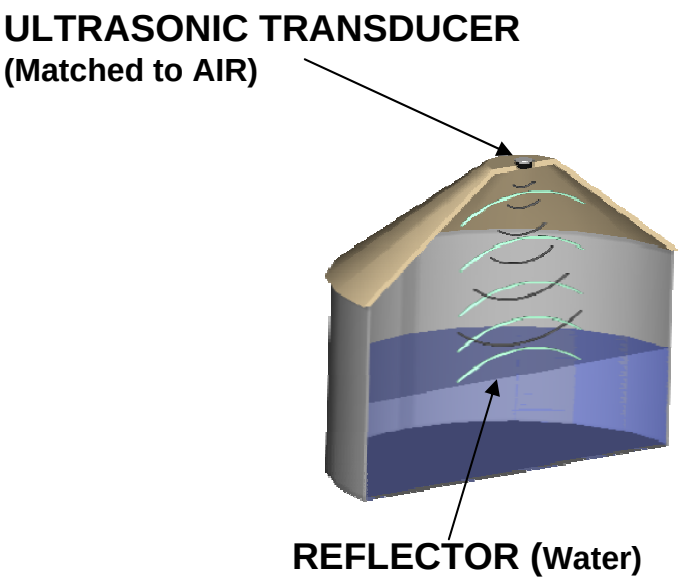
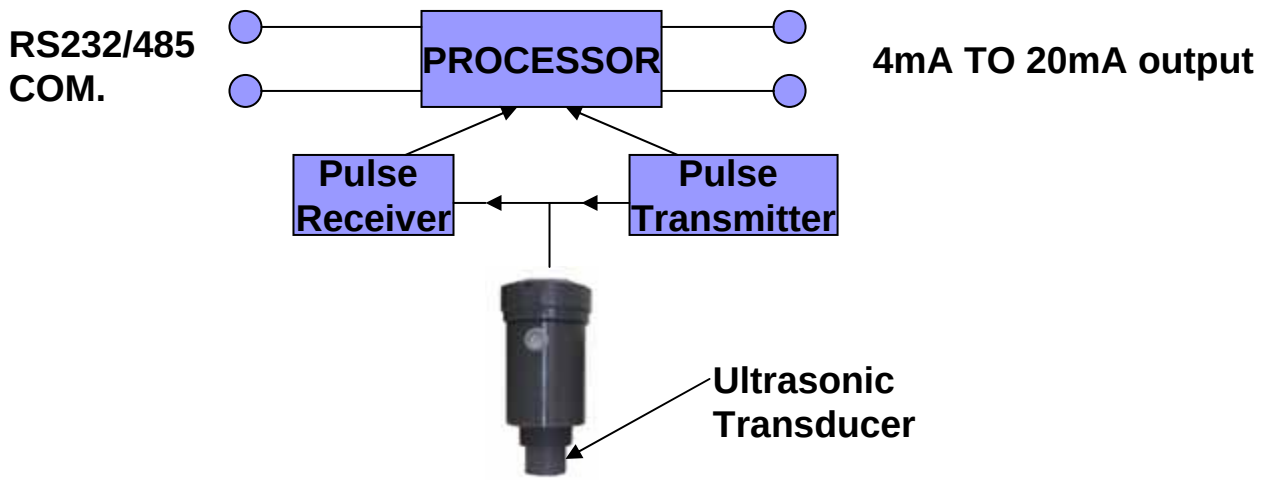
Propagation of Ultrasonic Waves



- Speed of Ultrasonic wave = 343m/s at 20°C to a target
- Speed of the ultrasonic wave depends on : Temperature, Pressure and Humidity
- Any material of different density and speed of sound than air reflects ultrasonic waves
- Hard surface materials, high density (Water) give good reflections
- Soft surface materials, low density give poor reflections (Foam)

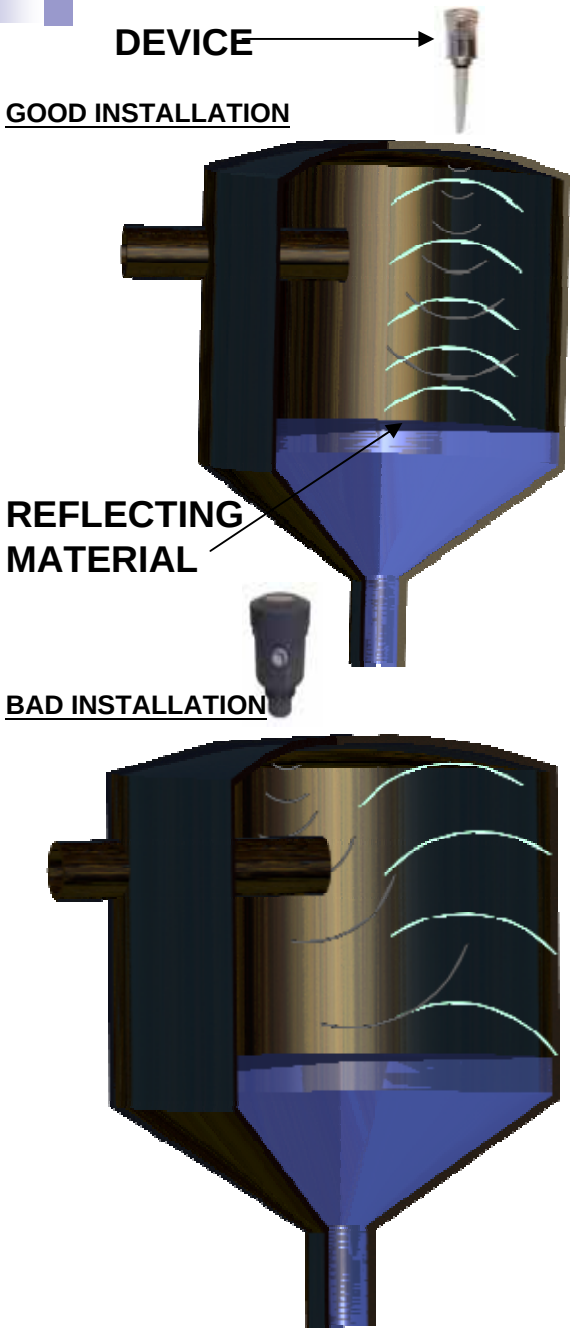
Principle of operation of Ultrasonic and Microwave Level Devices

1. **Ultrasonic Level Device:**



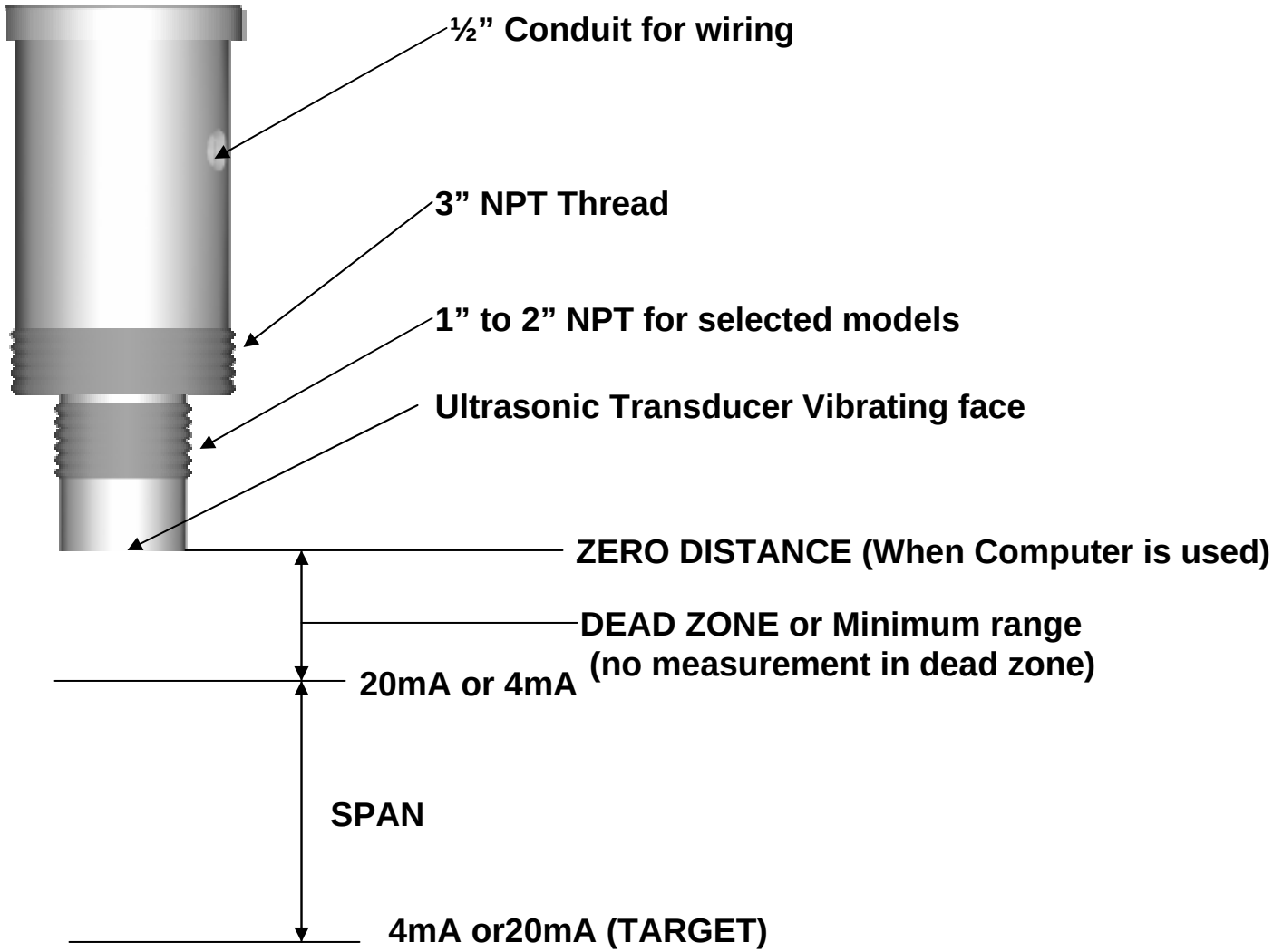
Ultrasonic transducer matched to air is stimulated by a pulse transmitter and it generates a pressure wave that propagates to a target and then reflects (Similar to a loud-speaker) . Reflected wave is received by the same transducer in the receiver mode and converted to an electrical signal (similar to a microphone). The electrical signal is amplified and processed to find the reflected echo and then calculated to find the distance to a specific target. Distances to a target are converted linearly to 4mA to 20mA current and optionally information about level measurement is sent via RS232 or RS 485 to a PC for processing such as diagnostics, programmable set-up and data logging.

Typical Application of Ultrasonic and Microwave Devices



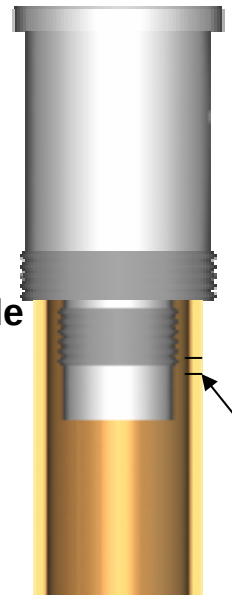
- For Ultrasonic Devices the tanks can be made of any material (Metal, plastic, concrete,…)
- For Microwave use metal tanks only
- Devices are mounted at the top of a tank with ABM Sensor Tech. Standard Threading or in some cases custom mounting.
- Devices have to be directed straight down to a discharge hole, even if a material is not flat (sloped). This is typical for pellets/powder applications; the devices will still receive an echo
- When installed properly the devices transmit microwave/ ultrasonic waves down to a material (liquids or solids)
- During installation make sure that you do not have any large objects in front of transducer or antenna
- Reflected pulses from materials are received and processed to obtain correct distances
- Due to very narrow and uniform polar patterns (directivity) and signal processing of ultrasonic/ microwave devices, small unwanted echoes from tanks walls, ladders, filling pipes, ext. can be ignored or cancelled.

Architecture of Ultrasonic Level Device

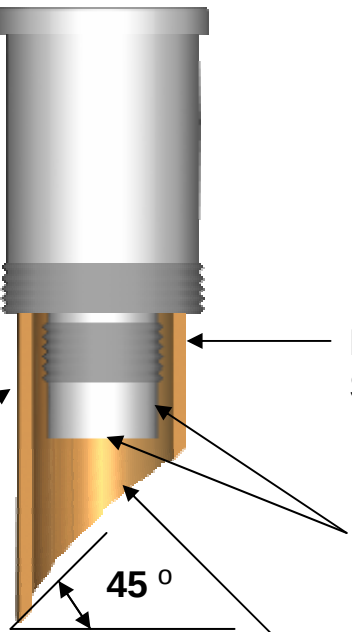


Stand Pipe Mounting of Ultrasonic Devices

No termination required for pipes shorter than 6” and ID of Pipes must be greater than OD of the transducer nozzle



If a pipe is submerged in liquid, a vent hole is required



Metal or Plastic pipes with Smooth inside

Transducer nozzle can’t have Physical Contact

Remove sharp edges

- If pipe is longer than 6” a 45 o cut is required

Application for Ultrasonic Devices

1. Water without foam
2. Liquids without methane and CO_2
3. Water and solid mixtures
4. Diesel fuel, oil
5. Inks and paint containers (low fume)
6. Plastic powder, pellets, seed, grain, cement with dust
7. Any object detection
8. No vacuum
9. No rapid changes of temperature in tanks

New Features of Ultrasonic and Microwave Level Devices

1. **Automatic power, pulse width and sensitivity adjustment to any tank condition (plug and play operation)**
2. **Rejections of any unwanted echoes from stand pipes, tanks walls and any other small obstructions**
3. **Self-cleaning of the ultrasonic transducers radiating faces**
4. **Ignorance to build-up on microwave antenna**
5. **Measurement of very low dielectric constant materials given by microwave device**
6. **Echo detection of materials with high angle of repose**
7. **Perfect operation in pipes, no influence**
8. **No influence of mounting structures**
9. **Very narrow and uniform polar patterns of the ultrasonic transducers and antennas**
10. **Very wide operating bandwidth of the ultrasonic transducers and antennas**