

Beyond Piezo: The Future of Ultrasound with XENSIV™ MEMS Ultrasonic Transceiver

Dr. Stefan Mastel

October 21st, 2026

Public

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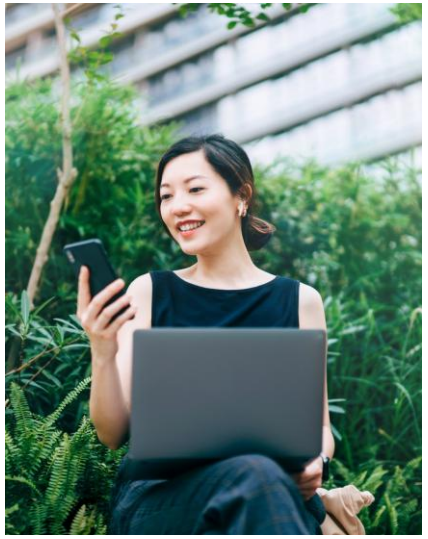
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The growing need for smart sensing

Modern systems need to understand their environemnt reliably, continuously, and cost-efficiently



Consumer devices

- ✓ Wake-up/lock through presence detection
- ✓ Device position



Robotics

- ✓ Obstacle avoidance
- ✓ Self-localization
- ✓ Material recognition



Smart home & appliances

- ✓ Activation by proximity sensing
- ✓ Level sensing
- ✓ Gesture control



Industrial automation

- ✓ Sensing of objects in assembly line
- ✓ Tank level measurement



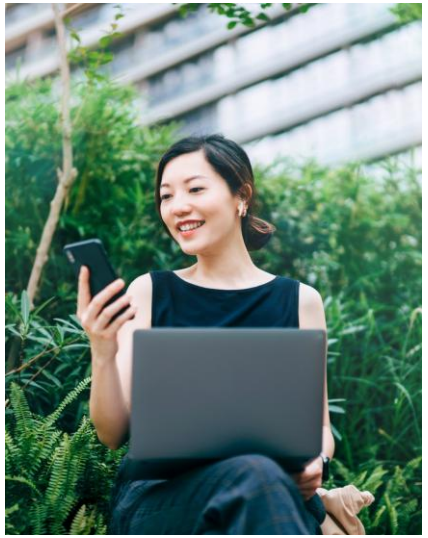
Smart buildings

- ✓ Door/window opeing sensing
- ✓ Human presence detection

Smart sensing

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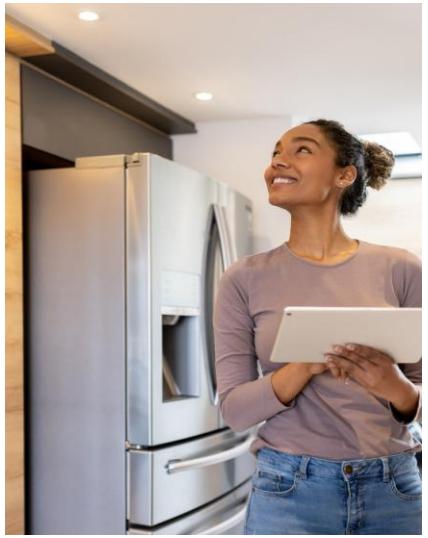
The unique advantages of ultrasonic sensing



Consumer devices



Robotics



Smart home & appliances



Industrial automation



Smart buildings

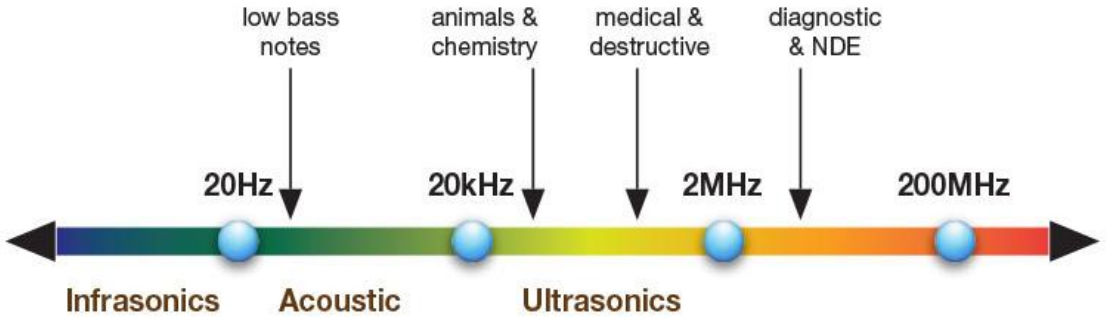
- ✓ Works in darkness
- ✓ Handles dust and fog
- ✓ Detects transparent objects
- ✓ Privacy preserving
- ✓ Direct distance measurement
- ✓ Low processing load

Ultrasound often provides the simplest and most reliable solution where optical modalities struggle

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What is ultrasonic sensing?

- Ultrasound is a sound wave characterized by a frequency higher than the human ear can detect (higher than 20,000 Hz)
- Uses of ultrasound include e.g. object detection, distance measurement, medical imaging, non-destructive investigations



Up to 20 kHz



Audible range

Up to 200 kHz



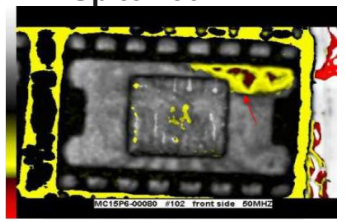
Echolocation (or bio sonar)

Up to 15 MHz

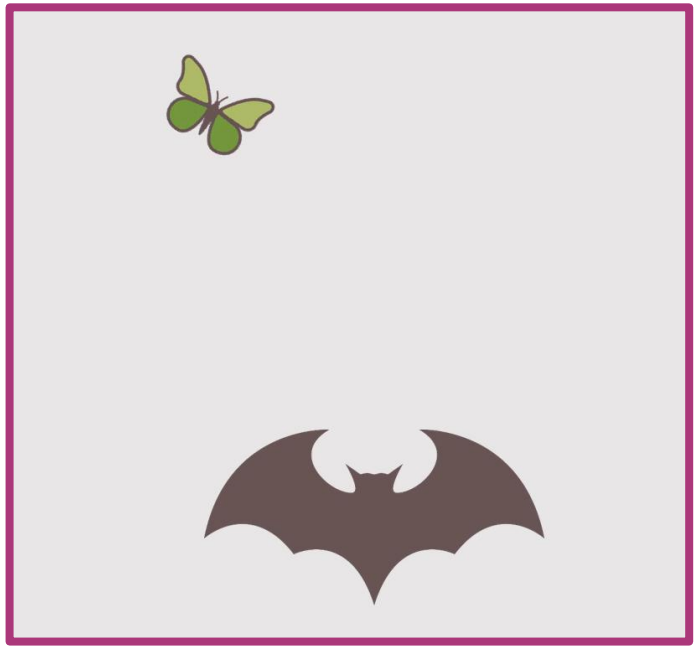


Echography

Up to 230 MHz

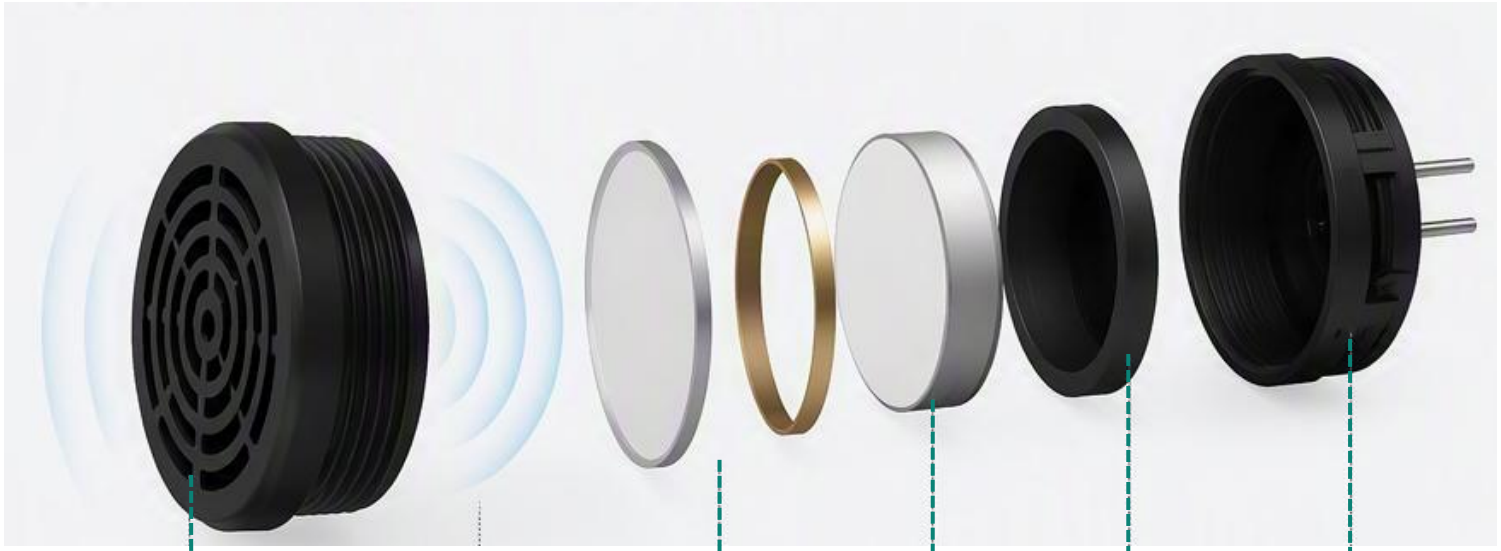


Scanning acoustic microscopy



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Conventional piezo ultrasonic sensor with decades of successful deployment



Proven technology

- Decades of successful deployment
- Mature and reliable technology
- Widely adopted across industries

Typical applications

Distance measurement

Measure distance accurately and reliably

Presence detection

Detect presence or absence of objects or people

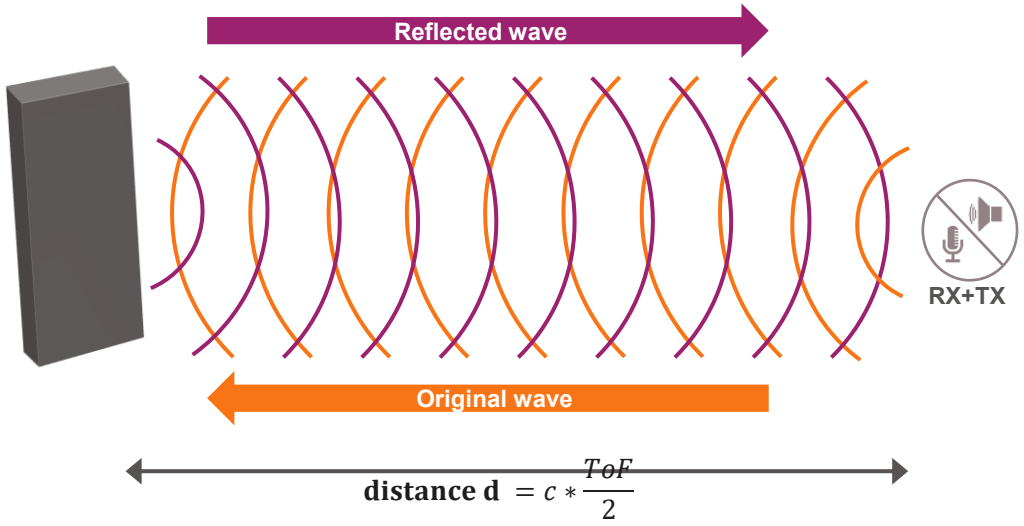
Liquid level sensing

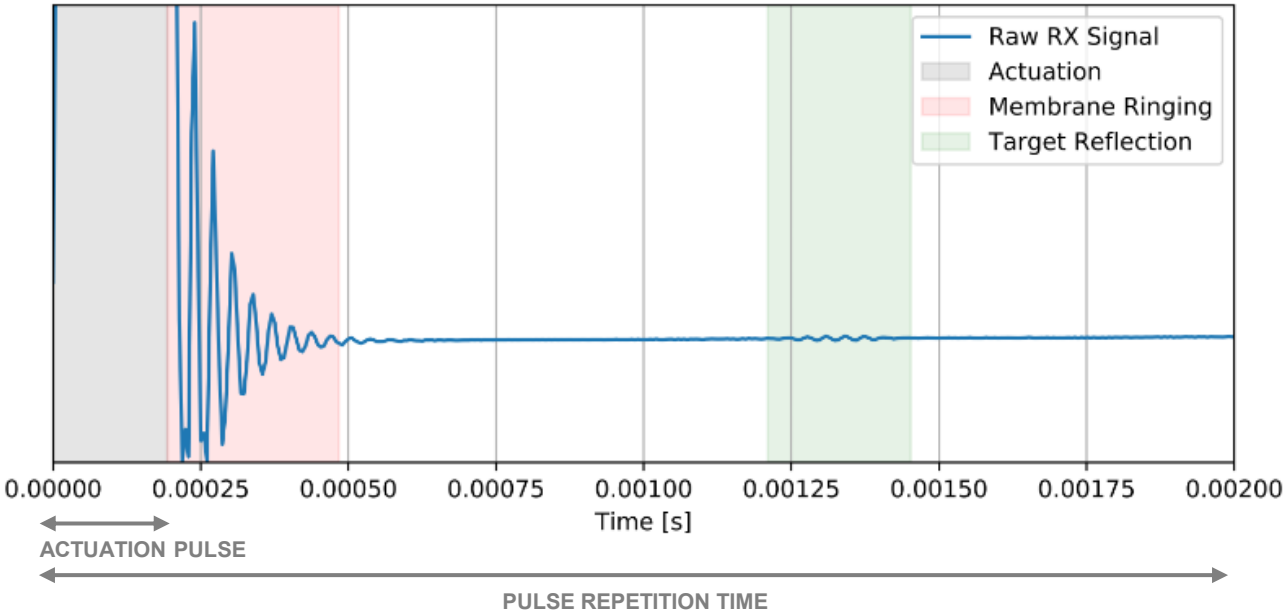
Monitor fill level in tanks or containers

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Pulsed-echo recordings enable distance measurement

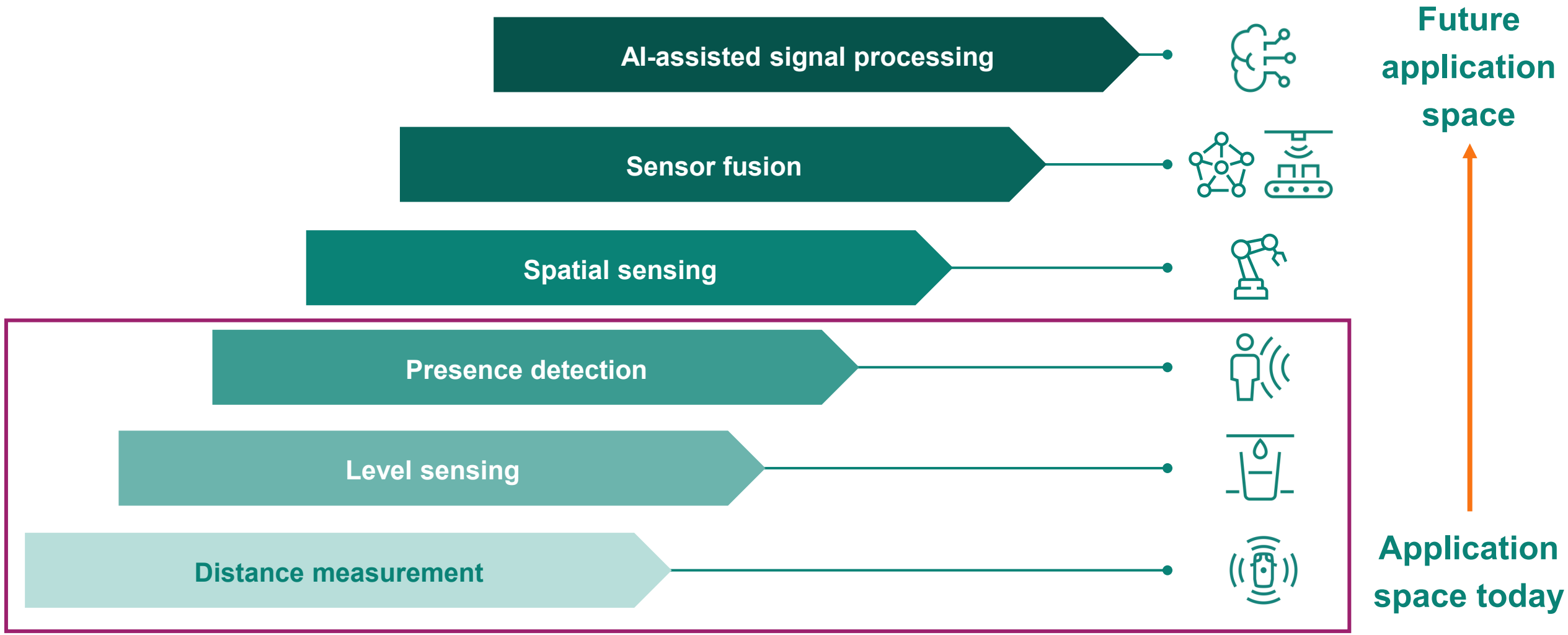
- The transducer is actuated by a burst, emitting a sequence of short ultrasonic pulses. These waves are reflected by close-by objects and subsequently received by the transceiver in receiving mode.
- In the recorded signal, we can distinguish three regions:
  1. **Actuation** → burst-like actuation (audio not detectable, transmit mode only)
  2. **Membrane ringing** → membrane free oscillations after actuation. This artefact can be reduced by using higher actuation frequencies and suppressed by proper algorithms
  3. **Target reflection** → detected echo from reflecting target





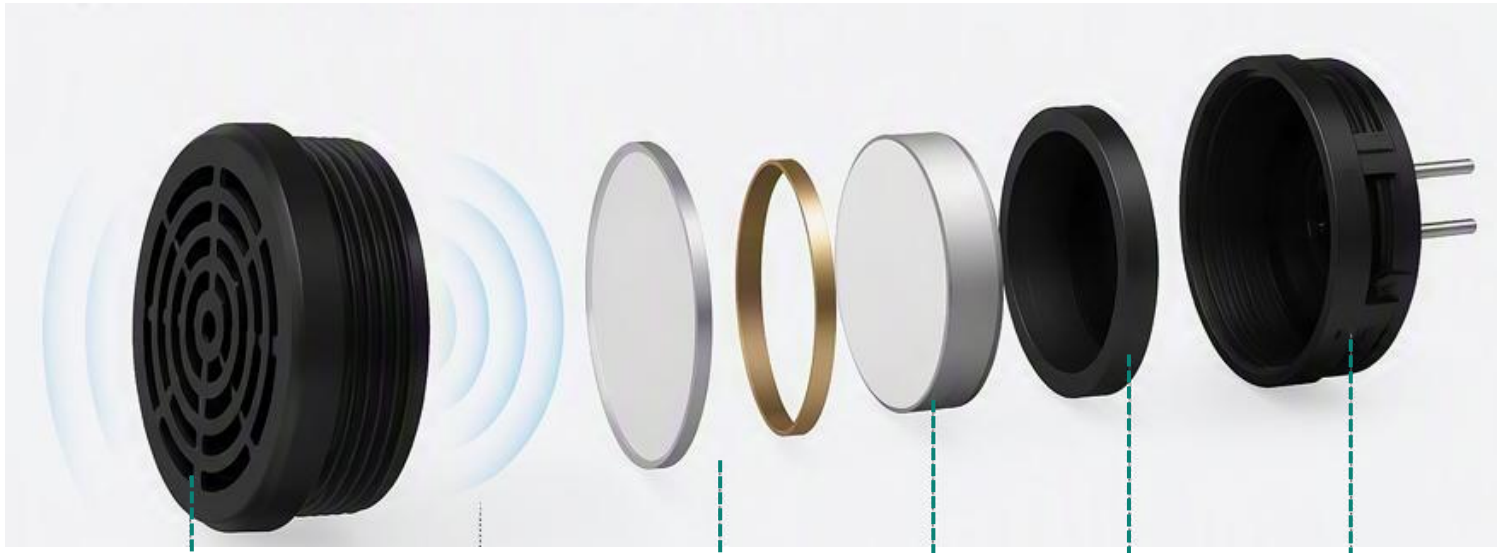
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New applications require smaller size, lower power, easier integration, higher scalability and semiconductor-compatible manufacturing.



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XENSIV™ ultrasound transduce offer significant reduced size and integration compared to legacy transducer



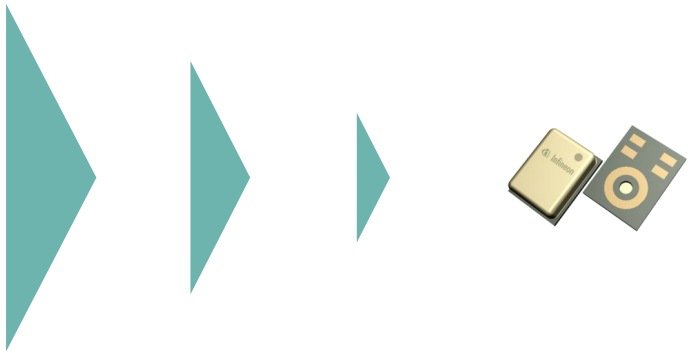
Protective housing

Matching layer & electrodes

Piezo ceramic element

Backing material

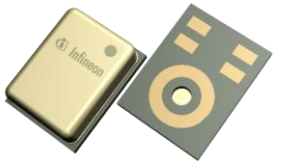
Rear housing & terminal



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Why beyond piezo?

What MEMS is changing in the ultrasonic sensor landscape



MEMS

Advantages

Low cost:
Cheaper implementation

Small size/high-performance density:
Easier implementation and higher performance density in a greatly reduced package size

Robustness:
Resistance to environmental factors like vibrations, electrical noise, and temperature variations

Integrated analog or digital ASICs:
Preconditions and AD-conversion of the sound signal

Tight performance:
Precise and consistent performance across applications

Ease of assembly:
Can be handled by pick-and-place PCB mounting machines

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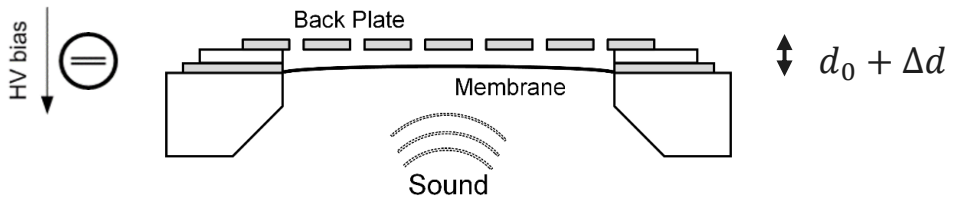
What is a MEMS ultrasonic transducer?

Micro-Electro-Mechanical System transducer

Micromechanical semiconductor structures in the acoustic MEMS sensor that vibrate to transmit and receive ultrasonic signal

Electrical circuitry that enables converting the vibrations received by the acoustic sensor into electrical output signals

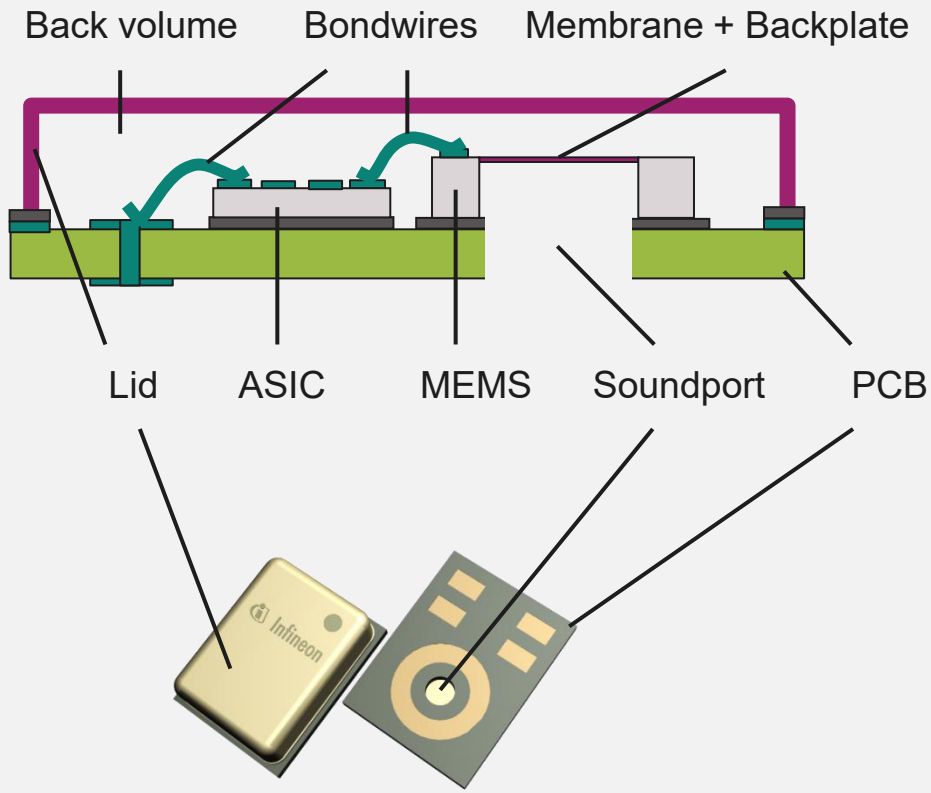
$$\Delta V_{out} = V_{bias} \frac{\Delta d}{d_0}$$



Strength

- Low cost
- Low power
- Small size
- Robust Performance

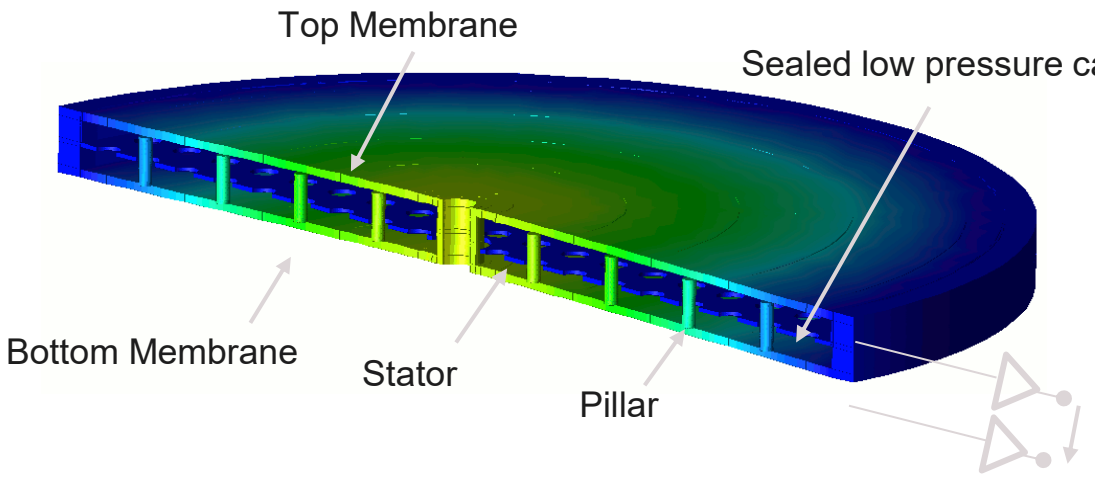
IFX bottom port MEMS ultrasonic transceiver

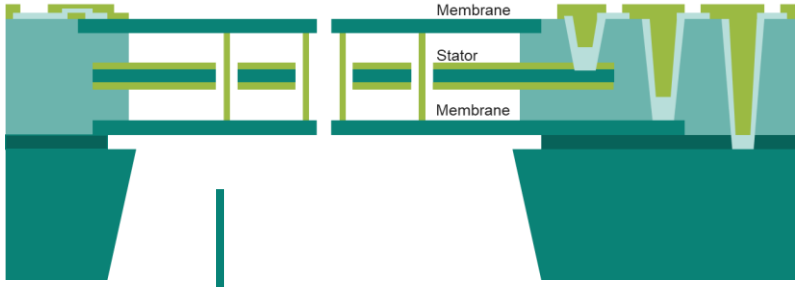


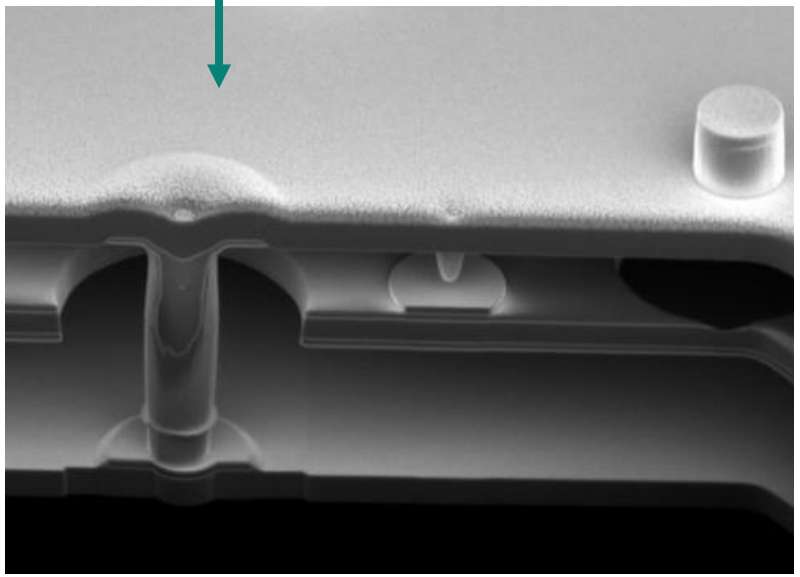
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Our Sealed Dual Membrane (SDM) technology enables up to 80 dB SNR

Sealed Dual Membrane (SDM) – Revolutionary technology for capacitive MEMS ultrasonic transceiver



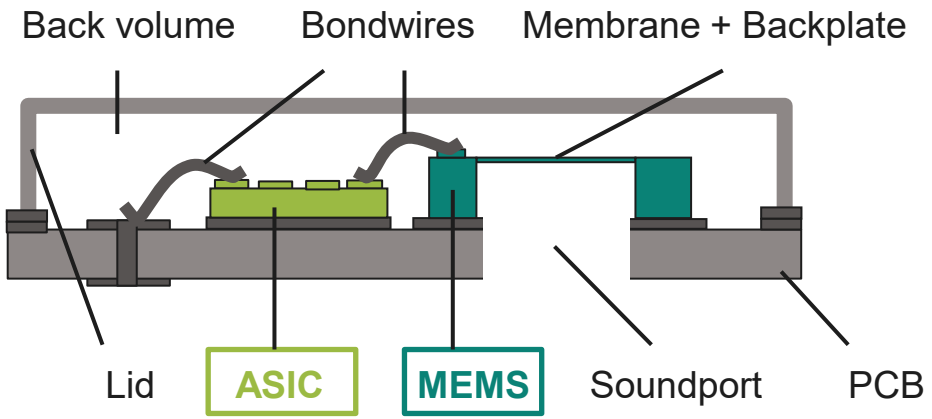




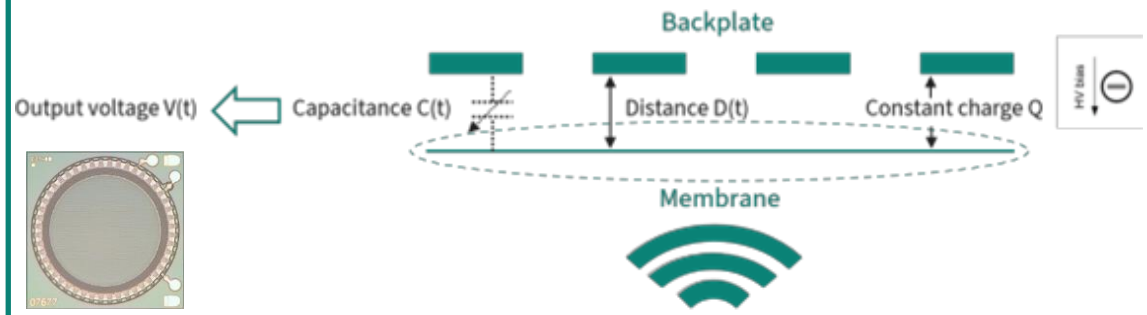
- True-differential topology
  - Enables ultra high SNR of up to 76 dB SNR (82 dB for dual MEMS)
  - Distortion improvement by cancellation of even order distortion
- IP57 environmental robustness leads to less field returns and better manufacturability

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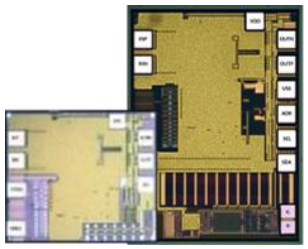
Infineon has a full ownership of every building block of XENSIV™ MEMS ultrasonic transducer bringing unprecedented innovation & quality



Advanced MEMS ultrasonic transducer

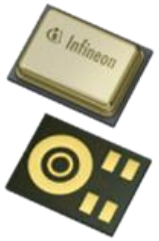


ASIC



- Integral part of the microphone
- Amplifies the output of the MEMS
- Generates the bias voltage for MEMS
- Fuses for calibration

Package



- Provides mechanical and environmental protection
- Shields against EMI and RF interference
- Provides proper acoustical working environment

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XENSIV™ analog MEMS ultrasonic transceivers (ES - IM70A135UT)

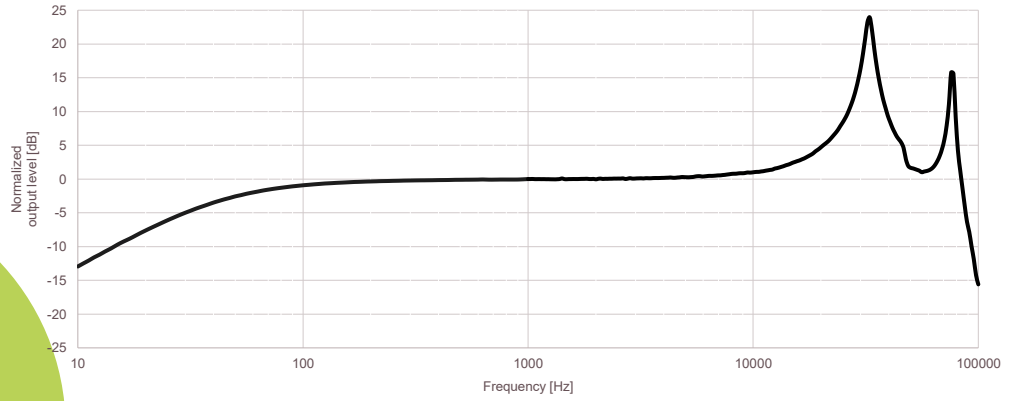
Summary features

- **70 dB(A)** Signal-to-Noise Ratio
- AOP **~135 dB SPL**
- Tight sensitivity (-38±1 dBV)
- **~45 Hz** low frequency roll-off
- **225 µA** current consumption in high performance mode

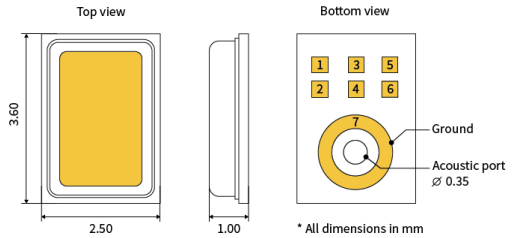
Analog



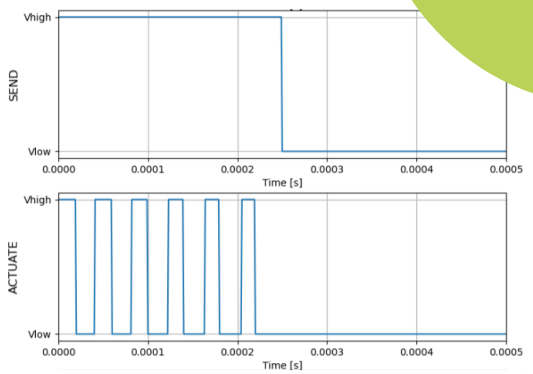
Acoustic and ultrasonic sensitivity



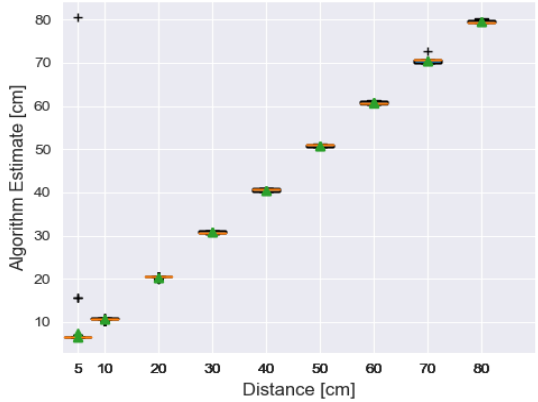
Package information



Pin	Name	Description
1	OUTP	Differential output positive
2	OUTN	Differential output negative
3	VDD	Power supply
4	SEND	Transceivers functionality select
5	ACTUATE	Arbitrary frequency pattern
6	NC	
7	GND	Ground



Target detection



- Detection of $10x10cm^2$ metal reflector

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XENSIV™ digital MEMS ultrasonic transceivers (ES – IM67D131UT)

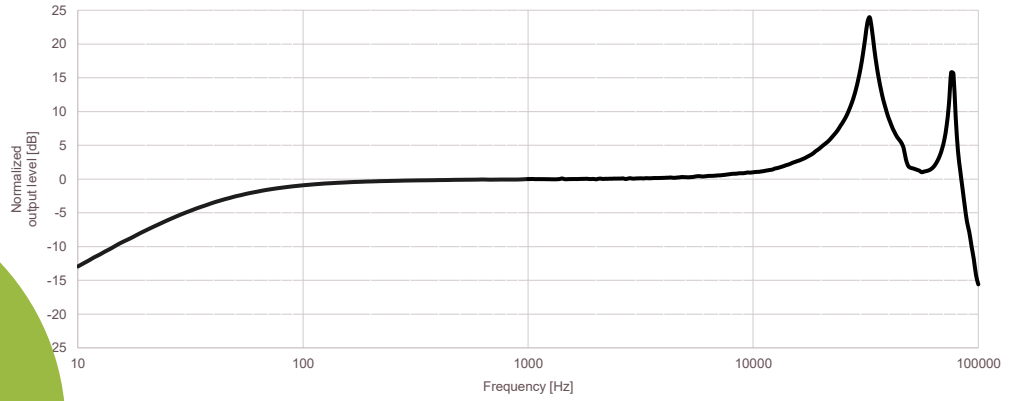
Summary features

- **67 dB(A)** Signal-to-Noise Ratio
- AOP **~131 dB SPL**
- Tight sensitivity (-36±1 dBFS)
- **~45 Hz** low frequency roll-off
- **1100 µA** current consumption in high performance mode

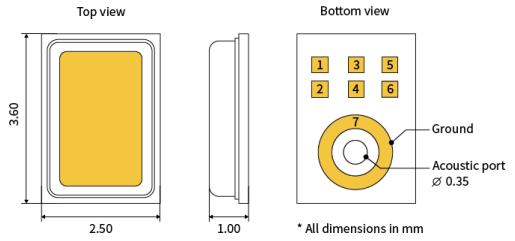
Digital



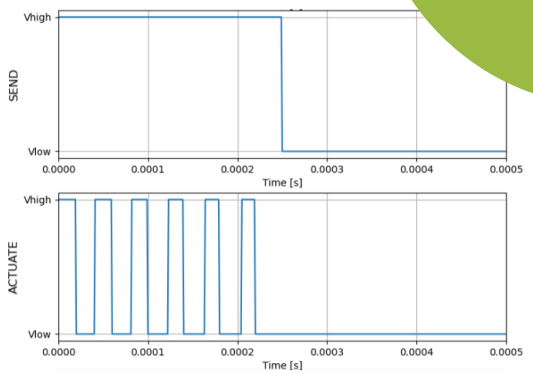
Acoustic and ultrasonic sensitivity



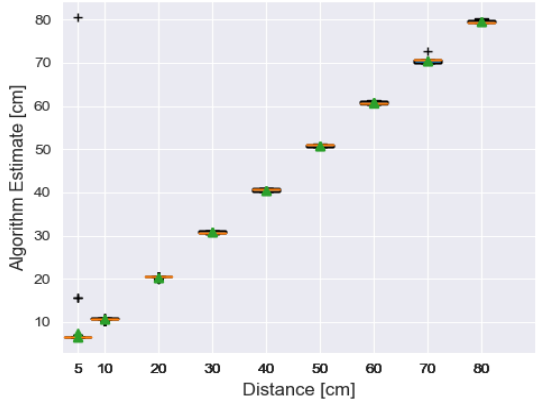
Package information



Pin	Name	Description
1	VDD	Power supply
2	DATA	PDM data output
3	CLOCK	PDM clock input
4	SELECT	PDM left/right select
5	SEND	Transceiver functionality select
6	ACTUATE	Arbitrary frequency pattern
7	GND	Ground



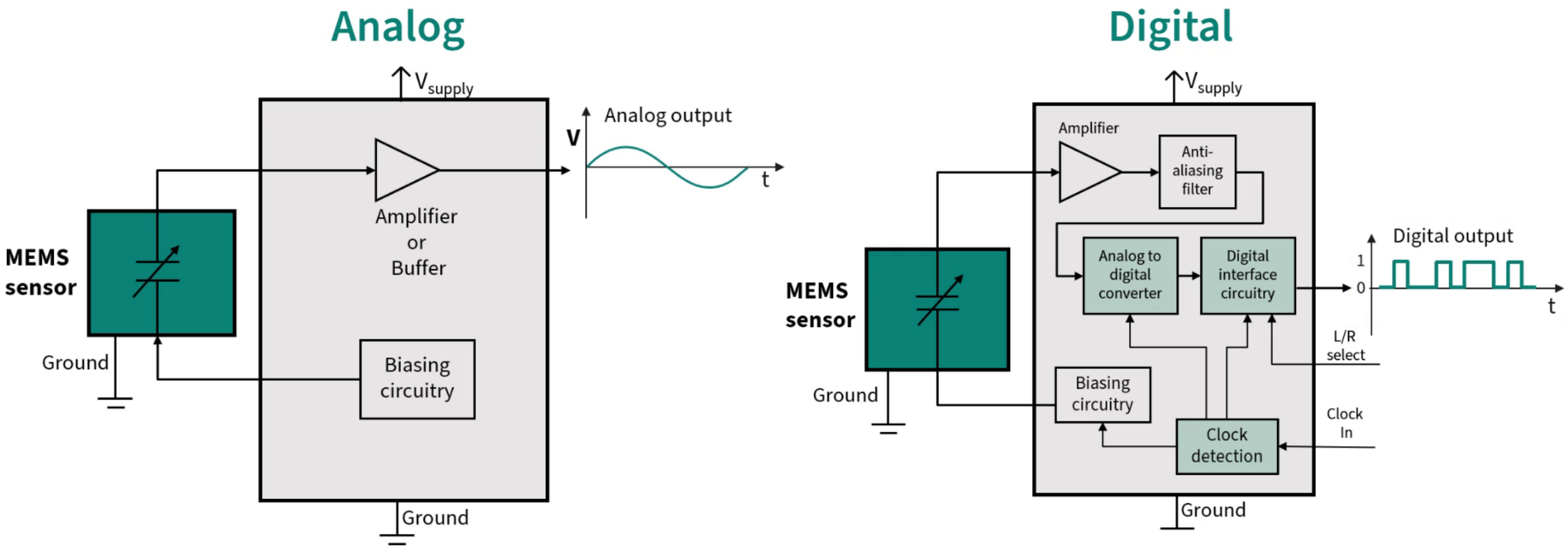
Target detection



- Detection of $10x10cm^2$ metal reflector

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XENSIV™ MEMS microphones are available with either analog or digital output signal

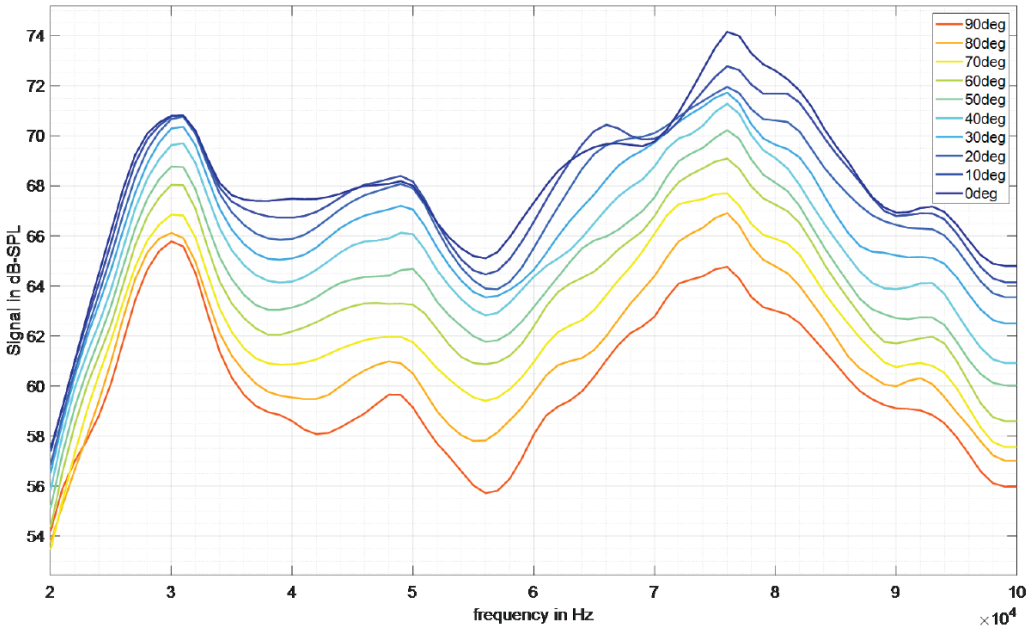


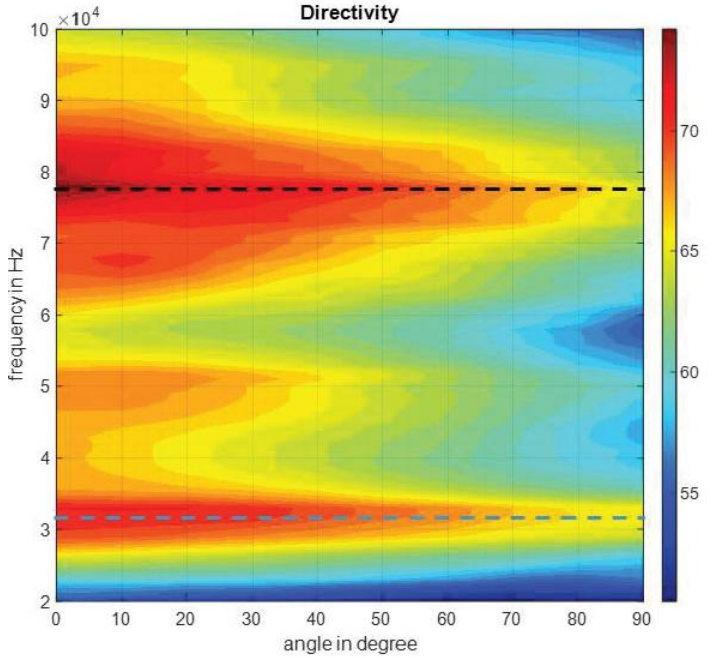
The decision to employ MEMS ultrasonic transducer with analog or digital interfaces depends on how the final output signal will be used

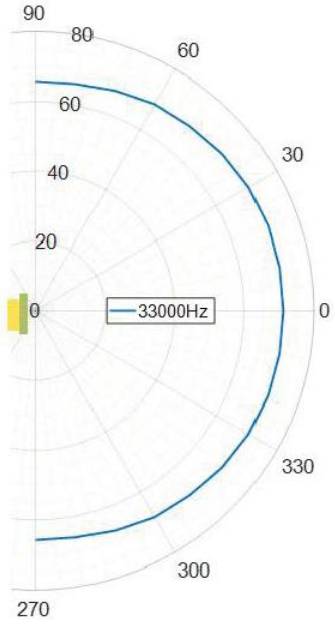
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Typical ultrasonic transmit performance and directivity

- XENSIV™ Ultrasonic Transceiver (UT) on a 200 µm flex-PCB in an anechoic chamber with ultrasonic reference microphone at 10 cm distance. Angle convention: 0° is the sound-channel pointing directly at the reference mic.
- **Note:** Resonance frequencies may be shifted depending on the dimensions of the final sound-channel in application







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Why beyond piezo?
What MEMS is changing in the ultrasonic sensor landscape

MEMS

Advantages



Low cost:
Cheaper implementation



Integrated analog or digital ASICs:
Preconditions and AD-conversion of the sound signal



Small size/high-performance density:
Easier implementation and higher performance density in a greatly reduced package size



Tight performance:
Precise and consistent performance across applications



Robustness:
Resistance to environmental factors like vibrations, electrical noise, and temperature variations



Ease of assembly:
Can be handled by pick-and-place PCB mounting machines

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MEMS ultrasound enables privace-preserving and highly reliable occupancy sensing

Challenge

- Reduce energy consumption
- Improve building automatization
- Preserve privacy



Why ultrasound

- No camera required
- Works in darkness
- Cost efficient



Applications

- Smart lighting
- HVAC optimization
- Meeting room management
- Elderly care





Unlike cameras, ultrasound provides occupancy information without capturing images.

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Ultrasound complements cameras and lidar in robotics and automation

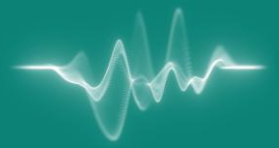
Challenge

- Dust
- Dynamic environemnt
- Transparent objects
- Variable lightning



Why ultrasound

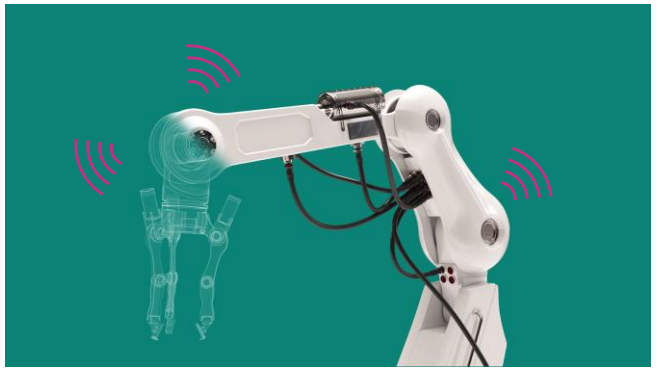
- Detects glass surfaces
- Works in darkness
- Reliable close-range sensing



Applications

- Obstacle detection
- Collision avoidance
- Spatial orientation
- Surface material characterization



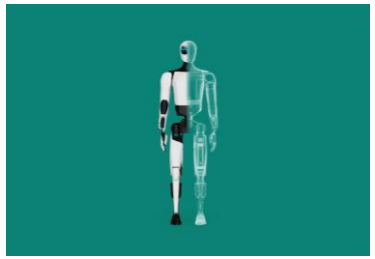




Ultrasound is usually not replacing vision systems. It strengthens them.

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MEMS ultrasound is moving beyond distance measurements



Collaborative robots





Human-Machine Interface



Smart warehouses and buildings



IoT devices

Future development:

- Multi-sensor array
- Beamforming
- Spatial sensing
- AI-assisted signal processing

The future is not just detecting distance. It is understanding space.

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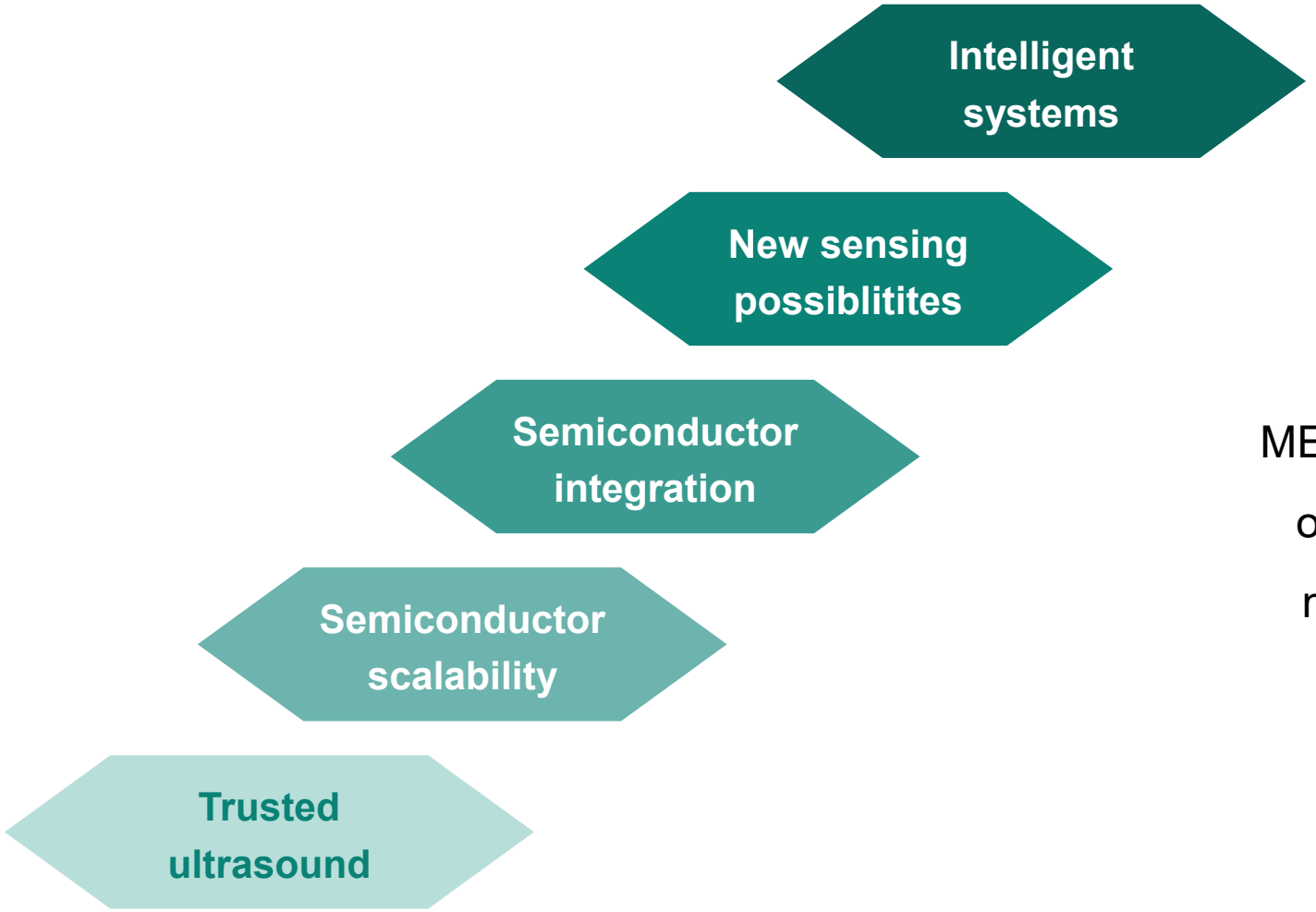
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The future of ultrasound with XENSIV™ MEMS ultrasonic transceivers



Ultrasound is evolving

MEMS technology combines the proven advantages of ultrasound with the scalability, integration, and miniaturization of semiconductor manufacturing.

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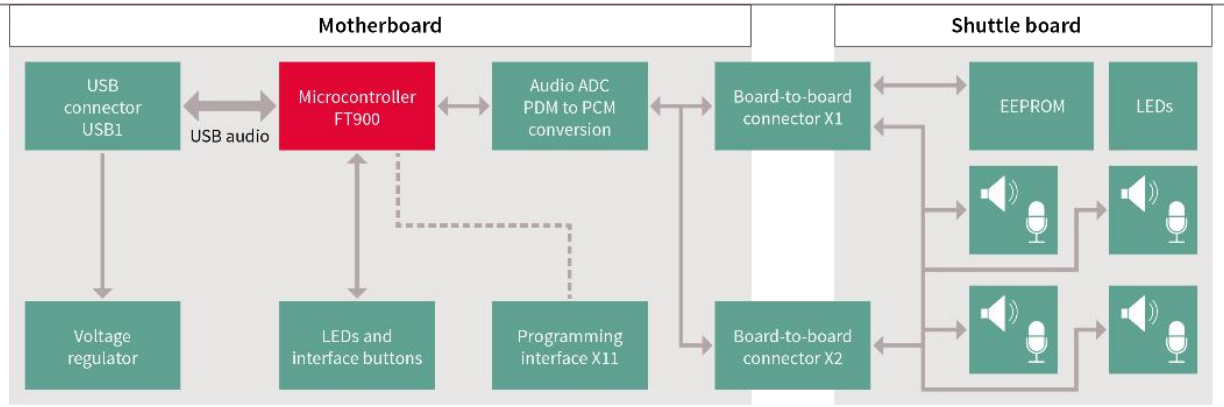
Evaluation kit is available providing ready-to-use solution for customer own evaluations

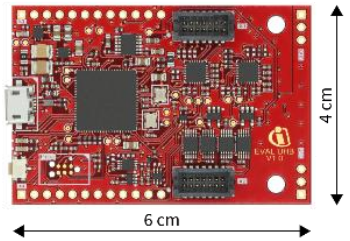
HARDWARE ARCHITECTURE

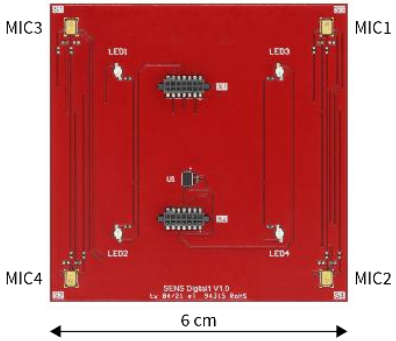
- Infineon ultrasonic and audio evaluation kit composed of:
  - Motherboard responsible for streaming the data to the host
  - Shuttle board including **4 interchangeable ultrasonic transceivers of two types** (digital and analog, SDM+ASIC test-chips with internal actuation)

SPECIAL BENEFITS

- Removable shuttle board for digital and analog MICs
- USB audio 2.0 for data streaming *and* UART interface for configurations
- Easy design of shuttle board to enabled easy customer integration
- Parallel readout of up to four (4) mics
- Side pins for additional sensors integration



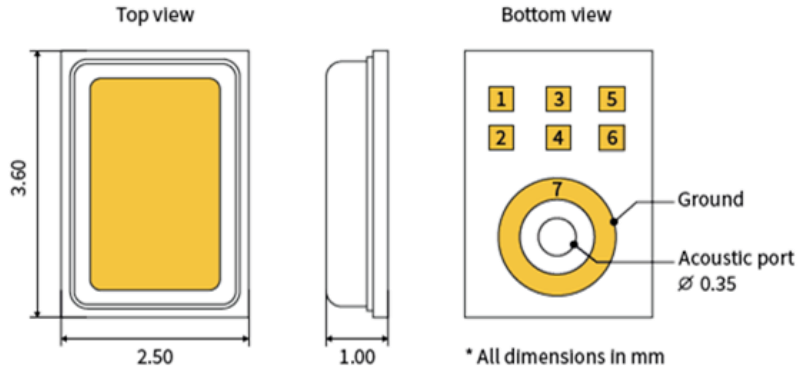




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Summary and outlook

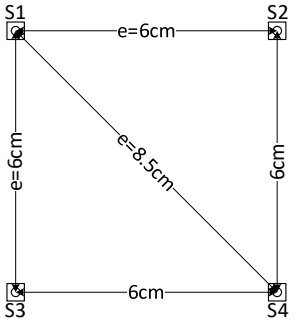
- **Infineon ultrasonic transceivers** samples **available**:
  1. Analog interface: **ES – IM70A135UT**
  2. Digital interface: **ES – IM67D131UT**



- **Evaluation board:**
  - Ultrasonic hub evaluation board incl. 4 transceivers available

- **Evaluation software:**
  - Software development tool incl. GUI and SDK





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