USEFUL MAGNETIC FORMULAE

Area of Cores with Rectangular Cross Section A_{fe}

$A_{fe} = E_{min} \times D_{min} \times K$

Mean Magnetic Path Length (L_m) for 'C' Cores

$L_m = A_{max} + B_{max} + F_{min} + G_{min} - 1.72 \left(R + \frac{E_{max}}{2}\right)$

Core Weight (M_{fe})

$M_{fe} = A_{fe} \times L_m \times 7.65\ 10^{-6}$

Where

A_{fe} = Cross sectional Area (mm^2)
L_m = Mean Magnetic Path Length (mm)
M_{fe} = Core Weight (Kg)
A = Overall Core Width (mm)
B = Overall Core Length (mm)
D = Strip Width (mm)
E = Build Up (mm)
F = Core Window Width (mm)
G = Core Window Length (mm)
R = Inner Radius (mm)
K = Stacking Factor
= 0.95 for 0.3mm Strip
= 0.92 for 0.1mm Strip
= 0.88 for 0.05mm Strip

Permeability

$\mu = \frac{B}{H}$ . . . . . .(1)

$H = \frac{I \times N}{L_m}$ . . . . . .(2)

$\mu = \mu_0\ \mu_r$ . . . . . .(3)

Where B = Induction in Tesla (Webers per Sq. Metre)
H = Magnetising Force in Amps/Metre
μ = Permeability
μ_0 = Permeability of free space ($4\pi \times 10^{-7}$)
μ_r = Relative Permeability
I = Current in Amps
N = Number of turns
L_m = Magnetic Path Length in Metres

Modules of Complex Permeability

$$\mu = \frac{B_{max}}{H_{peak}} = \frac{B_{max}}{H_{rms} \times \sqrt{2}}$$

Effective Permeability p

$$P = \frac{B_{max}}{H_{rms}}$$

Transformer Equation

$V = 4 \times f \times B_m \times N \times A_{fe} \times f$

Where V = RMS Voltage
F = Form Factor for Voltage Wave
B_m = Maximum Induction in Tesla
N = Number of Turns
A_{fe} = Cross Section of Iron in Metres^2
F = Frequency in Hertz

For 50 hz sine wave, this reduces to

$V = 222 \times B_m \times A_{fe} \times N$

Inductance

$$\text{Inductance in Henries} = \frac{4\pi \text{ X } N^2 \text{ X } A_{fe} \text{ X } \mu_r}{10^7 \text{ X } L_m}$$

Where N = Number of Turns
A_{fe} = Cross Sectional Area of Iron M^2
μ_r = Relative Permeability
L_m = Magnetic Path Length in metres