ModusToolbox™ Sensor Designer tool user guide

ModusToolbox™ CAPSENSE™ and Multi-Sense Pack
Sensor Designer tool version 1.21.0

About this document

A newer revision of this document may be available on the web here.

Scope and purpose

The Sensor Designer tool is a standalone software tool included with the ModusToolbox™ software. The tool is used to create and configure Liquid Level and Button sensor designs.

Intended audience

This document helps application developers understand how to use the Sensor Designer tool as part of a ModusToolbox™ application.

Document conventions

Convention	Explanation
Bold	Emphasizes heading levels, column headings, menus and sub-menus
Italics	Denotes file names and paths.
`Monospace`	Denotes APIs, functions, interrupt handlers, events, data types, error handlers, file/folder names, directories, command line inputs, code snippets
File > New	Indicates that a cascading sub-menu opens when you select a menu item

Abbreviations and definitions

The following define the abbreviations and terms used in this document:

- Application – One or more projects related to each other.
- CAD – computer-aided design
- CAPSENSE – capacitive sensing
- Configurator – A GUI-based tool used to configure a resource.
- DXF – drawing exchange format
- ISX – inductive sensing method
- Liquid Level sensor – A sensor that consists of several electrodes and is designed for the liquid level calculation.
- PCB – printed circuit board
- PSOC™ – programmable system-on-chip

Reference documents

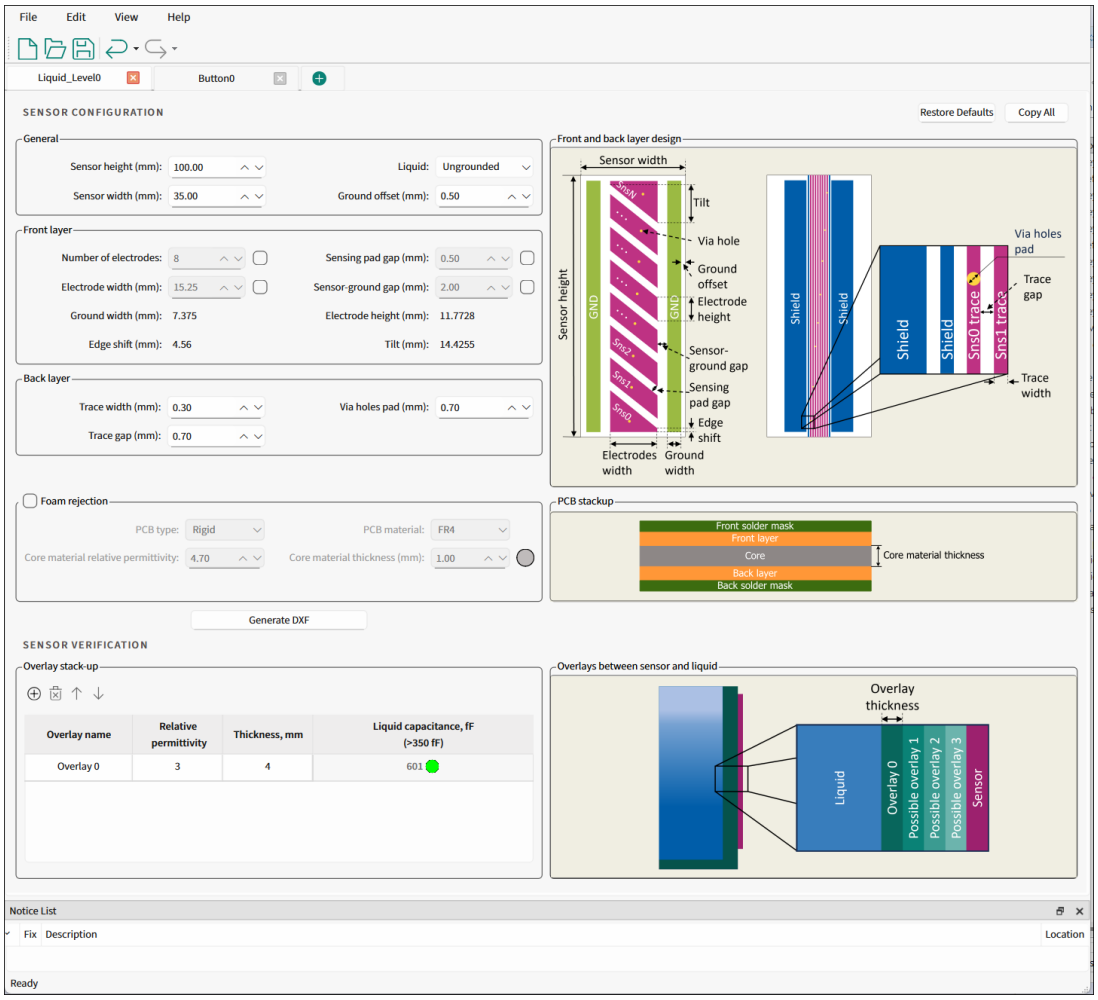
Refer to the following documents for more information as needed:

- ModusToolbox™ tools package user guide
- CAPSENSE™ Configurator user guide
- CAPSENSE™ Tuner user guide
- Eclipse IDE for ModusToolbox™ user guide
- VS Code for ModusToolbox™ user guide

Table of contents

1 Overview

The Sensor Designer tool generates sensor drawings in the **.dxf* file format to be imported into PCB layouts. The tool interface contains the parameters description and illustrative images of the sensor drawings. You can add multiple Liquid Level tab and Button tab tabs to generate data for the sensor. The tool is supported on Windows, Linux, and macOS.



2 Launch the Sensor Designer tool

There are several ways to launch the Sensor Designer tool, and those ways depend on the application, and how you use the various tools.

2.1 VS Code and Eclipse IDE

VS Code and Eclipse have tools to launch the Sensor Designer tool from within an open application. Refer to the applicable user guide for more details:

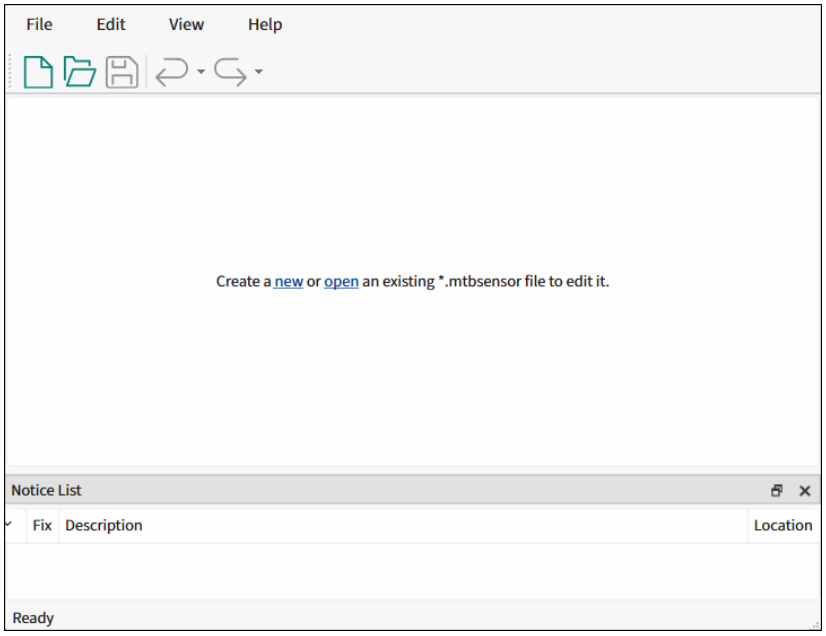
- VS Code for ModusToolbox™ user guide
- Eclipse IDE for ModusToolbox™ user guide

2.2 Executable

You can launch the Sensor Designer tool GUI by running its executable as appropriate for your operating system. By default, it is installed here:

<install_dir>/ModusToolbox/packs/ModusToolbox-Multi-Sense-Pack/tools/sensor-designer-tool

When opened this way, the Sensor Designer tool GUI opens blank without any information.



3 Quick start

This section provides a simple workflow for how to use the Sensor Designer tool.

1. Launch the Sensor Designer tool.
2. Create a new or open an existing sensor configuration to edit it.
3. Edit the configuration.
4. Generate a Liquid Level or Button sensor drawing.
5. Save the configuration.
6. Click the **Generate DXF** button to generate a **.dxf* file to the specified directory. Then, import the file to the CAD software.

4 GUI description

Menus

- **File**
  - **New** – Creates a new file with new configuration.
  - **Open…** – Opens a specified *.mtbsensor configuration file. The current configuration file, if any, will be closed. If there are unsaved changes, a dialog opens asking to save or not.
  - **Close** – Closes the current configuration file.
  - **Save** – Saves the current configuration file.
  - **Save As…** – Saves the existing file under a different name.
  - **Open in System Explorer** – This opens your computer's file explorer tool to the folder that contains the *.mtbsensor configuration file.
  - **Recent files** – Shows recent files that you can open directly.
  - **Exit** – Closes the tool. You will be prompted to save any pending changes.
- **Edit**
  - **Undo** – Undoes the last action or sequence of actions.
  - **Redo** – Redoes the last undone action or sequence of undone actions.
- **View**
  - **Notice List** – Hides or shows the Notice List pane. The pane displays by default.
  - **Toolbar** – Hides or shows the Toolbar.
  - **Reset View** – Resets the view to the default.
- **Help**
  - **View Help** – Opens this document.
  - **About Sensor Designer tool** – Opens the About box for version information, with links to open https://www.infineon.com and the current session log files of the application.

Toolbar

The toolbar contains common commands from the **File** and **Edit** menus. Use the check box under the **View** menu to show or hide the toolbar.

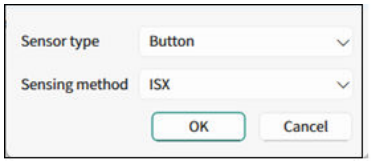
Sensor tabs

The Liquid Level tab and Button tab sensor tabs represent the relevant sensor configuration. A tab contains a set of parameters to configure the settings of a sensor drawing pattern and generate it to the **.dxf* file.

The tab name is provided as the default name for the generated **.dxf* file. To rename the sensor/tab, double-click its name.

Add sensor tabs

To create new configuration, click **New** on the **File** menu. It will display the "Select sensor" dialog.



- **Sensor type** – Liquid Level or Button.
- **Sensing method** – CSD for Liquid Level, ISX for Button.

4 GUI description

Types of sensor tabs

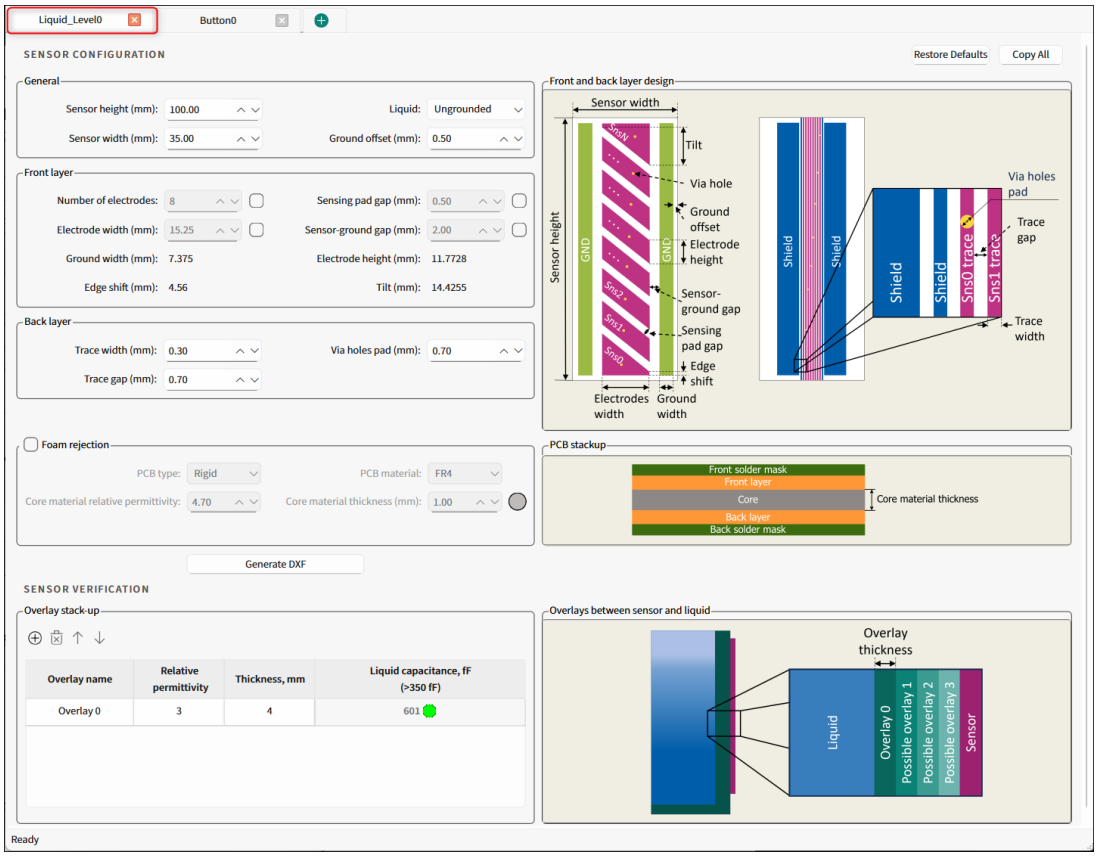
- Liquid Level tab
- Button tab

Actions

- To add a tab for a new level, click the  . It will display the "Select sensor" dialog.
- To remove a tab, click the  .
- To rename the sensor, double-click its name.
- To change the tabs order, left-click a tab name and drag it to the preferred position.

5 Liquid Level tab

The **Liquid Level** tab is used to design a liquid level sensor for the preferred application requirements and generate a **.dxf* file.



Commands

- **Restore Defaults** – Restores parameters values on the current tab to their default values.
- **Copy All** – Click this button to copy the list of input and output parameters to the system clipboard as plain text.

5.1 Sensor configuration

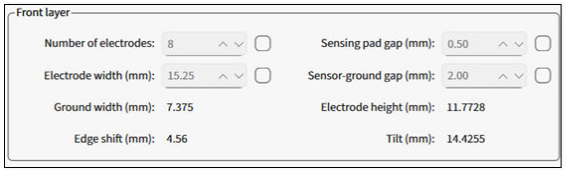
General

- **Sensor height (mm)** – The height of the sensor measurable stack-up. The range – 30.00-422.5, default – 100.00.
- **Sensor width (mm)** – The width of the entire sensor stack-up. The range – 20.00-60.00, default – 35.00.
- **Liquid** – Select whether the liquid is Ungrounded or Grounded. Default – Ungrounded.
- **Ground offset (mm)** – The spacing gap between the outer ground traces and the edge of the sensor area. The range – 0.5-15, default – 0.50.

5 Liquid Level tab

Front layer

Select the relevant check box to use the parameter as an input parameter.

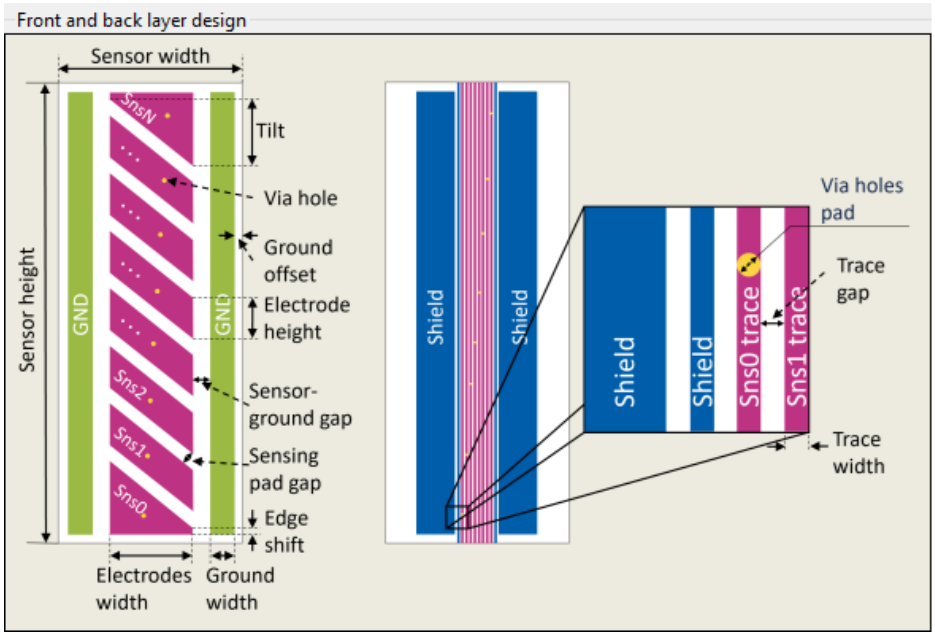


- **Number of electrodes** – The total number of electrodes. The range – 3-32.
- **Electrode width (mm)** – The horizontal width of each electrode. The range – 1-59.99.
- **Ground width (mm)** – Read-only. The width of the ground traces.
- **Sensing pad gap (mm)** – The space between the electrodes. The range – 0.1-10.
- **Sensor-ground gap (mm)** – The horizontal space between the electrodes and neighboring ground traces. The range – 0.1-10.
- **Electrode height (mm)** – Read-only. The height of an electrode when measured at a single point on the horizontal axis.
- **Edge shift (mm)** – Read-only. The edge shift area on the top and bottom electrodes. This value can be negative.
- **Tilt (mm)** – Read-only. The distance between the highest and lowest points of the tilted edge of an electrode.

Back layer

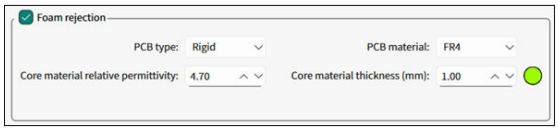
- **Trace width (mm)** – The width of the trace, which connects some segment of the Liquid Level sensor with the connector. The range – 0.1-10, default – 0.30.
- **Trace gap (mm)** – The distance between adjacent trace widths. The range – 0.1-10, default – 0.70.
- **Via holes pad (mm)** – The diameter of through-hole pads for each sensor between the front and back layer. The range – 0.1-10, default – 0.70.

Illustration of front and back layer design parameters



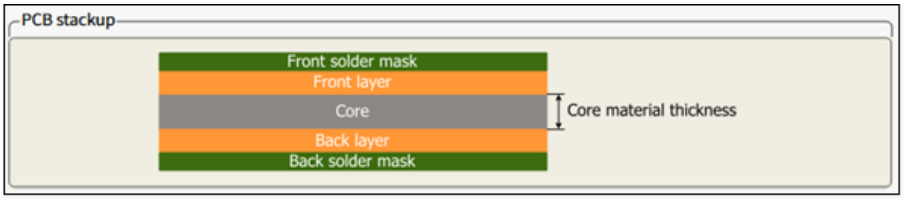
Foam rejection

Enables the foam rejection analysis for the selected sensor design.



- **PCB type** – The PCB technology used for the sensor: Rigid, Flex, Other.
- **Core material relative permittivity** – The relative permittivity of the PCB core material.
- **PCB material** – The PCB base material used for the sensor.
- **Core material thickness (mm)** – The thickness of the PCB core material between the conductive layers.

Illustration of PCB stackup

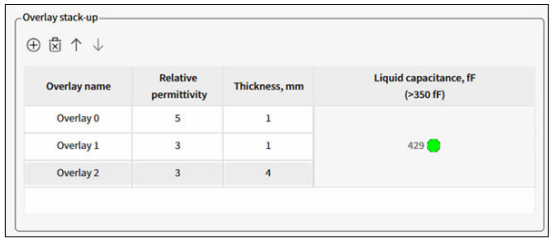


Generate DXF

Click this button to generate a **.dxf* file of the calculated liquid level sensor to a specified file location.

5.2 Sensor verification

Overlay stack-up



Toolbar

- To add an overlay, click the "plus" icon.
- To remove an overlay, click the "cross" icon.
- To move an overlay up/down, use the arrows.

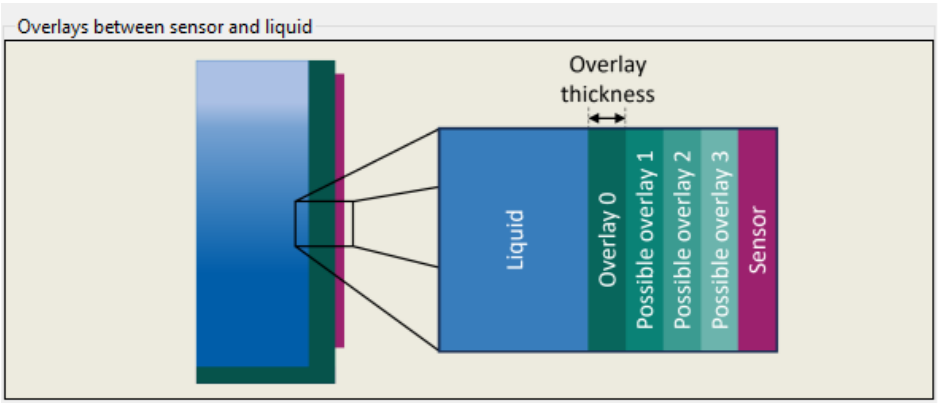
Verification parameters table

- **Overlay name** – The name of an overlay stack-up.
- **Relative permittivity** –Relative permittivity of the overlayer/stack-up material.
- **Thickness, mm** – The thickness of an overlay stack-up.
- **Liquid capacitance, fF (>350fF)** – The guarding value of calculated sensor capacitance depending on the sensor design and amount of added liquid. In short, the sensor capacitance caused by added liquid. This

parameter must exceed 350fF. The sign in the executive button and a message in the Notice List will be displayed to indicated inefficient design.

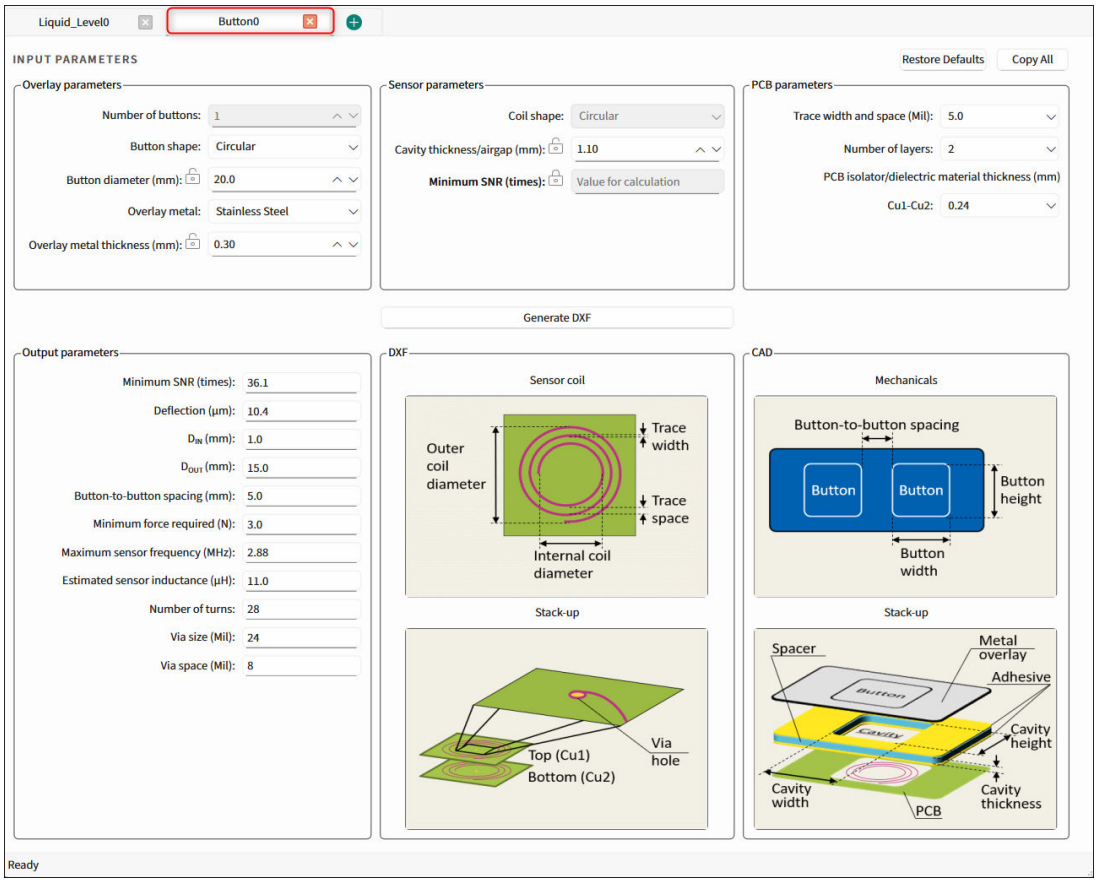
***Note**: When the value is below 350fF, you can still generate a *.dxf file but the sensor may have low performance.*

Illustration of overlays between sensor and liquid



6 Button tab

The **Button** tab is used to design an inductive sensing coil and its parameters for the preferred application requirements and generate a **.dxf* file.



Commands

- **Restore Defaults** – Restores parameters values on the current tab to their default values.
- **Copy All** – Click this button to copy the list of input and output parameters to the system clipboard as plain text.

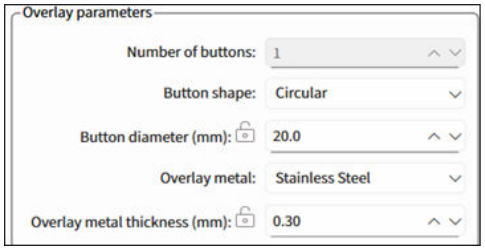
6.1 Input parameters

The **Input parameters** include **Overlay**, **Sensor**, and **PCB** parameters.

***Note**:* *The first output parameter will always be the same parameter, which is locked in the **Input parameters** section. Lock the relevant parameter by double-clicking its unlocked icon. Only one parameter can be locked at a time.*

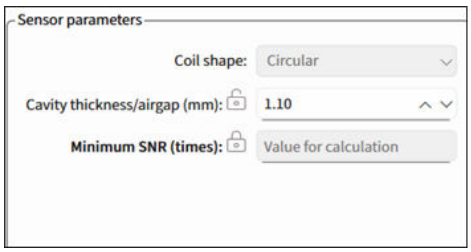
6 Button tab

Overlay parameters



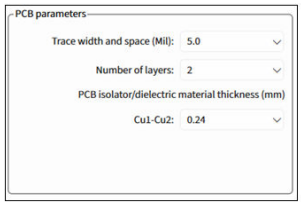
- **Number of buttons** – The number of buttons in the specified widget. Default – 1.
- **Button shape** – Circular.
- **Button diameter (mm)** – The range is 8-28, default – 20.
- **Overlay metal** [1)] – Stainless Steel, Aluminum. Default – Stainless Steel.
- **Overlay metal thickness (mm)** – The thickness of the specified overlay. The range is 0.2-0.5, default – 0.30.
  - Stainless Steel – The range is 0.2-0.5, default – 0.30.
  - Aluminum – The range is 0.25-0.5, default – 0.30.

Sensor parameters



- **Coil shape** – Circular.
- **Cavity thickness/airgap (mm)** – The gap between the overlay and the sensor coil. The range is 0.3-7. Default – 1.10.
- **Minimum SNR (times)** – The minimum SNR required for the sensor optimum performance. The range is 1-40.

PCB parameters



- **Trace width and space (Mil)** – The minimum sensor PCB trace width for generating output parameters. Select from: 3.5, 4.0, 5.0, or 7.0. Default – 5.
- **Number of layers** – The number of Cu layers. Select from: 1, 2 or 4. Default – 2.
- **PCB isolator/dielectric material thickness (mm)** – Enabled for more than 1 layer. The thickness of PCB Isolator or dielectric material used between Cu layers.
  - For 2 layers, Cu1-Cu2, select from: 0.24, 0.4, 1.0, 1.2. Default – 0.24.
  - For 4 layers, the spaces between the layers are fixed: 0.24 – 1.0 – 0.24.

1 Titanium, Copper – not supported for this release.

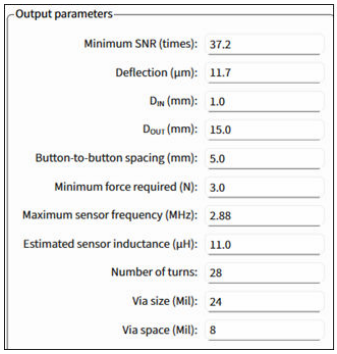
Generate DXF

Click this button to generate a **.dxf* file of the calculated liquid level sensor to a specified file location.

This button is disabled if the calculated value is beyond the allowed range and the first field of the **Output parameters** indicates that.

6.2 Output parameters

The first output parameter will always be the same parameter, which is locked  in the Input parameters section. Lock the relevant parameter by double-clicking its unlock  icon .



***Note**: Only one parameter can be locked at a time.*

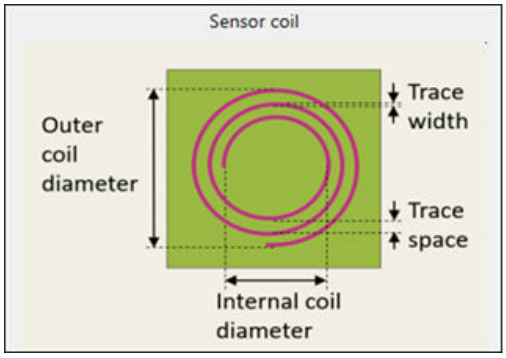
- **Button height and width, Button diameter, Minimum SNR (times), Overlay metal thickness, and Cavity thickness/airgap** – The calculated value of a specified parameter.
- **Deflection (µm)** – The overlay deflection for the minimum force applied to trigger the sensor to achieve the calculated or specified SNR.
- **D_{IN} (mm)** – The sensor-coil inner diameter/diagonal.
- **D_{OUT} (mm)** – The sensor-coil outer diameter/diagonal. Always – 75 % of the referred button size.
- **Button-to-button spacing (mm)** – The minimum spacing between buttons.
- **Minimum force required (N)** – The minimum sensor-activation force to achieve the calculated or specified SNR. Always – 3 N.
- **Maximum sensor frequency (MHz)** – The maximum sensor-drive frequency.
- **Estimated sensor inductance (µH)** – The estimated effective sensor coil inductance. The estimate is based on the number of coil turns, trace width, PCB layers, PCB layers spacing.
- **Number of turns** – The number of coil turns per each layer.
- **Via size (Mil)** – The diameter of the through-hole pad in the multi-layer PCB.
- **Via space (Mil)** – Spacing between through-hole pads and coil wire in the multi-layer PCB.

6.3 Illustration of DXF design

Displays the calculated structure of a designed sensor array.

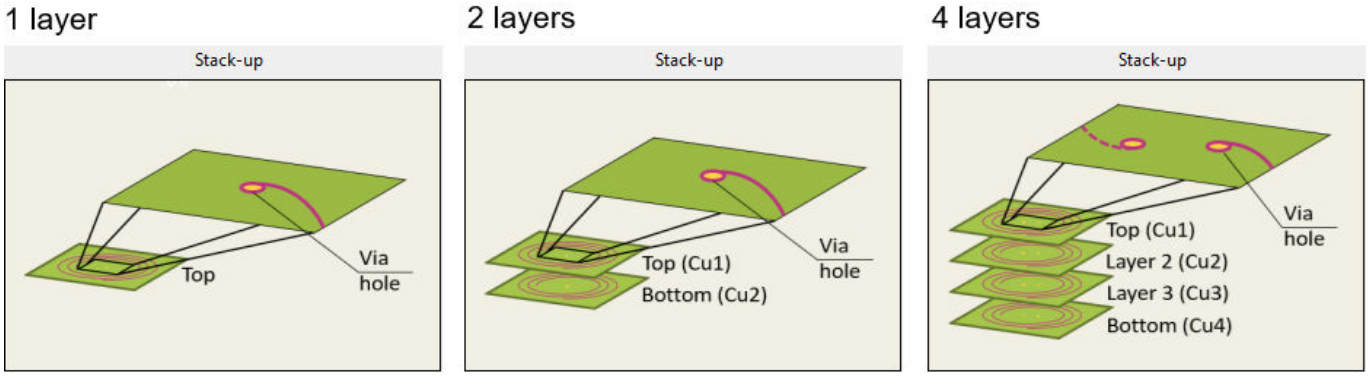
Sensor coil

The illustrative image of a sensor coil.



Stack-up

The illustrative image of a DXF Stack-up.

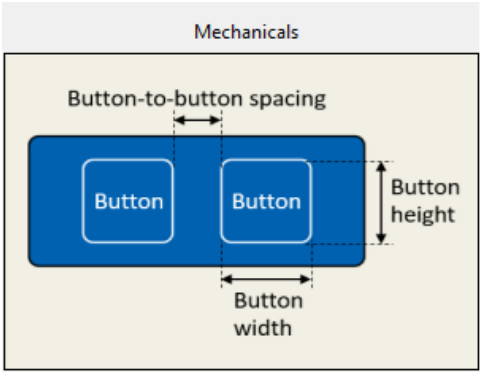


6.4 Illustration of CAD design

Displays the calculated mechanical structure of a designed button.

Mechanicals

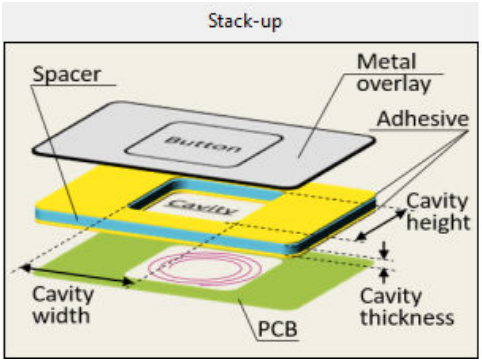
The illustrative image of the buttons' placement.



Stack-up

The illustrative image of the CAD stack-up.

6 Button tab


Stack-up
Spacer
Metal overlay
Adhesive
Button
Cavity
Cavity height
Cavity width
Cavity thickness
PCB

7 Version changes

Version	Change descriptions
1.0	New tool.
1.10	Improved ISX Button tab design and calculation Unified Liquid Level and ISX Button tabs behavior
1.20	Updated Liquid Level sensor dimensions.
	Updated GUI style.
1.21	Restricted Coil Shape to the Circular option for ISX Button sensors.
	Added core material estimation for the foam rejection feature.

Revision history

Revision	Date	Description
**	2025-02-12	New document.
*A	2025-03-04	Updated to version 1.10.
*B	2025-10-06	Updated to version 1.20.
*C	2026-04-14	Updated to version 1.21.

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