RF Terminology

ZCG Help Guide

A general guide to RF terminology used in the RF Industry

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Introduction

ZCG realise that not everyone is involved and love antennas as much as we do. And sometimes the terminology used on both our specification sheets and website can be lost in translation to non-RF trained consumers.

At ZCG we believe that supplying easy to understand information to help you choose the right antenna for your specific requirements is in our best interests. You will find below some common use terminology within the RF industry:

Antenna

The part of a transmitting or receiving system which is designed to radiate or to receive electromagnetic waves". An antenna can also be viewed as a transitional structure (transducer) between free-space and a transmission line (such as a coaxial line). An important property of an antenna is the ability to focus and shape the radiated power in space e.g.: it enhances the power in some wanted directions and suppresses the power in other directions.

Frequency

The resonation of the antenna represented in Hz (hertz), kHz (kilohertz), MHz (Megahertz) or GHz (Gigahertz) determined by physics and calculations. The frequency and calculations will determine the length of the resonating elements, spacings between antennas and overall lengths of antennas.

Bandwidth

The range of frequencies within which the performance of the antenna, with respect to some characteristics, conforms to a specified standard". VSWR of an antenna is the main bandwidth limiting factor, i.e. 1.5:1 VSWR or 1.2:1 VSWR which are standard VSWR measurements.

Input impedance

The impedance presented by an antenna at its terminals. The input impedance is a complex function of frequency with real and imaginary parts. The input impedance is graphically displayed using a Smith chart.

Reflection coefficient

The ratio of the voltages corresponding to the reflected and incident waves at the antenna's input terminal (normalized to some impedance Z0). The return loss is related to the input impedance Zin and the characteristic impedance Z0 of the connecting feed line by: Gin = (Zin – Z0) / (Zin+Z0)

VSWR (Voltage Standing Wave Ratio)

The ratio of the maximum/minimum values of standing wave pattern along a transmission line to which a load is connected. VSWR value ranges from 1 (matched load) to infinity for a short or an open load. For most base station antennas the maximum acceptable value of VSWR is 1.5. VSWR is related to the reflection coefficient Gin by: VSWR= (1+|Gin|)/(1-| Gin |).

Isolation

A measure of power transfer from one antenna to another". This is also the ratio of the power input to one antenna to the power received by the other antenna, expressed in decibel (dB). The same definition is applicable to two-port antennas such as dual-polarization antennas.

Far-field region

That region of the field of an antenna where the angular field distribution is essentially independent of the distance from a specified point in the antenna region". The radiation pattern is measured in the far field.

Antenna polarisation

In a specified direction from an antenna and at a point in its far field, is the polarization of the (locally) plane wave which is used to represent the radiated wave at that point". "At any point in the far-field of an antenna the radiated wave can be represented by a plane wave whose electric field strength is the same as that of the wave and whose direction of propagation is in the radial direction from the antenna. As the radial distance approaches infinity, the radius of curvature of the radiated wave's phase front also approaches infinity and thus in any specified direction the wave appears locally a plane wave". In practice, polarization of the radiated energy varies with the direction from the center of the antenna so that different parts of the pattern and different side lobes sometimes have different polarization. The polarization of a radiated wave can be linear or elliptical (with circular being a special case).

Co-polarisation

That polarization which the antenna is intended to radiate.

Cross-polarisation

In a specified plane containing the reference polarization ellipse, the polarization orthogonal to a specified reference polarization. The reference polarization is usually the co-polarization.

Antenna pattern

The antenna pattern is a graphical representation in three dimensions of the radiation of the antenna as a function of angular direction. Antenna radiation performance is usually measured and recorded in two orthogonal principal planes (such as E-Plane and H-plane or vertical and horizontal planes). The pattern is usually plotted either in polar or rectangular coordinates. The pattern of most base station antennas contains a main lobe and several minor lobes, termed side lobes. A side lobe occurring in space in the direction opposite to the main lobe is called back lobe.

Normalised pattern

Normalizing the power/field with respect to its maximum value yields a normalized power/field pattern with a maximum value of unity (or 0 dB).

Gain pattern

Normalizing the power/field to that of a reference antenna yields a gain pattern. When the reference is an isotropic antenna, the gain is expressed in dBi. When the reference is a half-wave dipole in free space, the gain is expressed in dBd.

Radiation efficiency

The ratio of the total power radiated by an antenna to the net power accepted by the antenna from the connected transmitter.

E Plane

For a linearly polarized antenna, the plane containing the electric field vector and the direction of maximum radiation". For base station antenna, the E-plane usually coincides with the vertical plane.

H Plane

For a linearly polarized antenna, the plane containing the magnetic field vector and the direction of maximum radiation". For base station antenna, the H-plane usually coincides with the horizontal plane.

Front-to-back ratio

The ratio of the maximum directivity of an antenna to its directivity in a specified rearward direction. Sometimes the directivity in the rearward direction is taken as the average over an angular region.

Major/main lobe

The radiation lobe containing the direction of maximum radiation". For most practical antenna there is only one main beam.

Side lobe level

Is the ratio, in decibels (dB), of the amplitude at the peak of the main lobe to the amplitude at the peak of a side lobe.

Half-power beamwidth

In a radiation pattern cut containing the direction of the maximum of a lobe, the angle between the two directions in which the radiation intensity is one-half the maximum value". The Half-power beamwidth is also commonly referred to as the 3-dB beamwidth.

Antenna directivity

The directivity of an antenna is given by the ratio of the maximum radiation intensity (power per unit solid angle) to the average radiation intensity (averaged over a sphere). The directivity of any source, other than isotropic, is always greater than unity.

Antenna gain

The maximum gain of an antenna is simply defined as the product of the directivity by efficiency. If the efficiency is not 100 percent, the gain is less than the directivity. When the reference is a loss less isotropic antenna, the gain is expressed in dBi. When the reference is a half wave dipole antenna, the gain is expressed in dBd (1 dBd = 2.15 dBi).

Antenna efficiency

The total antenna efficiency accounts for the following losses: (1) reflection because of mismatch between the feeding transmission line and the antenna and (2) the conductor and dielectric losses.

Effective radiated power

In a given direction, the relative gain of a transmitting antenna with respect to the maximum directivity of a half-wave dipole multiplied by the net power accepted by the antenna from the connected transmitter.

Power handling

Is the ability of an antenna to handle high power without failure. High power in antenna can cause voltage breakdown and excessive heat (due to conductor and dielectric antenna losses) which would results in an antenna failure.

P.I.M. (Passive InterModulation)

As in active devices, passive intermodulation occurs when signals at two or more frequencies mix with each other in a non-linear manner to produce spurious signals. PIM is caused by a multitude of factors present in the RF signal path. These include poor mechanical contact, presence of ferrous contents in connectors and metals, and contact between two galvanically unmatched metals. PIM spurious signal, which falls in the up link band, can degrade call quality and reduce the capacity of a wireless system.

Side lobe suppression

Any process, action or adjustment to reduce the level of the side lobes or to reduce the degradation of the intended antenna system performance resulting from the presence of side lobes. For base station antenna, the first side lobe above the horizon is preferred to be low in order to reduce interference to adjacent cell sites. At the other hand, the side lobes below the horizon are preferred to be high for better coverage.

Null filling

Is the process to fill the null in the antenna radiation pattern to avoid blind spots in a cell site coverage.

Isotropic radiator

A hypothetical, loss less antenna having equal radiation intensity in all direction. For based station antennas, the gain in dBi is referenced to that of an isotropic antenna (which is 0 dB).

Omni-directional antenna

An antenna having an essentially non-directional pattern in a given plane of the antenna and a directional pattern in any orthogonal plane. For base station antennas, the omnidirectional plane is the horizontal plane.

Directional antenna

An antenna having the property of radiating or receiving electromagnetic waves more effectively in some directions than others.

Half-wave dipole

A wire antenna consisting of two straight collinear conductors of equal length, separated by a small feeding gap, with each conductor approximately a quarter-wave length long.

Log periodic antenna

Any one of a class of antennas having a structural geometry such that its impedance and radiation characteristics repeat periodically as the logarithm of frequency.

Microstrip antenna

An antenna which consists of a thin metallic conductor bonded to a thin grounded dielectric substrate. An example of such antennas is the microstrip patch.

Linear array

A set of radiating elements (e.g. dipole or patch) arranged along a line. Radiating elements such as dipole and patch have dimensions comparable to a wavelength. A linear array has a higher gain, than a single radiator and its radiation pattern can be synthesized to meet various antenna performance requirements such as upper side lobe suppression and null fill. It should be noted that the gain of any antenna is proportional to its size.

Coaxial antenna

An antenna comprised of a extension to the inner conductor of a coaxial line and a radiating sleeve which in effect is formed by folding back the outer conductor of the coaxial line.

Collinear array antenna

A linear array of radiating elements, usually dipoles, with their axes lying in a straight line.

Adaptive (smart) antenna

An antenna system having circuit elements associated with its radiating elements such that one or more of the antenna properties are controlled by the received signal.

If you need any more assistance with other RF terminology or information on any of our range of RF products your ZCG sales consultants will be happy to help.

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