



# PreView Sentry®

ST97 Series

Sensor Operating Manual



[www.preco.com](http://www.preco.com)





## FCC STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Warning:** Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**NOTE:** This equipment has been tested and found to comply with the limits of a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference.

## INDUSTRY CANADA STATEMENT

Per RSS-Gen, Section 8.4 This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Par RSS - Gen, Section 8.4 Cet appareil est conforme à Industrie Canada exempts de licence standards RSS. Le fonctionnement est soumis aux deux conditions suivantes : (1 ) ce dispositif ne peut pas provoquer d'interférences et ( 2) cet appareil doit accepter toute interférence , y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

## REGULATORY COMPLIANCE

The PreView Sentry® is compliant with the following countries/regions and their regulations as of the published date of this manual. The sensor may be compliant in other countries/regions. Please check your local regulations.

- **United States** - FCC- Part 15.249
  - **FCCID:** OXZTHUN2019
- **Canada** - RSS-210 Radio Standards Specification
  - **IC ID-** 20379-PREVIEW200
- **European Union** - ETSI EN300 440-1 Electromagnetic Compatibility and Radio Spectrum Matters (ERM)
- **Australia/New Zealand** - AS/NZ 4268 Radio Equipment and Services – Short Range Devices

## PATENTS:

7088284 and 7215278.

This document may be amended, corrected, and enhanced in keeping with the sensor development progress. The most recent version can be found at [www.preco.com](http://www.preco.com)

## TRADEMARKS

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## Product Description

The PreView Sentry® is a Frequency Modulated Continuous Waveform radar object detection system designed to alert equipment (vehicle, truck, machine) operators to the presence of obstacles. The sensor detects both moving and stationary objects in a pre-defined coverage area and can report the distance of the closest object via visual range indicators (display) and an audible signal (display or buzzer) to the equipment operator.



**Figure 1. PreView Sentry® Radar Sensor**

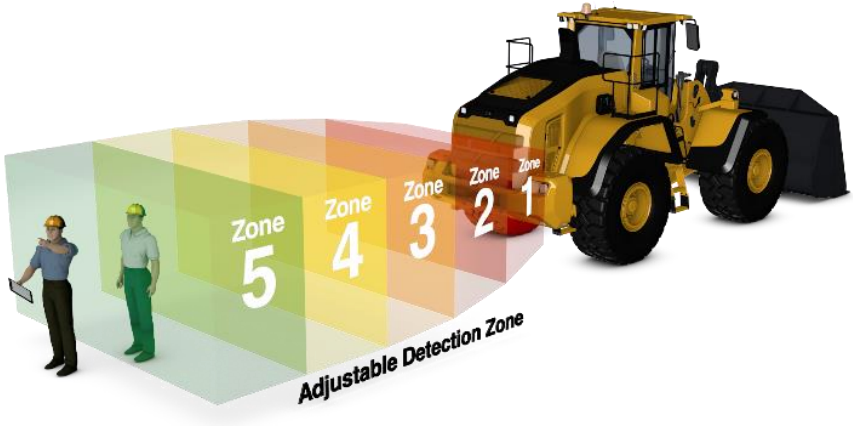
Although the PreView® sensor performs well in harsh environments (high temperature, fog, rain, snow, etc.) it is still recommended that the sensor face be cleaned periodically as you would your equipment lights. The sensor is sealed to meet IP69K, withstands high vibration and shock levels, and is virtually maintenance free.

## Sensor Description

The PreView Sentry® is a small, rugged, short/medium range radar sensor designed by PRECO Electronics® for use in heavy duty applications, such as trucks/busses, construction, mining, waste, utilities, and other applications requiring a robust, high-performance radar. **This frequency band is legal throughout most of the world, but check with PRECO Electronics® or your country's regulations before purchasing.**

The sensor transmits and receives low power 24 GHz radar signals. It then processes the returned signals to determine if an object has reflected any energy back to the sensor and reports this to the operator display. The sensor is designed to process and report detections within 240 milliseconds (ms) allowing the operator to quickly respond to any object within the detection zone. All connections to the equipment are accomplished at the sensor. Power is typically obtained from the equipment reverse lights.

Using a FMCW, the Sentry® measures radial range, speed and angle, reflectivity, and other parameters of multiple stationary and moving targets simultaneously. This radar sensor has a wide horizontal field of view up to +/- 75° (150°), providing coverage flexibility to be a solution for virtually any application. Figure 2 illustrates an example of the Sentry® sensor's adjustable detection zone.



**Figure 2. Adjustable Detection Zone**

The Sentry® has multiple models with preconfigured detection zones: both range and width. **Note:** the [www.preco.com](http://www.preco.com) website contains the most current data on radar sensor models.

Sentry® ST97 Series radar sensors include an 8-pin Deutsch connector pigtail as shown in Figure 1.

The Sentry® model numbering system is as follows:

Model ST8XYZ, where:

X defines the connector type - 7 is for Deutsch and 2 is for Conxall

YY defines the sensor's detection range in meters (0 to 30)

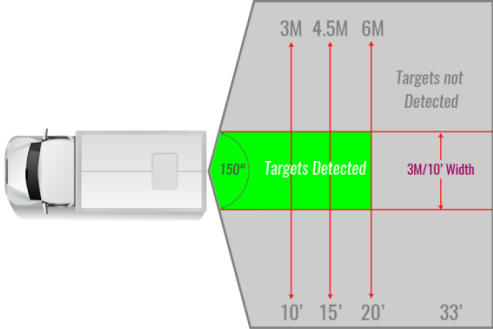
Z defines the detection width in meters

**Example:** Model ST97063 describes a sensor with a Deutsch connector, a 6 m (20') detection range and a 3 m (10') detection width.

Please contact PRECO Electronics® or refer to [www.preco.com](http://www.preco.com) with your specific requirements.

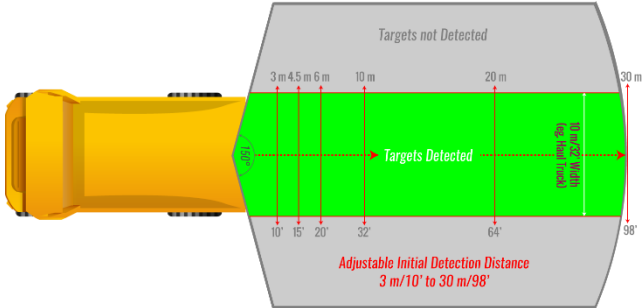


Figure 3 illustrates a truck backing application with the radar detection zone set to a range of 6 m (20') and a width of 3 m (10').



**Figure 3. Detection Zone 6 m**

Figure 4 illustrates a mining haul truck backing application with the radar detection zone set to a range of 30 m (98') and a width of 10 m (32').



**Figure 4. Detection Zone 30 m**

The sensor is active and starts reporting detections within 240 ms after power up.

The Sentry® performance is not affected by other PreView Sentry® or similar sensors operating in close proximity with each other.

**Other Sensor Features**

The Sentry® sensor has a continuous Built-In-Self-Test (BIST) that notifies the operator via the in-cab display of sensor failure within a fraction of a second. This test functions by monitoring the transmit and receive performance as well as other internal operations.

The Sentry® sensor can also determine if the face of the sensor is blocked with excessive ice, mud, or snow that is impeding proper operation. This blockage is then reported to the operator via the display.

The self-test and blockage detection features are important to a fail-safe operation.

# Sensor Interfaces and Configuration

## Communication

The Sentry® communicates with the in-cab display using a CAN interface as specified in ISO 11898-2. The CAN bus operates at 250 KBits/second and is not terminated in the sensor.

Since CAN is a standard communication interface, the sensor can be connected to other CAN controllers, telematics interfaces, displays, etc. Contact PRECO Electronics® for further details.

## Alarm Output

The Sentry® provides an auxiliary output that becomes active whenever the Sentry® detects an object. This output can be used to activate an external backup alarm or other devices as desired. The output is switched from a high impedance state to ground when active and is protected against an over-current or electrical short condition. The maximum operating current is approximately 1 amp, including any inrush current.

## Sensor Input

The PreView Sentry® ST97 (Deutsch connector) series radar sensor provides an auxiliary input that can be used to activate the alarm output, if configured. Contact PRECO Electronics® for more information.

## Cable Connection

The Sentry® comes equipped with a Deutsch DT connector (ST97 series) pigtail harness terminated.

## Object Detection Capability

PreView® systems are blind spot collision warning systems designed to supplement other safety practices and/or devices. The equipment operator is always the first line of defense when safely operating equipment.

PreView® radar sensor can detect most objects within the detection zone. However, there are some instances where objects can go undetected. Obstacle size, shape, relative location, and composition are all factors determining if, when, and where an object is detected. PreView® sensors operate by transmitting low power electromagnetic energy. Any energy that strikes an object reflects a certain amount of this energy back to the PreView® radar sensor. If the returned energy is of sufficient magnitude, it is used to indicate object presence and determine the object's distance. While the Sentry® can resolve multiple objects, only the object closest to the equipment is reported to the operator display since it represents the most significant collision threat.

The amount of energy returned is based on a few factors:

**Size** – a larger object usually reflects more energy than a smaller object.

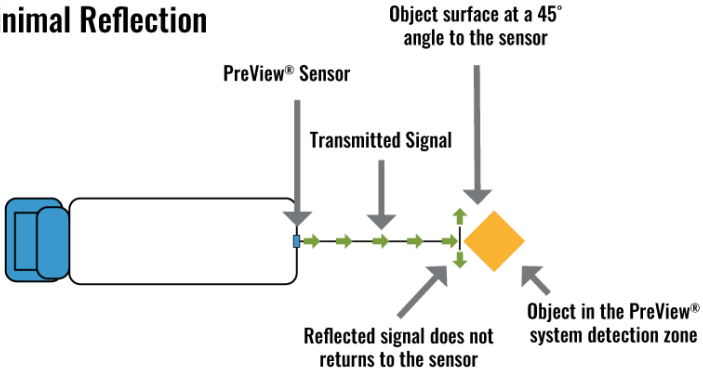
**Composition** – a metal object typically reflects more energy than a non-metallic object.

**Scattering** – a solid object reflects more energy than a non-solid object such as tree branches, gravel, bushes, etc.

**Shape** – complex shapes cause energy to be returned in a very non-uniform way. Very small variations or movement can change detection status.

**Angle** – an object flat side perpendicular to the sensor will reflect more energy than an object at an angle. See Figure 5 for an example of how angle can affect return energy.

## Minimal Reflection



## Full Reflection

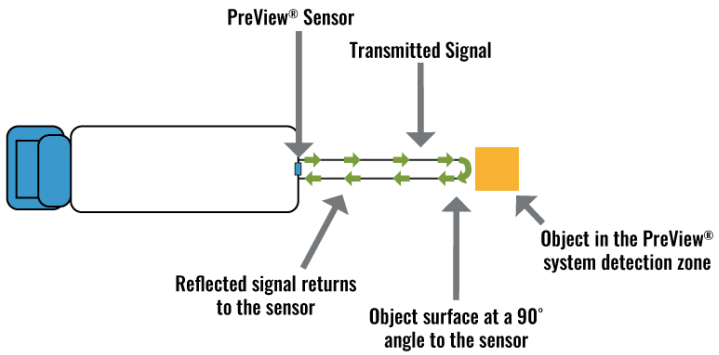


Figure 5. Object Reflection

# Sensor Installation

## Before you Start

Prior to installing the PreView® Object Detection System take time to familiarize yourself with all of the all documentation, theory of operation, and system components.

## Sensor Location

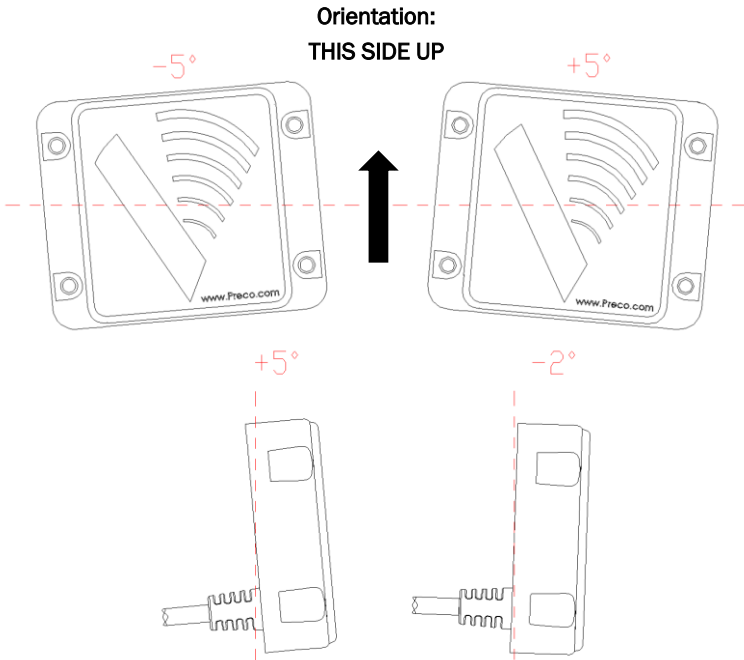
The PreView® sensor mounting location is integral to proper system operation. The sensor's detection zone must cover the blind spot you wish to monitor and the sensor must be mounted at the appropriate height. For example, to monitor a blind spot directly behind your equipment, the sensor should be mounted on the rear as close to the center of the equipment as possible. The sensor face should be perpendicular to the ground and oriented properly, see Figure 6. Select a location that will provide some protection from impact and debris while allowing an unobstructed field of view covering the targeted blind spot. Refer to the Keep Out/Interference Zones shown in Figure 7.

## Sensor Mounting

1. Select the appropriate location to mount the sensor.
  - a. Height tolerance (from ground); 36", +/- 12" (1 m, +/- 0.3 m)
  - b. Vertical angle tolerance +5° (up), -2° (down)
  - c. Horizontal angle tolerance +/- 5°
2. See Figure 6 for orientation of the sensor.
3. Use the included sensor mounting bracket to scribe position marks through the holes. Drill 1/4" (6 mm) holes centered on the marks.
4. For Deutsch models (with a pigtail), drill a 1 1/2" (38 mm) hole for the sensor connector and mating connector. For Conxall models, drill a 1" (24 mm) hole for the connecting cable.
5. Secure the sensor to the equipment using the supplied hardware, with a maximum 22 in-lbs torque.

## Mounting Tolerances

Mounting height tolerance at 36" (1 m) is +/- 12" (0.3 m). For optimal performance at 36" (1 m), the vertical angle (Up/Down) tolerances are +5° (up) and -2° (down), and the horizontal angle tolerance is +/- 5°.



**Figure 6. Vertical and Horizontal Angle Mounting Tolerances**

**Exceptions:** if mounting higher than 4 feet (1.3 m), the sensor can be angled down a few degrees as necessary (less than 5° in most applications).

The performance of the sensor can be negatively impacted if the sensor is angled down, causing false detection from the ground. Any time the sensor must be mounted outside the mounting tolerances, the performance should be tested. In some instances, mainly with longer range models, the sensor may need to be angled upward to reduce false detections from the ground.

# Keep Out/Interference Zones

For optimal performance, the sensor should protrude beyond any other portion of the vehicle. If this is not possible, it is important to understand how surrounding objects can impact the sensor’s performance. The sensor’s horizontal field of view is  $\pm 75^\circ$  ( $150^\circ$ ) and the vertical field of view is  $\pm 10^\circ$  ( $20^\circ$ ); however, metallic and other strong radar reflecting objects outside but near this field of view can cause interference. These objects must remain outside the expanded area shown as the “Keep Out Zones” below in Figure 7. If your specific implementation requires radar reflecting objects to reside in the Keep Out Zones, testing must be performed to determine their influence on the sensor’s performance.

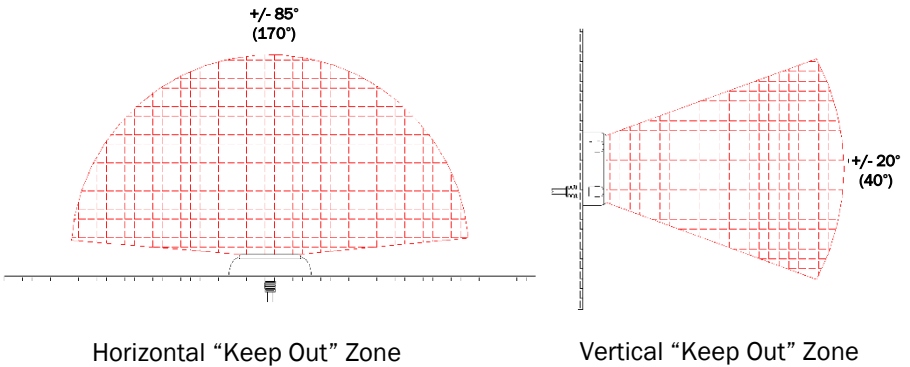


Figure 7. Keep Out Zones

## ***Important!***

Before the PreView® sensor is permanently installed on the equipment, verify the selected location provides a clear detection zone. Move the equipment to an open field with no objects in the sensor’s field of view, temporarily attach the sensor to the equipment in the proposed location, apply power and activate the system. Verify that nothing is being detected.

# PreView® Daily Maintenance

## Safety Message to Equipment Operators with PreView® Systems

1. Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death. It is necessary to read, understand and follow all instructions shipped with the product.
2. Systems on operating equipment must be tested each day prior to the equipment operation. The equipment operator must check for proper operation at the beginning of every shift or safety inspection period.
3. The PreView® system is intended as an Object Detection System and should not be relied upon as your first line of defense for the safe operation of the equipment. It should be used in conjunction with established safety programs and procedures to augment the safe operation of the equipment, ground personnel, and adjacent property.
4. People's lives depend on the proper installation of this product in conformance with these instructions. Should the system become inoperative, it could jeopardize the safety or lives of those who depend on the system.
5. The PreView® Object Detection System is intended for commercial use. Proper installation of the object detection system requires a good understanding of equipment electrical systems and procedures, along with proficiency in the installation.
6. Store these instructions in a safe place and refer to them when maintaining and/or reinstalling the system.

## Testing and Maintenance

NOTE: A walk around test shall be performed every day to verify proper function of the system and to familiarize the operator with the zone of detection. More frequent inspections should be performed when:

- The equipment is operating in a particularly dirty or harsh environment.
- The operator has reason to suspect the system has been damaged.

This test should be performed with two people, the operator who remains in the cab, and the assistant who walks through the sensor field (detection zone).

1. Move the equipment to an open field larger than the detection zone to test.
2. Clean the sensor face of any accumulation of dirt, mud, snow, ice, or debris.
3. Visually inspect the attached wiring and cable and verify that they are properly secured, not chafing or dangling free where they could become snagged and damaged. Inspect the PreView® Sensor and Operator Display and verify that they are securely attached to the equipment.



4. Place the sensor in active mode. Make sure the equipment has been secured and remains stationary.
5. Verify the sensor is operational. Depending on operator notification, this may be: green LED (for display), green icon (in-cab video monitor), or beep (buzzer or SAS).
6. Assure the detection zone has been cleared of all obstacles. Any obstacles in the detection zone will interfere with the test.
7. The assistant should walk across the sensor field while the operator notes when the warning activates, signifying the sensor has detected the assistant and identifying the detection zone limits.
8. Next, the assistant should walk from the center of the sensor field straight back, away from the equipment (the center line of the detection zone) while the operator notes when the warning (notification) stops.
9. The assistant should move to a point near the center of the detection zone and remain still for a few seconds, the warning should continue, demonstrating the system's ability to detect a still object.
10. The assistant should walk the complete sensor field while the operator notes the detection edges of the entire coverage area.
11. Finally, after the test the operator and the assistant need to communicate the details on the detection zone.

For questions, call +1.844.787.2327 toll free in the USA. Call +1.208.323.1000 or send a fax request to +1.208.323.1034 for outside the USA, or submit an online request at [www.preco.com/contact-us/](http://www.preco.com/contact-us/)

# Troubleshooting

The troubleshooting below is for the most common PreView® display. Refer to your display manual for errors code descriptions.

## Display Status LED is not illuminated.

- Verify that DC power (9-33 V) is applied to the sensor.
- Verify that the cable between the sensor and display is connected.

## Display Status LED is RED.

- Check connection between display and sensor.

## Display Status LED is RED and one or more of the Yellow LEDs are illuminated.

LED Error Code	Possible Reason
LED #5 on	No communication with any sensor(s)
LED #4 on	Built in Self-Test Error – Contact Factory
LED #3 on	Missing sensor(s)
ALL LEDs on	Blockage Error – Verify sensor face is clean.

## All the display LEDs are illuminated when sensor is mounted.

- Verify the sensor is pointing outward from the equipment in an open area with no obstructions. This may require removing the mounting screws and lifting the sensor out and away from the rear of the equipment. If the display LEDs are not active when moved away from the equipment, but are active when mounted, then the sensor's mounting position will have to be moved.

## Sensor is detecting the ground, indicated by a few of the display LED's being lit.

- In an open field, either move the sensor up higher or slightly angle the sensor upward 2° to 5°. The minimum recommended mounting height is 24”.

# Specifications

## Sensor Specifications

Transmitter	FMCW Radar @24 GHz
Connector:	See Figure 8, <b>Error! Reference source not found.</b>
Protection Rating:	IP69K
Housing Material:	Polycarbonate radome
Dimensions:	4.90" (w) x 4.06" (h) x 1.28" (d) (12.4 cm x 10.3 cm x 3.25 cm)
Weight:	1.0 lb (0.45 kg).
Operating Temperature:	-40°F to +185F (-40°C to +85°C)
Storage Temperature:	-67°F to +221°F (-55°C to +105°C)
Vibration:	25 G, random, all three axis
Shock:	50 G
Mounting:	Four 0.22" (5.6 mm) diameter mounting holes.

### Operating Characteristics

Range:	0 – 30 m (10 dBsm target) depending on model number
Range Accuracy:	0.3 m
Azimuth Field of View:	±75° (10 dBsm target)
Elevation Field of View:	±10° (10 dBsm target)
Angle Accuracy:	±2° @ ±10° FOV, ±5° @ ±30° FOV, ±10° @ ±75° FOV
Velocity Range:	± 9 m/sec (± 20 mph)
Velocity Accuracy:	0.2 m/sec (0.5 mph)
Target Resolution:	1.4 m for static targets, approaching 0.3 m for dynamic targets
Cycle Time:	80 ms (A CAN bus target message is provided in every cycle.)
Detection Pattern:	Fixed based on model
Target Detection Time:	240 ms
Power On to Active Time:	240 ms

### Electrical Specifications

Frequency:	24.05 – 24.25 GHz
Power Supply:	9 – 33 VDC, Reverse polarity and over-voltage protected
Current:	<0.5 A
Fuse Requirements:	Fuse System using 3A fuse



### Communications Interface

J1939 CAN Bus:	250 Kbits/sec, not terminated
Alarm Output	Active - Switch to ground, sink up to 1 A, over current protected Inactive State – High Impedance

### Maintenance

Daily: Follow test and maintenance procedure on pages 10 and 11.

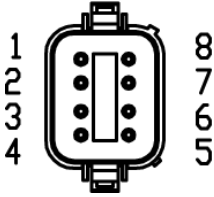
### Regulatory Compliance

Compliant with FCC Part 15.249	
FCC ID:	OXZTHUN2019
'CE' 'E' mark:	E13*10R05/01*15387*00

PRODUCT MANUFACTURED IN THE USA

# Connector Pin Outs

CONNECTOR END VIEW  
DEUTSCH DT06-08SA-E008



CONNECTOR PIN OUT	
PIN	SIGNAL NAME
1	BATTERY PWR (+)
2	GROUND
3	CAN HIGH
4	CAN LOW
5	DISPLAY PWR (+)
6	DISPLAY GROUND
7	N/C
8	TURN SIGNAL INPUT

Figure 8. Deutsch Connector Pin Out (ST97 series)

# Warranty Information

## **MANUFACTURER STANDARD LIMITED WARRANTY AND LIMITATION OF LIABILITY**

Manufacturer warrants that on the Date of Purchase this Product will conform to Manufacturer's published specifications for the product, which are available from Manufacturer on request, and Manufacturer warrants that the product is free from defects in materials and workmanship. This Limited Warranty for the sensor extends for sixty (60) months from the date of shipment. Manufacturer will, at its option, repair or replace any product found by Manufacturer to be defective and subject to this Limited Warranty.

This Limited Warranty does not apply to parts or products that are misused; abused; modified; damaged by accident, fire or other hazard; improperly installed or operated; or not maintained in accordance with the maintenance procedures set forth in Manufacturer's Installation and Operating Instructions.

To obtain warranty service, you must ship the product(s) to the specified Manufacturer location within thirty (30) days from expiration of the warranty period. To obtain warranty service, call Customer Service at +1.866.977.7236 or +1.208.323.1000, or fax your request to +1.208.323.1034. Customer Service will issue warranty authorization and further instructions. You must prepay shipping charges and use the original shipping container or equivalent.

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**LIMITATION OF LIABILITY:** IN THE EVENT OF LIABILITY FOR DAMAGES ARISING OUT OF THIS LIMITED WARRANTY OR ANY OTHER CLAIM RELATED TO MANUFACTURER'S PRODUCTS, MANUFACTURER'S LIABILITY FOR DAMAGES SHALL BE LIMITED TO THE AMOUNT PAID FOR THE PRODUCT AT THE TIME OF ORIGINAL PURCHASE. IN NO EVENT SHALL MANUFACTURER BE LIABLE FOR LOST PROFITS, THE COST OF SUBSTITUTE EQUIPMENT OR LABOR, PROPERTY DAMAGE, OR OTHER SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES BASED UPON ANY CLAIM FOR BREACH OF CONTRACT, NEGLIGENCE OR OTHER CLAIM, EVEN IF MANUFACTURER OR A MANUFACTURER'S REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Manufacturer shall have no further obligation or liability with respect to the product or its sale, operation and use, and Manufacturer neither assumes nor authorizes the assumption of any other obligation or liability in connection with such product.

This Limited Warranty gives you specific legal rights, and you may also have other legal rights, which vary, from state to state. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.

Any oral statements or representations about the product, which may have been made by salesmen or Manufacturer representatives, do not constitute warranties. This Limited Warranty may not be amended, modified or enlarged, except by a written agreement signed by an authorized official of Manufacturer that expressly refers to this Limited Warranty.

# More PRECO Electronics® Safety Products

## PreView® Radar Blind Spot Monitoring

- **Sentry®** - 150° fully adjustable detection zone. Detects distance, relative velocity, and angle of up to 16 objects simultaneously from 0 to 30 m (98') away.
- **Side Defender®** - 150° intelligent side object detection radar. Ignores guardrails while warning of vehicles and people in your side blind spots.
- **Xtreme** – Designed for equipment used in extreme mining conditions. Variable detection ranges up to 10 m (32') available.
- **WorkSight®** – Dual antennas for broad detection zones. Designed for crowded urban environments. Variable detection ranges up to 6 m (20') available.
- **Wireless** – WorkSight® sensor with wireless connection to a touch screen in-cab display. Customizable detection range up to 6 m (20').
- **WorkZone** – Designed for equipment that operates on the worksite and narrow neighborhood streets. Available with 3 m (10') or 4.5 m (15') detection range.

## PreView® Camera Monitor Solutions

- **PreView® Plus** – 7" IP67 monitor supports 1 to 4 cameras with 1 to 24 radar sensors providing combined camera and radar technologies to deliver the most complete active blind spot monitoring solution available.
- **Monitor 5HD** – 5" heavy-duty IP67 monitor supports up to 3 cameras.
- **Monitor 5 LD** – 5" monitor for closed cabs. Supports a single camera.
- **Mirror Monitor** – Rear-view mirror with built-in monitor. Supports a single camera.
- **Mini Cam** – Compact cameras with 120°, 150°, or 180° field of view.
- **Heavy-Duty Cam** – IP67 Heavy- Duty camera with 118° field of view, IR LEDs, and built-in heater.

**PreView® VideoLink** – Make your existing camera system an active safety resource by adding visual and audible alerts from a PreView® Radar sensor to your in-cab monitor.

## PreView® Backup Alarms

- **SAS** – An intelligent reverse alarm designed to work with PreView® Radars. Operates at 5 dB above the ambient noise levels and alerts those around your equipment when they are inside the detection zone by increasing in volume to 112 dB.
- **SAS97DT** – An intelligent reverse alarm designed to work with PreView® Radars. Operates at 97 dB and alerts those around your equipment when they are inside the detection zone by increasing the frequency of the alarm.



Proudly developed by

**PRECO**<sup>®</sup>  
*ELECTRONICS*

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