

## **ANTENNA AND ELECTRONIC TERM DEFINITIONS**

**Absolute gain:** Of an antenna, for a given direction and polarization, the ratio of (a) the power that would be required at the input of an ideal isotropic radiator to (b) the power actually supplied to the given antenna, to produce the same radiation intensity in the far-field region. Note 1: If no direction is given, the absolute gain of an antenna corresponds to the direction of maximum effective radiated power. Note 2: Absolute gain is usually expressed in dB. Synonym isotropic gain. Of a device, the ratio of (a) the signal level at the output of the device to (b) that of its input under a specified set of operating conditions. Note 1: Examples of absolute gain are no-load gain, full-load gain, and small-signal gain. Note 2: Absolute gain is usually expressed in dB.

**Absorption loss:** That part of the transmission loss caused by the dissipation or conversion of electrical, electromagnetic, or acoustic energy into other forms of energy as a result of its interaction with a material medium.

**Altazimuth mount:** A mounting, for a directional antenna or telescope, in which slewing takes place in (a) the plane tangent to the surface of the Earth or other frame of reference and (b) elevation about, i.e., above or below, that plane. Synonym x-y mount. {alt-azimuth mount}

**Alternating current:** Current that is continually changing in magnitude and periodically in direction from a zero reference level. Also called AC.

**Amplification:** The process of increasing the strength (current, voltage, or power) of a signal.

**Amplifier:** An electronic component that boosts the voltage or power level of a signal that is a linear replica of the input signal, but with greater power or voltage level, and sometimes with an impedance transformation. The output may also be a nonlinear analog function of the input signal, as in a signal compression device. Also See fiber amplifier, optical repeater. [Amplifier Manufacturers](#)

**Amplitude:** The level of an audio or other signal in voltage or current. The magnitude of variation in a changing quantity from its zero value.

**Amplitude modulation:** Modulation in which the amplitude of the

carrier wave is varied above and below its normal value in accordance with the intelligence of the signal being transmitted. Also called AM.

**Antenna:** A device used to radiate or receive electromagnetic energy (generally RF).

**Antenna bandwidth:** The frequency range over which a given antenna will accept signals.

**Antenna feed:** Means by which power is transferred to and from the antenna and the connecting transmission line.

**Antenna gain:** The effectiveness of a directional antenna as compared to a standard nondirectional antenna. It is usually expressed as the ratio in decibels of standard antenna input power to directional antenna input power that will produce the same field strength in the desired direction. For a receiving antenna, the ratio of signal power values produced at the receiver input terminals is used. The more directional an antenna is, the higher is its gain.

**Amp / Ampere:** The basic unit of current flow

**Attenuation:** the decrease of a signal's amplitude level over any distance during transmission or through purpose designed attenuators. Attenuation measures signal loss in decibels (dB). Power loss resulting from conductor resistance and dielectric loss within the insulating material used to separate the conductors.

**Balanced antenna:** An antenna is balanced with respect to ground when both its arms have the same electrical relationship to ground.

**Balanced transmission line:** A transmission line whose conductors have voltages of opposite polarity and equal magnitude with respect to the Earth.

**Balun:** A device for feeding a balanced load with an unbalanced line, or vice versa. An acronym for Balanced/Unbalanced. A device used to couple a balanced system {impedance} to an un-balanced system. A wide-band impedance matching transformer providing a 4:1 impedance ratio.

**Bandwidth:** The width of a band of frequencies used for a particular purpose.

**CAPACITANCE.** The property of an electrical circuit that opposes changes in voltage.

**CAPACITIVE REACTANCE.** The opposition, expressed in ohms, offered to the flow of an alternating current by capacitance. The symbol for capacitive reactance is  $X_C$ .

**Capacitor:** A pair of parallel "plates" separated by an insulator (the dielectric). Stores an electric charge, and tends to pass higher frequencies more readily than low frequencies. Does not pass direct current, and acts as an insulator. Electrically it is the opposite to an inductor. Basic unit of measurement is the Farad, but is typically measured in micro-farads ( $\mu F = 1 \times 10^{-6} F$ ) or nano-farads ( $nF = 1 \times 10^{-9} F$ )

**CHOKER.** An inductor used to impede the flow of pulsating dc or ac by means of self-inductance. A choke is designed to have a high reactance to a particular frequency. Common-mode chokes are used to protect from EMI. High frequency chokes may be called ferrite chokes or choke baluns. RF chokes normally have air core, while low frequency chokes have ferromagnetic iron cores.

**CIRCUIT.** The complete path of an electric current.

**Coaxial Cable:** a metallic cable constructed in such a way that the inner conductor is shielded from EMR (electromagnetic radiation) interference by the outer conductor. Coaxial cable is less susceptible to more transmission impairments than twisted pair cable, and it has a much greater bandwidth; thus coaxial cable is used by most analogue and digital systems for the transmission of low level signals. There is little radiation loss from this type of cable.

**COIL.** An inductive device made by looping turns of wire around a core.

**CORE.** Any material that affords a path for magnetic flux lines in a coil.

**CURRENT.** The movement of electrons past a reference point. The passage of electrons through a conductor. Measured in amperes

**dB - Decibel - (0.1 Bel):** defined (more or less) as the smallest variation of volume detectable by ear. This is measured on a logarithmic scale, so a change of 3dB from 1 Watt is equivalent to 0.5 Watt or 2 Watts. A change of 10dB from 1 Watt is equivalent to 100mW or 10 Watts. In electronics, 0dBm is a reference value corresponding to 1mW at 600 Ohms - this equates to approximately

775mV. The threshold of sound is 0dB, and typical sounds can reach 140dB or more. Any prolonged sound above 90dB may cause hearing damage

**DIELECTRIC.** A substance in which an electric field may be maintained with zero or near-zero power dissipation, i.e., the electrical conductivity is zero or near zero. An insulator; a term applied to the insulating material between the plates of a capacitor.

**DIODE.** An electron tube containing two electrodes: a cathode and a plate. A two element, solid-state device made of either germanium or silicon; it is primarily used as a switching device to allow current flow in only one direction. .

**DIPOLE.** A common type of half-wave antenna made from a straight piece of wire cut in half. Each half operates at a quarter wavelength of the output.

**Distortion (1):** Any modification to a signal which results in the generation of frequencies which were not present in the original

**DUMMY LOAD.** A dissipative but non-radiating device that has the impedance characteristics of an antenna or transmission line. Also called ARTIFICIAL LOAD.

**Electromagnetic field:** The field of force that an electrical current produces around the conductor through which it flows.

**Electromagnetic waves:** A wave propagating as a periodic disturbance of the electric and magnetic fields and having a frequency in the electromagnetic spectrum; the means by which energy is transmitted from one place to another.

**Feeder:** A transmission line that carries energy to the antenna.

**Feedpoint impedance:** Impedance that is measured at the input terminals of an electrical device such as an antenna.

**Folded Dipole:** An ordinary half-wave antenna (dipole) that has one or more additional conductors connected across the ends parallel to each other.

**Frequency:** The rate at which an alternating current changes in a cyclic manner from positive to negative and back again (one cycle). The basic unit of measurement is the Hertz (Hz), which equates to one cycle per second

**Frequency modulation:** The process of varying the frequency of a carrier wave, usually with an audio frequency, in order to convey intelligence. Also called FM.

**Gain:** The increase in signal strength that is produced by an amplifier.

**Ground-Plane Antenna:** A type of antenna that uses a ground plane as a simulated ground to produce low-angle radiation.

**Half-wave dipole antenna:** A center-fed antenna whose electrical length is half the wavelength of the transmitter or received signal. An antenna consisting of two rods (1/4 wavelength each) in a straight line, that radiates electromagnetic energy.

**Half-wave vertical dipole antenna:** A half-wave dipole constructed vertical to the Earth's surface.

**Hertz:** One cycle per second.

**Hertz antenna:** A half-wave antenna installed some distance above ground and positioned either vertically or horizontally.

**High frequency:** frequencies between 3 and 30 MHz.

**Hop:** A single reflection of the wave back to Earth at a point beyond the horizon.

**Horizontal dipole:** A dipole constructed parallel to the Earth's surface.

**Impedance:** The total opposition offered by a circuit or component to the flow of alternating current. A load applied to an amplifier (or other source) which is not a pure resistance. This is to say that its loading characteristics are frequency dependent. Impedance consists of some value of resistance in conjunction with capacitance and/or inductance. The equivalent circuits can vary from two components to hundreds.

**Impedance match:** The condition where the load impedance equals the characteristic impedance of a transmission line.

**Inductance:** The natural property of an electrical circuit which opposes the rate of change of current, i.e., electrical inertia

**Inductor:** A coil of wire which exhibits a resistance to any change of amplitude or direction of current flow through itself. Inductance is inherent in any conductor, but is "concentrated" by winding into a coil. An inductor tends to pass low

frequencies more readily than high frequencies. Electrically it is the opposite of a capacitor. Basic unit of measurement is the Henry (H), in crossover networks it will typically be measured in milli-henrys (mH = 1 x 10<sup>-3</sup>H) and for RF micro-henrys (uH) are common

**Inverted L antenna:** A half-wave dipole fed by a one-quarter wavelength long vertical section.

**Inverted vee antenna:** A half-wave dipole erected in the form of an upside-down vee, with the feed point at the apex. It is essentially omnidirectional, and is sometimes called a dropping doublet.

**Megahertz:** One million cycles per second. Also called MHz.

**Modulate:** To change the output of a transmitter in amplitude phase, or frequency in accordance with the information to be transmitted.

**Monopole antenna:** An antenna with a single radiating element; a whip antenna.

**Ohm** is the electrical resistance offered by a current-carrying element that produces a voltage drop of one [volt](#) when a current of one [ampere](#) is flowing through it.

$$\Omega = \frac{V}{A} = \frac{m^2 \cdot kg}{s^3 \cdot A^2}$$

**Propagation:** A phenomenon by which any wave moves from one point to another; the travel of electromagnetic waves through space of along a transmission line.

**Propagation path:** The path or route over which power flows from the transmitter to the receiver.

**Quarter-wave antenna:** An antenna with an electrical length that is equal to one-quarter wavelength of the signal being transmitter or received

**Radiate:** To transmit RF energy.

**Radiation:** Energy that moves through space as electromagnetic waves.

**Radiation patterns:** A chart of relative radiation intensity (or power)

versus direction.

**Radio frequency:** Any frequency of electrical energy capable of propagation into space (usually above 20 kHz). Also called RF.

**Radio horizon:** The greatest distance on the Earth at which a transmitted wave can be received by the direct path from a transmitter located on the Earth.

**Radio waves:** Electromagnetic waves at a frequency lower than 3,000 GHz and propagated through space without and artificial guide.

**Reactance** is the [imaginary part](#) of [electrical impedance](#), a measure of opposition to a [sinusoidal alternating current](#). Reactance arises from the presence of [inductance](#) and [capacitance](#) within a circuit, and is denoted by the symbol  $X$ , the [SI unit](#) is the [ohm](#). Both reactance  $X$  and resistance  $R$  are required to determine the impedance  $\tilde{Z}$ ; although in some circumstances the reactance may dominate the impedance, at least an approximate knowledge of the resistance is required to establish this.

$$\tilde{Z} = R + jX$$

**Resistance:** The property of a material or substance to oppose the passage of current through it, thus causing electrical energy to be converted into heat energy.

**Resistor:** An electrical device which impedes (resists) current flow regardless of frequency. Basic unit of measurement is the Ohm

**Resonance:** The natural frequency at which a physical body will oscillate. An example is when you blow gently across the top of a bottle, the enclosed air resonates at a frequency determined by the internal volume. Also refers to the natural resonance of loudspeaker drivers, cabinets and ports, or the frequency where an inductance and capacitance have the same impedance (this causes maximum impedance with a parallel circuit, and minimum impedance for series circuits) The state or frequency of vibration, electrical or mechanical, in which forces that impede the motion are minimum.

**Resonant length:** The proper length of an antenna to render it resonant

**Shortened dipole:** A dipole antenna made to resonate at a lower frequency by use of a coil.

**Signal:** A radio wave that contains the transmitted message.

**Signal loss:** The amount of signal power lost between the transmitter and receiver.

**Signal-to-noise ratio:** [SNR] The power intensity of the signal compared to that of the noise.

**Skip distance:** The distances on the Earth's surface between the points where a radio wave sky wave leaves the antenna and is successfully reflected and/or refracted back to Earth from the ionosphere.

**Skip zone:** The space or region within the transmission range where signals from a transmitter are not received, i.e., between the ground wave and the point where the refracted wave returns.

**Standing-wave:** The distribution of voltage and current formed by the incident and reflected waves which have minimum and maximum points on a resultant wave that appears to stand still.

**Standing-wave ratio:** [SWR] The ratio of the maximum to minimum amplitudes of voltage, or current, along a transmission line.

**Transistor:** A minute electronic device that permits a small current to control the flow of a larger current.

**Transmission line:** A conductor that transfers radio frequency RF energy from the transmitter to the antenna or from the antenna to the receiver.

**Twin-lead transmission line:** A balanced transmission line generally used with balanced antennas.

**Unbalanced transmission line:** A transmission line one of whose conductors is grounded.

**Vertical dipole:** A balanced or dipole antenna oriented vertically

**Volt:** The basic unit of "electromotive force". One Volt applied to a resistance of one Ohm will force a current of one Ampere to flow (Abbreviation - V)

**Voltage:** Electrical pressure, expressed in volts, which is the result of squeezing electrons together.

**Voltage standing-wave ratio:** [VSWR] The ratio of the amplitude of the electric field or voltage at a voltage maximum to that at an adjacent voltage minimum. Also called VSWR.

**Watt:** The basic unit of power. 1 Volt across 1 Ohm (giving 1 Amp) dissipates 1 Watt (all as heat with a resistive load)

**Wavelength:** the length of one cycle of an AC signal. Determined by *Wavelength* =  $c / f$  where "c" is velocity and "f" is frequency. The wavelength of a 345Hz audio signal in air is one metre

**Yagi antenna:** A combination of dipoles to increase the gain.

# ANTENNA REFERENCE SHEET

IMPEDANCE = AC Resistance found in radio waves

Antennas include characteristics of **Capacitors** (store current electrostatically), **Inductors** (store current magnetically) and **Resistors** (impede current flow). These components, Capacitors and Inductors can cancel each other out because they store the energy in different ways. This opposition is known as **Reactance**. **Reactance** is the imaginary part of electrical impedance, a measure of opposition to a sinusoidal alternating current. **Reactance** arises from the presence of inductance and capacitance within a circuit, and is denoted by the symbol  $x$ , the SI unit is the ohm represented by the Greek letter Omega  $\Omega$ .

Both **reactance X** and **resistance R** are required to determine the **impedance Z** although in some circumstances the reactance may dominate the **impedance**, at least an approximate knowledge of the **resistance** is required to establish this.

$$\tilde{Z} = R + jX$$

The combined response of these component parts to alternating currents (radio waves) is called **Impedance**

- Moving electrons in an antenna create a magnetic field
- This changing magnetic field create an electric field
- Waves travel by the back and forth between magnetic and electric fields
- One complete change between magnetic and electric fields equals the distance a radio wave travels during one cycle. This is the **wavelength** represented by the

Greek letter lamda  $\lambda$ . The formula to compute the wavelength is 300 divided by the frequency in megahertz equals the wavelength in meters. For **example**, the wavelength of a 145.470 Mhz radio wave is  $300/145.470=2.062$  meters or 6.77 feet or 81  $\frac{1}{4}$  inches.

- For a **half wavelength dipole antenna** compute the length in feet of antenna by **dividing 468** by frequency in megahertz. For example for a half wavelength dipole on 3.912 mhz  $468/3.912=119.63$  feet or 59.82 feet for each part.

- The RF (Radio Frequencies) are divided into 8 **bands** or groups of frequencies that have similar characteristics.

Very Low Frequency VLF 3khz to 30 khz

Low Frequency LF 30khz to 300 khz

Medium Frequency MF 300 khz to 3000 khz (3mhz) AM

High Frequency HF 3mhz to 30 mhz Ham DX

Very High Frequency VHF 30 mhz to 300 mhz FM

Ultra High Frequency UHF 300 mhz to 3000 mhz (3 ghz)

Extremely High Frequency EHF 3 ghz to 30 ghz

Super High Frequency SHF 30 ghz to 300 ghz

**Resonance** means the frequency the antenna receives and transmits best which is where **reactance** is **zero** (**capacitance** and **inductance cancel each other** out leaving only resistance.

**Modulation** means **turning the wave on and off**. Different modulation techniques called **Modes**.

**Antennas** have a characteristic **impedance** usually **50 ohms** but depends on: antenna design, height above ground, frequency of operation, distance to surrounding objects, other factors.

Match feed line impedance to antenna impedance. Ratio of energy radiating out of antenna compared with energy reflected back to transmitter is called **SWR (Standing Wave Ratio)**

**Ground Plane Antenna is a vertical dipole** with one half of it replaced by the earth or ground. To compute the length of the vertical element divide **234** by desired frequency. For example a 145.470 mhz ground plane vertical element would be  $234/145470=1.6$  feet. Also known as a  $\frac{1}{4}$  wavelength antenna.

**Inverters** convert DC to AC; Generator creates AC  
**Rectifiers** convert AC to DC using diodes.

**TO CONVERT FEET TO METERS MULTIPLY BY 0.305**  
**TO CONVERT METERS TO FEET MULTIPLY BY 3.28**