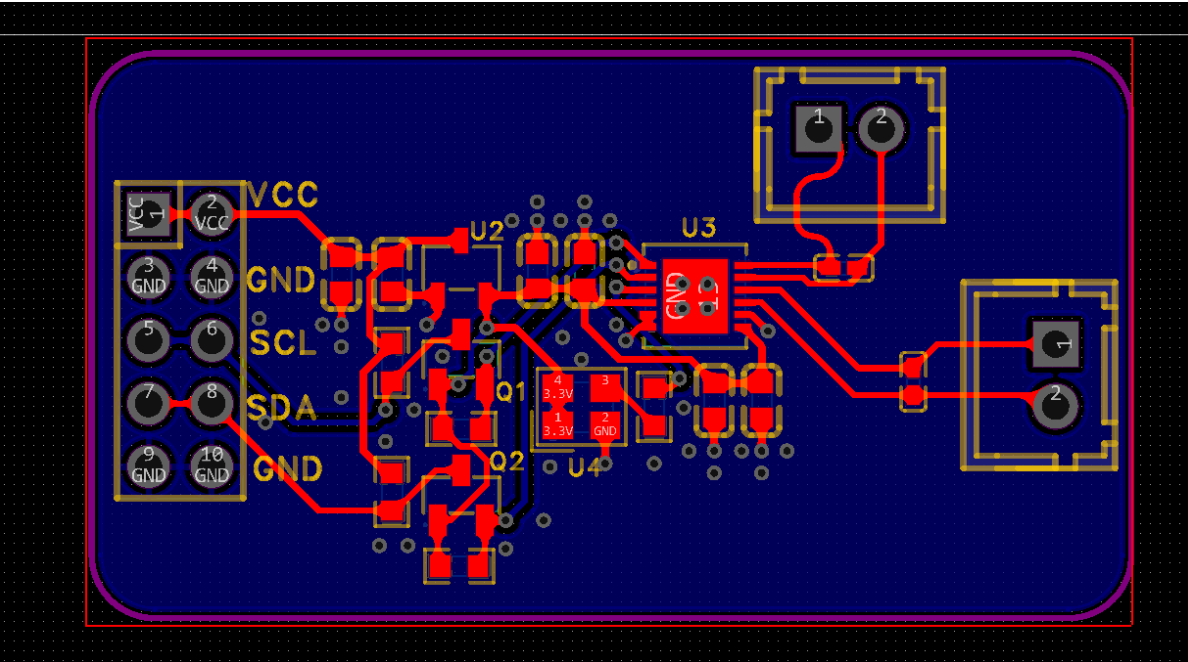
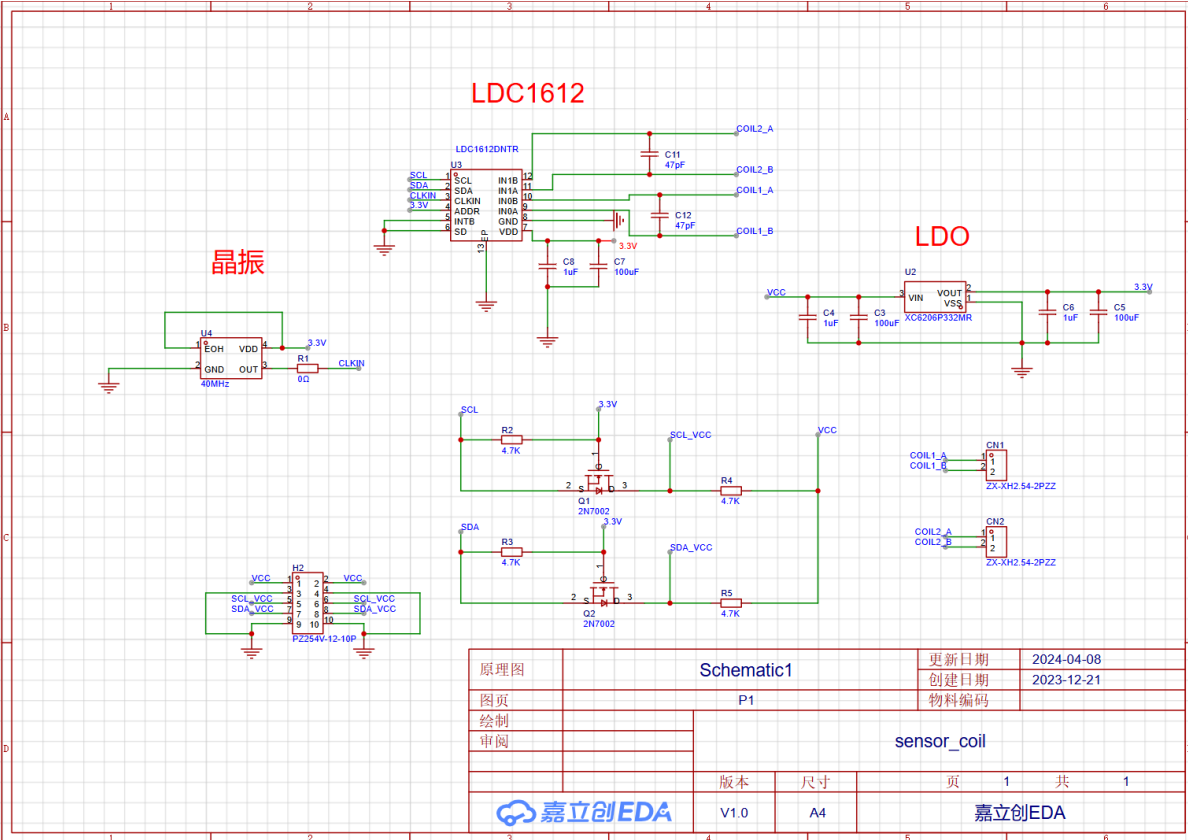


# mmlab-Sensor-Coil

## Introduction

Inductive\_displacement\_sensor.epro is PCB based on 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 studio](#).

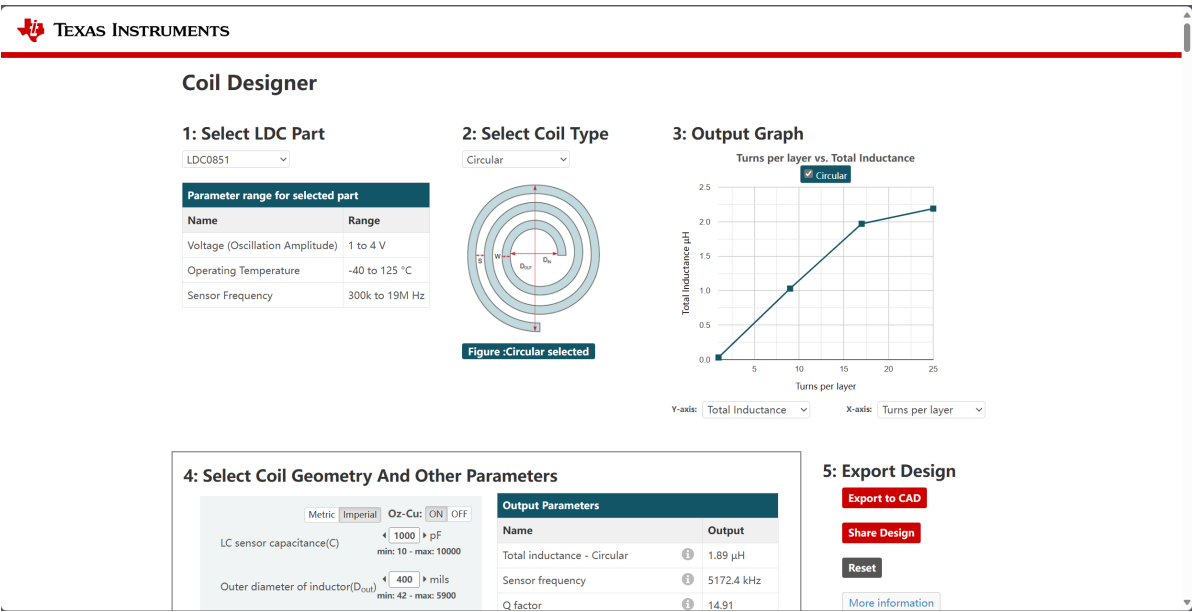


Sensor\_colis\_examples.epro is sensor coils examples, this file obtains certain classic coil design, you can choose a proper coil according to your motor. If you want more, please utilize TI's calculator: [Coil Designer \(ti.com\)](https://www.ti.com/tool/coil-designer) . This calculator can help you derive the proper coils in Altium Designer or Cadence Allegro and so on.

LDC1612\_user\_manual.pdf is TI's LDC1612/LDC1614 user manual, I put here to offer users to consult.

## Coil Designer (ti.com) basic tutorial

1. When you click into this address, it should be look like this :



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.

## Coil Designer

### 1: Select LDC Part

LDC1612

▼

Parameter range for selected part	
Name	Range
Voltage (Oscillation Amplitude)	1 to 4 V
Operating Temperature	-40 to 125 °C
Sensor Frequency	1k to 10M Hz

### 2: Select Coil Type

Circular

▼

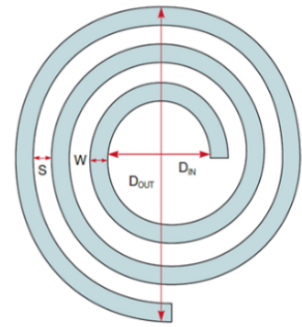


Figure :Circular selected

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. You can also click on view more to see more parameters, here we recommend you click on view more.

#### 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)

16Turns

min: 1 - max: 120

Trace width(W)

4mils

min: 2 - max: 400

Spacing between traces(S)

4mils

min: 2 - max: 400

Copper thickness(t)

1oz-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

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)

16Turns

min: 1 - max: 120

Trace width(W)

4.00mils

min: 2 - max: 40

Spacing between traces(S)

4.00mils

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	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
DC resistance	i	3.37 Ω
Average diameter	i	272 mils
Geometric mean diameter	i	0.47
Self inductance per layer	i	1.89 μH
Coil length per layer	i	13672.21 mils
Skin depth	i	1.88 mils
Self resonant frequency	i	32.22 MHz
Resonance impedance	i	1516.79 Ω
Current	i	0.93 mA
Power dissipation	i	1.68 mW

[View less](#)

#### 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>) 5 mm  
min: 1.067 - max: 149.860

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

Turns per layer(N) 2 Turns  
min: 1 - max: 120

Trace width(W) 0.102 mm  
min: 0.051 - max: 1.016

Spacing between traces(S) 0.102 mm  
min: 0.051 - max: 0.305

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) 0.102 mm  
min: 0.025 - max: 1.524

Output Parameters		
Name		Output
Total inductance - Circular	i	0.084 µH
Sensor frequency	i	17357.924 kHz
Q factor	i	13.182
AC resistance (skin effect only)	i	0.694 Ω
Coil fill ratio	i	0.837
Coil inner diameter (D <sub>in</sub> )	i	4.184 mm
DC resistance	i	0.279 Ω
Average diameter	i	4.592 mm
Geometric mean diameter	i	0.089
Self inductance per layer	i	0.038 µH
Coil length per layer	i	28.852 mm
Skin depth	i	0.016 mm
Self resonant frequency	i	425.535 MHz
Resonance impedance	i	120.865 Ω
Current	i	11.691 mA
Power dissipation	i	21.043 mW

[View less](#)

#### 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>) 590.51 mils  
min: 42 - max: 5900

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

Turns per layer(N) 20 Turns  
min: 1 - max: 120

Trace width(W) 5 mils  
min: 2 - max: 40

Spacing between traces(S) 10 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	7.84 µH
Sensor frequency	i	1793.32 kHz
Q factor	i	17.37
AC resistance (skin effect only)	i	5.08 Ω
Coil fill ratio	i	-0.01
Coil inner diameter (D <sub>in</sub> )	i	-4.45 mils
DC resistance	i	3.64 Ω
Average diameter	i	293.05 mils
Geometric mean diameter	i	1.02
Self inductance per layer	i	2.04 µH
Coil length per layer	i	18412.87 mils
Skin depth	i	1.92 mils
Self resonant frequency	i	25.42 MHz
Resonance impedance	i	1541.97 Ω
Current	i	0.92 mA
Power dissipation	i	1.65 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.

## 5: Export Design

Export to CAD

Share Design

Reset

More information

Support & Community

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

MetricImperialOz-Cu: ON OFF

LC sensor capacitance(C)

1000pFmin: 50 - max: 10000

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

590.5milsmin: 42 - max: 5900

Layers(M)

2Layermin: 1 - max: 8

Turns per layer(N)

20Turnsmin: 1 - max: 120

Trace width(W)

5milsmin: 2 - max: 40

Spacing between traces(S)

4milsmin: 2 - max: 12

Copper thickness(t)

1oz-Cumin: 0.5 - max: 5

Temperature(T)

25°Cmin: -40 - max: 125

Voltage (Oscillation Amplitude) (V)

1.8Vmin: 1 - max: 1.8

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

4.00milsmin: 1 - max: 60

Output Parameters

Name	Output
Total inductance - Circular	17.68 $\mu$ H
Sensor frequency	1193.92 kHz
Q factor	19.77
AC resistance (skin effect only)	6.71 $\Omega$
Coil fill ratio	0.39
Coil inner diameter (D <sub>in</sub> )	229.55 mils
DC resistance	5.09 $\Omega$
Average diameter	410.05 mils
Geometric mean diameter	0.44
Self inductance per layer	4.61 $\mu$ H
Coil length per layer	25764.2 mils
Skin depth	2.35 mils
Self resonant frequency	16.93 MHz
Resonance impedance	2636.08 $\Omega$
Current	0.54 mA
Power dissipation	0.96 mW

#### 5: Export Design

Export to CAD

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Coil Designer - 用户配置 1 - Microsoft Edge

https://webench.ti.com/wb5/LDC/jsp/login.jsp?...

Export Board Layout

Altium Designer

Cadence Allegro 16.0-16.6

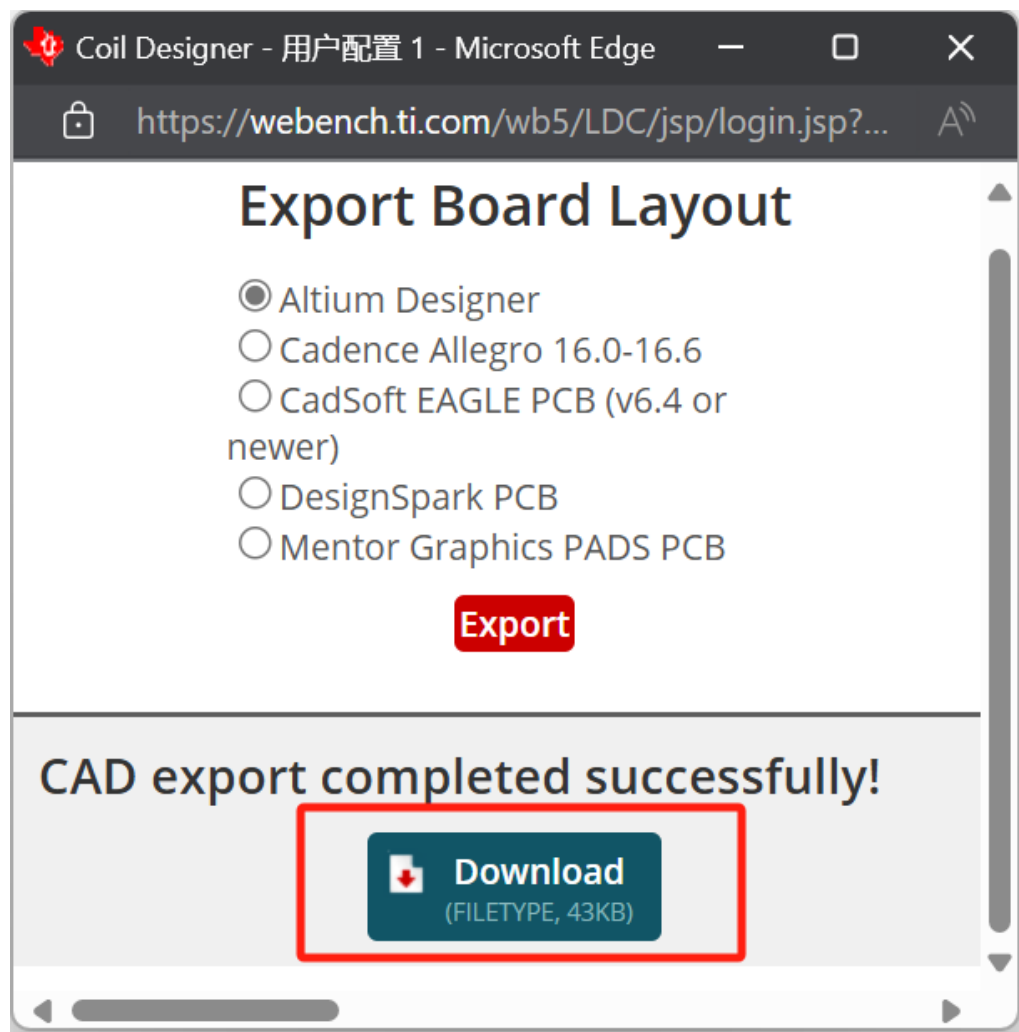
CadSoft EAGLE PCB (v6.4 or newer)

DesignSpark PCB

Mentor Graphics PADS PCB

Export

- 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.



6. 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.

### Coil Designer

#### 1: Select LDC Part

LDC1612

Parameter range for selected part	
Name	Range
Voltage (Oscillation Amplitude)	1 to 4 V
Operating Temperature	-40 to 125 °C
Sensor Frequency	1k to 10M Hz

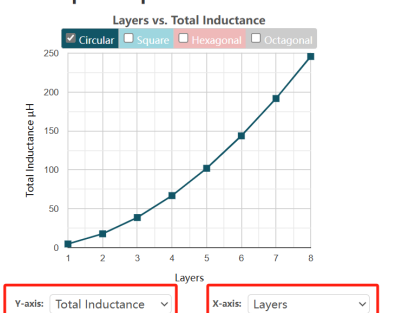
#### 2: Select Coil Type

Circular



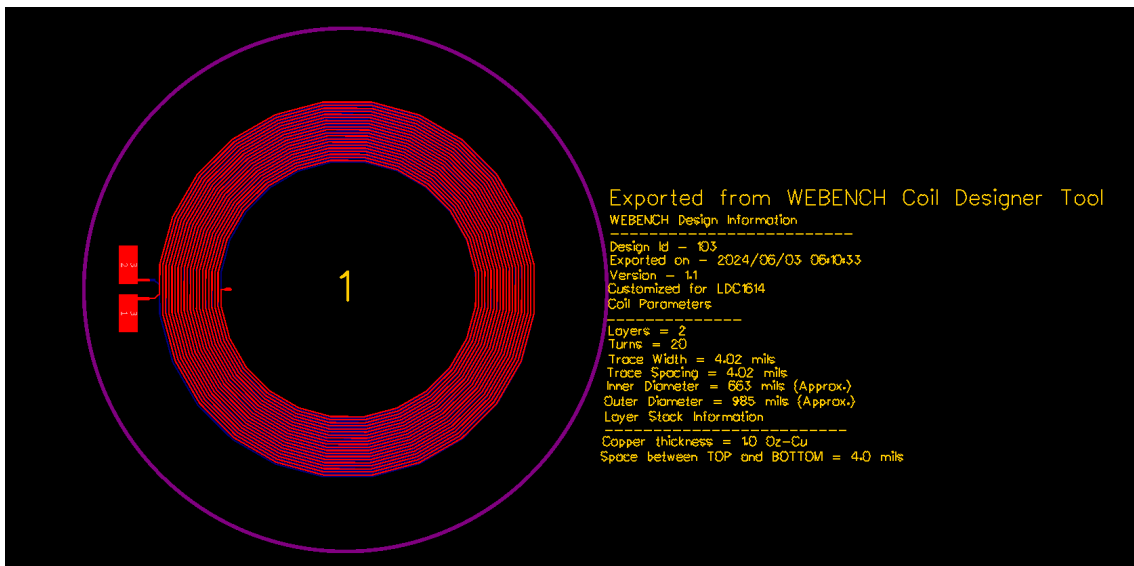
Figure :Circular selected

#### 3: Output Graph

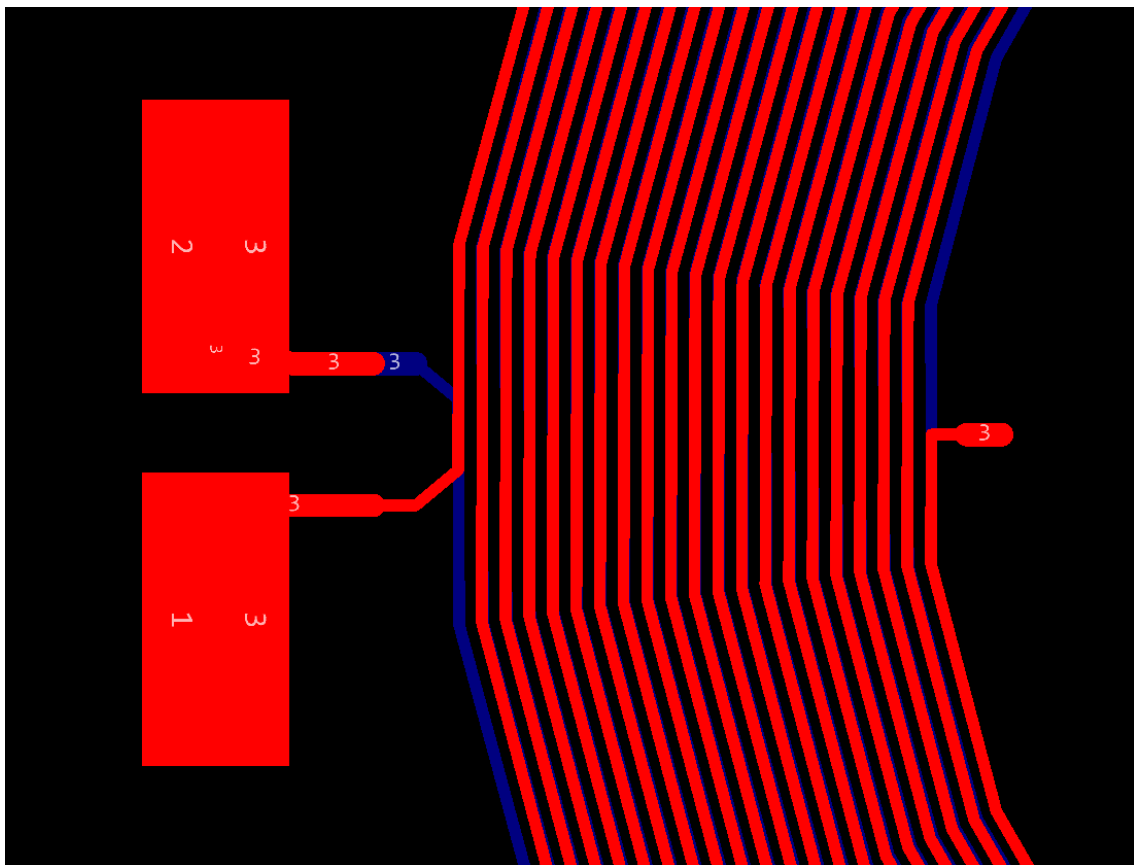


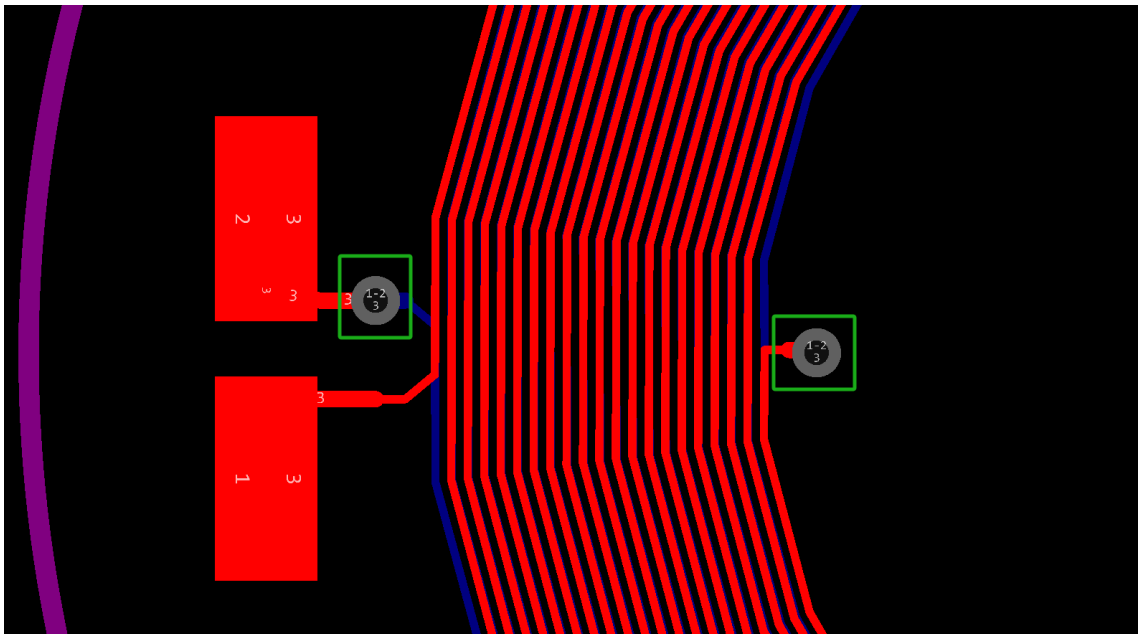
## The problem you may face during learning and using

- 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:



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.





- The address of LDC1612 or LDC1614 is uncertain.
- You must set the pull-up (access 3.3V) or pull-down (access GND) on the ADDR pin of LDC1612 or LDC1614, **must not float**. To be specify, When the ADDR pin of LDC1612/LDC1614 is set low, the device I2C address is 0x2A; when the ADDR pin is set high, the I2C address is 0x2B. So, when user design the hardware, this address is fixed. In beneath figure and whole project, we use address 0X2B.

