

PRECOTM
ELECTRONICS

PreView Sentry®X
SX97
Sensor Operating Manual



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®X 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
- **FCC ID:** OXZSTNB2019
- **Canada** - RSS-210 Radio Standards Specification
- **IC ID:** 20379-PREVIEWNB
- **European Union** - E-Mark E13 10R-05 15458
- **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 preco.com.

TRADEMARKS

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Product Description

The PreView Sentry®X 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 reports these detections via J1939 CAN bus messages to the chosen Human Machine Interface (HMI).



Figure 1. PreView Sentry®X Radar Sensor

Although PreView® sensors perform extremely 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®X is a small, rugged, short/medium range radar sensor operating in the 24 GHz band (24.05 to 24.25) 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 can be accomplished at the sensor. Power is typically obtained from the equipment reverse lights.



Using FMCW, the Sentry®X measures radial range, speed and angle, reflectivity, and other parameters of multiple stationary and moving targets simultaneously. This radar sensor has a bell shaped horizontal field of view to support installations that must be inset such as the rear of large haul trucks, and provides range and width flexibility to be a solution for many different equipment types and sizes. Figure 2 illustrates an example of the Sentry®X sensor's adjustable detection zone.



Figure 2. Adjustable Detection Zone

The Sentry®X has multiple models with preconfigured detection zones: both range and width. Note: the preco.com website contains the most up to date data on radar sensor models. Sentry®X SX97 Series radar sensors include an 8-pin Deutsch connector pigtail. The Sentry®X model numbering system is as follows:

Model SX97YYZZ, where:

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

ZZ defines the detection width in meters

Example: Model SX97063 describes a sensor with a 6 m (20') detection range and a 3 m (10') detection width.



Figure 3 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').

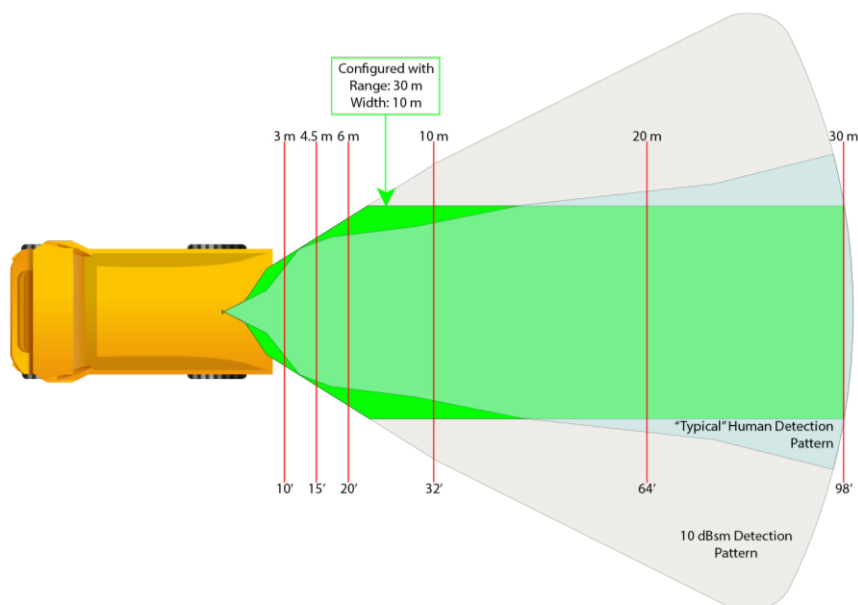


Figure 3. Detection Zone 30 m
Should say “typical” human detection pattern

The sensor is active and starts reporting detections within 240 ms after power up. The Sentry®X performance is not affected by other PreView Sentry®X or similar sensors operating in close proximity with each other.

Other Sensor Features

The Sentry®X 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®X 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®X 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®X provides an auxiliary output that becomes active whenever the Sentry®X 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®X 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®X comes equipped with a Deutsch DT connector pigtail harness.



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®X 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.

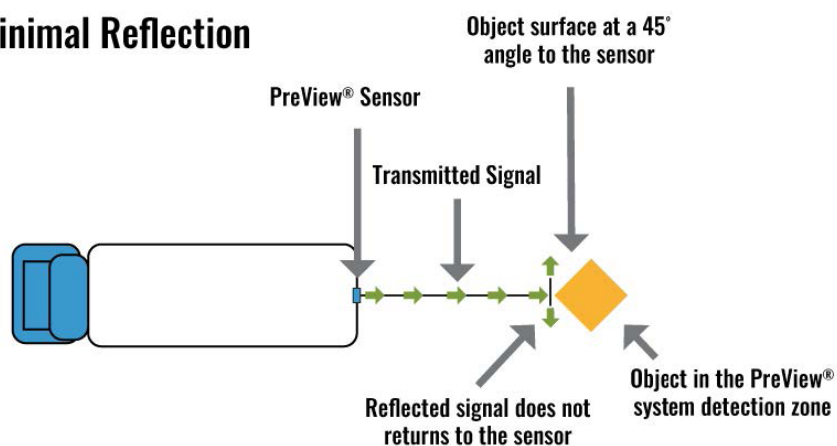
Scattering – a solid object reflects more energy than a non-solid object such as tree branches, gravel, bushes, etc.

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 4 for an example of how angle can affect return energy.



Minimal Reflection



Full Reflection

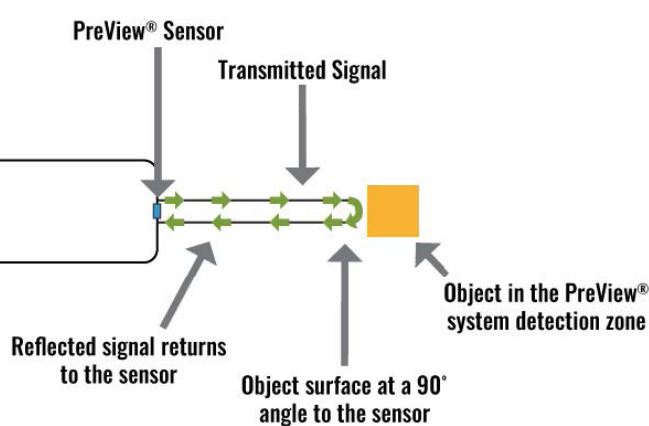


Figure 4. Object Reflection



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 5. 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 6.

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 5 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. Drill a 1 1/2" (38 mm) hole for the sensor connector and mating connector.
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 $\pm 12"$ (0.3 m). For optimal performance at 36" (1 m), the vertical angle (Up/Down) tolerances are $+5^\circ$ (up) and -2° (down), and the horizontal angle tolerance is $\pm 5^\circ$.

**Orientation:
THIS SIDE UP**

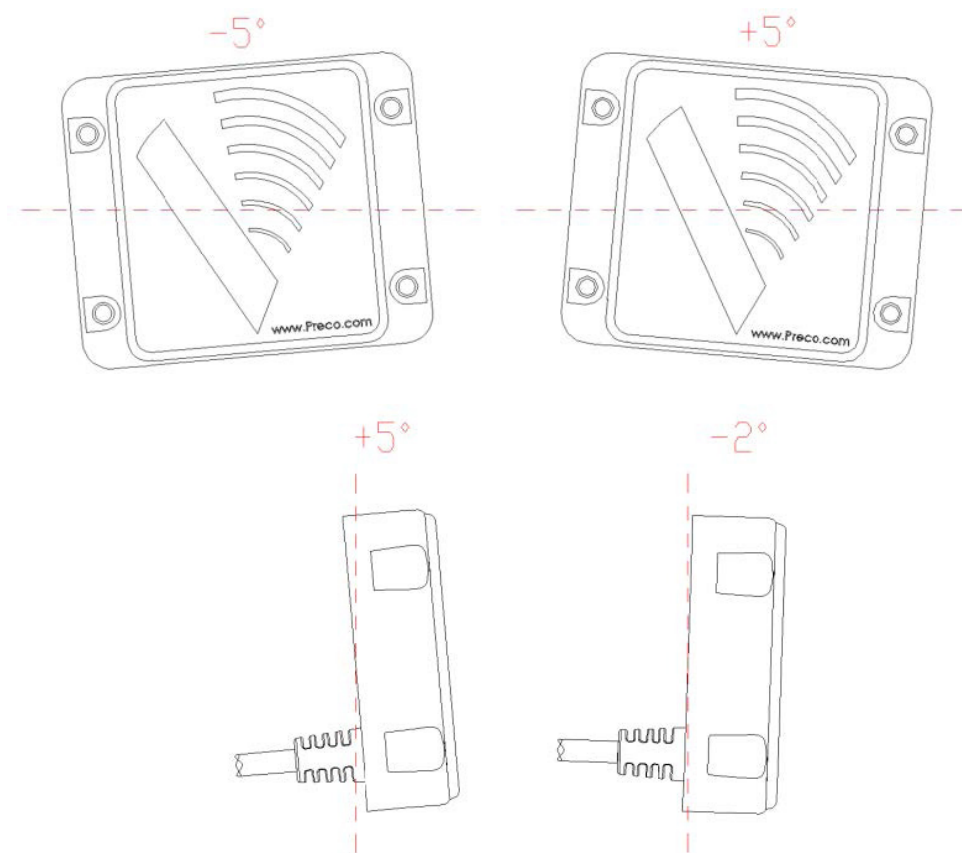


Figure 5. Vertical and Horizontal Angle Mounting Tolerances

Exceptions: if mounting higher than 4' (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 in the first 3' (1 m) is approximately $\pm 35^\circ$ (70°) widening to approximately $\pm 60^\circ$ (120°) between 3' and 10' (1 and 3 m). The vertical field of view is $\pm 10^\circ$ (20°). 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 6, $\pm 55^\circ$ (110°) horizontal and $\pm 20^\circ$ (40°) vertical. 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.

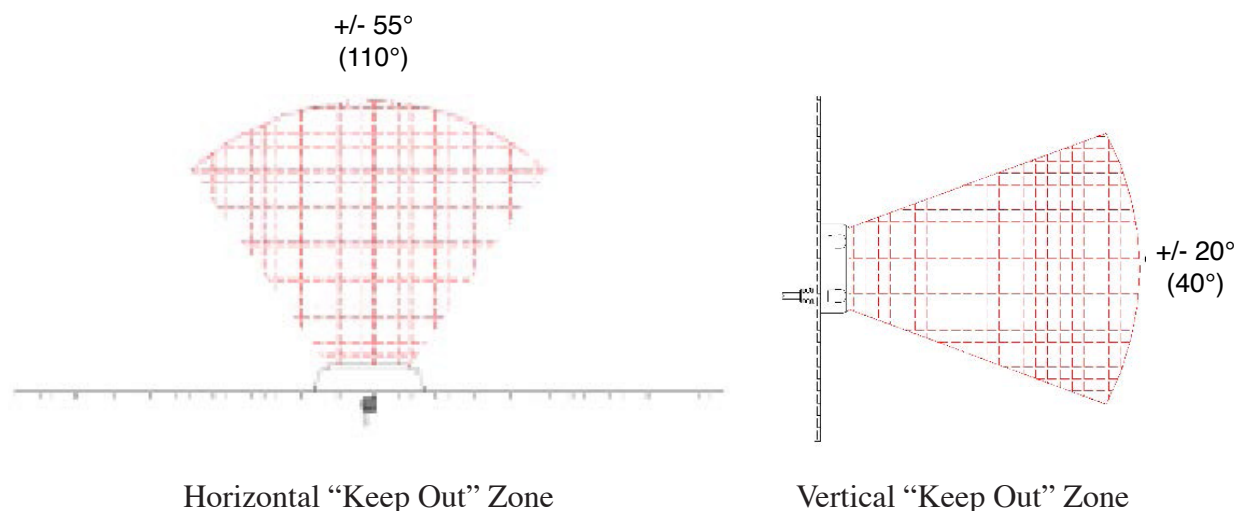


Figure 6. Keep Out Zones

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.

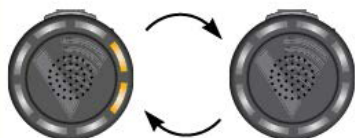


Troubleshooting

The troubleshooting below is for the Sentry®X when used with a PreView® v2 Display. If you are using the Sentry®X with a different display or monitor, refer to the display/monitor user manual for trouble code descriptions.



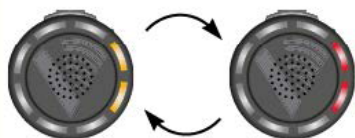
SENSOR BLOCKAGE



Problem:
The sensor is blocked.

Solution:
Wipe the face of the sensor.

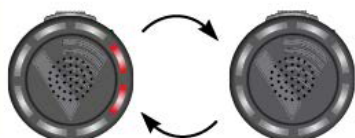
MISSING SENSOR



Problem:
A sensor on the side indicated is not communicating with the display.

Solution:
Check the cable connections

BUILT-IN SELF TEST ERROR



Problem:
A sensor has failed the built-in self test.

Solution:
The sensor must be replaced.

- All error notifications will start with 3 audible beeps.
- The location of the LEDs indicating the error also indicate the location of the sensor(s) exhibiting the error.

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.

Sensor is detecting the ground, indicated by the display showing a detected object when the sensor field of view is clear.

- 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 7
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 configured detection zone
Range Accuracy:	0.3 m
Azimuth Field of View:	See Figure 3
Elevation Field of View:	±10° (10 dBsm target)
Angle Accuracy:	±2° @ ±10° FOV, ±5° @ ±30° FOV, ±10° @ ±40° 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.
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Regulatory Compliance

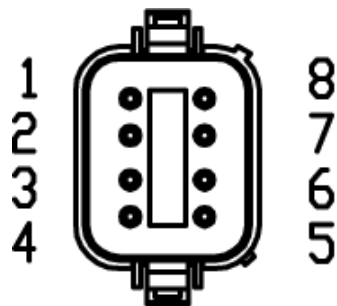
Compliant with FCC Part 15.249	
FCC ID:	OXZSTNB2019
'CE' 'E' mark:	E13 10R-05 15458

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	Auxiliary Out
8	TURN SIGNAL INPUT

Figure 7. Deutsch Connector Pin Out



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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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.

