WEBENCH® Coil Designer

Generate Custom Inductance to Digital Converter (LDC) Coil Layouts in Seconds

Inductive Sensing vs Coil Designer

	WEBENCH® Inductive Sensing Designer	WEBENCH® Coil Designer
Enter max sensing distance	Yes	
Enter desired resolution	Yes	
Enter coil shape		Yes
Enter target material and size	Yes	
Calculate resolution based on impedance or inductance	Yes	
Helps you select the best sensing IC	Yes	
Selects the LC sensor capacitor	Yes	
Export coil to CAD tools	Yes	Yes
Automatically designs coil and calculates resolution	Yes	
Enter coil diameter, trace width and trace spacing		Yes
Enter number of PCB layers and spacing		Yes
Enter coil number of turns		Yes
Enter sensing IC and LC sensor capacitance		Yes
Enter copper thickness		
Generates key operating values such as total inductance, sensor frequency, Q-factor, AC resistance, fill ratio, inner diameter		Yes
Generates inductance		Yes

Coil Designer vs. Inductive Sensing Designer

	Coil Designer	Inductive Sensing Designer	Difference
1. Input to the tool	Shape, Diameter, Turns, Layer,	Sensing distance, target diameter, target material, resolution	Inductive Sensing Designer is used to find the inductance required and Coil Designer is used for designing a custom coil of a given specifications
2. Output of the tool	Coil specific operating values, layout	Resolution metrics, operating values, layout	Inductive Sensing tool provides a layout of a coil of a specific shape and size for LDC application where as Coil Designer can provide coil geometry/layout of various shapes and customized coil parameters.
3. Method of calculation	Equation	Simulation	The inductance value can slightly vary in case of Coil Designer as it is based on equations and not simulation.
4. Usage	General	Axial distance	Coil Designer is generic and can be used for any application including axial distance.

WEBENCH® Coil Designer

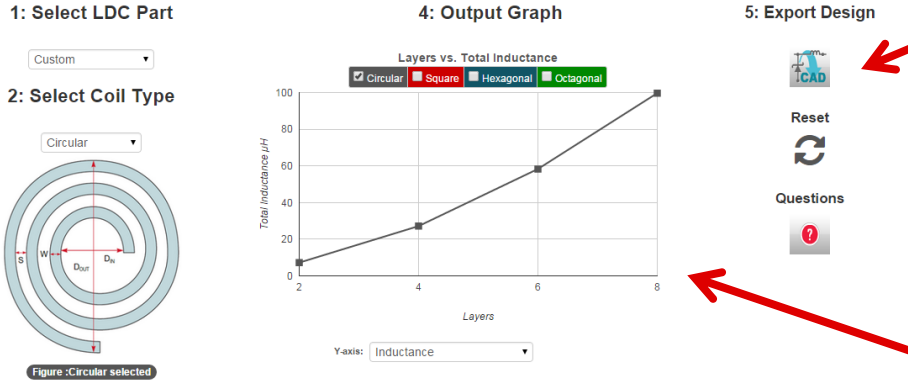
http://webench.ti.com/wb5/LDC

Choose LDC part

Choose coil type

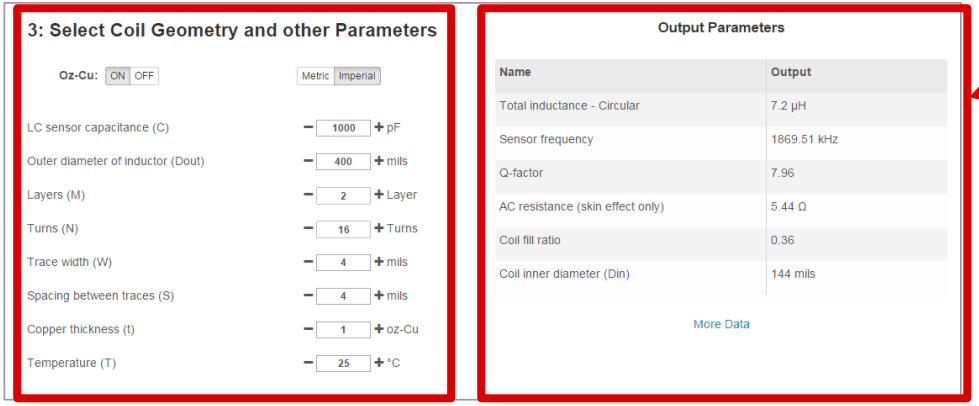
Enter parameters for coil

Now supports LDC0851 for stacked coils!



Export to CAD tools

View resulting inductance and other key parameters



Hands-on Demo

Design Problem:	Goals:
Customer has used LDC Designer to get the following desired characteristics of the coil: LDC1612 Capacitance: 113pF Inductance: 183uH Frequency: 1MHz Layers: 2	Generate and export a coil that meets the specifications

WEBENCH® Coil Designer for LDC ICs

The WEBENCH® Inductive Sensing Design tools enable quick and easy way to generate custom PCB coils for various LDC applications. The LDC Design tools consist of WEBENCH® Inductive Sensing Designer and WEBENCH® Coil Designer.

WEBENCH® Inductive Sensing Designer is a tool focused on axial position sensing applications and allows users to generate PCB coils for desired LDC measurement and resolution capabilities.

WEBENCH® Coil Designer enables further coil customization by taking coil design parameters such as shape, size, and number of turns as input and directly computes performance parameters such as inductance and Q.

In both these tools, the user can then export the custom LDC coil into their preferred PCB CAD environment.

WEBENCH® Coil Designer Features

- Support for multiple coil shapes – choices include circular, square, hexagonal, and octagonal.
- Capability to fine tune coil geometries
- Quickly analyze coil characteristics based on the coil settings.
- Export PCB layout of coil to a variety of CAD formats

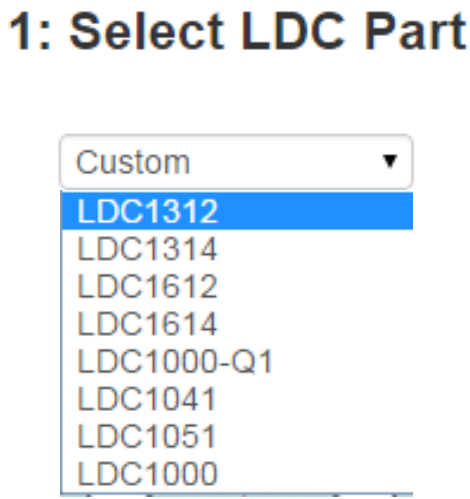
Recommended Coil Design Flow

- Determine the maximum size inductor that can physically be used in the application, and set the **Dout** value to that size.
- Based on the PCB manufacturing rules, set:
  - a. Trace Width and Trace Space to the minimum permitted. This value is typically **4mils** (0.1mm) or **6mils**(0.15mm).
  - b. Copper thickness; this is typically **1oz-cu** (~35µm). Thicker is better.
- Set the Number of Layers to match the number of board layers in the design.
- Set the Capacitance- the range of **500pF to 2nF** is typically near the optimum unless a specific sensor frequency is needed. Adjust the capacitance as needed if your sensor frequency is not with the device limits.
- Set the number of turns so that the ratio of **Din/Dout is >0.3**.
- Export the design into the desired format.

Step by Step:

1. **Select the LDC Part**

   Choose one of the parts for which you intend to design the coil.



Step by Step:

2. Select the Coil Shape

Based on need select the coil shape - choices include Square, Circular, Hexagonal and Octagonal shapes.

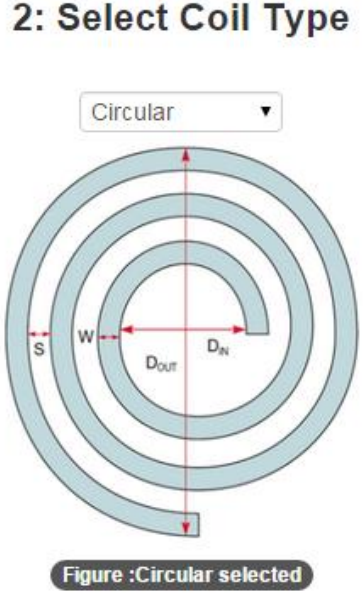
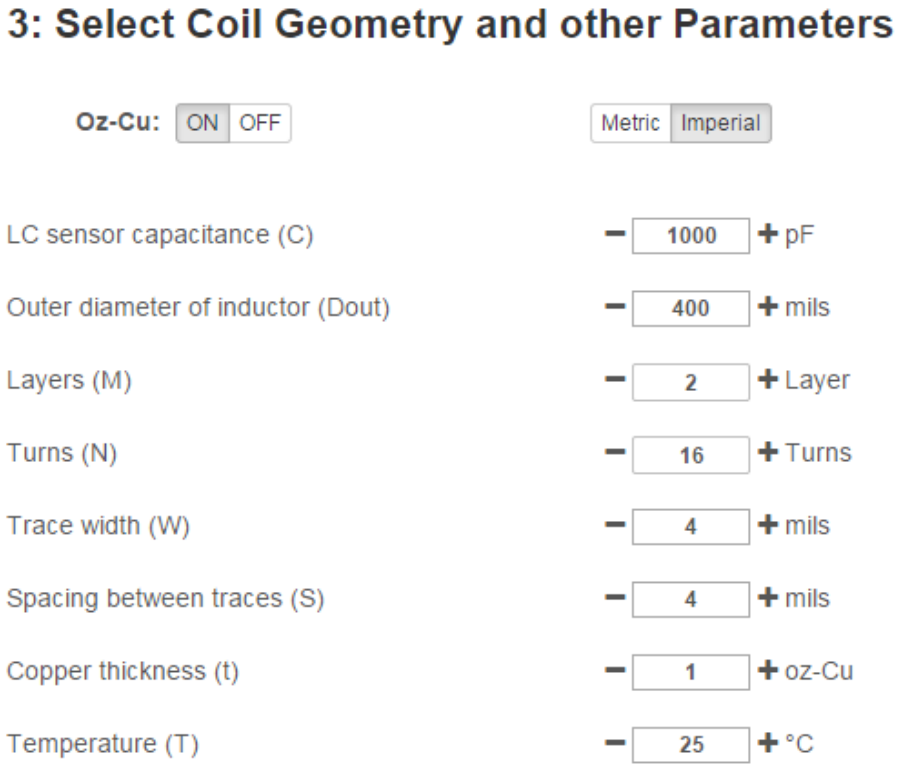


Figure :Circular selected

Select Coil Geometry

- Change the Coil Parameters like Layers, Turns, Shapes, Trace width and other parameters.

- They can be changed using the text box by entering any required value or using the step increment or decrement option provided.



Analyze Coil Design

- Analyze the coil output parameters such as Inductance of the coil, Inner diameter, Q factor etc. shown in the grid for corresponding input values.
- Option is provided to click on more data which shows more output and input parameters and it can be used for deeper coil analysis.

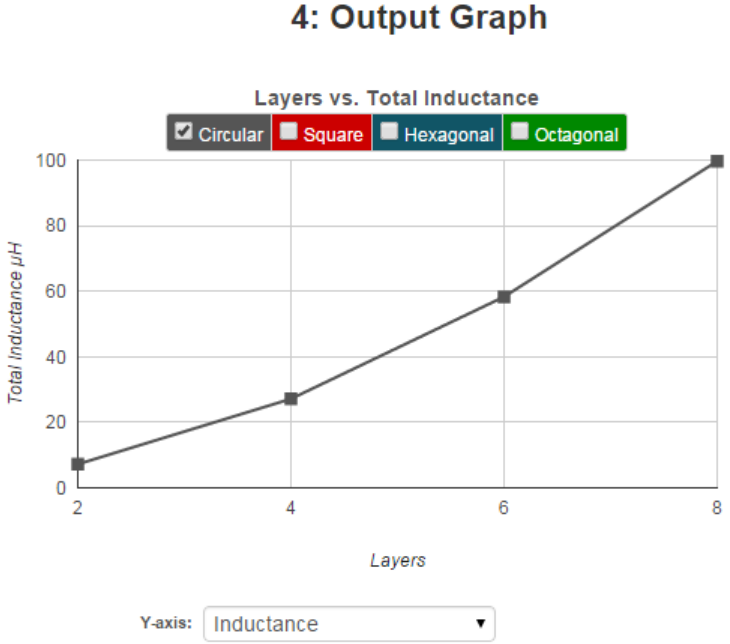
Output Parameters

Name	Output
Total inductance - Circular	7.2 µH
Sensor frequency	1869.51 kHz
Q-factor	7.96
AC resistance (skin effect only)	5.44 Ω
Coil fill ratio	0.36
Coil inner diameter (Din)	144 mils

More Data

Analyze Coil Design (Cont.)

- The Graph between different parameters provides an understanding of how the inductance and other parameters of the coil vary with different inputs.



Export Coil Design

- Export the coil into one of 5 popular CAD tools shown here and you're ready to generate your Gerber files.

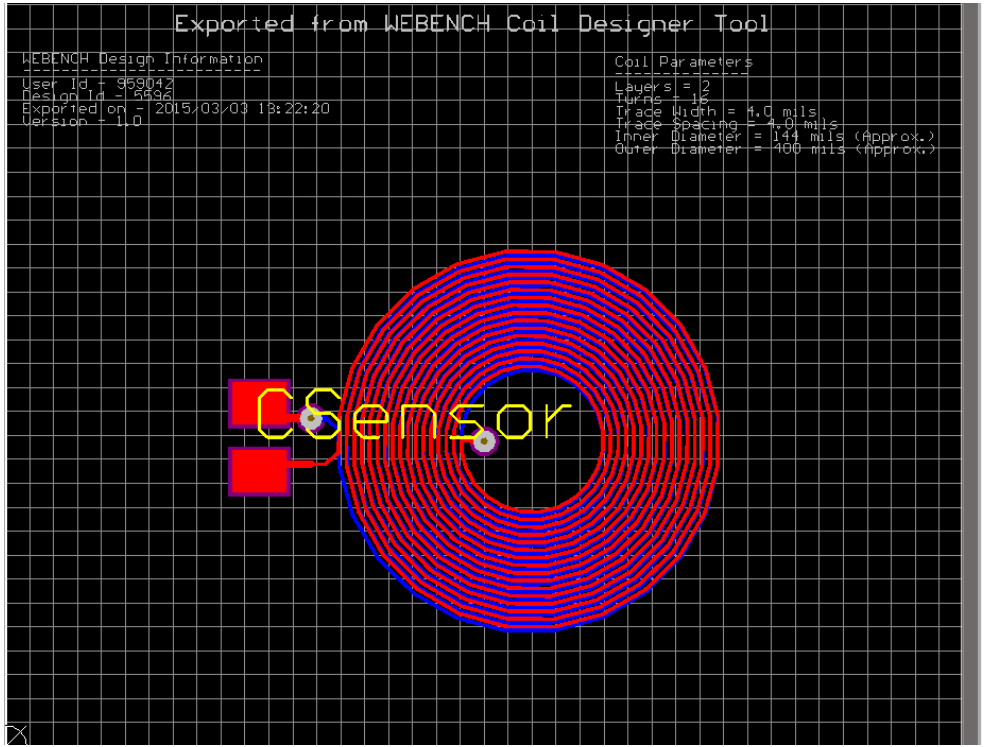
5: Export Design

- Export coil option is currently supported for only 2 and 4 layers.

Hands On Problems

- Go to hands on problem set for Signal Chain
- Work the problems from the following:
- **Coil Designer**
  - 1) Stacked coil problem
  - 2) Stacked coil problem with max C

Exported Layout from Coil Designer in Altium Designer



Overview of Spiral Inductance Calculation

- Planar spiral inductors are less expensive than either chip or coil inductors for PCB (printed-circuit-board)-based designs.
- Accuracy in designing a spiral inductor is important because it is difficult to modify the inductor once you have built it on the PCB.
- Some formulas are available for calculating the spiral inductor for RF-IC applications with inductance of less than 100 nH on a single-layer design.
- Only few published paper or report accurately calculates spiral inductors with a large value in multiple layers.
- This Inductance calculator is based on the excel sheet provided by PL which is based on this EDN article.

Advantages of WEBENCH® Coil Designer

- One of the first online tool for multilayer inductance calculation and design and will give TI a competitive advantage

- Enhanced features for existing tools when used with Inductance Sensing Designer

- Could be used for Power Applications and Filters which need a multi-layer PCB inductor design and layout.