Coupled Inductors: Mutual Inductance, Series and Parallel Equivalents

Mutual inductance from coupling coefficient, the equivalent of two coupled inductors in series aiding or opposing and in parallel, and stored energy at a current.

Method: Coupled inductor relations

Input parameters

Unit system: SI

Parameter	Value	Unit
Inductance 1	10.000	mH
Inductance 2	4.0000	mH
Coupling coefficient	0.60000	
Current (series connection)	2.0000	A

Calculated results

Parameter	Value	Unit
Mutual inductance	3.7947	mH
Series aiding	21.589	mH
Series opposing	6.4105	mH
Parallel aiding	3.9934	mH
Energy stored, series aiding	0.043179	J

Notes for this case

• M = k√(L₁L₂); series L₁ + L₂ ± 2M; parallel (aiding) (L₁L₂ − M²)/(L₁ + L₂ − 2M). Measuring series aiding and opposing inductances gives M = (L₊ − L₋)/4, a common way to find coupling. With k = 1 and equal coils the parallel-aiding value equals each coil's inductance.

Formula and method

$$M = k\sqrt{L_1 L_2}, \quad L_{s\pm} = L_1 + L_2 \pm 2M, \quad L_{p+} = \frac{L_1 L_2 - M^2}{L_1 + L_2 - 2M}$$

Variables

L_1	Inductance 1	H
L_2	Inductance 2	H
k	Coupling coefficient	-
I	Current (series connection)	A
M	Mutual inductance	H
L_{s+}	Series aiding	H
L_{s-}	Series opposing	H
L_{p+}	Parallel aiding	H
W	Energy stored, series aiding	J

Method and standards

Coupled inductors.

Assumptions and limits

- Linear inductors; no losses.

References

Coupled inductor relations

Report details

Report reference	FCC-RZ0Y-AFZ0 (the same inputs always give the same reference)
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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/coupled-inductors-mutual

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.