Air-Core Coil Inductance (Wheeler's Formula)

Inductance of a single-layer air-core coil (solenoid) from its diameter, length and turns by Wheeler's formula, and the turns needed for a wanted inductance.

Method: H.A. Wheeler; Simple inductance formulas for radio coils; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Coil diameter (to the centre of the wire)	50.000	mm
Coil length	100.00	mm
Number of turns	100.00	
Inductance wanted (to find the turns)	1.0000	mH

Calculated results

Parameter	Value	Unit
Inductance	200.87	µH
Turns for the inductance wanted (same diameter and length)	223.12	
Length to radius ratio	4.0000	

Formula and method

$$L\,[\mu\mathrm{H}] = \frac{r^2 N^2}{9r + 10l} \quad (r,\ l \text{ in inches}), \qquad N_t = \sqrt{\frac{L_t(9r + 10l)}{r^2}}$$

Variables

d	Coil diameter (to the centre of the wire)	m
l	Coil length	m
N	Number of turns	-
L_t	Inductance wanted (to find the turns)	H
L	Inductance	H
N_t	Turns for the inductance wanted (same diameter and length)	-
l/r	Length to radius ratio	-

Method and standards

Wheeler's 1928 empirical fit to the exact current-sheet solution.

Assumptions and limits

- Single layer, air core, l > 0.8 r.

References

- H.A. Wheeler
- Simple inductance formulas for radio coils
- Proc. IRE 16 (1928) 1398

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/circuits/coil-inductance-wheeler

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.