



Bendix™ VORAD® VS-400

Driver Instructions

Bendix™ VORAD® Collision Warning System

Bendix™ SmartCruise® Adaptive Cruise Control

Bendix™ BlindSpotter® Side Object Detection

BW2769 (Formerly VODR0100)

May 2010

FCC Compliance Statement

Federal Communications Commission

This device complies with Part 15 of the FCC (Federal Communications Commission) rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must be able to accept any interference received, including interference that may cause undesired operation. Any interference that may be caused should be reported to the local FCC field office or to the Federal Communications Commission; Enforcement Bureau; 445 12th Street S.W.; Room 7-C485; Washington, DC 20054.

Any changes or modifications made by the user to this equipment that are not expressly approved by Bendix Commercial Vehicle Systems LLC could void the user's authority to operate the equipment.

Every effort has been made to ensure the accuracy of all information in this brochure. However, Bendix Commercial Vehicle Systems LLC makes no expressed or implied warranty or representation based on the enclosed information. Errors or omissions should be reported to: Bendix Commercial Vehicle Systems LLC, 901 Cleveland Street, Elyria, OH 44035 or 1-800-AIR-BRAKE (1-800-247-2725).

Warnings & Cautions

Warnings and Cautions

 WARNING

Improper use of this system could lead to a serious accident. Read this entire Driver Instructions before operating the Bendix™ VORAD® VS-400 Forward Collision Warning System (CWS), Bendix™ SmartCruise® Adaptive Cruise Control System or Bendix™ BlindSpotter Side Object Detection System. Pay particular attention to the safety messages below. This manual should be used in conjunction with proper training.

Limitations of the Bendix™ VORAD® VS-400 Collision Warning System

The Bendix™ VORAD® VS-400 Forward CWS, Bendix™ SmartCruise® Adaptive Cruise Control System and Bendix™ BlindSpotter® Side Object Detection is intended solely as an aid for an alert and conscientious professional driver. It is not to be used or relied upon to operate a vehicle. The system should be used in conjunction with rear view mirrors and other instrumentation to maintain safe operation of the vehicle, ground personnel, and adjacent property. A vehicle equipped with the Bendix™ VORAD® VS-400 Forward Collision Warning System should be operated in the same safe manner as if the system were not installed. The system is not a substitute for normal safe driving procedures. It will not compensate for any driver impairment, such as drugs, alcohol, or fatigue. Should the system become inoperative, it could jeopardize the safety or lives of those who depend on the system for safety.

 WARNING

The system will not sense objects if the sensor view is obstructed. Therefore, do not place objects in front of the system sensor. Remove heavy buildups of mud, dirt, ice, and other materials.

Proper alignment is critical to correct operation of the system.

Testing and inspection of the system in accordance with these instructions and record of the results should be listed on the daily maintenance report. The units on operating vehicles must be tested each day (see the “Testing and Maintenance” section) prior to the vehicle’s operation. Results of this test must be recorded in the maintenance log.

People operating this equipment **MUST** check for proper operation at the beginning of every shift or safety inspection period.

Warnings & Cautions



People's lives depend on the proper installation of this product in conformance with these instructions. It is necessary to read, understand, and follow all instructions shipped with the product.

Failure to follow all safety precautions and instructions may result in property damage, serious injury, or death.

The Bendix™ VORAD® VS-400 Forward Collision Warning System (CWS), Bendix™ SmartCruise® Adaptive Cruise Control System or Bendix™ BlindSpotter Side Object Detection System is intended for commercial use. Proper installation of a backup aid requires a good understanding of truck electrical systems and procedures, along with proficiency in the installation.

Store these instructions in a safe place and refer to them when maintaining and/or reinstalling the product.

Table of Contents

FCC Compliance Statement	i
Warnings & Cautions	ii-iii
Overview.....	1
System Operation	3
Collision Warning System	5
Vehicle Tracking.....	12
User Option Settings.....	14
Side Object Detection	19
Calculating Following Distance.....	21
Preventive Maintenance.....	22
Troubleshooting.....	23

Overview

The Bendix™ VORAD® VS-400 collision warning system is an advanced vehicle on-board radar system that monitors traffic conditions, warning the driver of potentially hazardous driving situations.

The Bendix™ VORAD® VS-400 system can be configured with the following features:

- Collision Warning System only
- SmartCruise® Adaptive Cruise Control only
- Collision Warning and SmartCruise

The Collision Warning System tracks vehicles ahead of the host vehicle, warning the driver with visual and audible indicators from the in-cab Driver Interface Unit whenever following distances become unsafe.

SmartCruise® adaptive cruise control adjusts the vehicle's cruise speed in order to match the speed of detected traffic ahead allowing the driver to maintain a safe following distance while in cruise control.

The optional Side Object Detection system warns of unsafe lane changes by detecting a vehicle that may be difficult to see in the adjacent lane.



 **WARNING**

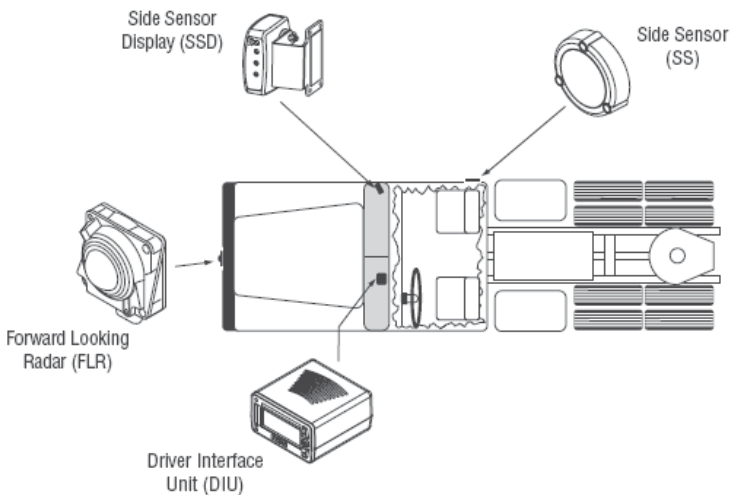
The Bendix™ VORAD® VS-400 system should only be used as a driving aid and not as a substitute for safe driving practices.

System Components

Components

The Bendix™ VORAD® VS-400 system is comprised of two main components, the Forward Looking Radar (FLR) and the Driver Interface Unit (DIU).

The optional Bendix™ BlindSpotter® Side Object Detection System includes a Side Sensor (SS) and Side Sensor Display (SSD).



The FLR is located on the forward most position of the vehicle, centered on or near the front bumper or grill of the vehicle. The DIU is mounted in the dash of the vehicle within plain view and reach of the driver.

The Side Sensor is typically mounted along the passenger side of the vehicle. The Side Sensor Display is located on the windshield pillar inside of the cab on the same side of the vehicle as the sensor.

System Operation

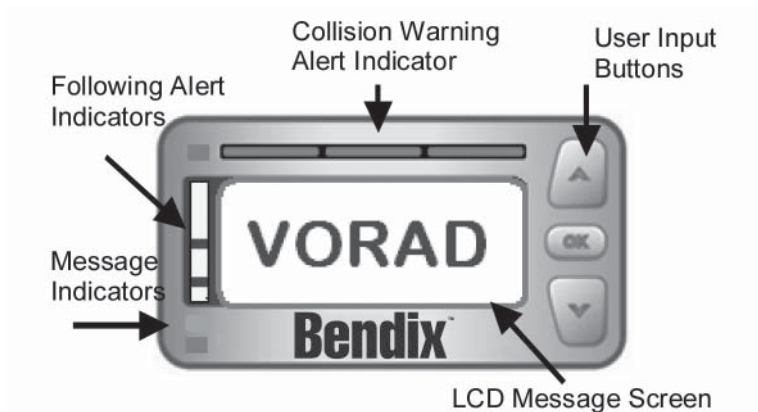
The Bendix™ VORAD® VS-400 collision warning system is powered by the vehicle's ignition circuit and becomes active whenever the ignition key is switched to the 'ON' position.

Bendix™ SmartCruise® adaptive cruise control is automatically engaged whenever the vehicle's cruise control is activated. See Bendix™ SmartCruise® adaptive cruise control section for more information.



Driver Interface Unit (DIU)

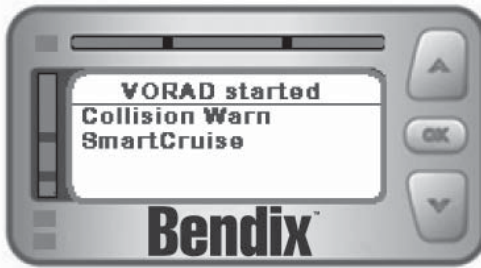
The driver interface unit provides visual and audible following alerts, along with system status information. The DIU also provides a user interface for changing system settings.



System Operation

System Start Up

When the system is first powered on, the DIU will display which features are currently installed.



Note: Check with your OEM dealer if you are not sure which features are installed on your system.

Radarm Warm-up

During power-up, if the outside air temperature is below 32 degrees (0 degrees Celsius) the system start up may be delayed for up to one minute until the forward radar unit reaches operating temperature. During the warm up period, the DIU will display a warm up message. Collision Warning and SmartCruise® adaptive cruise control are not operational during warm up.

System Ready

When the system is operational, the DIU will display the status of the installed functions, indicating which functions are currently active.



Bendix™ VORAD® VS-400 Collision Warning System

Bendix™ VORAD® VS-400 Collision Warning System

The Bendix™ VORAD® VS-400 collision warning system is designed to help the driver recognize when the following distance is becoming unsafe or to warn the driver when closing in on slower moving traffic.

Visual Following Alerts

The illustration below shows the different LED indicators for each level of alert. Three, two, and one second headway indicators are displayed in yellow up the left hand side of the LCD screen, and the collision alert indicator is displayed in red across the top of the display.



Audible Closing Alerts

When the headway following distance closes in to two seconds following or less, the driver will be alerted with audible warning tones.

- Closing less than two seconds (single tone)
- Closing less than one second (double tone)
- Collision Alert (repeated tone)

Bendix™ VORAD® VS-400 Collision Warning System

Object Detected

If a vehicle is detected in the same lane within 350 feet from the radar, but greater than a three second following distance, the DIU will display “Object Detected” in the LCD screen. The driver will not be alerted with any warning lamps or tones.



3 Second Alert

When the vehicle ahead is detected to be within a three-second following distance, the driver will be alerted with a single yellow LED indicator along with the text “3 Seconds” displayed on the LCD screen. No warning tones are reported with the three-second alert.

Note: If Bendix™ SmartCruise® adaptive cruise control is active at three seconds following, the SmartCruise status screen will remain displayed and the three-second LED indicator will illuminate.

Refer to the Bendix™ SmartCruise® adaptive cruise control section in this manual for more information.



Bendix™ VORAD® VS-400 Collision Warning System

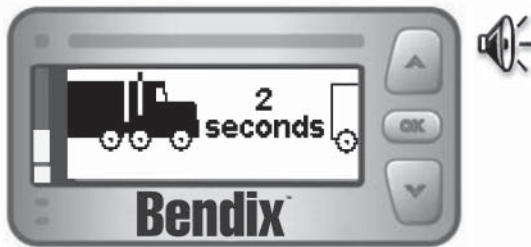
2 Second Alert

If the headway following distance decreases to within two seconds, the driver will be alerted with a second yellow LED indicator and the text “2 Seconds” displayed in the LCD screen. The DIU will also alert with an audible tone if the following distance is closing in, warning the driver that the following distance is becoming unsafe.

Note: If a vehicle cuts into your lane in front, but is accelerating away from you, the DIU may not warn with an audible tone.

Note: If Bendix™ SmartCruise® adaptive cruise control is active at two seconds following or less, the SmartCruise status screen will remain displayed and the LED following indicators will illuminate.

Refer to the Bendix™ SmartCruise® adaptive cruise control section in this manual for more information.



In most driving situations, following at three seconds or less is considered unsafe and should warrant the driver to react by slowing the vehicle down in order to increase the following distance.

Bendix™ VORAD® VS-400 Collision Warning System

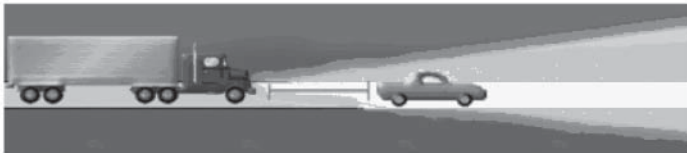
1 Second Alert

If the headway following distance decreases to one second, the driver will be alerted with three yellow LED indicators along with the text “1 Sec” displayed in the LCD screen. The DIU will also report an audible tone if the following distance is closing in.



Collision Alert

If the headway following distance closes to less than one-half second, or the radar detects slow moving or stopped traffic within 350 feet of the vehicle, the driver will be alerted with the three red LED indicators along with an audible tone. The LCD screen will display “Collision Alert”, warning that a collision may occur if the driver does not take immediate action.

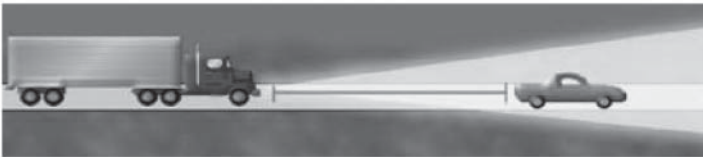
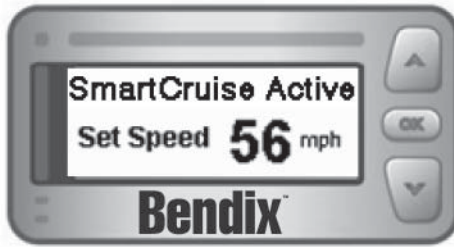


Bendix™ SmartCruise® Adaptive Cruise Control

Bendix™ SmartCruise® Adaptive Cruise Control

When approaching slower moving traffic with the vehicle's cruise control active, Bendix™ SmartCruise® adaptive cruise control adapts your vehicle's cruise speed to that of the closest vehicle ahead, allowing the vehicle to maintain a set following distance while remaining in cruise control.

When the vehicle's cruise control is set, the Driver Interface Unit (DIU) will display the SmartCruise status screen indicating the vehicle's current set cruise speed.



Bendix™ SmartCruise® Adaptive Cruise Control Operation

When the driver sets the desired cruise speed of the vehicle and the VS-400 Forward Looking Radar detects a vehicle in the lane ahead, the Forward Looking Radar will calculate that vehicle's speed and lane position and will attempt to maintain a safe following distance by 'adapting' the engine's cruise speed to that of the vehicle ahead.

The engine will remain in an adaptive cruise control state until the detected vehicle's speed increases beyond the original set cruise speed of the engine, or the driver changes to a clear lane.

Bendix™ SmartCruise® Adaptive Cruise Control

Driver Control

Like normal cruise control, the driver is always in control of the vehicle when Bendix™ SmartCruise® adaptive cruise control is active. Depressing the throttle will override the SmartCruise and will cause the vehicle to accelerate. Releasing the throttle will allow Bendix™ SmartCruise® adaptive cruise control to regain control. Depressing the brake and / or clutch pedal (if equipped), will deactivate SmartCruise.

Approaching Slow Moving Traffic

When approaching slower moving traffic, or if the traffic ahead suddenly slows down, Bendix™ SmartCruise® adaptive cruise control will attempt to maintain the minimum following distance by reducing the engine's cruise speed. In some cases, the engine's compression brake may be applied in order to assist in decelerating the vehicle.

Note: The three second following LED indicator will illuminate whenever SmartCruise is overriding the vehicle's set cruise speed.

Collision Warning and SmartCruise

If the system is unable to maintain the minimum following distance, and the Collision Warning feature is installed, the driver will be alerted with the headway alert indicators and closing alert tones until the driver takes control or conditions clear.



The Bendix™ SmartCruise® adaptive cruise control system should not be relied upon to effectively slow the vehicle down when approaching slower moving traffic. The driver should remain alert and in control of the vehicle at all times.

Bendix™ SmartCruise® Adaptive Cruise Control

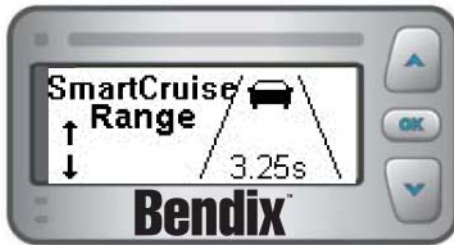
Bendix™ SmartCruise® Adaptive Cruise Control and Automatic Transmissions

Automated shifting transmissions are fully compatible with the Bendix™ SmartCruise adaptive cruise control system. SmartCruise allows the automated transmission to change gears while keeping the adaptive cruise control active when the vehicle decelerates and/or accelerates.

Adjusting Following Distance

When SmartCruise® is active, the forward looking radar will attempt to maintain a default following distance of approximately 3.25 seconds. Some systems allow the driver to adjust the following distance by changing the range setting in the DIU menu options.

The user may be able to adjust the following distance from a maximum of 3.25 seconds down to 2.25 seconds.



Note: Refer to the “User Option Settings” section in this manual for more information on the range setting.

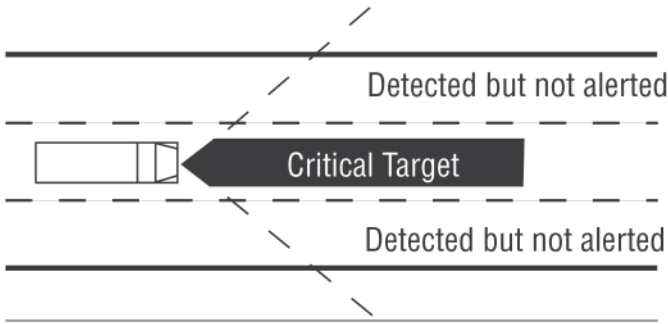
Vehicle Tracking

Vehicle Tracking

Multilane Highways and Curves

The forward looking radar (FLR) will track vehicles that are in front of you and in the left and right adjacent lanes ahead of you. The FLR's lane discrimination feature allows the radar to identify which vehicle is in your lane and only track that vehicle. Lane discrimination also allows the radar to detect if an adjacent vehicle cuts into the lane in front of you and to track vehicles when entering curves.

Vehicle tracking on a multi-lane highway.



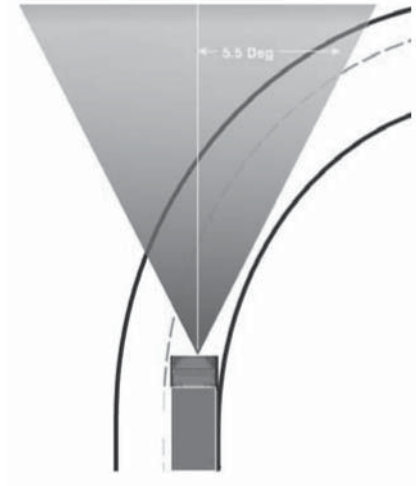
Vehicle tracking in a curve.



Vehicle Tracking

Entering Sharp Curves

The forward looking radar's built-in yaw sensor calculates turn radius in order to track the vehicles in your lane when entering curves, but because of the limitations of the radar's beam width, the radar may not be able to effectively detect objects in sharp curves.



 **WARNING**

Do not rely on the system to effectively detect objects when entering sharp curves.
Do not engage cruise control while on an on-ramp or off-ramp.

Menu Options

User Option Settings

To access the user options menu, press the 'OK' button on the front of the driver interface unit (DIU). Use the up/down buttons to navigate the menu options. Use the OK button to select a menu option.

Note: The vehicle should be stopped before accessing the DIU menu options. Some menu options may not be available if the vehicle is moving.



Menu Options

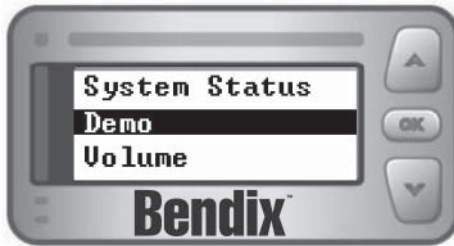
The following menu selections will appear in a scrollable window in the DIU screen. Some items may not appear if the feature is not configured or if the item is not allowed to be viewed when the vehicle is moving.

- Demo
- Volume (default)
- Range
- Brightness
- MPH/KPH
- System Status
- Diagnostics Display

Menu Options

Driver Demo

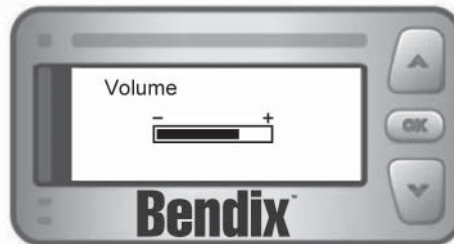
The Bendix™ VORAD® VS-400's demo mode allows the driver to become familiar with all the different alerts and screens of the Driver Interface Unit before using the system.



Note: If the vehicle is moving, demo mode will not be available.

Volume

The volume setting allows the driver to adjust the level of the audible warning tones. Optional configurations for the volume setting are a set minimum level and a default maximum volume setting at power up.

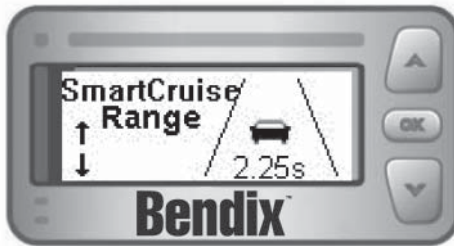
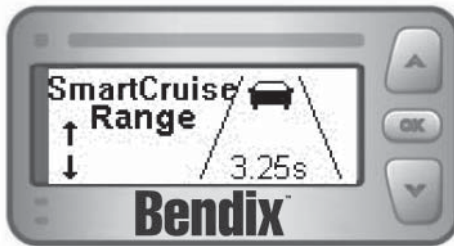


Menu Options

Range - (Optional)

The default following distance for Bendix™ SmartCruise® adaptive cruise control is 3.25 seconds. Some systems may allow the driver to adjust the following distance down to as close as 2.25 seconds by adjusting the range setting.

- Maximum Range = 3.25 seconds
- Minimum Range = 2.25 seconds



Brightness

The brightness setting allows the driver to adjust the intensity of the DIU backlight and LED warning indicators.



Menu Options

MPH / KPH

The driver interface unit can be set to display in miles per hour (MPH) or kilometers per hour (KPH).



System Status

This is the default system screen displayed during normal operation. The system status screen shows the configured features of the system and their current operational status (i.e. available or unavailable). A failed status may imply that some system or fault condition is preventing the feature from properly functioning.



Menu Options

Diagnostics Display Screen

The diagnostics screen will display any active Bendix™ VORAD® VS-400 system faults that may be present. Use the up/down buttons to select the driver display unit or the Forward Looking Radar (AC20) then select OK.

Refer to the Troubleshooting section for more information about system diagnostics.



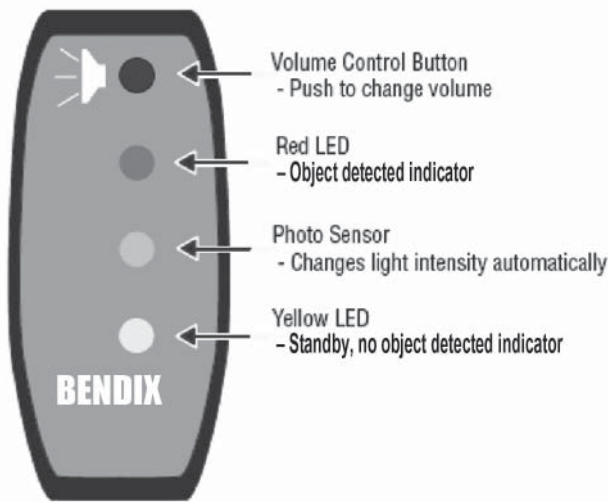
Bendix™ BlindSpotter® Side Object Detection

Bendix™ BlindSpotter® Side Object Detection

The Bendix™ BlindSpotter® side object detection system is an option to the Bendix™ VORAD® VS-400 collision warning system that can be installed on one or both sides of the vehicle. The system is comprised of a side radar sensor located on the side of the vehicle and a driver display unit located on the windshield pillar that warns the driver when an object is detected along side the vehicle.

Side Object Detection System Driver Display Unit

The driver display unit for the Bendix™ BlindSpotter® side object detection system uses two LED indicators to display the status of the side sensor, a photo sensor to automatically dim the display in low light conditions, and a volume control to adjust the volume of the internal speaker.



Red Indicator	Object Detected
Yellow Indicator	No Object Detected
Red and Yellow (power up)	Self-Test
Red and Yellow (constant)	Sensor Fault

Bendix™ BlindSpotter® Side Object Detection

Visual Warning

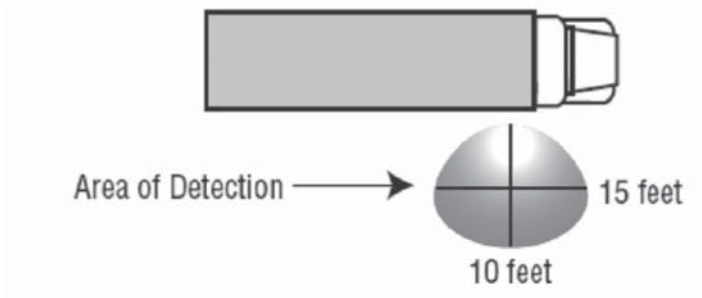
The side object display unit uses two LED indicators to display the status of the side radar sensor. The yellow LED indicates the system is active, but no objects are detected. The red LED indicates the system is detecting an object.

Audible Warning Tone

If the vehicle's turn signal is active and the sensor detects an object along side the vehicle, the side sensor display will report an audible warning tone.

Side Radar Detection Area

The side radar sensor has an effective detection range of 10 feet (3 meters) deep and up to 15 feet (5 meters) wide.



Following Distance

Calculating Following Distance

One of the safest habits any driver can perform while operating a motor vehicle is maintaining a minimum following distance from the other vehicles. Most commercial vehicles traveling at a highway speed of 55 MPH require a minimum of 200 feet or more to bring the vehicle to a complete stop on dry pavement. Conditions like heavy loads, slippery roads, and worn tire tread can drastically increase a vehicle's stopping distance.

There are many factors that affect how quickly a driver can react to slowing or stopping a vehicle. Every situation requires the driver's best judgment. One driving method that has been proven to reduce the likelihood of a front-end collision is maintaining a following distance of no closer than three seconds.

Following distance is based on the speed of travel and the time to reach the vehicle ahead should that vehicle come to a stop. You can use the formula below to calculate following distance by first converting road speed to feet per second.

$$55\text{MPH} = 290,400 \text{ Feet per Hour } [5,280 \times 55]$$

$$290,400 / 3,600 = 80.7 \text{ Feet per Second}$$

Using the example above, a vehicle traveling 55 MPH would need to maintain a minimum gap of approximately 242 feet from the vehicle ahead to maintain a three-second following distance.

$$80.7 \times 3 \text{ Sec.} = 242.1 \text{ Feet}$$



Preventive Maintenance

Preventive Maintenance

The following steps should be performed daily before operating any vehicle equipped with the Bendix™ VORAD® VS-400 forward collision warning system and Bendix™ BlindSpotter® side object detection system.

- Inspect the forward looking radar and side radar sensor(s) for damage. Remove any mud, snow, and debris that may interfere with the sensor operation.
- Inspect the front of the vehicle for any damage that may have knocked the forward looking radar out of alignment.

Cleaning

The forward looking radar and side radar sensor should be cleaned periodically to remove dirt and bugs from the radar lens. All external components can be cleaned with any products approved by the vehicle's OEM for cleaning the exterior of the vehicle.

The driver interface unit should be cleaned with a dry soft cloth. Avoid using ammonia, silicone, or alcohol-based cleaning products that may dull the display surface or damage the LCD screen.

Servicing

All of the Bendix™ VORAD® VS-400 components are factory sealed and should never be taken apart. The forward looking radar should only be removed and/or installed by a qualified service technician.

Forward Looking Radar Alignment

The forward looking radar is precision aligned during installation. If the front of the vehicle becomes damaged, or the forward looking radar is removed, the radar unit must be re-aligned by a qualified service technician. Failure to align the forward looking radar can result in improper vehicle tracking or reduce the ability of the system to properly detect and warn.

Troubleshooting

Bendix™ VORAD® Failed Message

Whenever a fault condition is detected by the forward radar or the driver interface unit, the Bendix™ VORAD® system will become disabled and the driver interface unit will illuminate the orange fault indicator lamp along with a description of the system status displayed in the LCD screen.



Note: When the system is in a failed state, the system will not alert and the Bendix™ SmartCruise® adaptive cruise control will not function (if enabled). Refer to your OEM service center for help on troubleshooting the Bendix™ VORAD® VS-400 system faults.

Resetting the System

If the system experiences a fault while driving, you must stop the vehicle and reset the system by cycling the vehicle's ignition in order to resume normal operation. If the fault does not clear after resetting the system or returns after a period of driving, the system must be serviced by a qualified repair center.



Troubleshooting

Forward Looking Radar Blocked

Whenever the system determines the forward looking radar has become blocked, obstructed, or becomes blind due to heavy rain or snow, the Bendix™ VORAD® system will disable itself and the driver interface unit will display the “Radar Blocked” message on the LCD screen.



To clear this message you must stop the vehicle and power off the system. The radar must be clear of any debris, snow, or obstructions before the system will resume normal operation.

Inspect the forward looking radar unit to clear any debris that may be interfering with its operation. If the radar appears to be damaged or misaligned, take the vehicle to your OEM service center for repair.



Do not rely on the system to warn in inclement weather like heavy rain or snow.

Using Bendix™ SmartCruise® Adaptive Cruise Control When Bendix™ VORAD® VS-400 Forward Collision Warning System Has Failed

If the Bendix™ VORAD® VS-400 forward collision warning system becomes inoperative due to a system failure or blocked radar, this will prohibit the Bendix™ SmartCruise® adaptive cruise control from operating. Most engines allow the driver to enable normal cruise mode by toggling the cruise control on/off switch two times (off, on, off, on).

