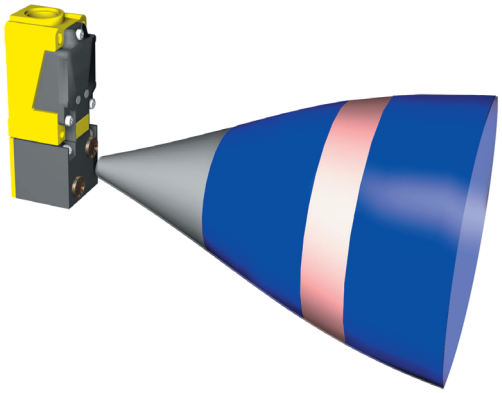
## Principle of Operation

The sensor emits an ultrasonic pulse that reflects back from any object entering the sonic cone. Because sound has a constant velocity at a given temperature and humidity, the time taken for this echo to return to the sensor is directly proportional to the distance of the object. The sensor's output status is dependent on the comparison of this time with the setting of the detection zone.



## Medium

TURCK ultrasonic transducers are calibrated for use in air. The sensors can also be used in other gaseous media with a corresponding change in sensing range.

## Targets

Solid, fluid, granular and powdery targets can be detected by TURCK ultrasonic sensors.

The **variations** of an "ideal" target should not exceed 0.15 mm (.006 in). Larger surface variations allow for larger alignment variations but may reduce sensing range.

Target **temperature** affects the sensing range in that hot surfaces reflect sonic waves less than cold ones.

The ultrasonic reflectivity of **liquid surfaces** is the same as that of solid, flat objects. Correct alignment should be observed.

Textiles, foams, wool, etc. absorb sonic waves, thereby reducing the sensing range.

## Air pressure

Normal atmospheric pressure changes of ±5% (at a fixed reference point) can cause a ±6% deviation in sensing range.

## Air temperature and humidity

Both air temperature and humidity influence the sonic pulse duration. An air temperature increase of 20°C (68°F) results in a +3.5% change in sensing distance for M18, M30 or Q30 styles and +8% for CP40s.

An increase in humidity results in an increased sound speed (max. 2%) compared with dry air.

## Air streams

Air streams affect the echo propagation time, but the effects of air flow speeds of up to 10 m/s are negligible. The use of ultrasonic sensors is not recommended in turbulent areas such as above glowing metal because the sonic waves become distorted, making the echos difficult to evaluate.

## Dewing

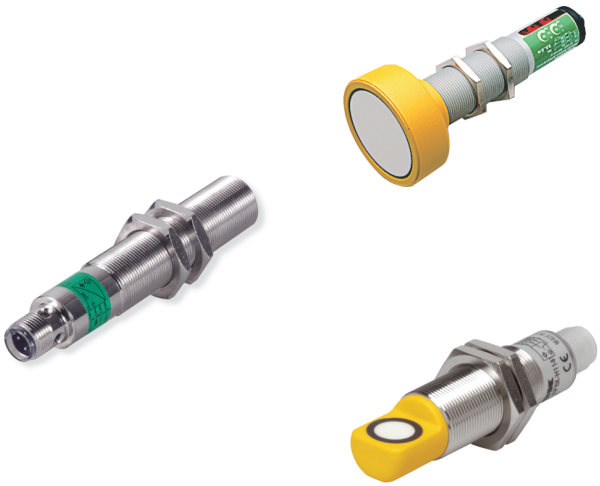
Normal concentrations of rain or snow falling in front of the sensor do not affect sensor operation.

CP40 transducers are not protected against wetting. All other ultrasonic sensors are not damaged by water, but correct functionality may be impaired when wet. Therefore, the transducers should not be subjected to direct wetting during use.

## Sensor styles

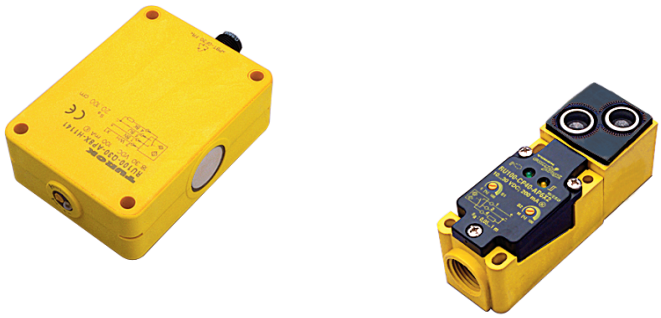
**M18, M30 & Q30**: these sensor styles have one transducer that functions both as emitter and receiver, which results in a larger blind zone. They have a narrow sonic cone (6°) and are especially suited for detection of small objects in a small area at a long distance.

**CP40** - these sensor styles have two transducers - one emitter and one receiver, which results in a smaller blind zone. They have a wide sonic cone (60°). The wide cone angle allows for a greater angle of inclination for the target. CP40 style sensors are especially suited for detecting objects in a large area.



## Simultaneous operation of several sensors

When several ultrasonic sensors are used, mutual interference of the sonic cones may arise. To eliminate this problem, some of the sensors have synchronization and multiplexing features. For those sensors without these features, maintaining a minimum distance between sensors will also solve this problem.



## Synchronization

Synchronization of ultrasonic sensors causes the sensors to emit their sonic pulses simultaneously. Using RUC...M30, RU..-Q30 or RU..-M18 sensors, up to six sensors may be synchronized by tying their X1 lines.

## Multiplexing

Multiplexing the sensors causes them to emit their pulses at pre-defined intervals, independent of one another. This eliminates the possibility of mutual interference and of sensors seeing targets that are actually in front of other sensors. The more sensors that are operated alternately, the lower the switching frequency.

The X1 line of sensors RUC..-M30, RU..-Q30 and RU..-M18 can be used as an enable input for multiplexing purposes. An X1 input of +24 V enables the sensor while an X1 input of 0 V disables it. Multiplexing via the X1 line instead of by powering down the sensors has the advantage that only the response time has to be considered and not the time delay before availability.

## Range adjustments

M30 and CP40 style sensors have two potentiometers to enable both foreground and background suppression. Q30 and discrete M18 style sensors have one potentiometer to enable background suppression only.

Analog M18 sensors have a fixed range.

Sensing ranges given are at nominal conditions, i.e. Tu = +20°C (68°F) using a standard target, vertically aligned, with reflective surface (metal, 1 mm thick).

## Sensors with two switch points

**RUC...2AP8X** - the potentiometers on these sensors set the far limits of each detection zone. Potentiometer S1 sets the far limit of Zone 1, which begins at the end of the blind zone.

Potentiometer S2 sets the far limit of Zone 2, which begins at the far limit of Zone 1 (Figure 1).

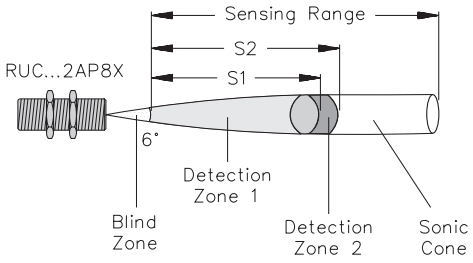



***Figure 1***

## Sensors with one switch point

**CP40** - potentiometer S1 sets the near limit while potentiometer S2 sets the depth of the detection zone. This allows both foreground and background suppression. Changes to S1 will cause the far limit to follow (Figure 2).

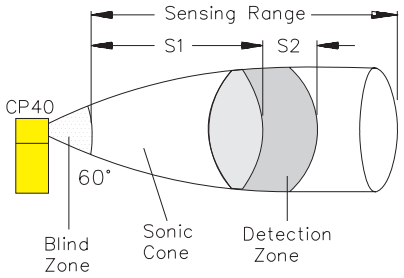



***Figure 2***

**Q30 and discrete M18** - one potentiometer sets the far limit of the detection zone. The near limit is not adjustable, and is determined by the blind zone. This allows for background suppression only (Figure 3).

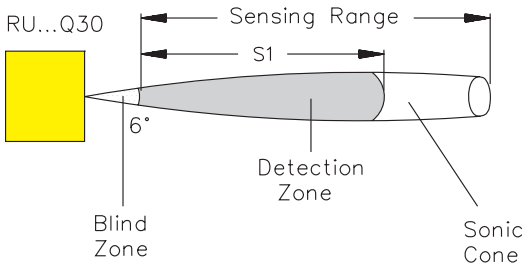



***Figure 3***

**M30** - potentiometers S1 and S2 set the near and far limits of the detection zone. This allows for foreground and background suppression. The pots are independent of each other (Figure 4).

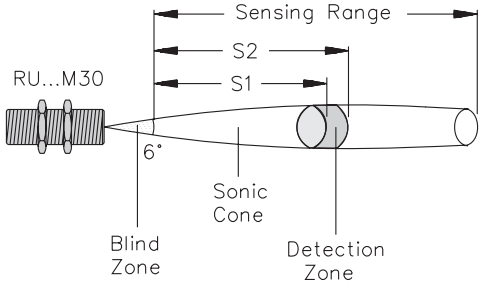
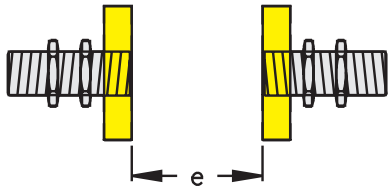
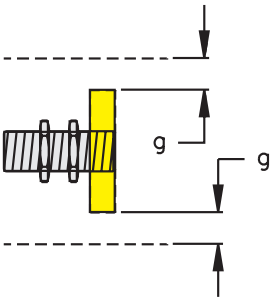
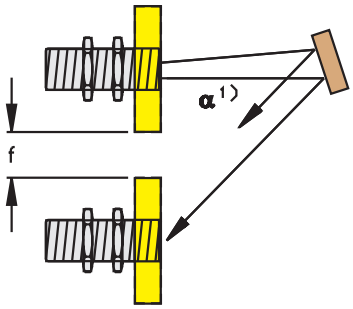


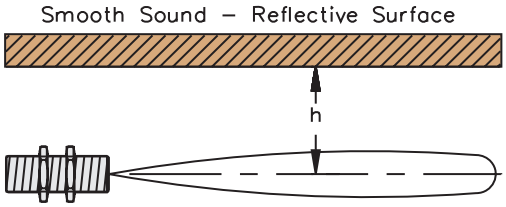

***Figure 4***

## Mounting Considerations




| Sensor Type | e (cm) | f (cm) | g (cm) | h (cm) |
|---|---|---|---|---|
| RU20-M18K- | 80 | 6 | 3 | 1.5 |
| RU70-M18K- | 280 | 18 | 10 | 5.0 |
| RUN20-M18K | 80 | 6 | 3 | 1.5 |
| RUN70-M18K- | 280 | 18 | 10 | 5.0 |
| RUR20-M18K- | 80 | 6 | 3 | 1.5 |
| RUR70-M18K- | 280 | 18 | 10 | 5.0 |
| RU20-M18KS- | 80 | 6 | 3 | 1.5 |
| RU70-M18KS- | 280 | 18 | 10 | 5.0 |
| RUN20-M18KS- | 80 | 6 | 3 | 1.5 |
| RUN70-M18KS- | 280 | 18 | 10 | 5.0 |
| RUR20-M18KS- | 80 | 6 | 3 | 1.5 |
| RUR70-M18KS- | 280 | 18 | 10 | 5.0 |
| RU 30-M18- | ≥120 | ≥15 | ≥6 | ≥3 |
| RU100-M18- | ≥400 | ≥60 | ≥30 | ≥15 |
| RU 30-M30- | ≥120 | ≥15 | ≥6 | ≥3 |
| RU100-M30- | ≥400 | ≥60 | ≥30 | ≥15 |
| RU600-M3065- | ≥2500 | ≥250 | ≥80 | ≥40 |
| RUC 30-M30- | ≥120 | ≥15 | ≥6 | ≥3 |
| RUC130-M30- | ≥400 | ≥60 | ≥30 | ≥15 |
| RUC300-M3047- | ≥1200 | ≥150 | ≥60 | ≥30 |
| RUC600-M3065- | ≥2500 | ≥250 | ≥80 | ≥40 |
| RU 30-Q30 | ≥120 | ≥15 | ≥6 | ≥3 |
| RU100-Q30 | ≥400 | ≥60 | ≥30 | ≥15 |
| RU100-CP40-AP6X2 | ≥600 | ≥100 | ≥120 | ≥60 |
| RU100-CP40-LIUX | ≥600 | ≥100 | ≥120 | ≥60 |

1) The greater the angle α, the larger the distance f. The minimum f values in the table refer to α = 0°.