



## LDC0851 Configuration Tool Instructions

*These calculation tools are provided without any warranty. Users should verify any result.*

The latest version of the LDC Tools Spreadsheet is available at <http://www.ti.com/lit/zip/slyc137>.

Refer to the LDC0851 Datasheet for detailed information on operation and specifications for the LDC0851 at <http://www.ti.com/lit/ds/symlink/ldc0851.pdf>.

### 1 Overview

The LDC0851 Config tool is a tab on an Excel worksheet which helps configure the LDC0851 devices, providing:

- Initial recommended switching configuration
- Estimated Current consumption and sample rate
- Event counting configuration

This worksheet is provided with modification protection to ensure that calculation cells are not changed. Only edit cells which have a Yellow background. Outputs are provided in the Orange background cells:

Enter values or select settings in yellow cells only.
Results provided in Orange cells. Do not edit these fields.
Intermediate Calculation cells. Do not edit.

The spreadsheet has several sections:

- Free Space Sensor Characteristics
- Sensor Characteristics with Target Interaction
- Duty-Cycled Low Power Operation
- Operating Region Graphs
- Rotation Event Counting

### LDC0851 Design Space Calculator

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This tool determines appropriate device settings and sensor settings for optimum LDC0851 usage.

#### Free Space Sensor Characteristics

Supply Voltage	3.3	V
Sensor Inductance	6.00	$\mu\text{H}$
External Sensor Capacitance ( $C_{\text{SENSOR}}$ )	40.0	pF
Parasitic PCB capacitance ( $C_{\text{BOARD}}$ )	4.0	pF
Total Capacitance ( $C_{\text{TOTAL}}$ )	56.0	pF
Sensor Frequency	12.279	MHz
Conversion Latency	353	$\mu\text{s}$
Continuous Sample Rate	2.836	ksps
$I_{\text{SENSOR}}$ without Target	2.81	mA
$\text{IDD}_{\text{LDC}}$ without Target	3.88	mA

Includes 12pF on LCOM pin

#### Sensor Characteristics with Target Interaction

Sensor Diameter	10.00	mm
Closest Target Distance	1.00	mm
Est. Inductance with Target Interaction	3.853	$\mu\text{H}$
Max Sensor Frequency with target	15.323	MHz
$\text{IDD}_{\text{LDC}}$ with Maximum Target Interaction	4.67	mA
Desired Switch On distance	2.0	mm
Recommended ADJ Code	10	
Approx Switch On Distance	1.98	mm
Approx Switch Off Distance	2.12	mm

#### LDC0851 Battery Life Calculator

[refer to section 9.2.3 of the LDC0851 datasheet for details.](#)

Battery Capacity	200	mAh
Sample Rate	50	sps
LDC0851 Enable pulse duration	1.16	ms
<b>LDC0851 Average Current</b>	<b>0.097</b>	<b>mA</b>
<b>Battery Lifetime (LDC0851 loading only)</b>	<b>0.20</b>	<b>years</b>

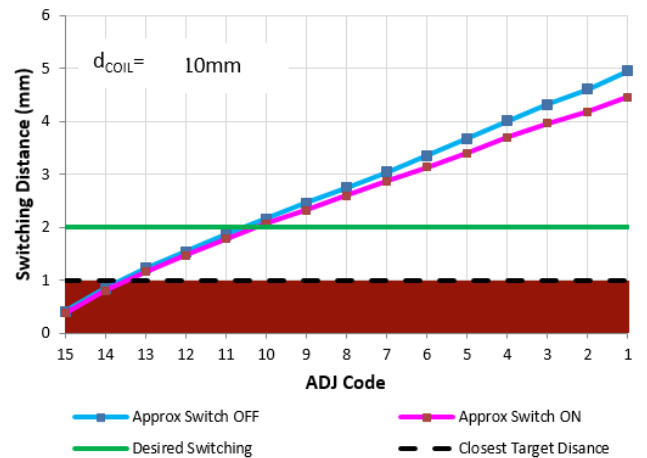
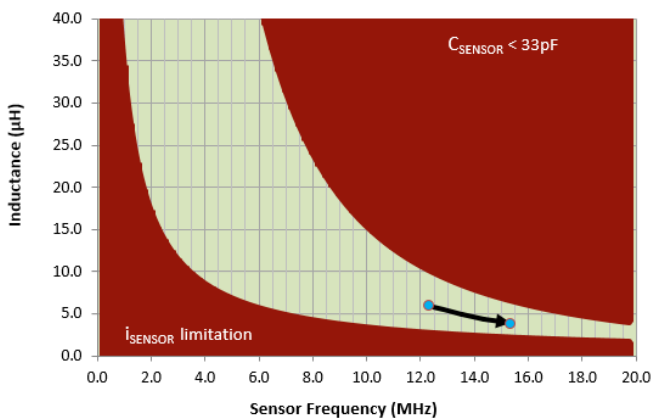


Figure 1: LDC0851 Config Tool

## 2 Free Space Sensor Characteristics

At the top of the worksheet is the free space sensor characteristics section, as shown in Figure 2. These settings apply to all the calculations produced on the worksheet and need to be set first.

Supply Voltage	3.3	V
Sensor Inductance	6.00	$\mu$ H
External Sensor Capacitance ( $C_{\text{SENSOR}}$ )	40.0	pF
Parasitic PCB capacitance ( $C_{\text{BOARD}}$ )	4.0	pF
Total Capacitance ( $C_{\text{TOTAL}}$ )	56.0	pF
Sensor Frequency	12.279	MHz
Conversion Latency	353	$\mu$ s
Continuous Sample Rate	2.836	ksps
$I_{\text{SENSOR}}$ without Target	2.81	mA
$IDD_{\text{LDC}}$ without Target	3.88	mA

**Figure 2: Free Space Sensor Characteristics**

**Step 1:** Enter the system supply voltage – either 1.8V or 3.3V.

**Step 2:** Next, enter the sensor electrical parameters:

- Free-space inductance (no metal near the inductor)
- Sensor capacitance
- board parasitic capacitance

These parameters can be measured or estimated using the Spiral Designer tab or Webench.

The spreadsheet will calculate the Sensor free-space frequency, the first sample conversion latency, sample rate, and the supply current.

If you are working with real-world coils and have a discrepancy between the measured frequency and the spreadsheet estimate, it is often due to parasitic inductance or capacitance which was not included. Other sources include metal near the sensor. Adjust the Capacitance or Inductance as appropriate.

If any of the parameters result in a condition which is outside of the operating region of the LDC0851, the worksheet will flag this condition with a red warning:

**Free Space Sensor Characteristics**

Supply Voltage	3.3	V
Sensor Inductance	1.50	$\mu$ H
External Sensor Capacitance ( $C_{\text{SENSOR}}$ )	80.0	pF

Inductance is below acceptable minimum of 1.82 $\mu$ H

**Figure 3: Tool warning that parameter is outside of LDC0851 operating region**

### 3 Target Interaction

Sensor Diameter	10.00	mm
Closest Target Distance	1.00	mm
Est. Inductance with Target Interaction	3.853	$\mu$ H
Max Sensor Frequency with target	15.323	MHz
IDD <sub>LDC</sub> with Maximum Target Interaction	4.67	mA
Desired Switch On distance	2.0	mm
Recommended ADJ Code	10	
Approx Switch On Distance	1.98	mm
Approx Switch Off Distance	2.12	mm

Figure 4: Target Movement

Next, enter the sensor physical size and the target movement range. Note that the target material is assumed to be an Aluminum disk the same size as the sensor; if the material, shape, or size of the target is different then the later calculations may not be as accurate.

This section will calculate the appropriate ADJ code for the desired switching performance, and reports the calculated on and off distances, along with the estimated supply current when the target is at the closest position.

### 4 Duty Cycled Operation

The LDC0851 can be duty-cycled by toggling the EN pin for applications which do not need higher sample rates. This duty-cycled mode of operation can provide significant reduction in current consumption.

#### LDC0851 Battery Life Calculator

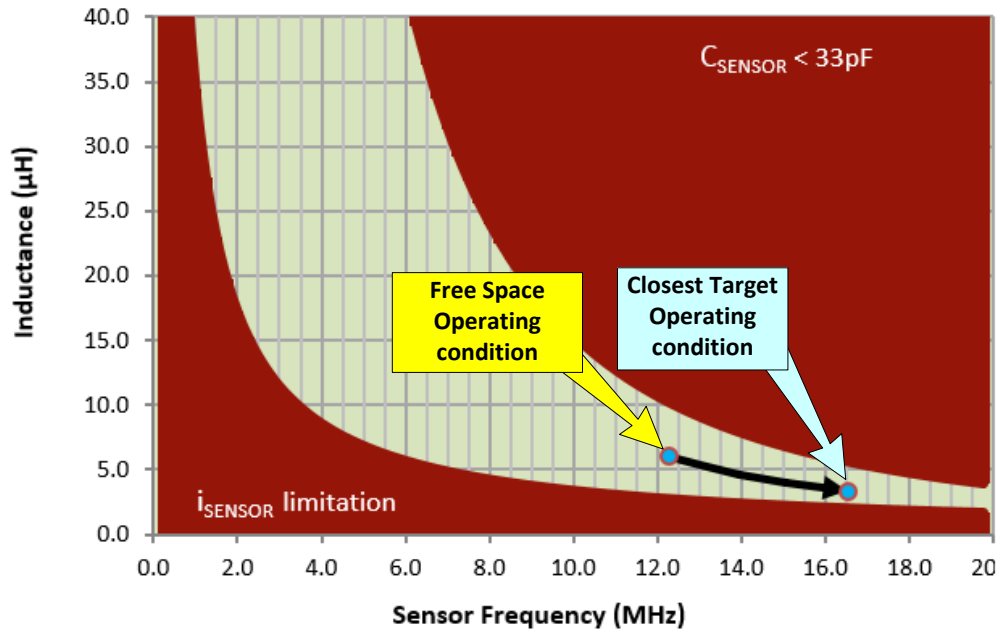
[refer to section 9.2.3 of the LDC0851 datasheet for details.](#)

Battery Capacity	200	mAh
Sample Rate	50	sps
LDC0851 Enable pulse duration	1.16	ms
<b>LDC0851 Average Current</b>	<b>0.097</b>	<b>mA</b>
<b>Battery Lifetime (LDC0851 loading only)</b>	<b>0.20</b>	<b>years</b>

This section requires the preceding sections be filled out. Current consumption is estimated based on the highest current operation, which occurs when the target is closest to the LDC0851.

### 5 Operating Region Graphs

The generated graph shows the operating region of the LDC0851; invalid operating ranges are filled in red. The black line starts at the free-space operating condition and points towards the LDC0851 operating condition when the target is closest to the sensor. The line should never enter an invalid region.

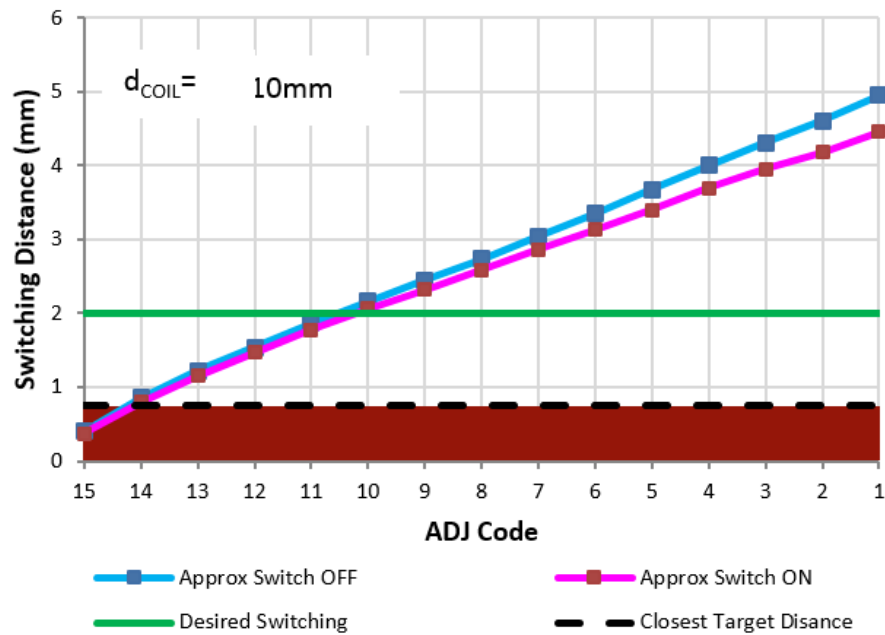


**Figure 5: Operating Region graph**

To the right of operating region graph is the switching distance graph. This graph shows the on and off switching distances for the ADJ settings of the specified coil diameter.

The Red region corresponds to the closest target-sensor distance.

The Green line shows the desired switching distance.



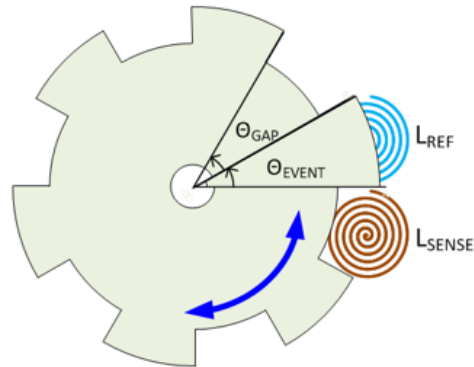
**Figure 6: Switching Distance and ADJ Code Calculations**

## 6 Rotation Event Counting

The LDC0851 can be used in applications where the rotation speed needs to be measured. One example implementation is detailed at <http://www.ti.com/tool/TIDA-00851-LDC0851>. Simply enter the physical geometry information and the desired oversample ratio (the minimum ratio is 3, while 4-5 may be needed for some systems).

The tool then calculates the maximum RPM that can be measured.

### LDC0851 Rotation Speed Estimate



LDC0851 Sample Rate	2.836	ksps
Minimum Angle for one event ( $\theta_{GAP}$ )	30	°
Minimum Angle for Gap between events	10	°
Effective Number of teeth/blades	9	
Oversample ratio	3	
Maximum Rotation speed	6303.3	RPM

**Figure 7: Rotation Event Counting**