CarSense303™

Single Saw Cut Magnetoresistive Vehicle Detector



Instruction Manual

The CarSense303 features advanced 3-axis, magnetoresistive sensing technology. The small size of the CS303 allows for easy installation in pavement with a **single saw cut**. It provides cost savings on labor and materials when compared to the multiple cuts and corner reliefs required for the installation of inductive loops. The sensor measures the Earth's magnetic field and responds to disturbances caused by ferrous objects. Three sensing elements provide magnetic field measurement in the X, Y and Z axis, improving detection sensitivity. The CS303 flat pack (FP) and direct burial (DB) sensors are also suitable for above ground installations, making them ideal for use in confined areas or hidden in non-ferrous architectural components for security purposes. The CS303's exciting new technology provides a high-sensitivity, compact and cost-effective solution for reliable vehicle detection.

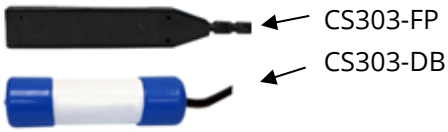
NOTE: When power is applied to the CS303-C-1 controller and a CS303-FP or DB sensor is connected, the settings on the controller will be sent to the sensor. The sensor stores these settings even when disconnected from the CS303-C-1. However, **the controller is required to program and recalibrate the sensor**.

Specifications

	CS303-C-1 Controller	CS303-FP and DB Sensor
Detection Range	5 ft (1.5 m) radius	
Response Time	125 ms	
Outputs	SPDT relay	NPN (open collector)
Output Current Rating	Relay: 1 A @ 24-120 VDC	50 mA (max)
Connection	10 position screw terminal	5 conductor direct burial
Operating Environment	-40° to 82°C (-40° to 180°F); 0 to 95% relative humidity	
Housing Material	ABS (plastic)	CS303-FP: Polyamide CS303-DB: PVC
Environmental Rating	IP30	IP69K
Power	12-30 VDC and 24 VAC	12-30 VDC
Current Draw	40 mA (max)	10 mA (max)
Supply Protection	Reverse polarity and fuse protected	
Dimensions (L x W x H)	76 mm (3.0") x 22 mm (0.9") x 70 mm (2.75")	CS303-FP: 108 mm (4.3") x 22 mm (0.9") x 9 mm (0.3") CS303-DB: 102 mm (4.0") x 27 mm (1.0")
Weight	68 g (0.15 lbs)	CS303-FP: 27 g (0.06 lbs) CS303-DB: 43 g (0.09 lbs)

Ordering Information

- CS303-C-1 Controller (included, required to program and recalibrate the CS303-FP or DB)
- CS303-FP-50 Flat pack sensor 50’ lead-in wire
- CS303-FP-100 Flat pack sensor 100’ lead-in wire
- CS303-DB-50 Direct burial sensor 50’ lead-in wire
- CS303-DB-100 Direct burial sensor 100’ lead-in wire
- CS303-L Logic Interface (can be used to increase size of detection zone size with multiple sensors or to set-up AB direction control logic)

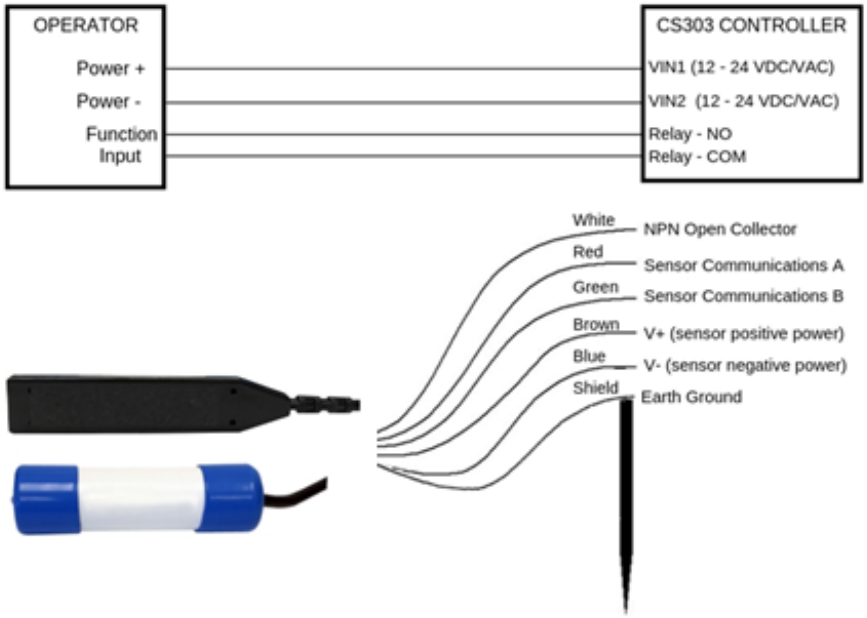


Wiring Connections



Terminal	Description	Sensor Shielded Cable	
VIN1	Power (12-24 VDC/AC)	--	Operator Connections
VIN2	Power (12-24 VDC/AC)	--	
NO	Relay – NO (normally open contact)	--	
COM	Relay – COM (common contact)	--	
NC	Relay – NC (normally closed contact)	--	
NPN Output	Open Collector Output		
NPN Input	Open Collector Input	WHITE	CS303-FP or DB Sensor Connections
RED	Sensor Communications A	RED	
GRN	Sensor Communications B	GREEN	
V+	V+ (sensor positive power)	BROWN	
V-	V- (sensor negative power)	BLUE	
External Earth Ground Wire	Earth Ground	SHIELD	

The shield (bare) wire on the sensor cable should be connected to earth ground to help prevent electromagnetic interference.



Settings & Display

Presence	**DIP Switch 8**
Normal	on
Infinite	off

Infinite presence mode causes the output to remain in detect mode as long as the vehicle remains near the sensor. **Normal** presence mode causes the output to reset after 5 minutes of detection. **Do not use normal presence mode in reversing loop applications.**

Detect-on-Stop	**DIP Switch 7**
DOS On	on
DOS Off	off

The **Detect-On-Stop (DOS)** feature requires that a vehicle must come to a complete stop near the sensor for a minimum of 1-2 seconds before the output activates. **Do not use the DOS feature for reversing loop applications.**

Output	**DIP Switch 6**
Pulse	on
Presence	off

The output feature provides the ability to toggle between pulse and presence mode. When **Pulse** is selected, the output will be activated for approximately 500ms on vehicle entry or exit. When **Presence** is selected, the output will be activated according to the setting on DIP switch 8.

Pulse on Entry/Exit	**DIP Switch 5**
Entry	on
Exit	off

When DIP switch 6 is on (**Pulse**), it will determine if the output relay pulses when a vehicle is entering or exiting the detection zone.

Delay	**DIP Switch 4**
Delay On	on
Delay Off	off

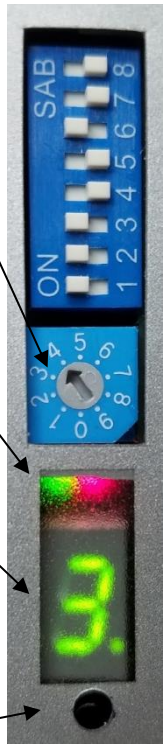
Turning on the **Delay** setting provides a 2 second delay before activating the relay after the sensitivity threshold is met.

Axis Settings	**DIP Switch**		
	3	**2**	**1**
X-axis	on		
Y-axis		on	
Z-axis			on

The CS303 has the ability to detect in 3 dimensions (X, Y, Z axis). In most applications, all three **Axis Settings** should be switched on. For more information on axis settings, see Installation.

Sensitivity Setting

The 10-position rotary switch allows for adjustment of the detection level. The sensitivity level increases from position 0 (lowest setting) through 9 (highest setting). Typical applications require a setting of 3 or 4. Adjusting the sensitivity level applies to all axes. The rotary adjustment must be set to a specific/whole number. There are no half settings. For more information on sensitivity settings, see Installation.



Green & Red LED

The green LED indicates the detector is powered and operational. When the red LED is on, a vehicle presence is detected. When it is off, there is no presence detected.

ULTRAMETER™ Sensitivity Display

The display shows the sensitivity setting required to detect a vehicle near the sensor. To use this feature, observe the display while a vehicle is moving into position near the sensor, note the number displayed, then adjust the sensitivity setting to the displayed position. The display will adjust from 9 for a weak signal to 0 for a very strong signal. During normal operation, when a vehicle is not on or near the sensor, the display is blank. The effects of cross-traffic interference can be observed on the display when the sensing area is vacant.

Sensor Calibration/Reset

Pressing the reset button calibrates the sensor to the local magnetic field. This must be used whenever the sensor is moved from its position or when any DIP switch settings are changed and may be necessary if the sensor's local magnetic environment has changed (see Troubleshooting).

Installation

Read the following list of tips prior to beginning the installation process.
This will save significant time in the long run.

- Every time the settings are changed on the CS303-C-1 or the sensor is moved, press the RESET button on the CS303-C-1.

- The CS303-FP and DB sensors are sensitive to minute changes in the magnetic field around them. Power lines, transformers, and other electrical devices located in the vicinity of the sensor that produce transients could cause disturbances in the magnetic field that may result in triggering the detector. Avoid installation of the sensor near these devices.

- Do not mount on any moving surface, such as bridges or walkways that may vibrate under traffic. The sensor must always be installed in such a way that it remains completely motionless. Any movement will cause the sensor to trigger.

Sensor Installation

1. Determine the location for the CS303-FP or DB sensor installation. **The sensor must be at least 6 feet away from all moving metal**. **The sensor must be installed above rebar.**

2. Tape the sensor and lead to the pavement and connect the sensor to the CS303-C-1 (see Wiring Connections).

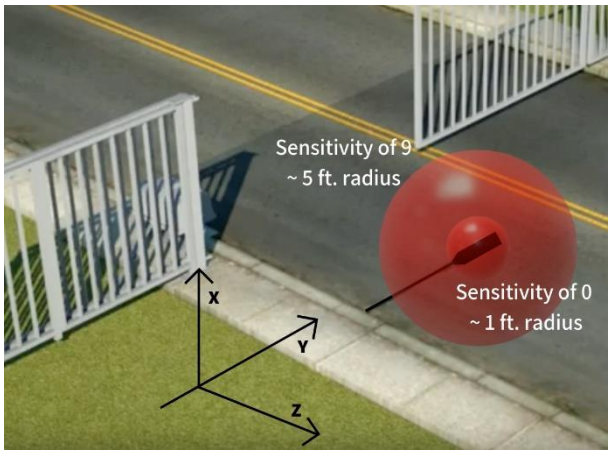
3. Connect the CS303-C-1 to the operator according to the operator's instructions.

4. Configure the DIP switch and sensitivity settings according to preferences (see Settings & Display for more information). **Press the RESET button on the CS303-C-1 after changing settings.**

5. Test the product. Without moving the sensor or the lead going to the sensor, drive a vehicle near the sensor. When the vehicle is five feet from the sensor, "9" will be displayed on the ULTRAMETER™ display. Once the vehicle is the desired distance from the sensor, take note of the number displayed on the ULTRAMETER™ and change the sensitivity setting (10-position rotary switch) to match that number. Move the test vehicle away from the sensor to remove it from the detection zone (the ULTRAMETER™ display should be blank). Press the RESET button on the CS303-C-1 and **do not move the sensor or lead**. Retest the sensor by moving the vehicle into and out of the detection zone to make sure the set-up and location are working as intended.

TIP: The CS303-FP and DB sensors have the ability to detect in 3 dimensions (X, Y, Z axis). In most applications, all three axes should be switched on (DIP switch 1, 2, and 3).

- Note that the CS303-FP sensor allows for the best implementation of the axis settings. The installer knows the direction of all axes because of the flat pack's fixed orientation within the saw cut. (See the axis diagram in the photo.)



- The only known axis for the CS303-DB sensor is the Y axis, which is in the same direction as the lead.
- To find the axis most affected by an unwanted disturbance when using the CS303-DB, perform the following procedure:

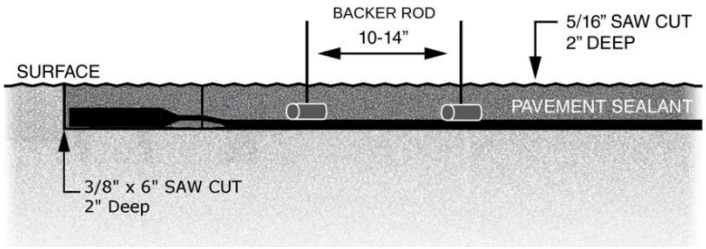
  A. Calibrate the sensor with the disturbance removed.
  B. Move the disturbing object into position.
  C. Select each axis individually, observing the ULTRAMETER™ display for each.
  D. Turn off the axis that causes the *lowest* number to appear due to the disturbance.

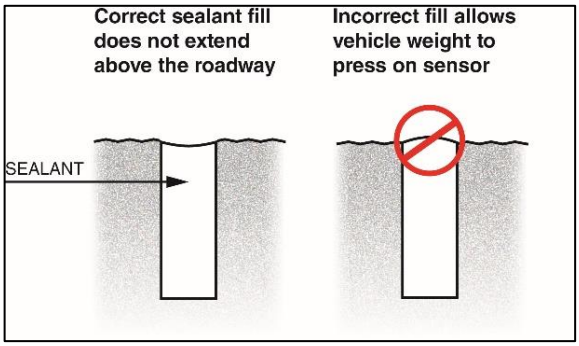
6. After the sensor is working correctly, cut the pavement according to the instructions starting below. Use a hard sealant, such as epoxy, around the sensor. **The sealant fill should not extend above the roadway.** Incorrect fill allows vehicle weight to press on and move the sensor in the concrete, which will cause the sensor to go into detection. **Press the RESET button on the CS303-C-1 once the sensor is in place.**
7. Retest the product to ensure proper detection.

CS303-FP

HORIZONTAL INSTALLATION

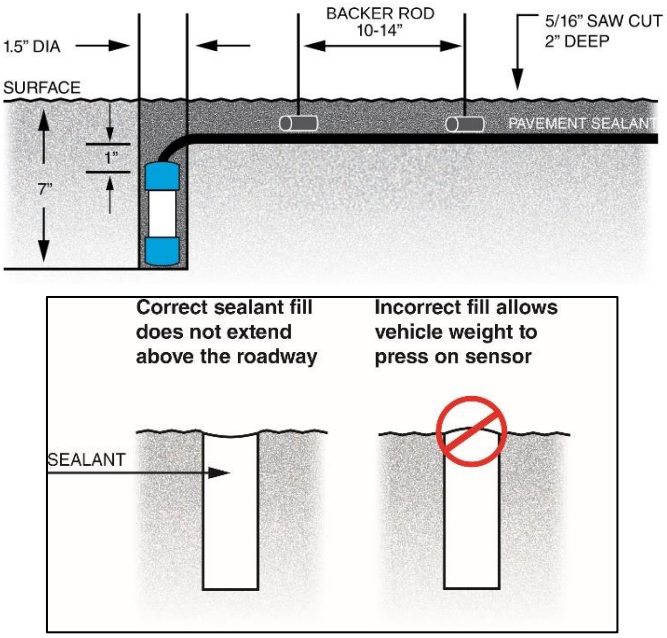
The flat pack requires a 2" x 3/8" x 6" cut in the pavement for the sensor, with a 5/16" x 2" deep saw cut for the cable lead. Backer rod should be place at a minimum of every 10-14". Hard epoxy pavement sealant can then be used to fill the cable and sensor cavities. **Make sure pavement sealant does not extend above roadway surface.**





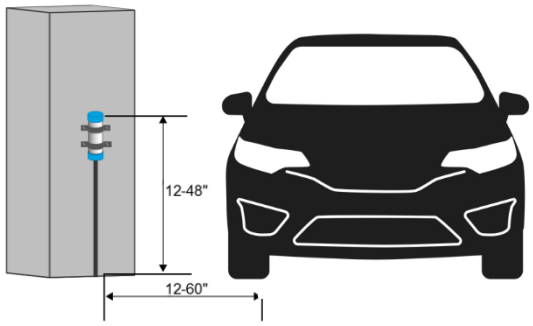
VERTICAL INSTALLATION

For vertical installation, drill a 7" x 1.5" hole in the surface with a 5/16" x 2" deep saw cut exiting the cutout for the communications /power cable. Backer rod should be placed at a minimum of every 10-14". Hard epoxy pavement sealant can then be used to fill the cable and sensor cavities. **Make sure pavement sealant does not extend above roadway surface.**



ABOVE-GRADE MOUNTING

When mounting above-grade, make sure that the sensor is placed at a height to maximize the sensitivity of the detector. This typically means installing it at door level to prevent dropouts. The maximum distance maintained between the sensor and the vehicle should be less than five feet.



Above-Grade Installation

The sensor should be secured to minimize any movement that might provide false detections or dropouts. Consideration should be made to ensure the sensor is not mounted next to moving metal (for example, barrier arm counterweight). Securing the sensor may be accomplished with at least one 1" ID (internal diameter) plastic pipe/conduit strap. If plastic straps are not available, aluminum may be used, but should be placed towards the cable-end of the CS303-DB to avoid sensitivity related issues. The CS303-FP can be secured with cable ties and suitable mounts.

The sensor can be installed inside of any non-ferrous architectural structures, such as fiberglass, plastic, aluminum, etc.

Cabling should be enclosed in conduit to minimize environmental degradation.

Troubleshooting

Symptom	Possible Cause	Solution
No detection	Sensitivity set too low	With a vehicle within the desired proximity, observe the ULTRAMETER™ display to find the minimum sensitivity required for detection.
	Aluminum vehicle (non-ferrous)	The CS303 is detecting changes in Earth's magnetic field caused by ferrous metal. Aluminum is non-ferrous and will not be detected. Aluminum vehicles will need to be much closer to the sensor for steel components on vehicle to be detected.
Red LED on constantly (stuck in detection mode) or ULTRAMETER™ display shows a value when no car is present	Local environmental change (example: high voltage lines, power plants, newly introduced steel in detection field of CS303 sensor), movement of sensor	Recheck wiring. Make sure earth ground is secure and connected to the shield wire on the CS303-FP or DB. Recalibrate the sensor using RESET button and see if problem reoccurs. If the issue is still present, the sensor may need to be moved or adjust an axis setting (DIP switch 1, 2, or 3) and push RESET button to undetect new environmental change.
	Surface sealant is above pavement	If surface sealant projects above the surface of the pavement when a vehicle drives over the sealant, it will push down on the sensor and cause it to move. If the sensor moves, it will be in permanent detection. Remove the sealant and replace it with a hard epoxy sealant that does not project above the surface of the pavement. Recalibrate sensor using RESET button.
	Electromagnetic noise or dirty power	Enabling the detection delay by turning on DIP switch 4 might help alleviate the problem. The system will now have a 2 second delay before activating after the sensitivity threshold is met.
No green LED, red LED or ULTRAMETER™ display on	No power from operator or short circuit in sensor	1. Using a multimeter, check the voltage across VIN1 and VIN2. 2. Unhook the CS303-FP or DB and see if power returns to the CS303-C-1 controller, as indicated by the green LED on. 3. If power returns, replace the CS303-FP or DB sensor.

Symptom	Possible Cause	Solution
Green LED flashes half second on, half second off, “E” “1” flashes on display	Communication failure	1. Check the communications and power wiring to the sensor. 2. Cycle power to the control unit and sensor.
Green and red LEDs flash simultaneously, “E” “2” flashes on display	Insufficient supply voltage	1. Make sure the power supply is working correctly and properly rated (see Wiring Connections). If supply voltage is confirmed to be correct with multimeter and being supplied by operator, consider using a separate power supply, such as 120 VAC to 12 VDC power converter (minimum 100 mA). 2. Disconnect the sensor and see if power returns to the controller, as indicated by the green LED on.
Green LED flashes half second on, half second off, “E” “3” flashes on display	Damaged sensor module	1. Cycle power to the CS303-C-1 controller and check if error code “E” “3” reoccurs. 2. If error reoccurs, replace the CS303-FP or DB sensor.
Green LED slow flash	Previous communication failure	1. Check the connection between the controller and sensor. 2. With no vehicle over the sensor, press the RESET button to clear the error and recalibrate.

Warranty

EMX Industries, Inc. products have a warranty against defects in materials and workmanship for a period of two years from date of sale to our customer.