ULTRASONIC TRANSDUCERS

Dependable. Durable.

Your Partner from Prototype to Production

Level and flow
Automation
Proximity sensing
Inventory control

Contact Tanya Shenk at
1-603-249-7187

www.airmar.com
## PRODUCT OVERVIEW

As Airmar constantly improves its products, all specifications are subject to change without notice. All specifications typical at 22°C (72°F). Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing. Factory Mutual approved models suitable for: Class I, Division 1, Hazardous Locations. AIRDUCER® is a registered trademark of Airmar Technology Corporation. Other company or product names mentioned in this document may be trademarks or registered trademarks of their respective companies, which are not affiliated with Airmar.

### Model Frequency Diameter Typical Range Beamwidth

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency</th>
<th>Diameter</th>
<th>Typical Range</th>
<th>Beamwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR20</td>
<td>19.5 kHz</td>
<td>ø 205 mm</td>
<td>80 cm to 40 m</td>
<td>7°</td>
</tr>
<tr>
<td>AR30</td>
<td>30 kHz</td>
<td>ø 106 mm</td>
<td>80 cm to 25 m</td>
<td>12°</td>
</tr>
<tr>
<td>ARK30</td>
<td>30 kHz</td>
<td>ø 106 mm</td>
<td>80 cm to 25 m</td>
<td>12°</td>
</tr>
<tr>
<td>AR41</td>
<td>41 kHz</td>
<td>ø 92.2 mm</td>
<td>35 cm to 15 m</td>
<td>14°</td>
</tr>
<tr>
<td>ARK41</td>
<td>41 kHz</td>
<td>ø 92.2 mm</td>
<td>35 cm to 15 m</td>
<td>14°</td>
</tr>
<tr>
<td>AR50</td>
<td>50 kHz</td>
<td>ø 92.2 mm</td>
<td>30 cm to 10 m</td>
<td>12°</td>
</tr>
<tr>
<td>AR50CH</td>
<td>50 kHz</td>
<td>ø 57 mm</td>
<td>30 cm to 10 m</td>
<td>12°</td>
</tr>
<tr>
<td>ARK50-THD</td>
<td>50 kHz</td>
<td>ø 51 mm</td>
<td>35 cm to 10 m</td>
<td>10°</td>
</tr>
<tr>
<td>AT50</td>
<td>50 kHz</td>
<td>ø 57 mm</td>
<td>35 cm to 10 m</td>
<td>12°</td>
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<td>ATK50</td>
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<td>ø 57 mm</td>
<td>35 cm to 10 m</td>
<td>10°</td>
</tr>
<tr>
<td>ARK50</td>
<td>50 kHz</td>
<td>ø 57 mm</td>
<td>35 cm to 10 m</td>
<td>10°</td>
</tr>
<tr>
<td>ARK50CH</td>
<td>50 kHz</td>
<td>ø 57 mm</td>
<td>35 cm to 10 m</td>
<td>10°</td>
</tr>
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<td>ARK75-THD</td>
<td>75 kHz</td>
<td>ø 40.6 mm</td>
<td>25 cm to 7 m</td>
<td>14°</td>
</tr>
<tr>
<td>AT75</td>
<td>75 kHz</td>
<td>ø 38 mm</td>
<td>25 cm to 7 m</td>
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<tr>
<td>ATK75</td>
<td>75 kHz</td>
<td>ø 38 mm</td>
<td>25 cm to 7 m</td>
<td>14°</td>
</tr>
<tr>
<td>AT120</td>
<td>120 kHz</td>
<td>ø 25 mm</td>
<td>20 cm to 3 m</td>
<td>12°</td>
</tr>
<tr>
<td>ATK120</td>
<td>120 kHz</td>
<td>ø 25 mm</td>
<td>20 cm to 3 m</td>
<td>10°</td>
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<td>ARK120-THD</td>
<td>120 kHz</td>
<td>ø 40.6 mm</td>
<td>20 cm to 3 m</td>
<td>12°</td>
</tr>
<tr>
<td>AT200</td>
<td>200 kHz</td>
<td>ø 16 mm</td>
<td>12 cm to 2 m</td>
<td>12°</td>
</tr>
<tr>
<td>ATK200</td>
<td>200 kHz</td>
<td>ø 16 mm</td>
<td>12 cm to 2 m</td>
<td>10°</td>
</tr>
<tr>
<td>AT225</td>
<td>225 kHz</td>
<td>ø 13 mm</td>
<td>10 cm to 1.5 m</td>
<td>15°</td>
</tr>
<tr>
<td>AT300</td>
<td>300 kHz</td>
<td>ø 12 mm</td>
<td>5 cm to 50 cm</td>
<td>10°</td>
</tr>
<tr>
<td>TTW-550</td>
<td>Variable</td>
<td>63 mm X 63 mm</td>
<td>.2 m to 3.75 m</td>
<td>N/A</td>
</tr>
</tbody>
</table>

PVDF housing for chemically aggressive environments

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[RoHS Compliant](#) [ISO Certified](#)

PATENT PENDING
Airmar Technology Corporation designs and manufactures standard and custom ultrasonic transducers for a wide variety of OEM applications.

The Company
Airmar Technology Corporation was founded in 1982 and has grown to include over 230 employees working at our two 72,000 square foot facilities. Our plants house an engineering lab, a model shop, and injection molding machines, in addition to state-of-the-art assembly and testing areas. The company is dedicated to manufacturing transducers of the highest quality. Airmar is proud of its ISO 9001:2000 registration, signifying our high standards.

The Products
A force in the industrial sensing market, Airmar’s team of scientists, engineers, and technicians design sensors for a wide variety of applications. These include flow and level measurement, roll diameter, proximity sensing, positioning, and industrial control. Airmar holds over thirty U.S. and foreign patents and has a world-wide customer base. The company is dedicated to manufacturing transducers of the highest quality; that not only have excellent transmitting and receiving response, but are known globally for low-ringing, low-sidelobes, and tight tolerances.

The Ultrasonic Advantage
Airmar’s ultrasonic transducers provide non-contact solutions for your toughest sensing problems. Safe, rugged and reliable, our transducers function extremely well in harsh environments. Airducers® are rated IP68 and have no movable parts to break down. Unlike other sensing techniques, ultrasonic sensors can detect clear, transparent or shiny objects and are not affected by color.

The Measuring Principle of Airducer® Ultrasonic Sensors
Sound generated above the human hearing range (typically above 20 kHz) is called ultrasonic. Airmar’s standard product line frequencies range from 19.5 kHz to 300 kHz. Ultrasonic sensors operate by emitting short bursts of high-frequency sound waves in a cone-shaped pattern (also known as a beam). The echoes reflected by the target are received by the sensor and are used to determine position or measure distance. The distance can be computed using the speed of sound in the transmission medium by measuring the time it takes for the echo to return to the transducer. Using air as an example at 22°C, sound travels at an approximate rate of 345 meters per second. Changes in environmental conditions such as temperature, humidity and pressure can cause a change in the speed of sound in air.

Typical Applications
For AIRDUCER® Ultrasonic Sensors

Level and Flow Measurement and Control
- Liquids, bulk solids, or grains

Process Control
- Distance measurement
- Web tension, roll diameter, web edge, or break detection
- Counting, sorting, or monitoring parts
- Determining loop measurement
- Collision avoidance or proximity sensing
- Robotics

Medical Applications
- Bubble detection
AR20

**SPECIFICATIONS**

- **Best Operating Frequency:** 19.5 kHz, ±4%
- **Typical Sensing Range:** 80 cm to 40 m
- **Beamwidth (@ -3 dB Full Angle):** 7°, ±2°
- **Operating Temperature:** -40°C to 60°C
- **Weight:** 7.25 kg
- **Housing Material:** Glass filled polyester
- **Acoustic Window:** Glass reinforced epoxy

**19.5 kHz**

AIRDUCER® Ultrasonic Transducer

**Applications**

- Powder, granular, slurry, and liquid
- Long-range level measurement

**Features**

- Long-term reliability
- Low-maintenance
- Non-contact
- No moving parts

**Options**

- Stainless steel 1” NPT or BSP thread mounts
- FM approved

**Dimensions**

- **Thread Choices:**
  - 1” tapered BSP x 0.72” long
  - 1” NPT x 0.72” long

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### AR30

**30 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement
- Proximity
- Obstacle avoidance
- Traffic control

**Features**
- Rugged sealed construction
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

**Options**
- Cylinder housing available with mounting cap kit
- Complete assembly available with standard cable lengths
- Mounting cap available in BSP, NPT, or M32 threads
- 10 KΩ thermistor available for temperature compensation
- Available in PVDF housing for use in chemically aggressive environments
- FM approved

**Dimensions**

<table>
<thead>
<tr>
<th>Frequency in kHz</th>
<th>TVR in dB re 1µPa/V at 1 m</th>
<th>RVR in dB re 1V/µPa</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>29</td>
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<tr>
<td></td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>32</td>
</tr>
</tbody>
</table>

**Figure of Merit** (Sum of TVR & RVR)

<table>
<thead>
<tr>
<th>Frequency in kHz</th>
<th>TVR</th>
<th>RVR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Directivity Pattern**

-10 dB
-20 dB
-30 dB
-40 dB
30° 30°
0°
60°
90°
60°
90°

**Impedance Magnitude & Phase**

<table>
<thead>
<tr>
<th>Frequency in kHz</th>
<th>Magnitude in Ω</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>27</td>
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<td>28</td>
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<td>29</td>
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<tr>
<td>31</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

**Transmit & Receive Voltage Response**

<table>
<thead>
<tr>
<th>Frequency in kHz</th>
<th>TVR in dB re 1µPa/V at 1 m</th>
<th>RVR in dB re 1V/µPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>-15</td>
<td>110</td>
</tr>
<tr>
<td>27</td>
<td>-10</td>
<td>120</td>
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<td>28</td>
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<td>130</td>
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<tr>
<td>29</td>
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<td>140</td>
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<tr>
<td>30</td>
<td>5</td>
<td>150</td>
</tr>
<tr>
<td>31</td>
<td>10</td>
<td>160</td>
</tr>
<tr>
<td>32</td>
<td>15</td>
<td>170</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

- **Best Operating Frequency**: 30 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency**: 105 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency**: -155 dB re 1V/µPa
- **Minimum Parallel Resistance**: 700 Ω, ±30%
- **Minimum and Maximum Sensing Range**: 60 cm to 30 m
- **Typical Sensing Range**: 80 cm to 25 m
- **Free (1 kHz) Capacitance**: 5,700 pF, ±20% pF
- **Beamwidth (3 dB Full Angle)**: 12°, ±2°
- **Maximum Driving Voltage (2% Duty Cycle Tone Burst)**: 2,200 Vpp
- **Operating Temperature**: -40°C to 90°C
- **Weight**: 800 g
- **Housing Material**: Glass filled polyester
- **Acoustic Window**: Glass reinforced epoxy

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.
ARK30

30 kHz

AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Level measurement in chemically aggressive environments
- Food and beverage processing
- Proximity sensing
- Obstacle avoidance

Features
- Rugged sealed construction
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

Options
- Complete assembly available with standard cable lengths
- 10 KΩ thermistor available for temperature compensation
- FM approved
- Mounting caps available in BSP, NPT, or M32 threads

Dimensions

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Operating Frequency:</td>
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<tr>
<td>Minimum Transmit Sensitivity at Best Transmit Frequency:</td>
<td>105 dB re 1μPa/V at 1 m</td>
</tr>
<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency:</td>
<td>-155 dB re 1V/μPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance:</td>
<td>700 Ω, ±30%</td>
</tr>
<tr>
<td>Minimum and Maximum Sensing Range*:</td>
<td>60 cm to 30 m</td>
</tr>
<tr>
<td>Typical Sensing Range:</td>
<td>80 cm to 25 m</td>
</tr>
<tr>
<td>Free (1 kHz) Capacitance:</td>
<td>5,700 pF, ±20% pF</td>
</tr>
<tr>
<td>Beamwidth (@ -3 dB Full Angle):</td>
<td>12°, ±2°</td>
</tr>
<tr>
<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst):</td>
<td>2,200 Vpp</td>
</tr>
<tr>
<td>Operating Temperature:</td>
<td>-40°C to 90°C</td>
</tr>
<tr>
<td>Weight:</td>
<td>800 g</td>
</tr>
<tr>
<td>Housing Material:</td>
<td>Kynar® 720</td>
</tr>
<tr>
<td>Acoustic Window:</td>
<td>Kynar® 720</td>
</tr>
</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

Directivity Pattern

Transmit & Receive Voltage Response

Impedance Magnitude & Phase

Figure of Merit (Sum of TVR & RVR)

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AR41

41 kHz
AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Proximity
- Obstacle avoidance
- Traffic control
- Flow measurement

Features
- Rugged sealed construction
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

Options
- Complete assembly available with standard cable lengths
- Mounting cap available in BSP, NPT, or M32 threads
- Available in PVDF housing for use in chemically aggressive environments
- 10 KΩ thermistor available for temperature compensation

Dimensions

**SPECIFICATIONS**

- **Best Operating Frequency:** 41 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency:** 110 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency:** -160 dB re 1V/µPa
- **Minimum Parallel Resistance:** 150 Ω, ±30%
- **Minimum and Maximum Sensing Range***: 30 cm to 20 m
- **Typical Sensing Range:** 35 cm to 15 m
- **Free (1 kHz) Capacitance:** 5,000 pF, ±20% pF
- **Beamwidth (@ -3 dB Full Angle):** 14°, ±2°
- **Maximum Driving Voltage (2% Duty Cycle Tone Burst):** 1,800 Vpp
- **Operating Temperature:** -40°C to 90°C
- **Weight:** 560 g
- **Housing Material:** Glass filled polyester
- **Acoustic Window:** Glass reinforced epoxy

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Figure of Merit (Sum of TVR & RVR)**

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ARK41

**SPECIFICATIONS**

**Best Operating Frequency:** 41 kHz, ±4%
**Minimum Transmit Sensitivity at Best Transmit Frequency:**
108 dB re 1µPa/V at 1 m
**Minimum Receive Sensitivity at Best Receive Frequency:** -175 dB re 1V/µPa
**Minimum Parallel Resistance:** 200 Ω, ±30%
**Minimum and Maximum Sensing Range**: 30 cm to 20 m
**Typical Sensing Range:** 35 cm to 15 m
**Free (1 kHz) Capacitance:** 5,000 pF, ±20% pF
**Beamwidth (@ -3 dB Full Angle):** 14°, ±2°
**Maximum Driving Voltage (2% Duty Cycle Tone Burst):** 1,800 V
**Operating Temperature:** -40°C to 90°C
**Weight:** 560 g
**Housing Material:** Kynar® 720
**Acoustic Window:** Kynar® 720

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

**41 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement in chemically aggressive environments
- Food and beverage processing
- Flow monitoring

**Features**
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

**Options**
- Complete assembly available with standard cable lengths
- 10 KΩ thermistor available for temperature compensation
- FM approved
- Mounting caps available in BSP, NPT, or M32 threads

**Dimensions**

<table>
<thead>
<tr>
<th>Thread Choices:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; tapered BSP x 0.75&quot; long</td>
</tr>
<tr>
<td>1&quot; NPT x 0.94&quot; long (ref.)</td>
</tr>
<tr>
<td>M32-1.5 x 0.75&quot; long</td>
</tr>
</tbody>
</table>

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AR50

**SPECIFICATIONS**

- **Best Operating Frequency:** 50 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency:** 106 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency:** -162 dB re 1V/µPa
- **Minimum Parallel Resistance:** 450 Ω, ±30%
- **Minimum and Maximum Sensing Range**: 25 cm to 15 m
- **Typical Sensing Range:** 30 cm to 10 m
- **Free (1 kHz) Capacitance:** 5,700 pF, ±20% pF
- **Beamwidth (@ -3 dB Full Angle):** 12°, ±2°
- **Maximum Driving Voltage (2% Duty Cycle Tone Burst):** 1,500 Vpp
- **Operating Temperature:** -40°C to 90°C
- **Weight:** 560 g
- **Housing Material:** Glass filled polyester
- **Acoustic Window:** Glass reinforced epoxy

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

**Applications**

- Level measurement
- Open channel flow
- Obstacle avoidance
- Proximity

**Features**

- Rugged sealed construction
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

**Options**

- Complete assembly available with standard cable lengths
- Mounting cap available in BSP, NPT, or M32 threads
- 10 KΩ thermistor available for temperature compensation
- Available in PVDF housing for use in chemically aggressive environments
- FM approved

**Dimensions**

- **Thread Choices:**
  - 1" tapered BSP x 0.75" long
  - 1" NPT x 0.94" long (ref.)
  - M32-1.5 x 0.75" long

**Figure of Merit**

(Sum of TVR & RVR)

**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Magnitude in Ω**

- 46
- 47
- 48
- 49
- 50
- 51
- 52

**Phase in Degrees**

- 0°
- 30°
- 60°
- 90°
- 120°
- 150°
- 180°

**TVR**

- 10 dB
- 20 dB
- 30 dB
- 40 dB
- 50 dB
- 60 dB
- 70 dB
- 80 dB
- 90 dB

**RVR**

- 100 dB
- 110 dB
- 120 dB
- 130 dB
- 140 dB
- 150 dB

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AR50CH

50 kHz
AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Open channel flow
- Obstacle avoidance
- Proximity
- Robotics

Features
- Improved deadband performance as compared to AT50
- Rugged sealed construction
- Cylindrical design allows for installation in various applications

Options
- 10 KΩ thermistor available for temperature compensation

Dimensions

SPECIFICATIONS

Best Operating Frequency: 50 kHz, ±4%
Minimum Transmit Sensitivity at Best Transmit Frequency:
106 dB re 1µPa/V at 1 m
Minimum Receive Sensitivity at Best Receive Frequency: -162 dB re 1V/µPa
Minimum Parallel Resistance: 450 Ω, ±30%
Minimum and Maximum Sensing Range*: 25 cm to 15 m
Typical Sensing Range: 30 cm to 10 m
Free (1 kHz) Capacitance: 5,700 pF, ±20% pF
Beamwidth (@ -3 dB Full Angle): 12°, ±2°
Maximum Driving Voltage (2% Duty Cycle Tone Burst): 1,500 V_{pp}
Operating Temperature: -40°C to 90°C
Weight: 160 g
Housing Material: Glass filled polyester
Acoustic Window: Glass reinforced epoxy

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

Directivity Pattern

Transmit & Receive Voltage Response

Impedance Magnitude & Phase

Figure of Merit
(Sum of TVR & RVR)
# ARK50-THD

## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Best Operating Frequency</td>
<td>50 kHz, ±4%</td>
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<tr>
<td>Minimum Transmit Sensitivity at Best Transmit Frequency</td>
<td>-170 dB re 1V/µPa</td>
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<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency</td>
<td>-170 dB re 1V/µPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance</td>
<td>350 Ω, ±30%</td>
</tr>
<tr>
<td>Minimum and Maximum Sensing Range*</td>
<td>30 cm to 15 m</td>
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<tr>
<td>Typical Sensing Range</td>
<td>35 cm to 10 m</td>
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<tr>
<td>Free (1 kHz) Capacitance</td>
<td>5,000 pF, ±20% pF</td>
</tr>
<tr>
<td>Beamwidth (@ -3 dB Full Angle)</td>
<td>10°, ±2°</td>
</tr>
<tr>
<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst)</td>
<td>1,000 Vpp</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to 90°C</td>
</tr>
<tr>
<td>Weight</td>
<td>250 g</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Kynar® 720</td>
</tr>
<tr>
<td>Acoustic Window</td>
<td>Kynar® 720</td>
</tr>
</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

## 50 kHz

### AIRDUCER® Ultrasonic Transducer

- **Applications**
  - Level measurement in chemically aggressive environments
  - Food and beverage processing
  - Flow monitoring

- **Features**
  - Rugged one-piece PVDF housing is U.S. FDA compliant
  - Threaded design allows for installation in various applications
  - Standard internal shielding
  - 8 mm M3 PCB standoffs

- **Options**
  - Nut—2” BSP thread
  - Complete assembly available with standard cable lengths
  - 10 KΩ thermistor available for temperature compensation
  - FM approved
  - 12 mm extension sleeve
  - Mounting caps available in BSP, NPT, or M32 threads

- **Dimensions**
  - Thread Choices: 1” tapered BSP x 0.75” long
  - 1” NPT x 0.94” long
  - M32-1.5 x 0.75” long
  - 3/4” NPT x 0.75” long

**Figure of Merit**

- **Impedance Magnitude & Phase**
- **Transmit & Receive Voltage Response**
- **Directivity Pattern**
- **Voltage Response**
- **Impedance Magnitude & Phase**
- **Figure of Merit (Sum of TVR & RVR)**

Housing design will accommodate transceiver and signal processing electronics.

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www.airmar.com
AT50

50 kHz

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement
- Open channel flow
- Proximity
- Obstacle avoidance
- Robotics

**Features**
- Rugged sealed construction
- Cylindrical design allows for installation in various applications

**Options**
- Available in PVDF housing for use in chemically aggressive environments
- 10 KΩ thermistor available for temperature compensation

**Dimensions**

---

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Best Operating Frequency</td>
<td>50 kHz, ±4%</td>
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<tr>
<td>Minimum Transmit Sensitivity at Best Transmit Frequency:</td>
<td>106 dB re 1µPa/V at 1 m</td>
</tr>
<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency:</td>
<td>-162 dB re 1V/µPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance</td>
<td>450 Ω, ±30%</td>
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<tr>
<td>Minimum and Maximum Sensing Range*</td>
<td>30 cm to 15 m</td>
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<tr>
<td>Typical Sensing Range</td>
<td>35 cm to 10 m</td>
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<tr>
<td>Free (1 kHz) Capacitance</td>
<td>5,700 pF, ±20% pF</td>
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<tr>
<td>Beamwidth (@ -3 dB Full Angle)</td>
<td>12°, ±2°</td>
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<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst)</td>
<td>1,500 V&lt;sub&gt;pp&lt;/sub&gt;</td>
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<tr>
<td>Operating Temperature</td>
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</tr>
<tr>
<td>Weight</td>
<td>160 g</td>
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<tr>
<td>Housing Material</td>
<td>Glass filled polyester</td>
</tr>
<tr>
<td>Acoustic Window</td>
<td>Glass reinforced epoxy</td>
</tr>
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</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

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www.airmar.com
ATK50

**50 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement in chemically aggressive environments
- Food and beverage processing
- Proximity sensing
- Obstacle avoidance

**Features**
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Cylindrical design allows for installation in various applications

**Options**
- 10 KΩ thermistor available for temperature compensation

**Dimensions**

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td>Best Operating Frequency</td>
<td>50 kHz, ±4%</td>
</tr>
<tr>
<td>Minimum Transmit Sensitivity at Best Transmit Frequency</td>
<td>105 dB re 1µPa/V at 1 m</td>
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<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency</td>
<td>-170 dB re 1V/µPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance</td>
<td>350 Ω, ±30%</td>
</tr>
<tr>
<td>Typical Sensing Range</td>
<td>35 cm to 10 m</td>
</tr>
<tr>
<td>Free (1 kHz) Capacitance</td>
<td>5,000 pF, ±20% pF</td>
</tr>
<tr>
<td>Beamwidth (@ -3 dB Full Angle)</td>
<td>10°, ±2°</td>
</tr>
<tr>
<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst)</td>
<td>1,000 Vpp</td>
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<td>Operating Temperature</td>
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<tr>
<td>Weight</td>
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<tr>
<td>Housing Material</td>
<td>Kynar® 720</td>
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<tr>
<td>Acoustic Window</td>
<td>Kynar® 720</td>
</tr>
</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

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ARK50

50 kHz
AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement in chemically aggressive environments
- Food and beverage processing
- Flow monitoring
- Proximity sensing

Features
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Housing design will accommodate transceiver and signal processing electronics
- Standard internal shielding

Options
- Complete assembly available with standard cable lengths
- 10 KΩ thermistor available for temperature compensation
- FM approved
- Mounting cap available in BSP, NPT or M32 threads

Dimensions

**SPECIFICATIONS**

- **Best Operating Frequency:** 50 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency:**
  105 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency:** -170 dB re 1V/µPa
- **Minimum Parallel Resistance:** 350 Ω, ±30%
- **Minimum and Maximum Sensing Range**: 30 cm to 15 m
- **Typical Sensing Range**: 35 cm to 10 m
- **Free (1 kHz) Capacitance**: 5,000 pF, ±20% pF
- **Beamwidth (@ -3 dB Full Angle)**: 10°, ±2°
- **Maximum Driving Voltage (2% Duty Cycle Tone Burst)**: 1,000 Vpp
- **Operating Temperature**: -40°C to 90°C
- **Weight**: 250 g
- **Housing Material**: Kynar® 720
- **Acoustic Window**: Kynar® 720

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

- **Directivity Pattern**
- **Transmit & Receive Voltage Response**
- **Impedance Magnitude & Phase**
- **Figure of Merit (Sum of TVR & RVR)**

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**ARK75-THD**

**SPECIFICATIONS**

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<th>Specification</th>
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<td><strong>Best Operating Frequency:</strong></td>
<td>75 kHz, ±4%</td>
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<tr>
<td><strong>Minimum Transmit Sensitivity at Best Transmit Frequency:</strong></td>
<td>106 dB re 1µPa/V at 1 m</td>
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<tr>
<td><strong>Minimum Receive Sensitivity at Best Receive Frequency:</strong></td>
<td>-165 dB re 1V/µPa</td>
</tr>
<tr>
<td><strong>Minimum Parallel Resistance:</strong></td>
<td>150 Ω, ±30%</td>
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<tr>
<td><strong>Minimum and Maximum Sensing Range</strong>:</td>
<td>20 cm to 10 m</td>
</tr>
<tr>
<td><strong>Typical Sensing Range:</strong></td>
<td>25 cm to 7 m</td>
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<tr>
<td><strong>Free (1 kHz) Capacitance:</strong></td>
<td>1,850 pF, ±20% pF</td>
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<tr>
<td><strong>Beamwidth (@ -3 dB Full Angle):</strong></td>
<td>14°, ±2°</td>
</tr>
<tr>
<td><strong>Maximum Driving Voltage (2% Duty Cycle Tone Burst):</strong></td>
<td>1,000 V&lt;sub&gt;pp&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>Operating Temperature:</strong></td>
<td>-40°C to 90°C</td>
</tr>
<tr>
<td><strong>Weight:</strong></td>
<td>250 g</td>
</tr>
<tr>
<td><strong>Housing Material:</strong></td>
<td>Kynar® 720</td>
</tr>
<tr>
<td><strong>Acoustic Window:</strong></td>
<td>Kynar® 720</td>
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</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.*

**Applications**
- Level measurement in chemically aggressive environments
- Food and beverage processing
- Flow monitoring

**Features**
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Threaded design allows for installation in various applications
- Standard internal shielding
- 8 mm M3 PCB standoffs

**Options**
- Nut—1.5" BSP thread
- Complete assembly available with standard cable lengths
- 10 KΩ thermistor available for temperature compensation
- FM approved
- 12 mm extension sleeve
- Mounting caps available in BSP, NPT, or M32 threads

**Dimensions**

**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Figure of Merit (Sum of TVR & RVR)**

**Thread Choices:**
- 1" tapered BSP x 0.75" long
- 1" NPT x 0.94" long
- M32-1.5 x 0.75" long
- 3/4" NPT x 0.75" long

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**AT75**

**75 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement
- Open channel flow
- Proximity
- Obstacle avoidance
- Robotics

**Features**
- Rugged sealed construction
- Cylindrical design allows for installation in various applications

**Options**
- AR style with threaded cap available
- Complete assembly or kit versions
- Available in PVDF housing for use in chemically aggressive environments
- 10 kΩ thermistor available for temperature compensation

**Dimensions**

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**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Operating Frequency:</td>
<td>75 kHz, ±4%</td>
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<tr>
<td>Minimum Transmit Sensitivity at Best Transmit Frequency:</td>
<td>111 dB re 1µPa/V at 1 m</td>
</tr>
<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency:</td>
<td>-162 dB re 1V/µPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance:</td>
<td>170 Ω, ±30%</td>
</tr>
<tr>
<td>Minimum and Maximum Sensing Range*:</td>
<td>20 cm to 10 m</td>
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<tr>
<td>Typical Sensing Range:</td>
<td>25 cm to 7 m</td>
</tr>
<tr>
<td>Free (1 kHz) Capacitance:</td>
<td>1,850 pF, ±20% pF</td>
</tr>
<tr>
<td>Beamwidth (@ -3 dB Full Angle):</td>
<td>15°, ±2°</td>
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<tr>
<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst):</td>
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<td>Operating Temperature:</td>
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<tr>
<td>Weight:</td>
<td>45 g</td>
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<td>Housing Material:</td>
<td>Glass filled polyester</td>
</tr>
<tr>
<td>Acoustic Window:</td>
<td>Glass reinforced epoxy</td>
</tr>
</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

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**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Figure of Merit (Sum of TVR & RVR)**

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www.airmar.com
ATK75

**Applications**
- Level measurement in chemically aggressive environments
- Automation control
- Food and beverage processing
- Proximity sensing
- Obstacle avoidance

**Features**
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Cylindrical design allows for installation in various applications

**Options**
- 10 KΩ thermistor available for temperature compensation

**Dimensions**
- Diameter: 38 mm

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**SPECIFICATIONS**

- **Best Operating Frequency**: 75 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency**: 110 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency**: -160 dB re 1V/µPa
- **Minimum Parallel Resistance**: 150 Ω, ±30%
- **Minimum and Maximum Sensing Range**: 20 cm to 10 m
- **Typical Sensing Range**: 25 cm to 7 m
- **Free (1 kHz) Capacitance**: 1,850 pF, ±20% pF
- **Beamwidth (@ -3 dB Full Angle)**: 14°, ±2°
- **Maximum Driving Voltage**: 1,000 Vpp
- **Operating Temperature**: -40°C to 90°C
- **Weight**: 50 g
- **Housing Material**: Kynar® 720
- **Acoustic Window**: Kynar® 720

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

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www.airmar.com
AT120

125 kHz
AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Automation control
- Proximity
- Obstacle avoidance
- Robotics

Features
- Rugged sealed construction
- Cylindrical design allows for installation in various applications

Options
- Optional circuit board mounting pins
- Available in PVDF housing for use in chemically aggressive environments
- 10 KΩ thermistor available for temperature compensation

Dimensions

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www.airmar.com
ATK120

125 kHz AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement in chemically aggressive environments
- Automation control
- Food and beverage processing
- Proximity sensing
- Obstacle avoidance

Features
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Cylindrical design allows for installation in various applications

Options
- 10 KΩ thermistor available for temperature compensation

Dimensions

**SPECIFICATIONS**

Best Operating Frequency: 125 kHz, ±4%
Minimum Transmit Sensitivity at Best Transmit Frequency: 102 dB re 1µPa/V at 1 m
Minimum Receive Sensitivity at Best Receive Frequency: -172 dB re 1V/µPa
Minimum Parallel Resistance: 500 Ω, ±30%
Minimum and Maximum Sensing Range*: 15 cm to 5 m
Typical Sensing Range: 20 cm to 3 m
Free (1 kHz) Capacitance: 1,000 pF, ±20% pF
Beamwidth (@ -3 dB Full Angle): 10°, ±2°
Maximum Driving Voltage (2% Duty Cycle Tone Burst): 800 Vpp
Operating Temperature: -40°C to 90°C
Weight: 30 g
Housing Material: Kynar® 720
Acoustic Window: Kynar® 720

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

Directivity Pattern

Transmit & Receive Voltage Response

Impedance Magnitude & Phase

Figure of Merit (Sum of TVR & RVR)

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**125 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement in chemically aggressive environments
- Food and beverage processing

**Features**
- Rugged one-piece PVDF housing is U.S. FDA compliant
- Threaded design allows for installation in various applications
- Standard internal shielding
- 8 mm M3 PCB standoffs

**Options**
- Nut—1.5" BSP thread
- Complete assembly available with standard cable lengths
- 10 KΩ thermistor available for temperature compensation
- 12 mm extension sleeve

**Dimensions**
- **Housing design will accommodate transceiver and signal processing electronics**
- **Thread Choices:**
  - 1/2" tapered BSP x 0.75" long
  - 1" NPT x 0.94" long
  - M32-1.5 x 0.75" long
  - 3/4" NPT x 0.75" long

**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Figure of Merit**

(Sum of TVR & RVR)

---

**SPECIFICATIONS**

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<th>Value</th>
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<td><strong>Best Operating Frequency:</strong></td>
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<tr>
<td><strong>Minimum Transmit Sensitivity at Best Transmit Frequency:</strong></td>
<td>102 dB re 1µPa/V at 1 m</td>
</tr>
<tr>
<td><strong>Minimum Receive Sensitivity at Best Receive Frequency:</strong></td>
<td>-172 dB re 1V/µPa</td>
</tr>
<tr>
<td><strong>Minimum Parallel Resistance:</strong></td>
<td>500 Ω, ±30%</td>
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<tr>
<td><strong>Minimum and Maximum Sensing Range</strong>*:</td>
<td>15 cm to 5 m</td>
</tr>
<tr>
<td><strong>Typical Sensing Range:</strong></td>
<td>20 cm to 3 m</td>
</tr>
<tr>
<td><strong>Free (1 kHz) Capacitance:</strong></td>
<td>1,000 pF, ±20% pF</td>
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<tr>
<td><strong>Beamwidth (@ -3 dB Full Angle):</strong></td>
<td>12°, ±2°</td>
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<tr>
<td><strong>Maximum Driving Voltage (2% Duty Cycle Tone Burst):</strong></td>
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<td><strong>Operating Temperature:</strong></td>
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<td><strong>Weight:</strong></td>
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<td><strong>Housing Material:</strong></td>
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<tr>
<td><strong>Acoustic Window:</strong></td>
<td>Kynar® 720</td>
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</tbody>
</table>

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

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**AT200**

**200 kHz**

**AIRDUCER® Ultrasonic Transducer**

**Applications**
- Level measurement
- Automation control
- Proximity
- Obstacle avoidance
- Robotics

**Features**
- Rugged sealed construction
- Cylindrical design allows for installation in various applications
- Available in PVDF housing for use in chemically aggressive environments

**Dimensions**
ATK200

SPECIFICATIONS

Best Operating Frequency: 200 kHz, ±4%
Minimum Transmit Sensitivity at Best Transmit Frequency:
102 dB re 1µPa/V at 1 m
Minimum Receive Sensitivity at Best Receive Frequency: -180 dB re 1V/µPa
Minimum Parallel Resistance: 300 Ω, ±30%
Minimum and Maximum Sensing Range*: 10 cm to 3 m
Typical Sensing Range: 12 cm to 2 m
Free (1 kHz) Capacitance: 500 pF, ±20% pF
Beamwidth (@ -3 dB Full Angle): 10°, ±2°
Maximum Driving Voltage (2% Duty Cycle Tone Burst): 500 V<sub>pp</sub>
Operating Temperature: -40°C to 60°C
Weight: 6 g
Housing Material: Kynar<sup>®</sup> 720
Acoustic Window: Kynar<sup>®</sup> 720

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

200 kHz
AIRDUCER<sup>®</sup> Ultrasonic Transducer

Applications
• Level measurement in chemically aggressive environments
• Automation control
• Food and beverage processing
• Proximity sensing
• Obstacle avoidance
• Flow monitoring

Features
• Rugged one-piece PVDF housing is U.S. FDA compliant
• Cylindrical design allows for installation in various applications

Dimensions

Directivity Pattern

Transmit & Receive Voltage Response

Impedance Magnitude & Phase

Figure of Merit (Sum of TVR & RVR)

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www.airmar.com
AT225

228 kHz

AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Automation control
- Proximity
- Obstacle avoidance
- Robotics
- Flow

Features
- Rugged sealed construction
- Cylindrical design allows for installation in various applications

Options
- Optional circuit board mounting pins (as shown in photo above)

Dimensions

Specifications

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<td>Minimum Transmit Sensitivity at Best Transmit Frequency</td>
<td>101 dB re 1µPa/V at 1 m</td>
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<tr>
<td>Minimum Receive Sensitivity at Best Receive Frequency</td>
<td>-180 dB re 1V/µPa</td>
</tr>
<tr>
<td>Minimum Parallel Resistance</td>
<td>400 Ω, ±30%</td>
</tr>
<tr>
<td>Minimum and Maximum Sensing Range*</td>
<td>8 cm to 2.5 m</td>
</tr>
<tr>
<td>Typical Sensing Range</td>
<td>10 cm to 1.5 m</td>
</tr>
<tr>
<td>Free (1 kHz) Capacitance</td>
<td>450 pF, ±20% pF</td>
</tr>
<tr>
<td>Beamwidth (@ -3 dB Full Angle)</td>
<td>15°, ±2°</td>
</tr>
<tr>
<td>Maximum Driving Voltage (2% Duty Cycle Tone Burst)</td>
<td>500 Vpp</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to 90°C</td>
</tr>
<tr>
<td>Weight</td>
<td>4 g</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Glass filled polyester</td>
</tr>
<tr>
<td>Acoustic Window</td>
<td>Glass reinforced epoxy</td>
</tr>
</tbody>
</table>

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AT300

300 kHz
AIRDUCER® Ultrasonic Transducer

Applications
- Level measurement
- Automation control
- Proximity
- Obstacle avoidance
- Robotics

Features
- Rugged sealed construction
- Cylindrical design allows for installation in various applications
- Short-range measurement capabilities

Dimensions

**SPECIFICATIONS**

- **Best Operating Frequency:** 300 kHz, ±4%
- **Minimum Transmit Sensitivity at Best Transmit Frequency:** 95 dB re 1µPa/V at 1 m
- **Minimum Receive Sensitivity at Best Receive Frequency:** -180 dB re 1V/µPa
- **Minimum Parallel Resistance:** 650 Ω, ±30%
- **Minimum and Maximum Sensing Range**: 4 cm to 1 m
- **Typical Sensing Range**: 5 cm to 50 cm
- **Free (1 kHz) Capacitance**: 450 pF, ±20% pF
- **Beamwidth (@ -3 dB Full Angle)**: 10°, ±2°
- **Maximum Driving Voltage (2% Duty Cycle Tone Burst)**: 200 Vpp
- **Operating Temperature**: -40°C to 70°C
- **Weight**: 4 g
- **Housing Material**: Glass filled polyester
- **Acoustic Window**: Glass reinforced epoxy

*Pulse-Echo Mode. Minimum and maximum ranges are best case scenarios. Actual range may vary, depending on drive circuitry and signal processing.

**Directivity Pattern**

**Transmit & Receive Voltage Response**

**Impedance Magnitude & Phase**

**Figure of Merit (Sum of TVR & RVR)**
TTW-550

Through the Tank Wall
Ultrasonic Liquid Level Sensor

Applications
• Beverage Tanks
• Chemical Storage
• ISO Tanks

For external mounting on plastic, steel, stainless steel tanks and totes including sealed/pressurized tanks

Features
• Non-invasive ultrasonic technology
• Optimized for standard 5 mm thickness of a single wall ISO tank; can be optimized for other wall thicknesses
• Reports external tank temperature
• Provides continuous bottom-up liquid level detection
• No moving parts to wear out or break down
• Rugged sealed construction

Benefits
• Ideal solution for measuring the rate of consumption of uniform liquids where inventory levels are critical
• Improved efficiencies in liquid asset monitoring that translate into cost savings and profitability
• System integration allows for remote monitoring

Options:
• Alternative serial outputs can be configured
• Customization available to accommodate a wide range of tank materials and thicknesses
• Additional cable lengths available

Contact Tanya Shenk at 1-603-249-7187

SPECIFICATIONS

Acoustic Output: Adaptive to a wide range of tank material and thicknesses
External Signal Interface: RS 485, half duplex
Level Range: Minimum .2 m to 3.75 m
Power Draw: 2 Watts Max.
Power Voltage: +7VDC +/-1.0V
External Tank Temp Accuracy: +/- 1°C
Temperature Range: -10°C to +60°C
Relative Humidity: 0% to 100%
IP Rating: (Ingress Protection) IP68
Depth Resolution: 20 mm
Weight: 227 g
Cable Length: 4 m Typical
Housing Material: Glass filled polyester

Board provided, but power will interface to customer provided electronics

Dimensions

Contact Tanya Shenk at 1-603-249-7187

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www.airmar.com
T1

Developer’s Module for Evaluation of AIRDUCER™ Transducers

Designed for fast and easy evaluation of Airmar’s Ultrasonic Transducers, we are pleased to offer our versatile, T1 Transceiver Module. The entire frequency range of 30 kHz to 300 kHz Airmar transducers can be driven by the T1. With transmit voltage output of 200 V\textsubscript{pp} to 500 V\textsubscript{pp} and adjustable pulse width and frequency, the suitability of a piezoelectric transducer for a specific application can be clearly assessed.

A selectable receiver gain up to 60 dB allows amplification of echoes and viewing of waveforms on any oscilloscope. The T1 is a compact printed circuit board 76 mm x 76 mm and offers convenient connections to our ultrasonic transducer and your power supply.

### 30-300 kHz Transceiver Module

**Applications**
- Echo-ranging
- Liquid-level detection
- Obstacle avoidance
- Proximity sensing

**Features**
- Frequency and pulse width adjustable

### Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Voltage</td>
<td>200 V\textsubscript{pp} to 500 V\textsubscript{pp}</td>
</tr>
<tr>
<td>Selectable Receiver Gain</td>
<td>0 dB, 20 dB, 40 dB, or 60 dB</td>
</tr>
<tr>
<td>Frequencies</td>
<td>30 kHz, 41 kHz, 50 kHz, 75 kHz, 120 kHz, 200 kHz, 225 kHz or 300 kHz</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>15 VDC</td>
</tr>
<tr>
<td>Printed Circuit Board Size</td>
<td>76 mm x 76 mm</td>
</tr>
</tbody>
</table>
Designers of ultrasonic systems have their choice of frequency, housing design, and mounting options when utilizing Airmar Airducer® Ultrasonic Sensors. Balancing the trade-offs between sensor performance, acoustic beam characteristics, and incorporated electronics is a critical step in the system design process. The transducer’s performance can be affected by the propagating media, the environmental conditions, and the electronics themselves. Several parameters need to be considered when selecting a transducer appropriate to the application. The purpose of this overview is to outline key factors to be considered.

**Maximum Sensing Range**
Several factors have an effect upon the maximum sensing range of a transducer. Ranges listed for Airmar Airducer Ultrasonic Sensors are derived from measurements in tone-burst pulse-echo mode and are listed under “Specifications.” When designing an ultrasonic system, several factors should be considered beyond the transducer itself. These factors include atmospheric conditions, drive and receive electronics, and signal processing. Some of these factors are discussed below.

**Temperature And Humidity**
Changes in temperature cause a change in sound speed of air as well as the materials of any ultrasonic transducer. Airmar transducers are optimized and specified for operation at 22°C. Operation at significantly higher or lower temperatures results in “detuning” of the acoustic matching layer of the transducer and shifting of the resonant frequency resulting in degraded performance. Resonant frequency shifts approximately -0.8% per 10°C (0.8% per -10°C). The reduced sensitivity is tolerable for most applications, but for applications with a wide temperature range, correction may be necessary.

The characteristics of air are dramatically changed by environmental conditions. Shown in Figure 1, signal attenuation is a function of temperature, humidity, frequency, and air pressure. The speed of sound is mainly a function of temperature, shown in Figure 2. Humidity plays a minor role in sound speed, accounting for less than 0.6% change in speed for the temperature range shown. Airmar offers optional internal thermistors for speed of sound compensation. External temperature sensors can be used for a more accurate calibration over a longer range.

**Air Currents and Atmospheric Influences**
Maximum measurement ranges are affected by air turbulence, which may deflect or deteriorate sound waves and reduce echo signal. Air currents tend to carry sound downwind; large currents can deflect sound enough to miss the intended target. Large sudden temperature differentials will reflect sound.

Light snow or rain in the sound path will attenuate the sound waves thereby reducing range. Lower frequency transducers emit a longer wavelength and the degrading effect of snow and rain is not as significant as it is for high frequencies.

Airducer Ultrasonic Sensors are not damaged by wetting or by brief immersion in water. Liquid on the transducer’s active surface temporarily degrades performance by detuning the matching layer. When the sensor is operating, water on the transducer face is typically vaporized. Standing water on the face of a sensor will impair it’s ability to function correctly.

**Interference (Electrical and Acoustical)**
Airducer Ultrasonic Sensors are susceptible to RFI and EMI. AR series Airducers include standard internal shielding. Additional shielding may be required in certain environments and is optional on all AR series transducers. Shielded cabling options are also available.

High-pressure air nozzles, such as blow off guns, create large amounts of ultrasonic noise. This noise can be very wide band and difficult to filter out. Installations near air nozzles should be avoided.

Transducers mounted to vibrating equipment can receive mechanically coupled interference. If the transducer will be subject to vibration, a very compliant mounting material should be considered to minimize vibration transmission to the transducer.
Target Strength
Hard, smooth, and flat targets mounted orthogonally to the transmitted beam return the strongest signals and hence will be detectable at longer ranges. Examples of these mediums are liquid, glass, or metal. If the beam is not orthogonal, it will be reflected off at the angle of incidence and not be received by the transducer. For example, the signal for a transducer with a 10° beam angle will be degraded by 3 dB if the target is misaligned by 2.5°.

If a surface is rough and irregular, the signal returned is varied in amplitude due to the scattering of sound. This type of target has the disadvantage that the return signal is smaller, but has the advantage that the target’s alignment is less critical. Further, different materials have widely different abilities to reflect sound. For example, surfaces such as fabric and foam have the lowest reflectivity resulting in low amplitude echoes thereby significantly reducing the effective range of the transducer.

Beam Angle
A transducer transmits energy in a beam pattern. Most of the energy is concentrated in the main lobe which defines the beam width. Energy outside the main lobe is concentrated in sidelobes. Sidelobes can disguise the true location of targets by generating phantom echoes. No transducer is ever completely free of sidelobes but at Airmar, we strive to design transducers with low sidelobes. Most Airducer Ultrasonic Sensors are designed with side lobe levels at least 17 dB below the main lobe.

Beam width is specified at the –3 dB level of the beam pattern at the full angle. The beam angle of each particular model is noted in the specifications in our catalog. Wide beam angles reduce the sensing range of the transducer and provide less target discrimination when compared to narrow beam models. Wide beams spread acoustic energy over a greater volume and hence less acoustic energy is reflected from potential targets than from a narrower, more concentrated beam. When compared to wide beams, narrow beam angles tend to have greater variations in echo amplitude with irregular surfaces such as a wavy fluid target.

Environmental Conditions
AT and AR models can be used in most environments where the sensor will not be in contact with [or in a condensing environment of] corrosive materials. Most chemical vapors do not damage AT or AR series sensors (except ketones). ATK and ARK series sensors are designed for installations in which the sensor may come in contact with a corrosive chemical or with damaging vapors. Custom design models are available for hazardous environment applications.

Minimum Sensing Range
The distance from the active surface of a transducer to the minimum sensing range is often referred to as the Blanking Zone. Within this zone no echo signals can be received. Ideally, this distance would be zero.

The blanking zone is caused by a phenomenon called ringing. Ringing is the continued vibration of the piezoelectric transducer element beyond the electrical excitation pulse. Due to the nature of piezoelectric ceramics and the constraints of transducer design, there will always be some amount of ring time. This time is necessary to dissipate mechanical and electrical energy after excitation ceases.

The extent to which a transducer rings depends on its design. The amount of ring will also vary slightly from transducer to transducer of the same design due to manufacturing tolerances.

The type of electrical pulse used to drive the sensor can have a profound effect on the amount of ring. Airmar’s characterizations of ring time are based on a tone burst drive (i.e., typically ten cycles at best operating frequency). A transducer has many modes of vibration, some are strongly coupled to air and some are not. When designing a system, the objective is to drive the transducer at a frequency strongly coupled to air and avoid exciting extraneous resonances. Hence, the use of a tone burst (narrow bandwidth) is beneficial. In contrast, the use of a wide-band transmit scheme can excite undesirable vibration.
modes. For example, “impulse” drive electronics in which a high-voltage, short duration burst of energy is applied to the transducer excites virtually all vibration modes. Modes of vibration other than the desired resonance often dissipate their energy more slowly. When these undesirable frequencies are stimulated, ring time increases.

Mounting
Since the transducer is an electromechanical device, some vibrational energy is transmitted to the transducer housing. A rigid mount of the transducer can accentuate these vibrations and cause an increase in ring time. A compliant mount typically has the least effect on sensor performance. Transducers should not be forced into a press fit mounting location. If a rigid mount is required on an AT sensor, glue the sensor into a slip fit hole, preferably touching only the front or rear edges of the sensor. Use a soft encapsulant if a sensor is to be mounted in a pocket.

AR sensors should be mounted by the supplied threads on the cap. Mounting the transducer on the outside diameter of the housing could cause an increase in ring time. If additional isolation is necessary, the use of an isolation bushing (as shown) is recommended.
Notes On The Design Of Matching Systems for Piezo Elements

These notes describe a simplified approach to match a piezo device to a source of power. The optimum matching circuit will result in maximum transmitted energy which will result in stronger echoes.

Delivering power to a piezo device, such as a transducer for a ranging instrument, is relatively simple in a normal situation. If the fundamentals are understood, then special circumstances can also be accommodated in a straightforward manner.

Like most reactive loads, a piezo device can be represented by a series resistor and capacitor. The values of both these elements vary with frequency.

By means of the classic transformation, the series values may be transformed to an exactly equivalent parallel resistor and capacitor combination. Unfortunately, the value of these components also vary with frequency (See Transducer Impedance).

The solution to these variations with frequency of operation is to use the values at the desired frequency. In the case of a depth sounder, it is the “Best Echo Frequency”. At exactly this frequency, the resistance and capacitance values of the piezo device are obtained either by measurement or from the manufacturer of the device.

The simplest matching method is to use an inductor to tune out the reactance of the parallel capacitance, yielding a purely resistive load very nearly equal to the parallel resistance. If the resulting load resistance is too high to directly match the driving source, the inductor may also be used as a tuned transformer to provide a lower, more convenient driving point.

The procedure now follows classic RF matching methods. First, the Q (figure of merit) of the inductor load must be reasonable (5-7 is acceptable).

If the Q is too low, place a capacitor across the load and reduce “L” until the load is again resistive.

A low impedance winding may now be added to provide a match to the driving source. The turns ratio is the square root of the impedance ratio. However, there is a limit to how high the turns ratio can be. For the usual universal wound inductor with a ferrite adjustment slug and ferrite shell, a ratio of 22 to 1 is about the maximum that can be achieved. Higher ratios may be achieved if toroidal forms are used for the inductor. This is because tighter coupling is achieved with toroids than is available with other types of inductors. Pot cores are between toroids and slug-tuned coils in coupling.

The foregoing discussions of matching assumes that the coil is lossless, at least compared to the Rp of the desired transducer load. Often this is not the case.

To evaluate whether there is a problem, a sample coil of the calculated inductance must be obtained. If the HP4800 is available, the Rp of the coil may be measured by placing the calculated total capacity across the coil and adjusting the frequency for zero phase angle. The instrument will indicate the Rp directly. If the HP4800 is not available, the same results can be obtained by another technique.
Find the frequencies at which the response of the tuned circuit is down 3dB from peak response.

\[ Q = \left( \frac{F_H + F_L}{F_H - F_L} \right) \]

\[ F_L = \text{lower -3 dB frequency} \]

\[ F_H = \text{higher -3 dB frequency} \]

\[ R_p = \frac{Q}{X_C} \]

The Rp of the coil should now be considered to be in parallel with Rp of the transducer.

The coil inductance and resonating capacity must now be recalculated based on the lower load resistance presented by the parallel combination of the Rp of both the coil and transducer.

Also, the division of the available output power must be considered. If the two Rp's are equal, only one half the power developed is available to the transducer to put into the water. So it is desirable that the Rp of the coil be as high as possible compared to the Rp of the transducer.

The advantages of this method of matching are:

- Minimum components —minimum cost
- Highest impedance in the connecting cable, hence the lowest I2R losses
- If the cable must be extended, a simple removal of fixed capacity is all that is required

Another method which might be considered is using the series equivalent values of the piezo device. To do this, an inductor is placed in series with the piezo device whose reactance is equal to the reactance of the equivalent series capacitance. This method presents the value of series resistance to the driving source. The disadvantage is that a second inductor is required because in the usual case, the series resistance is still higher than the required load impedance of semiconductor power sources. Also, the current through the load must pass through the effective series resistance of this (series) inductor, which increases the I2R losses, resulting in a net loss of power delivered to the load in the usual case.

Example:
Assume that a transducer is to be matched whose “Best Echo Frequency” is 196.0 kHz and the series R and X have been measured at that frequency as 151 – j239 (C = 3400pf).

\[ X_p = \frac{R_S X_S}{R_S + X_S} = \frac{151(529.3)}{151 + 239} = 334.4 \text{ ohms} \]

\[ (C_p) = 2483 \text{pf} \]

Since at resonance \( X_C = X_L \), the inductor will have a reactance of 334.4 ohms

Calculate Q of this situation

\[ Q = \frac{R_p}{X_L} = \frac{529.3}{334.4} = 1.58 \]
This is too low so capacitance must be added. Let us calculate on the basis of a loaded Q of 6

\[ X_L = \frac{R_P}{Q} = \frac{529.3}{6} = 88.22 \text{ ohms} \]

\[ L = \frac{X_L}{2\pi f} = \frac{88.22}{6.28(196 \times 10^3)} = 71.6\mu\text{H} \]

Total C is now

\[ C = \frac{1}{2\pi f X_L} = \frac{1}{6.28(196 \times 10^3)(88.22)} = 9204\text{pF} \]

Added capacity must then be 9204 – 2483 = 6721pf

\[ 71.6 \mu\text{H} \]
\[ 6271\text{pF} \]
\[ 529.3 \text{ ohms} \]
\[ 2483\text{pF} \]

The required primary impedance is calculated as 3.6 ohms to match the driving transistor

\[ N_P = \sqrt{\frac{529.3}{3.6}} = 12.1 \]

This is low enough so a slug tuned coil may be used. If a coil of 71.6mHy required 55 turns, then the primary would use 4.5 turns;

\[ T_{\text{primary}} = \frac{T_{\text{sec}}}{N_P} = \frac{55}{12.1} = 4.55 \]

The primary should be wound as tightly over the secondary as possible to obtain the best coupling. Use the start of the secondary coil as the high impedance end.

**Power Into A Piezo Device**

If the parallel resistance is known, power calculation is straightforward:

\[ P = \frac{E^2}{R} \]

E is RMS volts

R is the parallel resistance of the piezo device

Of course the voltage across the load will probably be measured with an oscilloscope and read as peak to peak voltage. Therefore, it must be divided by 2.83 to change to RMS voltage.

If parallel resistance is not used in the calculation, series resistance may be used. But the calculation is a bit more involved:

1. Impedance

\[ Z = \sqrt{R_P^2 + X_L^2} \]

2. Power

\[ I_L = \frac{E}{Z} \]

E is RMS voltage across the load as previously shown

3. Power

\[ P = I_L^2 R_P \]

4. The above equations are combined into a single equation

\[ P = \frac{R_P E^2}{R_P^2 + X_L^2} \]

**Considerations For Matching Systems During Receive Mode**

Once the matching has been accomplished for transmit, what are the considerations for receiving? If the input impedance of the receiving section is higher by a large margin, then it may be tied directly across the tuned circuit used to match in transmit.

If the receive input impedance margin is not large or is even small, then other methods must be used to achieve the maximum performance of which the piezo device is capable. Also, provisions must be made to prevent the transmit voltage from destroying the input device(s) of the receiver.

If the coupling of the transformer is high, a lower “Q” may operate satisfactorily. Reduce the capacity added in steps, increasing the inductance of the secondary in steps to maintain resonance. Keep the primary inductance constant. In the extreme it may be possible to resonate just the capacity of the transducer without adding any external capacitance. This will yield higher turns ratios and if the coupling is tight enough, will also yield more output voltage (power).

Note, however, that at Q values of 7 or less, the equation no longer holds. Until such time as an application note describing techniques of calculating such low Q matching systems is developed, proceed carefully, step by step, in developing these matching systems by empirical methods.