FREE

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Design of HF High V Power Amplifier

Inductance of a toroid of rectangular cross section

$$L = \frac{\mu_0 N^2 H \ln(b/a)}{2\pi}$$

$\mu_0 \rightarrow$ air core

$\mu = \mu_0 \mu_r$ for other

$N \rightarrow$ total no of turns
$a \rightarrow$ inner radius
$b \rightarrow$ outside radius
$H \rightarrow$ height of the toroid

Peak value of sinusoidal voltage required

$$V_{rat} \geq N_p \cdot A_\phi \cdot B_{max} \cdot \omega_{max}$$

$N_p \rightarrow$ no of primary turns
$A_\phi \rightarrow$ crossectional area of toroidal core.
$B_{max} \rightarrow$ peak flux density
$\omega_{max} \rightarrow$ max frequency.

Peak current rating $I_{rat} \geq H_{max} \dfrac{l_\phi}{N_p}$

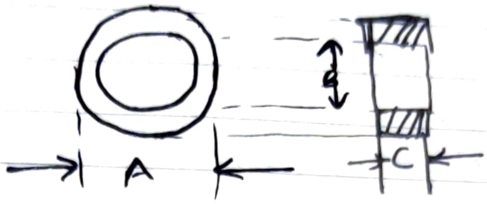
$l_\phi \rightarrow$ perimeter of core

1. Select a suitable toroid core (ferrite material) depending on availability.

eg: T7 toroid (Available at element14)

Dimensions:
(in mm)

$A = 61 \pm 1.3$
$B = 35.55 \pm 0.85$
$C = 12.7 \pm 0.5$



Core material grade: 77

77 Mn Zn ferrite
Can be used for frequencies up to 100 kHz

$\Sigma l/A \rightarrow$ core constant $9.2\ (cm^{-1})$

$l_e \rightarrow$ effective path length 14.5 cm

A_L (nH) — Inductance factor $2950 \pm 25\%$

$A_e \rightarrow$ eff cross. sectional area $1.58\ cm^2$

$V_e \rightarrow$ eff core vol $22.8\ cm^3$

$\mu_i = 2000$

B at field strength H
0.49T at $397.\cancel{88}$ A/m
≈ 398 A/m

$T_C = > 200°C$

$\rho = 100\ \Omega cm$

$V_{rat} \geq N_p \times 158 mm^2 \times 0.\cancel{2} \times 2\pi \times 10^4$

$\geq N_p \times 0.000158 \times 0.3 \times 2\pi \times 10^4$

$\geq N_p \times 2.97822$

$V_{rat} \simeq 3 \times N_p$

$N_p = 30$

$V_{rat} \geq 90$ V

$I_{rat} \geq H_{max} \dfrac{l_\phi}{N_p}$

$\geq \underline{\underline{4.044}}$ A

$N_p = N_s$

$2\pi r = 303.32$ mm

$r_{eff} = 35.55 + 12.7$
$= \underline{\underline{48.275}}$

$$L = \frac{\mu_0 N^2 H \ln(b/a)}{2\pi}$$ (air core)

$$= \frac{\mu_0 \mu_r N^2 H \ln(b/a)}{2\pi}$$ ferrite core.

$$= \frac{\mu_0 \times 2000 \times N^2 \times 12.7 \times 10^{-3} \ln\left(\frac{30.5}{17.775}\right)}{2\pi}$$

$b = 61/2 = 30.5$

$a = \frac{35.55}{2} = 17.775$

$$= \underline{\underline{2.74286}} \times N^2 \ \mu H$$

$$= \underline{\underline{2.468}} \ mH \qquad N_p = 30$$

$Z = 2\pi f L = \underline{\underline{155\,\Omega}}$

$I = 90V / 155\,\Omega = \underline{\underline{0.58}}\ A.$