THE PROBLEM WITH ANTENNAS AND DTT (Digital Terrestrial Television)

General Topics

1. UHF antenna minimum gain.
2. Front-to-Back antenna ratio.
3. Antenna directivity.
4. Other factors.

UHF broadband antennas will not have to be changed when the digital TV generation arrives and so they constitute the future in TV.

1. Introduction

Gain, Directivity and Front-to-Back ratio F/B (the difference between the gain of the antenna in the direction of maximum gain and the gain in the opposite direction) are two concepts that are very strongly linked with values that are directly related to each other.

In other words, more gain implies greater directivity and greater F/B ratio, and vice-versa. Normally, antenna catalogues give both Gain and F/B parameters (they give the F/B ratio as an indicator of its directivity).

2. Gain

The recommendation of the 1997 Chester act fixes minimum levels of electric field in BIV and BV obtained by an antenna gain at 12 to 14 dBi respectively.

3. Directivity

An F/B ratio that can be considered as good is a level greater than 25 dB. This value will always guarantee a good directivity.

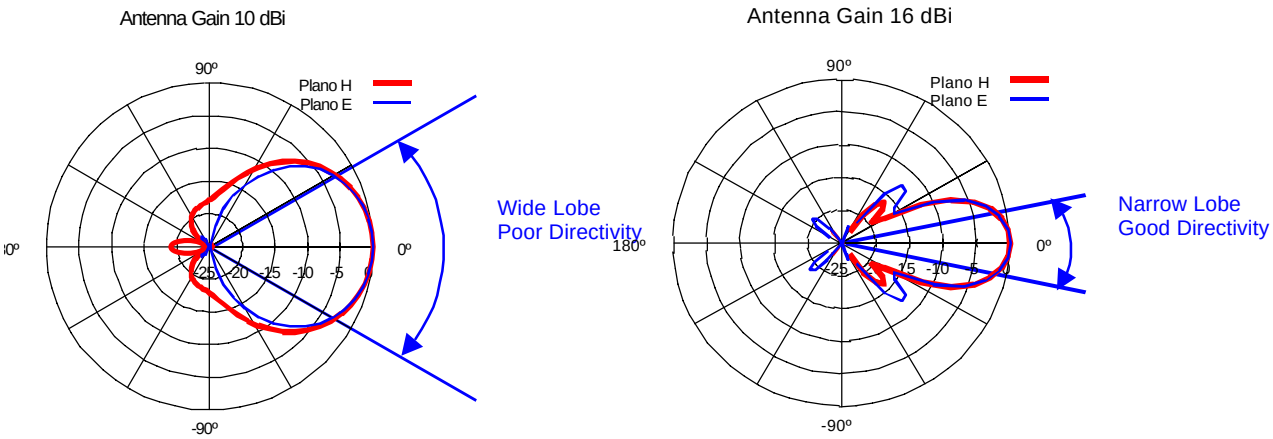


Fig.1: Gain of an antenna. The narrower the lobe the higher the directivity

4. dBd versus dBi

The best way to measure the gain of a particular antenna is comparing it with a pattern antenna. Normally, pattern antennas are ideally omnidirectional (antennas that radiate the same energy in all directions).

But, if a particular antenna has a 25 dB gain in a given direction in space, what does this mean? Simply that this antenna gains 25 dB more than the pattern antenna in the same direction.

The pattern antenna can be either an “isotropic” or a “dipole” antenna. Thus, the measured gain is given either in dBi (decibels related to isotropic antenna) or in dBd (decibels related to dipole antenna).

The conversion from one unit to the other is simple:

- If the units are in dBd, just subtract 2.15 to the obtained units in dBi:

$$N\ (dBi) = N\ (dB_d) - 2.15$$

- Add 2.15 to do the opposite conversion (dBi to dBd):

$$N\ (dB_d) = N(dB_i) + 2.15$$

There is no specific reason to choose one measurement or the other.

5. Expected rejection by using a broadband antenna or a grouped antenna.

A broadband antenna does not select channels in frequency like a grouped antenna. A grouped antenna, if it has been well designed, will reject the channels that do not belong to that group. This can be very handy if those channels come from another TV relay station and belong to another group.

However, we are talking of very little rejection between channels, especially in frequencies that are very close.

6. Benefits that arise from using a grouped filter or a grouped antenna.

First of all, a grouped filter will always have greater rejections against the channels that are out of the group than a grouped antenna, even if the antenna has a very complex design.

Normally with such a filter, you can obtain rejections that are 20 dB greater to the frequencies found outside of the group (more than 20 MHz away), which are impossible to obtain with an antenna.

7. Ground noise and its influence.

The exact definition of ground noise is:

“Microwave signals generated by the heat of the ground (physically) and captured by an antenna”

This type of noise is only important in satellite reception, since the level of reception is very low.

In terrestrial TV, this noise is not important and it is not generally taken into account.

But the type of noise that *is* important in terrestrial TV is the “**impulsive noise**”.

Impulsive noise does not last long. It is characterised by a fast rise time and it can appear in both UHF and VHF bands.

Industrial activity pollutes the RF spectrum with these sorts of signals.
The polluting agents are power lines, car ignitions, home appliances...

COFDM digital receivers can be affected and can work incorrectly if the impulsive noise is considerable: the image freezes for a moment or disappears entirely (artefacts).
This problem can be solved by a higher input signal level in the digital receiver or with the use of new IC's that are able to significantly reduce this phenomenon.

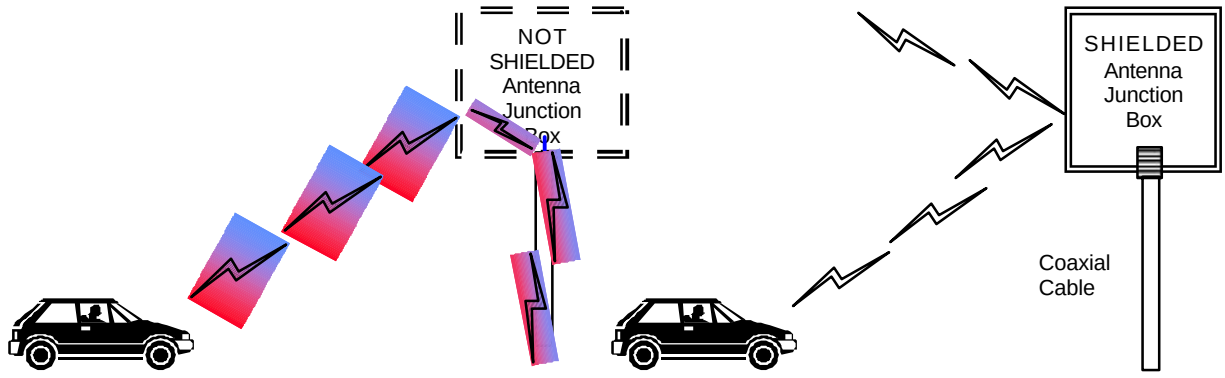
Nevertheless, the best solution is to avoid the ingress of this kind of noise into the system and this can be achieved by using the right antenna at the right site and pointed in the right direction.

8. Noise Sources

- **The antenna**
  Obviously, the antenna is the most important device through which the impulsive noise can ingress into a TV distribution network.

  There is very little that we can do regarding the noise entering in the same direction as the TV signal. But, in most cases, this is not the way the noise enters.
  The impulsive noise comes from the surroundings, e.g. from the street. We need both high gain and good directivity antennas to avoid this sort of noise, as shown in fig. 1, especially in environments where there is a high noise level, like in urban areas.

- **Impedance adapter**
  An antenna adapter (balun) in a non-shielded junction box receives a high amount of noise.
  It captures noise from various different directions even though the antenna presents good rejection levels due to its directivity. This consideration is important when the noise source is next to the antenna.



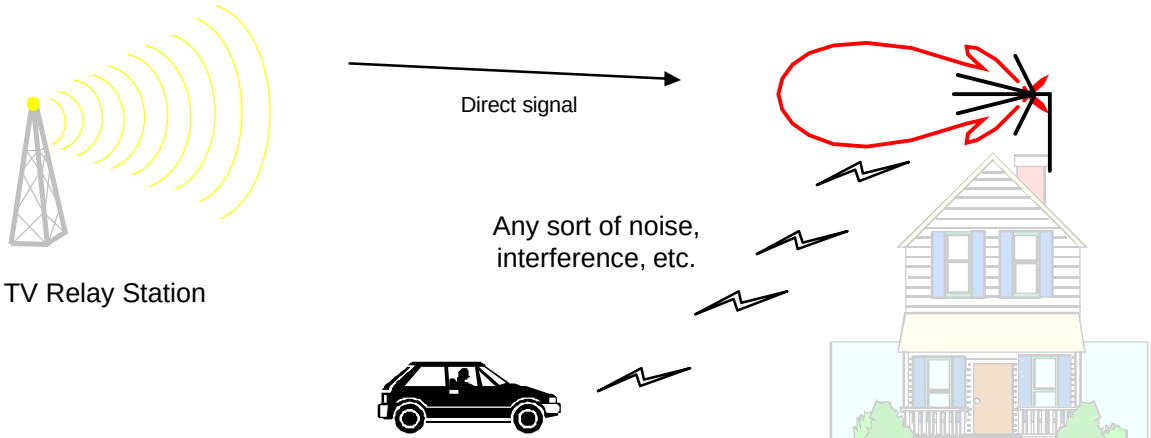
- **Cables**
  These elements become very important if they are not shielded.
  Nevertheless, in most cases, the majority of noise comes through the connectors and their installation due to mismatching factors.

- **Mixers**
  They must be shielded. Otherwise they can capture a high level of impulsive noise that could interfere with the reception of the TV digital signals.

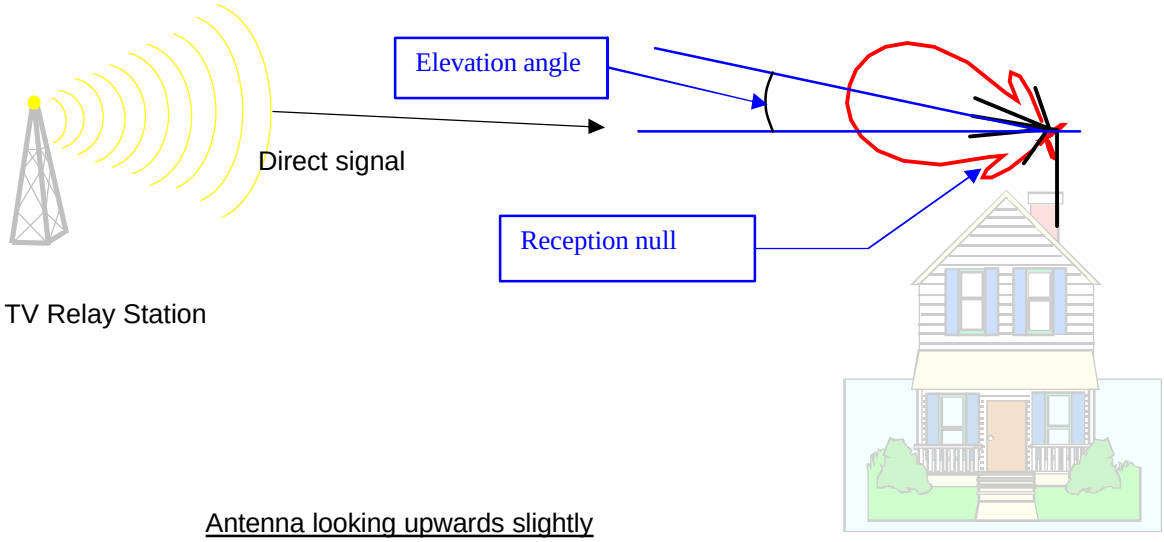
- ***Other considerations***

Usually an antenna is installed facing slightly upwards to minimize any type of interference (radio-electric noise, bouncing signals, etc.) that could come from the ground and the surroundings.
As we point it upwards, we lose some gain but we also gain rejection against this interference since this interference coincides with a null on the radiation diagram (see figures).

The exact angle can only be determined onsite during the installation (it does not always have to point upwards).
Never point the antenna to the ground because besides losing the signal and turning away from the TV relay station direction, we will likely to capture more interference.



The normal way to mount one antenna (looking towards the TV emitter)



Antenna looking upwards slightly

CONCLUSIONS: How to solve these problems.

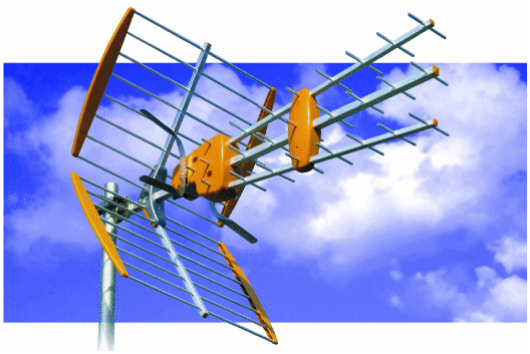
a) Create a little amplification in the antenna junction box to increase the signal level in order to cancel the interference due to the noise.

b) Use antennas with a shielded junction box, so that the adapter does not capture impulsive noise.

c) Use F connectors, which will give the best shielding.

d) Never use poorly shielded cables. Otherwise all the points mentioned above would be useless.

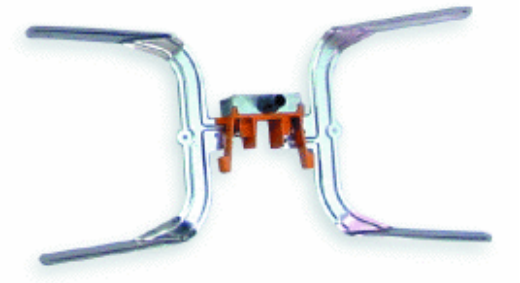
The best example is our new **DAT45** antenna working in conjunction with its MRD (Margin Rising Device).

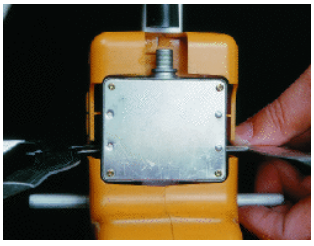


The DAT45 antenna and the MRD work together to achieve the best reception for digital terrestrial TV signals.

An antenna with a high level of directivity like the DAT45, adequately orientated, will not receive impulsive noise from the street.

On the other hand, the MRD avoids the amplification of the noise that would enter via the cable if it were situated on a mast.





Its diecast junction box and the F connector avoid the ingress of noise.
The 12 dB gain of the MRD makes the signal levels higher without allowing the analogue channels to cause the saturation of the digital receivers.