

# LDC131x and LDC161x EVM User's Guide

## User's Guide



Literature Number: SNOU135A  
August 2015–Revised September 2016

<b>1</b>	<b>Overview</b> .....	<b>6</b>
<b>2</b>	<b>Sensing Solutions EVM GUI</b> .....	<b>7</b>
2.1	System Requirements .....	7
2.2	Installation Instructions .....	7
2.3	Starting the GUI .....	14
2.4	Navigating the GUI .....	15
2.5	Connecting the EVM .....	17
2.6	Configuring the EVM Using the Register Page .....	17
2.6.1	Automatically Update GUI Register Values Using Auto Read .....	17
2.6.2	Manually Update Device Register Values .....	18
2.6.3	Reading Register Values Without Auto Read .....	20
2.6.4	Saving Device Configurations .....	22
2.6.5	Loading Previously Saved Configurations .....	23
2.7	Configuring the EVM Using the Configuration Page .....	24
2.7.1	Enabling and Disabling Channel Measurements .....	24
2.7.2	Selecting the Clocking Source .....	25
2.7.3	Setting the Measurement Timings .....	25
2.7.4	Using a Different Sensor .....	26
2.7.5	Setting the Input Deglitch Filter .....	26
2.7.6	Setting the Power Mode and Sensor Initialization Currents .....	26
2.8	Streaming Measurement Data .....	27
2.8.1	Choosing the Graph and Visible Channels .....	27
2.8.2	Logging Data to a File .....	28
2.8.3	Starting and Stopping Data Streaming .....	29
2.8.4	Data Statistics .....	30
2.8.5	Configuring the Graph .....	32
2.8.6	Navigating the Data Streaming Buffer .....	35
2.9	Updating the EVM Firmware .....	37
<b>3</b>	<b>LDC1312/1612 EVM REV B Schematics and Layout</b> .....	<b>42</b>
<b>4</b>	<b>LDC1314/1614 EVM REV B Schematics and Layout</b> .....	<b>50</b>
<b>5</b>	<b>LDC1312/1314/1612/1614 EVM REV B Bill of Materials</b> .....	<b>58</b>
<b>6</b>	<b>Appendix 1: LDC1312/1612 EVM REV A Schematics and Layout</b> .....	<b>66</b>
<b>7</b>	<b>Appendix 2: LDC1314/1614 EVM REV A Schematics and Layout</b> .....	<b>71</b>
<b>8</b>	<b>Appendix 3: LDC1312/1314/1612/1614 EVM REV A Bill of Materials</b> .....	<b>76</b>
	<b>Revision History</b> .....	<b>84</b>

## List of Figures

1	LDC1312/1612 Evaluation Module .....	6
2	User Account Control Prompt .....	7
3	Software Installer Wizard .....	8
4	Software Installer License Agreement .....	8
5	Software Installation Directory .....	9
6	Software Installer Ready .....	10
7	Software Installer in Progress .....	10
8	Device Driver Installer Wizard .....	11
9	Device Driver Installer in Progress .....	12
10	Device Driver Installer Completed .....	13
11	Software Installer Completed .....	13
12	Splash Screen .....	14
13	Introduction Page .....	15
14	Mouse Hovered Over Menu Button .....	16
15	Menu Display After Clicking Button .....	16
16	EVM Connected to GUI .....	17
17	Selecting Auto Read Interval on Register Page .....	18
18	Selecting a Register's Current Value for Editing on Register Page .....	19
19	Hovering Mouse Over Register Bit Value on Register Page .....	20
20	Selecting a Register on Register Page .....	21
21	Reading the Current Device Register Value on Register Page .....	22
22	Save Register Values to File on Register Page .....	23
23	Loading Previously Saved Register Values from File on Register Page .....	24
24	Measurement Settings on Configuration Page .....	25
25	Sensor Properties and Input Adjustments on Configuration Page .....	26
26	Current Drive on Configuration Page .....	27
27	Select the Data Graph on Data Streaming Page .....	28
28	Select Log File Button on Data Streaming Page .....	29
29	Start Button on Data Streaming Page .....	30
30	Show Statistics Button on Data Streaming Page .....	31
31	Hide Statistics Button on Data Streaming Page .....	32
32	Show Graph Configuration Button on Data Streaming Page .....	33
33	Graph Configuration Button on Data Streaming Page .....	34
34	Hide Graph Configuration Button on Data Streaming Page .....	35
35	Changing Number of Samples Displayed in Data Graph .....	36
36	Displaying Previous Data Samples on the Data Streaming Page .....	37
37	Select TI-TXT File Button on Firmware Upload Page .....	38
38	Selecting TI-TXT Firmware File for Upload to EVM .....	39
39	Upload Firmware Button on Firmware Upload Page .....	40
40	Firmware Upload in Progress .....	40
41	Firmware Upload Success .....	41
42	LDC1312/1612 USB Connection .....	42
43	LDC1312/1612 Power Circuit .....	43
44	LDC1312/1612 .....	44
45	LDC1312/1612 MSP430 Connections .....	45
46	LDC1312/1612 Layout Top Layer – Signals and Components .....	46
47	LDC1312/1612 Layout MidLayer 1 – Ground Plane .....	47

48	LDC1312/1612 Layout MidLayer 2 – Signals and Power Plane .....	48
49	LDC1312/1612 Layout Bottom Layer – Signals Plane .....	49
50	LDC1314/1614 USB Connection .....	50
51	LDC1314/1614 Power Circuit.....	51
52	LDC1314/1614.....	52
53	LDC1314/1614 MSP430 Connections.....	53
54	LDC1314/1614 Layout Top Layer – Signals and Components .....	54
55	LDC1314/1614 Layout MidLayer 1 – Ground Plane.....	55
56	LDC1314/1614 Layout MidLayer 2 – Signals and Power Plane .....	56
57	LDC1314/1614 Layout Bottom Layer – Signals Plane .....	57
58	LDC1312/1612 REV A USB Connection .....	66
59	LDC1312/1612 REV A Power Circuit.....	66
60	LDC1312/1612 REV A Clocking.....	67
61	LDC1312/1612 REV A .....	67
62	LDC1312/1612 REV A MSP430 Connections.....	68
63	LDC1312/1612 REV A Layout Top Layer – Signals and Components .....	69
64	LDC1312/1612 REV A Layout MidLayer 1 – Ground Plane.....	69
65	LDC1312/1612 REV A Layout MidLayer 2 – Signals and Power Plane .....	70
66	LDC1312/1612 REV A Layout Bottom Layer – Signals Plane .....	70
67	LDC1314/1614 REV A USB Connection .....	71
68	LDC1314/1614 REV A Power Circuit.....	71
69	LDC1314/1614 REV A Clocking.....	72
70	LDC1314/1614 REV A.....	72
71	LDC1314/1614 REV A MSP430 Connections.....	73
72	LDC1314/1614 REV A Layout Top Layer – Signals and Components .....	74
73	LDC1314/1614 REV A Layout MidLayer 1 – Ground Plane.....	74
74	LDC1314/1614 REV A Layout MidLayer 2 – Signals and Power Plane .....	75
75	LDC1314/1614 REV A Layout Bottom Layer – Signals Plane .....	75

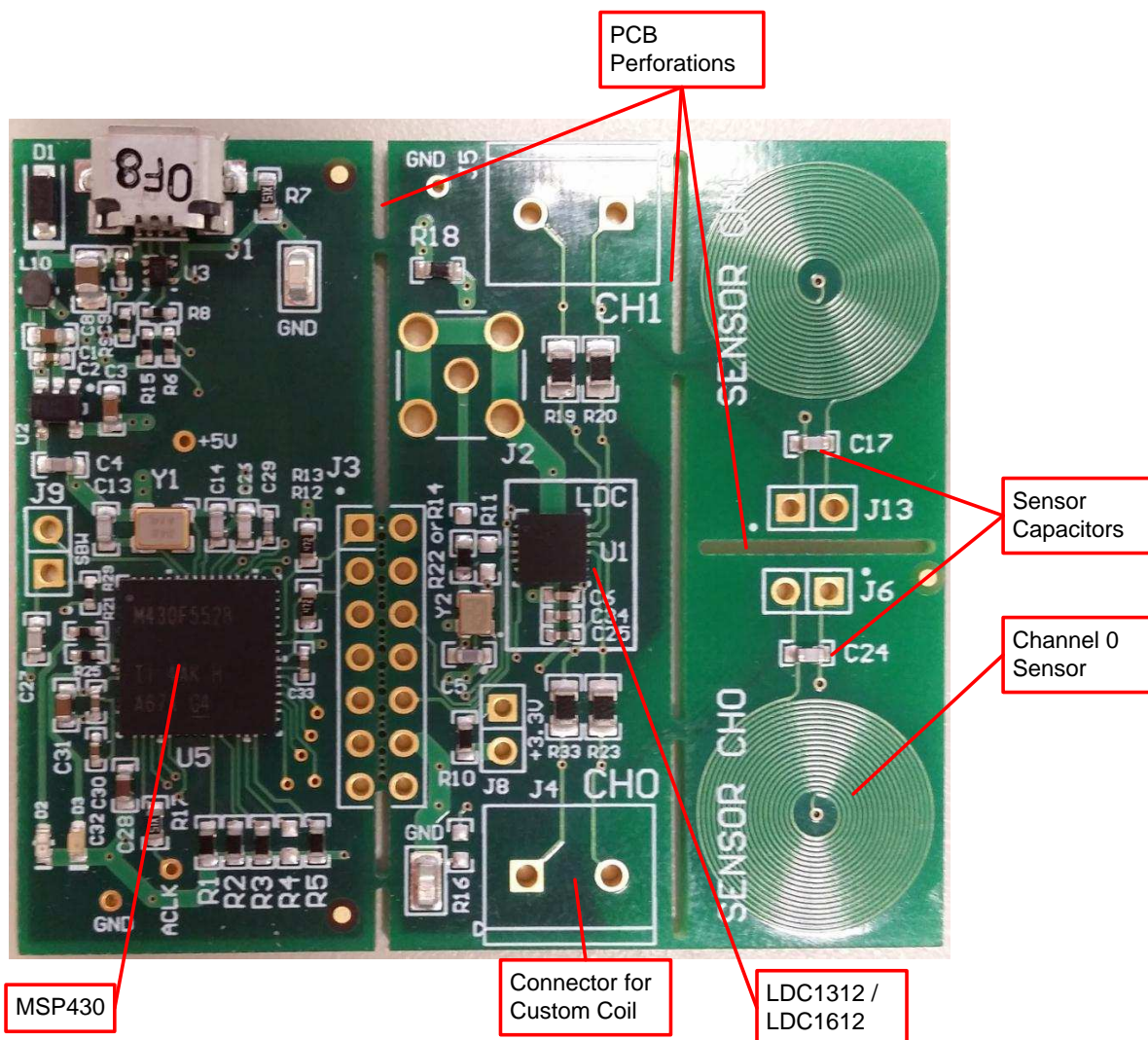
## List of Tables

1	BOM for LDC1312 EVM REV B .....	58
2	BOM for LDC1612 EVM REV B .....	60
3	BOM for LDC1314 EVM REV B .....	62
4	BOM for LDC1614 EVM REV B .....	64
5	BOM for LDC1312 EVM REV A .....	76
6	BOM for LDC1612 EVM REV A .....	78
7	BOM for LDC1314 EVM REV A .....	80
8	BOM for LDC1614 EVM REV A .....	82

## LDC131x and LDC161x EVM User's Guide

### 1 Overview

The LDC131x/161x Rev B EVM demonstrates the use of inductive sensing technology to sense and measure the presence or position of conductive target objects. The EVM contains two example LC tank sensors that are connected to the LDC131x/161x input channels. The latter is controlled by an MSP430, which interfaces to a host computer.



**Figure 1. LDC1312/1612 Evaluation Module**

The LDC1312/1612 EVM includes two example PCB sensors which are PCB inductors with 330 pF 1% COG/NP0 capacitors connected in parallel to form an LC tank. LDC1x14/1614 includes two additional spaces to which two sensors can be connected.

PCB perforations allow removal of the sensor coils or the microcontroller, so that custom sensors or a different microcontroller can be connected.

## 2 Sensing Solutions EVM GUI

The Sensing Solutions EVM GUI provides direct device register access, user-friendly configuration, and data streaming.

### 2.1 System Requirements

The host machine is required for device configuration and data streaming. The following steps are necessary to prepare the EVM for the GUI:

- The GUI and EVM driver must be installed on a host computer.
- The EVM must be connected to a full speed USB port (USB 1.0 or above).

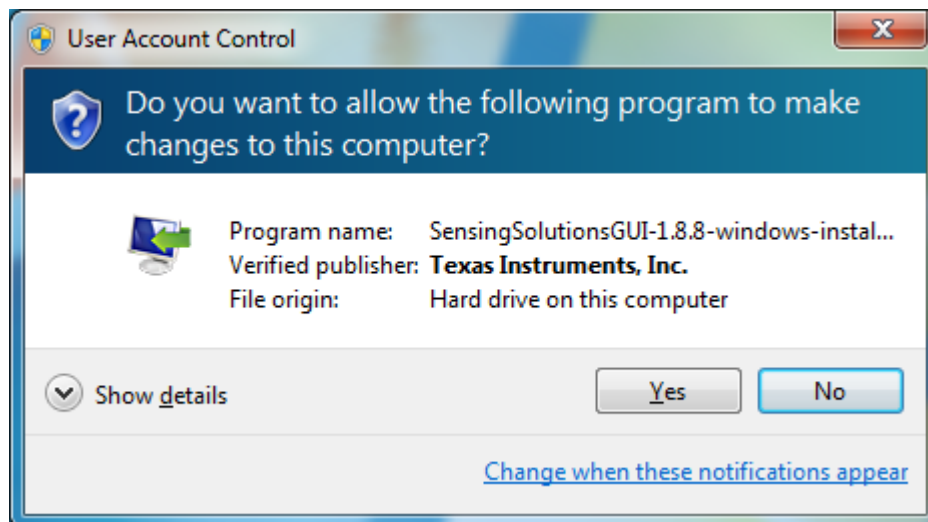
The Sensing Solutions EVM GUI supports the following operating systems (both 32-bit and 64-bit):

- Windows XP
- Windows 7
- Windows 8 and 8.1
- Windows 10

### 2.2 Installation Instructions

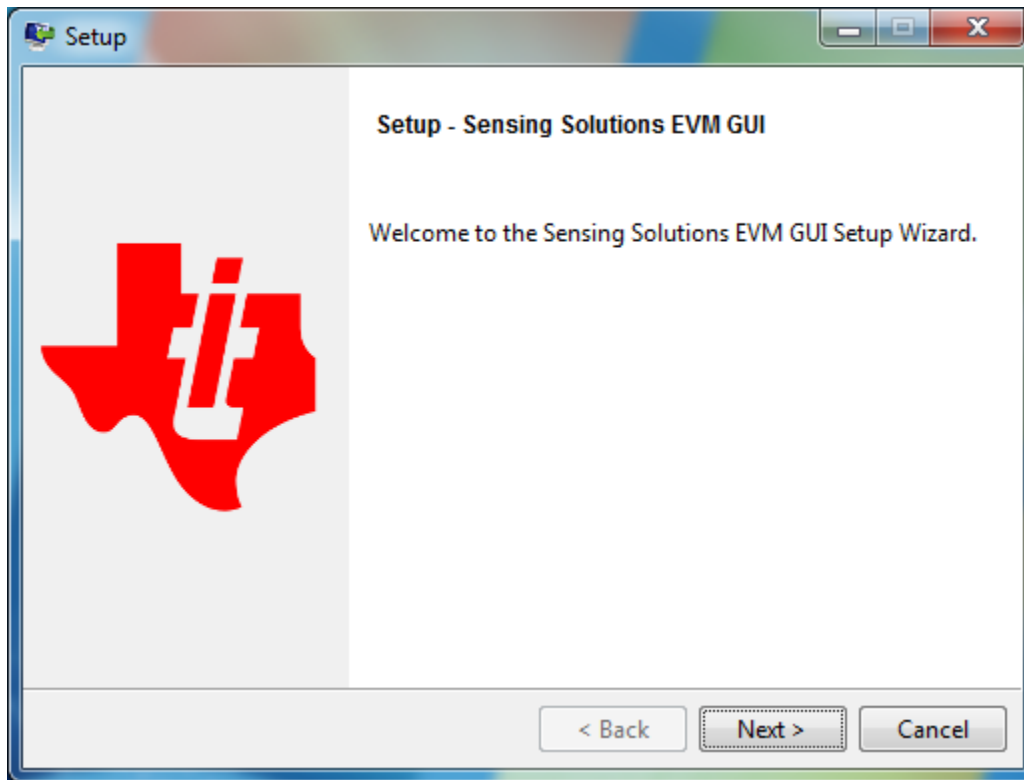
The Sensing Solutions GUI and EVM driver installer is packaged in a zip file. Follow these steps to install the software:

1. Download the software ZIP file from the EVM tool page.
2. Extract the downloaded ZIP file.
3. Run the included executable.
4. If prompted by the User Account Control about making changes to the computer, click Yes.



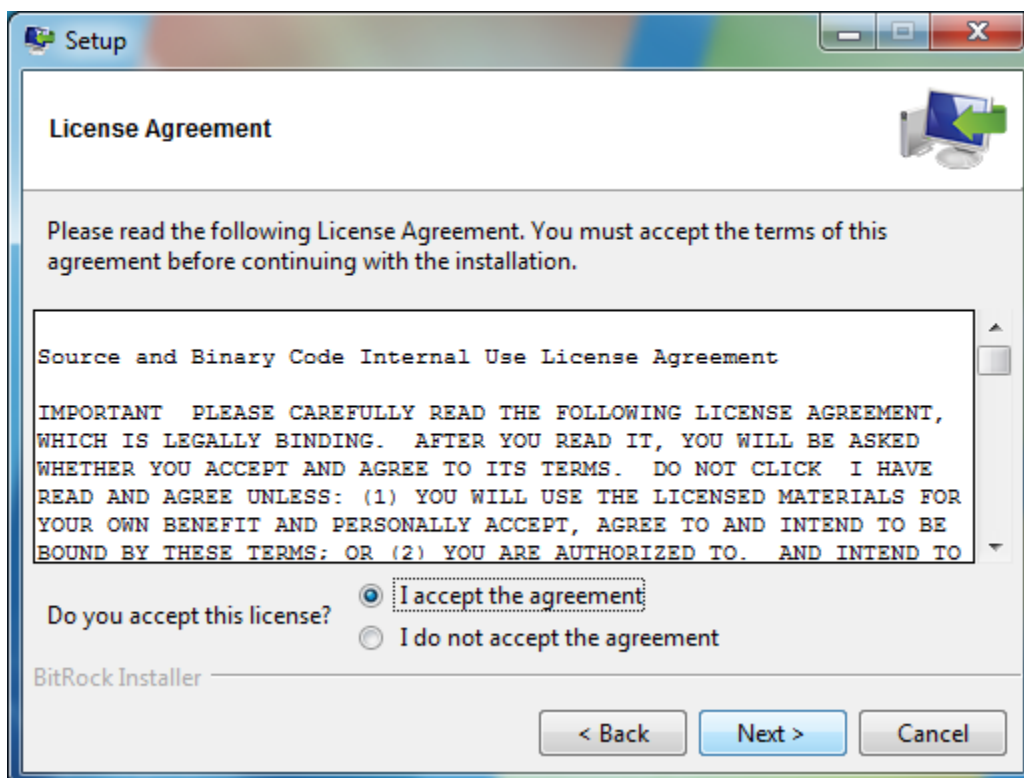
**Figure 2. User Account Control Prompt**

5. After the setup wizard starts, click *Next*.



**Figure 3. Software Installer Wizard**

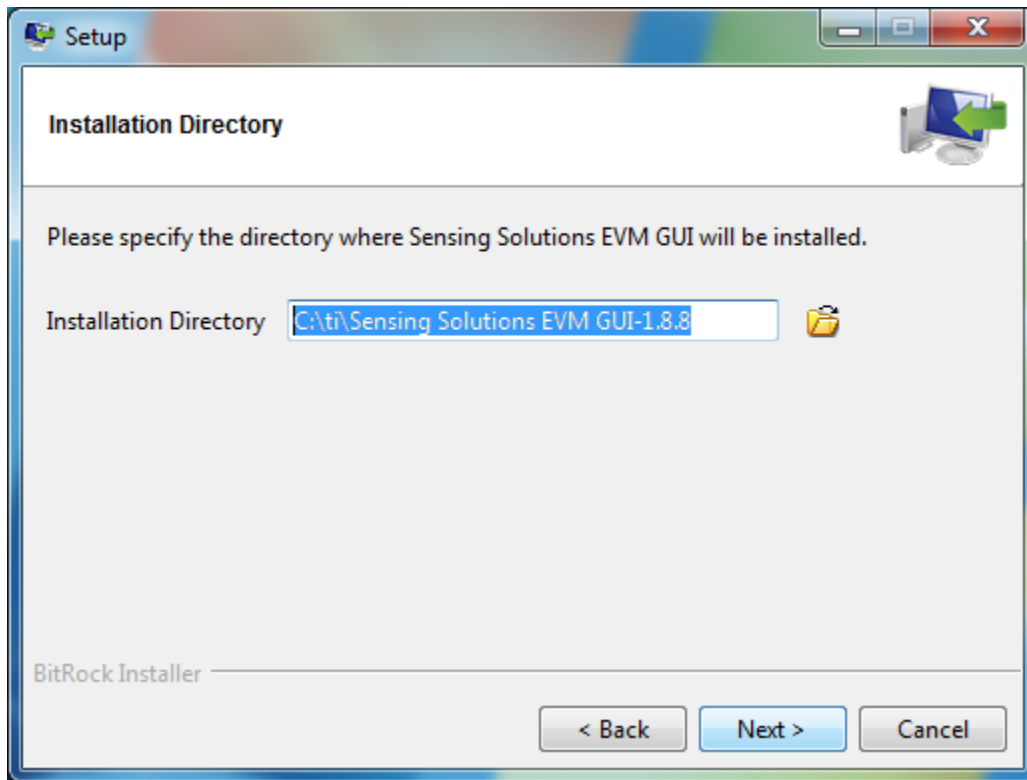
6. Read the license agreement, select *I accept the agreement*, and click *Next*.



**Figure 4. Software Installer License Agreement**

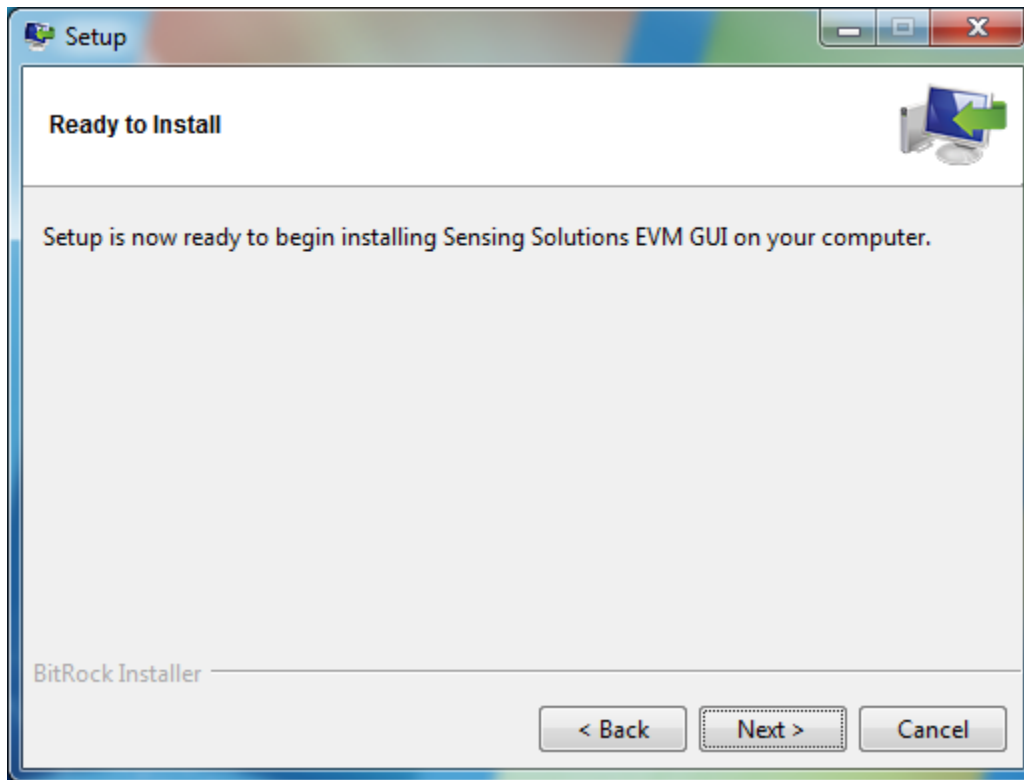


7. Use the preselected installation directory and click *Next*.



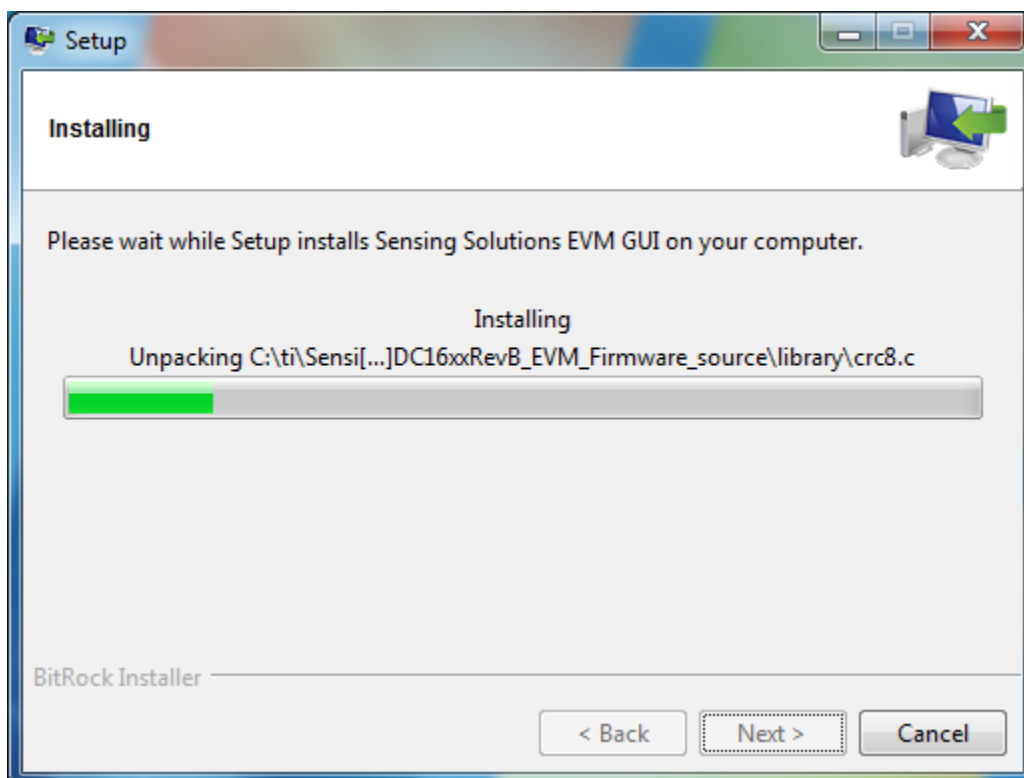
**Figure 5. Software Installation Directory**

8. Start the installation by clicking *Next*.



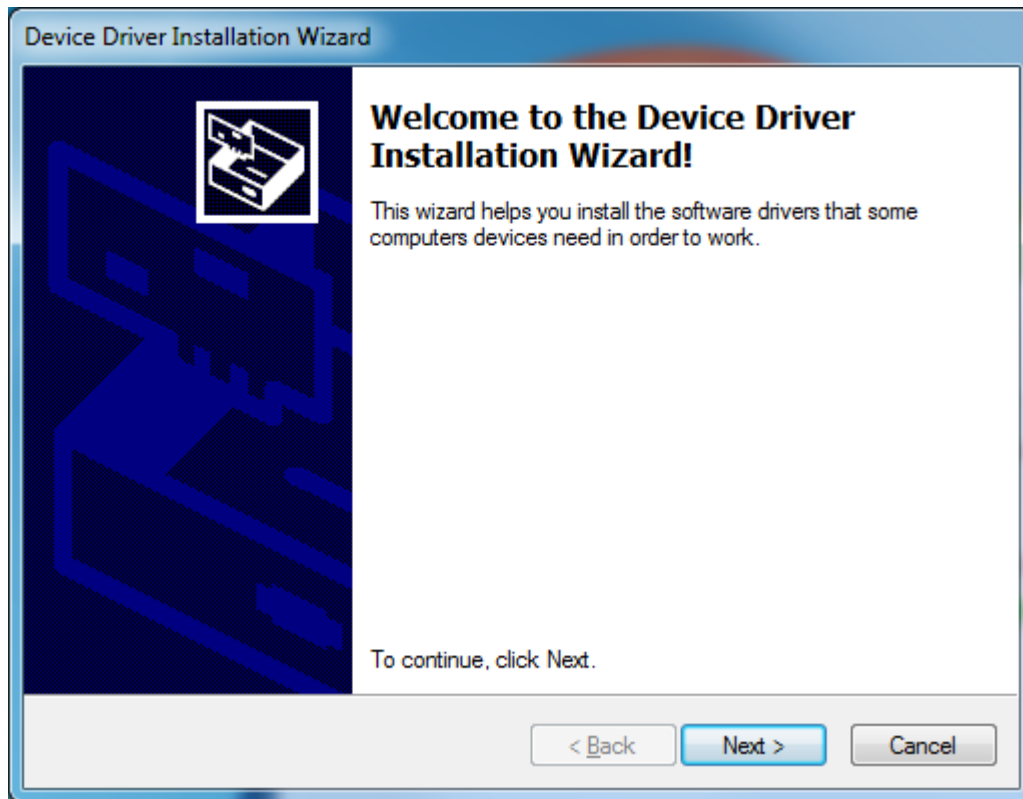
**Figure 6. Software Installer Ready**

9. Wait for the installation to complete.



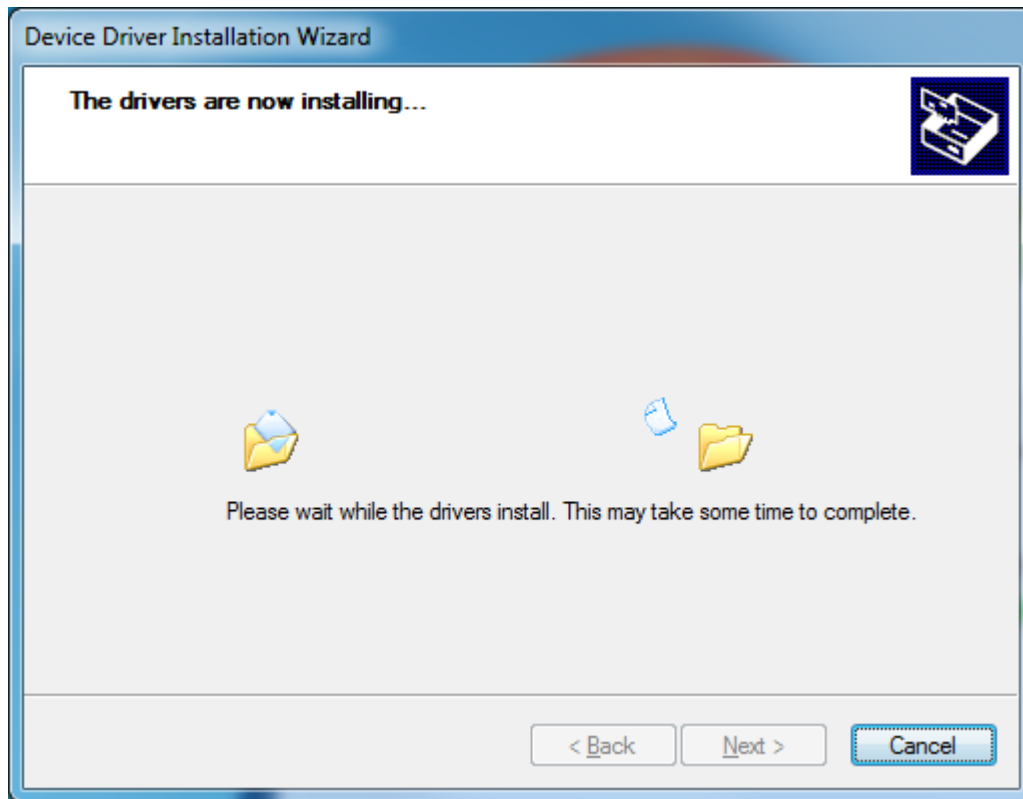
**Figure 7. Software Installer in Progress**

10. When the *Device Driver Installation Wizard* appears, click *Next* to install the EVM driver.



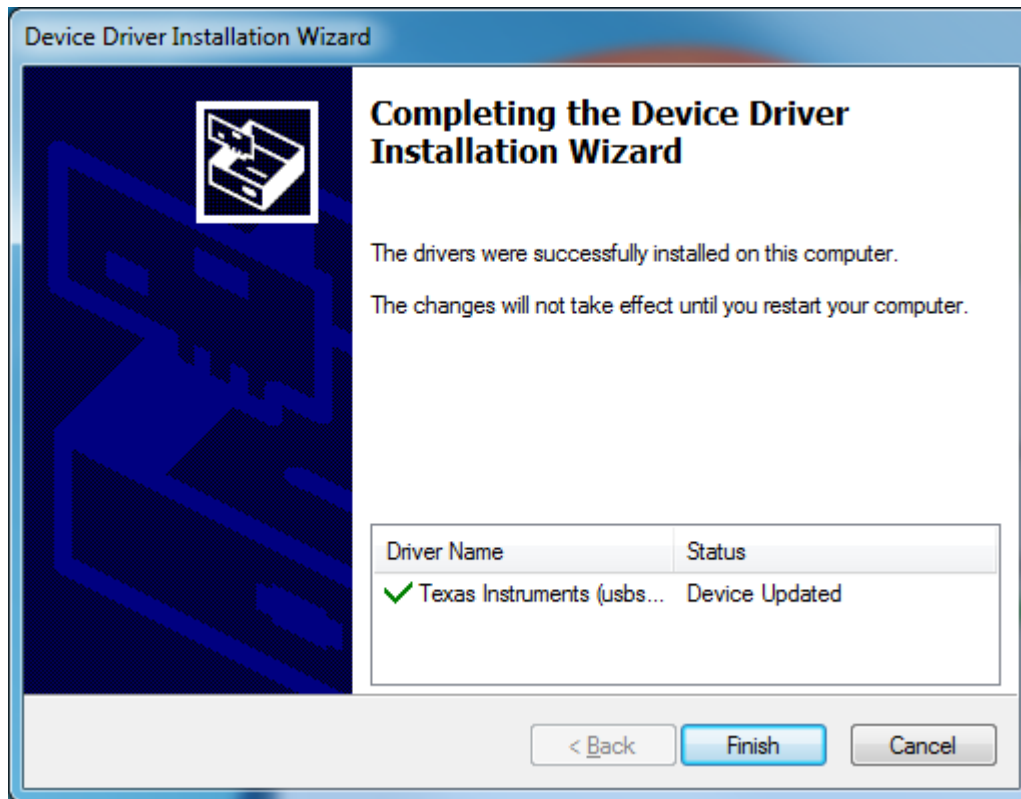
**Figure 8. Device Driver Installer Wizard**

11. Wait for the driver installation to complete.



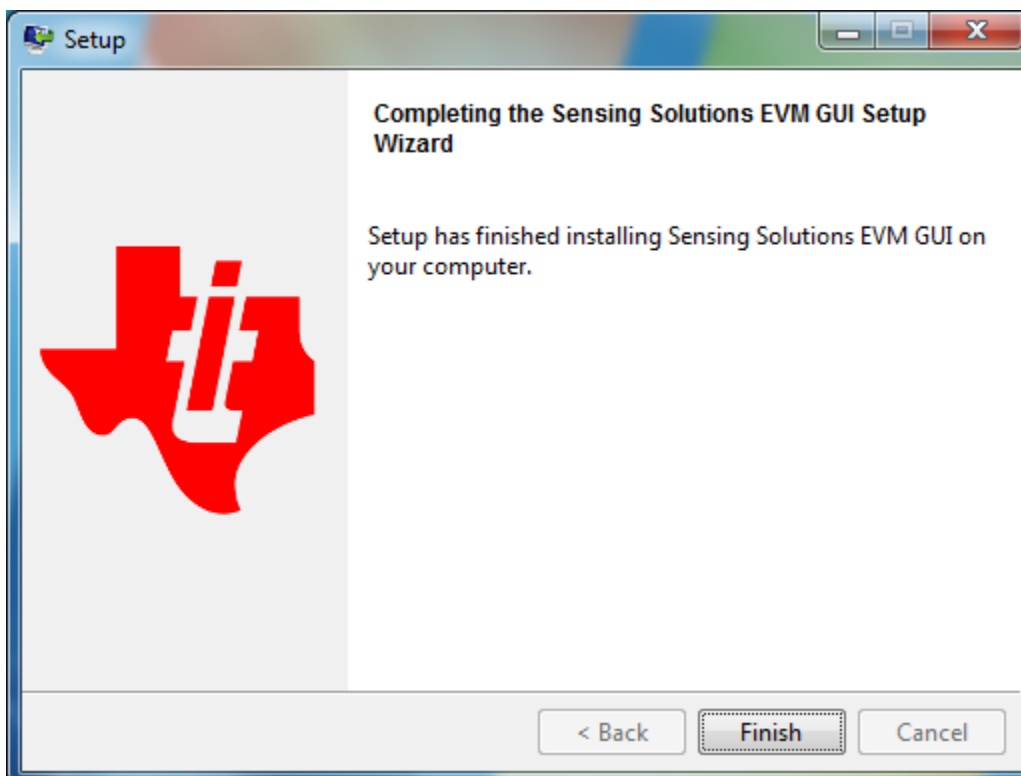
**Figure 9. Device Driver Installer in Progress**

12. After the driver installation is completed, click *Finish*.



**Figure 10. Device Driver Installer Completed**

13. Click *Finish* to complete the installation.

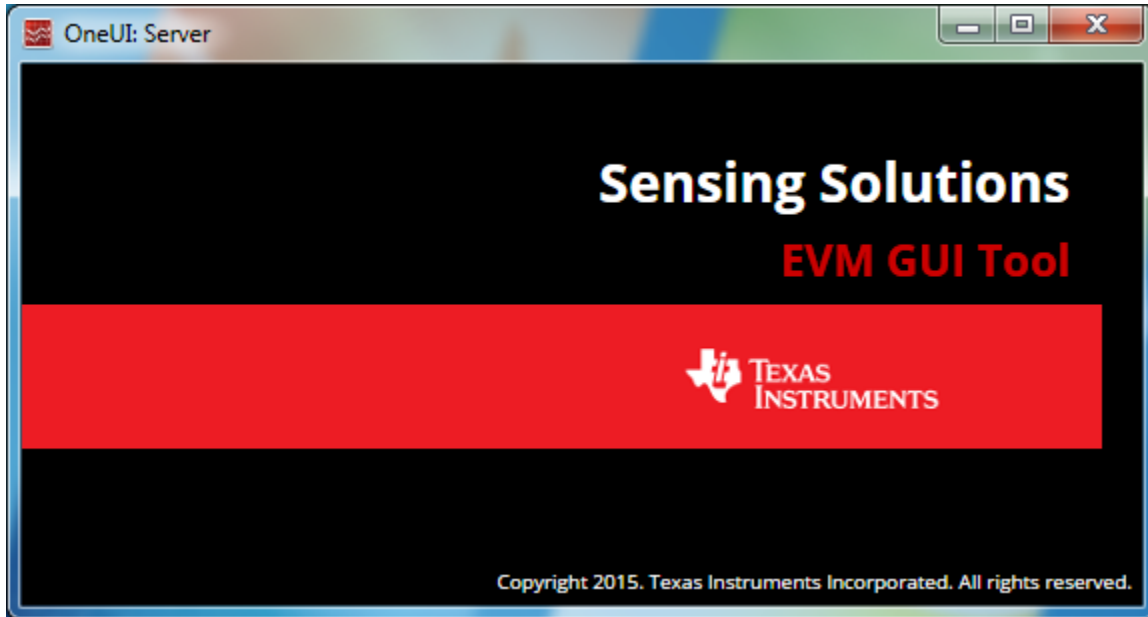


**Figure 11. Software Installer Completed**

### 2.3 Starting the GUI

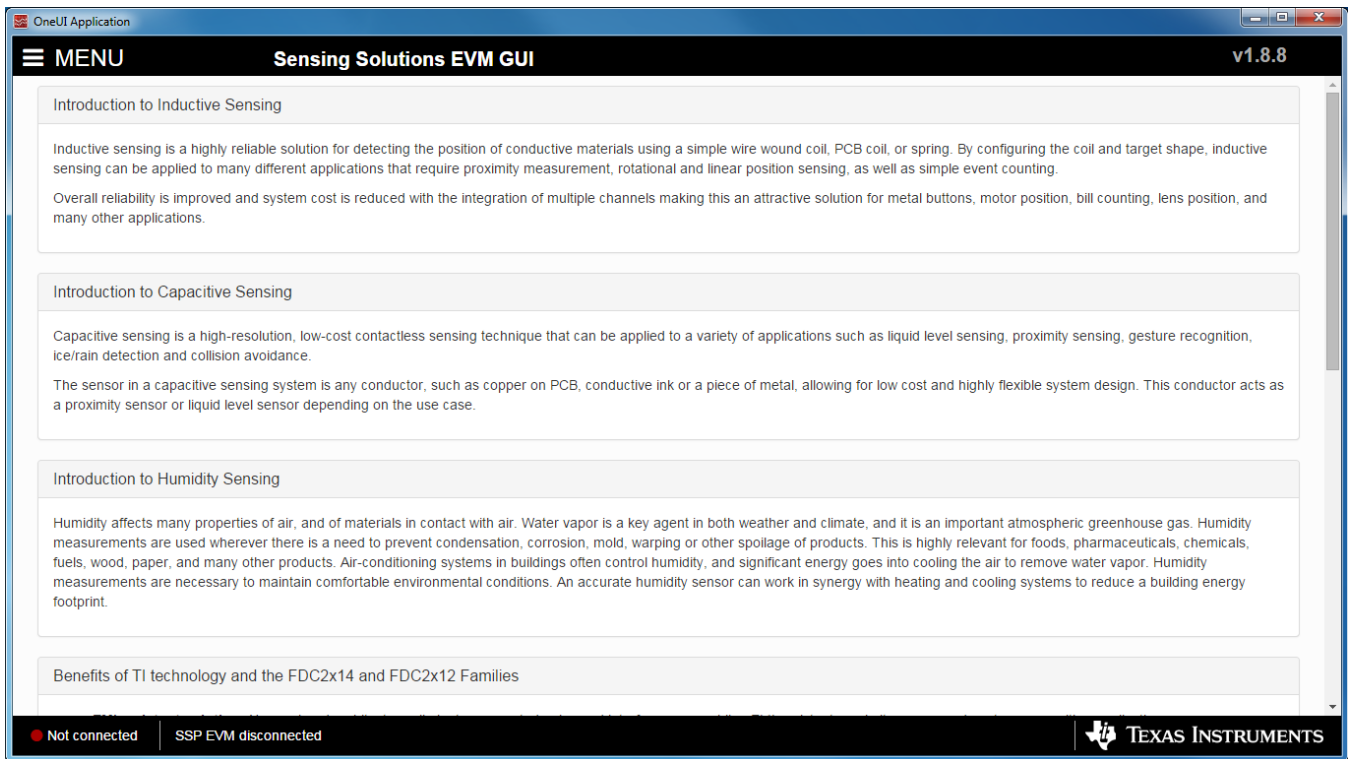
Follow these steps to start the GUI:

1. Select the Windows start menu.
2. Select *All programs*.
3. Select *Texas Instruments*.
4. Select *Sensing Solutions EVM GU*.
5. Click *Sensing Solutions EVM GU*.
6. The splash screen will appear for at least two seconds.



**Figure 12. Splash Screen**

7. After the splash screen is displayed the main window will open.



**Figure 13. Introduction Page**

## 2.4 Navigating the GUI

To navigate to different pages of the GUI follow these steps:

1. Click *Menu* in the upper left corner.

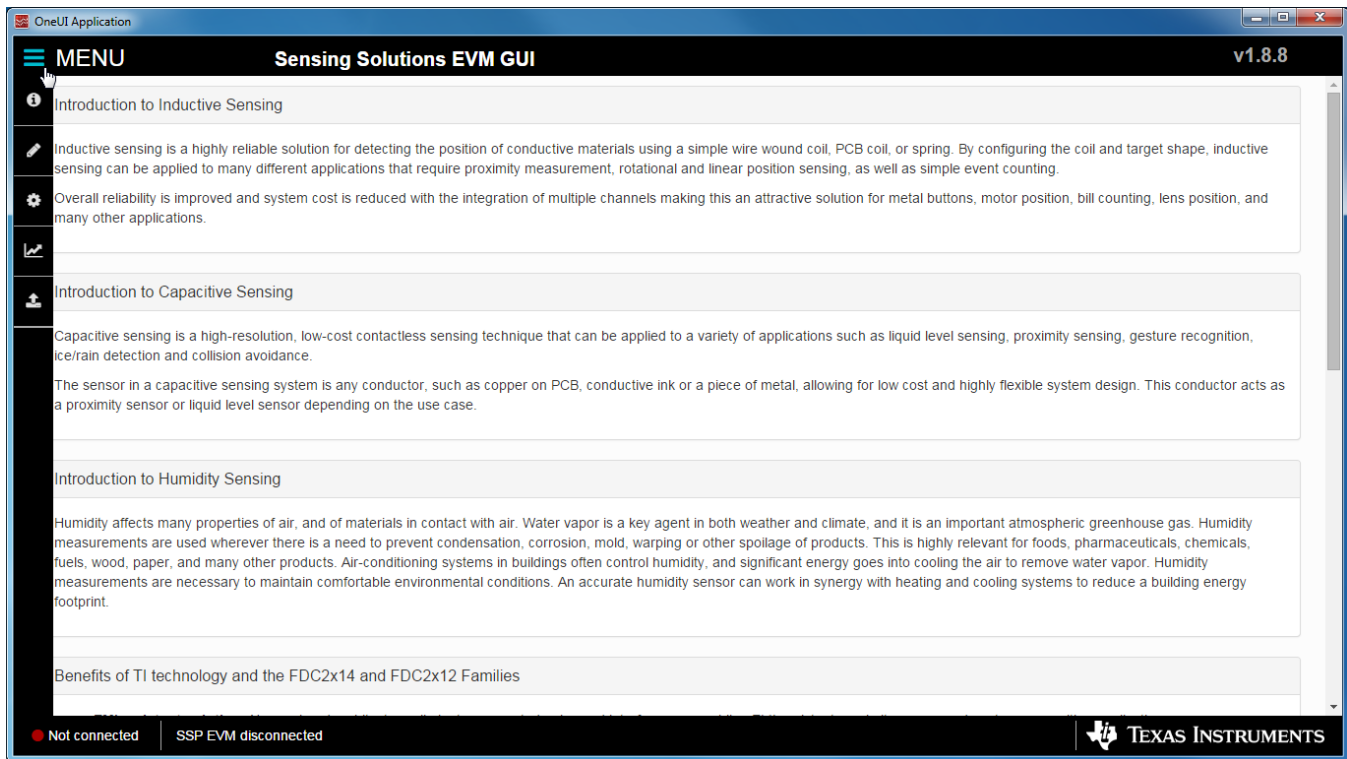


Figure 14. Mouse Hovered Over Menu Button

2. Select the desired page from the menu shown on the left.

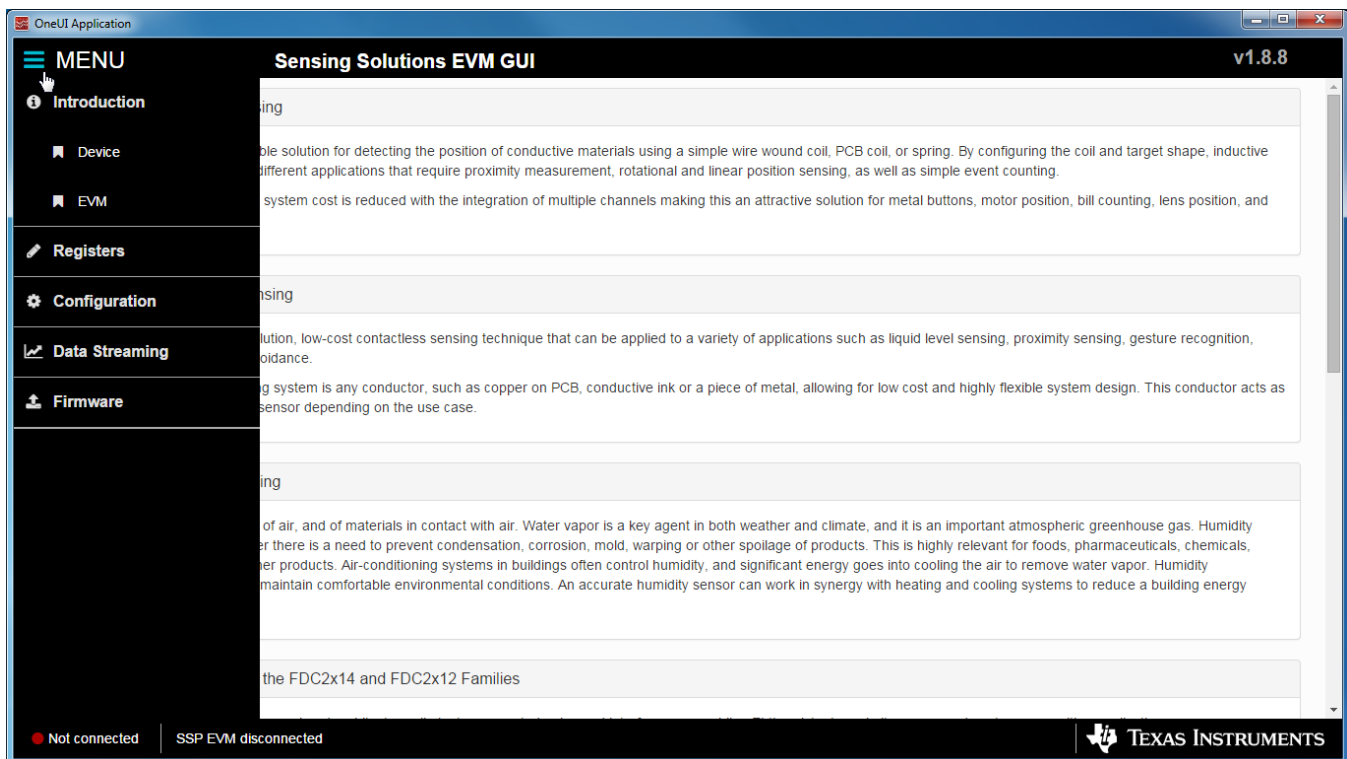


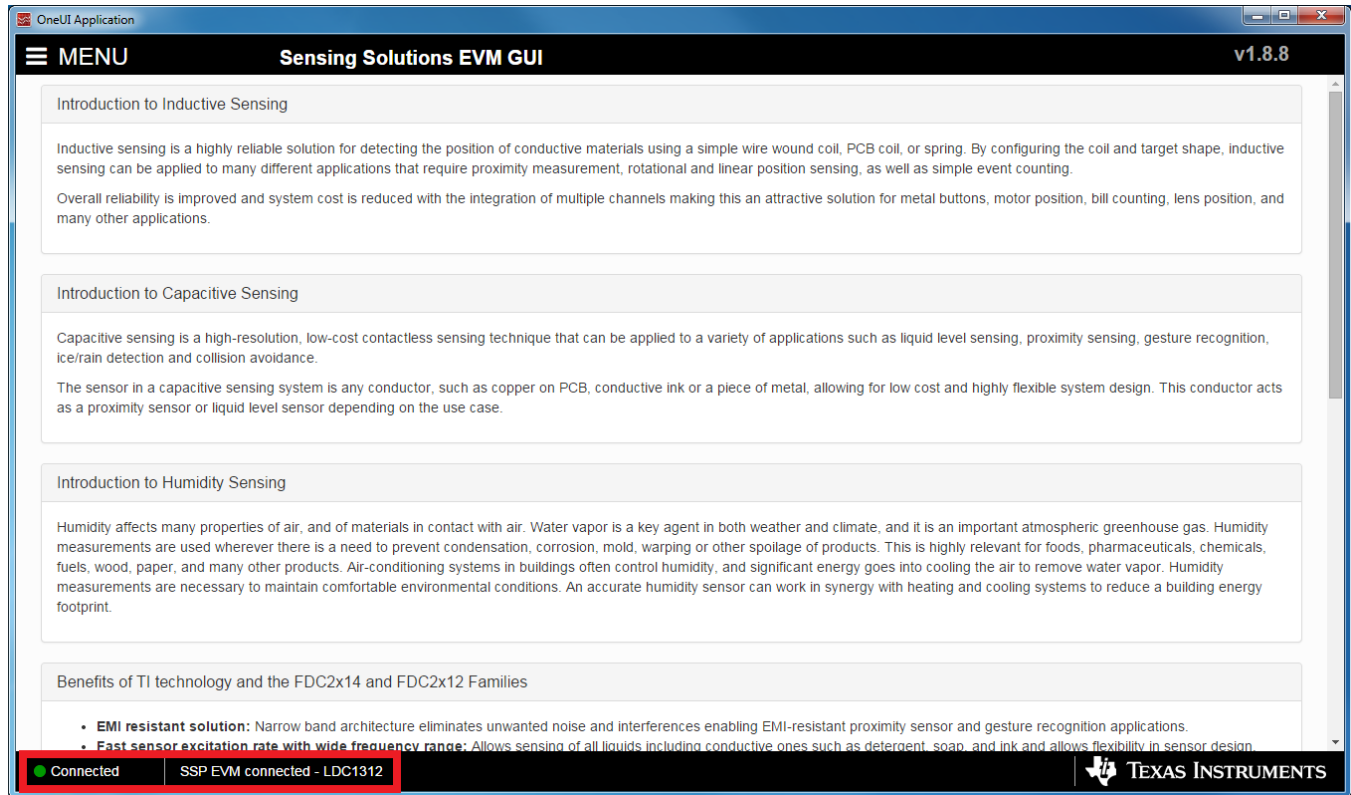
Figure 15. Menu Display After Clicking Button



## 2.5 Connecting the EVM

Follow these steps to connect the EVM to the GUI:

1. Attach the EVM to the computer through USB.
2. The GUI always shows the connection status on the bottom left corner of the GUI.



**Figure 16. EVM Connected to GUI**

## 2.6 Configuring the EVM Using the Register Page

The register page allows users to control the device directly with the register values. The user may also use this page to read the current register values on the device.

### 2.6.1 Automatically Update GUI Register Values Using Auto Read

Auto read will periodically request the register values on the device. Click the drop down box next to *Auto Read* to select the update interval.

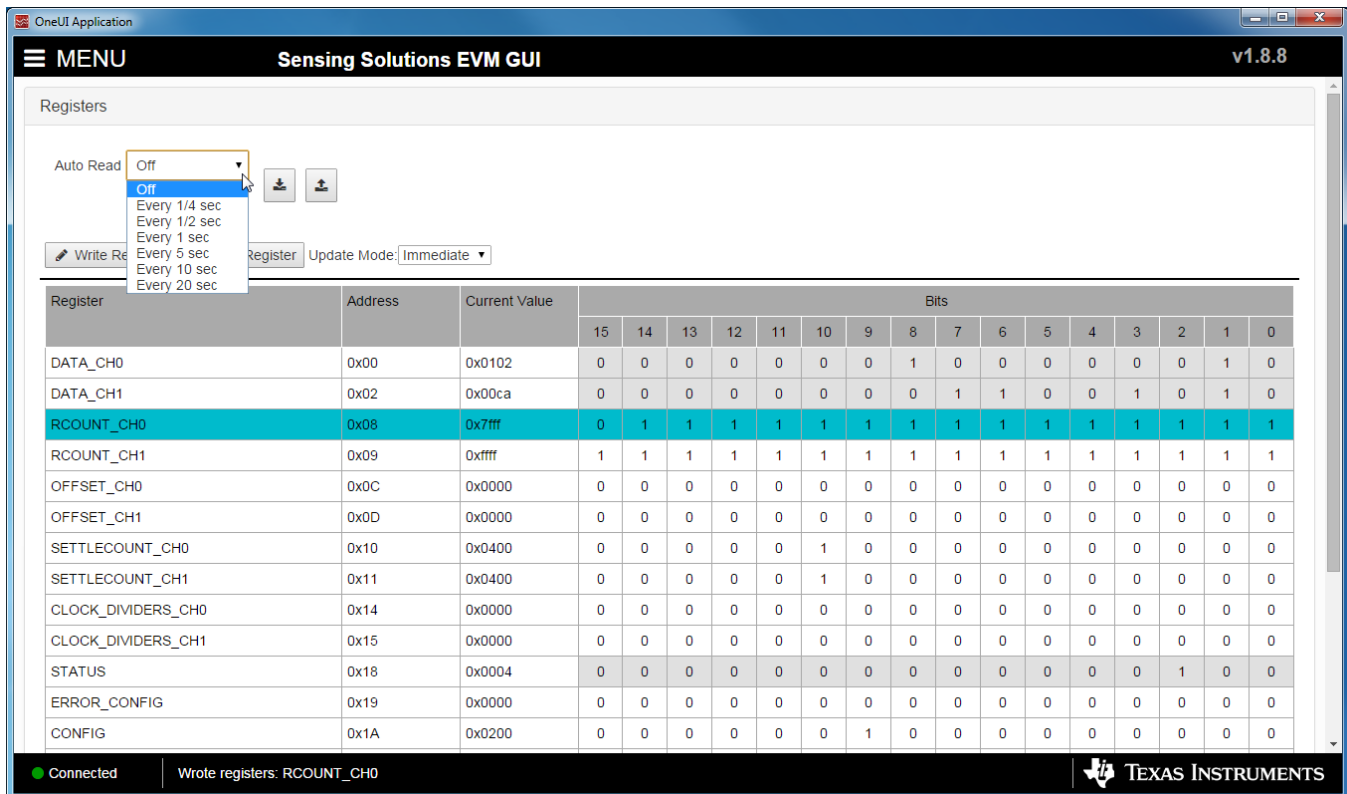
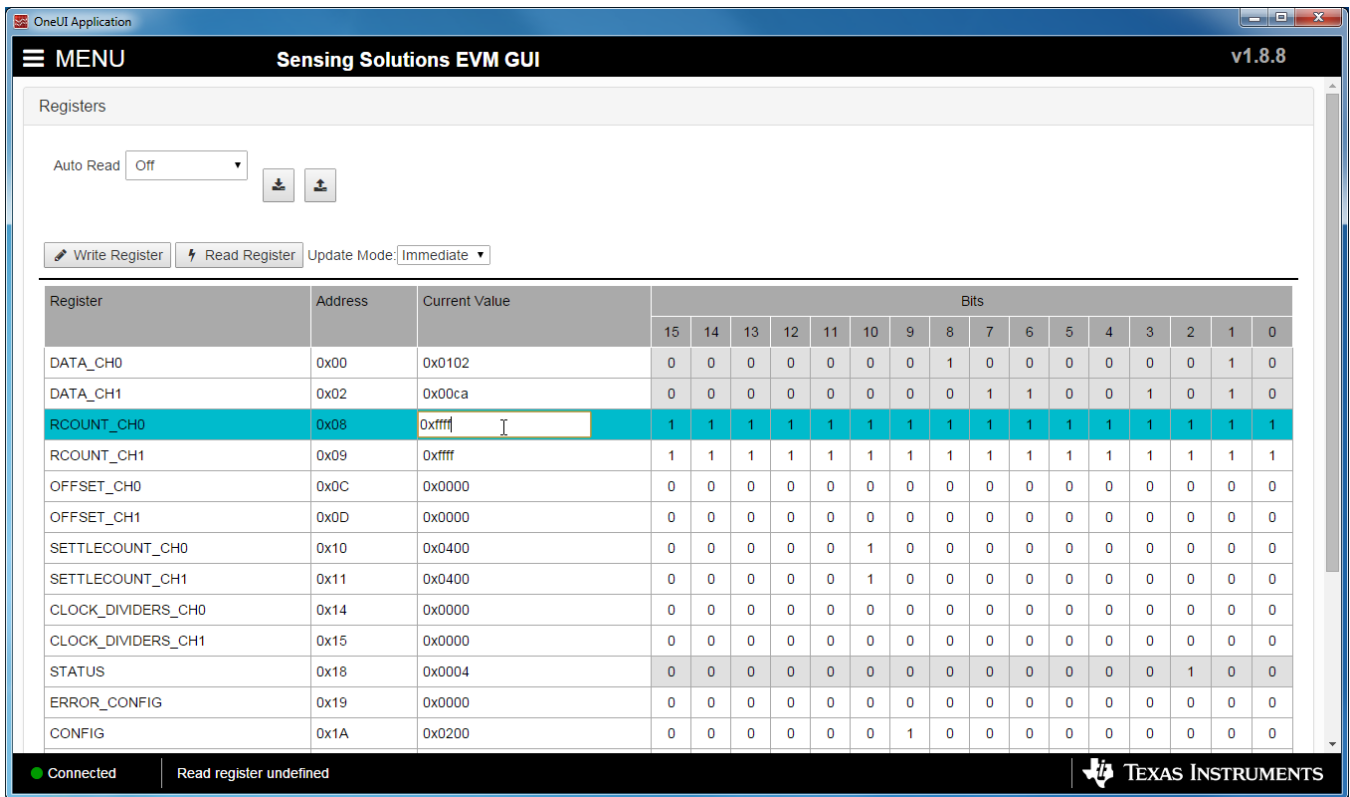


Figure 17. Selecting Auto Read Interval on Register Page

### 2.6.2 Manually Update Device Register Values

There are two methods to change register values: update the entire register value or change a single bit within the register. The recommended update mode is always *Immediate* and not *Deferred*. To update register values, follow these steps.

1. Double-click the current value of the register that needs to be changed. The text will turn into an editable text box.



**Figure 18. Selecting a Register's Current Value for Editing on Register Page**

2. Type the new hexadecimal value into the box and click enter. The text box changes to normal text and the GUI will send a command to the EVM to update the device register.

To change individual bit values rather than entire register values follow these steps.

1. Hover the mouse over the desired bit to change.

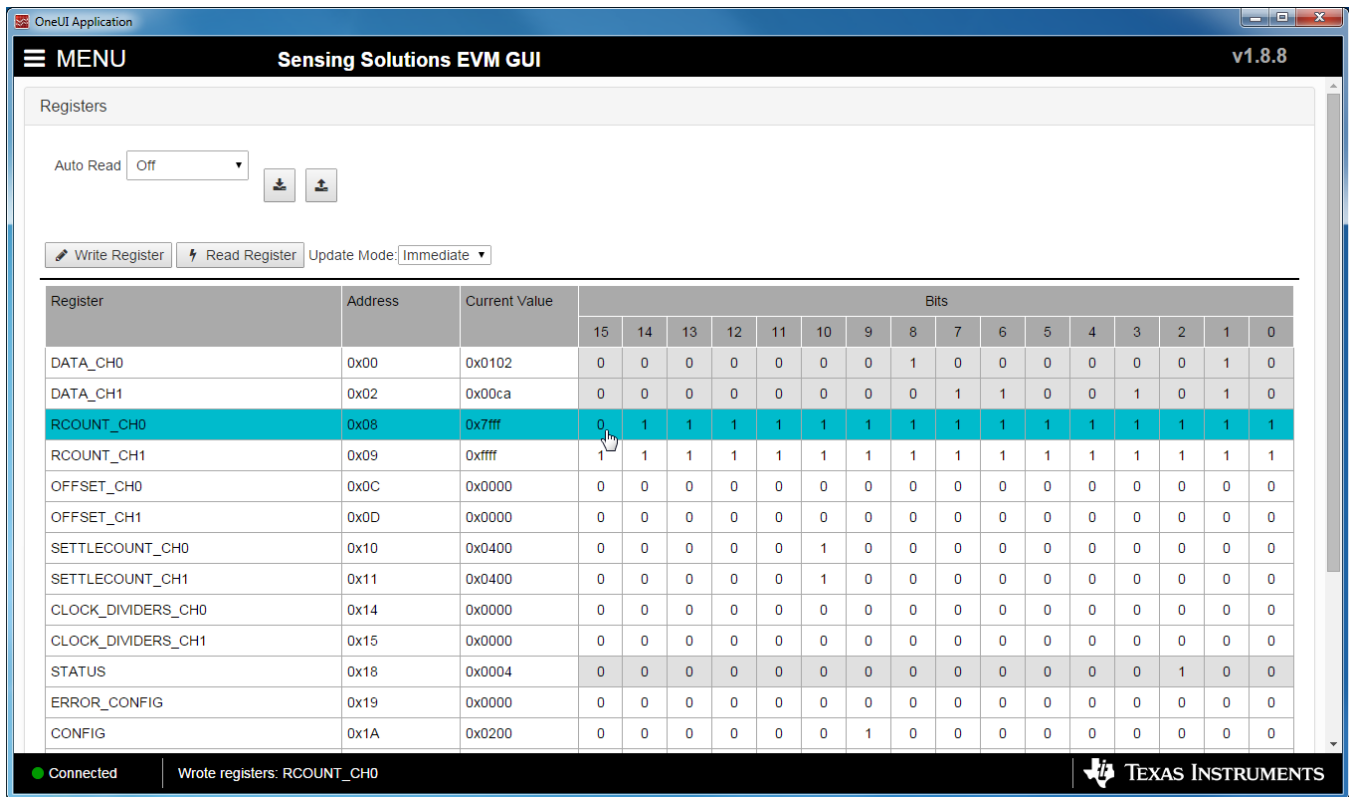


Figure 19. Hovering Mouse Over Register Bit Value on Register Page

2. Double-click the bit to toggle its value and the register's current value will update automatically.

### 2.6.3 Reading Register Values Without Auto Read

To read register values follow these steps.

1. Select the register to update by clicking any column of the register row in the table.

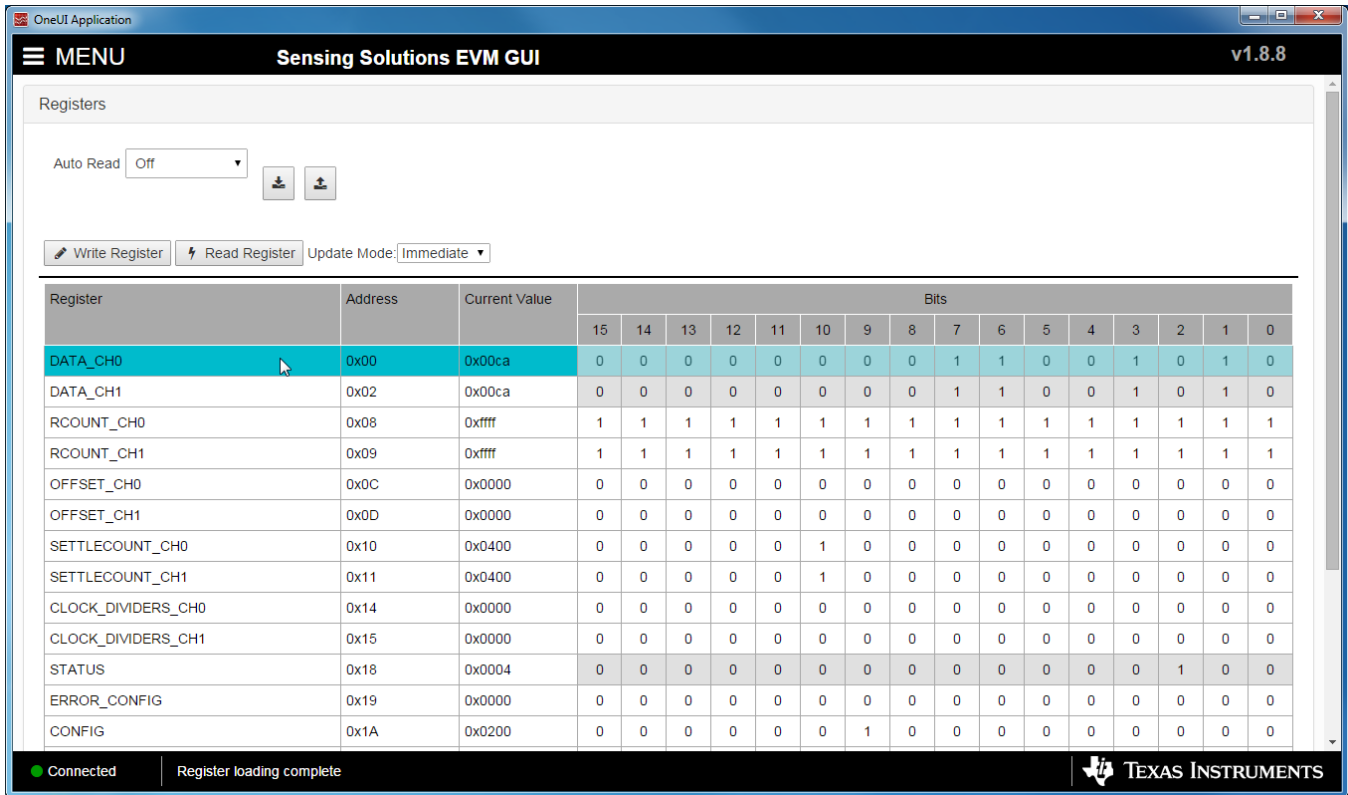


Figure 20. Selecting a Register on Register Page

2. Click the *Read Register* button to update the selected register's current value and bit values in the table.

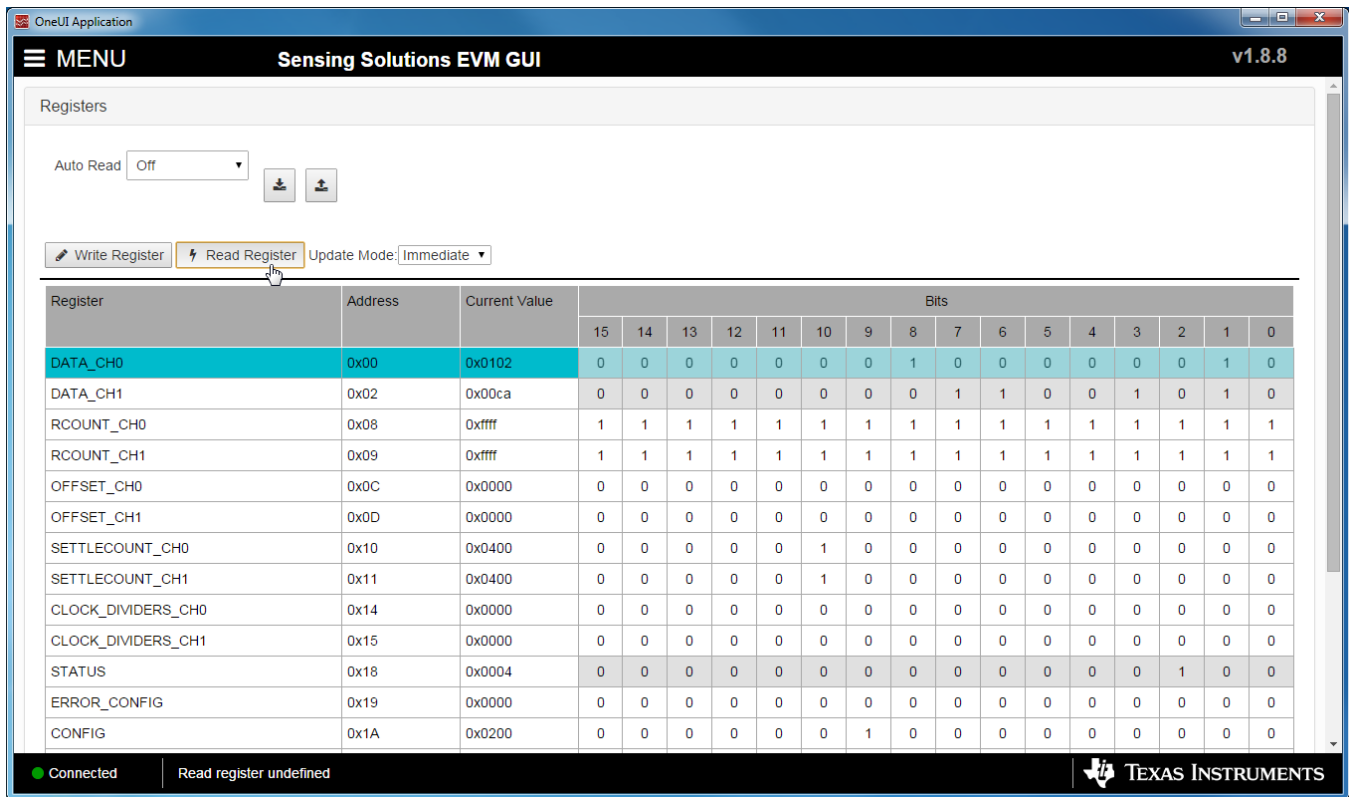


Figure 21. Reading the Current Device Register Value on Register Page

### 2.6.4 Saving Device Configurations

To save the current register settings of the device follow these steps.

1. Click the button immediately right to the *Auto Read* selection drop down.

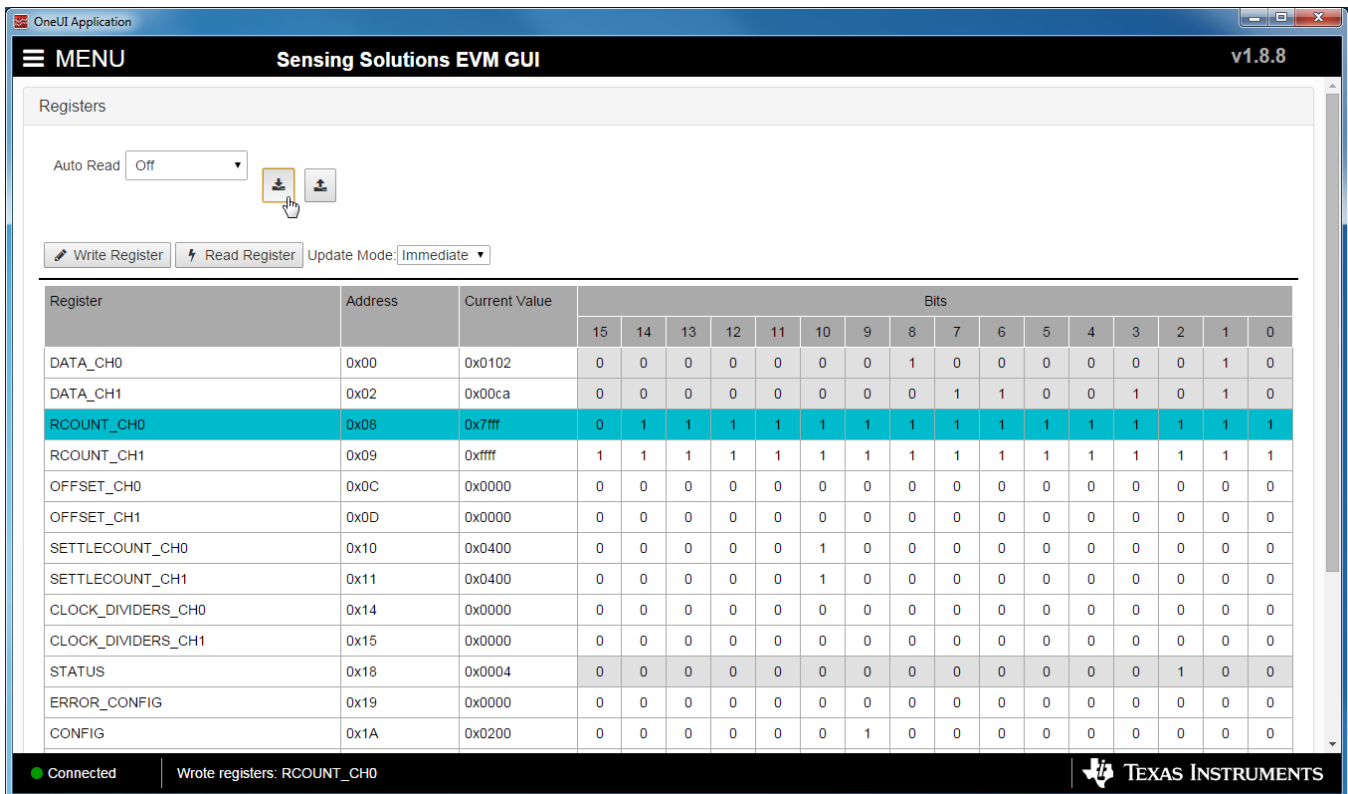


Figure 22. Save Register Values to File on Register Page

2. Choose a name for the JSON file and the directory to save it within. Then click **Save**.

### 2.6.5 Loading Previously Saved Configurations

To load previously saved register settings from a JSON file follow these steps.

1. Click the button furthest right from the *Auto Read* selection drop down.

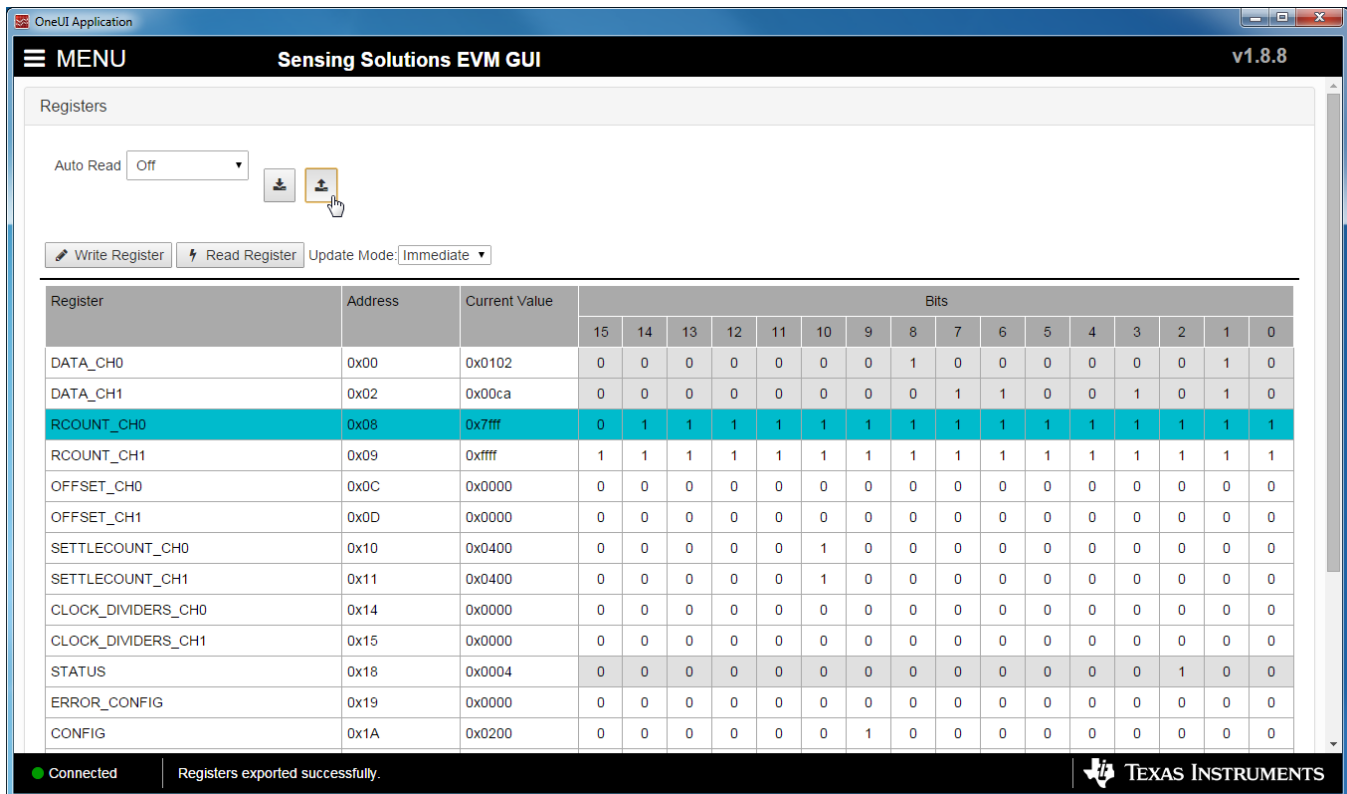


Figure 23. Loading Previously Saved Register Values from File on Register Page

2. Select the JSON file with the desired settings and click *Open*.

## 2.7 Configuring the EVM Using the Configuration Page

The Sensing Solutions GUI is capable on configuring the device more intuitively than the direct register values. The *Configuration* page provides an easy-to-use tool for updating the device configuration and provides additional information about how the device will perform.

### 2.7.1 Enabling and Disabling Channel Measurements

The LDC131x and LDC161x devices take measurements in two different modes: repeated single channel measurement and measuring single channels sequentially. When the device repeatedly measures a single channel any channel can be selected for measurement. To measure a single channel follow these steps.

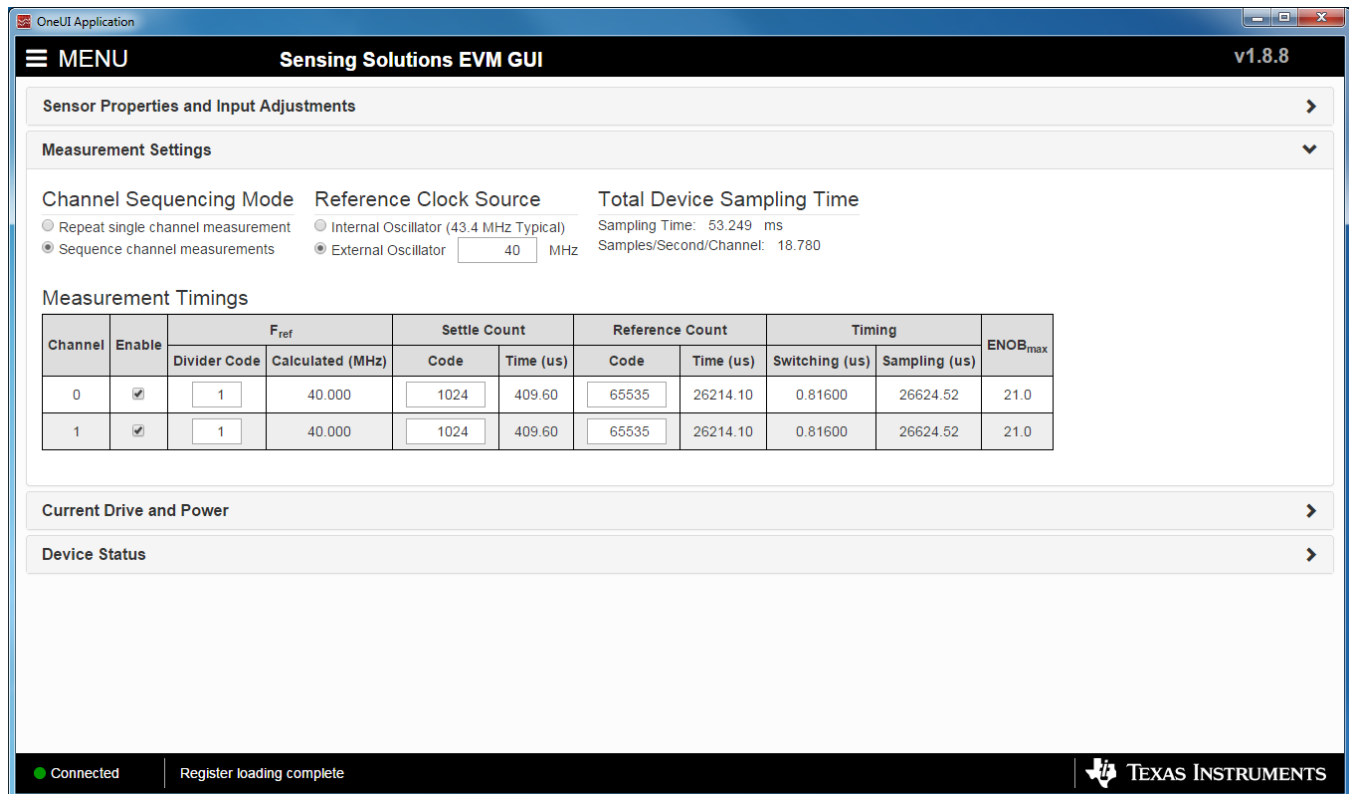
1. Select *Repeat single channel measurement* in the *Measurement Settings*.
2. Choose which channel to measure by clicking the enable check-box of the desired channel (any channel may be selected).

If measuring more than one channel, they are always measured sequentially from channel 0 to the highest selected channel. To measure multiple channels follow these steps.

1. Select *Sequence channel measurements* in the *Measurement Settings*.
2. Choose which channels to measure by clicking the highest channel desired:

Channel 0 and 1 will always be enabled in this mode





The screenshot shows the 'Sensing Solutions EVM GUI' v1.8.8 interface. The 'Measurement Settings' section is expanded, showing the following configuration:

- Channel Sequencing Mode:** Sequence channel measurements (selected)
- Reference Clock Source:** External Oscillator (selected), with a frequency of 40 MHz entered in the adjacent field.
- Total Device Sampling Time:** Sampling Time: 53.249 ms, Samples/Second/Channel: 18.780

The 'Measurement Timings' section contains a table with the following data:

Channel	Enable	F <sub>ref</sub>		Settle Count		Reference Count		Timing		ENOB <sub>max</sub>
		Divider Code	Calculated (MHz)	Code	Time (us)	Code	Time (us)	Switching (us)	Sampling (us)	
0	<input checked="" type="checkbox"/>	1	40.000	1024	409.60	65535	26214.10	0.81600	26624.52	21.0
1	<input checked="" type="checkbox"/>	1	40.000	1024	409.60	65535	26214.10	0.81600	26624.52	21.0

At the bottom of the GUI, there is a status bar showing 'Connected' (green dot) and 'Register loading complete'. The Texas Instruments logo is also present in the bottom right corner.

**Figure 24. Measurement Settings on Configuration Page**

### 2.7.2 Selecting the Clocking Source

While the device contains an internal oscillator which requires fewer components in a system, TI recommends using an external oscillator for precision applications. The EVM includes a 40-MHz oscillator on-board, but an external off-board signal can be used.

To choose the oscillator source select one of the options in the *Reference Clock Source* section of the *Measurement Settings*. If using an external oscillator, enter the oscillation frequency so that the GUI correctly displays data measurements of frequency and capacitance. Note that changing the value of the clock in the GUI is purely for calculations in the GUI, the actually clock frequency on the EVM will not change.

### 2.7.3 Setting the Measurement Timings

Determining the best timing settings for the device is largely dependent on the application and sensor design, but in general the following items should be considered

- Each channel should have the maximum reference frequency possible. Most applications should have the channel Fref dividers set to one.
- Settle count needs to be long enough, but increasing it arbitrary holds no value and only decreases the sampling rate. Reference the datasheet for calculating the optimal settle count.
- Reference count has the largest effect on the accuracy of a measurement. Increasing the reference count leads to a more accurate measurement, but at the cost of decreased sampling rate. The effective number of bits for each channel is calculated in the table for each channel based on the reference count.

### 2.7.4 Using a Different Sensor

When using a different sensor, several parameters could be changed. The sensor's resonant frequency could be vastly different or a different sensor inductor could be used. If the resonant frequency of the sensor is less than 8.75 MHz the  $F_{in}$  select should be set to one. If the sensor frequency is greater than 8.75 MHz,  $F_{in}$  select should be two. The sensor filter inductor for each channel should be updated to reflect to actual component value on the sensor.

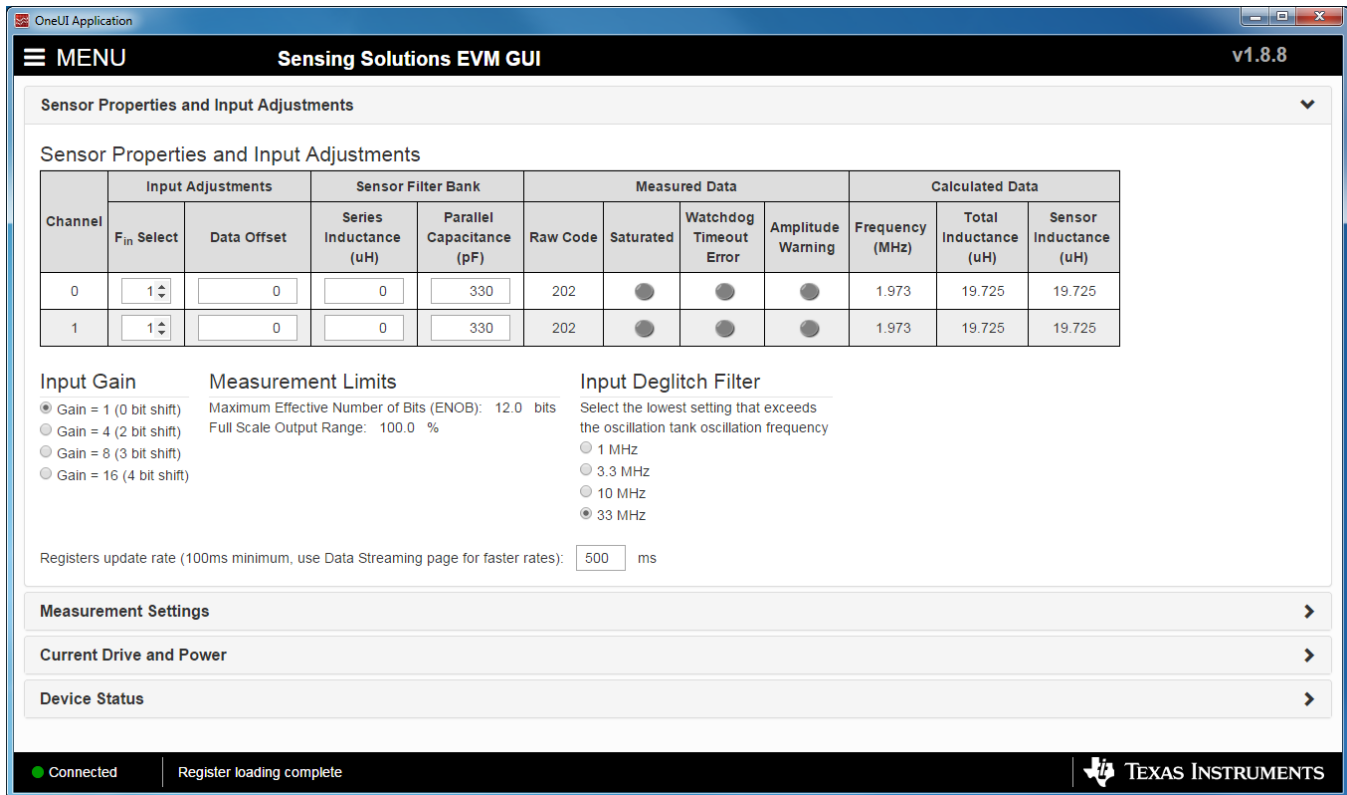


Figure 25. Sensor Properties and Input Adjustments on Configuration Page

While the LDC161x doesn't support any gain or offset adjustments, the LDC131x device has a limited measurement resolution and so a gain or offset may need to be set. The code offset may be set in the *Sensor Properties and Input Adjustments* table and the input gain is globally set for all channels. Please reference the device datasheet for more information to correctly set these values. The [Inductive sensing: Improve the ENOB of a multichannel LDC by 4 bits in 3 simple steps](#) blog post also provides valuable information.

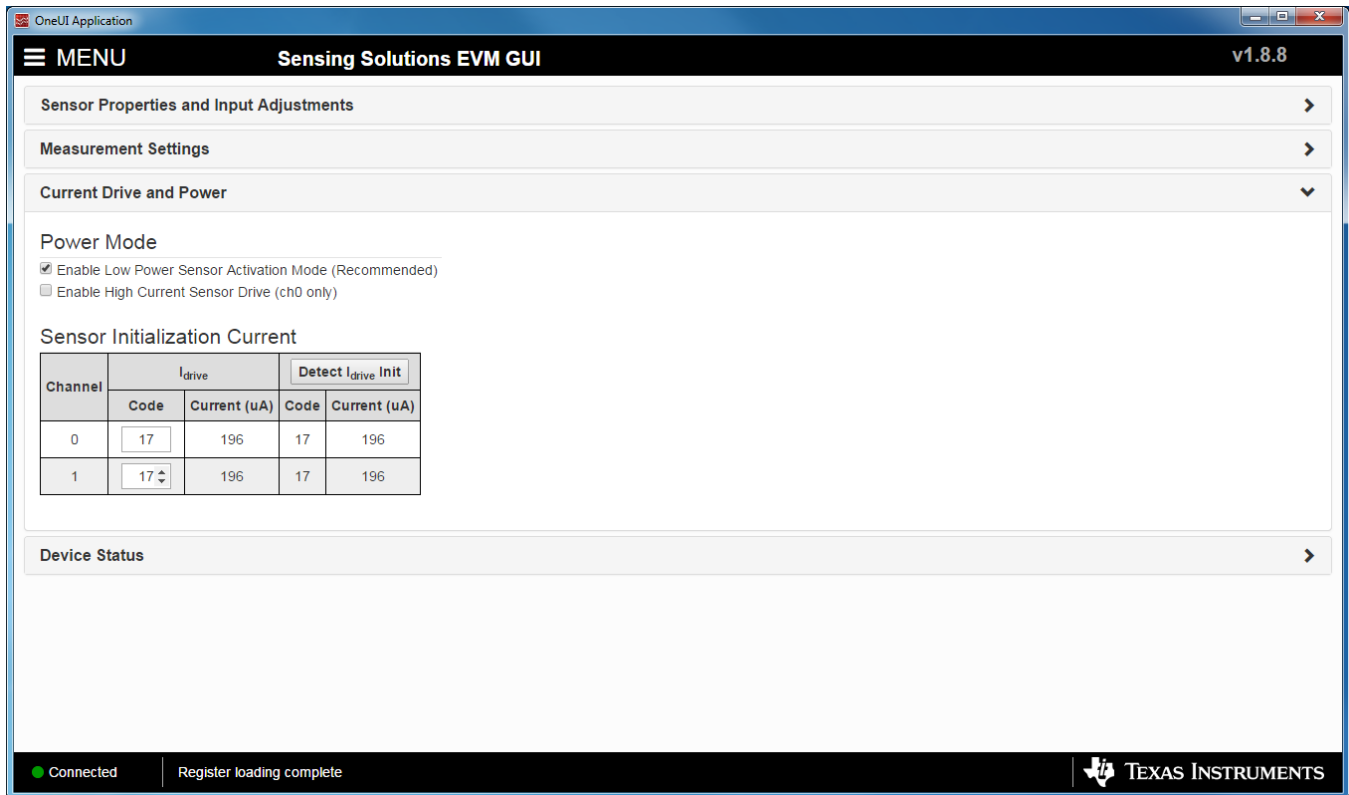
### 2.7.5 Setting the Input Deglitch Filter

The input deglitch filter suppresses EMI and ringing above the sensor frequency. It does not impact the conversion result as long as its bandwidth is configured to be above the maximum sensor frequency. After the sensor frequency is determined, select the lowest setting which exceeds the sensor frequency.

### 2.7.6 Setting the Power Mode and Sensor Initialization Currents

Most applications do not need maximum channel initialization currents and the low power sensor activation mode should be enabled. When low power sensor activation mode is enabled, the IDRIVE code determines how much current the device supplies to the sensor. To determine the optimal current drive setting, move the system target to its furthest distance from the sensor and click the *Detect iDriveInit with Auto-Amplitude Correction* button. This will take a measurement to determine an appropriate current setting. After the setting has been measured, the code value of  $I_{drive}$  must be adjusted.

If the low power sensor activation mode is disabled, the  $I_{drive}$  settings are ignored. If only measuring channel 0 and the sensor requires maximum drive current, enable the high current sensor drive.



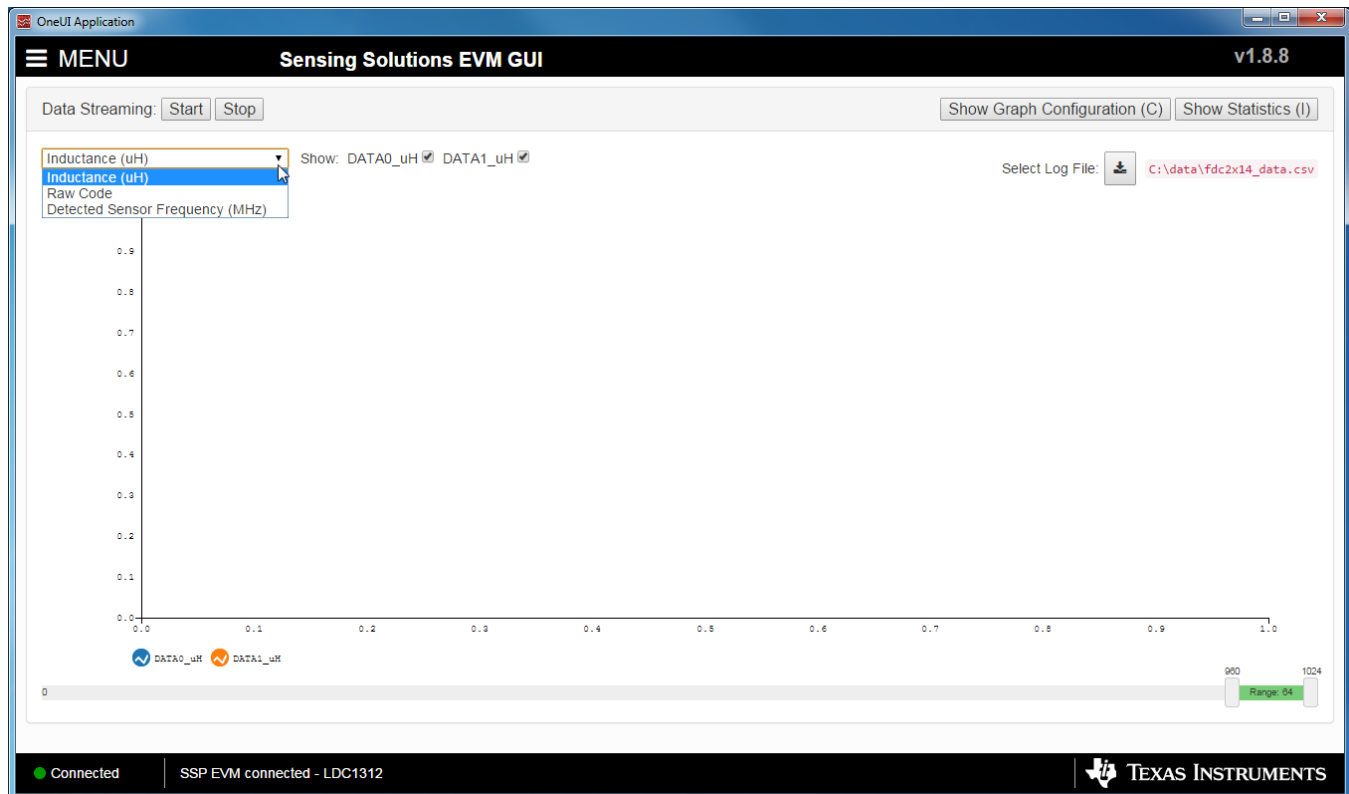
**Figure 26. Current Drive on Configuration Page**

## 2.8 Streaming Measurement Data

The Sensing Solutions GUI and EVM provide a tool to capture, display, and log measurement data. The section describes how to use the data measurement tools from the *Data Streaming* page accessible from the GUI menu.

### 2.8.1 Choosing the Graph and Visible Channels

Select the drop down menu on top of the y-axis to choose the graph to display.



**Figure 27. Select the Data Graph on Data Streaming Page**

To select which channel measurements are displayed in the graph, check or uncheck the available channels shown next to the graph units. Selecting or not selecting the channels only affects the graph and not the data logged to a file. If a channel is not enabled in the Configuration page it will not appear on the Data Streaming page.

### 2.8.2 Logging Data to a File

Follow these steps to log measurement data to a file.

1. Click the button in the upper right under next to *Click to Select Log File*.



**Figure 28. Select Log File Button on Data Streaming Page**

2. Select a file name and directory to save the data to and then click the *Save* button.
3. Whenever data streaming is running the data for all channels will be logged to this file. The selected file is shown next to the button.

### 2.8.3 Starting and Stopping Data Streaming

To start data streaming click the *Start* button.



Figure 29. Start Button on Data Streaming Page

To stop data streaming click the *Stop* button.

### 2.8.4 Data Statistics

Click the *Show Statistics* button to view the measurement statistics.



Figure 30. Show Statistics Button on Data Streaming Page

Click the *Hide Statistics* button to hide the measurement statistics.

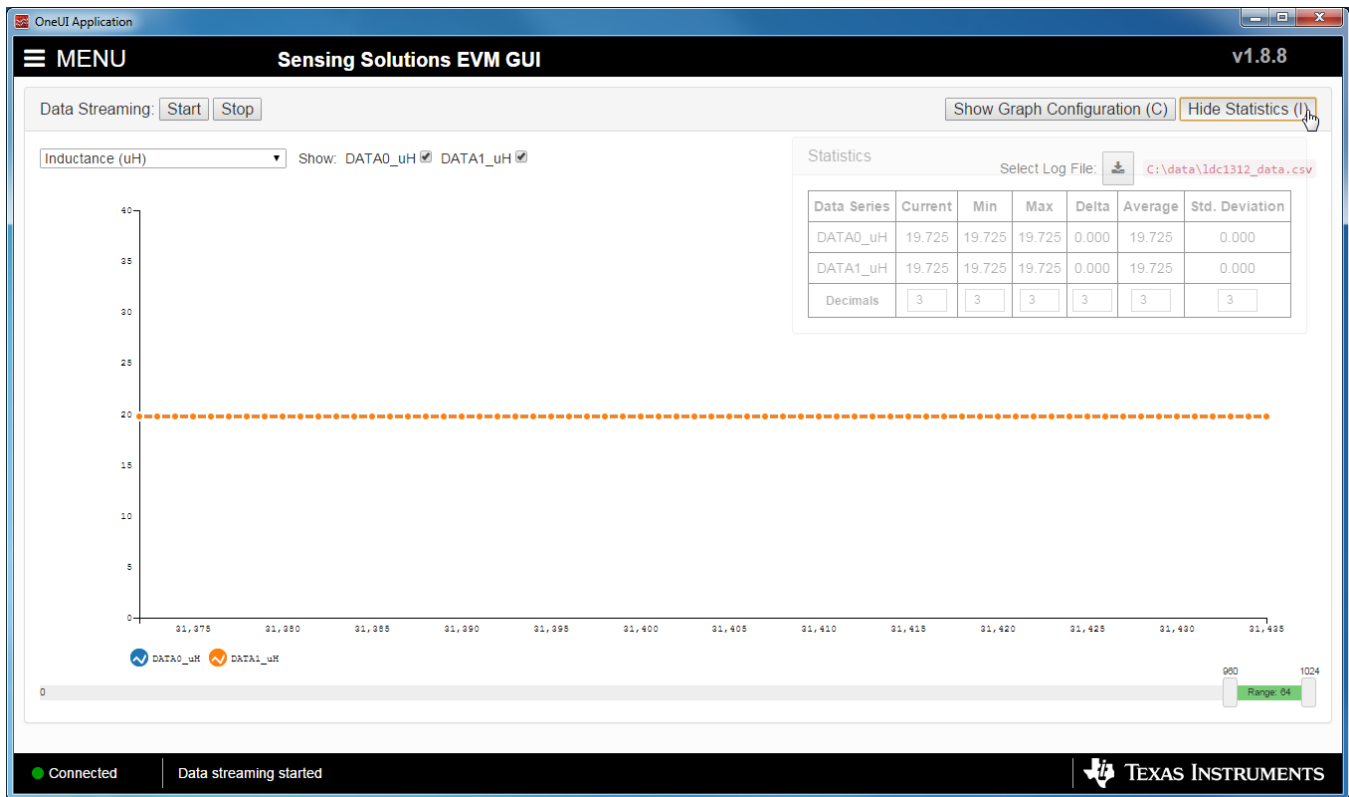


Figure 31. Hide Statistics Button on Data Streaming Page

### 2.8.5 Configuring the Graph

To configure the graph, click the *Show Graph Configuration* button.



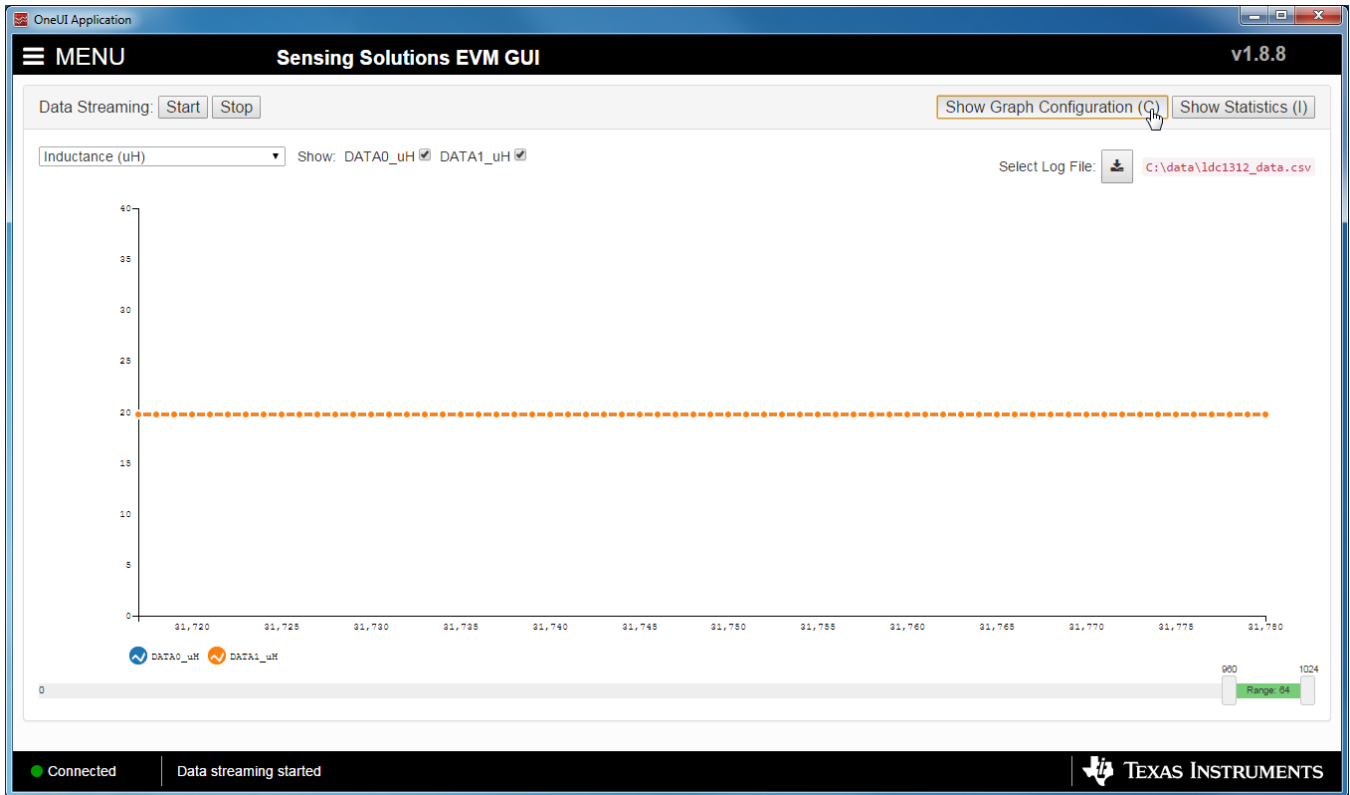


Figure 32. Show Graph Configuration Button on Data Streaming Page

### Graph Configuration

**Display Frame Rate**  
16.0 ms = 62.5 Hz

**New Data Sample Rate**

EVM Output Rate (Infinity ms = 0.0 Hz)  
 Add sample to graph every  ms

**Vertical Scaling**  
*Vertical Left Axis (Y1)*

Minimum:   
 Maximum:   
 Autoscale

**Sample Counts**

Display:  ≈ 0.000 s  
 Buffer:  ≈ 0.000 s

**Figure 33. Graph Configuration Button on Data Streaming Page**

The configuration window displays the actual frame rate of the graph, the rate at which data is added to the graph, the vertical scaling, and the sample buffer size. The display rate is the rate at which the graph updates on the computer display and is not configurable. It is automatically optimized by the GUI.

The *New Data Sample Rate* allows the user to choose when new data is added to the graph. Selecting *EVM Output Rate* will display data on the graph as fast as is available from the EVM. This should not be confused with the actual sampling rate of the device on the EVM which could be different. The *Add sample to graph every ... ms* will add a new sample to the graph at the specified rate.

The *Vertical Scaling* allows the user to either manually set the minimum and maximum values of the y-axis on the graph or use auto-scaling. The *Autoscale & Lock* button scales the graph based on the data of the current display and then locks those vertical scaling settings.

The *Sample Counts* allows the user to specify the number of samples displayed on the graph and the total number of samples stored in the buffer. Please note the buffer size does not affect data logging to a file.

To hide the configuration window, click the *Hide Graph Configuration* button.

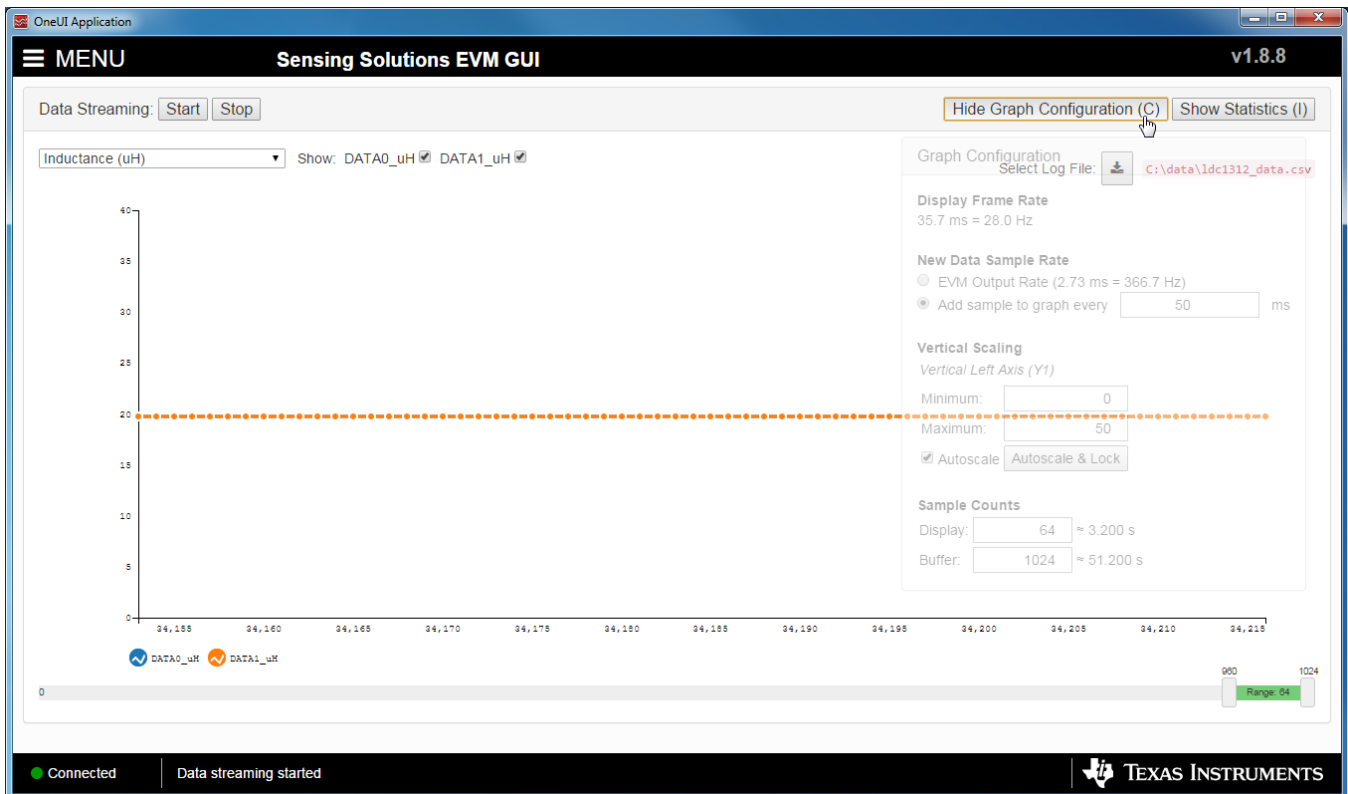
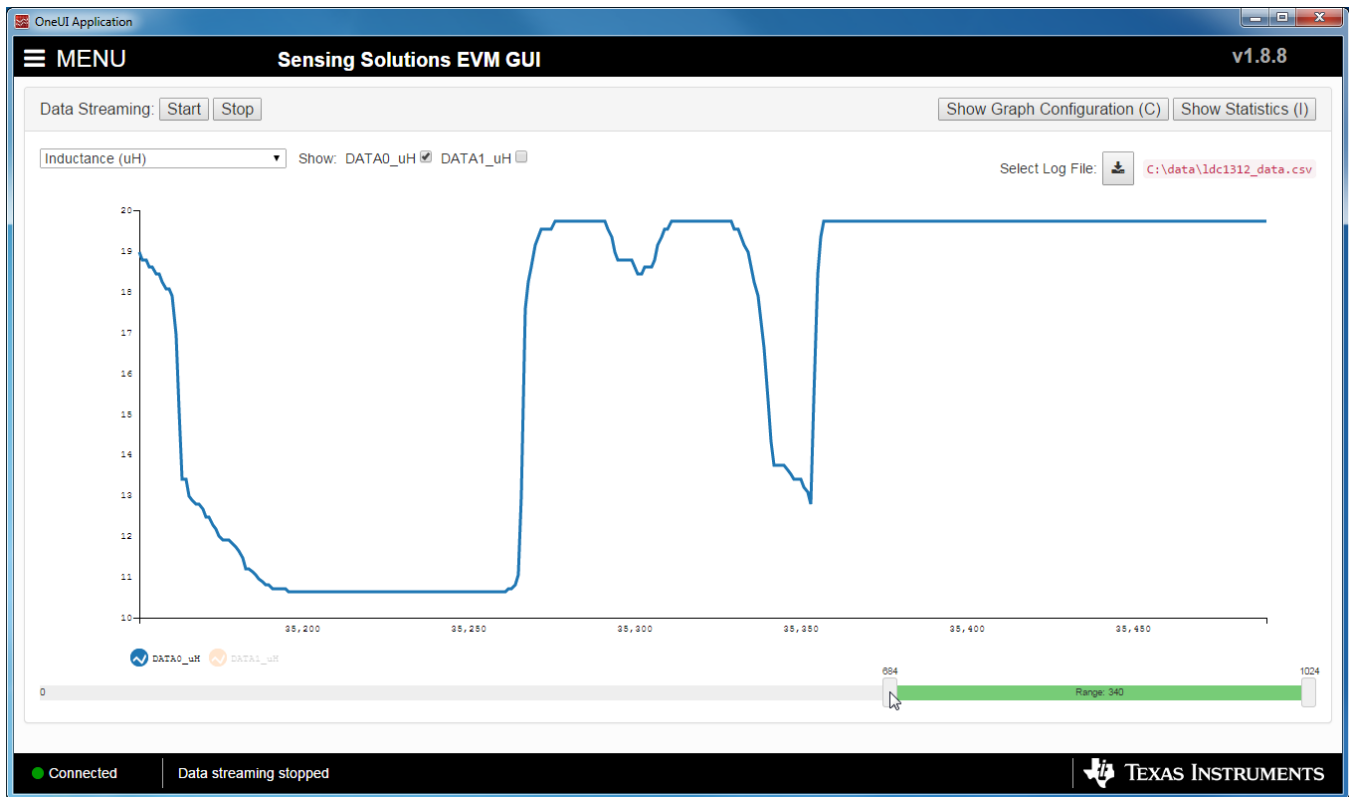


Figure 34. Hide Graph Configuration Button on Data Streaming Page

### 2.8.6 Navigating the Data Streaming Buffer

The Sensing Solutions EVM GUI stores a buffer of data samples and then displays a subset of those samples. The data buffer can be navigated using the horizontal slider below the graph. To show more samples on the graph, click either the slider on the left or right side of the green bar and drag it closer or further from the other slider. The number of samples displayed is shown between the left and right sliders in the green bar.



**Figure 35. Changing Number of Samples Displayed in Data Graph**

By clicking on the green bar and dragging the mouse left or right, previous samples in the buffer can be displayed.

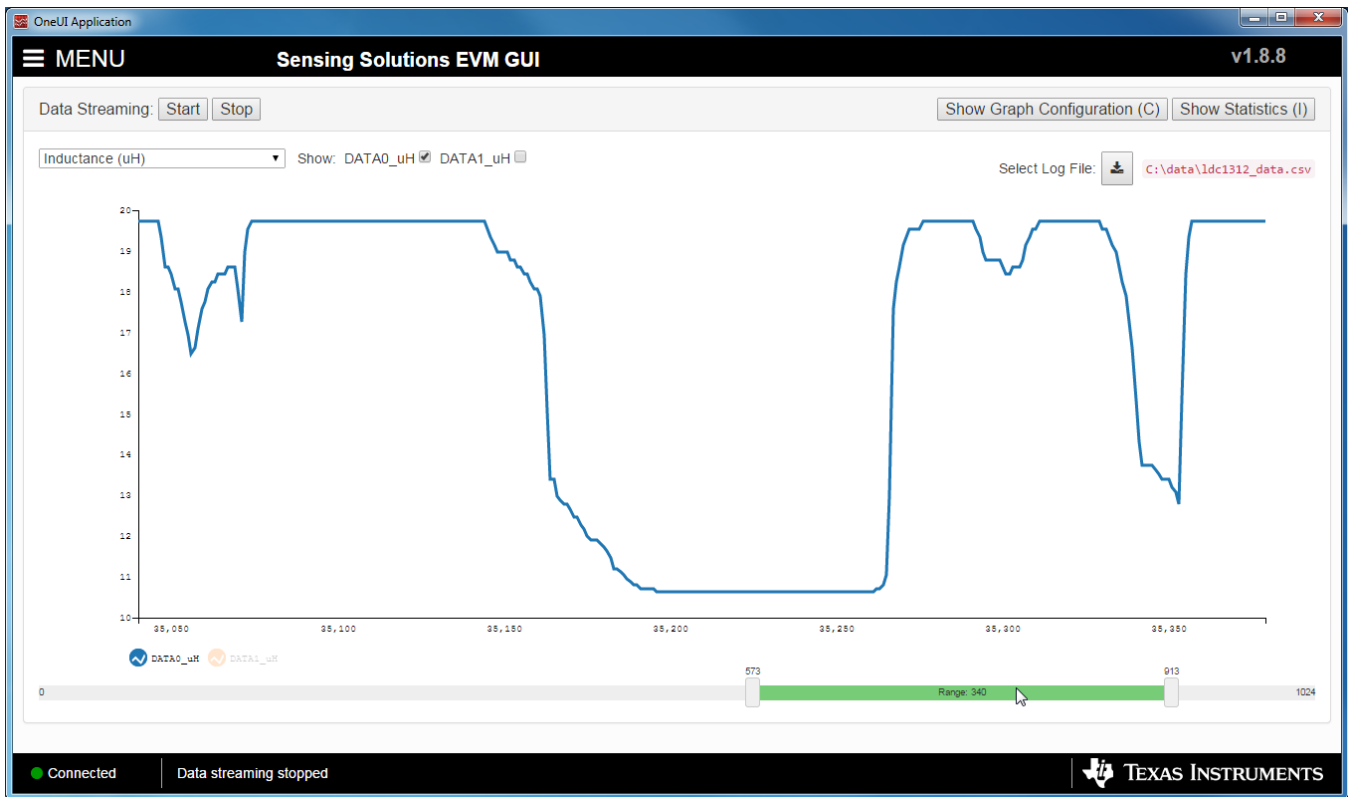
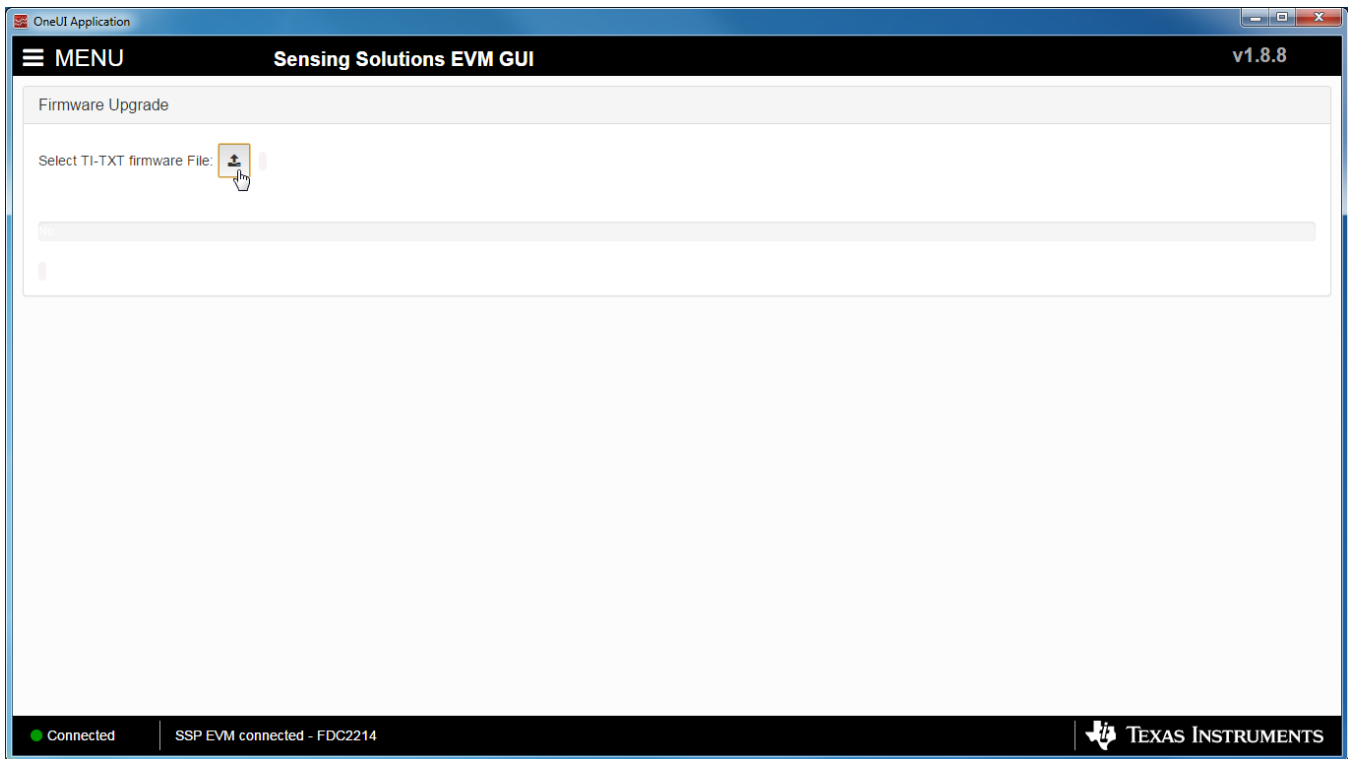


Figure 36. Displaying Previous Data Samples on the Data Streaming Page

## 2.9 Updating the EVM Firmware

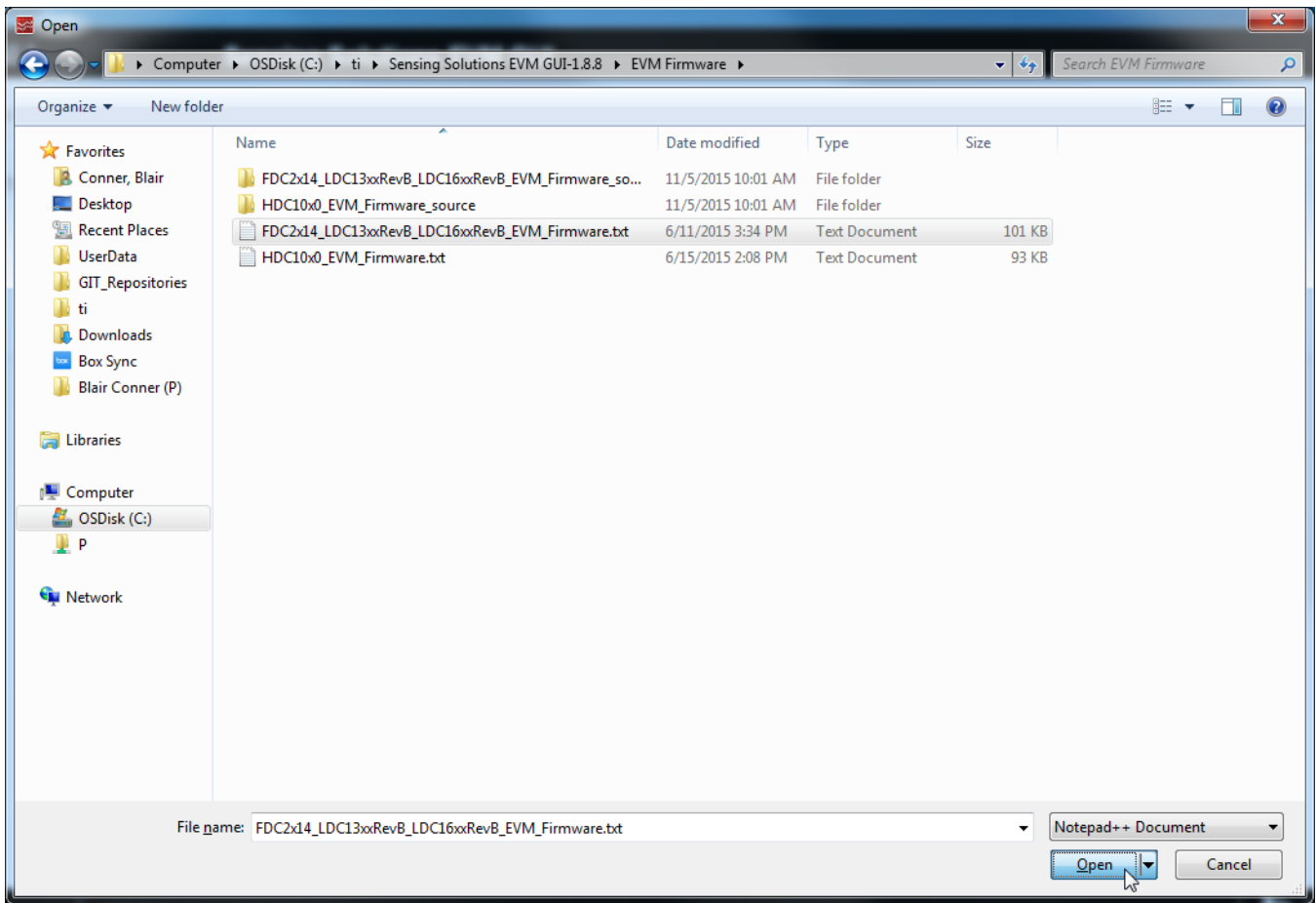
To upload new firmware to the EVM, navigate to the *Firmware* page from the GUI menu and follow these steps. The images below show uploading the FDC2214 EVM firmware, but the steps are identical for any LDC, FDC, or HDC EVM when using their respective firmware files.

1. Click the button to select a TI-TXT firmware file.



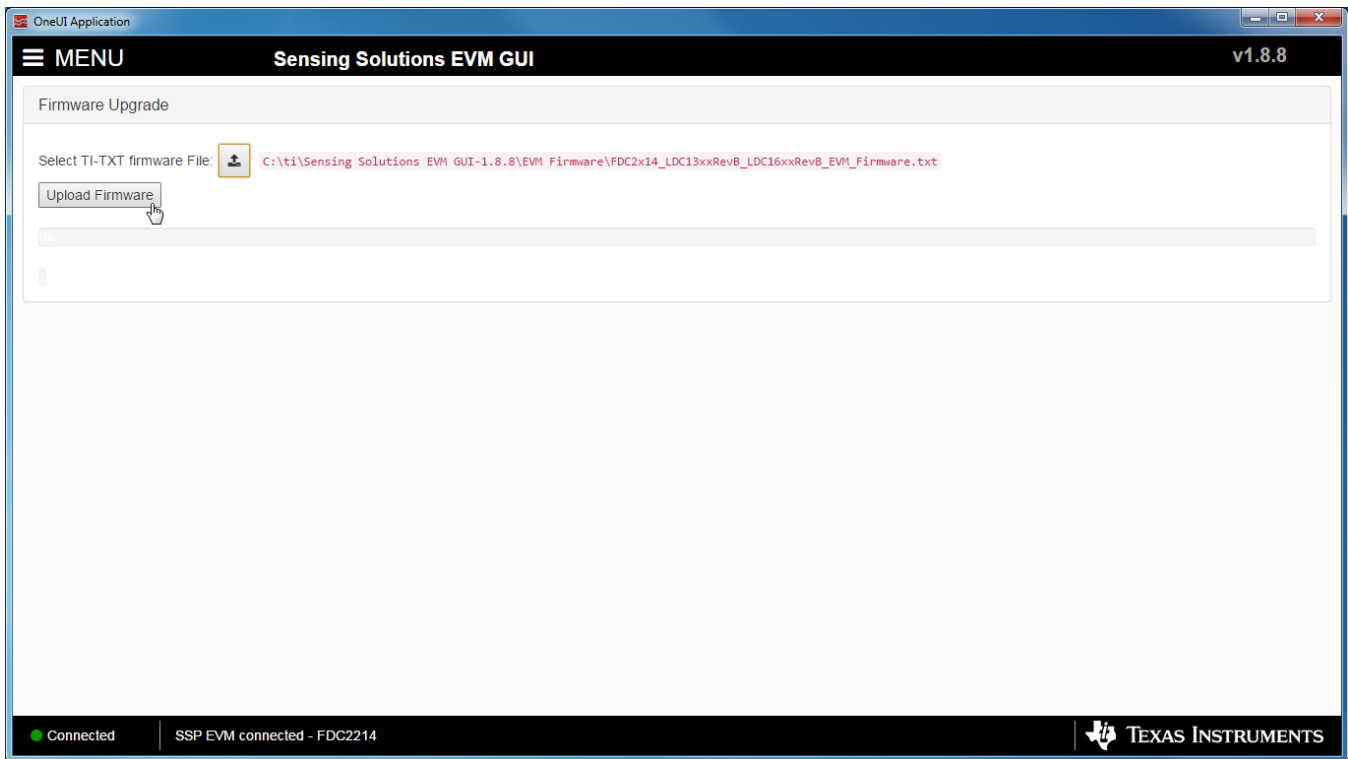
**Figure 37. Select TI-TXT File Button on Firmware Upload Page**

2. Select the firmware file and click *Open*.



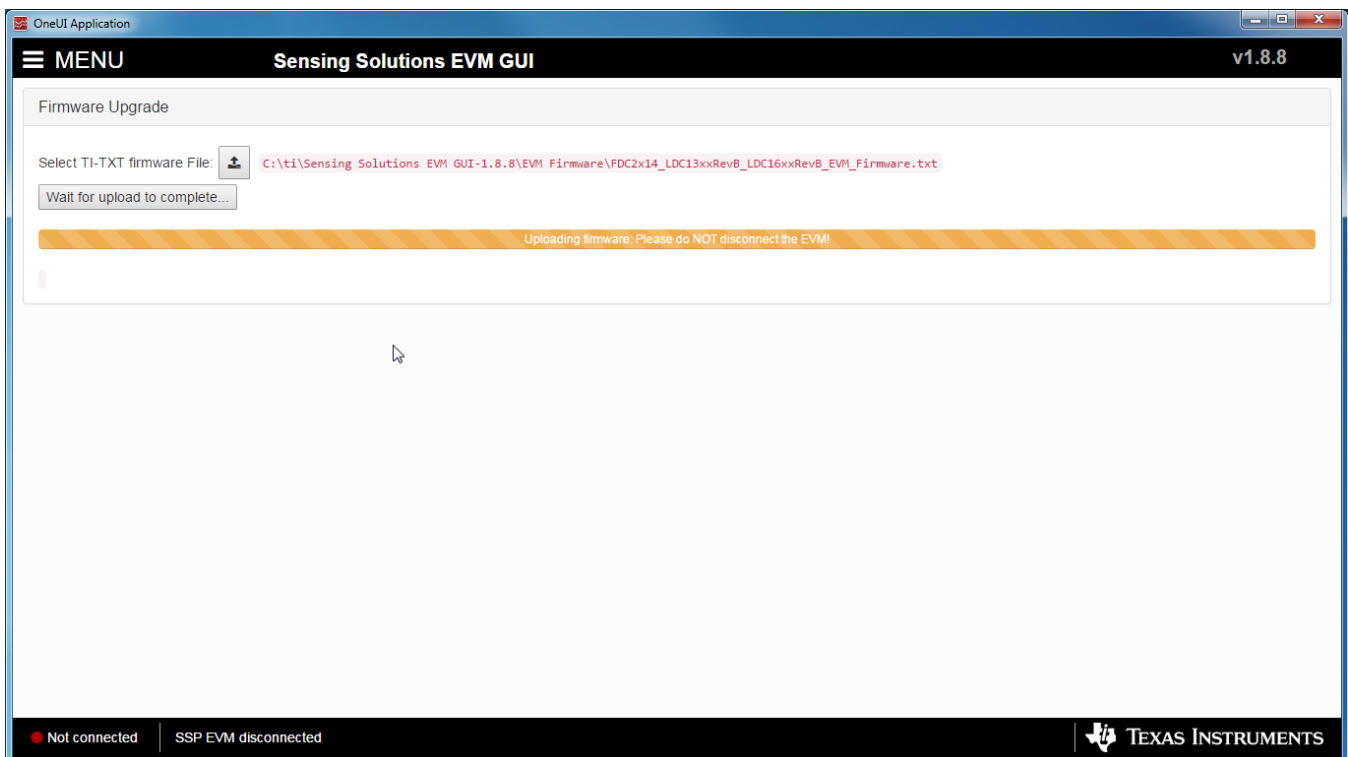
**Figure 38. Selecting TI-TXT Firmware File for Upload to EVM**

3. Click the *Upload Firmware* button.



**Figure 39. Upload Firmware Button on Firmware Upload Page**

4. Wait for the firmware to upload. Do NOT disconnect the EVM from the PC at this time! Also note that the GUI will disconnect from the EVM. The upload process should not take more than one minute. If the upload fails or lasts longer than one minute, unplug the EVM and restart the GUI.



**Figure 40. Firmware Upload in Progress**



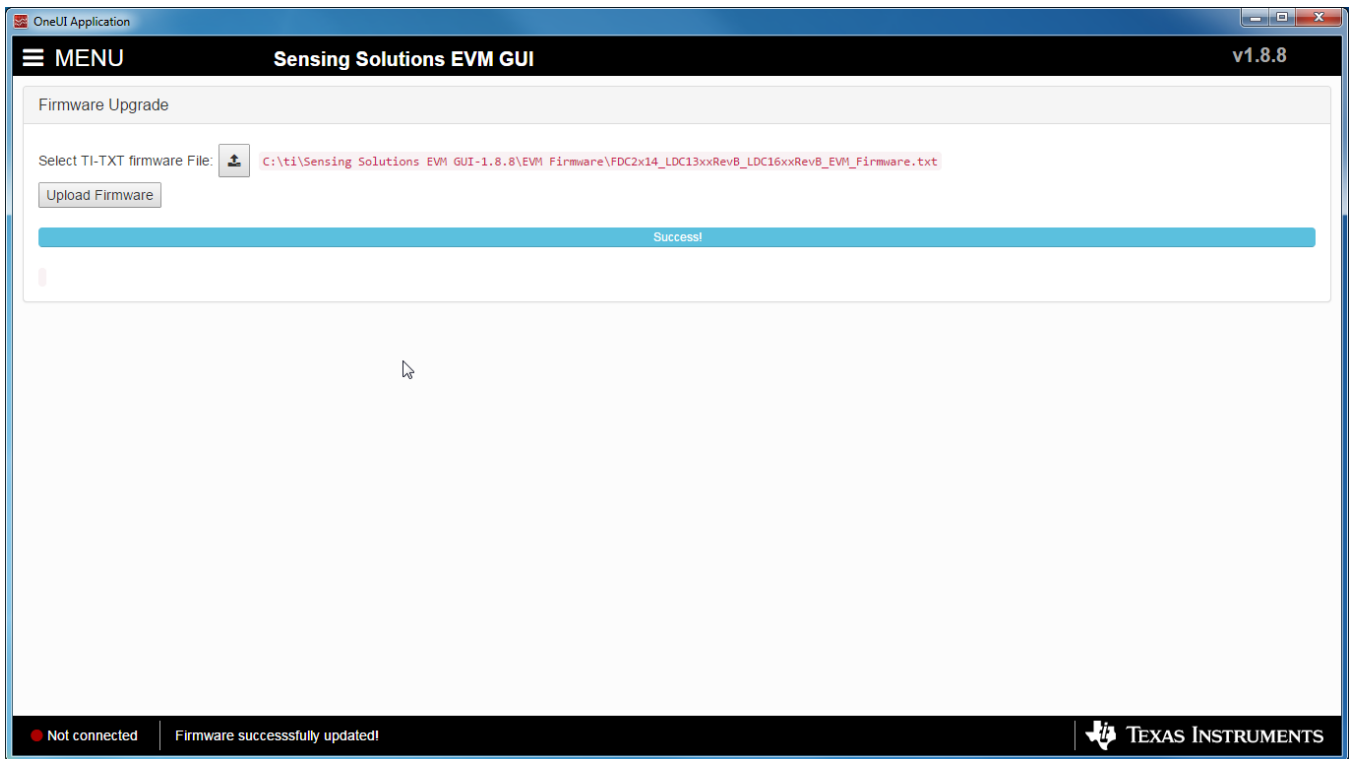


Figure 41. Firmware Upload Success

### 3 LDC1312/1612 EVM REV B Schematics and Layout

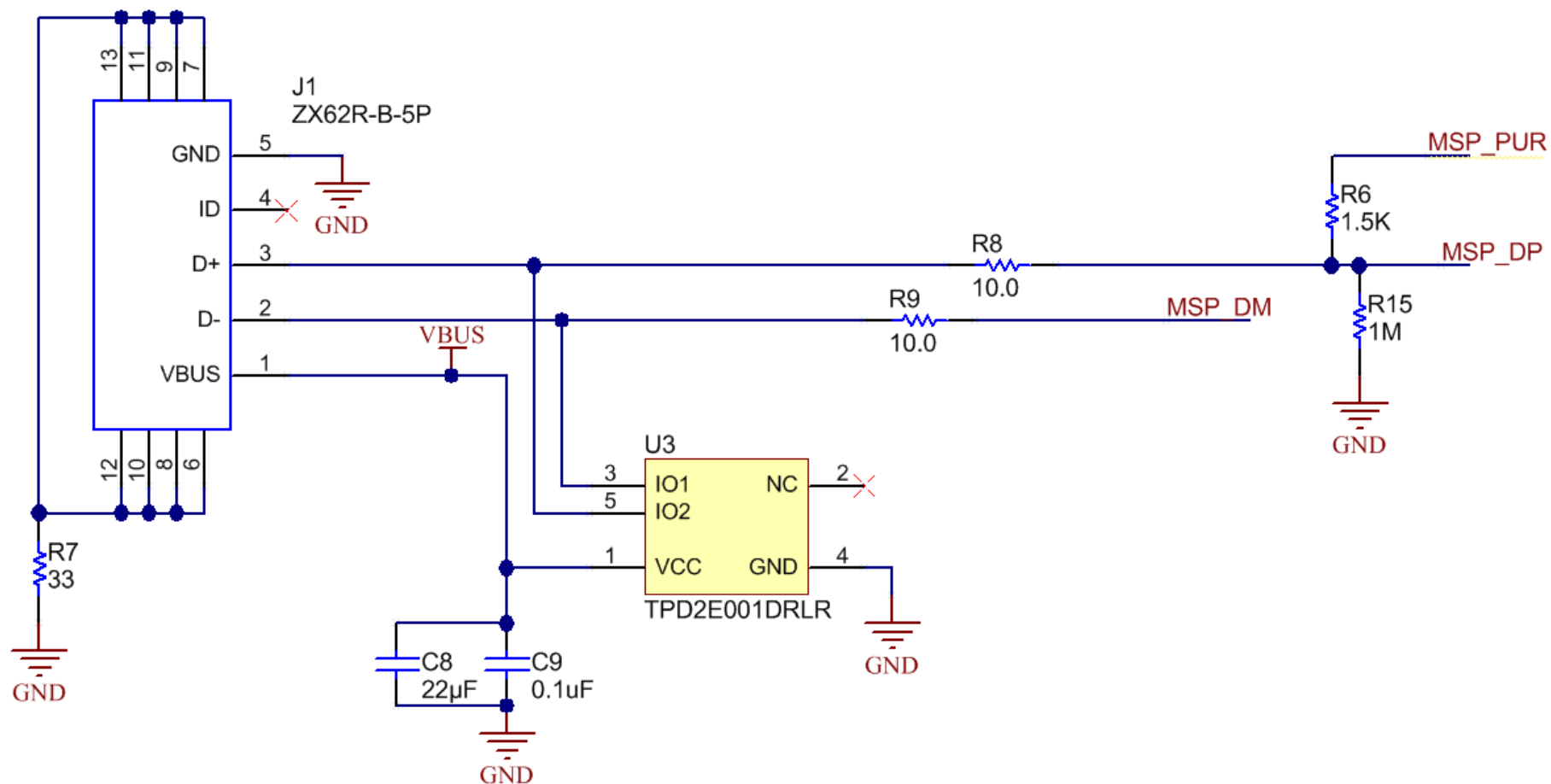


Figure 42. LDC1312/1612 USB Connection

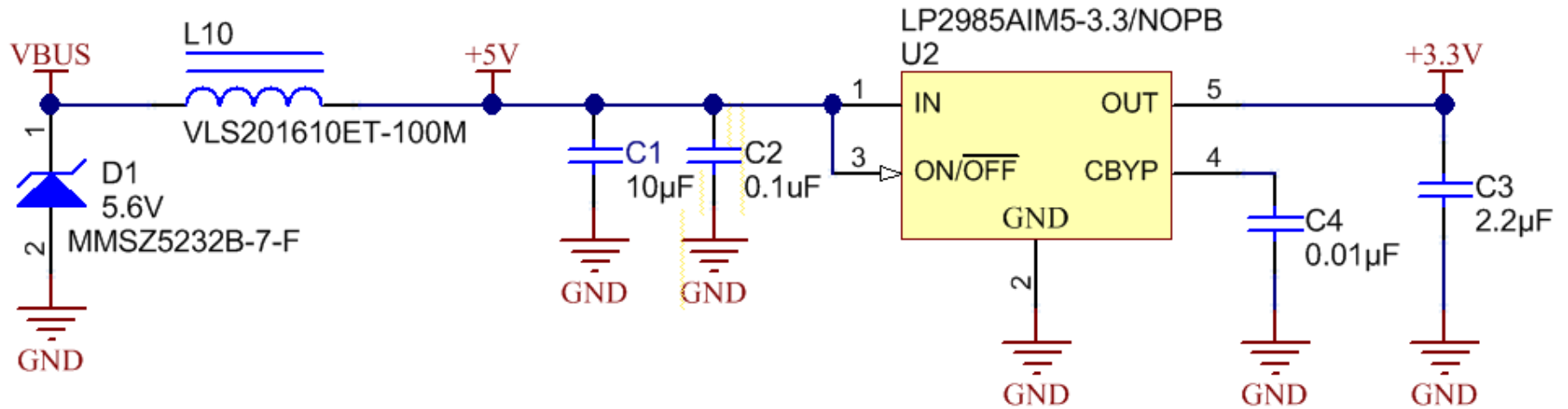
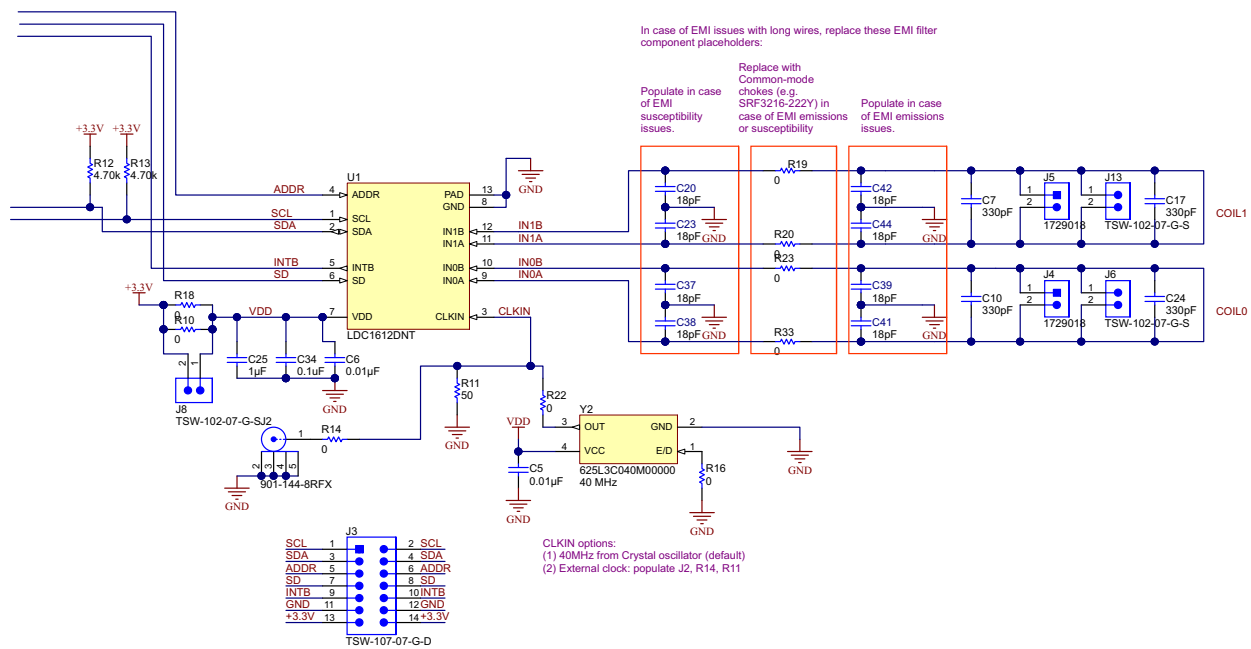


Figure 43. LDC1312/1612 Power Circuit



Copyright © 2016, Texas Instruments Incorporated

Figure 44. LDC1312/1612

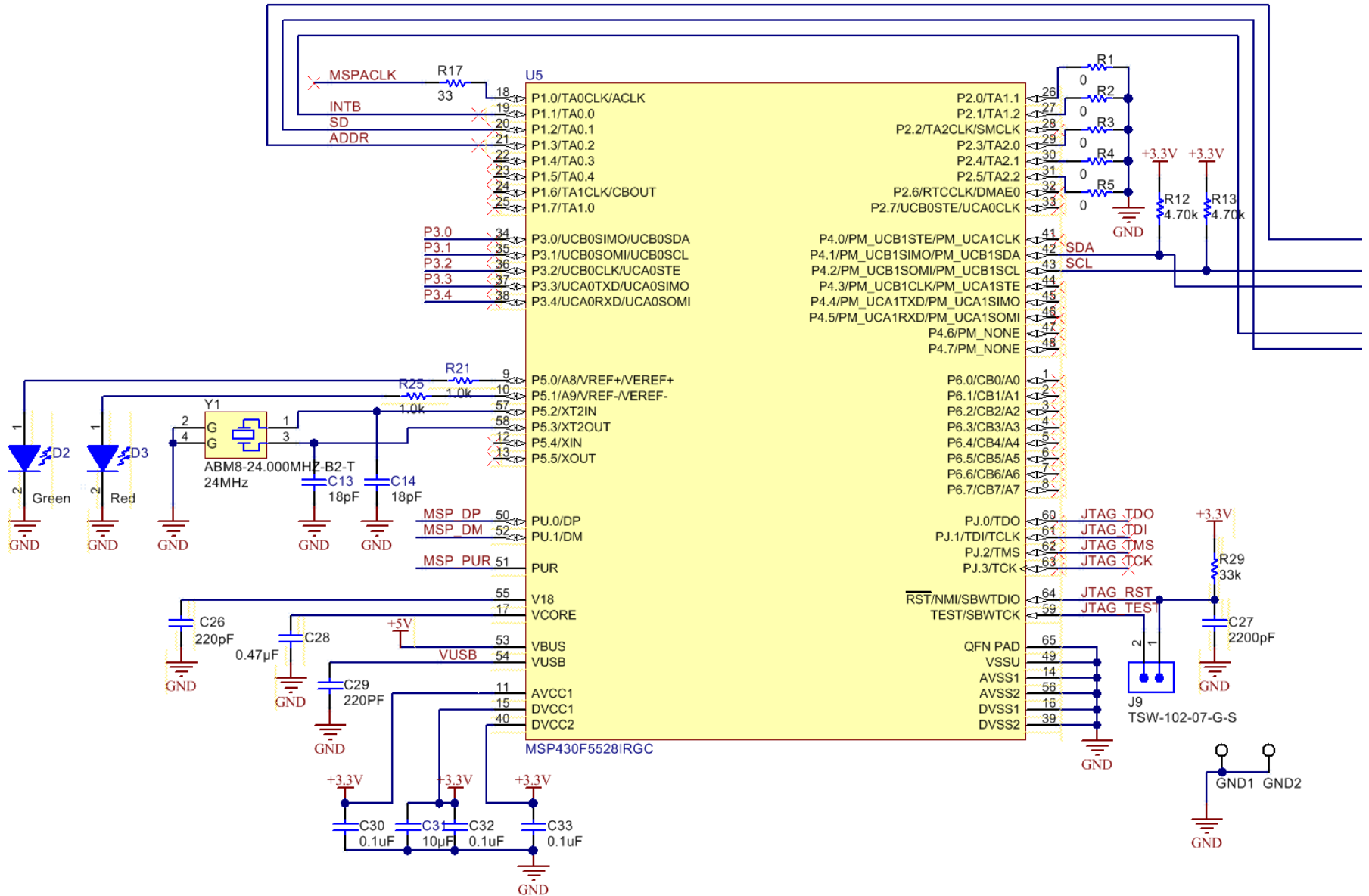


Figure 45. LDC1312/1612 MSP430 Connections

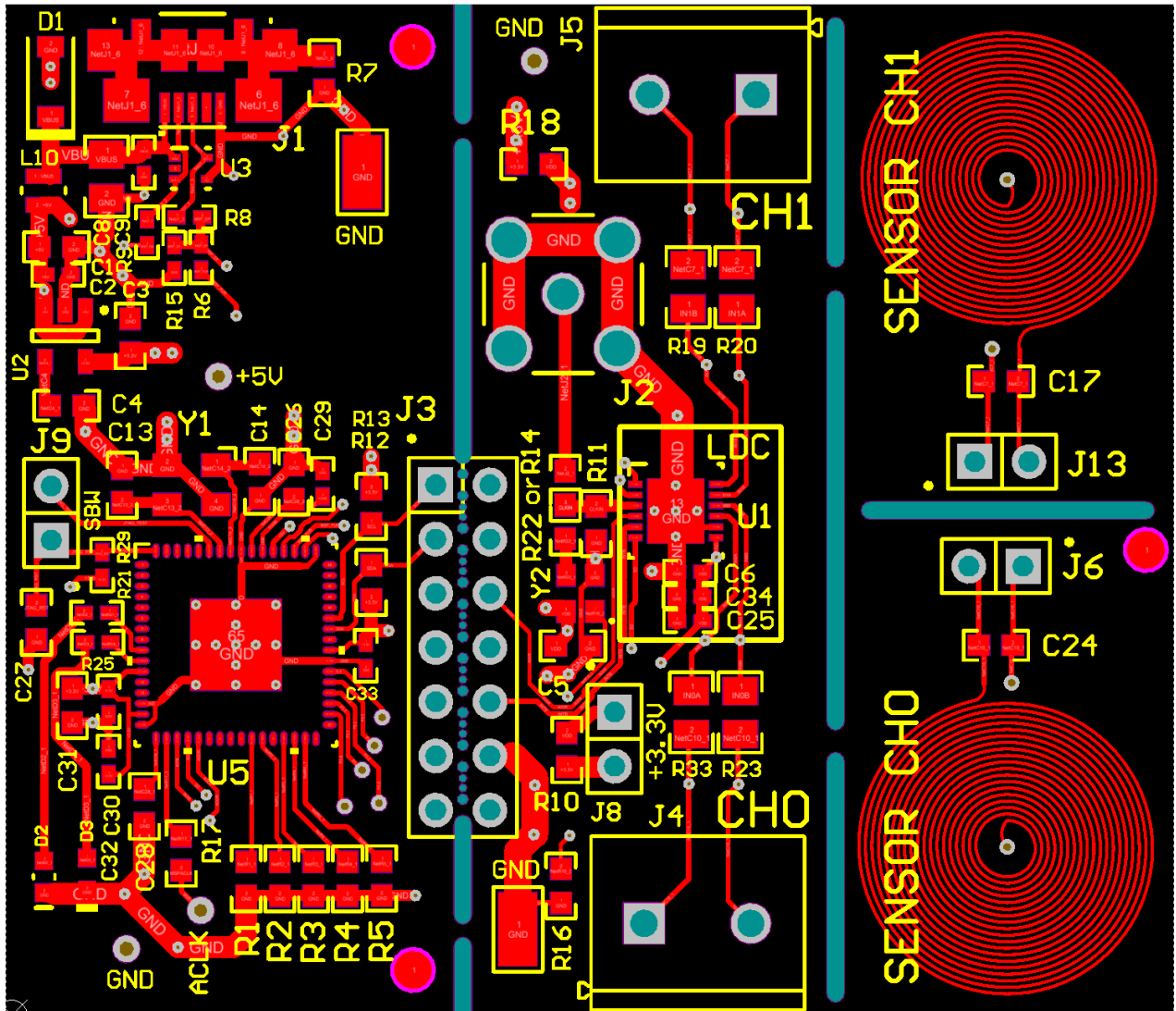


Figure 46. LDC1312/1612 Layout Top Layer – Signals and Components

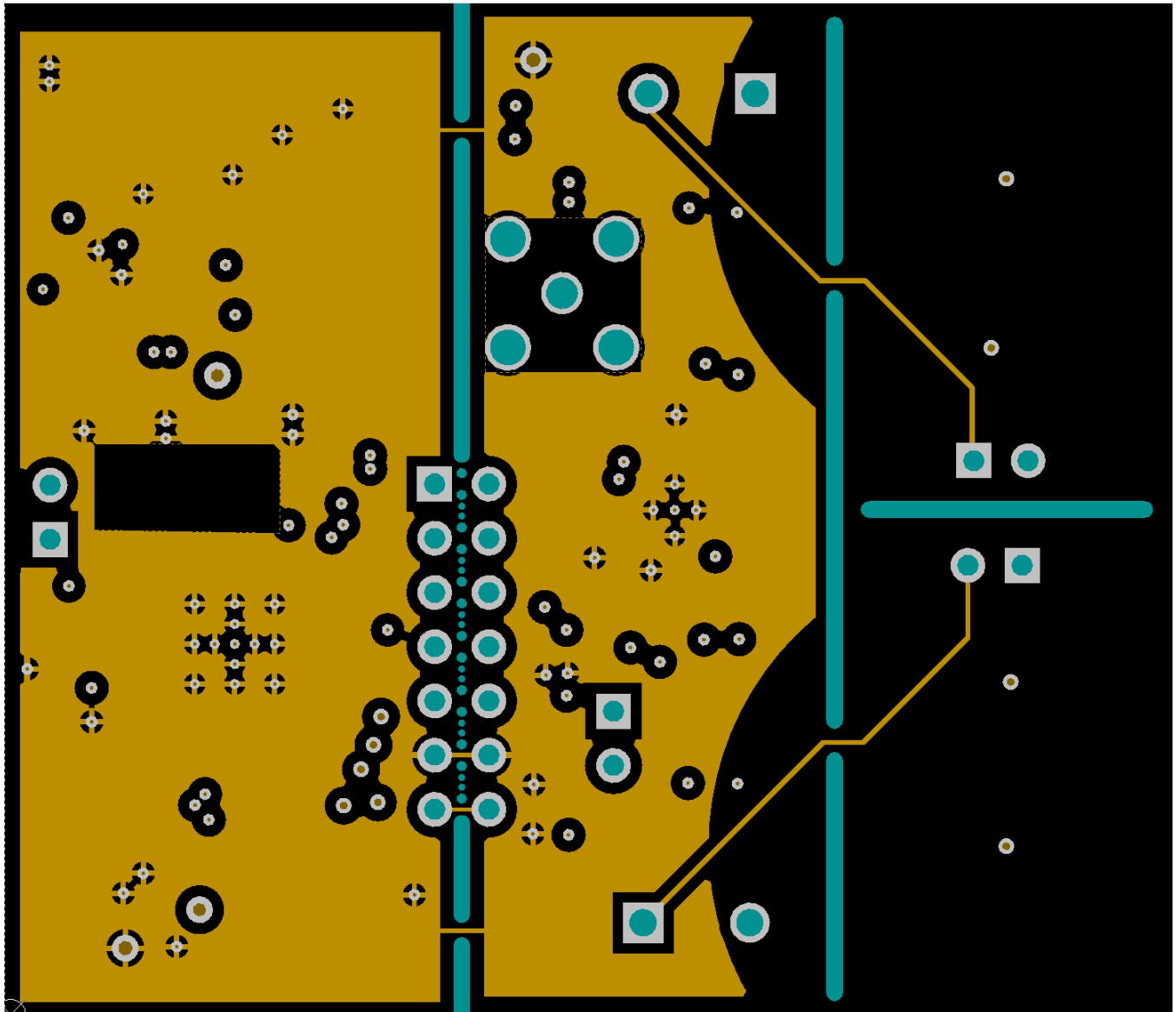


Figure 47. LDC1312/1612 Layout MidLayer 1 – Ground Plane

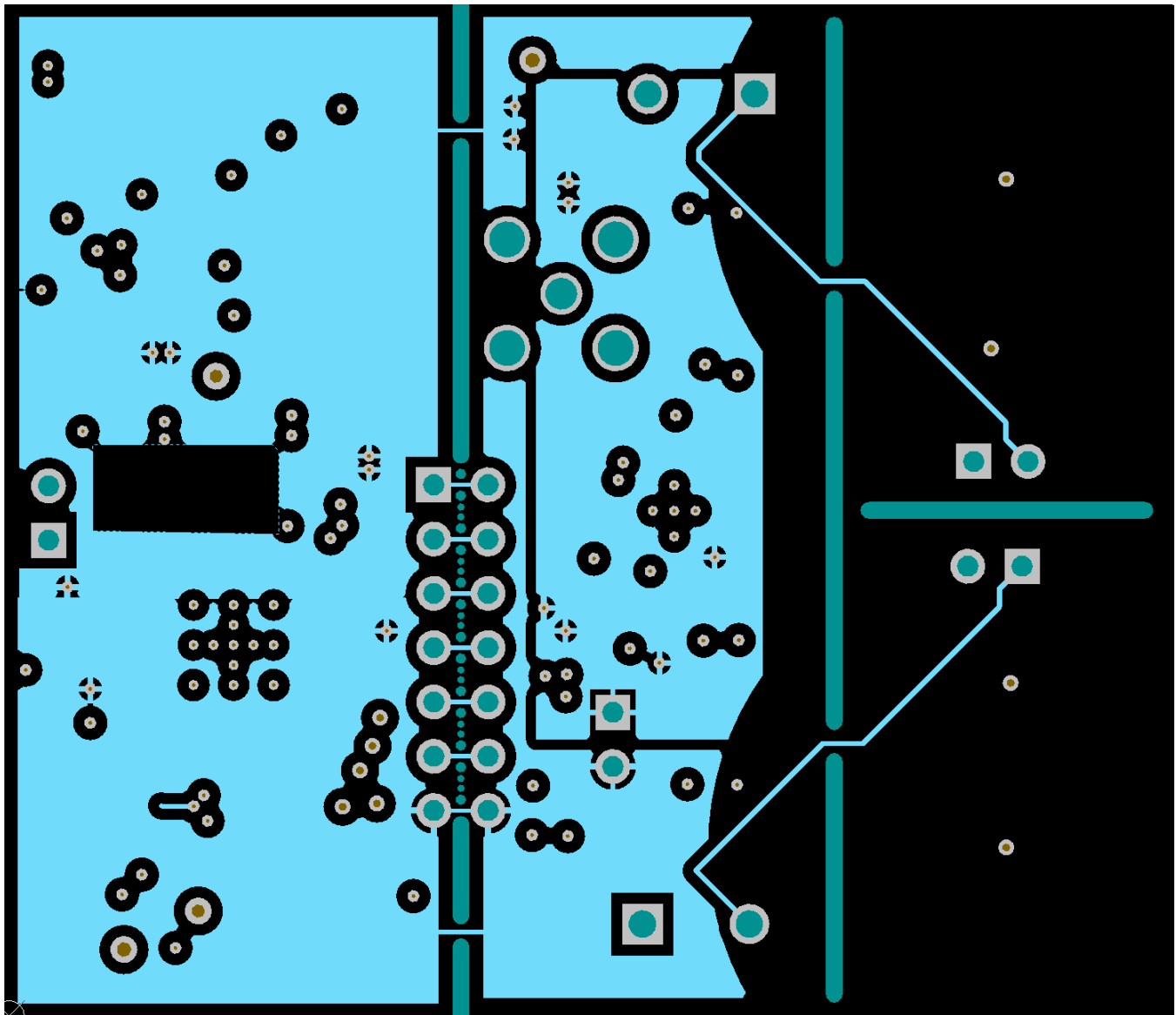


Figure 48. LDC1312/1612 Layout MidLayer 2 – Signals and Power Plane





4 LDC1314/1614 EVM REV B Schematics and Layout

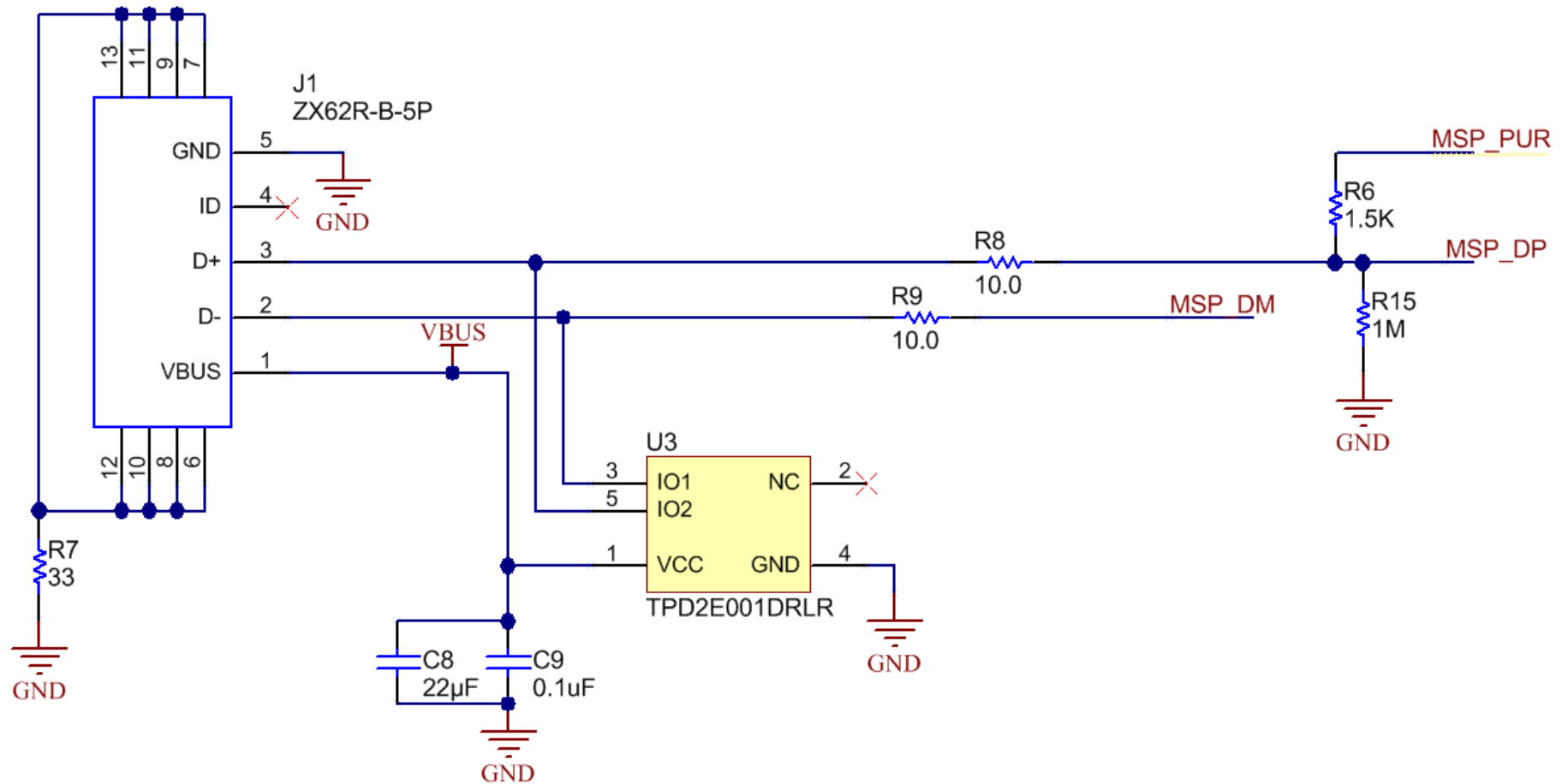


Figure 50. LDC1314/1614 USB Connection

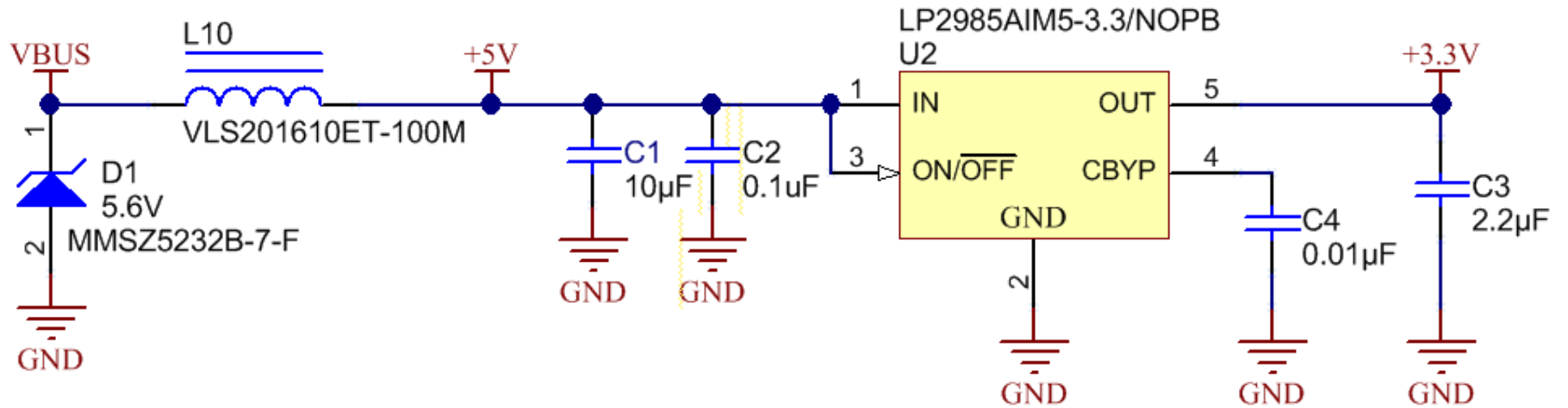
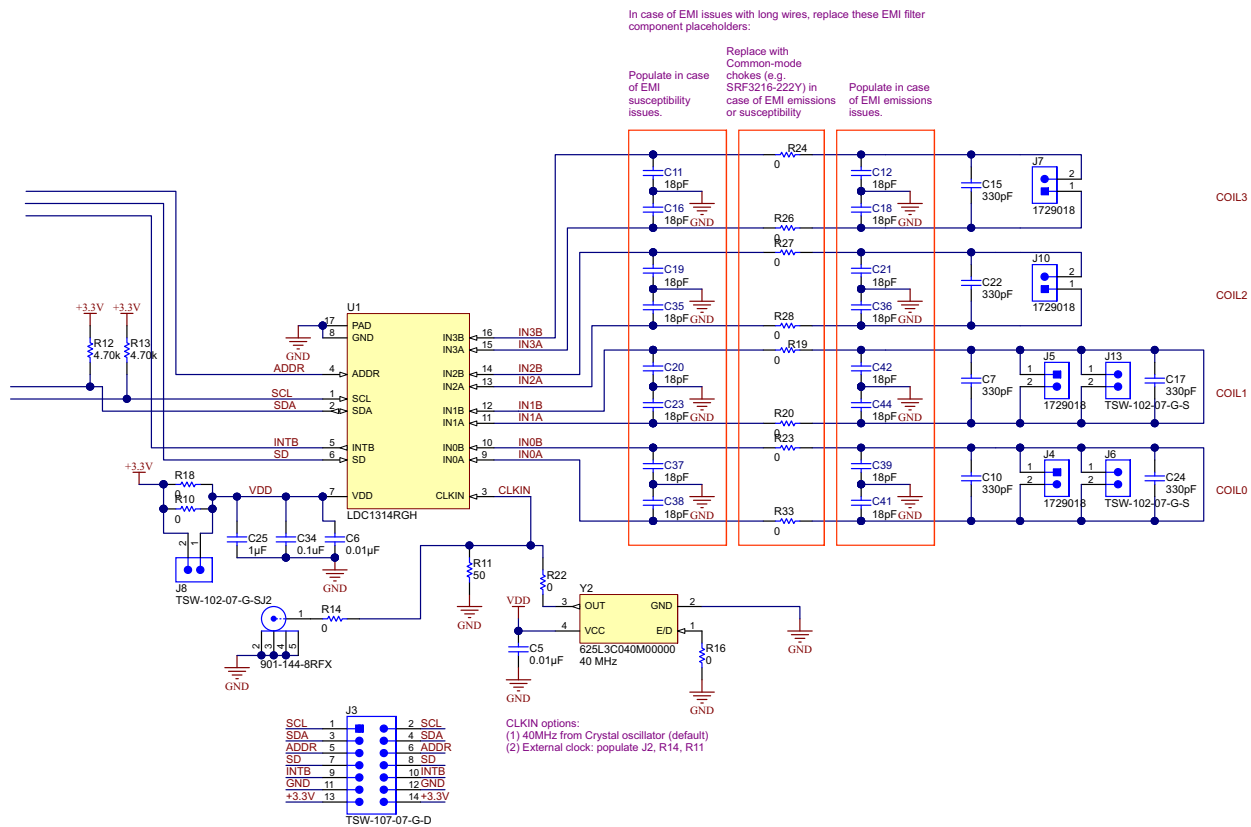


Figure 51. LDC1314/1614 Power Circuit



Copyright © 2016, Texas Instruments Incorporated

Figure 52. LDC1314/1614

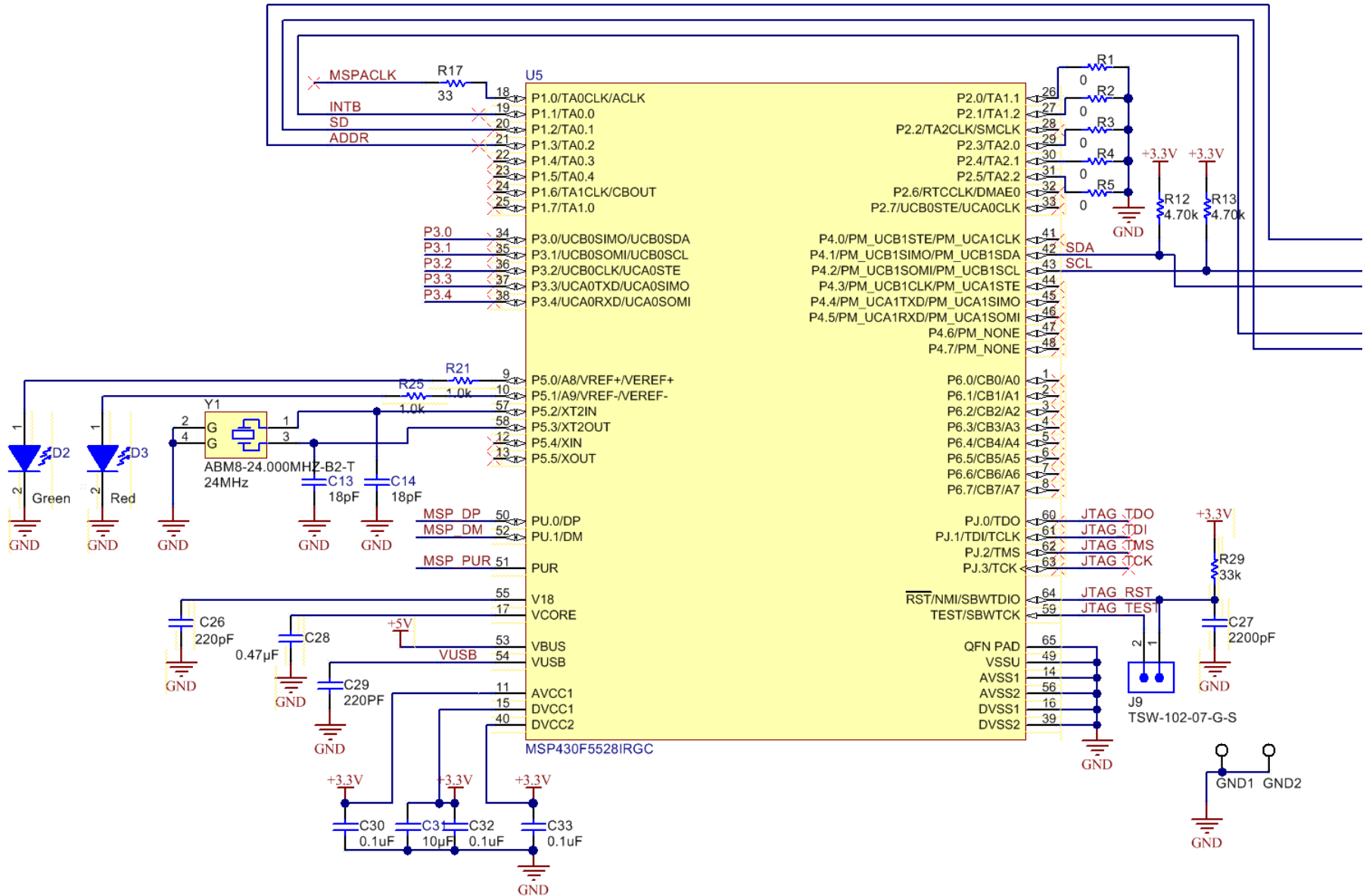


Figure 53. LDC1314/1614 MSP430 Connections

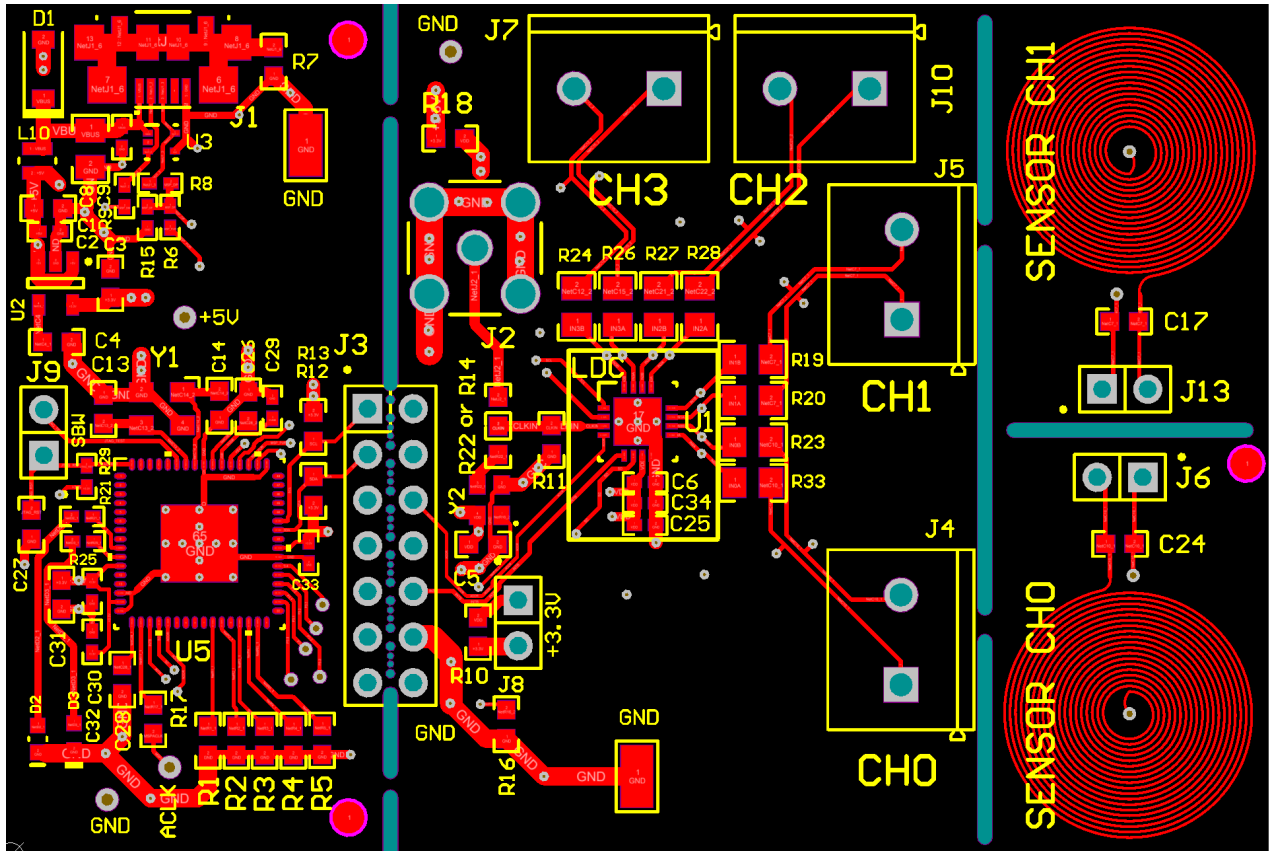


Figure 54. LDC1314/1614 Layout Top Layer – Signals and Components

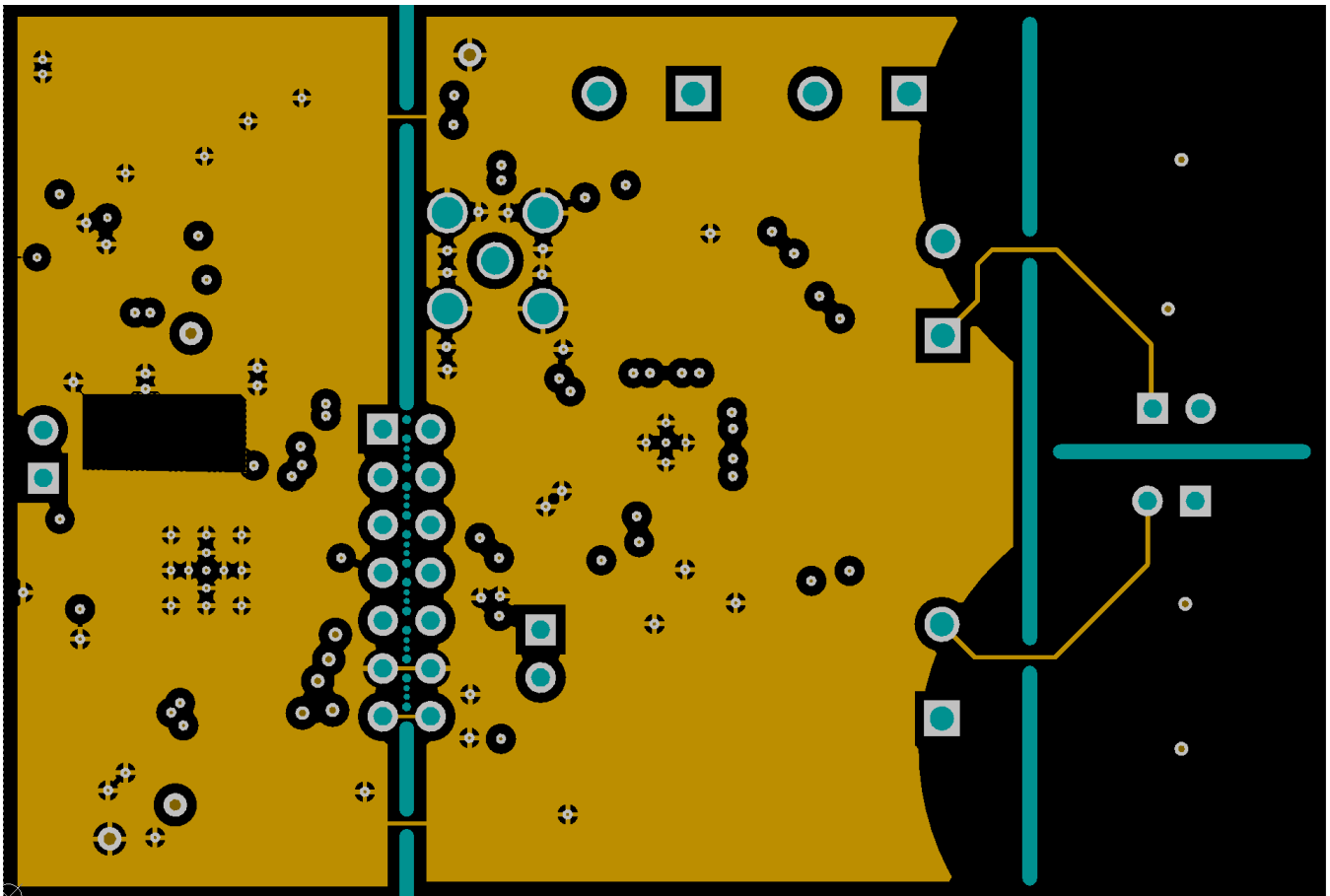


Figure 55. LDC1314/1614 Layout MidLayer 1 – Ground Plane

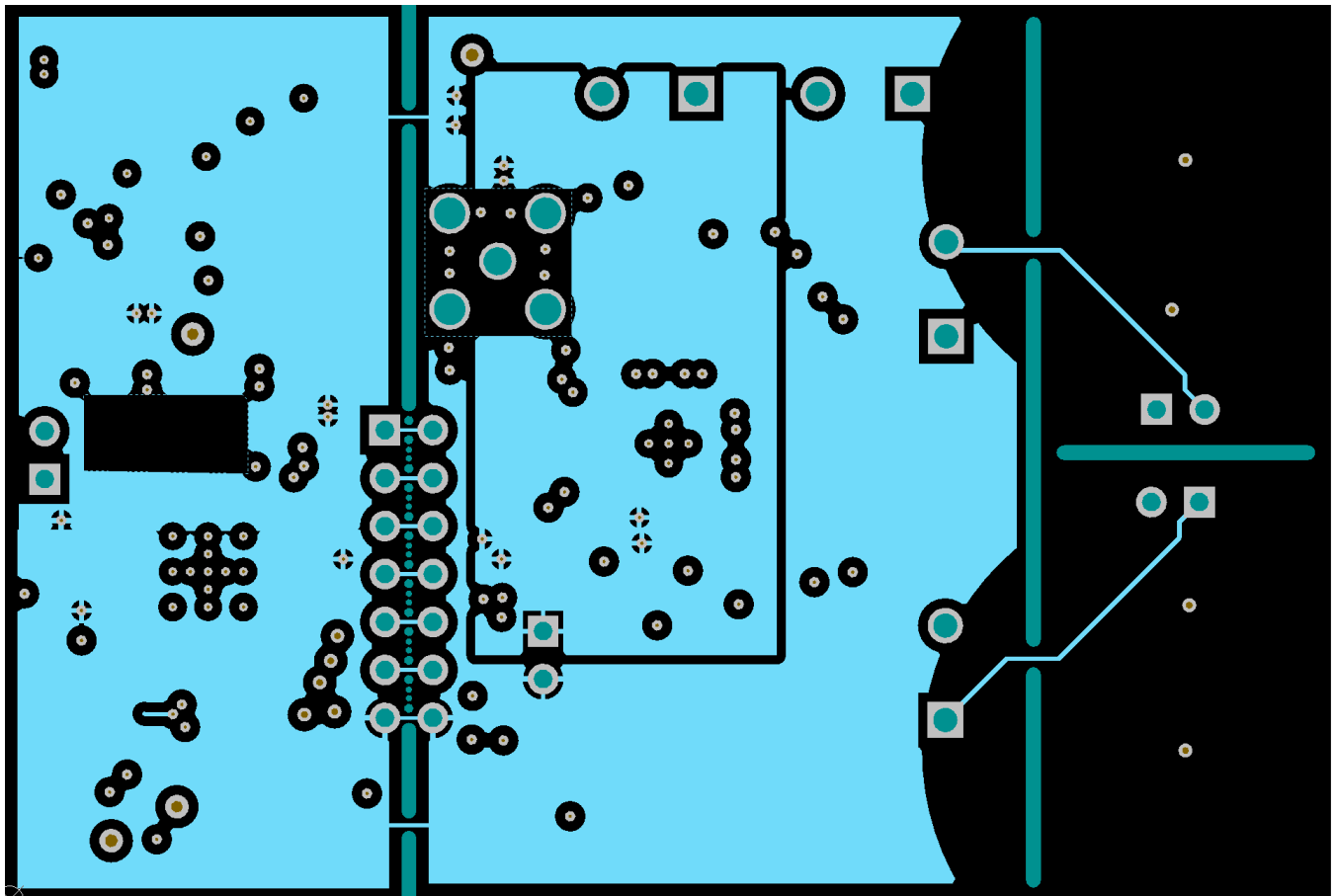


Figure 56. LDC1314/1614 Layout MidLayer 2 – Signals and Power Plane



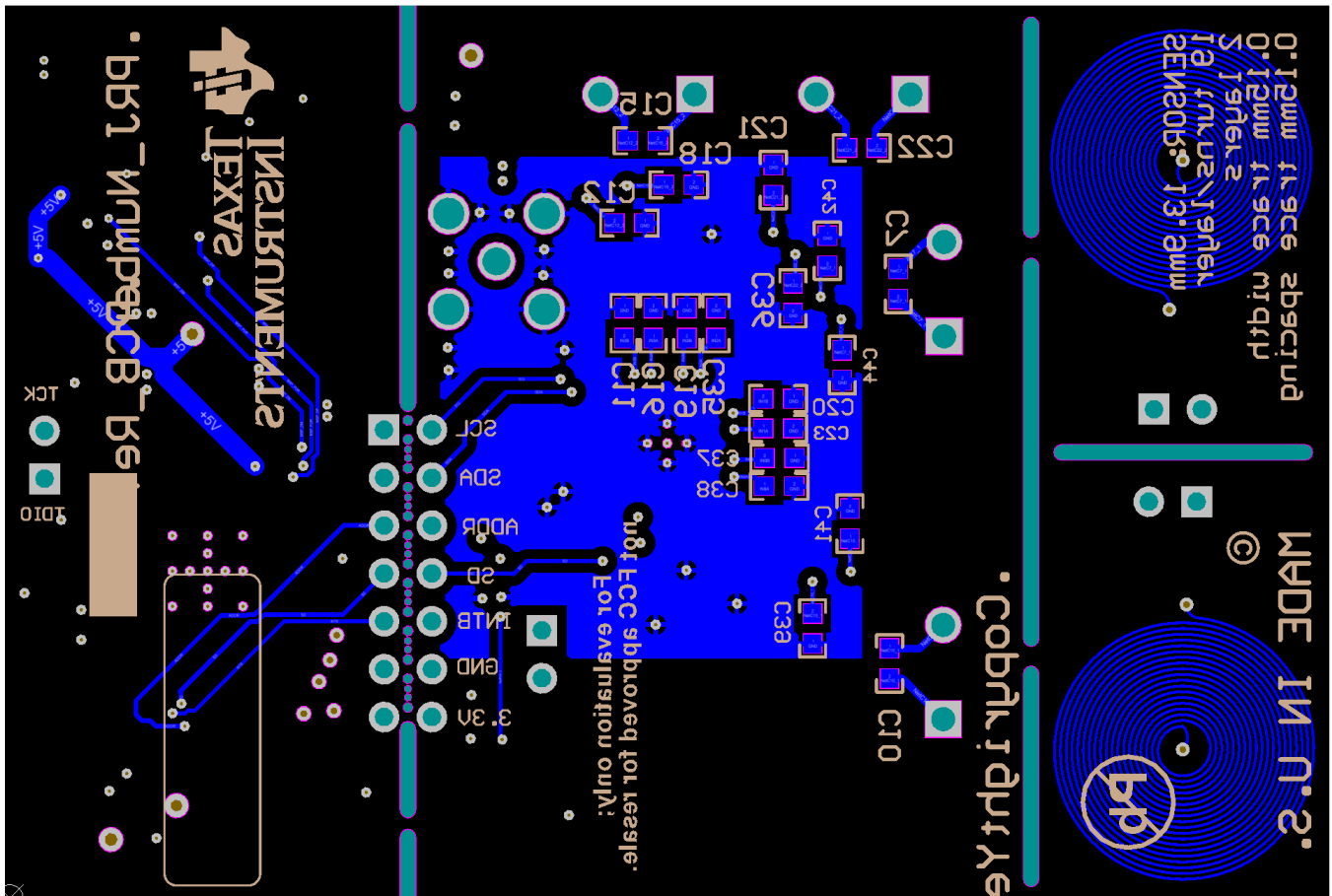


Figure 57. LDC1314/1614 Layout Bottom Layer – Signals Plane

**5 LDC1312/1314/1612/1614 EVM REV B Bill of Materials**
**Table 1. BOM for LDC1312 EVM REV B**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C9, C30, C32, C33, C34	6	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4, C5	2	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25 V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C6	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 16 V, +/- 10%, X7R, 0402	C1005X7R1C103K	TDK
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C13, C14	2	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
C17, C24	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C25	1	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND1, GND2	2	SMT	Test Point, Miniature, SMT	5015	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R3, R4, R10, R18, R22	7	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R6	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R7, R17	2	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9	2	10.0	RES, 10.0, 1%, 0.063 W, 0402	CRCW040210R0FKED	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15	1	1M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R19, R20, R23, R33	4	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale

**Table 1. BOM for LDC1312 EVM REV B (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U1	1		Multi-Channel 12-Bit Inductance to Digital Converter with I2C, DNT0012B	LDC1312DNT	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABM8-24.000MHZ-B2-T	Abracon Corporation
Y2	1		OSC, 40 MHz, 3.3 V, SMD	625L3C040M00000	CTS Electrocomponents
C7, C10	0	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C20, C23, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2	0		SMA Straight Jack, Gold, 50 Ω, TH	901-144-8RFX	Amphenol RF
J3	0		Header, 100mil, 7x2, Gold, TH	TSW-107-07-G-D	Samtec
J4, J5	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
R5, R14, R16	0	0	RES, 0 Ω, 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R11	0	50	RES, 50, 1%, 0.1 W, 0603	CRCW060350R0FKEA	Vishay-Dale

**Table 2. BOM for LDC1612 EVM REV B**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C9, C30, C32, C33, C34	6	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4, C5	2	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C6	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 16 V, +/- 10%, X7R, 0402	C1005X7R1C103K	TDK
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C13, C14	2	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
C17, C24	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C25	1	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND1, GND2	2	SMT	Test Point, Miniature, SMT	5015	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R3, R5, R10, R18, R22	7	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R6	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R7, R17	2	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9	2	10.0	RES, 10.0, 1%, 0.063 W, 0402	CRCW040210R0FKED	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15	1	1M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R19, R20, R23, R33	4	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 28-Bit Inductance to Digital Converter with I2C, DNT0012B	LDC1612DNT	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments

**Table 2. BOM for LDC1612 EVM REV B (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABM8-24.000MHZ-B2-T	Abracon Corporation
Y2	1		OSC, 40 MHz, 3.3 V, SMD	625L3C040M00000	CTS Electrocomponents
C7, C10	0	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C20, C23, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2	0		SMA Straight Jack, Gold, 50 $\Omega$ , TH	901-144-8RFX	Amphenol RF
J3	0		Header, 100mil, 7x2, Gold, TH	TSW-107-07-G-D	Samtec
J4, J5	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
R4, R14, R16	0	0	RES, 0 $\Omega$ , 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R11	0	50	RES, 50, 1%, 0.1 W, 0603	CRCW060350R0FKEA	Vishay-Dale

**Table 3. BOM for LDC1314 EVM REV B**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C9, C30, C32, C33, C34	6	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4, C5	2	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25 V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C6	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 16 V, +/- 10%, X7R, 0402	C1005X7R1C103K	TDK
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C13, C14	2	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
C17, C24	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C25	1	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND1, GND2	2	SMT	Test Point, Miniature, SMT	5015	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R3, R10, R18, R22	6	0	RES, 0 $\Omega$ , 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R6	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R7, R17	2	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9	2	10.0	RES, 10.0, 1%, 0.063 W, 0402	CRCW040210R0FKED	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15	1	1M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R19, R20, R23, R24, R26, R27, R28, R33	8	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 12-Bit Inductance to Digital Converter with I2C, DNT0012B	LDC1314RGH	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments

**Table 3. BOM for LDC1314 EVM REV B (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABM8-24.000MHZ-B2-T	Abracon Corporation
Y2	1		OSC, 40 MHz, 3.3 V, SMD	625L3C040M00000	CTS Electrocomponents
C7, C10, C15, C22	0	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C11, C12, C16, C18, C19, C20, C21, C23, C35, C36, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2	0		SMA Straight Jack, Gold, 50 Ω, TH	901-144-8RFX	Amphenol RF
J3	0		Header, 100 mil, 7x2, Gold, TH	TSW-107-07-G-D	Samtec
J4, J5, J7, J10	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
J6, J8, J9, J13	0		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
R4, R5, R14, R16	0	0	RES, 0 Ω, 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R11	0	50	RES, 50, 1%, 0.1 W, 0603	CRCW060350R0FKEA	Vishay-Dale

**Table 4. BOM for LDC1614 EVM REV B**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C9, C30, C32, C33, C34	6	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4, C5	2	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C6	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 16 V, +/- 10%, X7R, 0402	C1005X7R1C103K	TDK
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C13, C14	2	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
C17, C24	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C25	1	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND1, GND2	2	SMT	Test Point, Miniature, SMT	5015	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R2, R4, R5, R10, R18, R22	7	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R6	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R7, R17	2	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9	2	10.0	RES, 10.0, 1%, 0.063 W, 0402	CRCW040210R0FKED	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15	1	1M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R19, R20, R23, R24, R26, R27, R28, R33	8	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 12/28-Bit Inductance to Digital Converter with I2C, RGH0016A	LDC1614RGH	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments



**Table 4. BOM for LDC1614 EVM REV B (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABM8-24.000MHZ-B2-T	Abracon Corporation
Y2	1		OSC, 40 MHz, 3.3 V, SMD	625L3C040M00000	CTS Electrocomponents
C7, C10, C15, C22	0	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
C11, C12, C16, C18, C19, C20, C21, C23, C35, C36, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2	0		SMA Straight Jack, Gold, 50 Ω, TH	901-144-8RFX	Amphenol RF
J3	0		Header, 100 mil, 7x2, Gold, TH	TSW-107-07-G-D	Samtec
J4, J5, J7, J10	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
J6, J8, J9, J13	0		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
R3, R14, R16	0	0	RES, 0 Ω, 5%, 0.1W, 0603	CRCW06030000Z0EA	Vishay-Dale
R11	0	50	RES, 50, 1%, 0.1 W, 0603	CRCW060350R0FKEA	Vishay-Dale

6 Appendix 1: LDC1312/1612 EVM REV A Schematics and Layout

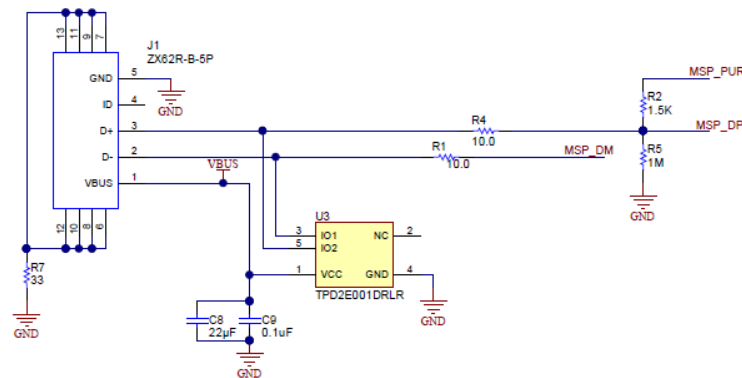


Figure 58. LDC1312/1612 REV A USB Connection

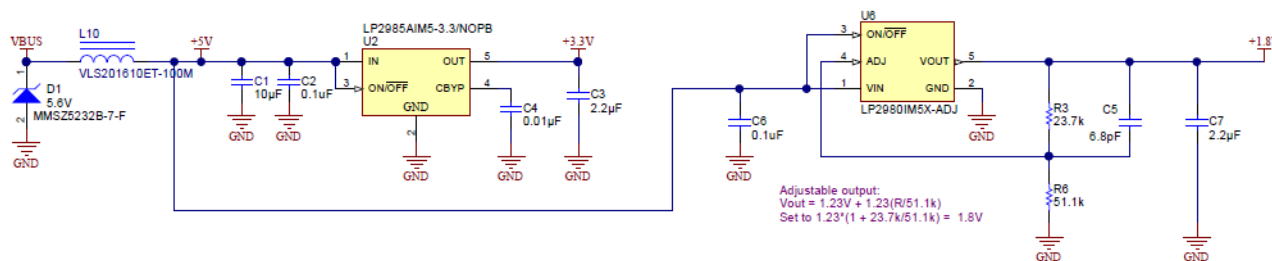


Figure 59. LDC1312/1612 REV A Power Circuit

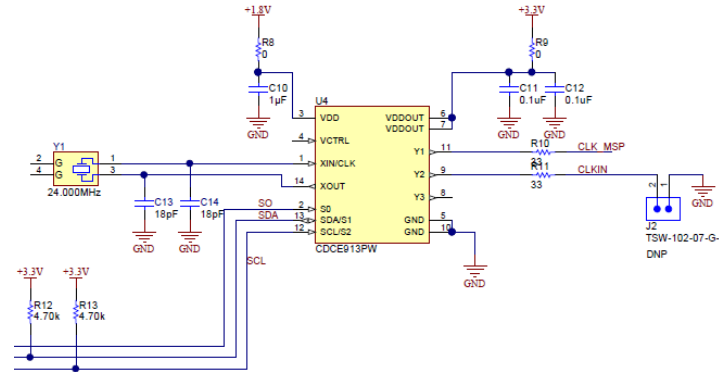


Figure 60. LDC1312/1612 REV A Clocking

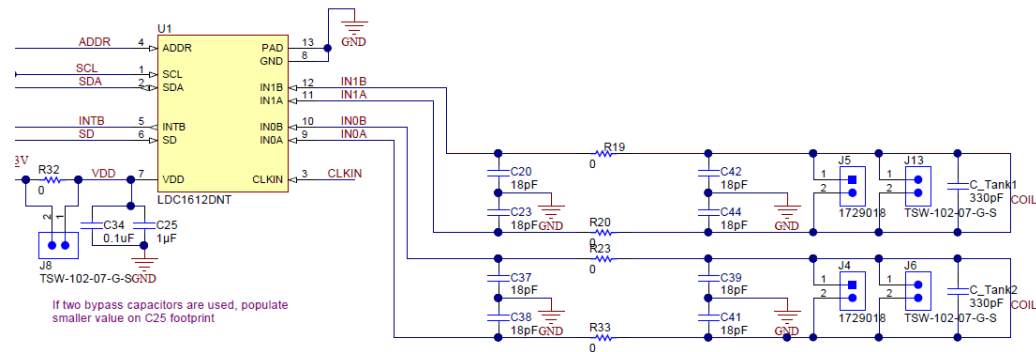


Figure 61. LDC1312/1612 REV A

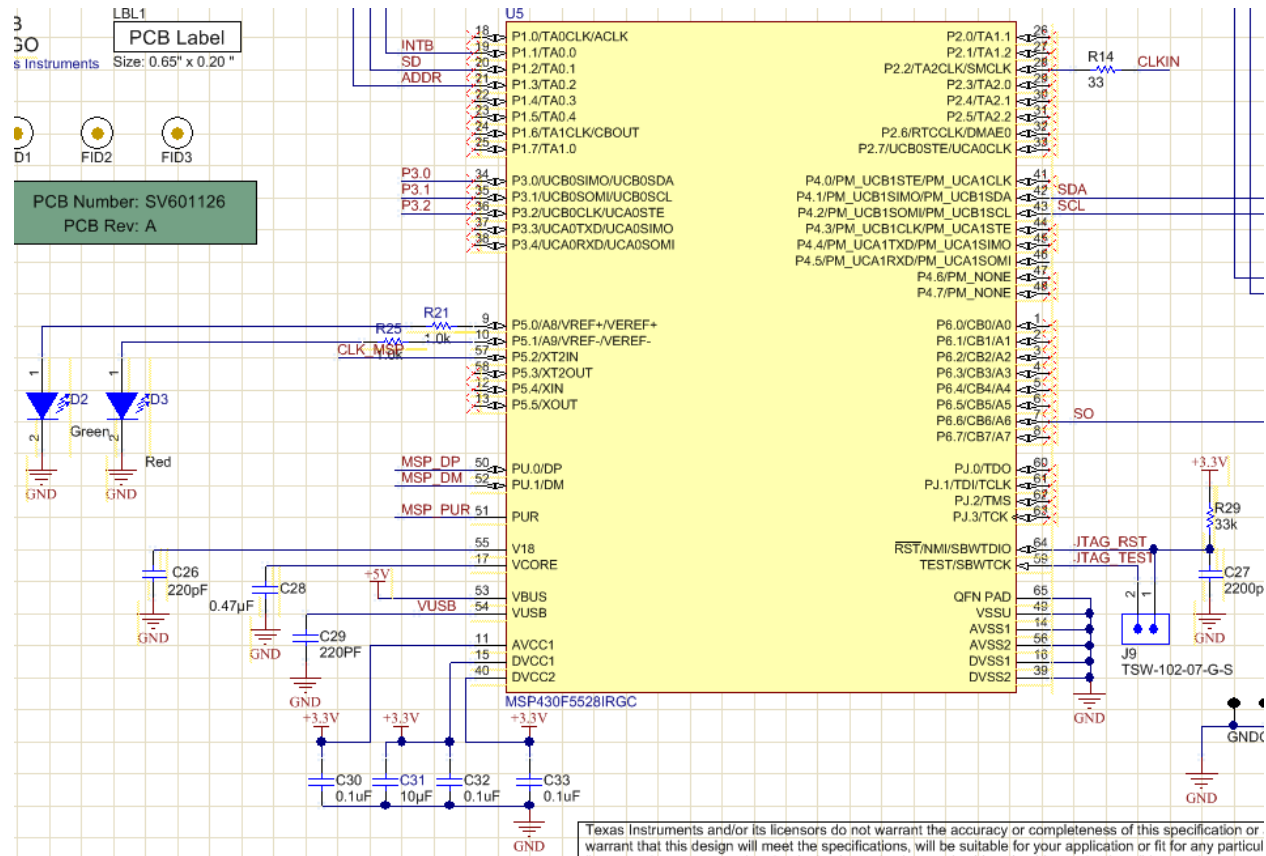


Figure 62. LDC1312/1612 REV A MSP430 Connections

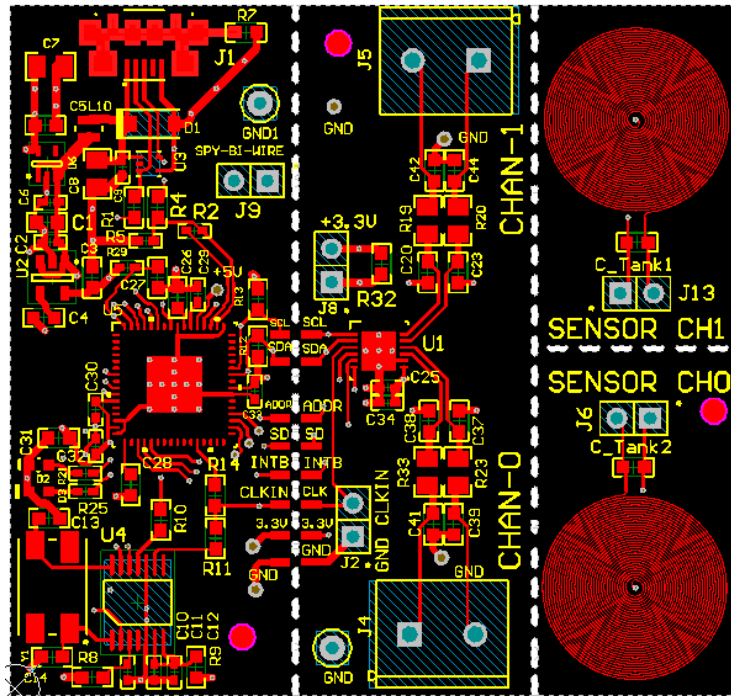


Figure 63. LDC1312/1612 REV A Layout Top Layer – Signals and Components

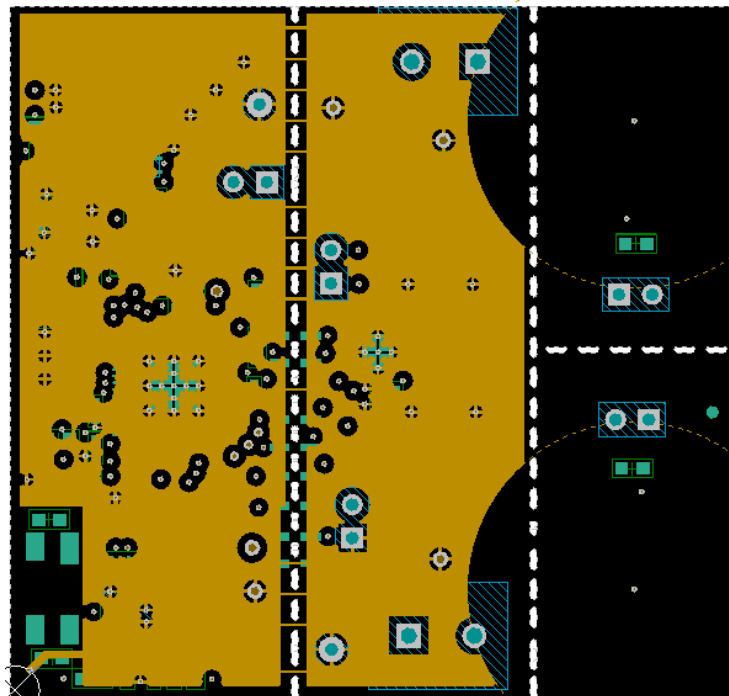


Figure 64. LDC1312/1612 REV A Layout MidLayer 1 – Ground Plane

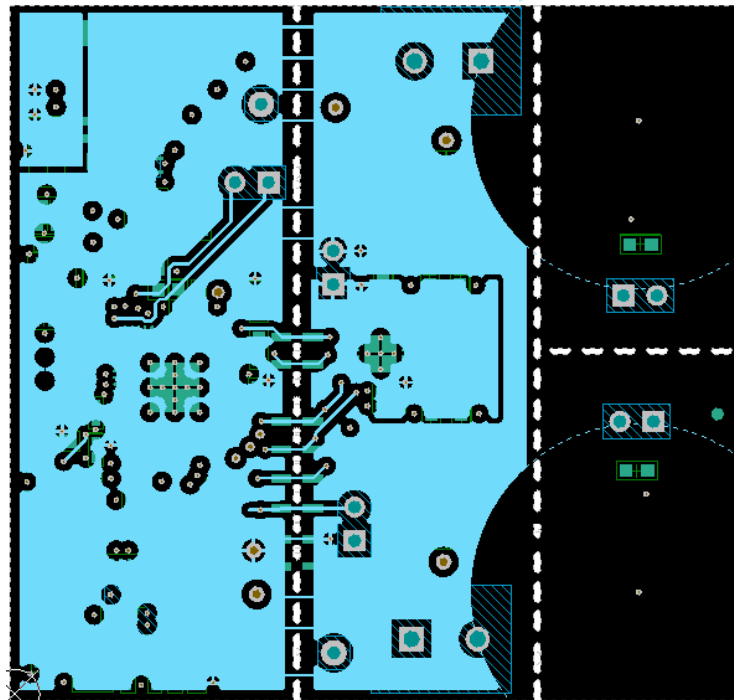


Figure 65. LDC1312/1612 REV A Layout MidLayer 2 – Signals and Power Plane

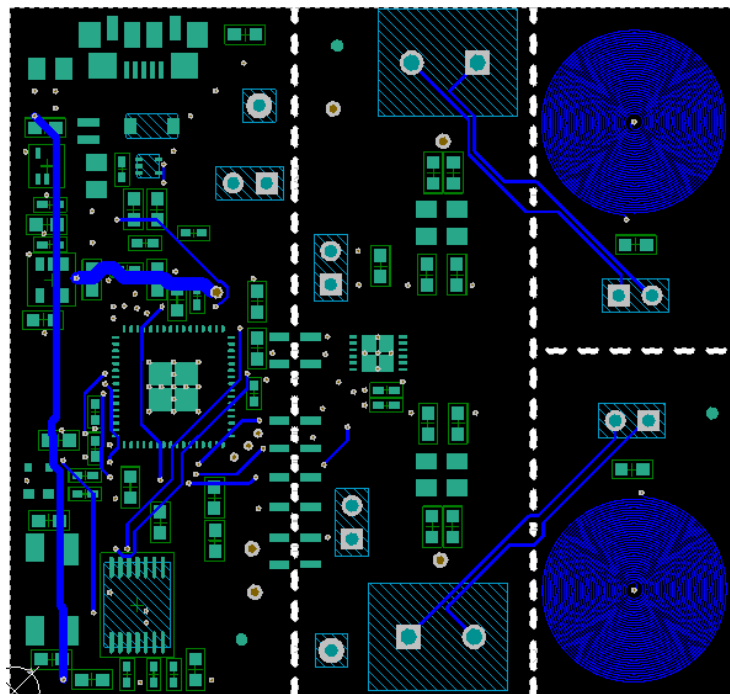
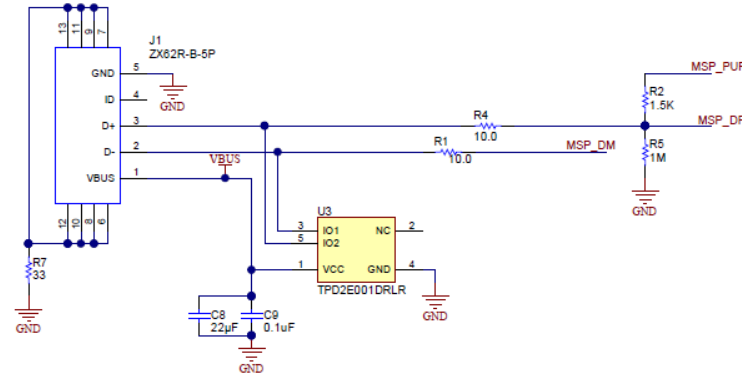
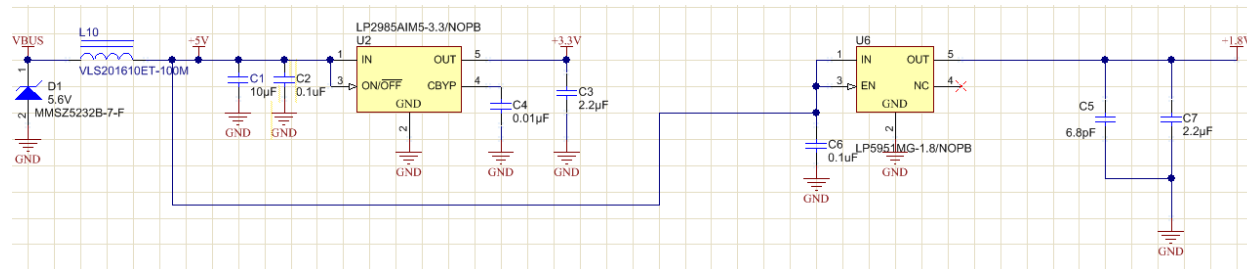


Figure 66. LDC1312/1612 REV A Layout Bottom Layer – Signals Plane

**7 Appendix 2: LDC1314/1614 EVM REV A Schematics and Layout**



**Figure 67. LDC1314/1614 REV A USB Connection**



**Figure 68. LDC1314/1614 REV A Power Circuit**

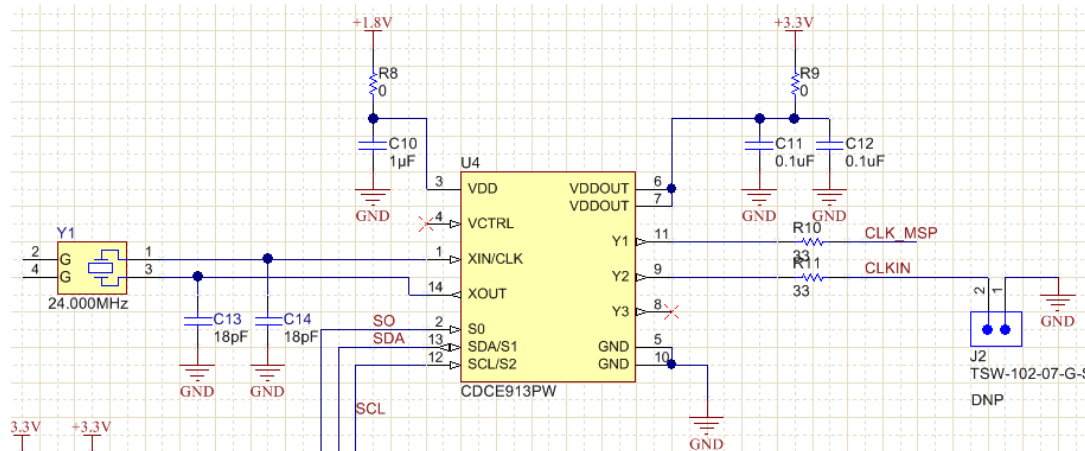


Figure 69. LDC1314/1614 REV A Clocking

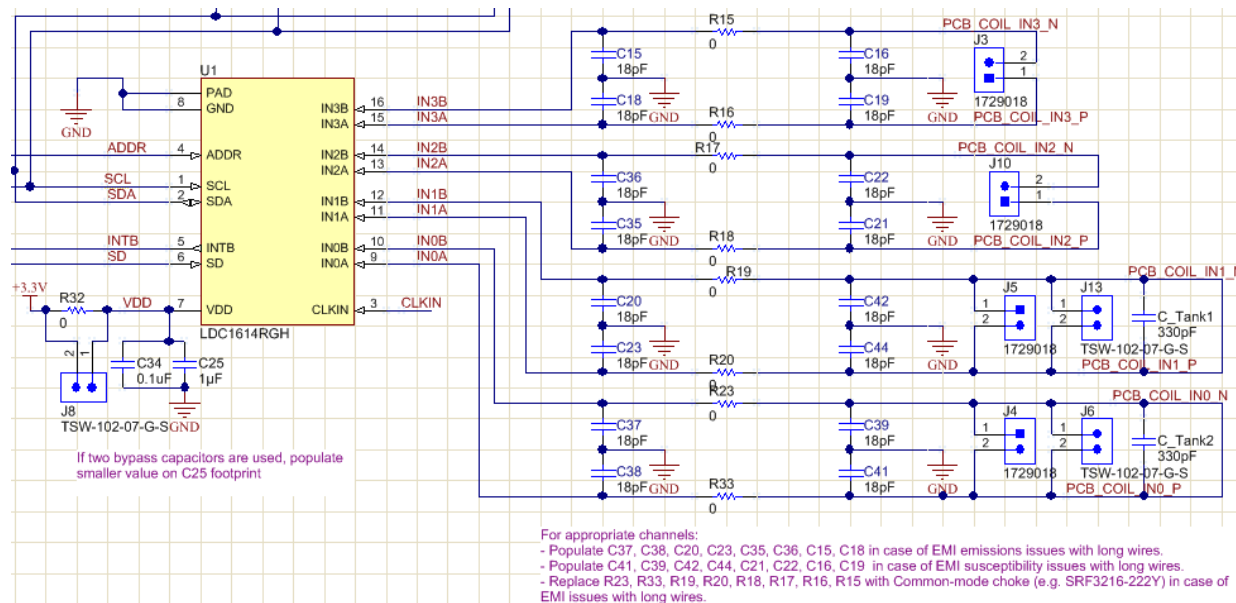


Figure 70. LDC1314/1614 REV A



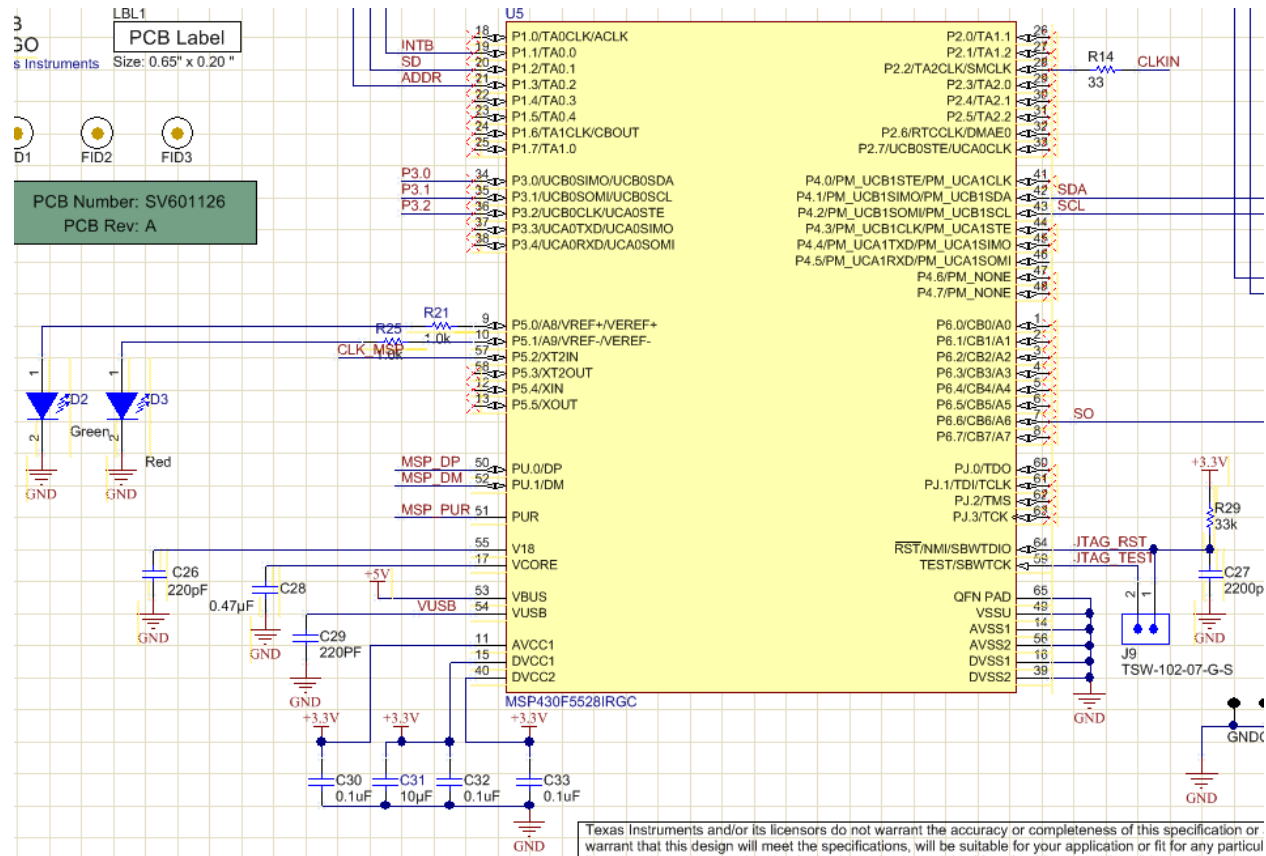


Figure 71. LDC1314/1614 REV A MSP430 Connections

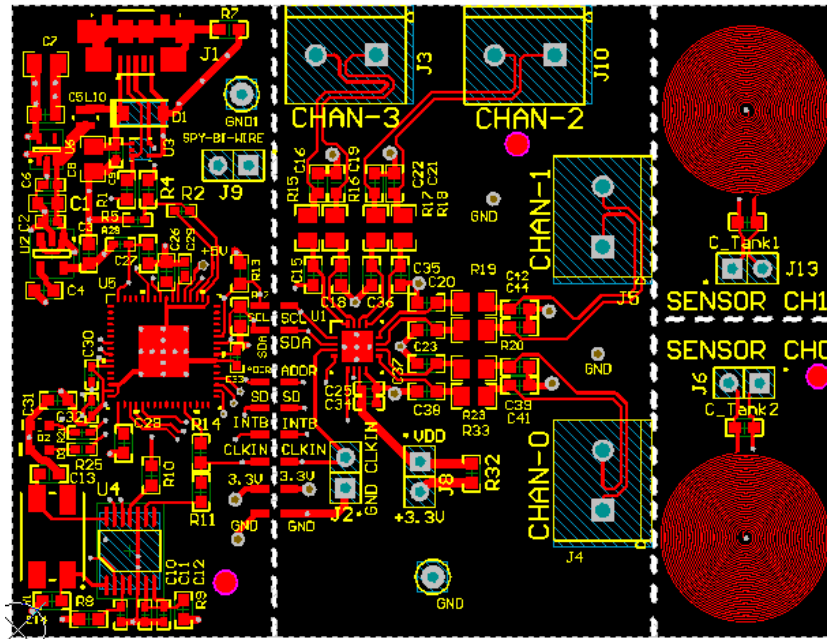


Figure 72. LDC1314/1614 REV A Layout Top Layer – Signals and Components

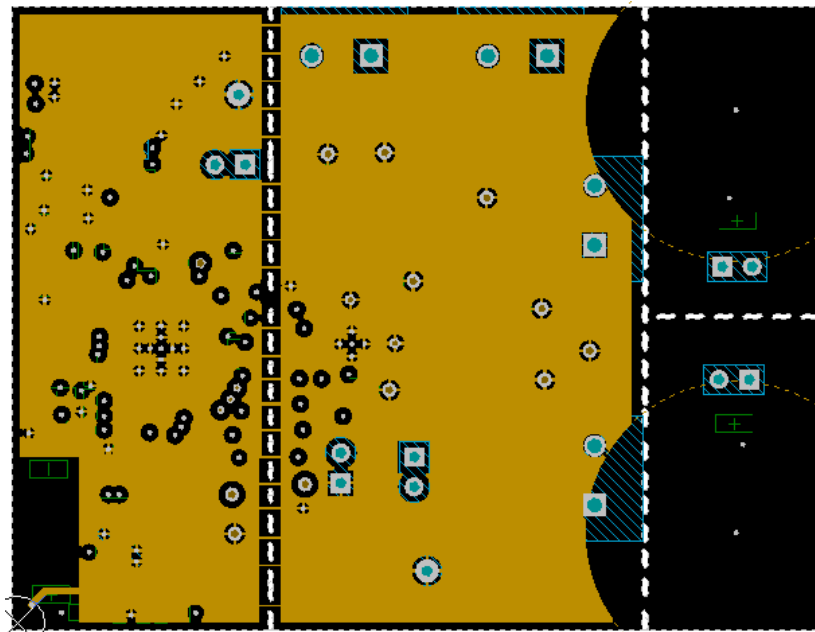


Figure 73. LDC1314/1614 REV A Layout MidLayer 1 – Ground Plane

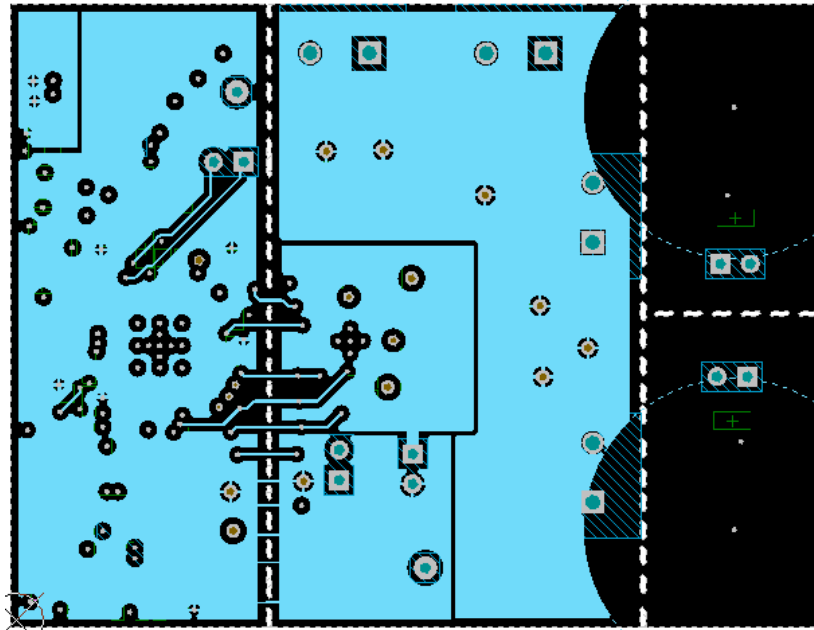


Figure 74. LDC1314/1614 REV A Layout MidLayer 2 – Signals and Power Plane

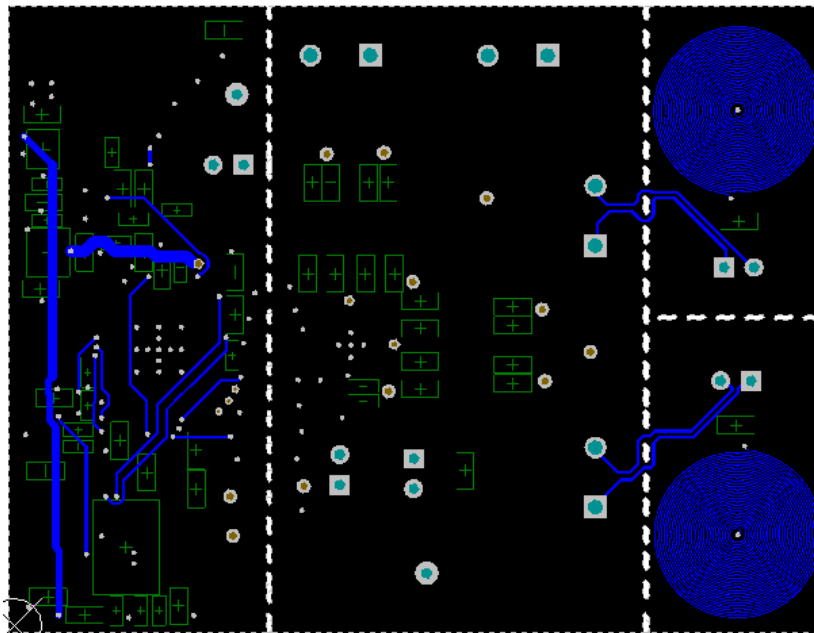


Figure 75. LDC1314/1614 REV A Layout Bottom Layer – Signals Plane

**8 Appendix 3: LDC1312/1314/1612/1614 EVM REV A Bill of Materials**
**Table 5. BOM for LDC1312 EVM REV A**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
!PCB1	1		Printed-Circuit Board	SV601147	Any
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C6, C9, C11, C12, C30, C32, C33	8	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C5	1	6.8 pF	CAP, CERM, 6.8 pF, 50V, +/-4%, C0G/NP0, 0603	06035A6R8CAT2A	AVX
C7	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 16V, +/-10%, X7R, 0805	C0805C225K4RACTU	Kemet
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C10, C25	2	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
C_Tank 1, C_Tank 2	2	330 pF	CAP, CERM, 330 pF, 50V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
D1	1	5.6 V	Diode, Zener, 5.6 V, 500mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND, GND1	2	Black	Test Point, Miniature, Black, TH	5001	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R4	2	10.0	RES, 10.0 $\Omega$ , 1%, 0.1 W, 0603	CRCW060310R0FKEA	Vishay-Dale
R2	1	1.5 K	RES 1.5 K $\Omega$ 1/16W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R5	1	1 M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R7, R10, R11	3	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9, R32	3	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R19, R20, R23, R33	4	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale

**Table 5. BOM for LDC1312 EVM REV A (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 12-Bit Inductance to Digital Converter with I2C, DNT0012B	LDC1312DNT	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U4	1		Programmable 1-PLL VCXO Clock Synthesizer With 1.8-V, 2.5-V, and 3.3-V Outputs, PW0014A	CDCE913PW	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
U6	1		Micropower, 150 mA Low-Dropout CMOS Voltage Regulator, 5-pin SC-70, Pb-Free	LP5951MG-1.8/NOPB	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABMM-24.000MHZ-B2-T	Abrakon Corporation
C13, C14, C20, C23, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, C0G/NP0, 0603	GRM1885C2A180JA01D	MuRata
C34	0	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2, J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
J4, J5	0		TERM BLOCK 2POS 5 mm, TH	1729018	Phoenix Contact
R14	0	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale

Table 6. BOM for LDC1612 EVM REV A

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
!PCB1	1		Printed-Circuit Board	SV601147	Any
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C6, C9, C11, C12, C30, C32, C33	8	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25 V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C5	1	6.8 pF	CAP, CERM, 6.8 pF, 50 V, +/-4%, C0G/NP0, 0603	06035A6R8CAT2A	AVX
C7	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 16 V, +/-10%, X7R, 0805	C0805C225K4RACTU	Kemet
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C10, C25	2	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220 PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
C_Tank1, C_Tank2	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND, GND1	2	Black	Test Point, Miniature, Black, TH	5001	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R4	2	10.0	RES, 10.0 $\Omega$ , 1%, 0.1 W, 0603	CRCW060310R0FKEA	Vishay-Dale
R2	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R5	1	1 M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R7, R10, R11	3	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9, R32	3	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R19, R20, R23, R33	4	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 28-Bit Inductance to Digital Converter with I2C, DNT0012B	LDC1612DNT	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments
U3	1		Low-Capacitance +/- 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U4	1		Programmable 1-PLL VCXO Clock Synthesizer With 1.8-V, 2.5-V, and 3.3-V Outputs, PW0014A	CDCE913PW	Texas Instruments

**Table 6. BOM for LDC1612 EVM REV A (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
U6	1		Micropower, 150-mA Low-Dropout CMOS Voltage Regulator, 5-pin SC-70, Pb-Free	LP5951MG-1.8/NOPB	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABMM-24.000MHZ-B2-T	Abracon Corporation
C13, C14, C20, C23, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, COG/NP0, 0603	GRM1885C2A180JA01D	MuRata
C34	0	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2, J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
J4, J5	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
R14	0	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale

**Table 7. BOM for LDC1314 EVM REV A**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
!PCB1	1		Printed-Circuit Board	SV601126	Any
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C6, C9, C11, C12, C30, C32, C33	8	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25 V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C5	1	6.8 pF	CAP, CERM, 6.8 pF, 50 V, +/-4%, C0G/NP0, 0603	06035A6R8CAT2A	AVX
C7	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 16 V, +/-10%, X7R, 0805	C0805C225K4RACTU	Kemet
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C10, C25	2	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220 PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
C_Tank1, C_Tank2	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND, GND1	2	Black	Test Point, Miniature, Black, TH	5001	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R4	2	10.0	RES, 10.0 $\Omega$ , 1%, 0.1 W, 0603	CRCW060310R0FKEA	Vishay-Dale
R2	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R5	1	1 M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R7, R10, R11	3	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9, R32	3	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15, R16, R17, R18, R19, R20, R23, R33	8	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 12-Bit Inductance to Digital Converter with I2C, RGH0016A	LDC1314RGH	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments



**Table 7. BOM for LDC1314 EVM REV A (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U4	1		Programmable 1-PLL VCXO Clock Synthesizer With 1.8-V, 2.5-V, and 3.3-V Outputs, PW0014A	CDCE913PW	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
U6	1		Micropower, 150-mA Low-Dropout CMOS Voltage Regulator, 5-pin SC-70, Pb-Free	LP5951MG-1.8/NOPB	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABMM-24.000MHZ-B2-T	Abracon Corporation
C13, C14, C15, C16, C18, C19, C20, C21, C22, C23, C35, C36, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, COG/NP0, 0603	GRM1885C2A180JA01D	MuRata
C34	0	0.1 µF	CAP CER 0.1 µF 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2, J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
J3, J4, J5, J10	0		TERM BLOCK 2POS 5mm, TH	1729018	Phoenix Contact
R14	0	33	RES, 33 Ω, 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale

Table 8. BOM for LDC1614 EVM REV A

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
!PCB1	1		Printed-Circuit Board	SV601126	Any
C1, C31	2	10 $\mu$ F	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0603	C1608X5R1A106M	TDK
C2, C6, C9, C11, C12, C30, C32, C33	8	0.1 $\mu$ F	CAP CER 0.1 $\mu$ F 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
C3	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X5R, 0603	C0603C225K8PACTU	Kemet
C4	1	0.01 $\mu$ F	CAP, CERM, 0.01 $\mu$ F, 25 V, +/-5%, C0G/NP0, 0603	C1608C0G1E103J	TDK
C5	1	6.8 pF	CAP, CERM, 6.8 pF, 50 V, +/-4%, C0G/NP0, 0603	06035A6R8CAT2A	AVX
C7	1	2.2 $\mu$ F	CAP, CERM, 2.2 $\mu$ F, 16 V, +/-10%, X7R, 0805	C0805C225K4RACTU	Kemet
C8	1	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 16 V, +/-10%, X5R, 0805	C2012X5R1C226K125AC	TDK
C10, C25	2	1 $\mu$ F	CAP, CERM, 1 $\mu$ F, 10 V, +/-10%, X5R, 0402	GRM155R61A105KE15D	MuRata
C26	1	220 pF	CAP, CERM, 220 pF, 50 V, +/-1%, C0G/NP0, 0603	06035A221FAT2A	AVX
C27	1	2200 pF	CAP, CERM, 2200 pF, 50 V, +/-10%, X7R, 0603	C0603X222K5RACTU	Kemet
C28	1	0.47 $\mu$ F	CAP, CERM, 0.47 $\mu$ F, 10 V, +/-10%, X7R, 0603	C0603C474K8RACTU	Kemet
C29	1	220 PF	CAP CER 220 PF 50 V 1% NP0 0402	C1005C0G1H221F050BA	TDK Corporation
C_Tank1, C_Tank2	2	330 pF	CAP, CERM, 330 pF, 50 V, +/-1%, C0G/NP0, 0603	C1608C0G1H331F080AA	TDK
D1	1	5.6 V	Diode, Zener, 5.6 V, 500 mW, SOD-123	MMSZ5232B-7-F	Diodes Inc.
D2	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D3	1	Red	LED, Super Red, SMD	SML-LX0603SRW-TR	Lumex
GND, GND1	2	Black	Test Point, Miniature, Black, TH	5001	Keystone
J1	1		Connector, Receptacle, Micro-USB Type B, SMT	ZX62R-B-5P	Hirose Electric Co. Ltd.
L10	1	10 $\mu$ H	Inductor, Shielded, Ferrite, 10 $\mu$ H, 0.4 A, 1.38 $\Omega$ , SMD	VLS201610ET-100M	TDK
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
R1, R4	2	10.0	RES, 10.0 $\Omega$ , 1%, 0.1 W, 0603	CRCW060310R0FKEA	Vishay-Dale
R2	1	1.5 K	RES 1.5 K $\Omega$ 1/16 W 5% 0402 SMD	CRCW04021K50JNED	Vishay Dale
R5	1	1 M	RES, 1 M $\Omega$ , 5%, 0.063 W, 0402	RC0402JR-071ML	Yageo
R7, R10, R11	3	33	RES, 33 $\Omega$ , 5%, 0.1 W, 0603	CRCW060333R0JNEA	Vishay-Dale
R8, R9, R32	3	0	RES, 0 $\Omega$ , 5%, 0.1 W, 0603	CRCW06030000Z0EA	Vishay-Dale
R12, R13	2	4.70 k	RES, 4.70 k $\Omega$ , 1%, 0.1 W, 0603	RC0603FR-074K7L	Yageo America
R15, R16, R17, R18, R19, R20, R23, R33	8	0	RES, 0 $\Omega$ , 5%, 0.125 W, 0805	CRCW08050000Z0EA	Vishay-Dale
R21, R25	2	1.0 k	RES, 1.0 k $\Omega$ , 5%, 0.063 W, 0402	CRCW04021K00JNED	Vishay-Dale
R29	1	33 k	RES, 33 k $\Omega$ , 5%, 0.063 W, 0402	CRCW040233K0JNED	Vishay-Dale
U1	1		Multi-Channel 28-Bit Inductance to Digital Converter with I2C, RGH0016A	LDC1614RGH	Texas Instruments
U2	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments

**Table 8. BOM for LDC1614 EVM REV A (continued)**

DESIGNATOR	QTY.	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
U3	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	TPD2E001DRLR	Texas Instruments
U4	1		Programmable 1-PLL VCXO Clock Synthesizer With 1.8-V, 2.5-V, and 3.3-V Outputs, PW0014A	CDCE913PW	Texas Instruments
U5	1		Mixed Signal MicroController, RGC0064B	MSP430F5528IRGC	Texas Instruments
U6	1		Micropower, 150-mA Low-Dropout CMOS Voltage Regulator, 5-pin SC-70, Pb-Free	LP5951MG-1.8/NOPB	Texas Instruments
Y1	1		Crystal, 24.000 MHz, 18 pF, SMD	ABMM-24.000MHZ-B2-T	Abracon Corporation
C13, C14, C15, C16, C18, C19, C20, C21, C22, C23, C35, C36, C37, C38, C39, C41, C42, C44	0	18 pF	CAP, CERM, 18 pF, 100 V, +/-5%, COG/NP0, 0603	GRM1885C2A180JA01D	MuRata
C34	0	0.1 µF	CAP CER 0.1 µF 16 V 5% X7R 0402	GRM155R71C104JA88D	Murata Electronics North America
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
J2, J6, J8, J9, J13	0		Header, TH, 100 mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec, Inc.
J3, J4, J5, J10	0		TERM BLOCK 2POS 5 mm, TH	1729018	Phoenix Contact
R14	0	33	RES, 33 Ω, 5%, 0.1W, 0603	CRCW060333R0JNEA	Vishay-Dale

---

## Revision History

### Changes from Original (August 2015) to A Revision

**Page**

- 
- Revised to reflect new Sensing Solutions GUI, added Appendix with EVM rev A Schematics, BOM, and Layout for reference ..... 6
-

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
  - 3.1 *United States*
    - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
    - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

## FCC Interference Statement for Class B EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### 3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

#### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号  
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)  
電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。 [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

#### 4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

#### 4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.
7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
8. *Limitations on Damages and Liability:*
- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2016, Texas Instruments Incorporated



## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)