

Keep this site on-line

[Make A Donation](#)

Last modified: 31 January 2015
 ©2007-2015 Serge Stroobandt, ON4AA



Single-Layer Helical Round Wire Coil Inductor Calculator

ENTER:

COILED ON 9 mm DIA

D = mm

Mean diameter of the air core coil, measured from wire centre to wire centre

N =

Number of turns

ℓ = mm

Length of the coil, measured from the connecting wires centre to centre

d = mm

Wire or tubing diameter

Cu, annealed

Plating material

ρ = nΩ·m

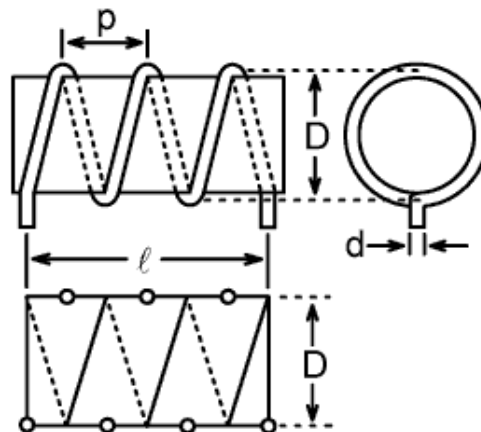
Plating conductivity

μ_r =

Plating permeability

f = MHz

Design frequency



Round wire coil with dimensions and its current-sheet approximation^[2]



INTERMEDIATE RESULTS:

p = mm

Winding pitch

Φ =

Proximity factor according to empirical Medhurst data^[2,3]

D_{eff} = mm

Effective coil diameter according to Stroobandt (see below)

Correction factors:

k_L =

Field non-uniformity correction factor according to Lundin^[2,4]

k_s =

Round wire self-inductance correction factor according to Rosa^[2,5,6]

k_m =

Round wire mutual-inductance correction factor according to Grover and Knight^[2,7]

Wire:

$\ell_{\text{wire, phys}}$ = mm

Physical wire length

$$\ell_{\text{wire, eff}} = 150.548 \text{ mm} \quad \text{Effective wire length}$$

$$\delta_i = 9.25376 \text{ } \mu\text{m} \quad \text{Skin depth at design frequency}$$

Sheath helix waveguide mode:

$$\psi = 7.26952^\circ \quad \text{Effective pitch angle}$$

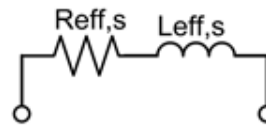
$$\beta = 3.04636 \text{ rad/m} \quad \text{Axial propagation factor of n=0 sheath helix waveguide mode at design frequency}^{[1,8]}$$

$$Z_c = 737.315 \text{ } \Omega \quad \text{Characteristic impedance of n=0 sheath helix waveguide mode at design frequency}^{[1]}$$



RESULTS:

$$L_{\text{eff,s}} = 0.10671 \text{ } \mu\text{H} \quad \text{Effective series inductance at design frequency from Corum \& Corum's sheath helix waveguide formula, corrected for field non-uniformity and round wire}^{[1,2,4-7]}$$



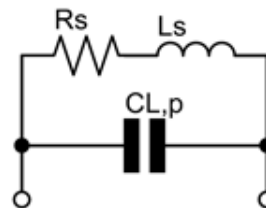
$$X_{\text{eff,s}} = 34.1948 \text{ } \Omega \quad \text{Effective series reactance of round wire coil at design frequency}$$

$$R_{\text{eff,s}} = 0.05707 \text{ } \Omega \quad \text{Effective series AC resistance of round wire coil at design frequency}$$

$$Q_{\text{eff,ul}} = 599.123 \quad \text{Effective unloaded quality factor of round wire coil at design frequency}$$

Lumped circuit equivalent:

$$L_s = 0.09339 \text{ } \mu\text{H} \quad \text{Frequency-independent series inductance from the current-sheet coil geometrical formula, corrected for field non-uniformity and round wire}^{[2,4-7]}$$



$$X_{L,s} = 29.9276 \text{ } \Omega \quad \text{Series reactance of round wire coil}$$

$$R_{L,s} = 0.04371 \text{ } \Omega \quad \text{Series AC resistance of round wire coil at design frequency}$$

$$Q_{L,ul} = 684.548 \quad \text{Unloaded quality factor of round wire coil at design frequency}$$

$$C_{L,p} = 13.0123 \text{ pF} \quad \text{Parallel stray capacitance at design frequency}^{[1]}$$

Self-resonant frequency:

$$f_{\text{res,L}} = 779.558 \text{ MHz} \quad \lambda/4 \text{ (parallel) self-resonant frequency of n=0 sheath helix mode}^{[1,8]}$$

Frequently Asked Questions

In what does this inductance calculator differ from the rest?

The inductor calculator presented on this page is unique in that it employs the n=0 sheath helix waveguide mode to determine the inductance of a coil, irrespective of its electrical length. This allows for more accurate inductance predictions at high frequencies. Furthermore, the calculator closely follows the National Institute of Standards and Technology (NIST) methodology for