



**TROPHÉES INNOVATION
HYDRO**

Microwave-based non-contact liquid level sensor

*A novel sensing technology for liquid level measurement
in harsh industrial environments*

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Challenges of current sensors in harsh environments



Contact sensors



Freezing of the sensor



Brittleness and mechanical failure



Contamination of the target liquid



Noncontact sensors



Low dielectric contrast in cryogenic liquids

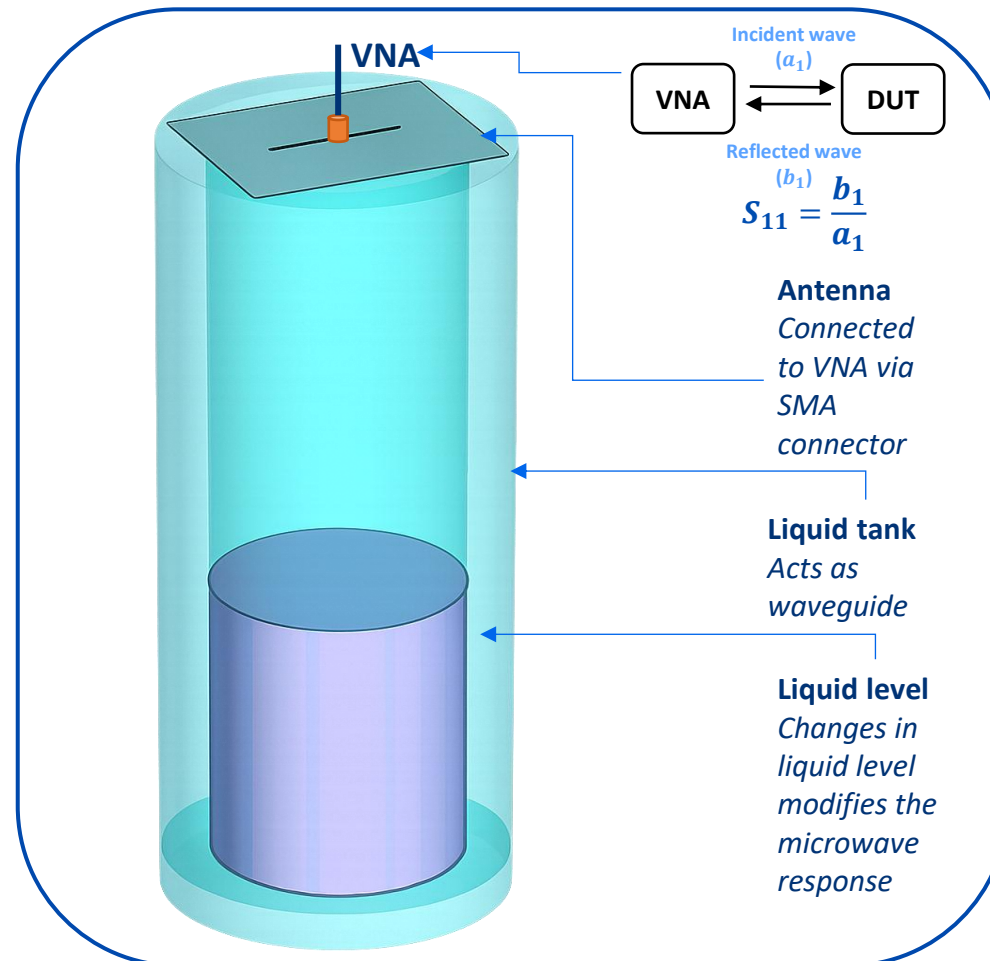


Low accuracy



Surface vibrations

Proposed sensing setup



What is new?



The innovation



Microwave transmission-based sensing method



Liquid tank acts as the sensing waveguide

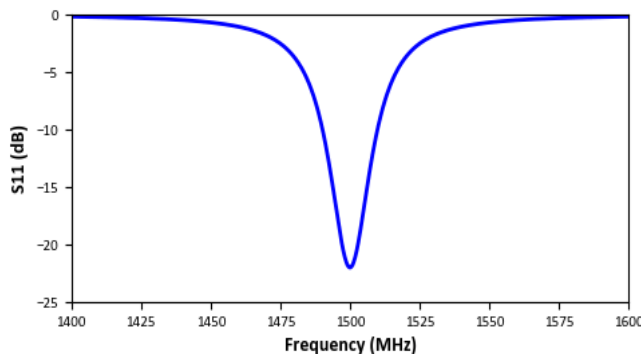
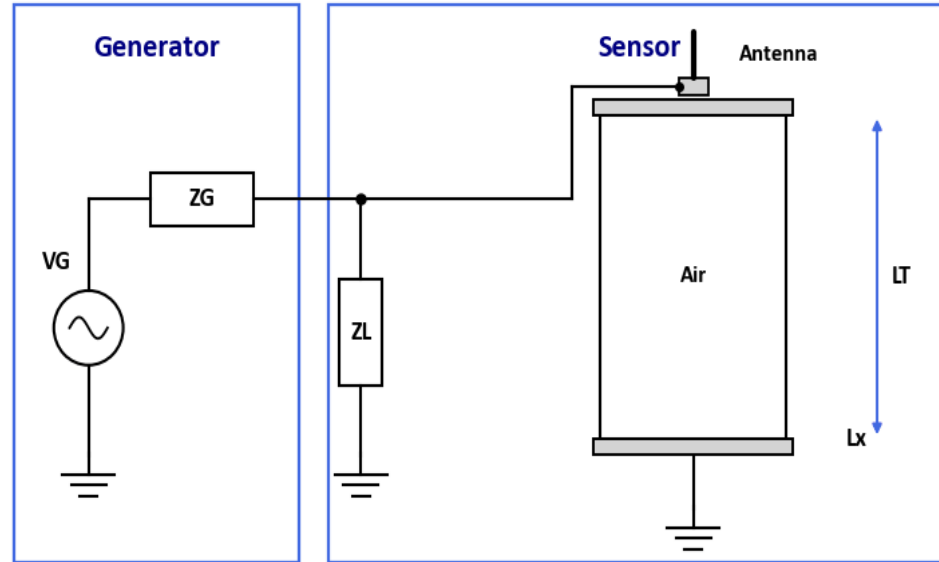


Suitable for harsh industrial environments



Simplified sensor architecture using just a single antenna

Sensor principle



- 1) The VNA transmits a microwave signal via the **antenna** into the tank
- 2) The metallic tank acts as a **waveguide**
- 3) Increasing the liquid level increases the **effective permittivity**
- 4) The **matching frequency** (minimum S11) decreases to lower frequency.
- 5) By tracking this **frequency shift**, the **liquid level** is estimated.

Objectives & Key challenges

Objectives

- Develop a non-contact liquid sensing solution
- Develop a compact, easy to fabricate, low cost and low power sensing method
- Provide continuous and accurate liquid-level monitoring
- Ensure industrial scalability and easy integration in existing storage tanks

Challenges

- Reliable monitoring in harsh industrial environments including cryogenic conditions
- Achieve high sensitivity for accurate and stable measurements
- Easy integration in existing liquid tanks with minimal modifications
- Maintain long-term measurement stability

Industrial applications & Perspectives

Potential applications

- Cryogenic storage and transportation
- Water and wastewater tanks
- Chemical industry to monitor the chemical processing
- Medical biobanks and food processing tanks

Perspectives

- Validation on different types of liquids
- AI-based liquid level detection
- Automated monitoring
- Industrial prototype