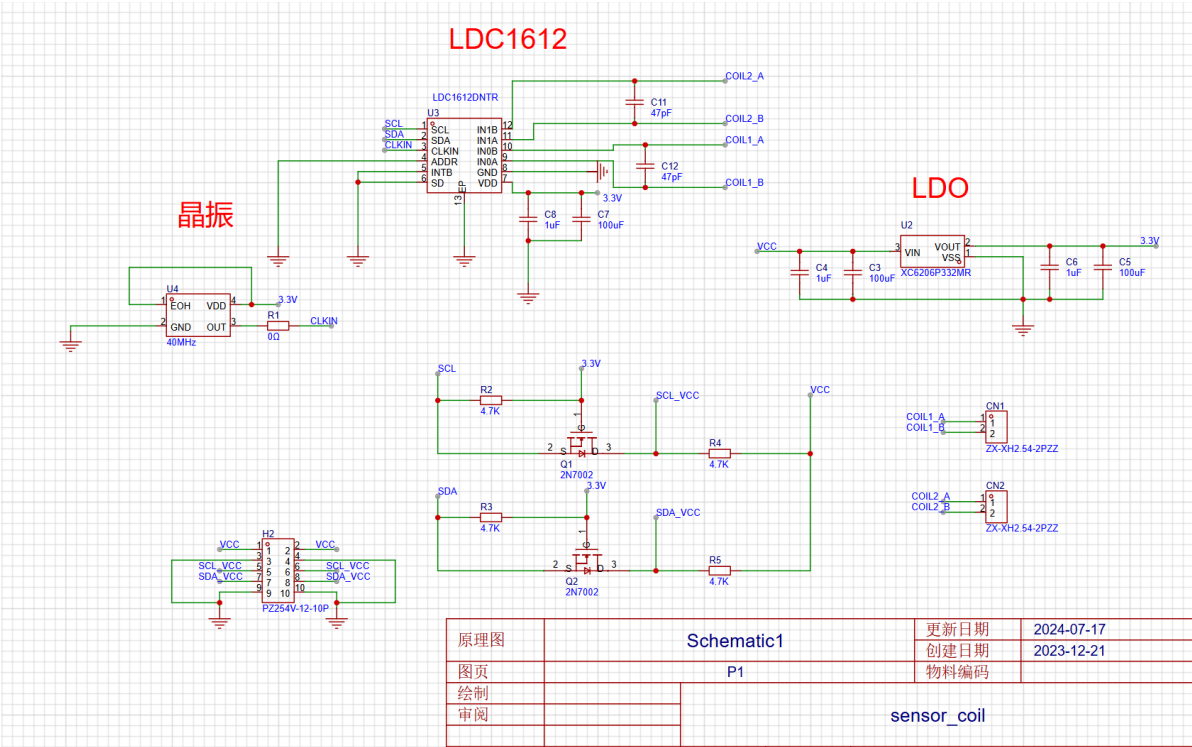


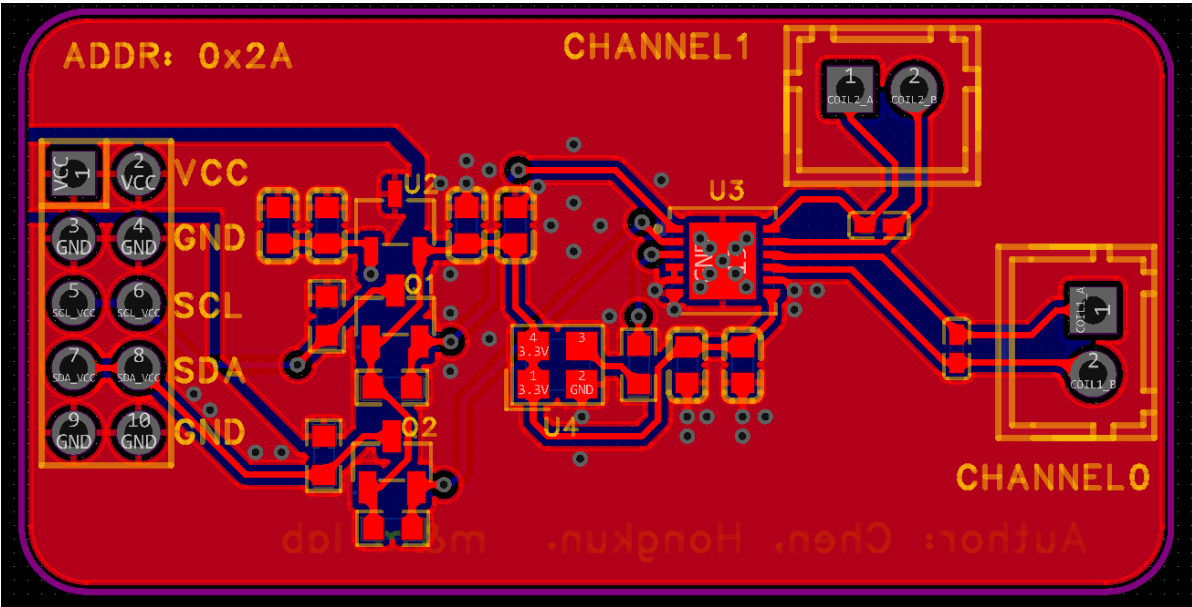
# mmlab-Sensor-Coil README

## Introduction

0x2A.epro and 0x2B.epro are PCB based on Texas Instruments' LDC1612. .epro means it is Jia-Li-Chuang EDA file, you have to use Jia-Li-Chuang to open it. If you don't have this EDA, I put the schematic underneath, this schematic is refer to [Seeed's studio](#).



The upper schematic corresponds to the slave address (or serial bus address byte from master) 0x2A, as we let ADDR connect to GND. If you want to make slave address turn to 0x2B, you should connect to 3.3V. **Pay attention: you are not allowed to make the ADDR pin to hang.**



sensor-coils-example.euro series is sensor coils examples, these files obtain classic coil design, you can choose a proper coil according to your motor. If you want more, please utilize TI's calculator: [Coil Designer](#). This calculator can help you derive the proper coils in Altium Designer or Cadence Allegro and so on.

## Coil Designer Basic Tutorial

1. First, you need to register and login your TI's account number. Then you click into [this address](#), it should be look like this :

The screenshot shows the Texas Instruments Coil Designer web application. The interface is divided into five main sections:

- 1: Select LDC Part**: A dropdown menu shows 'LDC0851'. Below it is a table titled 'Parameter range for selected part'.
- 2: Select Coil Type**: A dropdown menu shows 'Circular'. Below it is a diagram of a circular coil with labels  $r$ ,  $w$ ,  $D_{out}$ , and  $D_{in}$ . A caption below the diagram reads 'Figure :Circular selected'.
- 3: Output Graph**: A line graph titled 'Turns per layer vs. Total Inductance'. The Y-axis is 'Total Inductance  $\mu H$ ' (0.0 to 2.5) and the X-axis is 'Turns per layer' (0 to 25). A blue line shows the relationship, with a 'Circular' checkbox checked. Below the graph are dropdowns for 'Y-axis: Total Inductance' and 'X-axis: Turns per layer'.
- 4: Select Coil Geometry And Other Parameters**: This section contains input fields for 'Metric' (Imperial), 'Oz-Cu' (ON), 'LC sensor capacitance(C)' (1000 pF), 'Outer diameter of inductor( $D_{out}$ )' (400 mils), and an 'Output Parameters' table.
- 5: Export Design**: Buttons for 'Export to CAD', 'Share Design', 'Reset', and a link for 'More information'.

Name	Range
Voltage (Oscillation Amplitude)	1 to 4 V
Operating Temperature	-40 to 125 °C
Sensor Frequency	300k to 19M Hz

Name	Output
Total inductance - Circular	1.89 $\mu H$
Sensor frequency	5172.4 kHz
Q factor	14.91

2. Select LDC part : LDC1612 or LDC1614 (the difference between LDC1614 and LDC1612 is just the number of coils they can approve, LDC1614 can approve 4 coils in the same time, rather than 2 coils LDC1612 approve). We recommend select circular coil type, as this type can offer consistent accuracy and breadth.

# 1: Select LDC Part

LDC1612 ▼

LDC0851

LDC2114

LDC2112

LDC1614

LDC1612

LDC1314

LDC1312

LDC1000

LDC1041

LDC1051

LDC1000-Q1

Custom

selected part	
	Range
Amplitude)	1 to 4 V
re	-40 to 125 °C
	1k to 10M Hz

3. Slide down, here you can select the parameters you want to design, of course, within a reasonable range, when beyond a reasonable range, the calculator will display red or orange in a column, warning you should not do this, at this time you just need to adjust some parameters to get a reasonable coil or you will not be allowed to export the design files. You can also click on view more to see more parameters, here we recommend you click on view more.

Metric

Imperial

Oz-Cu:

ON

OFF

LC sensor capacitance(C)

◀ 1000 ▶ pF

min: 50 - max: 10000

Outer diameter of inductor( $D_{out}$ )

◀ 400.00 ▶ mils

min: 42 - max: 5900

Layers(M)

◀ 2 ▶ Layer

min: 1 - max: 8

Turns per layer(N)

◀ 10 ▶ Turns

min: 1 - max: 120

Trace width(W)

◀ 4 ▶ mils

min: 2 - max: 40

Spacing between traces(S)

◀ 4 ▶ mils

min: 2 - max: 12

Copper thickness(t)

◀ 1 ▶ oz-Cu

min: 0.5 - max: 5

Temperature(T)

◀ 25 ▶ °C

min: -40 - max: 125

Voltage (Oscillation Amplitude)  
(V)

◀ 1.8 ▶ V

min: 1 - max: 1.8

Space between 1<sup>st</sup> layer and 2<sup>nd</sup>  
layer(x12)

◀ 4.00 ▶ mils

min: 1 - max: 60

#### 4: Select Coil Geometry And Other Parameters

Metric Imperial Oz-Cu: ON OFF

LC sensor capacitance(C) ◀ 1000 ▶ pF  
min: 50 - max: 10000

Outer diameter of inductor(D<sub>out</sub>) ◀ 400.0 ▶ mils  
min: 42 - max: 5900

Layers(M) ◀ 2 ▶ Layer  
min: 1 - max: 8

Turns per layer(N) ◀ 16 ▶ Turns  
min: 1 - max: 120

Trace width(W) ◀ 4 ▶ mils  
min: 2 - max: 40

Spacing between traces(S) ◀ 4 ▶ mils  
min: 2 - max: 12

Copper thickness(t) ◀ 1 ▶ oz-Cu  
min: 0.5 - max: 5

Temperature(T) ◀ 25 ▶ °C  
min: -40 - max: 125

Output Parameters		
Name		Output
Total inductance - Circular	i	7.2 μH
Sensor frequency	i	1871.94 kHz
Q factor	i	17.84
AC resistance (skin effect only)	i	4.75 Ω
Coil fill ratio	i	0.36
Coil inner diameter (D <sub>in</sub> )	i	144 mils

[View more](#)

#### 4: Select Coil Geometry And Other Parameters

Metric Imperial Oz-Cu: ON OFF

LC sensor capacitance(C) ◀ 1000 ▶ pF  
min: 50 - max: 10000

Outer diameter of inductor(D<sub>out</sub>) ◀ 400.0 ▶ mils  
min: 42 - max: 5900

Layers(M) ◀ 2 ▶ Layer  
min: 1 - max: 8

Turns per layer(N) ◀ 30 ▶ Turns  
min: 1 - max: 120

Trace width(W) ◀ 4 ▶ mils  
min: 2 - max: 40

Spacing between traces(S) ◀ 4 ▶ mils  
min: 2 - max: 12

Copper thickness(t) ◀ 1 ▶ oz-Cu  
min: 0.5 - max: 5

Temperature(T) ◀ 25 ▶ °C  
min: -40 - max: 125

Voltage (Oscillation Amplitude) (V) ◀ 1.8 ▶ V  
min: 1 - max: 1.8

Space between 1<sup>st</sup> layer and 2<sup>nd</sup> layer(x12) ◀ 4.00 ▶ mils  
min: 1 - max: 60

Output Parameters		
Name		Output
Total inductance - Circular	i	8.32 μH
Sensor frequency	i	1742.25 kHz
Q factor	i	17.58
AC resistance (skin effect only)	i	5.18 Ω
Coil fill ratio	i	-0.2
Coil inner diameter (D <sub>in</sub> )	i	-80 mils
DC resistance	i	3.72 Ω
Average diameter	i	160 mils
Geometric mean diameter	i	1.5
Self inductance per layer	i	2.17 μH
Coil length per layer	i	15079.64 mils
Skin depth	i	1.95 mils
Self resonant frequency	i	29.99 MHz
Resonance impedance	i	1605.64 Ω
Current	i	0.88 mA
Power dissipation	i	1.58 mW

[View less](#)

#### 4: Select Coil Geometry And Other Parameters

MetricImperial

Oz-Cu: ONOFF

LC sensor capacitance(C)

1000pF

min: 50 - max: 10000

Outer diameter of inductor(D<sub>out</sub>)

400.01mils

min: 42 - max: 5900

Layers(M)

2Layer

min: 1 - max: 8

Turns per layer(N)

20Turns

min: 1 - max: 120

Trace width(W)

5mils

min: 2 - max: 40

Spacing between traces(S)

4mils

min: 2 - max: 12

Copper thickness(t)

1oz-Cu

min: 0.5 - max: 5

Temperature(T)

25°C

min: -40 - max: 125

Voltage (Oscillation Amplitude)  
(V)

1.8V

min: 1 - max: 1.8

Space between 1<sup>st</sup> layer and 2<sup>nd</sup>  
layer(x12)

4.00mils

min: 1 - max: 60

Output Parameters

Name	Output
Total inductance - Circular	6.62 $\mu$ H
Sensor frequency	1952.46 kHz
Q factor	21.05
AC resistance (skin effect only)	3.86 $\Omega$
Coil fill ratio	0.1
Coil inner diameter (D <sub>in</sub> )	39 mils
DC resistance	2.72 $\Omega$
Average diameter	219.5 mils
Geometric mean diameter	0.82
Self inductance per layer	1.72 $\mu$ H
Coil length per layer	13791.59 mils
Skin depth	1.84 mils
Self resonant frequency	33.61 MHz
Resonance impedance	1716.04 $\Omega$
Current	0.82 mA
Power dissipation	1.48 mW

View less

4. After correctly designing, you need to click on the right column.(If not properly designed, the left table still has red or orange columns, will not be able to perform the next operation), export your design, here we choose is Altium Designer. Then, Click export, wait patiently for a while (please note that your network connection must be normal at this time), the following window will pop up, click download, your design will be downloaded in the form of a compressed package.

## 5: Export Design

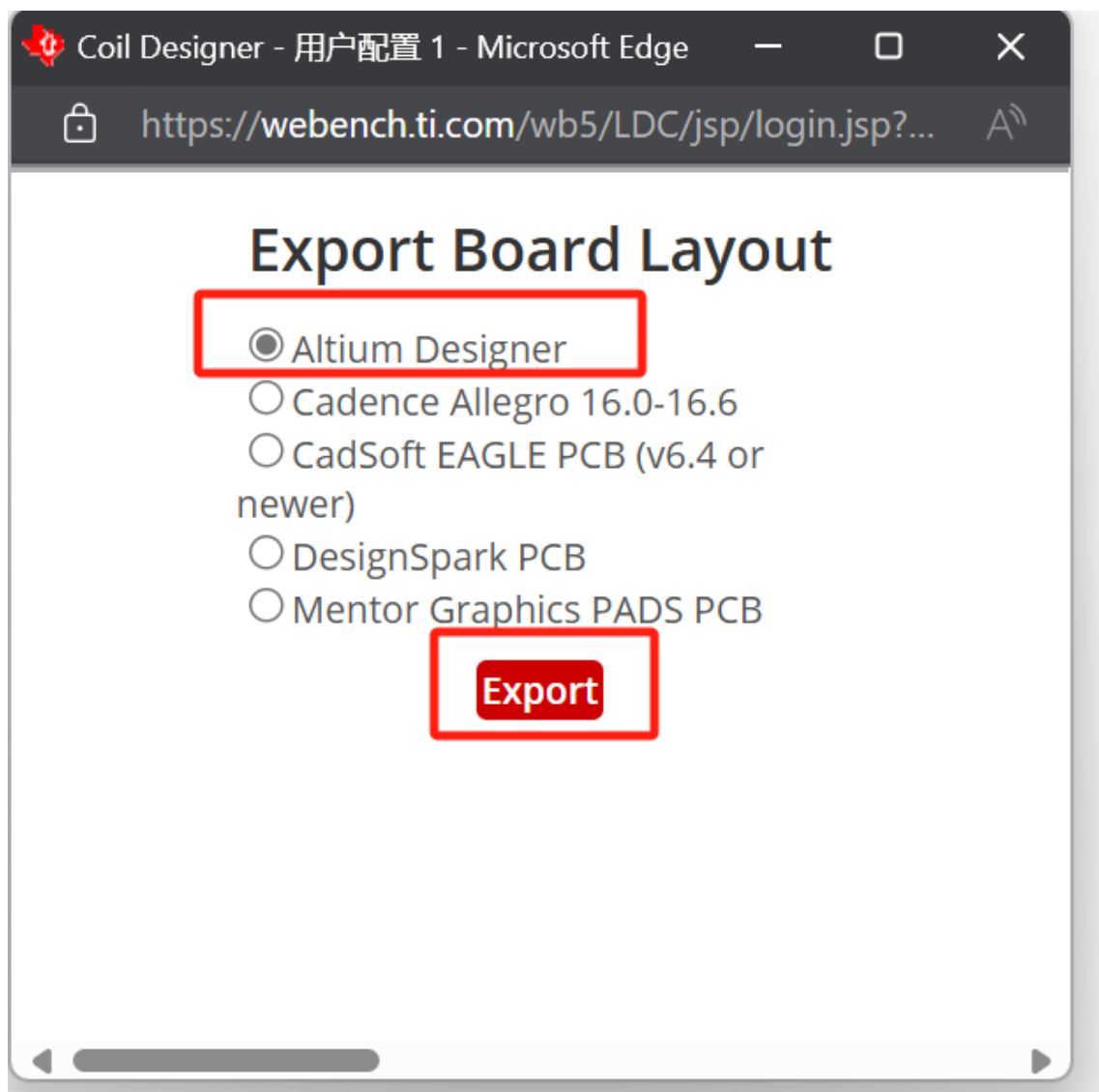
**Export to CAD**

**Share Design**

**Reset**

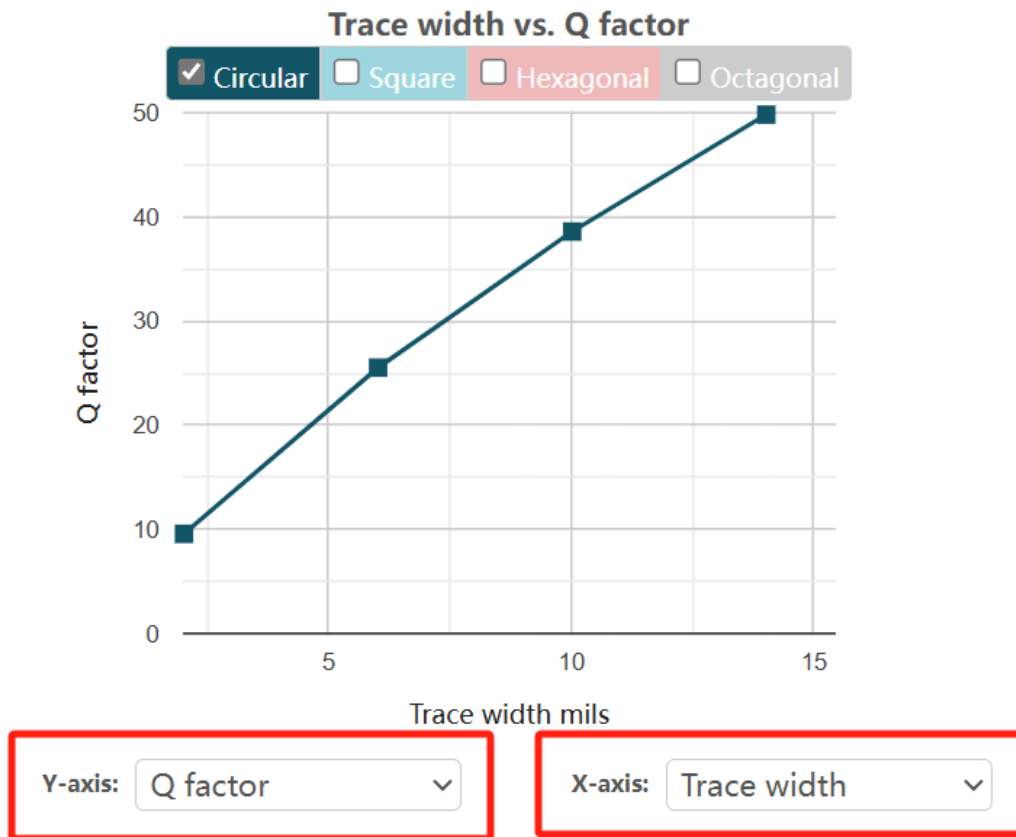
[More information](#)

[Support & Community](#)



5. You can also view the physical properties of the coil you designed, and you can select the physical meaning of the x-axis and y-axis.

### 3: Output Graph



## The problem you may face during learning and using

- **The coils that exported from Coil Designer can't be utilized**
- Solution: The coils that exported from Coil Designer look like this, the right side is the information of coil you have designed:



# Exported from WEBENCH Coil Designer Tool

## WEBENCH Design Information

Design Id - 103  
Exported on - 2024/06/03 06:10:33  
Version - 1.1  
Customized for LDC1614

## Coil Parameters

Layers = 2  
Turns = 20  
Trace Width = 4.02 mils  
Trace Spacing = 4.02 mils  
Inner Diameter = 663 mils (Approx.)  
Outer Diameter = 985 mils (Approx.)

## Layer Stack Information

Copper thickness = 1.0 Oz-Cu  
Space between TOP and BOTTOM = 4.0 mils

At this time, we can see that the upper and lower layers of the coil have formed an open circuit because there is no hole, and the coil cannot work normally. At this point we only need to add holes where we want to change layers. After adding holes, the coils can work perfectly. Pay attention: if you use FPC materials, Jia-Li-Chuang's work customer service will notify you it is an error to add a hole on this board, regardless of this warning, the design is workable after actual proofing tests.

