Ultrasonic Sensors

- USA Series
- US-T50/R25
- US-S25AN
- US-S300 Series
- US-1AH
USA series
Ultrasonic displacement sensors

- Capable of long-distance measurement
- Built-in teaching function for simple operation and highly-accurate measurement
- Integrated temperature sensor for stable measurement
- Anti Interference feature
- High resolution 12-bit D/A converter
- Attachments available for wider range of applications (wave guide/wave reflector)

### Type

<table>
<thead>
<tr>
<th>Measuring method</th>
<th>Measuring range</th>
<th>Model</th>
<th>Operation mode</th>
<th>Output mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective type</td>
<td>0.1~1m</td>
<td>USA-S1AN</td>
<td>Proportional output</td>
<td>Analog output</td>
</tr>
<tr>
<td></td>
<td>0.4~3m</td>
<td>USA-S3AN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Attachments (applicable to USA-S1AN)

<table>
<thead>
<tr>
<th>Type</th>
<th>Measuring range with attachment provided</th>
<th>Model</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave guide</td>
<td>Depends on the length of pipe</td>
<td>USA-WG08FS</td>
<td>Straight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>USA-WG08FL</td>
<td>Angled</td>
</tr>
<tr>
<td>Wave reflector</td>
<td>65~965mm</td>
<td>USA-WR</td>
<td>Side-on in direction of detection</td>
</tr>
</tbody>
</table>

### Optional Parts

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Shape, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord with connector</td>
<td>FAC-D4R2S</td>
<td>4-core M12 straight, 2 m</td>
</tr>
<tr>
<td></td>
<td>FAC-D4R5S</td>
<td>4-core M12 straight, 5 m</td>
</tr>
</tbody>
</table>
## Rating/Performance/Specification

<table>
<thead>
<tr>
<th>Model</th>
<th>USA-S1AN</th>
<th>USA-S3AN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting distance</td>
<td>0.1-1m</td>
<td>0.4-3m</td>
</tr>
<tr>
<td>Detection object</td>
<td>100x100mm (sample object: 2-mm thick aluminum plate)</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>12-24V DC ±10% / Ripple (p-p) 10% max.</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>1.3W max.</td>
<td></td>
</tr>
<tr>
<td>Response speed (standby use)</td>
<td>150ms max.</td>
<td>300ms max.</td>
</tr>
<tr>
<td>Analog output</td>
<td>4-20 mA current output (reverse output available with SET button); see *3 for voltage output</td>
<td></td>
</tr>
<tr>
<td>Minimum resolution *1</td>
<td>0.9mm (0.1%F.S.)</td>
<td>2.6mm (0.1%F.S.)</td>
</tr>
<tr>
<td>Linearity</td>
<td>±1% F.S.</td>
<td></td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>±1% of F.S. max. with reference to output at 23 °C between -10 and +55 °C (±0.03% of F.S./ °C max.)</td>
<td></td>
</tr>
<tr>
<td>Applicable load</td>
<td>0-250Ω</td>
<td></td>
</tr>
</tbody>
</table>

### Ultrasonic Frequency
- **Model**
  - USA-S1AN: About 200 kHz
  - USA-S3AN: About 75 kHz

### Indicator
- **Model**
  - USA-S1AN: RUN: (green) 4mA: (red) mid (orange) 20mA (green)
  - USA-S3AN: Teaching: distance setting, output inversion (with SET button)

### Teaching System
- **Model**
  - USA-S1AN: Teaching system
  - USA-S3AN: Teaching system

### Connection
- **Model**
  - USA-S1AN: Connector (M12) *2
  - USA-S3AN: Connector (M12) *2

### Mass
- **Model**
  - USA-S1AN: Approx. 150 g
  - USA-S3AN: Approx. 300 g

### Protective Feature
- **Model**
  - USA-S1AN: Output short circuit protection, power supply output protection against reverse connection
  - USA-S3AN: Output short circuit protection, power supply output protection against reverse connection

### Material
- **Model**
  - USA-S1AN: Case: brass (nickel plated) / Detection side: nylon, silicon, glass epoxy resin
  - USA-S3AN: Case: brass (nickel plated) / Detection side: nylon, silicon, glass epoxy resin

*1 Value applicable about 15 minutes after power-up. Output may be slightly fluctuated by external disturbance, etc.
*2 Cord with M12 connector is separately available.
*3 May be converted into voltage output (1-5 V) with the resistor (250 Ω) provided.

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## Environmental Specification

<table>
<thead>
<tr>
<th>Environment</th>
<th>USA-S1AN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>-10 - +55 °C (non-freezing)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>35-85%RH (non-condensing)</td>
</tr>
<tr>
<td>Protective structure</td>
<td>IP 67 (no drops of water allowed on head)</td>
</tr>
<tr>
<td>Vibration</td>
<td>10-55 Hz / 13 mm amplitude / 2 hours each in 3 directions</td>
</tr>
<tr>
<td>Shock</td>
<td>500 m/s² / 3 times each in 3 directions (ultrasonic element excluded)</td>
</tr>
<tr>
<td>Dielectric withstanding</td>
<td>1000VAC 50/60Hz for 1 minute</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>500 VDC; 50 MΩ or higher</td>
</tr>
</tbody>
</table>

## Panel and Indicators

- **Model**
  - USA-S1AN: RUN indicator (green), mid. indicator (orange), 4mA indicator (red), 20mA indicator (green)
  - USA-S3AN: RUN indicator (green), mid. indicator (orange), 4mA indicator (red), 20mA indicator (green)

### Applicable Comparator
- **Model**
  - USA-S1AN: Applicable comparator (ANP Series)

### Sensor I/O Connector (M12)
- **Model**
  - USA-S1AN: Sensor I/O connector (M12)

### Name | Color | Operation
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20 mA indicator</td>
<td>Green</td>
<td>Illuminated when output current is about 20 mA or larger</td>
</tr>
<tr>
<td>mid. indicator</td>
<td>Orange</td>
<td>Illuminated when detection object is within measuring range</td>
</tr>
<tr>
<td>4 mA indicator</td>
<td>Red</td>
<td>Illuminated when output current is about 4 mA or smaller</td>
</tr>
<tr>
<td>RUN indicator</td>
<td>Green</td>
<td>Illuminated while power is supplied</td>
</tr>
</tbody>
</table>
**Input/Output Circuit and Connection**

(For measurement)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Description</th>
<th>Core colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply (+)</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>I/O</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>0V</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>Current output</td>
<td>Black</td>
</tr>
</tbody>
</table>

Pin arrangement:

- **I/O circuit**
- **Current output**

- **Power supply (+)**

Schematic diagram:

- 12 - 24 V DC
- 4～20mA
- Input device: 0 ～250Ω

**Characteristics (Typical Example)**

- **Detecting area characteristics (flat plate)**
  - **USA-S1AN**
  - **USA-S3AN**

- **Detecting area characteristics (round bar)**
  - **USA-S1AN**
  - **USA-S3AN**

- **Current consumption characteristics**

**Surface temperature of detection object**

Ultrasonic waves reflected on a surface at a temperature above 100°C may be extremely low. Be sure to test the operation before putting the sensor to use.
Current output between 4-20 mA is available between arbitrary 2 points within the measuring range. (The factory setting is maximum measuring range.)

The operation can be switched between the modes in which output current increases and decreases according to the distance. (The factory setting is the incremental mode.)

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### Teaching procedure

**Range setting**

- **Procedure:** Provide the detection object at the far point of the measuring range.
- **Operation and indicator:** Detection object

- **Procedure:** Press and hold down the SET button for about 3 seconds (3-6 seconds)
- **Operation and indicator:** Flashes simultaneously

- **Procedure:** Release the SET button.
- **Operation and indicator:** Starts alternating

- **Procedure:** Provide the detection object at the near point of the measuring range.
- **Operation and indicator:** Detection object

- **Procedure:** Press the SET button once (0.5 seconds min.).
- **Operation and indicator:** Show current measuring conditions

- **Completed:** The setting has been made for output between 4 and 20 mA for near and far points respectively.

**Incremental/decremental mode switching**

- **Procedure:** Press and hold down the SET button for about 8 seconds (8-12 seconds).
- **Operation and indicator:** Starts alternating after about 3 seconds, Starts alternating after about 8 seconds

- **Completed:** The 20 mA (green) indicator starts flashing quickly about 4 seconds after the last switch operation and, about 2 seconds later, the mode is determined.

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- Do not use the sensor for protection of human body.
- For safety applications, ensure safe operation of the detection and control system as a whole.
Teaching procedure

- Default setting

![Graph showing maximum measuring range](image)

**Restoration of maximum range measurement setting (factory setting)**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Operation and indicator</th>
</tr>
</thead>
</table>
| 1         | With no incoming wave signal (no detection object), press and hold down the SET button for about 3 seconds.  
No detection object  
Flashes simultaneously  
20mA  
mid.  
4mA  
RUN |
| 2         | Release the SET button.  
20mA  
mid.  
4mA  
RUN  
Starts alternating |
| 3         | With no incoming wave signal (no detection object), press the SET button once.  
The maximum measuring range setting for the model is restored and the output between 4 and 20 mA for near and far points becomes available.  
(Previous setting data are lost.)  
20mA  
mid.  
4mA  
RUN |
| Completed | (Show current measuring conditions)  
20mA  
mid.  
4mA  
RUN |

- Anti Interference setting

For adjacent or face-to-face installation of two sensors, perform master/slave teaching. Connect (2) I/O lines (white) with each other and connect the 0 V together.

**Connection**

![Connection diagram](image)

**Procedure for setting the master/slave mode**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Operation and indicator</th>
</tr>
</thead>
</table>
| 1         | Supply power while holding down the SET button.  
All indicators flash quickly  
20mA  
mid.  
4mA  
RUN  
About 2 seconds later  
20mA  
mid.  
4mA  
RUN |
| 2         | Release the SET button.  
Slave mode setting complete  
20mA  
mid.  
4mA  
RUN  
Previous setting data are lost  
Not illuminated (slave mode) |
| 3         | Repeating Steps 1 and 2 allows switching between the master and slave modes.  
20mA  
mid.  
4mA  
RUN  
Not illuminated (master)  
Not illuminated (slave) |
| Completed | |

**Note**

For teaching with the Anti Interference connection enabled, turn off the power to the other sensor or disconnect the other sensor. The response speed will be reduced to about 50%. 

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**Input device**

- Master sensor
- Slave sensor

**Connection**

- 1 I/O (White)
- 2 I/O (White)
External teaching

Teaching operation may be performed by using the external switch (Pin (2) I/O line) instead of the SET button on the sensor unit.

Short-circuit Pin (2) (I/O) to Pin (3) (GND) for use as teaching switch wiring.

Installation

Be sure to use the nuts provided to install the sensor and tighten with a torque of 15 N·m max.

Cord Extension

To extend the cord, use wires of at least 0.3 mm² and limit the length to within 300 m. When the wiring is 5 m or longer, separate the GND lines for output and power supply at a point within 5 m.

Dimensions (in mm)

USA-S1AN

USA-S3AN

FAC-D4R2S (L:2m)
FAC-D4R5S (L:5m)
Produce name: wave guide

- Offers flexibility of detection head
- Small angle of aperture for pinpoint detection
- No dead zone and capable of close proximity detection
- Free-cutting pipe counteracts installation space restrictions

<table>
<thead>
<tr>
<th>Model</th>
<th>Straight USA-WG08FS</th>
<th>Angled USA-WG08FL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting distance(*)</td>
<td>0-300mm (with pipe length 200 mm)</td>
<td>0-200mm (with pipe length 150 mm)</td>
</tr>
<tr>
<td>Pipe length</td>
<td>Pipe can be cut freely on the sensor side.</td>
<td>0-100mm (with pipe length 75 mm)</td>
</tr>
<tr>
<td>Material</td>
<td>Pipe: copper (nickel plated)</td>
<td>0-75mm (with pipe length 50 mm)</td>
</tr>
<tr>
<td>Locking ring: brass (nickel plated)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model USA-WG08FS (straight)</th>
<th>Model USA-WG08FS (Angled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe length: 100-200mm</td>
<td>Pipe length: 100-200mm</td>
</tr>
<tr>
<td>Pipe length: 100-200mm</td>
<td>Pipe length: 100-200mm</td>
</tr>
</tbody>
</table>

**Detection area characteristics (Typical Example)**

**Flat plate detection (100x100mm)**

- Model USA-WG08FS (straight)
- Model USA-WG08FL

**Dimensions (in mm)**

- Model USA-WG08FS
- Model USA-WG08FL
Attachment

Product name: wave reflector

- Side-on attachment for deflecting the detection angle by 90°
- Eliminates installation space restrictions

---

### Detection area characteristics (Typical Example)

**Flat plate detection (100x100mm)**

Model USA-WR

<table>
<thead>
<tr>
<th>100-100 12mm Flat plate</th>
<th>100-100 12mm Flat plate</th>
<th>965mm Detecting distance</th>
<th>65mm (Dead zone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X(detecting position)</td>
<td>Y(Distance)</td>
<td>Sensor</td>
<td>Indicator</td>
</tr>
<tr>
<td>Sensor</td>
<td>19</td>
<td></td>
<td>M12 connector</td>
</tr>
</tbody>
</table>

**Round bar detection**

Model USA-WR

<table>
<thead>
<tr>
<th>Round bar</th>
<th>Round bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>X(detecting position)</td>
<td>Y(Distance)</td>
</tr>
<tr>
<td>Sensor</td>
<td>19</td>
</tr>
</tbody>
</table>

---

### Dimensions (in mm)

- Attachment
- Side-on attachment for deflecting the detection angle by 90°
- Eliminates installation space restrictions

---

**Table: USA-WR**

<table>
<thead>
<tr>
<th>Model</th>
<th>USA-WR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting distance</td>
<td>65-965mm</td>
</tr>
<tr>
<td>Detection object</td>
<td>100x100mm t=2mm aluminum plate</td>
</tr>
<tr>
<td>Material</td>
<td>Body: polyacetal resin</td>
</tr>
<tr>
<td></td>
<td>Locking ring: brass (nickel plated)</td>
</tr>
<tr>
<td>Applicable sensor</td>
<td>USA-S1AN</td>
</tr>
</tbody>
</table>

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**Dimensions (in mm)**

- (Attached to sensor)
US-T50/R25

- Microminiature ultrasonic element translates to compact sensor size
- Through-beam model is ideal for detecting transparent packaging or container
- Reflective model is suitable for detecting either a black sheet or a transparent container

<table>
<thead>
<tr>
<th>Type</th>
<th>Detecting distance</th>
<th>Model</th>
<th>Operation mode</th>
<th>Output mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through-beam type</td>
<td>500mm</td>
<td>US-T50</td>
<td>Wave-OFF</td>
<td>NPN open collector output *1</td>
</tr>
<tr>
<td>Reflective type</td>
<td>60-250mm</td>
<td>US-R25</td>
<td>Wave-ON</td>
<td></td>
</tr>
</tbody>
</table>

*The model No. for the through-beam type is a set model No. For prices of the transmitter and receiver for separate purchase, see the Price List at the end of this book.
*1 For ordering a PNP output mode type, add PN at the end of the model No.

Sample Applications

Detection of transparent glass bottle
Detection of transparent glass
### Rating/Performance/Specification

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection method</td>
<td>Through-beam type</td>
<td>Reflective type</td>
<td></td>
</tr>
<tr>
<td>Detecting distance</td>
<td>500mm max.</td>
<td>60-250mm</td>
<td></td>
</tr>
<tr>
<td>Detection object</td>
<td>10 x 30mm</td>
<td>30 x 30mm*</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>24V DC ±10% / Ripple % max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>TE50:25mA max.</td>
<td>TO50:15mA max.</td>
<td>25mA max.</td>
</tr>
<tr>
<td>Response time</td>
<td>10ms max.</td>
<td>OK: 30 ms max. / OFF: 50 ms max.</td>
<td></td>
</tr>
<tr>
<td>Output mode</td>
<td>NPN open collector output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode</td>
<td>Wave-OFF</td>
<td>Wave-ON</td>
<td></td>
</tr>
<tr>
<td>Operating angle</td>
<td>20°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>10% max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrasonic frequency</td>
<td>360kHz ±15kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Operation indicator (red LED) / Stability indicator (green LED)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td>Sensitivity adjustment</td>
<td>Distance adjustment</td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Permanently attached cord (φ4)</td>
<td>Permanently attached cord (φ4)</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>80 g max.</td>
<td>80 g max.</td>
<td></td>
</tr>
</tbody>
</table>

(*1) *Sample object: 1-mm thick aluminum plate

### Environmental Specification

- Ambient temperature: -10 - +55 °C (non-freezing)
- Ambient humidity: 35-85%RH (non-condensing)
- Ambient wind speed: 1m/s max.
- Protective structure: IP54 (no drops of water allowed on head)
- Vibration: 10-35 Hz / 1.5 mm amplitude / 2 hours each in 3 directions
- Shock: 100 m/s² / 3 times each in 3 directions (ultrasonic element excluded)

### Dimensions (in mm)

For all models (transmitter/receiver)

(Dotted lines show the dimensions with the mounting bracket (accessory) attached)

### Input/Output Circuit and Connection

**Model US-TE50**

- **Lead colors**
  - Brown: 24 V DC
  - Blue: 0V

**Model US-TD50 Model US-R25**

- **Load**
  - Brown: 24 V DC
  - Blue: 0V
  - Black: OUT PUT

### Characteristics (Typical Example)

#### Directional characteristics

**US-T50**

- **Distance**
  - Position (mm)
  - 0 10 20 30 40 50 60 70 80 90 100

- **Position**
  - Distance (m)
  - 0 10 20 30 40 50 60 70 80 90 100

#### Activation area characteristics

**US-R25**

- **Distance**
  - Position (mm)
  - 0 10 20 30 40 50 60 70 80 90 100

- **Position**
  - Distance (mm)
  - 0 10 20 30 40 50 60 70 80 90 100
US-S25AN  Ultrasonic Sensors

- Handy M18 cylinder
- Integrated amplifier for easy adjustment

## Type

<table>
<thead>
<tr>
<th>Detection method</th>
<th>Detecting distance</th>
<th>Model</th>
<th>Operation mode</th>
<th>Output mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective type</td>
<td>60-250mm</td>
<td>US-S25AN</td>
<td>Proportional output</td>
<td>Analog output</td>
</tr>
</tbody>
</table>

- Applicable comparator

(ANP Series)

## Sample Applications

- Detection of level of water in tank
- Height measurement
US-S25AN

Rating/Performance/Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>Ultrasonic (analog output)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>US-S25AN</td>
</tr>
<tr>
<td>Detection method</td>
<td>Ultrasonic reflective</td>
</tr>
<tr>
<td>Detecting distance</td>
<td>60 – 250mm ±10mm</td>
</tr>
<tr>
<td>Detection object</td>
<td>30 x 30mm (sample object: 1-mm thick aluminum plate)</td>
</tr>
<tr>
<td>Power supply</td>
<td>24V DC ±10% / Ripple 10% or less</td>
</tr>
<tr>
<td>Current consumption</td>
<td>25mA MAX</td>
</tr>
<tr>
<td>Response time</td>
<td>10 → 2 V: 30 ms max. / 2 → 10 V: 300 ms max.</td>
</tr>
<tr>
<td>Output mode</td>
<td>Voltage output in proportion to distance, effective voltage: 2 V ± 0.2 V ~ 10 V ± 0.3V (at output voltage 10 V)</td>
</tr>
<tr>
<td>Minimum resolution</td>
<td>2 mm (with 80 mV ripple) *</td>
</tr>
<tr>
<td>Linearity</td>
<td>±5% of F.S. max.</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>0.025% of F.S./ °C</td>
</tr>
<tr>
<td>Ultrasonic frequency</td>
<td>350kHz ±15kHz</td>
</tr>
<tr>
<td>Indicator</td>
<td>Not provided</td>
</tr>
<tr>
<td>Connection</td>
<td>Permanently attached cord (Φ4)</td>
</tr>
<tr>
<td>Mass</td>
<td>65 g max.</td>
</tr>
<tr>
<td>Protective feature</td>
<td>Protection against reverse connection</td>
</tr>
</tbody>
</table>

*While the minimum resolution is 2 mm, accuracy of less than 1 mm may be available by integrating the analog output voltage.

Environmental Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>−10 ~ +55 °C (non-freezing)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>35-85%RH (non-condensing)</td>
</tr>
<tr>
<td>Ambient wind speed</td>
<td>1m/s max</td>
</tr>
<tr>
<td>Protective structure</td>
<td>IP54(no water drops allowed on head)</td>
</tr>
<tr>
<td>Vibration</td>
<td>10-55 Hz / 1.5 mm amplitude / 2 hours each in 3 directions</td>
</tr>
<tr>
<td>Shock</td>
<td>500 m/s² / 2 times each in 3 directions (ultrasonic element excluded)</td>
</tr>
</tbody>
</table>

Dimensions (in mm)

Input/Output Circuit and Connection

Characteristics (Typical Example)

Activation area characteristics

*Normal voltage is not output unless the object passes across the central axis.

Distance-output characteristics

*The effective range is 60-250 mm (distance) or 2 V ± 0.2 V – 10 V ± 0.3V (voltage). Be sure to use signals within this range.

*It takes about 5-10 minutes before the output voltage stabilizes after power-up. For adjustment or operation requiring accuracy, supply power well in advance. The fluctuation may reach about 100 mV.
**US-S300 series**

- Handy M30 cylinder
- Highly-accurate analog output
- Improved resistance to noise by the use of an ultrasonic frequency of 186 kHz

### Type

<table>
<thead>
<tr>
<th>Detection method</th>
<th>Detecting distance</th>
<th>Model</th>
<th>Operation mode</th>
<th>Output mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective type</td>
<td>90-300mm</td>
<td>US-S303AN</td>
<td>Proportional output</td>
<td>Analog output</td>
</tr>
<tr>
<td></td>
<td>90-500mm</td>
<td>US-S305AN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Characteristics (Typical Example)

- Activation area characteristics
- Distance-output characteristics

*(Sample: 50 x 50 mm aluminum plate)*

![Graph](image)

Note: Normal voltage is not output unless the object passes across the central axis.
## Rating/Performance/Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>US-S303AN</th>
<th>US-S305AN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection method</td>
<td>Reflective type</td>
<td>Reflective type</td>
</tr>
<tr>
<td>Detecting distance</td>
<td>90-300mm±10mm</td>
<td>90-500mm±10mm</td>
</tr>
<tr>
<td>Dead zone</td>
<td>90±10mm max.</td>
<td>90±10mm max.</td>
</tr>
<tr>
<td>Detection object</td>
<td>100x100mm (sample object: 1-mm thick aluminum plate)</td>
<td>100x100mm (sample object: 1-mm thick aluminum plate)</td>
</tr>
<tr>
<td>Power supply</td>
<td>12-24V DC ±10% / Ripple 10% max.</td>
<td>12-24V DC ±10% / Ripple 10% max.</td>
</tr>
<tr>
<td>Current consumption</td>
<td>40mA max. (with no load)</td>
<td>40mA max. (with no load)</td>
</tr>
<tr>
<td>Response time</td>
<td>50ms max.</td>
<td>50ms max.</td>
</tr>
<tr>
<td>Output voltage</td>
<td>3-10V (11V max.)</td>
<td>1.8-10V (11V max.)</td>
</tr>
<tr>
<td>Output mode</td>
<td>Voltage output in proportion to distance, output current 20 mA max., minimum load resistance 600 Ω</td>
<td>Voltage output in proportion to distance, output current 20 mA max., minimum load resistance 600 Ω</td>
</tr>
<tr>
<td>Minimum resolution</td>
<td>1mm</td>
<td>1mm</td>
</tr>
<tr>
<td>Linearity</td>
<td>±3%FS max.</td>
<td>±3%FS max.</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>0.03%FS/°C</td>
<td>0.03%FS/°C</td>
</tr>
</tbody>
</table>

### Ultrasonic Specification
- Ultrasonic frequency: 186kHz ± 10kHz
- Indicator: Power indicator (green) / Reception indicator (red)
- Connection: Connector type (cord with connector: 2 m)
- Material: Vinyl chloride
- Mass: 150 g max. (including cord)
- Protective feature: Output short circuit protection, protection against reverse connection

### Environmental Specification
- Ambient temperature: -10 ~ +55 °C (non-freezing)
- Ambient humidity: 35 ~ 85%RH (non-condensing)
- Ambient wind speed: 1m/s max
- Protective structure: IP54 (no water drops allowed on head)
- Vibration: 10-55 Hz / 1.5 mm amplitude / 2 hours each in 3 directions
- Shock: 500 m/s² / 2 times each in 3 directions (ultrasonic element excluded)

### Dimensions (in mm)

**For all models**

- 36 x 41.6
- 75 x 57
- 18 x 5
- 9 x 5

**Cord with M8 connector (accessory)**

- Model FBC-4R2L
- Wire colors:
  - Brown: power
  - Blue: 0V
  - Black: output
  - White: unused

- Color: Black
**US series**

Ultrasonic Sensors

- Unique circuit achieving high accuracy (1 mm = 10 mV)
- Improved resistance to noise by the use of an ultrasonic frequency of 200 kHz
- Resistance to dust and dirt, wide range of detectable objects including transparent objects, liquid, particles, etc.
- Comparator output available

### Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Detection distance</th>
<th>Model</th>
<th>Operation mode</th>
<th>Output mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflective type</td>
<td>0.08-1mm</td>
<td>US-1AH</td>
<td>Wave-ON/Wave-OFF selectable (with switch)</td>
<td>Analog output</td>
</tr>
</tbody>
</table>

### Panel layout

- The distance adjustment is a 4-turn volume. Turning clockwise increases the detecting distance up to about 1 m.
- Set the operation mode selector switch according to the application.
  - NC: Wave-OFF (normally "closed")
  - NO: Wave-ON (normally "open")

For using the analog output only, the operation above is unnecessary. Use the sensor with the factory setting enabled.

### Indicators

The reception indicator (green LED) and operation indicator (red LED) on the panel respectively show different received signal levels as described in the figure.

The range of illumination for the operation indicator depends on the distance adjustment setting. The reception indicator is illuminated within the range of distance in which ultrasonic waves are received, although the boundaries may vary depending on the detection object. This indicates a margin of detection.

For detection of object with low ultrasonic reflectance such as rubber, the maximum detecting distance may be reduced.

### Sample Applications

- Winding thickness control/measurement
- Detection of transparent objects/bottles
- Analog control of level of liquid/fine particles

Ultrasonic wave sensor capable of detecting intense black rubber. Analog voltage output available for analog control.

Wave height controlled in pool equipped with wave generator.
### Rating/Performance/Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>Ultrasonic (analog output)</th>
<th>US-1AH</th>
<th>US-1AH PN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>US-1AH</td>
<td>US-1AH PN</td>
<td></td>
</tr>
<tr>
<td>Detection method</td>
<td>Reflective type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detecting distance</td>
<td>80-1000 ±10mm With 40x40mm aluminum plate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dead zone</td>
<td>60mm MAX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>12-24V DC ±10% / Ripple 10% max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>50mA max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output mode</td>
<td>Analog output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output impedance</td>
<td>600 Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation mode</td>
<td>Wave-ON/Wave-OFF selectable (with switch)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum resolution</td>
<td>1mm=10mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>±3% FS (full scale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response time</td>
<td>Analog output: 10V→2V 60ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2V→10V 50ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>analog response time + 10 ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hysteresis</td>
<td>3% max. of detecting distance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrasonic frequency</td>
<td>186kHz±10kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Operation indicator: red LED (each on front/back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reception indicator: green LED (front)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (VR)</td>
<td>Distance adjustment (4-turn without stopper) provided</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch (SW)</td>
<td>Wave-ON/Wave-OFF selector switch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective feature</td>
<td>Output short circuit protection, protection against reverse connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>Case: aluminum / Lid: polycarbonate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front panel: acrylic resin / Back panel: ABS resin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Permanently attached cord (Φ6.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.3 mm² 4 cores, 2 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>350 g max.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Environmental Specification

<table>
<thead>
<tr>
<th>Environment</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>~10 - +55 °C (non-freezing)</td>
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<tr>
<td>Ambient humidity</td>
<td>35-85%RH (non-condensing)</td>
</tr>
<tr>
<td>Ambient wind speed</td>
<td>1m/s max</td>
</tr>
<tr>
<td>Protective structure</td>
<td>IP51</td>
</tr>
<tr>
<td>Vibration</td>
<td>10-55 Hz / 1.5 mm amplitude / 2 hours each in 3 directions</td>
</tr>
<tr>
<td>Shock</td>
<td>500 m/s² / 2 times each in 3 directions (ultrasonic element excluded)</td>
</tr>
<tr>
<td>Dielectric withstanding</td>
<td>500VAC for 1 minute</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>500 VDC, 20 MΩ or higher</td>
</tr>
</tbody>
</table>

### Characteristics (Typical Example)

- **Activation area characteristics**
- **Distance-output characteristics**
- **Applicable comparator**
Ultrasonic Sensors

For Correct Use

Notes on use of ultrasonic sensors

Installation location and external disturbance

- Although a circuit is employed that uses ultrasonic waves with high oscillation frequency for distinction from external sounds, do not install the sensor in a place subject to frequent sound of glass cutting, sound generated from air nozzles, high-frequency clanks, etc.
- Ultrasonic sensors use air as the transmission medium and places subject to localized temperature change or significant change in convection (air from air conditioner or heat generator) must be avoided.
- While the sensor is waterproofed, note that water on the ultrasonic element (white part on the front of the sensor) may reduce the sensitivity. Also absorption of water may cause deterioration.

Interference

- Adjacent installation or installation of more than one sensor in a small space may cause interference.
- Prevent faulty operation due to irregular reflection caused by spread of ultrasonic waves especially by side lobe.

Installation adjustment and objects

Through-beam type

- Through-beam type offers high sensitivity and reflection on walls or floor may make it difficult to block the signals sufficiently. Apply noise absorbing materials or reduce the sensitivity with the adjustment.

Reflective type

- Certain limitations apply to objects detectable with reflective type. With objects that may function as nose absorbing materials, soft cloths, sponges, etc., operating distance may be significantly reduced or the sensor may not be activated. Use hard objects such as iron plate to check the operation at the same distance. Transparent or black objects offer the same detecting distances as objects of other colors. Objects with polished surfaces like mirrors, the reflected sound waves may not return to the sensor depending on the angle of the passing object.

Detection at the center of ultrasonic wave axis offers normal distance output. For detection of passing objects, set the sensor so that the detection occurs as close to the central axis as possible. The central axes of the sensor and the ultrasonic wave may be apart by a few degrees.

Dead zone

Ultrasonic sensors measure the distance from the object by measuring the time before the reflected ultrasonic waves are received. Reverberation is present in the vicinity of the ultrasonic element and the reception operation is stopped for a certain period for avoiding its effect. In a very short range, reflection and reception of waves may occur more than once between the object and sensor, which generates higher output than for the actual detecting distance and prevents the generation of normal output in proportion to the detecting distance. To avoid such situations, do not use the sensor in the short distance, which is specified as a dead zone.

Running time

After power-up, it takes about 30 minutes before the analog output stabilizes. For measurement or operation requiring accuracy, supply power well in advance.

Sensor mounting

Ultrasonic waves spread over a large angle and the angle of the object may significantly affect detection. Be sure to mount the sensor in such a way that it faces the surface to be detected at right angles except for objects that reflect waves diffusely such as fine particles.

Major Applications of Ultrasonic Sensors

<table>
<thead>
<tr>
<th>Classification</th>
<th>Application</th>
</tr>
</thead>
</table>
| Detection of passage or presence, counting | - Detection of passage of bottles or corrugated cardboard  
|                           | - Detection of height of piles                                              |
|                           | - Prevention of collision of cranes                                          |
| Level detection           | - Detection of level of fine particles in hopper                             |
|                           | - Detection of level of grain, feedstuff, etc.                              |
|                           | - Detection of chemicals, etc. in hopper                                    |
|                           | - Detection of water level                                                  |
| Sorting                   | - Sorting by height of packages                                             |
| Constant rate feeding/positioning | - Detection of stopping position of unmanned carriages                     |
|                           | - Detection of height of vehicles                                           |
| Safety/alert              | - Prevention of collision of cranes                                          |
|                           | - Detection of height of vehicles                                           |
|                           | - Detection of height of piles of goods                                     |
|                           | - Detection of ingress                                                     |