

Antenna Gain

The gain of an array describes the increase of signal in the main radiation direction which is produced by reducing radiation in all other directions and concentrating it in the main beam. The gain of a broadcast antenna system is normally increased by using a larger number of vertical bays (increasing the vertical aperture) and thereby forming a more narrow vertical radiation pattern.

In the case of a directional antenna system the gain is increased by reducing or eliminating radiation toward azimuth segments and re-directing it toward the areas where coverage is desired.

When calculating the gain of an array the losses in the feeder cables and the power splitters must be taken into account.

Downtilt in Panel Arrays

When transmitting antennas are located on elevated sites it is often beneficial to tilt the main beam of the vertical radiation pattern downward to provide higher signal levels in the areas to be served. There are two ways to accomplish downtilt (also known as “beam tilt”). The panels can be mechanically tilted to direct the beam downward, or phase differences can be introduced into the array feeder system to achieve electrical tilt.

Impedance Tuning

While the VSWR of a well-designed antenna system can be optimized by the use of tuning devices it is not possible to achieve broad bandwidth by compensating for poor components with tuners.

The characteristics of a truly high quality antenna system are established in many ways, beginning with proper component design and manufacture followed by competent system design and installation.

Mast or Tower Dimensions for Panel Arrays

The radiation pattern of a panel array depends on the relative positions of the individual panels in space and the relative amplitude and phase of the RF energy fed to each panel. Therefore it is necessary to have exact dimensional information about the supporting tower or mast if one is to optimize an array design.

The cross section of the mast or tower should be less than one wavelength for a good omni pattern. As the cross section increases beyond one wavelength nulls in the horizontal radiation pattern will rapidly become deeper.

Measurement Links

When large-diameter coax lines are used in an antenna system it is not possible to easily connect measurement equipment without disassembly of the coax system. In these cases it is advisable to install measurement links in the coax feeders to allow convenient connection of test equipment to the antenna system.

Mismatch Compensation

In a broadcast panel array the impedance match of individual panels can be disturbed by mutual coupling, icing and the presence of nearby obstacles. For this reason it is necessary to design the feed system so as to cancel reflections within the array and thereby minimize the presence of reflected signal at the antenna system input. This technique is also known as impedance compensation.

Null Fill

Panel arrays with multiple vertical bays will exhibit deep nulls in the vertical radiation pattern if all bays are fed with equal phase and amplitude. It is important to fill these nulls for proper signal coverage.

For TV systems it is not sufficient to provide the minimum signal level, but it is necessary to make the direct signal bigger than any reflexion to avoid ghost pictures.

There are three methods of introducing null fill in a panel array:

- Mechanically tilting some panels downward
- Using a non-linear phase taper between bays
- Using an unequal power split between bays

Since some energy is taken from the main beam to fill the null, the maximum gain of the antenna system will be reduced, typically 0.5 to 1.5 dB, when null fill is introduced.

Polarization

The polarization is defined as the direction of the electrical vector, in practice the plane of the dipoles.

The electric field of an antenna system can be split into a horizontal and a vertical component.

If there is only one component, the polarization is pure horizontal or vertical (plane polarized).

If there are two components which are not in phase, the polarization is elliptical.

For slant polarization both must exist and they must be in phase.

When an antenna produces vertically and horizontally polarized fields with equal amplitude and with a phase difference of exactly 90 degrees, the resulting signal is circularly polarized.

Power Rating of Components

Generally, the power rating of components refers to the maximum CW power (or mean power) level that can be applied to the input.

The maximum mean power output of a TV transmitter occurs during transmission of a black picture and it is typically equal to 70 % of the peak sync power level.

Split Antenna Systems

An antenna system can usually be divided into upper and lower halves which can be operated separately.

This arrangement allows the use of one half for broadcast operations while the other half is available for painting or maintenance or other work that must be performed in close proximity to the antenna.

The signal level will be reduced by 6 dB if one half of the antenna is fed with one half of the normal transmitter power. If the full transmitter power is available, the use of one half of the antenna will reduce the signal level by only 3 dB.

It will be necessary to climb the mast or tower to perform antenna switching unless a coax patch panel is installed at the transmitter output with two main feeders up to the antenna inputs.