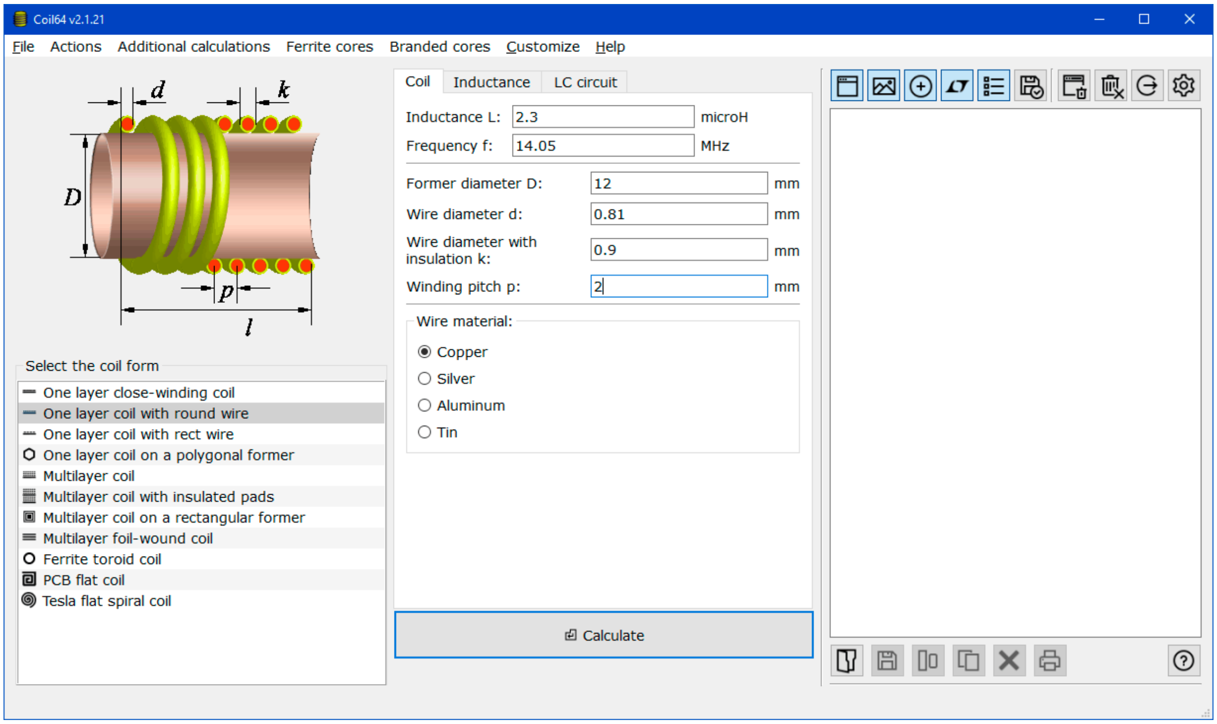
I Input data



The application allows you to calculate 4 types of single-layer winding.

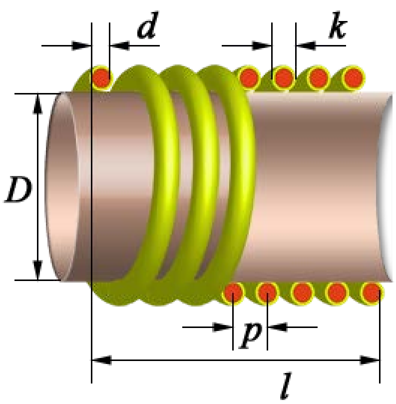
1. One-layer close-winding coil
2. One-layer coil with winding pitch and round wire
3. Single-layer coil with winding pitch and rectangular wire
4. Single-layer coil with a winding pitch, with a round wire wound on a polygonal former

The wire diameter with insulation cannot be less than the nominal diameter of the wire. The winding pitch cannot be less than the wire diameter with insulation.

II Output results

×

1 - 1/28/22 5:19 PM
Coil64 v2.1.21 - One layer coil with round wire



Input:
Inductance L: 2.3 microH
Frequency f: 14.05 MHz
Former diameter D: 12 mm
Wire diameter d: 0.81 mm
Wire diameter with insulation k: 0.81 mm
Winding pitch p: 0.81 mm

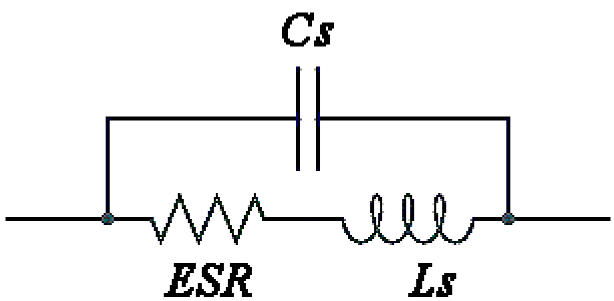
Result:
Number of turns of the coil N = 16.990
Length of wire without leads lw = 68.387 cm
Length of winding l = 14.572 mm
Weight of wire m = 3.158 g
DC resistance of the coil Rdc = 0.023 Ohm
Reactance of the coil X = 203.041 Ohm

Self capacitance Cs = 0.403 pF
Coil self-resonance frequency Fsr = 91.657 MHz
Coil constructive Q-factor Q = 193
Loss resistance ESR = 1.044 Ohm

Additional results for parallel LC circuit at the w orking frequency:
=> Circuit capacitance: Ck = 55.387 pF
=> Characteristic impedance: ρ = 203 Ohm
=> Equivalent resistance: Re = 32.847 kOhm
=> Bandwidth: 3dBΔf = 86.848kHz

Input data for LTSpice:
Series resistance: 22.9m
Parallel resistance: 39.187k
Parallel capacitance: 0.403p

Above, as an example, you can see the result of the calculation.
1. It consist input data that is repeating here.
2. Then in results section one can see the calculated number of turns or inductance, depending on the calculation tab. The total length filled by the winding on the former is calculated, the length of the wire required for winding, its weight in grams. DC wire resistance, coil reactance, parasitic self-capacitance, self-resonant frequency, constructive Q-factor of the coil are also calculated.
3. The equivalent series resistance ESR corresponds to the following model of the inductance coil.



The following expression is true: **ESR = Rdc + Rac** Where Rac is the AC loss in the coil at the working frequency.
4. The following are the calculation results for a parallel LC-circuit with such an inductor at the working frequency.
5. Next are the calculated input data for the **LTSpice** program.
They correspond to the following coil model assumed in this program:

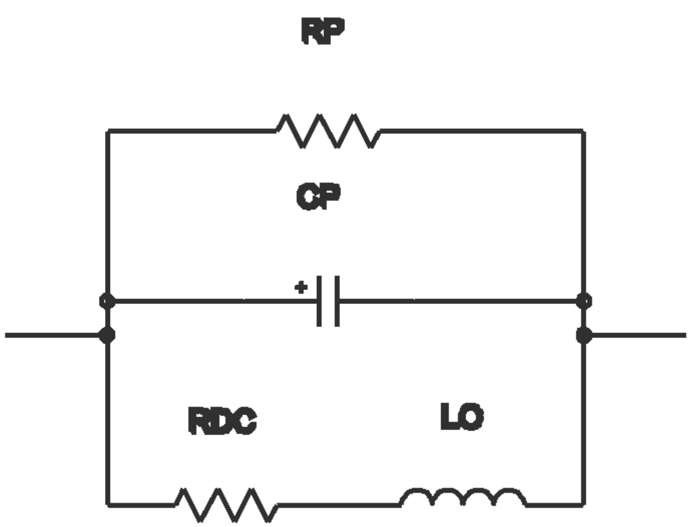
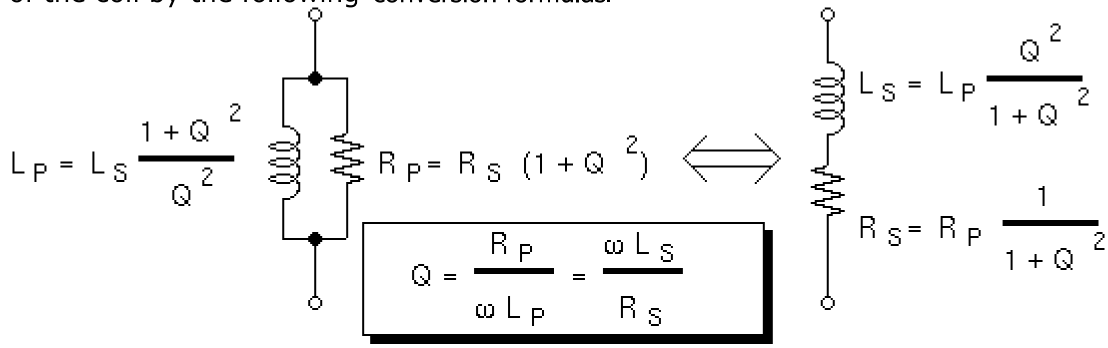


Figure 6: Completed Inductor Model

According to this circuit, the series resistance is equal to Rdc, the parallel capacitance Cp is equal to the stray self-capacitance of the coil, the parallel resistance Rp determines the AC losses in the coil. The **Rp** is related to the **Rs = ESR** and **Q-factor** of the coil by the following conversion formulas:



It is assumed that the working frequency of the inductor is much lower than its self-resonance frequency. Otherwise, the coil cannot be considered as a lumped elements model, but as a transmission line model. At frequencies close to the self-resonance, the inductance, self-capacitance, and losses in the coil are highly dependent on frequency, and above the self-resonance, the coil cannot be considered as an inductive element in principle.
So, if you see the warning "**Working frequency > 0.7 * Coil self-resonance frequency!**" - this is not a mistake. In this case, the coil is working at an unacceptable frequency near or even higher its self-resonance frequency. This means that part of the calculations loses its meaning and they are not shown, and the remaining calculations should be considered only as estimates. To correct the situation, you need to either reduce the working frequency or reduce the dimensions of the coil.

Related links:

- Agreement on the dimensions and notations
- Parallel resonant LC circuit
- Single-layer air core coil winding formulas
- Calculation of the single layer RF coil with an arbitrary winding pitch
- Inductor with noncircular winding
- About Q-factor of RF inductance coil
- The self-capacitance of a single-layer air core solenoid
- The self-resonance frequency of the solenoid