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## Single-Layer Helical Round Wire Coil Inductor Calculator

ENTER:

COILED ON 10.5 mm DIA

D = 12.5 mm

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

N = 5.5

Number of turns

$\ell$  = 19.05 mm

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

d = 2 mm

Wire or tubing diameter

Cu, annealed

Plating material

$\rho$  = 17.241 nΩ·m

Plating conductivity

$\mu_r$  = 0.99999044

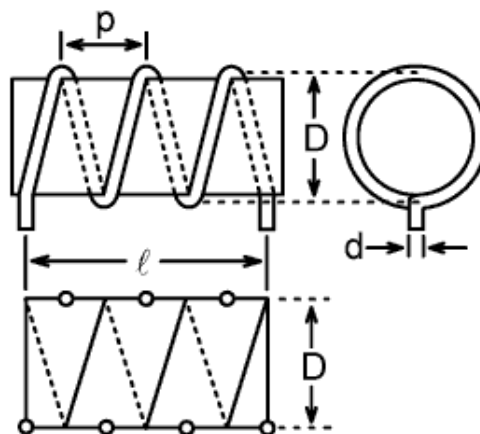
Plating permeability

f = 51 MHz

Design frequency

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Round wire coil with dimensions and its current-sheet approximation<sup>[2]</sup>



### INTERMEDIATE RESULTS:

p = 3.4636 mm

Winding pitch

$\Phi$  = 1.90926

Proximity factor according to empirical Medhurst data<sup>[2,3]</sup>

D<sub>eff</sub> = 11.947 mm

Effective coil diameter according to Stroobandt (see below)

### Correction factors:

k<sub>L</sub> = 0.780829

Field non-uniformity correction factor according to Lundin<sup>[2,4]</sup>

k<sub>s</sub> = 0.007680

Round wire self-inductance correction factor according to Rosa<sup>[2,5,6]</sup>

k<sub>m</sub> = 0.226037

Round wire mutual-inductance correction factor according to Grover and Knight<sup>[2,7]</sup>

### Wire:

$\ell_{\text{wire, phys}}$  = 216.822 mm

Physical wire length

$$\ell_{\text{wire, eff}} = 207.313 \text{ mm} \quad \text{Effective wire length}$$

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

Sheath helix waveguide mode:

$$\psi = 5.27232^\circ \quad \text{Effective pitch angle}$$

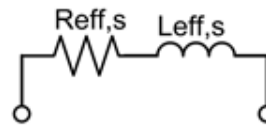
$$\beta = 4.33108 \text{ rad/m} \quad \text{Axial propagation factor of n=0 sheath helix waveguide mode at design frequency}^{[1,8]}$$

$$Z_c = 924.646 \text{ } \Omega \quad \text{Characteristic impedance of n=0 sheath helix waveguide mode at design frequency}^{[1]}$$



## RESULTS:

$$L_{\text{eff,s}} = 0.17667 \text{ } \mu\text{H} \quad \text{Effective series inductance at design frequency from Corum \& Corum's sheath helix waveguide formula, corrected for field non-uniformity and round wire}^{[1,2,4-7]}$$



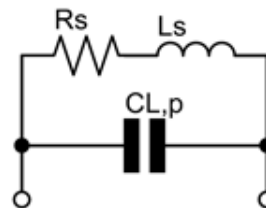
$$X_{\text{eff,s}} = 56.6128 \text{ } \Omega \quad \text{Effective series reactance of round wire coil at design frequency}$$

$$R_{\text{eff,s}} = 0.09647 \text{ } \Omega \quad \text{Effective series AC resistance of round wire coil at design frequency}$$

$$Q_{\text{eff,ul}} = 586.803 \quad \text{Effective unloaded quality factor of round wire coil at design frequency}$$

Lumped circuit equivalent:

$$L_s = 0.16502 \text{ } \mu\text{H} \quad \text{Frequency-independent series inductance from the current-sheet coil geometrical formula, corrected for field non-uniformity and round wire}^{[2,4-7]}$$



$$X_{L,s} = 52.8817 \text{ } \Omega \quad \text{Series reactance of round wire coil}$$

$$R_{L,s} = 0.08417 \text{ } \Omega \quad \text{Series AC resistance of round wire coil at design frequency}$$

$$Q_{L,ul} = 628.206 \quad \text{Unloaded quality factor of round wire coil at design frequency}$$

$$C_{L,p} = 3.88925 \text{ pF} \quad \text{Parallel stray capacitance at design frequency}^{[1]}$$

Self-resonant frequency:

$$f_{\text{res,L}} = 549.150 \text{ MHz} \quad \lambda/4 \text{ (parallel) self-resonant frequency of n=0 sheath helix mode}^{[1,8]}$$

## 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