



Eaton® VORAD® AlwaysAlert®
Eaton® VORAD® SmartCruise®
Eaton® VORAD® BlindSpotter®

Installation Guide VOIG-0035 March 2004



**A highly sophisticated radar-based system
that helps prevent front and side collisions.
Provides additional driver safety and
convenience with automated
cruise control.**



AlwaysAlert™ Helps Avoid Accidents

- Significantly reduces rear-end collisions.
- Helps drivers maintain safe following distances.
- Audible/visual alerts to dangerous obstacles ahead in rain, snow, fog and night conditions.
- Continuous undistracted road monitoring up to 500-feet ahead and around curves.



SmartCruise™ Reduces Driver Fatigue

- Uses radar to automatically maintain a safe cruise control following distance
- Electronically communicates with diesel engines to match following speed with traffic flow
- Automatically engages the engine retarder when engine braking is required to maintain safe following distances
- Automatically returns to cruise set speed when traffic clears

BlindSpotter™ - "Sees" what you can't.

- Reduces lane change/merge collisions.
- Warns driver of obstacles in their blind spot.
- Driver has constant visual alert when an object is detected in the blind spot.
- Audible and visual alerts activated with turn signal.



Visit our website www.roadranger.com/VORAD for additional information.
Or call 866-RV-VORAD (866-788-6723)

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Forward

This reference guide explains installation of the Eaton® VORAD® System.

Reference Data

The Eaton VORAD family of products:

- AlwaysAlert - front collision warning system
- SmartCruise - adaptive cruise control
- BlindSpotter - side radar lane change assistant
- EVIMS - Eaton VORAD information management/accident reconstruction data recorder

Special Tools

To perform installation, you will need:

- PC with the Eaton Service Ranger Diagnostic Software
- PC with the VORAD Align Installation Software
- Eaton vehicle link adapter VL-KIT-01
- Digital level
- Electrical connection crimping tool

Additional VORAD Literature

Visit the website <http://www.roadranger.com> or call 1-800-826-HELP.

- EVT-300 Troubleshooting - VOTS-0030
- EVT-300 Driver Reference Manual - VODR-0035
- EVT-300 Illustrated Parts List - VOIP-0030

IMPORTANT NOTICE

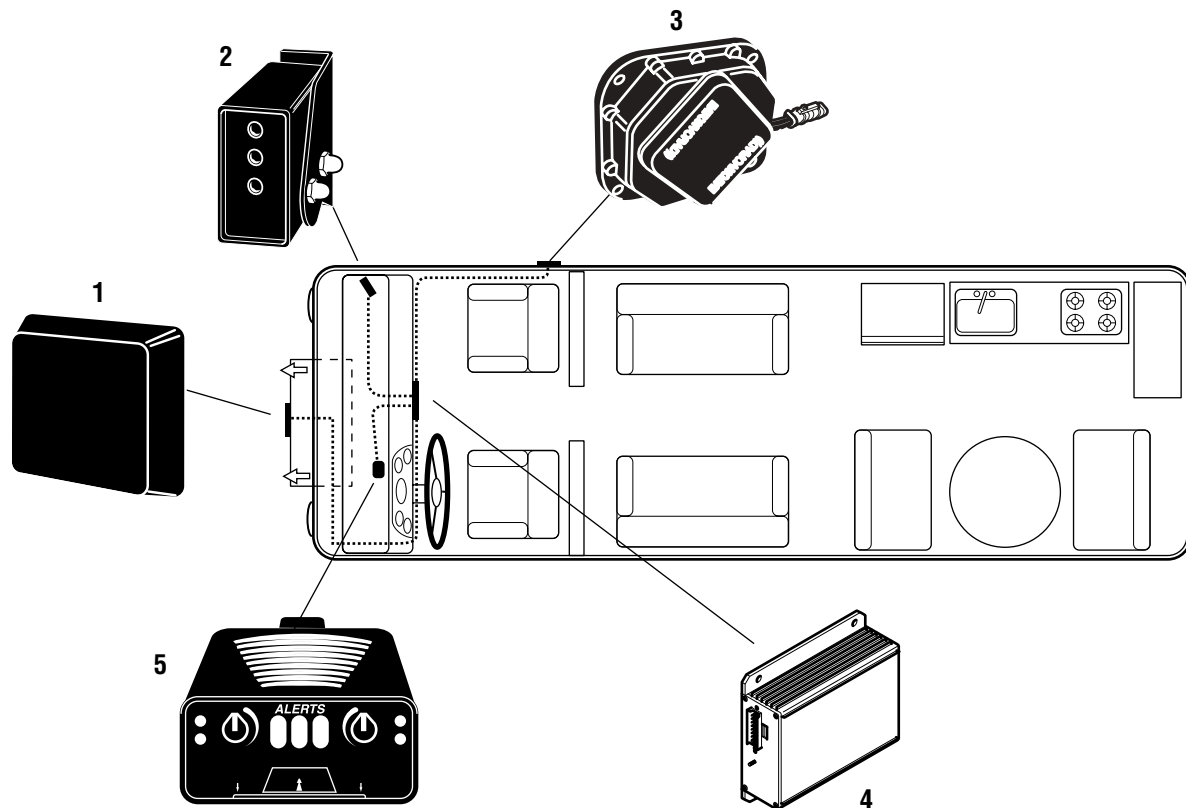


This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

General Information

The VORAD System can be installed on a variety of vehicles. Typical applications include heavy class 8 trucks, medium duty trucks, transit and shuttle buses, RV motor homes, SUVs and passenger cars.

The VORAD System components and locations are shown below:



- 1 - Antenna assembly
- 2 - Side sensor display
- 3 - Side sensor

- 4 - Central Processing Unit
- 5 - Driver display unit

Antenna Assembly

The antenna assembly on the front of the vehicle transmits and receives low-power, high-frequency radar signals. The transmitted radar signals are reflected by objects in front of the vehicle and received at the antenna assembly. The antenna assembly compares the transmitted and received signals, converts this information into a digital format, and transmits it to the Central Processing Unit for additional processing.

Side Sensor Display (optional system component)

The side sensor display contains red and yellow indicator lights. The yellow indicator light is on when there is no object within the side sensor detection zone. When the side sensor detects an object, the red indicator light illuminates and the yellow indicator light goes off. The side sensor display is usually mounted on the inside of the vehicle, in easy view by the driver, and usually along the same line of sight as the mirror.

Side Sensor (optional system component)

A side sensor is a radar device that senses objects from 2 to 10 feet from the side of the vehicle. Side sensors are generally mounted at or near a blind spot.

Central Processing Unit (CPU)

The Central Processing Unit processes information from the antenna assembly, engine-control unit, speedometer, optional side sensors, brake and turn signal circuits to produce audible and visual warnings.

Driver Display Unit

The driver display unit shows power-up conformation, speaker volume, range for vehicle warnings, and following distance for SmartCruise®.

Wiring Harness (not shown)

The main wiring harness connects all of the external inputs and the EVT-300 system components. A secondary wire harness is supplied with the optional side sensors, to facilitate connection to the main system.

Antenna Assembly Installation

There are three antenna assembly mounting options to choose from (two surface and one recessed). To determine which will work best, review the options and note that there are seven installation holes and one cable pass-through hole required. These locations are easily established using the license plate mounting plate as a template.

The antenna assembly must be mounted on the centerline of the vehicle between fifteen (15) and forty-five (45) inches from the ground.

Note: To locate the centerline, measure the distance between two reference points (e.g. headlights), and mark the center on the surface with a vertical line.

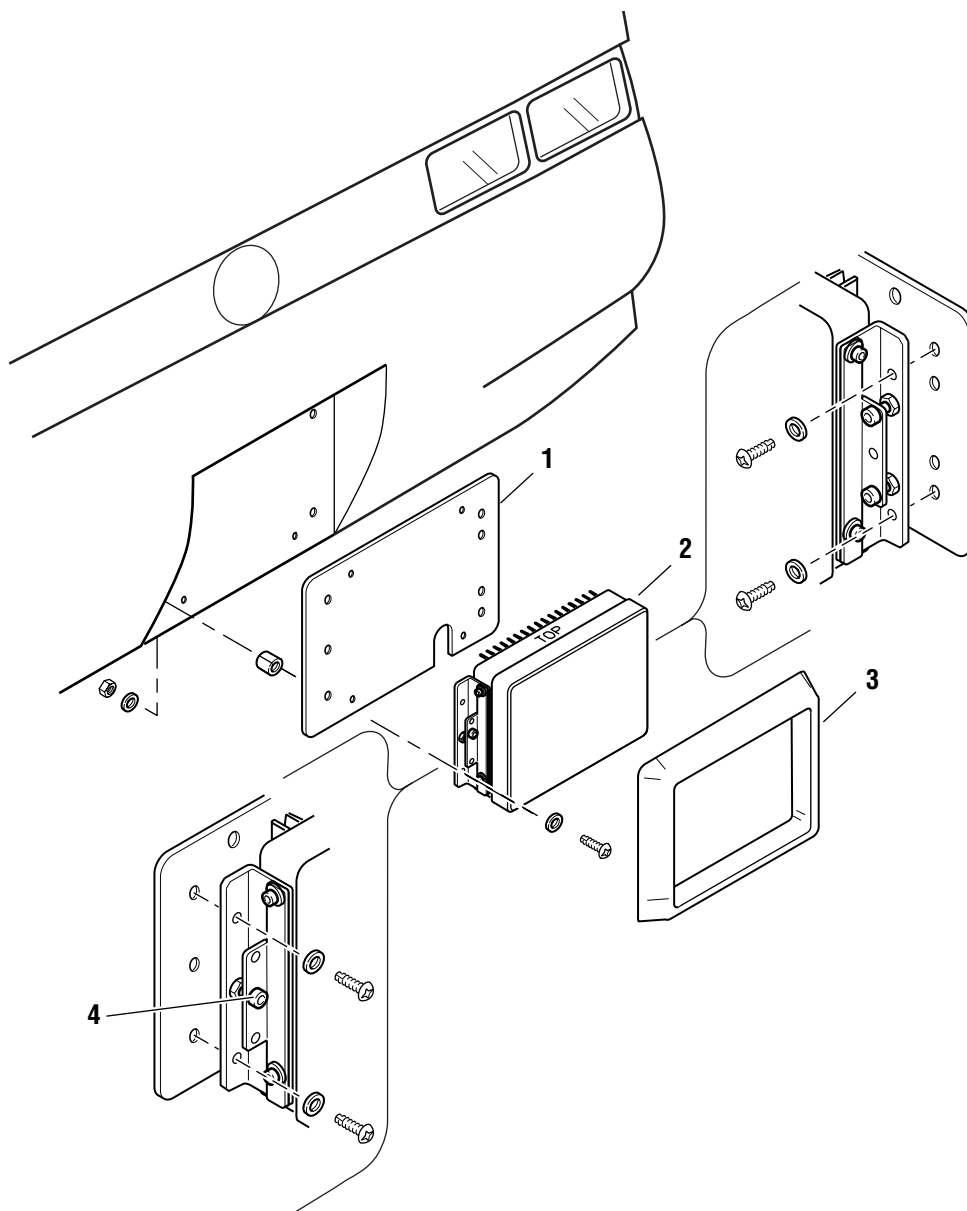
Surface - License plate mount

1. Attach mounting plate to license plate location.



CAUTION: Before drilling, check for any wiring, hoses and components that may be damaged by drilling and/or mounting hardware.

2. Drill needed holes though template.
3. Attach antenna assembly to mounting plate.
4. Attach fairing over antenna assembly.



1 - Mounting plate
2 - Antenna assembly

3 - Fairing
4 - Adjustment screw accessed from the front

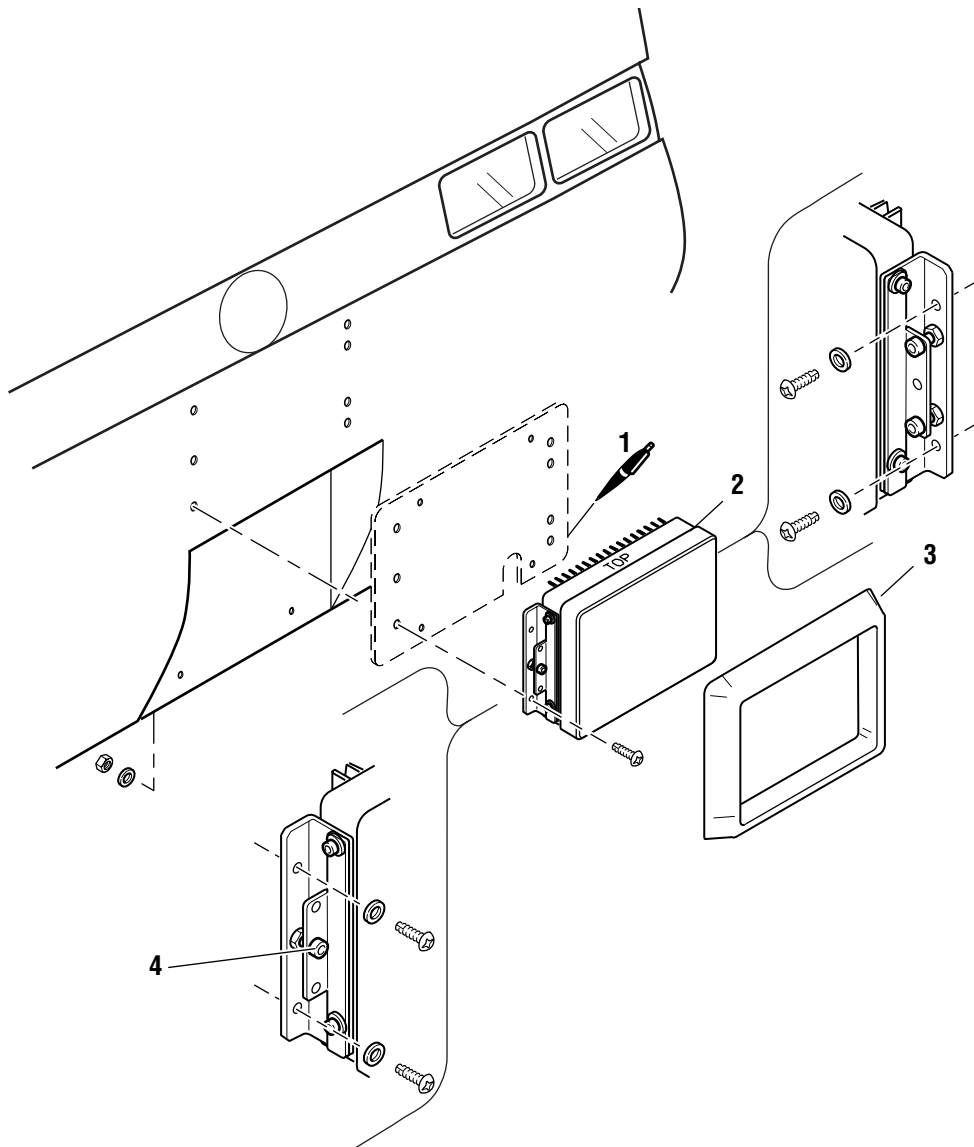
Surface - Front fascia mount

1. Locate mounting plate (template) at centerline above license plate and mark hole locations through template.



CAUTION: Before drilling, check for any wiring, hoses and components that may be damaged by drilling and/or mounting hardware.

2. Drill needed holes.
3. Attach antenna assembly directly to bumper/front fascia.
4. Attach fairing over antenna assembly.



1 - Mounting plate used as template
2 - Antenna assembly

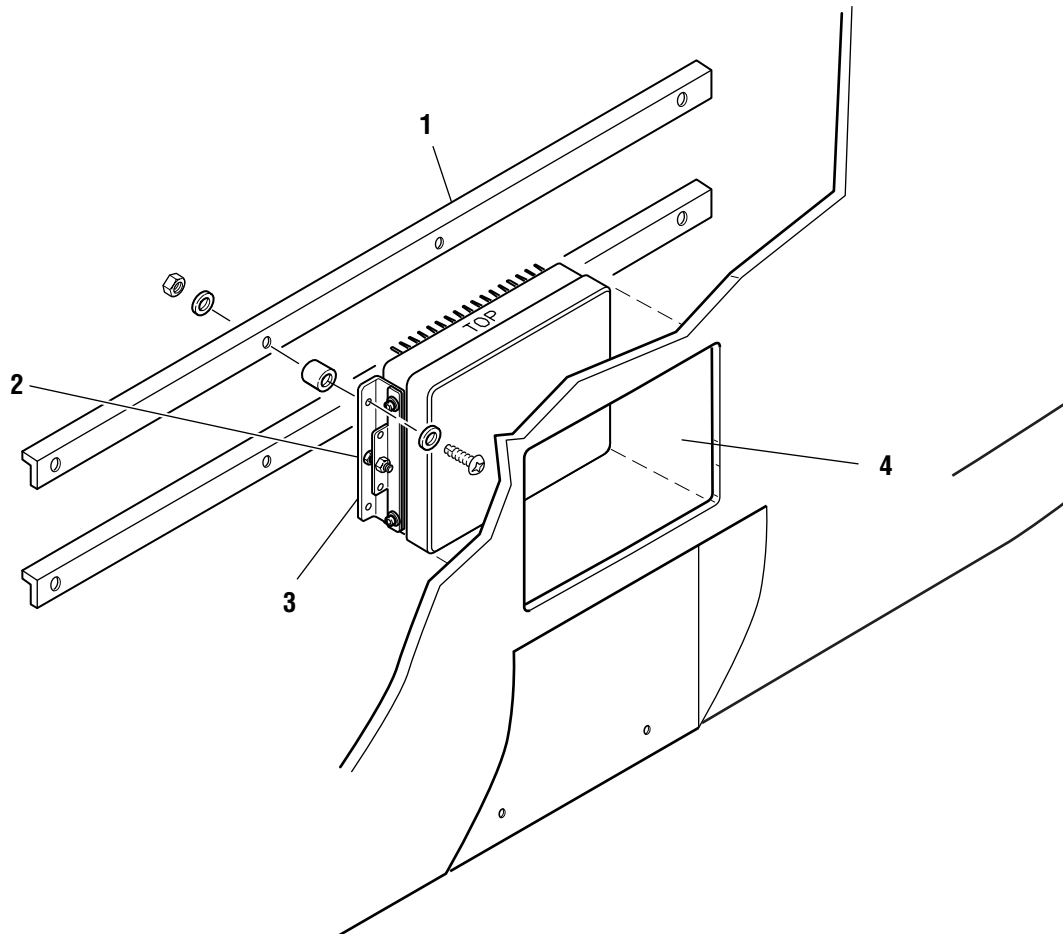
3 - Fairing
4 - Adjustment screw accessed from the front

Recessed - Mounted to bumper/facia from behind through cutout



CAUTION: Before drilling, check for any wiring, hoses and components that may be damaged by drilling and/or mounting hardware.

1. Measure antenna assembly at centerline of bumper and cut out shape in bumper.
2. Determine which bracket configuration will work best and secure antenna assembly to bracket.
3. Install brackets to RV such that antenna assembly fits through cutout.



1 - Support rails not supplied (fabricated by installer)
2 - Adjustment screw accessed from the rear

3 - Antenna assembly
4 - Cutout hole

Selecting Hardware

When selecting the antenna assembly hardware, consider how the antenna wire harness is to be routed from the Central Processing Unit to the antenna assembly. There must be room behind the antenna assembly for the antenna connector to be attached to the rear of the antenna assembly. Care must be taken with the wiring harness, so it does not contact sharp edges, moving or excessively hot parts.

After installation, align the antenna assembly (see Antenna Assembly Alignment on page 8).

Antenna Assembly Alignment

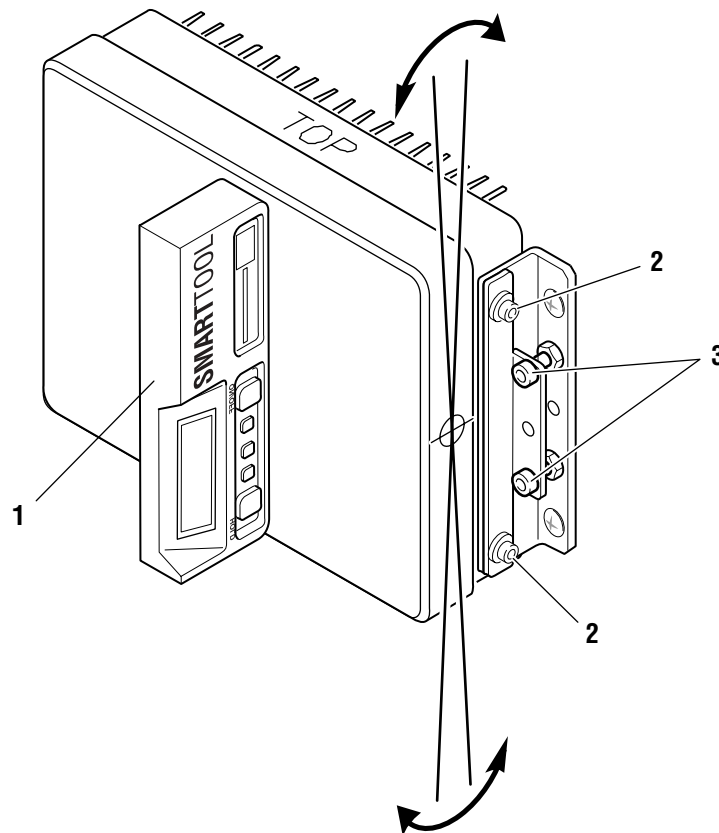
Note: Park the vehicle on a level surface. Make leveling compensations if necessary to ensure proper alignment.

Vertical Alignment

Adjust the antenna assembly to face down 0.50° from vertical.

Use a digital level held against the face of the antenna assembly.

1. Using a 5/32 Allen wrench, slightly loosen the four screws that attach the antenna assembly to its mounting brackets.
2. Hold the antenna alignment tool or digital level against face of the antenna assembly.
3. Adjust the two alignment screws on the right hand side of the antenna until the digital level indicates -0.50° (down).
4. Secure the antenna assembly by tightening the four locking screws with a 5/32 Allen wrench.



1 - Digital level

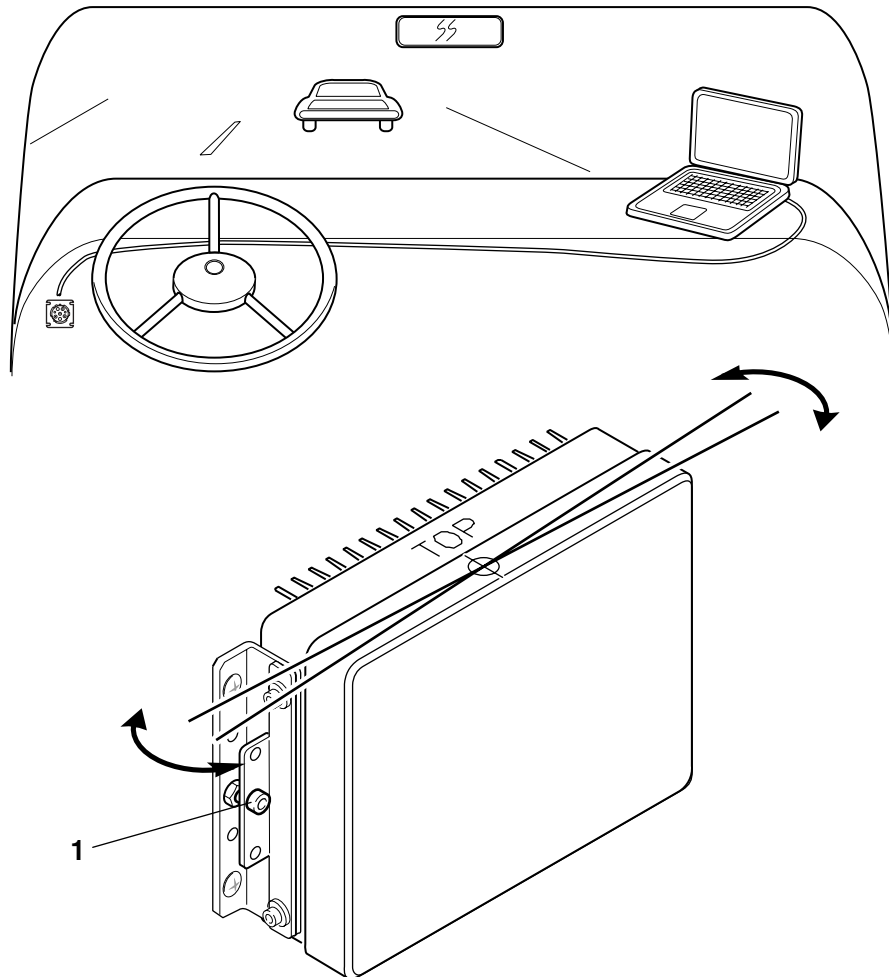
2 - 4 Allen screws that attach antenna assembly to mounting brackets

3 - Vertical alignment screws - up and down

Horizontal Alignment

The antenna assembly must face straight ahead (azimuth) to detect objects out to maximum range traveling in the same lane as the VORAD-equipped vehicle.

1. Select two vehicle reference points on the vehicle centerline that are identical and symmetrical. Ensure that the reference points are equally aligned. Items such as fenders and headlights should not be damaged or distorted; otherwise, the alignment will be off.
2. Place a long straight edge across the antenna assembly face. Center the straight edge horizontally.
3. Measure the distance between the reference points and the face of the straight edge.
4. Adjust the horizontal alignment screw until the two measurement points are equal.
5. A more precise final alignment will be obtained by using the alignment software supplied with the VORAD system and allowing the software to calculate the required alignment adjustment while the vehicle is following another vehicle on a straight section of highway. This can be done during the road test. See Road Test Check-Out Procedure on page 20.

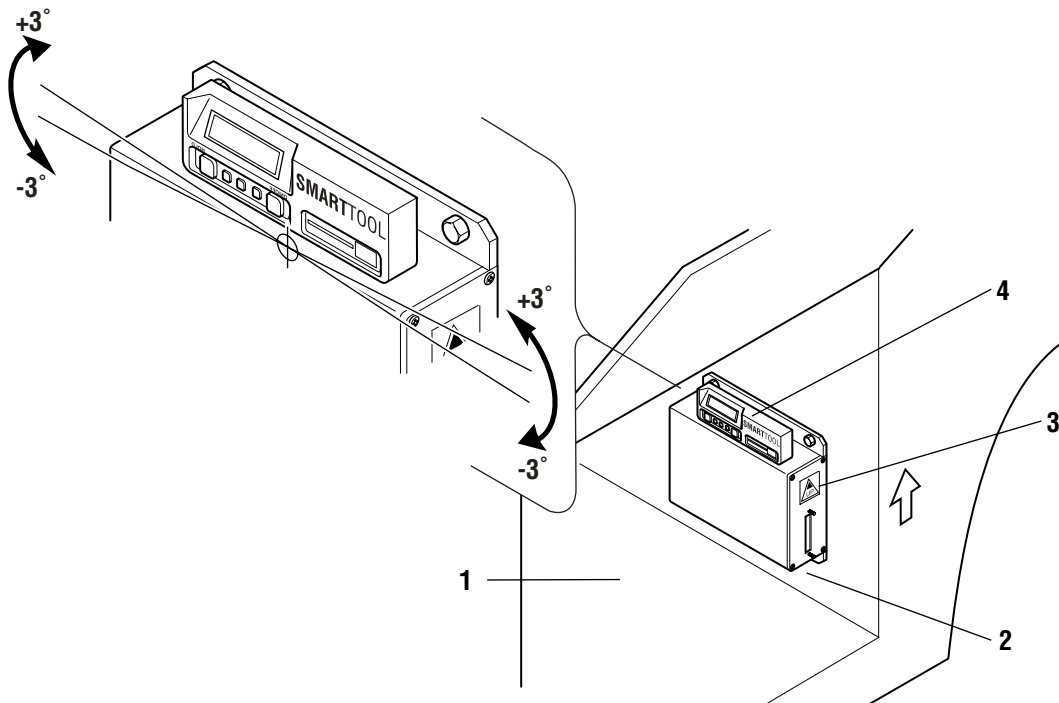


1 - Horizontal alignment screw - side to side

CPU Installation

Central Processing Unit (CPU) Installation

The CPU may be mounted in a variety of locations, such as under the dashboard, seat, or in the storage compartment, depending on owner preference. The location must be away from elements; such as water. Pick a location that will facilitate easy routing of the main wiring harness to the other components.



1 - Storage Compartment
2 - Central Processing Unit

3 - Yellow orientation label
4 - Digital level

The CPU must be installed with the yellow label on the CPU pointing up. The mounting location should:

- Allow for grounding the CPU to the chassis
 - Be out of the way of the driver and/or passenger
 - Allow for stowing any slack in the wiring harness.
1. Locate the CPU on a stable, vibration-free surface, where the top of the CPU is within 3 degrees of level.
 2. Position the CPU as a guide for drilling the mounting holes.



CAUTION: Before drilling, check for any wiring, hoses or components that may be damaged by drilling and/or mounting hardware.

3. Install the CPU on the mounting surface, using four #10 star washers and four #10 x 3/4" self-tapping screws.
Alternative: Install the CPU using four customer-furnished, screws, washers and nuts.
4. Attach the free end of the ground cable to chassis ground, either by using an existing screw or by using the appropriate size self-tapping screw. Ensure that the ground cable is secured on an unpainted and rust-free location out of the way of any obstructions.

Driver Display Unit Installation

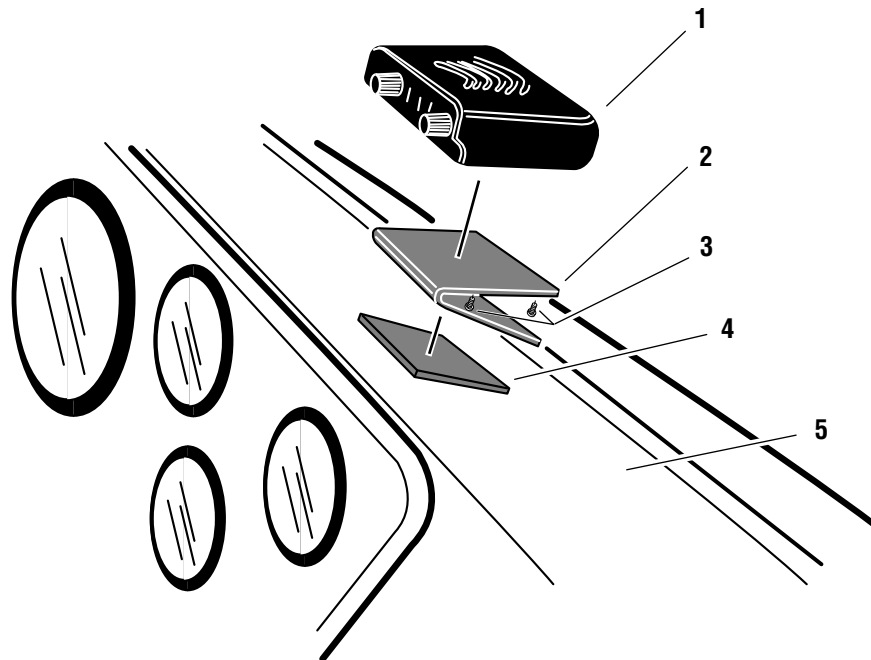
Install the driver display unit where the driver can easily view and adjust the controls. Usually it will be on top of the dashboard, flush with the front edge. For a more finished look, the display can be mounted in the dash, using the dash bezel.

Consider the method chosen for routing the wiring harness to the driver display unit when determining the optimal location, but ease of operation and visibility of the driver display unit front panel are the primary considerations.

Driver Display Unit Installation Procedure - on dash

The following illustration shows a typical installation.

1. Attach the driver display unit to the mounting bracket with the four supplied #6 x 5/16" self-threading screws.
2. Use an alcohol-based cleaner on the surface where the driver display unit bracket will be installed.
3. Attach the driver display unit mounting bracket to the desired spot on the dashboard.
4. Secure the driver display unit bracket with screws if necessary. Four #6 x 5/16" screws are provided.

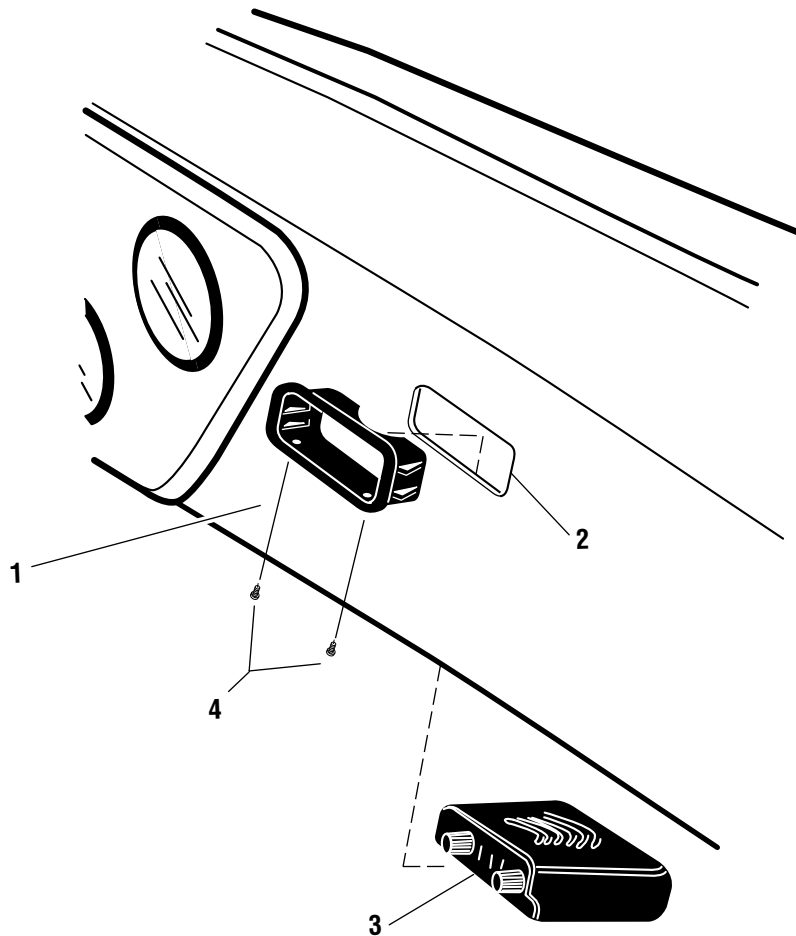


1 - Driver display unit
 2 - DDU mounting bracket
 3 - Screws (qty. = 4- #6 x 5/16")

4 - Double-sided tape (part of DDU mounting bracket)
 5 - Dashboard

Driver Display Unit Installation Procedure - in dash

1. Use bezel as a template tracing the outer and inner side of the bezel face on the area of dash to be cut.
2. Cut the dash between the two lines.
3. Attach bezel to display and snap into cutout.

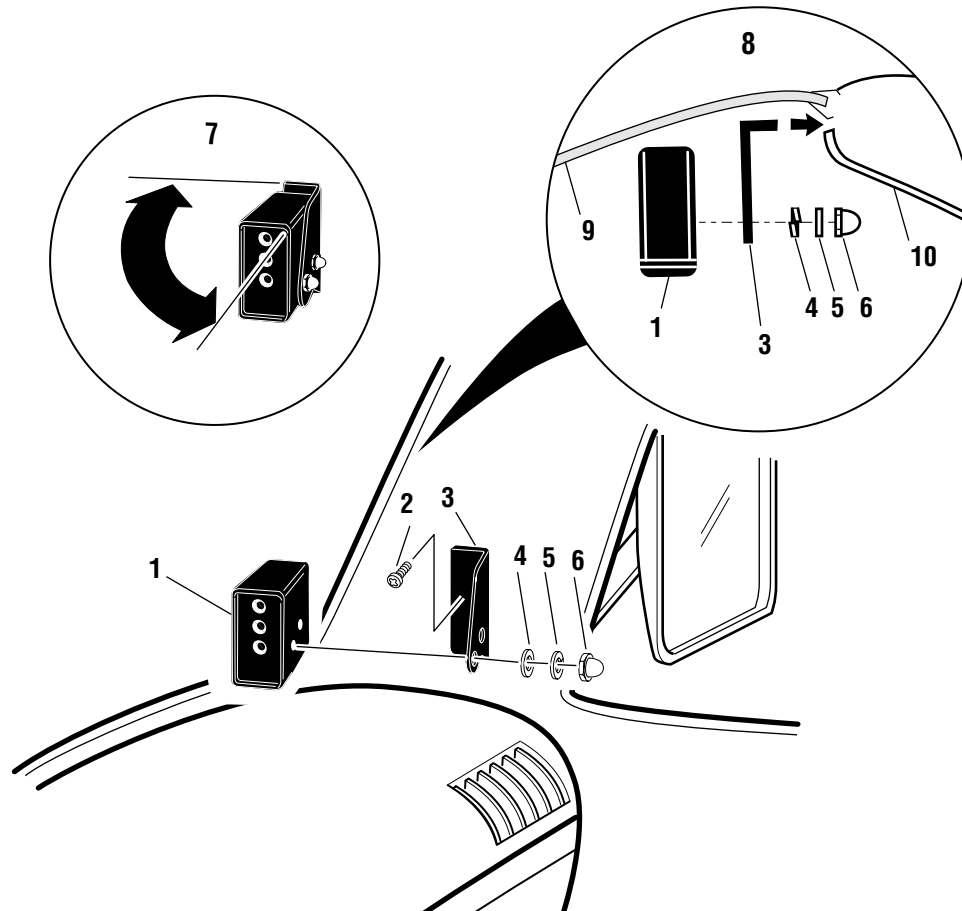


1 - Dashboard
2 - Cutout hole

3 - Driver display unit
4 - Screws (qty. = 2- #6 x 5/16")

Side Sensor Display Installation

Install the side sensor display where the driver can easily see it. Usually, this will be on the windshield pillar of the vehicle, generally in the same line of sight as the side mirror, so that the driver can monitor both at the same time. If possible, use existing hardware on the windshield pillar to secure the side sensor display bracket. If existing hardware cannot be used, drill a mounting hole. The following illustration shows a typical installation.



- 1 - Side sensor display
- 2 - Self-tapping screw (optional)
- 3 - Bracket
- 4 - Lock washer
- 5 - Flat washer

- 6 - Acorn nut
- 7 - Adjustment angle
- 8 - Optional mounting (top view)
- 9 - Windshield
- 10 - Interior trim



CAUTION: Before drilling, check for any wiring, hoses, or components that may be damaged by drilling and/or mounting hardware.

1. The perspective from the driver's seat should determine the proper position of the bracket. If necessary, adjust the bracket angle by bending the bracket to the desired angle.
2. Install the side sensor display on the mounting studs, using the two #4 flat washers, two #4 lock washers, and two #4-40 acorn nuts.

Note: Optional installation - bracket can be flipped over to allow insertion of the bracket between the windshield and the interior trim.

Side Sensor Installation

Install the side sensor where it provides maximum coverage of the driver's most vulnerable blind spot. The blind spot should be determined manually. Have an assistant walk from the front to the rear of the vehicle and mark on the ground where the driver loses sight of the assistant and then regains sight of the assistant as he or she continues to the rear of the vehicle. When the front and rear limits of the blind spot have been established, place the side sensor on the vehicle in the approximate middle of the front and rear limits.

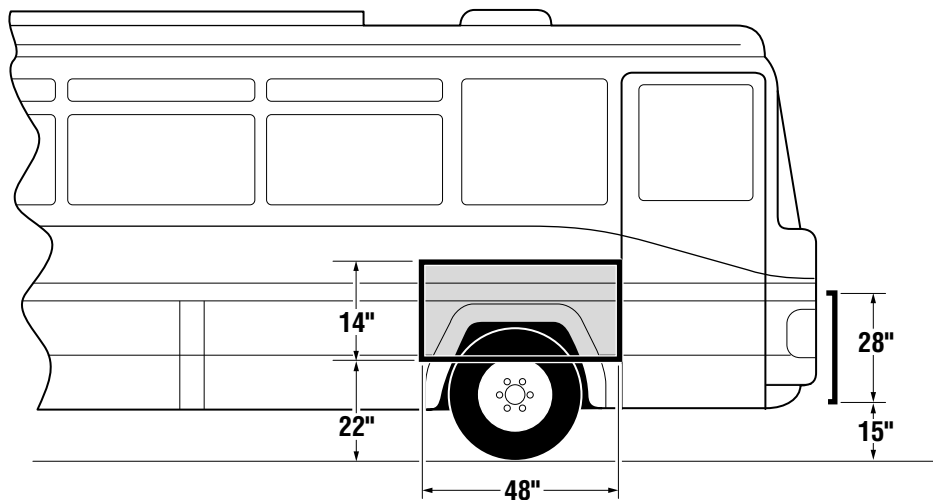
For most vehicles, the primary blind spot is on the right side, behind the passenger door. A secondary side sensor can be located on the right or on the left side of the vehicle. See the following illustration for suggested placement.



CAUTION: Other blind spot may exist; these are ONLY suggested locations for your side sensor.



CAUTION: If the sensor is mounted in a high splash/debris area such as a wheel well, a shield should be placed over the sensor for protection.



*Primary side sensor
OPTIMAL:
22" - 36" above ground
39" - 45" behind mirror*

*Secondary side sensor
OPTIMAL:
22" - 36" above ground
At least 48" away from
primary side sensor*

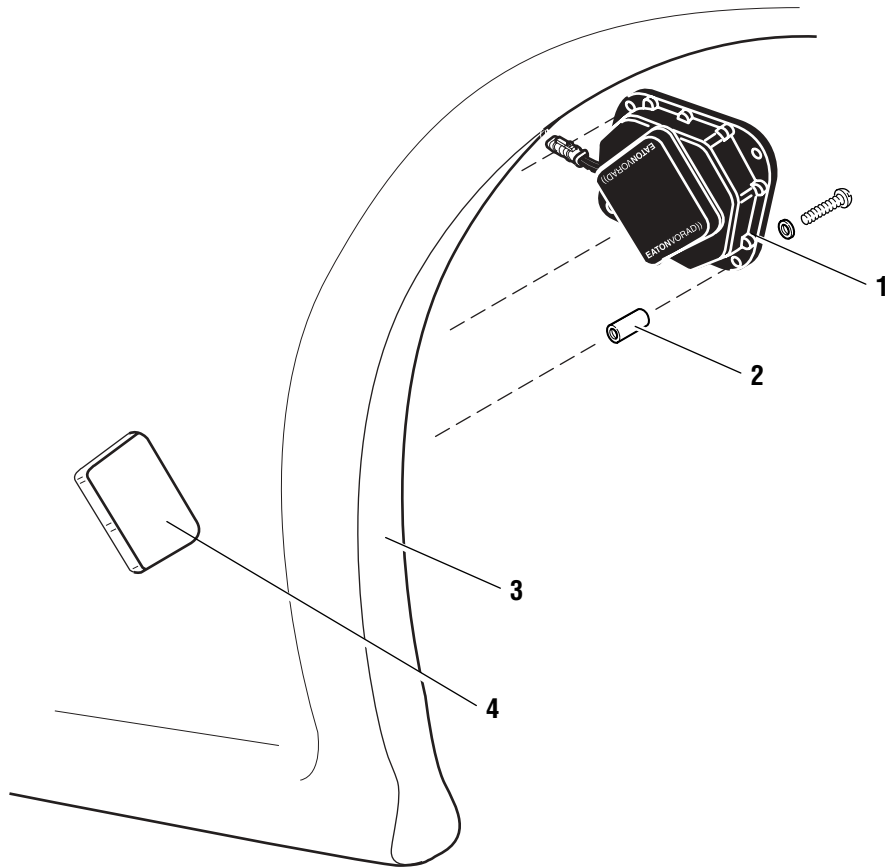
*Antenna assembly
OPTIMAL:
15" - 43" above ground
on vehicle centerline (required)*

The side sensor should be mounted on the most outer section of the vehicle body, side fairing or step. In certain applications, the customer may have to fabricate a side sensor mounting bracket.

Side Sensor Installation Procedure

Drill four mounting holes in the side of the vehicle or bracket.

1. Use the mounting bracket to trace the cutout for the sensor and mounting holes.
2. Bolt the spacer to the sensor.
3. Bring the sensor in from the rear and attach using four stainless steel Phillips screws supplied.
4. Option - glue or rivet the sensor to the vehicle.



1 - Side sensor
2 - Spacer

3 - Side of coach
4 - Cutout hole

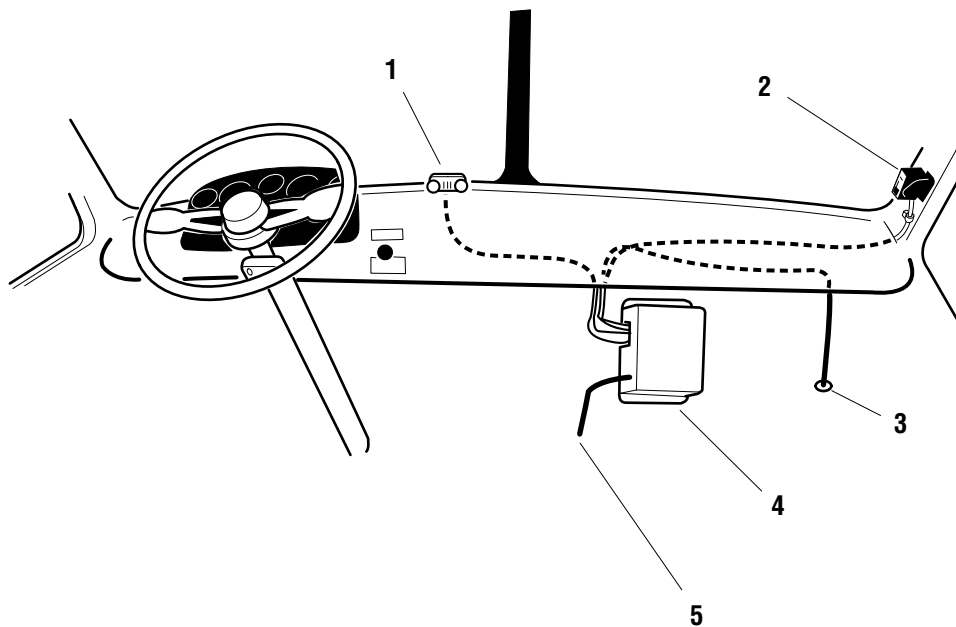
Wiring Harness Installation

Installation of the wiring harness should start from the CPU and then extend outward to the other components.



CAUTION: Avoid routing the wiring harness near sharp edges or extreme heat, which could damage wire insulation.

Route the wires along existing wires, up through existing pass-through holes or spaces in the floor or dashboard to the installed components. Coil up the slack in the wire harness and store it neatly behind the dashboard or kick panels, depending upon the location of the CPU. The following illustration shows a typical installation of the wiring harness.



1 - Driver display unit

2 - Side sensor display

3 - To side sensor and antenna assembly

4 - Central Processing Unit

5 - Ground strap

Note: Use the protective loom where necessary. Tie-wrap the harness for a secure/neat installation.

Wiring Harness Connection to Vehicle Wiring

Use the Butt connectors provided in this kit to connect the system wires to the existing vehicle wires (see VORAD Harness Schematics).

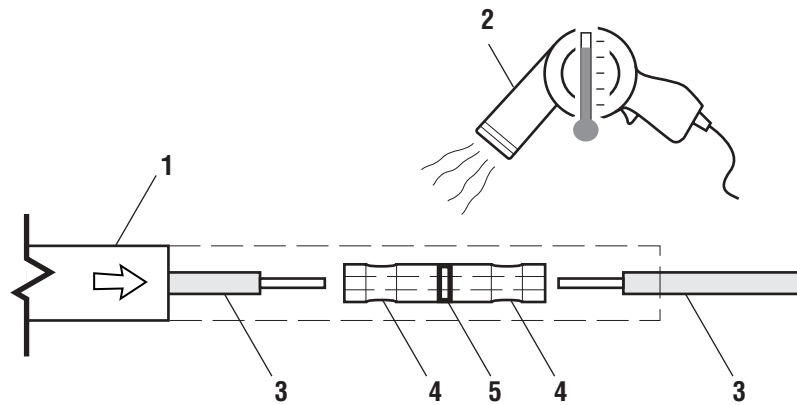
Parts:

Terminal, P/N 2B-14, Thomas & Betts®

Solder sleeve, P/N CWT-3805, Raychem®

Shrink tubing 5/16

1. Cut the vehicle wire and slide a solder sleeve over the wire that will remain single. Install the solder sleeve so the blue band is nearest the end just cut.
2. Strip 3/8" of insulation from the end of the wires just cut and the wire to be added.
3. Insert the single wire into one side of the terminal until the wire can be seen at the middle of the terminal. Crimp the wire in place.
4. Slide a 4" piece of heat-shrink tubing over the two other wires.
5. Insert the two stripped wires into the other end of the terminal. Crimp the wires in place.
6. Slide the solder sleeve over the crimped terminal until the solder ring is centered over the middle of the terminal. Use a heat gun to melt and shrink the solder sleeve over the terminal.
7. Slide and center the shrink tubing over the solder sleeve. Use the heat gun to shrink the tubing.



1 - Shrink tubing

2 - Heat gun

3 - Wires

4 - Solder sleeve

5 - Solder ring

Vehicle Wiring Connections

Brake

Required ONLY if the vehicle does not have an SAE J1587 or J1939 data link connection: Connect the wire marked “BRAKE” to the vehicle harness. Tap into the brake circuit so that current is sensed only when the vehicle service brakes are applied.

Power

Connect the wire marked “IGNITION,” with the fuse holder, to an ignition switched power source so that the VORAD will only power up, when the ignition switch is turned to the run position.

Turn Signals

The wires marked “RTURN” and “LTURN” are used only if mounting side sensors on the vehicle. In this case tap into the turn-signal indicator circuits.

Note: Once the electrical connections are completed, excess slack in the wiring harness should be tie-wrapped and stowed neatly behind the dash.

Ground

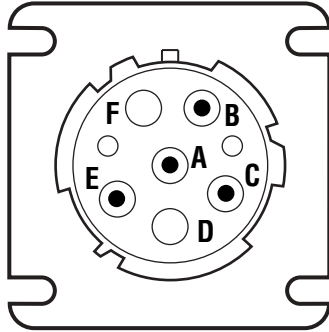
Connect the wire marked “PWR GND” to a battery negative location.

Diagnostic J1587 and J1939

On vehicles with an existing SAE J1587 diagnostic port: Connect the wire marked “1587POS” and the wire marked “1587NEG” to the vehicle J1587 data bus. Splice into the positive and negative data lines behind the vehicle diagnostic port. See the illustration on page 18 for location.

Note: On installations where a J1587 or J 1939 data bus is not on the vehicle, you will need to provide a vehicle speed signal to the VORAD system. In this case the “SPEEDP” must be connected to an electronic speed pickup usually located on the transmission or engine controller. See your vehicle OEM service dealer for assistance in identifying an appropriate speed sensor signal. The wire marked “SPEEDN” is not used.

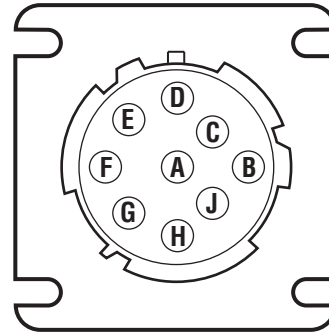
Backside of truck
J1587 Diagnostic Connector



*A - J1587 Positive
B - J1587 Negative
C - Battery (+12)*

*D - Not used
E - Battery ground
F - Not used*

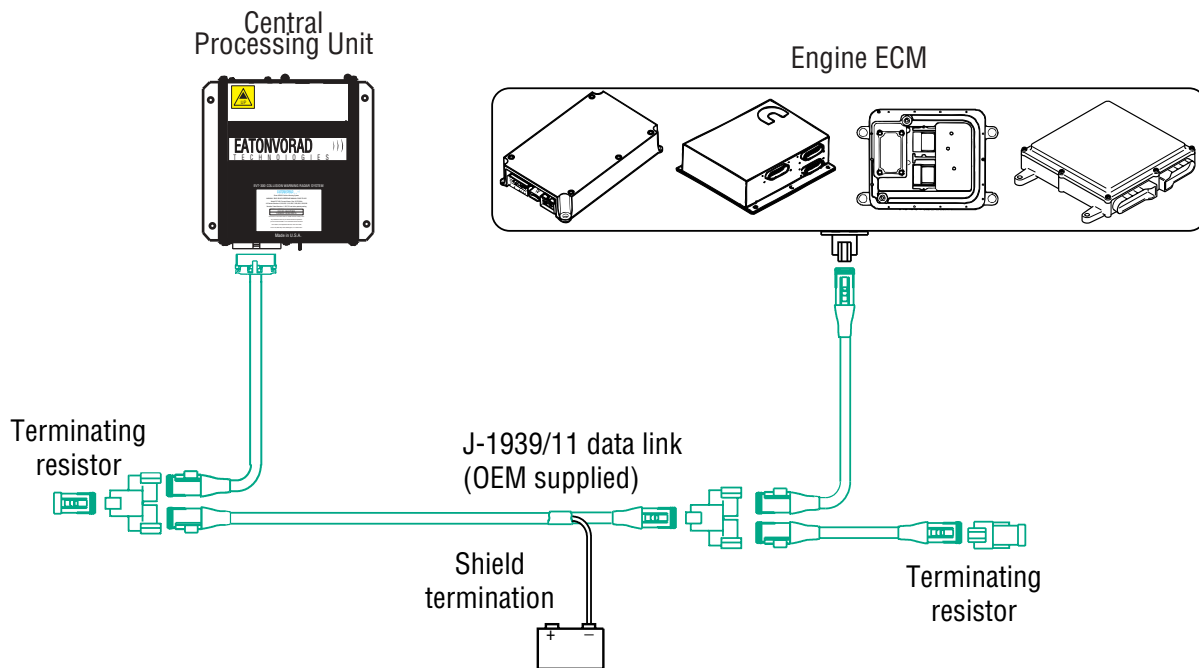
J1939 Diagnostic Connector



*A - Ground
B - Battery Positive
C - J1939 Positive
D - J1939 Negative
E - J1939 Shield*

*F - J1587 Positive
G - J1587 Negative
H - Not used
J - Not used*

SmartCruise requires connecting the VORAD CPU to the SAE J1939 Data Link for control of the engine speed and Jake Brake. See Appendix for Termination Procedure.



Road Test Check-Out Procedure

After completing the installation of the VORAD components, perform a test drive. It will be necessary to perform a final alignment of the antenna. If vehicle speed is being obtained through the discrete speed input connected to a speed sensor on the vehicle (common configuration on automotive retrofit installations), it will also be necessary to calibrate the speed signal. This can be done using a laptop PC and the align software provided with the system.

Insert the ignition key and turn it to the run position, the VORAD system will power-up and go into a self-test mode. During this test mode the lights on the driver display will be on. After successful completion of the test the green power light should remain on. If the systems fail to power up correctly the red fail light will be illuminated and diagnostics must be performed to identify and correct the problem before proceeding. See the Trouble shooting section.

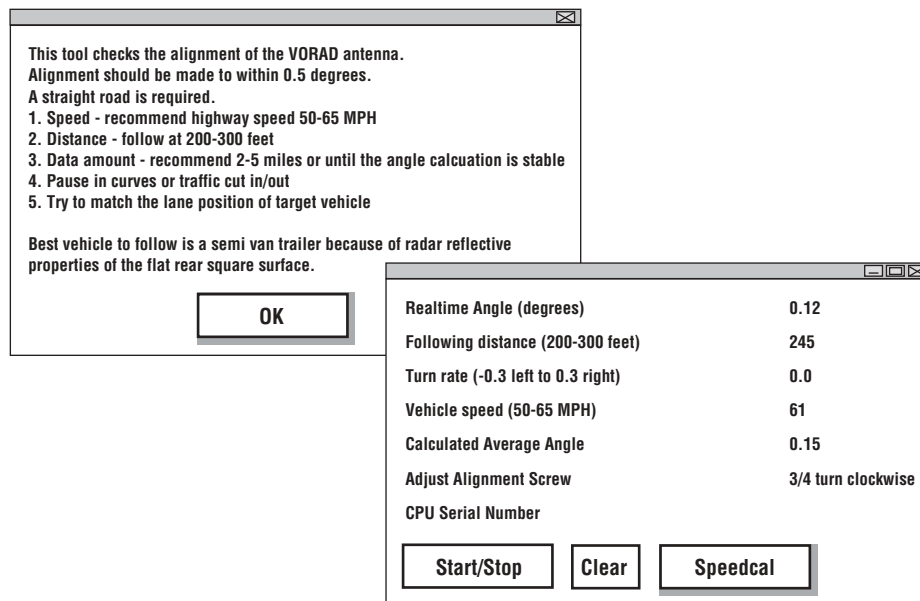
1. If the VORAD system has the SmartCruise feature the green s/c light will remain on after power-up until the brake peddle is depressed once.
2. Depress range knob for two seconds; then release. Confirm demo tones and lights are output on the driver display.
3. Side sensor test (if equipped with side sensors). Drive the vehicle and confirm that the side sensors are functioning as described:

The yellow light should be on when the ignition is on. When an object is within 2–10 feet of the sensor zone, the red light should be illuminated. **Note:** Relative motion is required. The sensor will not issue audible tones if the host vehicle is also stationary.

Calibrating the Discrete Speed Source

Note: Calibration is not required when using J1587 or J1939 as the speed source.

- a. Use the calibration function on the Alignment Program supplied by Eaton.
- b. Press Speedcal and follow procedure.



Dynamic Antenna Alignment Procedure

- a. Use Alignment Program supplied by Eaton.
- b. Press Start and follow procedure.

This tool checks the alignment of the VORAD antenna.
Alignment should be made to within 0.5 degrees.
A straight road is required.
1. Speed - recommend highway speed 50-65 MPH
2. Distance - follow at 200-300 feet
3. Data amount - recommend 2-5 miles or until the angle calculation is stable
4. Pause in curves or traffic cut in/out
5. Try to match the lane position of target vehicle

Best vehicle to follow is a semi van trailer because of radar reflective properties of the flat rear square surface.

OK

Realtime Angle (degrees)	0.12
Following distance (200-300 feet)	245
Turn rate (-0.3 left to 0.3 right)	0.0
Vehicle speed (50-65 MPH)	61
Calculated Average Angle	0.15
Adjust Alignment Screw	3/4 turn clockwise
CPU Serial Number	

Start/Stop

Clear

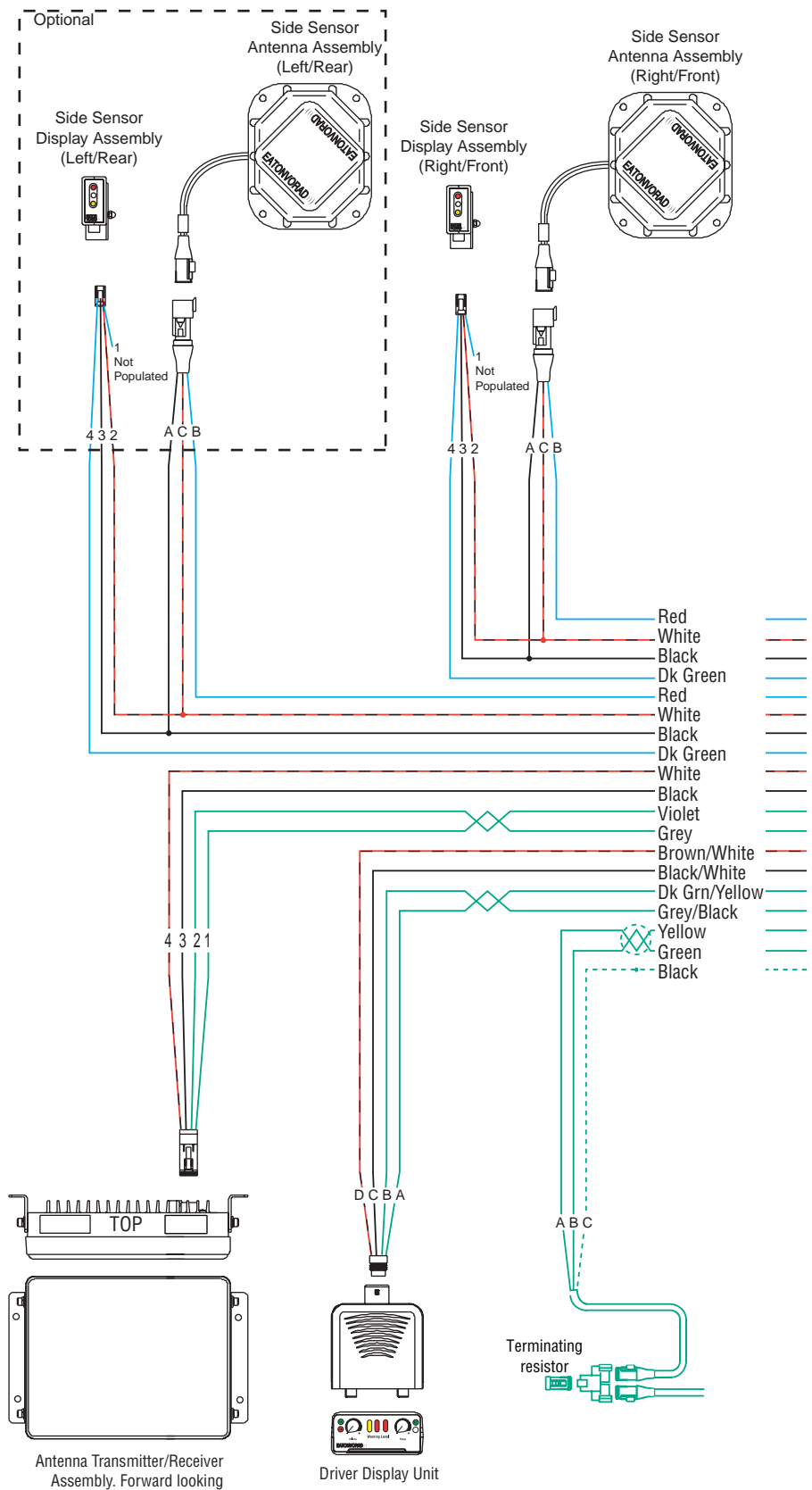
Speedcal

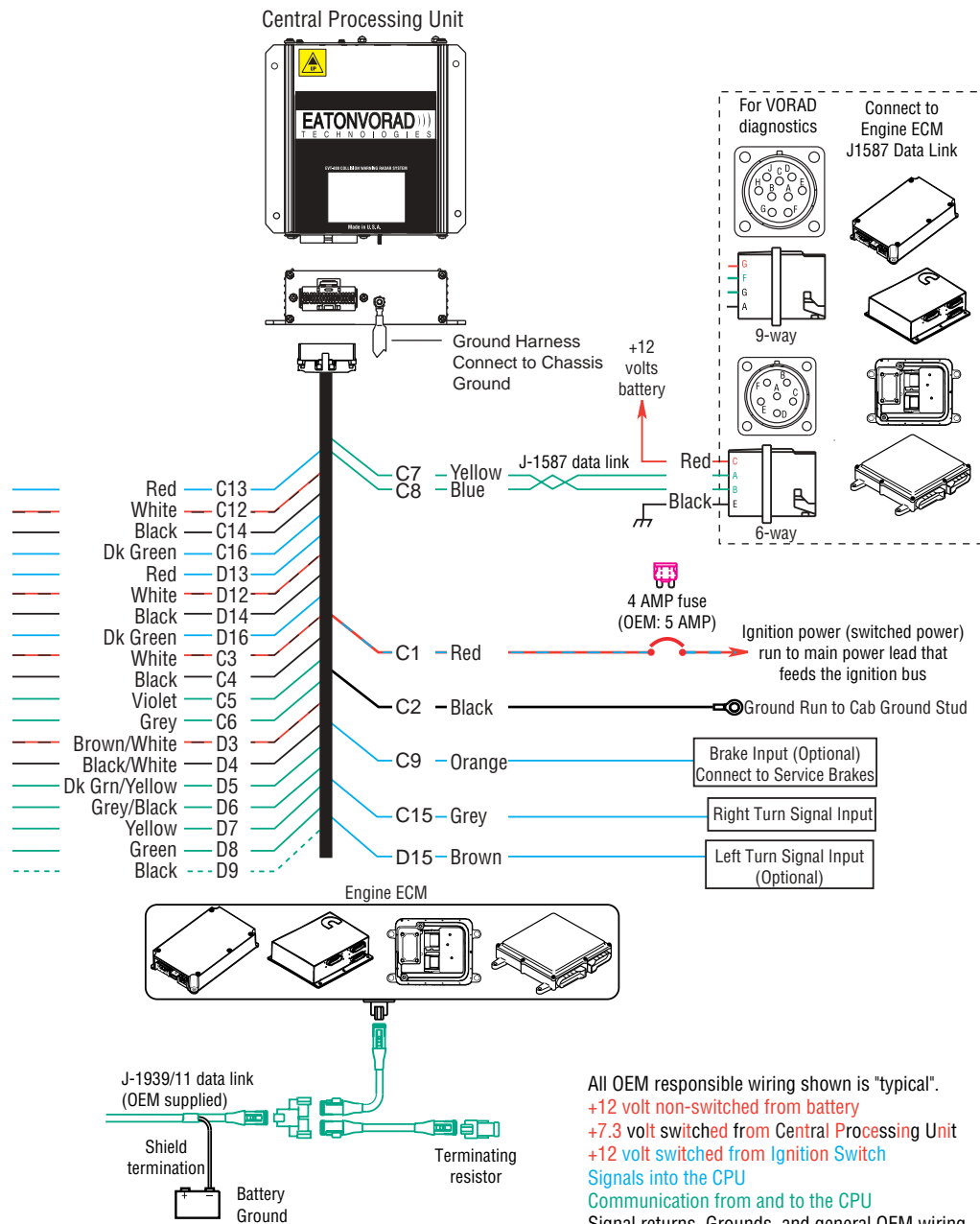
- 4. Activate SmartCruise and confirm operation S/C light should come on when host is within 2 seconds of another vehicle.
- 5. Confirm that the Jake brake activates to maintain the appropriate following distance.
- 6. Confirm audible alerts and that the audible alerts are canceled when the brakes are applied.



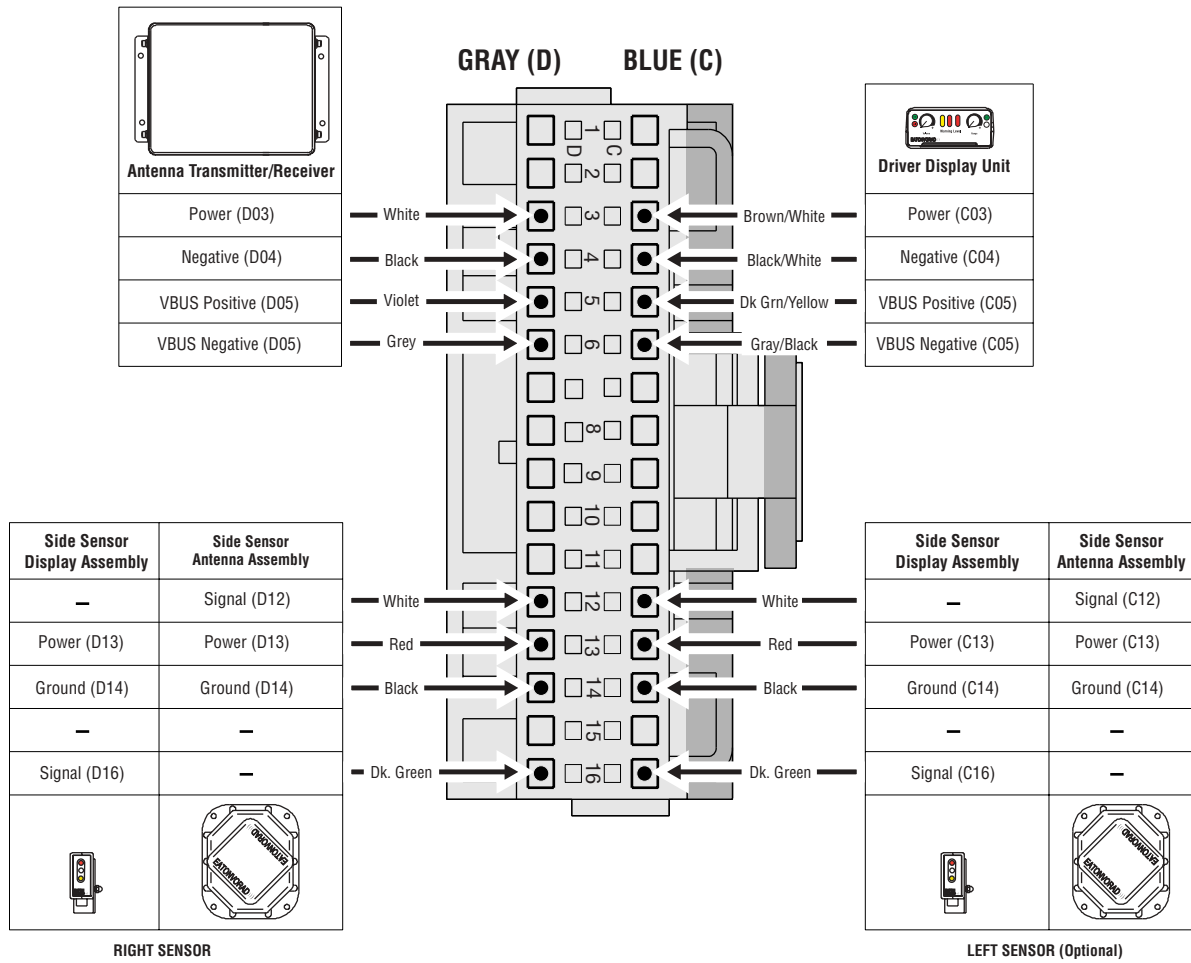
CAUTION: An operator must be driving the vehicle while an assistant performs the tests.

VORAD Harness Schematics



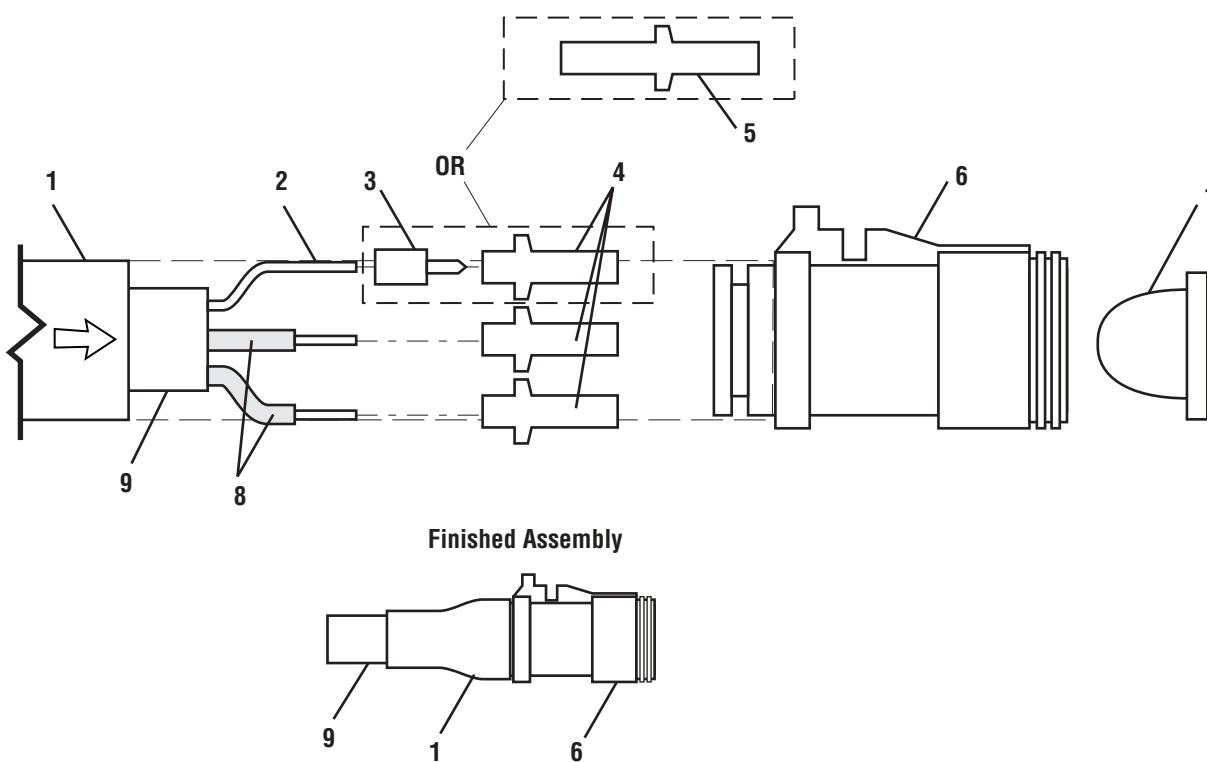


Connector Wiring Quick Reference



Recommended Cable Termination Procedure

1. Remove cable outer jacket approximately 25 mm.
2. Remove foil shield from exposed wires to within 2 mm of cable jacket.
3. Strip insulation from data wires 7 ± 0.8 mm.
4. Attach adhesive filled solder sleeve and wire to drain wire per manufacturers recommendation **OR** attach extended wire barrel socket contact to the drain wire.
5. For the solder sleeve option, cut wire on solder sleeve to a length of 25 mm and strip the insulation on that wire 7 ± 0.8 mm.
6. Crimp the appropriate terminal on each data wire and the solder sleeve wire **OR** extended socket per manufacturers recommendation.
7. Slide adhesive filled shrink tube over cable end.
8. Install terminals into connector body per manufacturers instructions.
9. Install wedge in front of connector body per manufacturers instructions.
10. Apply shrink tube to end of connector body per manufacturers recommendation.



1 - Shrink tube
 2 - Drain wire
 3 - Solder sleeve with wire
 4 - Terminals
 5 - Extended socket

6 - Plug
 7 - Wedge
 8 - Data wires
 9 - Cable

Eaton VORAD System Specifications

DESCRIPTION	VALUE
Vehicle Closing Rate	0.25-100 m.p.h., 0.4-160 km/hr.
Operating Range	3-350 feet, 0.9-110 meters (typical)
Host Vehicle Speed	0.5-120 m.p.h., 0.8-190 km/hr.
Power Requirements	12 to 24 Vdc, 20 watts (nominal)
Operating Frequency	
Antenna Assembly	24.725 Ghz
Side Sensor	24.725 Ghz
Transmitted PF Power	3.0 milliwatts (typical)
Temperature Range	-40° to +188° F, -40° to +85° C
Vibration Range	7 G's (10 to 2000 Hz, 5 grms)
Boresight Correction	±3°
System Accuracy	
Range	5% ±3 feet
Velocity	1% ±0.2mp
Azimuth	±0.2°
ANTENNA ASSEMBLY	
Height	6.45 in., 16.4 cm
Width	8.1 in., 20.6 cm
Depth	2.4 in., 6.09 cm
Weight	5.0 lbs., 2.25 kg
CENTRAL PROCESSING UNIT	
Height	2.05 in., 5.2 cm
Width	7.5 in., 18.98 cm
Depth	7.18 in., 18.17 cm
Weight	2.0 lbs., 0.9 kg
DRIVER DISPLAY UNIT	
Height	1.7 in., 4.3 cm
Width	3.65 in., 9.3 cm
Depth	4.125 in., 10.5 cm
Weight	0.33 lbs., 0.15 kg

DESCRIPTION	VALUE
SIDE SENSOR	
Height	1.7 in., 12.6 cm
Width	5.87 in., 14.86 cm
Depth	2.0 in., 5.06 cm
Weight	1.25 lbs., 0.57 kg
SIDE SENSOR DISPLAY	
Height	1.45 in., 3.7 cm
Width	0.65 in., 1.65 cm
Depth	1.7 in., 4.3 cm
Weight	0.09 lbs., 0.04 kg
MISC. HARDWARE	
Weight	1.0 lbs., 0.45 kg (approx.)
TOTAL SYSTEM	
Weight	11.22 lbs., 5.05 kg (approx.)

Reading Fault Codes - Troubleshooting

Faults are logged in the system memory as fault codes. A complete listing of these fault codes is provided in the Fault Code Table.

If the fail light is on when the VORAD system is powered up:

1. Set the range knob to the minimum level.

Note: Inactive fault codes are displayed if the range knob is turned between ½ and full range position.

2. Depress the volume dial and hold for six seconds.
3. In a few seconds the error codes will begin to flash on the Driver Display via the fail light. The format of these codes is two digits, with a two second pause between digits and a longer six second pause between fault codes. Record these codes and repeat the process to ensure that the codes have been properly identified.

Diagnostic Codes

Code	Description
11	CPU Internal Failure
12	Memory Card or Card Reader
13	Wiring or Driver Display
14	Wiring or Antenna Assembly
15	Wiring or Right Side Sensor
16	Wiring or Left Side Sensor
21	No Right Turn Signal Input
22	No Left Turn Signal Input
23	No Brake Signal Input
24	No / Bad Speed Signal
26	Unrecognized Engine
27	Engine not Programmed for S/C
28	Less than Desired Retarder Output
31	J1587 Link Failure
32	J1939 Link Failure
33	Internal VBUS Failure
34	No Communication to Display
35	No Communication to Antenna
41	Last Fault Code / No Codes



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