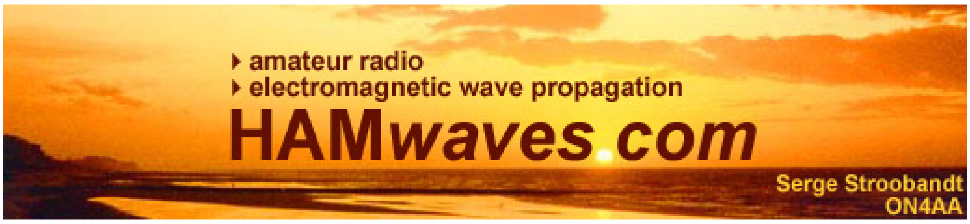
Antenna Notes



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Last modified: 2 February 2015

Single-Layer Helical Round Wire Coil Inductor Calculator

ENTER:

COILED ON 9 mm DIA

D = 11 mm — **Mean diameter of the air core coil, measured from wire centre to wire centre**

N = 5.5 — **Number of turns**

ℓ = 19.05 mm — **Lenght of the coil, measured from the connecting wires centre to centre**

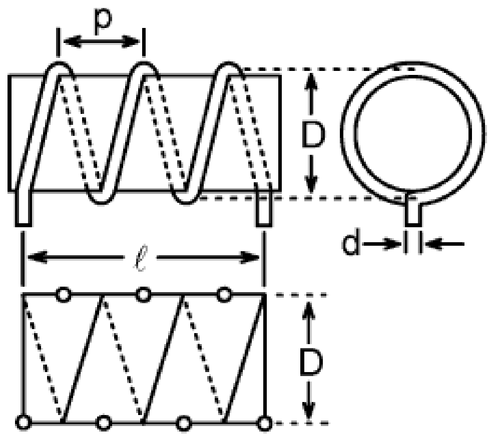
d = 2 mm — **Wire or tubing diameter**

Cu, annealed — **Plating material**

ρ = 17.241 nΩ·m — **Plating conductivity**

μ_r = 0.99999044 — **Plating permeability**

f = 51 MHz — **Design frequency**



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

Calculate | Clear

INTERMEDIATE RESULTS:

p = 3.4636 mm — **Winding pitch**

Φ = 1.8997 — **Proximity factor according to empirical Medhurst data** [2,3]

D_{eff} = 10.451 mm — **Effective coil diameter according to Stroobandt (see below)**

Correction factors:

k_L = 0.803487 — **Field non-uniformity correction factor according to Lundin**[2,4]

k_s = 0.007680 — **Round wire self-inductance correction factor according to Rosa**[2,5,6]

k_m = 0.226037 — **Round wire mutual-inductance correction factor according to Grover and Knight**[2,7]

Wire:

$\ell_{wire,\,phys}$ = 191.01 mm — **Physical wire length**

$\ell_{wire,eff}$ = 181.583 mm **Effective wire length**

δ_i = 9.25376 µm **Skin depth at design frequency**

Sheath helix waveguide mode:

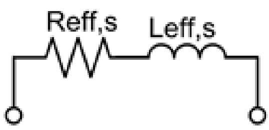
ψ = 6.02201 ° **Effective pitch angle**

β = 3.69142 rad/m **Axial propagation factor of n=0 sheath helix waveguide mode at design frequency**[1,8]

Z_c = 851.371 Ω **Characteristic impedance of n=0 sheath helix waveguide mode at design frequency**[1]

RESULTS:

$L_{eff,s}$ = 0.14192 µH **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]

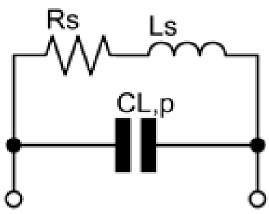


$X_{eff,s}$ = 45.4792 Ω **Effective series reactance of round wire coil at design frequency**

$R_{eff,s}$ = 0.08408 Ω **Effective series AC resistance of round wire coil at design frequency**

$Q_{eff,ul}$ = 540.898 **Effective unloaded quality factor of round wire coil at design frequency**

Lumped circuit equivalent:



L_s = 0.12909 µH **Frequency-independent series inductance from the current-sheet coil geometrical formula, corrected for field non-uniformity and round wire**[2,4-7]

$X_{L,s}$ = 41.3687 Ω **Series reactance of round wire coil**

$R_{L,s}$ = 0.06956 Ω **Series AC resistance of round wire coil at design frequency**

$Q_{L,ul}$ = 594.643 **Unloaded quality factor of round wire coil at design frequency**

$C_{L,p}$ = 6.81799 pF **Parallel stray capacitance at design frequency**[1]

Self-resonant frequency:

$f_{res,L}$ = MHz **λ/4 (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