

Ultrasonic Sensing Overview

TI Precision Labs – Ultrasonic Sensing

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Question #1:

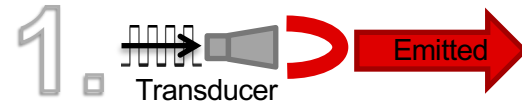
What is an ultrasonic sensor system used for?

Reasons to use ultrasonic sensing:

1. Detect the presence of objects
2. Measure distance to objects
3. Track position or movement of objects

Each method uses a principle called ultrasonic **time-of-flight** (ToF).

Ultrasonic Time-of-Flight Measurement



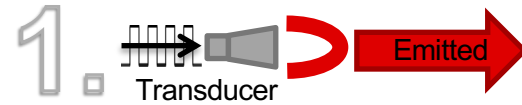
Steps:

1. Transducer emits ultrasound energy

Ultrasonic Time-of-Flight Measurement

Steps:

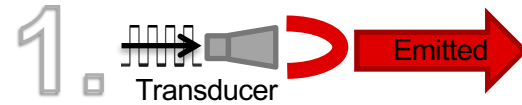
1. Transducer emits ultrasound energy
2. Ultrasound energy traverses forward



Ultrasonic Time-of-Flight Measurement

Steps:

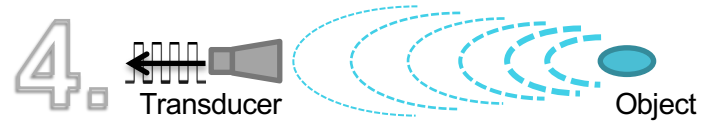
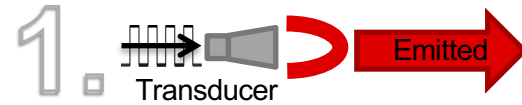
1. Transducer emits ultrasound energy
2. Ultrasound energy traverses forward
3. Ultrasound energy reflects off object



Ultrasonic Time-of-Flight Measurement

Steps:

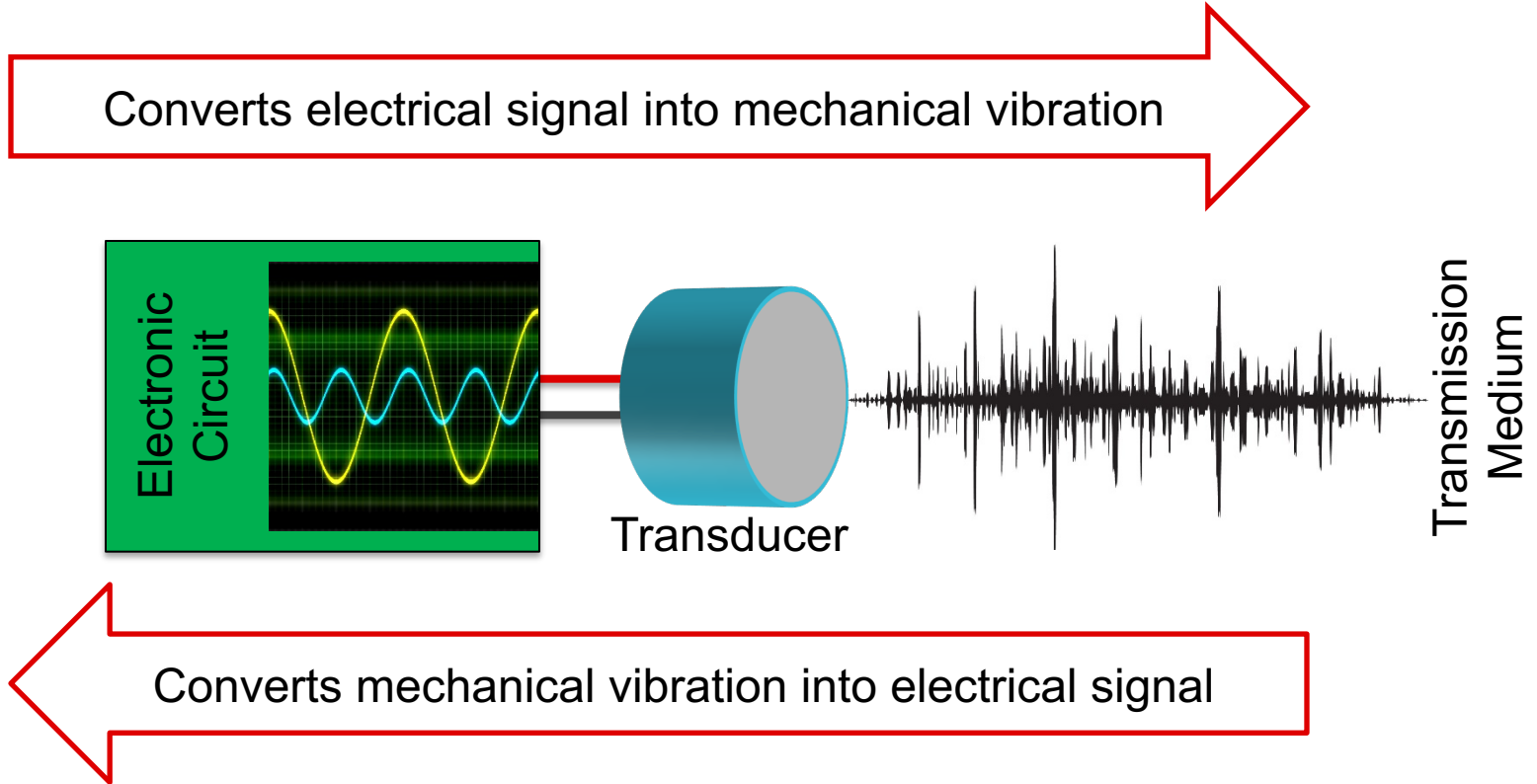
1. Transducer emits ultrasound energy
2. Ultrasound energy traverses forward
3. Ultrasound energy reflects off object
4. Transducer detects returned energy



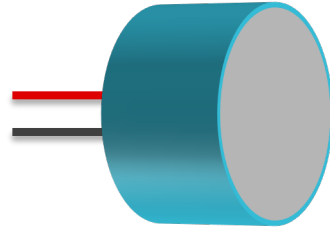
Question #2:

What is an ultrasonic transducer?

The Transducer is the Sensor Element



Ultrasonic Transducer Parameters

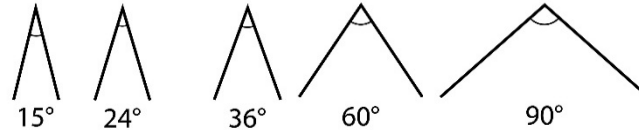


Transducer frequency and size affects...

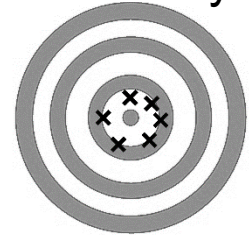
Detectable Range



Field-of-View



Accuracy



Question #3:

What are some real-world ultrasonic sensing applications?

Ultrasonic Example Applications



ADAS Parking Assist



Robotic Collision Avoidance



UAV Landing Assistance



Object Counting/Detection

Other Applications:

- Water Level Sensing
- Kick-to-Open Trunk
- Defect Detection
- Room Occupancy Detection
- Paper Counting
- Wind Speed
- Doppler Shifts
- and more...

Question #4:

What is the advantage of using ultrasonic sensing?

Ultrasonic Transducer Advantages



- Water-proof enclosure resistant to moisture and rain
- Robust performance through dirt, dust, and debris
- Operates at both high and low temperatures
- Able to detect opaque and transparent objects
- Able to detect light and dark colored objects

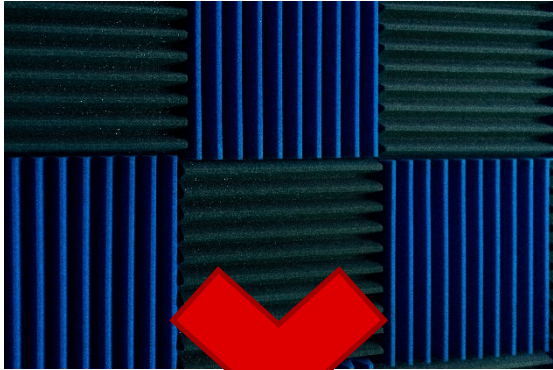


Question #5:

What is the disadvantage of ultrasonic sensing?

Ultrasonic Transducer Limitations

- Unable to detect objects with similar acoustic impedance to transmission medium.
- For example, in an air-coupled application, the ultrasonic energy will pass through, be absorbed, or scattered by soft, low-density objects.



Objective of this video series...

By the end of this video series, you should understand:

- the physics and principles of ultrasonic sensing
- how to properly select a transducer
- how optimize driver and receiver settings
- how to integrate a module(s) into a system

The targeted applications in this video series are for air-coupled or liquid-coupled ultrasonic sensing using transducers ranging from **20kHz to 1MHz**.

This video series does not cover the requirements for:

- medical ultrasound
- ultrasonic flow metering
- solid-coupled applications

To find more ultrasonic sensing technical resources and search products, visit ti.com/ultrasonic