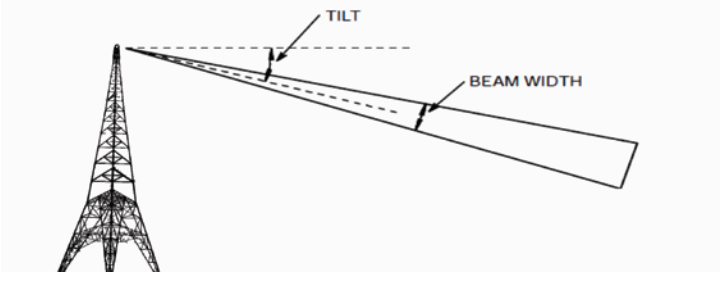
HOW TO CHOOSE YOUR ANTENNA ARRAY

Usually the choice of the right radiating system depends on:

1) **Power of your transmitter**
2) **Terrain Configuration**
3) **Distance and area to be covered**
4) **Azimut pattern you need and intensity of the signal in the desired area**
5) **Regulations of your licence**
6) **Polarization required for the system.**

First of all, whatever your power level will be, you should have a safety margin when choosing your system; for instance if your TPO is 10 KW, you need to have a radiating system capable of at least 13KW (30% margin). Remember that the radiating system is the most vulnerable part of the entire chain.
Antennas and cables are exposed to many types of weather conditions, sometimes very extreme. Maximum care has to be taken in the choice of the cables. They should handle at least 30% more power than the actual one. All the connections between cables and antennas should be done with the utmost care, making sure everything is properly sealed by using high quality tape. Water in the cables may produce huge damages to the system.

NUMBER OF BAYS



Many times people are under the assumption that the more bays a system is composed by, the better it is.
This may not be the case because if you don't have enough space on the tower and you place the antennas close to other systems or too close to ground you may have a negative impact on the pattern causing a loss of gain instead of an increase. The system needs to be as far as possible from ground and from every metal obstacle. We recommend a distance of at least 15-20 feet from any metal obstacle and 30-40 feet from ground.
If the system is composed of 4 or more bays then you also need to pay attention to **the BEAM TILT**. Depending of the difference in height from the radiating tower and the receiving areas you might need to create a tilt to your system to make the best use of your signal.. Because it is not possible mechanically give a tilt to the tower, the tilt angle is created by cutting the interbay cables in different lengths so that the power will reach every single antenna at different times. This will electrically lower the vertical lobe and concentrate the signal in the desired area. The longer the difference in length of the interbay cables, the higher the beam angle. The top cable should be the shortest one and the bottom cable the longest one.

NicomUsa Inc. - 1690 Cactus Rd – San Diego, CA 92154 - Website: www.nicomusa.com
Phone: 1-619-671-9500 Fax: 1-619-671-9575 Email : info@nicomusa.com

.

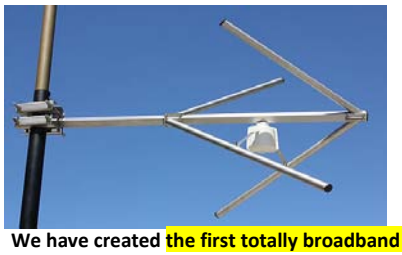
POLARIZATION

POLARIZATION IS VERY IMPORTANT BECAUSE IF YOUR TRANSMITTING SYSTEM AND RECEIVING SYSTEM DO NOT HAVE THE SAME POLARIZATION THERE IS HUGE LOSS (ABOUT 20 Db).
Here are some considerations about the different types of Polarization:

HORIZONTAL:
This type of polarization is not commonly used these days; it was used in the past since radio stations for the most part were listened at home and people had horizontally polarized FM antennas on their roofs.
VERTICAL:
Vertical polarization is the most used worldwide because it has the advantage of a much better penetration compared to the horizontal one. The majority of cars receive the signal with a vertically polarized antenna. Also vertical polarization has a much better gain compared to a crossed polarized antenna and for this reason you need less bays to achieve the same gain. For example a 4 bay array with vertically polarized antenna has the same gain as that of an 8 bay crossed polarized antenna.
MIXED:
Some countries, like the USA, have the rule that polarization has to be at least 50% horizontal. For this reason in these countries the crossed polarization has become the most common. It has a very important advantage and we will explain why.
Imagine a radio wave vertically polarized hitting an obstacle (building, trees, etc), this brakes the wave into many parts and when it re-compose it's weaker and not all the parts maintain the original polarization.
In this case if the antenna has both vertical and horizontal components it will provide better coverage, in particular in cities where huge buildings can create problems in the reception.
In addition, we know that after many miles the polarization tends to rotate naturally; again the mixed polarization will take care of this type of situation allowing the signal to reach longer distances.
The other side of the coin is that you need to double either the antenna system or the transmitter power to achieve the same gain of linear polarization.

BROADBAND OR NARROW BAND

This is another issue to consider in the choice of an antenna or antenna system.
Generally speaking, narrow band antennas are simpler in construction and less expensive. They were very popular In the Americas, however, today broadband antennas are outselling narrow band ones. In Europe the broadband antenna has been widely used for many years. Well know companies like KATHREIN (German), have developed a great line of broadband antennas for almost every frequency .



Nicom, with its 20 years of experience in the European market, has been the first to bring the Broadband concept to the mixed polarized antennas. It created the BKG77 antenna in 1998 when it moved and open its business in the US. At that time most of the antennas were Narrow Band, as well as the one knows as "the penetrator" which covered only part of the FM band.
We have created the first totally broadband antenna mostly because we think that the advantages of the broadband antenna are so much more than its disadvantages.

BROADBAND CIRCULAR:
PRO'S

- **NO TUNING NECESSARY. MOST BRAND (LIKE NiCOM BKG77 WORK WELL FROM 88-108 MHz)**
- **GOOD FOR MULTI CHANNEL BROADCASTING. WITH THE APPROPRIATE COMBINER IT CAN BROADCAST MORE THEN ONE FREQUENCY**
- **THEY ARE SAFER FOR THE MOS-FETS (IN TRANSMITTERS) AS THEY WORK IN THE WHOLE BAND AND THE HOT POINT OF THE ANTENNA IS INSIDE AND PROTECTED**
- **SOME BRAND (LIKE NICOM BKG 77) CAN BE ORDERED WITH RADOME OPTIONS TO FURTHER PROTECT THE ANTENNA FROM INCLEMENT WEATHER CONDITIONS**

BROADBAND CIRCULAR:
CON'S

- **SLIGHTLY LESS GAIN THEN THE NARROW BAND**
- **WEIGHT AND SIZE CAN BE A PROBLEM FOR SOME INSTALLATIONS AS THEY ARE NEARLY DOUBLE IN WEIGHT AND SIZE**
- **COST**

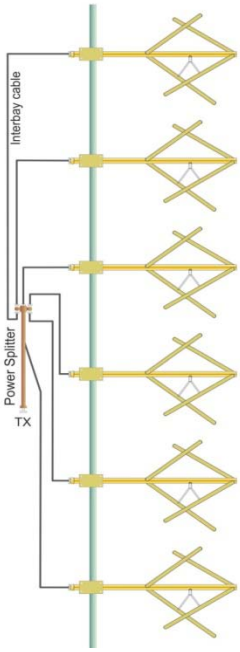
NicomUsa Inc. - 1690 Cactus Rd – San Diego, CA 92154 - Website: www.nicomusa.com
Phone: 1-619-671-9500 Fax: 1-619-671-9575 Email : info@nicomusa.com

MATERIAL USED TO BUILD ANTENNAS

- **In the US it was and mostly is still very popular to build antennas with copper since this metal is a wonderful conductor. However, copper is not very strong. Some manufacturers are using aluminum that is lighter and cheaper; however, this material is delicate and not long lasting, especially in areas with moisture and humidity, therefore rendering a very short life to the antennas. Many customers first look at the price and since they are less expensive they tend to purchase those, however, in the long run they end up spending more.**
- **Large, well known European companies like Kathrein are using Hot Galvanized Steel. This is a very sturdy way to build antennas; they will probably have a little less performance than if using copper, although not noticeable, but they will last a long time.**
- **Nicom has chosen to follow this idea of sturdy antennas, however, since many of our customers are small radio stations and don't often have large towers, we decided to use stainless steel which gives the same longevity as that of galvanized steel but with less weight.**

SPACING BETWEEN THE BAYS

- **When assembling an array it is very important to determine the distance between each antenna in the system. There are different ways to build up a system; you can assemble arrays with antennas of various impedance and transform the impedance itself with rigid lines.**
- **We have chosen to make antennas that are already 50 ohms and combine them through 50 ohm cables. The power divider does the match of the impedance. For example a 2 way power divider transform the impedance of 2 antennas (50:2 = 25 ohms) back to 50 ohms using a quarter wave line of calculating diameter so that the impedance of the line will result at 35 ohms. In fact 35 ohms is the necessary impedance of a quarter wave line to transform 25 ohms into 50. In former times radio amateurs used to couple 2 50 ohms antennas by using 2 pieces of 75 ohm cable in parallel so as to achieve almost 35 ohms.**
- **The same applies for a 4 way power divider and so on.**
- **Assembling the array with cables and not with rigid lines gives us a very important advantage. We can decide what distance to keep between the bays. For example if we have a 4 bay system and we need to keep the down radiation as low as possible, we will go for half wave spacing which will give less gain but will attenuate much more the down radiation. If we want the max gain we stay close to full wave spacing, being aware that some secondary lobes can interfere with the main lobe which results with some areas where the signal is lower than expected.**
- **We recommend a compromise between the two previous configuration using a 0.8 lambda that keeps the lobe uniform and at the same time does not greatly reduce the gain of the system.**



The distance between the bays is calculated with the following formula:

300.000 : Freq. (Mhz) x 0.8 = distance in mm. where 300000 is the speed of light and 0.8 is the fraction of lambda.

An easier way is to divide everything by 1000 and use the formula: ***300:freq.(Mhz) x 0.8 = distance in meters***

Do not hesitate to contact Nicom Sales Department at 619-671-9500 to request technical specifications and pricing!

NicomUsa Inc. - 1690 Cactus Rd – San Diego, CA 92154 - Website: www.nicomusa.com
Phone: 1-619-671-9500 Fax: 1-619-671-9575 Email : info@nicomusa.com