Glossary

Common mode current: The component of signal current that induces electric and magnetic fields that do not tend to cancel one another. For example, in a circuit with one outgoing signal conductor and one return (“ground”) conductor, the common mode current is the component of the total signal current that flows in the same direction on both conductors. Common mode current is the primary source of EMI in many electronic systems.

Common mode voltage: The voltage that drives directed common mode (noise) currents.

Curie Temperature T_C (°C): The temperature above which a ferromagnetic material (such as ferrite) loses its unique magnetic properties. Above the Curie temperature, the relative permeability of a ferrite drops to a value of 1.0.

Differential mode voltage: The voltage that drives equal and oppositely directed currents to achieve an intended circuit function; the source of differential mode currents.

Differential mode current: The intended signal currents that are equal and oppositely directed on pairs of signal and return (“ground”) conductors.

Impedance Z (ohm): The impedance of a ferrite may be expressed in terms of its complex permeability:

$$Z = j\Omega L_s + R_s = j\Omega L_0 (\mu'_s j\mu''_s) \text{ (ohm)}$$

Incremental Permeability (µD): The permeability of a magnetic material about a specified operating point and applied H (especially under DC bias). The incremental permeability is expressed as the slope of the B-H characteristic about the given operating point.

$$\mu_\Delta = \frac{\Delta B}{\Delta B}$$

Initial Permeability (µi): The measured permeability of a magnetic material (with zero initial magnetization) at small flux densities under 10 gauss (1 milliTesla).

Leakage Flux & Inductance: Leakage flux is the small fraction of the total magnetic flux in a transformer or common mode choke that does not contribute to the magnetic coupling of the windings of the device. In a transformer with a single set of primary and secondary windings, the leakage flux is that portion of flux that is produced by the primary that does not link the secondary. The presence of leakage flux in a transformer or common mode choke is modeled as a small “leakage” inductance in series with each winding. In a multi-winding choke or transformer, leakage inductance is the inductance measured at one winding with all other windings short circuited.

Loss Tangent: The measure of the loss of a magnetic material at high operating frequencies due to the oscillation of microscopic magnetic regions within the material. The loss tangent is expressed as the ratio of the imaginary permeability component µ” to the real permeability µ’ of the material.

Magnetomotive Force (mmf): The electromagnetic force that causes a magnetic flux to flow in a magnetic circuit. It is analogous to the electromotive force (emf) that gives rise to current in an electrical circuit. The mmf applied to a multi-turn inductor is expressed as F = mmf = NI ampere turns, where N is the number of conductor turns and I is the series current through the inductor.

Magnetic Field Intensity or Magnetizing Force (H) (measured in Oersteds or Amperes/m): The mmf per unit length. H can be considered to be a measure of the strength or effort that the magnetomotive force applies to a magnetic circuit to establish a magnetic field. H may be expressed as H = NI/l where l = the mean length of the magnetic circuit in meters. Common industry practice uses a magnetizing force of .01 Oersted (79.6 amp-turns/m) to find the initial permeability of a magnetic material.

Magnetic Flux Density (B) Gauss: The number of magnetic flux lines per area (measured in Gauss or Webers/m2) that is induced by an applied magnetic field intensity H. The B results from an applied H is given by B = µH, where µ is the permeability (sometimes referred to as the absolute permeability) of the magnetic material in which the flux is contained.

Permeability (µ): The extend to or ease with which a material can be magnetized, often expressed as the parameter relating the magnetic flux density B induced by an applied magnetic field intensity H, as B = µH. The “absolute” permeability of a given material is expressed as the product of its relative permeability µr (a dimensionless constant) and the free space constant µo.

Resistivity (ρ): The intrinsic property measured in ohm-centimeters that quantifies a material’s oppositon to free electron motion. Resistivity is the reciprocal property to conductivity. The resistance of a homogeneous material of uniform cross section A and length l can be found by:

$$R = \rho \frac{\ell}{A}$$

Saturation: The point at which the flux density B in a magnetic material does not increase with further applications of greater magnetization force H. At saturation, the slope of a material’s B-H characteristic curve becomes extremely small, with the instantaneous permeability approaching that of free space (relative permeability = 1.0)

Saturation Flux Density: The flux density B at which saturation of a magnetic material occurs.