PSOC™ 4 Liquid level sensing (LLS) training
Customer training workshop (CTW)

December 2025

Prerequisites

- Basic hands-on with ModusToolbox™
- Basic understanding of PSOC™ 4 devices

- Install or update the following on your PC:
  - ModusToolbox™ tools package v3.6.0
  - ModusToolbox™ Eclipse IDE 2025.4.0
  - ModusToolbox™ programming tools 1.5
  - ModusToolbox™ CAPSENSE ™ and Multi-sense pack

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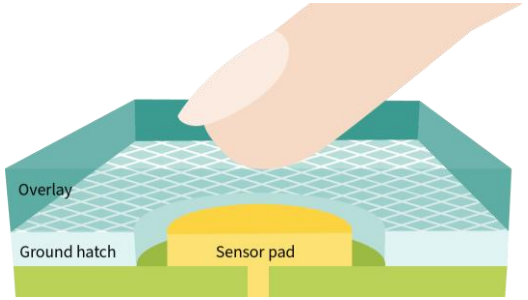
Liquid-level sensing

CAPSENSE™ technology with inductive and liquid sensing

Infineon PSOC™ 4 with Multi-sense

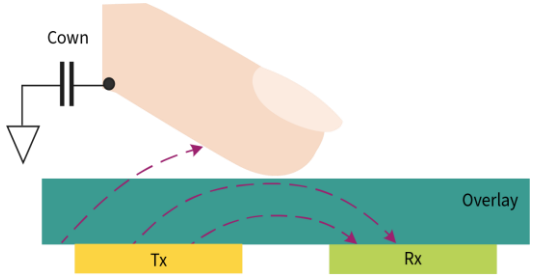
CAPSENSE™ – Capacitive sensing

Self-capacitive sensing



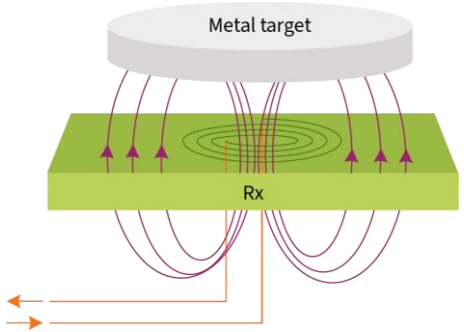
- **CSD** – Infineon's proprietary self-capacitance sensing method
- Measures capacitance of a single electrode
- User touch increases the capacitance of the electrode

Mutual capacitive sensing



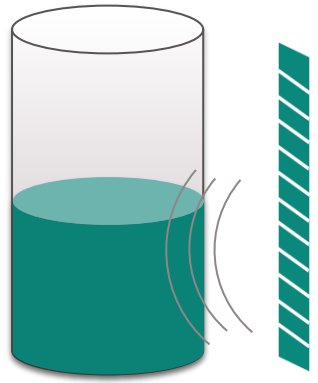
- **CSX** – Infineon's proprietary Mutual-capacitance sensing method
- Measures capacitance between two electrodes
- User touch decreases capacitance between electrodes

Inductive sensing



- **ISX** – Infineon's proprietary Inductive sensing method
- Measures inductance of sensor coil
- Deflection of metal decreases inductance of the electrode

Liquid sensing



- **LLS** – Infineon's proprietary liquid sensing method
- Detects presence and level of liquid without contacts
- Reliable sensing and rejects false signals such as foam mist and droplets

Applications/Use cases

- **Humidifiers**
  - Liquid level calculation helps estimate the number of hours the humidifier can run before refilling is required

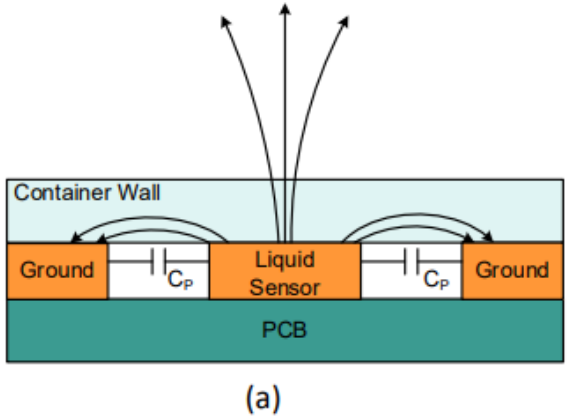
- **Coffee makers**
  - It enables the estimation of the number of cups that can be brewed before the water reservoir needs to be refilled

- **Robot mopping machines**
  - Help estimate the number of cleaning cycles that can be completed before the water tank needs to be refilled
  - Prevents machine damage due to low water levels

- **Pet water-bowl**
  - Detects the low and empty levels to control the motor that pumps the water through the fountain

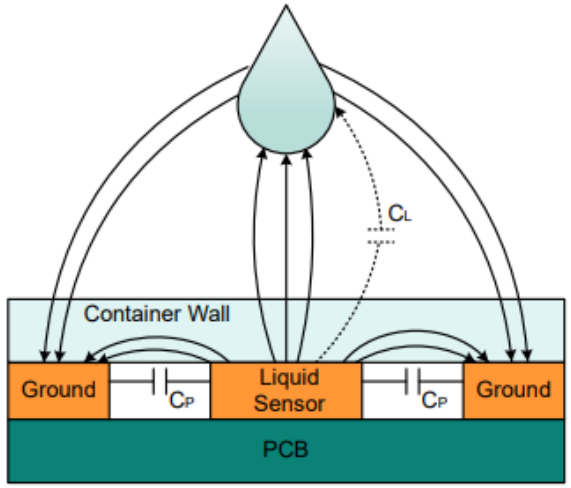
Basic concept

– Liquid level sensing (LLS) involves measuring the increased capacitance when water is near the sensor



(a)

Capacitance and electric field of a capacitive liquid level sensor

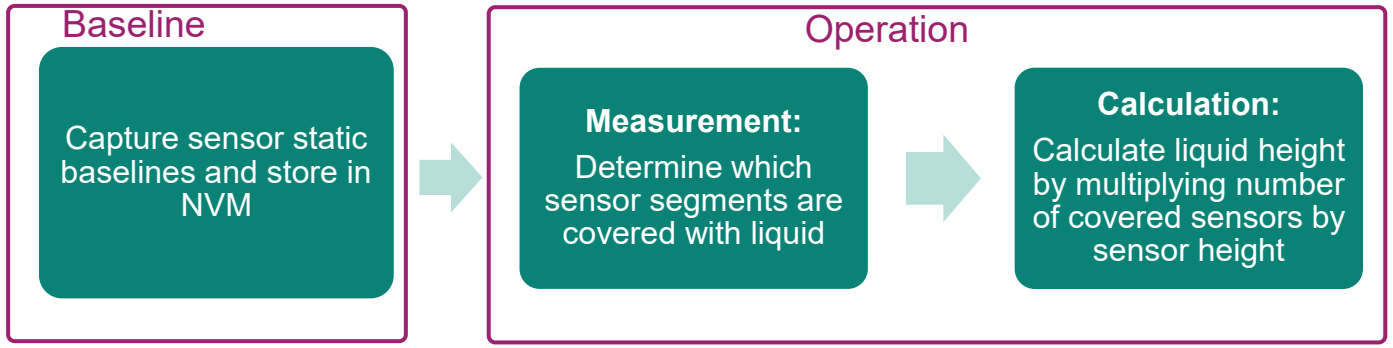


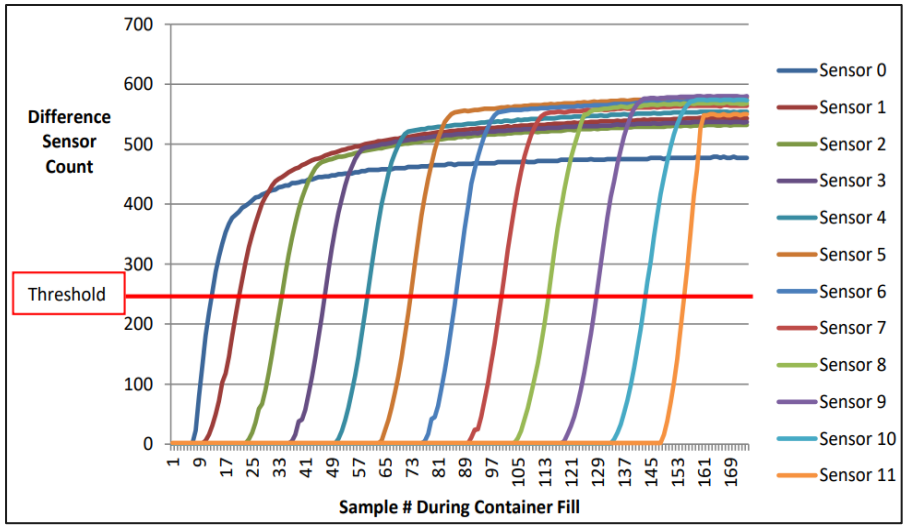
(b)

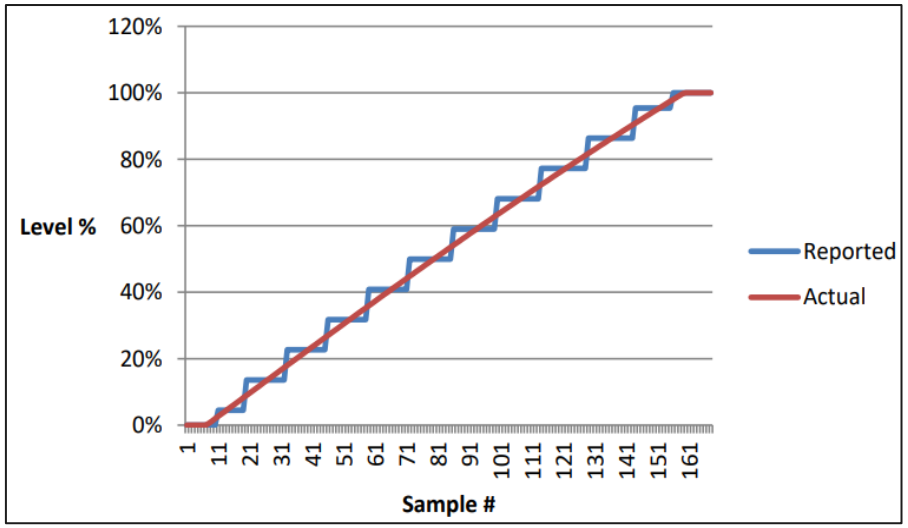
Added capacitance (CL) when the liquid approaches a capacitive sensor

Standard liquid level sensing

- Algorithm is based on signal changes relative to a static baseline measured during manufacturing
- Place equally sized sensors along the length of the container
- Drawback: Lower accuracy

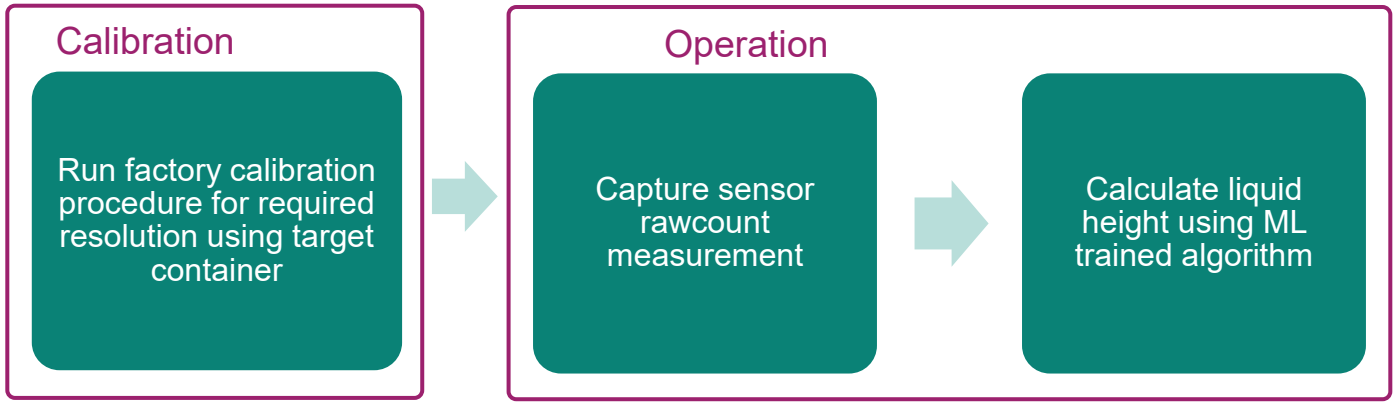


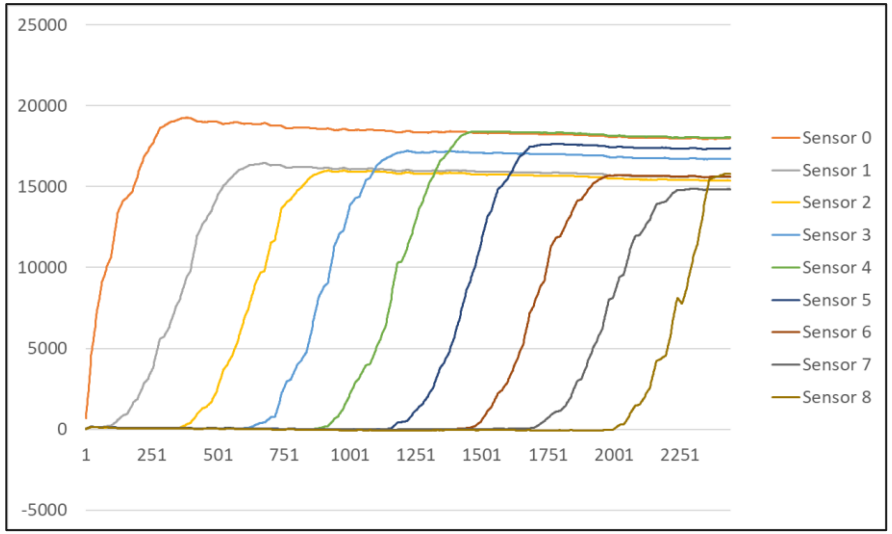


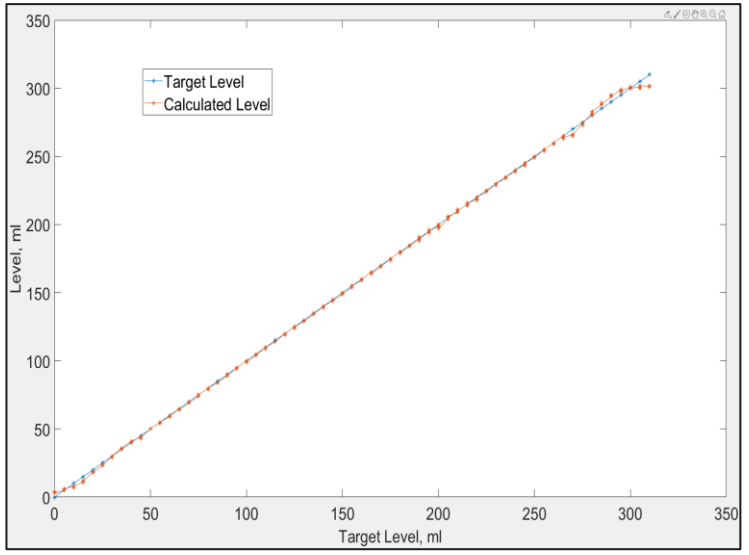


ML-based approach used by LLS

– Algorithm uses an ML trained model to detect liquid level

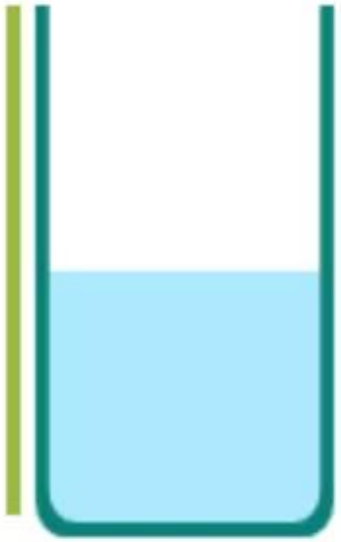






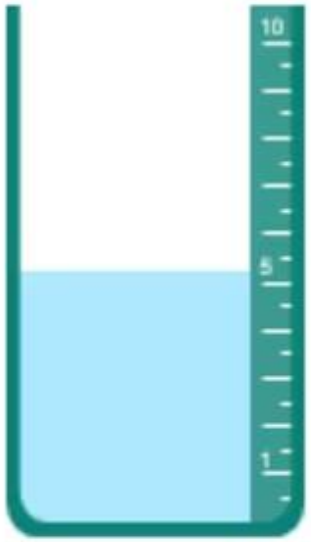
Advantages

Contactless



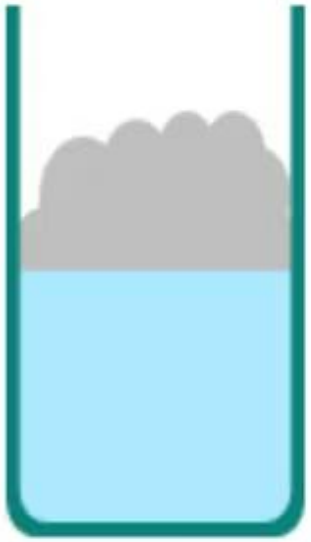
- **Contactless OR contact-based** liquid sensing designs
- **Up to 3mm airgap** for low-res liquid detection

High-resolution



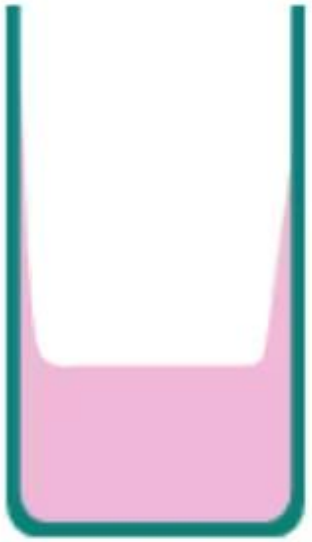
- Supports high-resolution designs
- **Up to 0.1mm step size** (e.g. 1,000 levels in container with 10cm height)

Foam rejection



- Operates highly reliable **differentiating liquids from foam**

Residue rejection



- Operates highly reliable **rejecting residue on container walls**

Special containers

- Supports **non-linear shapes and thicknesses**
- Sensor can be **trained with ML based tool**

+ Infineon liquid sensing solution has **low temperature dependency** and is **agnostic to assembly/process variations**

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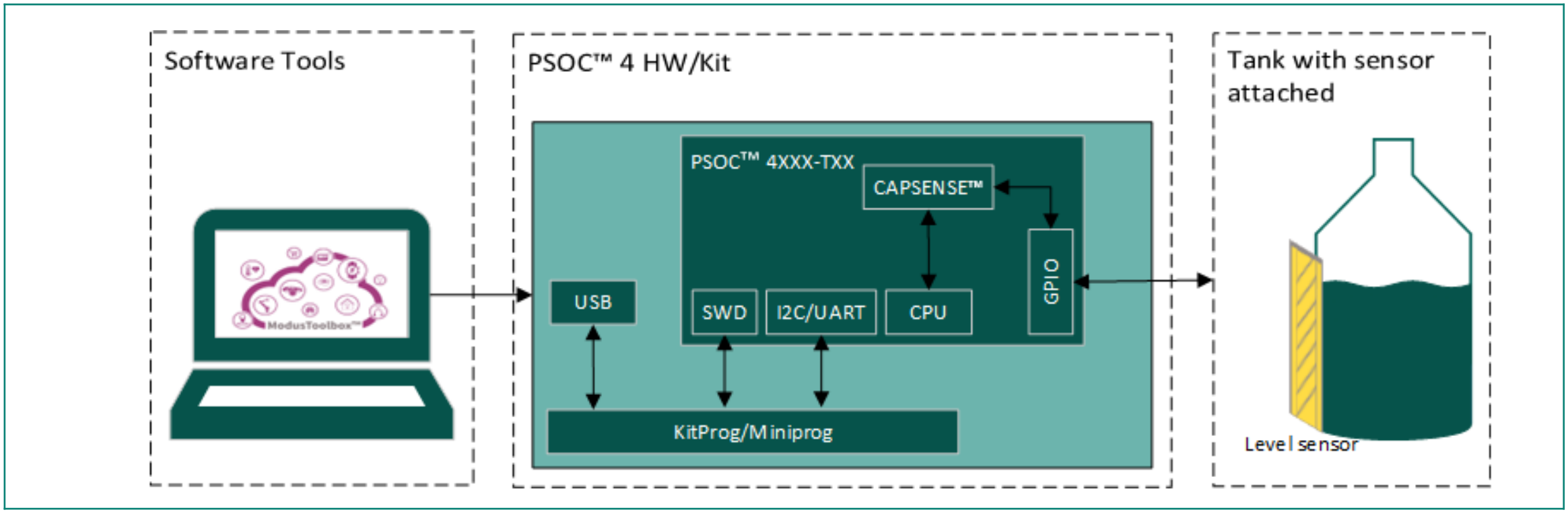
Development ecosystem

Development resources

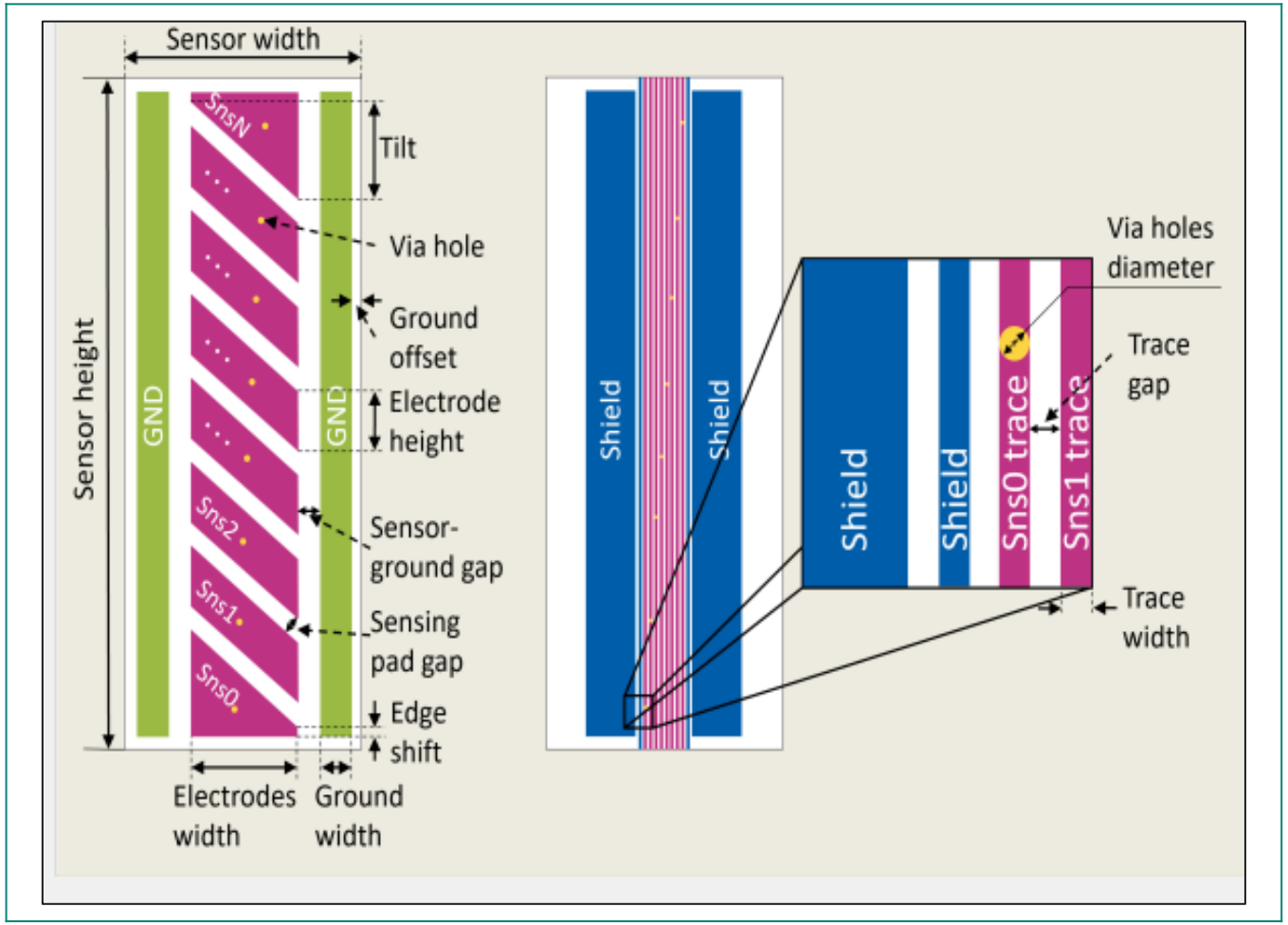
Components required for developing and tuning an LLS design:

- Liquid in a container
- LLS sensor
- PSOC™ 4 device
- Software tools



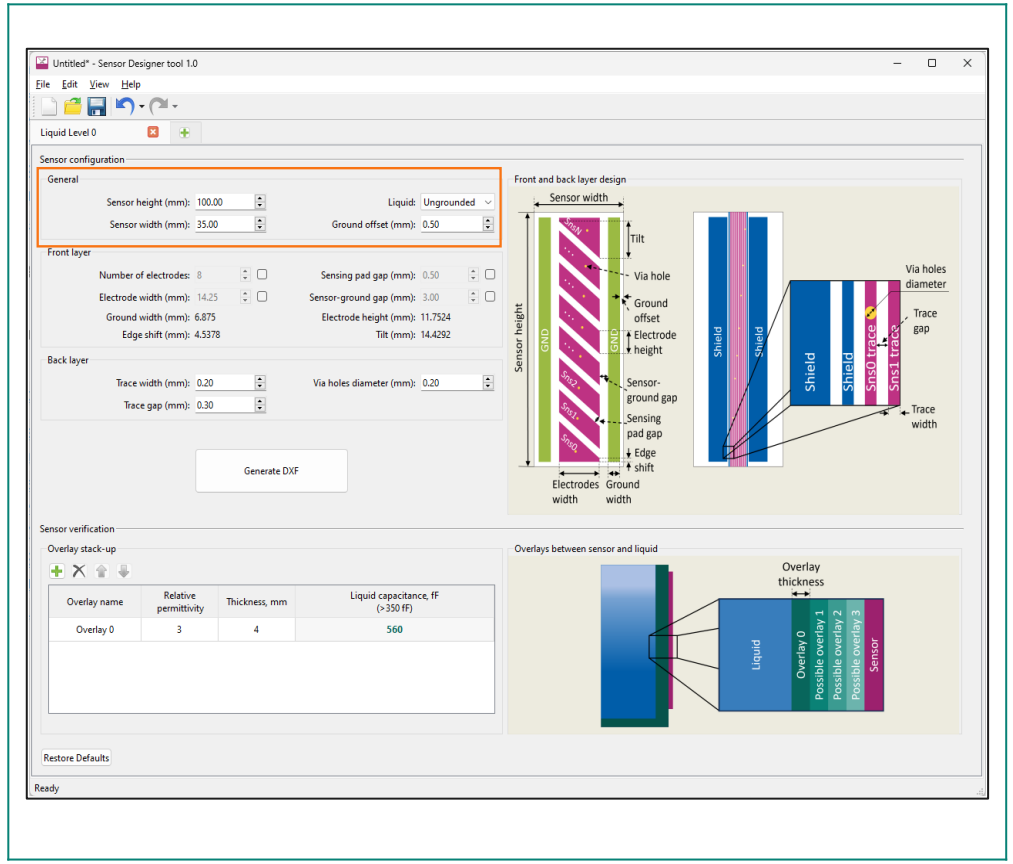
Sensor pattern

- Array of sensor segments equally spaced from the top to the bottom of the container
- Sensor Designer tool to generate a pattern



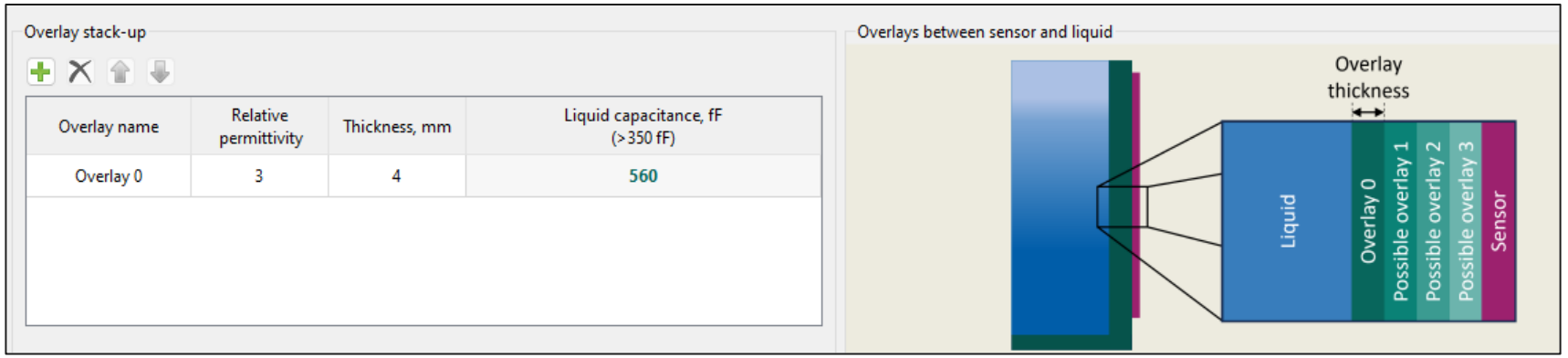
Sensor designer tool

- Inputs: Sensor dimensions, tank details (overlay stack-up)
- Output: DXF file



Tank details (overlay stack-up)

- Input thickness and dielectric constant of the layers of the tank
- Estimate achievable liquid capacitance
- Indicate if good liquid sensing performance is expected



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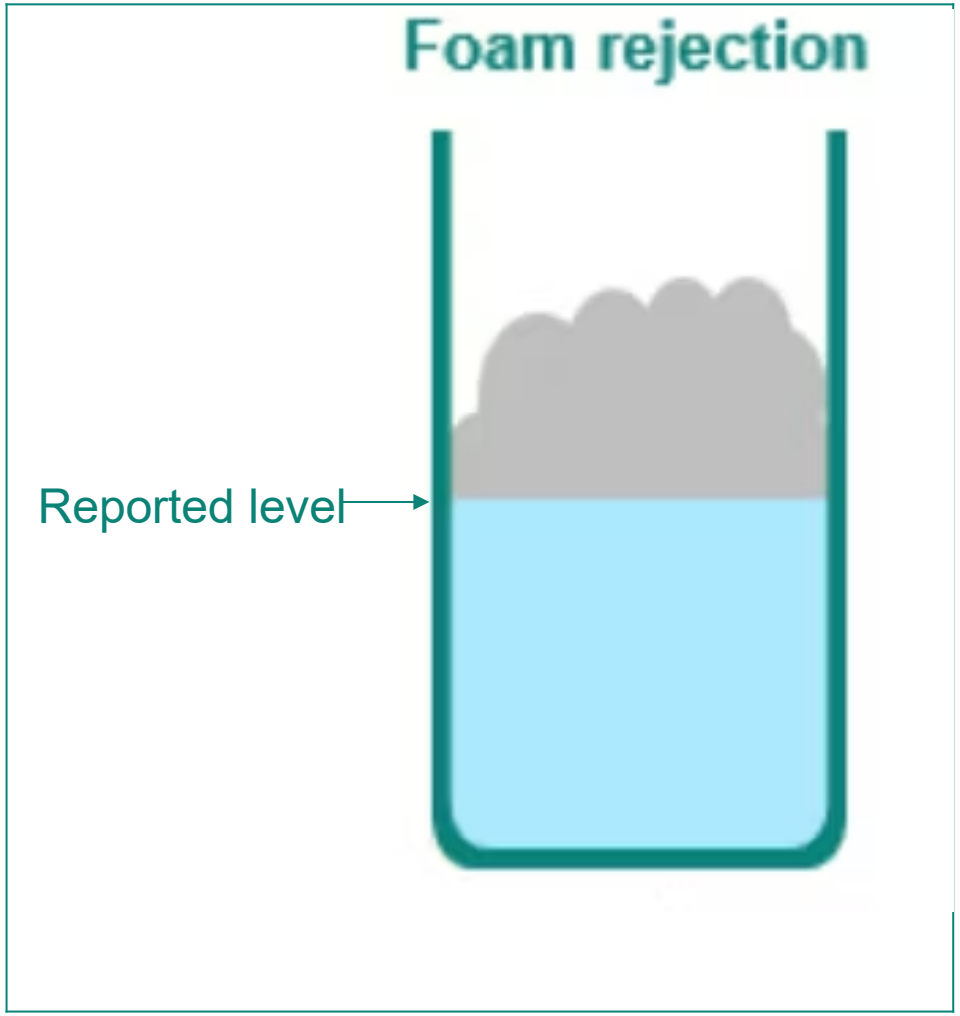
Tuning and calibration

Tuning and calibration

- CAPSENSE™ performance tuning
  - Sensors must be tuned as per guidelines for optimal performance
- CAPSENSE™ LLS factory calibration
  - Required for the ML model-based algorithm to work accurately
  - Explained in lab 1
- CAPSENSE™ LLS foam rejection calibration
  - Explained in lab 2

Foam rejection

- Detects liquid level accurately even in the presence of foam
- Enable ‘foam rejection’ in CAPSENSE™ configurator
- Perform foam rejection calibration before the regular calibration procedure



Environmental effects

- **Temperature fluctuations**
  - Can have a significant impact on the capacitance of the system
  - Calibrate your system for your typical liquid temperature
- **Mechanical variations**
  - Static variations are compensated for during manufacturing with the calibration operation
  - Dynamic variation is caused by changes during operation
    - Ensure that there are no air bubbles present in the adhesive
    - Ensure that the mechanical design is sufficient to maintain accurate sensor alignment

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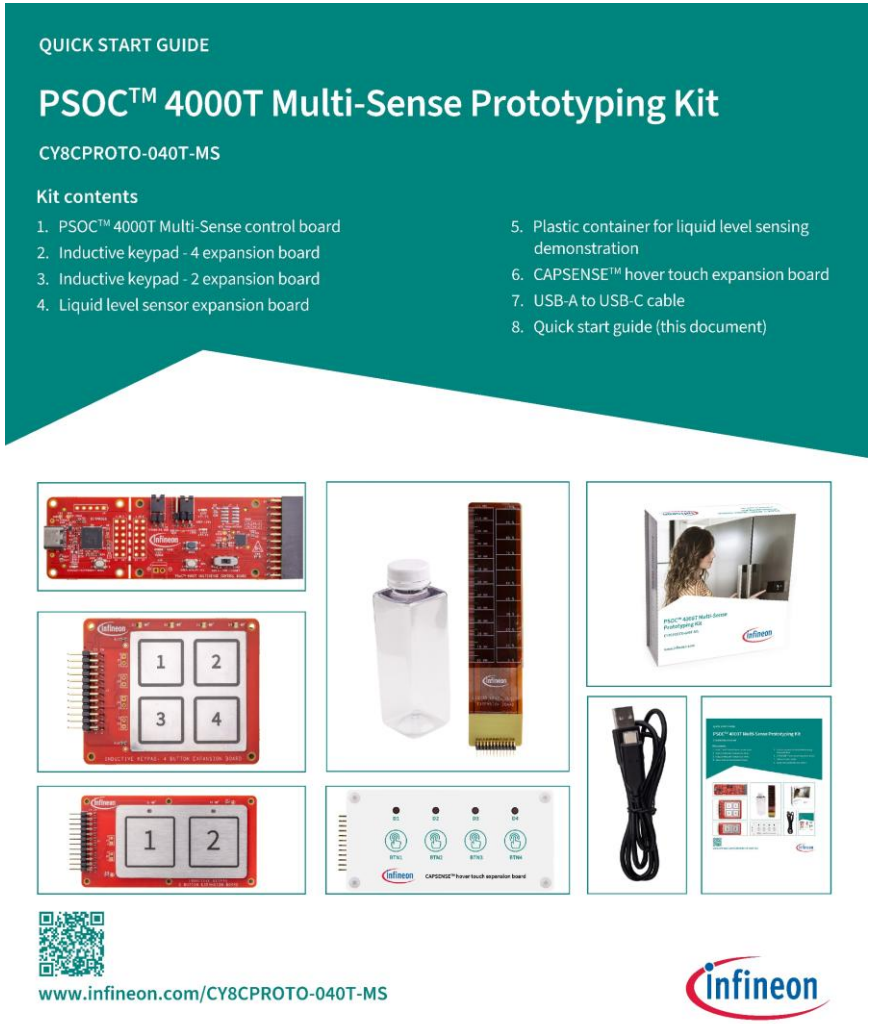
Lab 1: Liquid level sensing (LLS) factory calibration

PSOC™ 4000T Multi-Sense Prototyping Kit [CY8CPROTO-040T-MS]

The CY8CPROTO-040T-MS PSOC™ 4000T Multi-Sense Prototyping Kit allows you to evaluate the features of the PSOC™ 4000T device.

The kit also comes with the following expansion boards:

- A flex PCB with nine sensors, offering a full-scale liquid-level reading of 120 mm
- A touch-over-metal (ToM) Keypad-4 board with 14 mm coils
- A touch-over-metal (ToM) Keypad-2 board with 22 mm coils
- A hover-touch board with four 10 mm buttons that can detect a touch from a distance of 10 mm



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Lab 2: Liquid level sensing (LLS) foam rejection calibration

Thank you!
Stay tuned for more trainings…

Join with us on our mission to drive decarbonization and digitalization Together.

Revision history

Document revision	Date	Description of change
**	2025-12-12	Initial release.


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