



REVERSE SMART AEB OPERATING MANUAL.

V1.1 – 26/08/15

Overview of the Reverse Smart AEB?

The Reverse Smart AEB device is designed to reduce the incidents of large vehicles impacting objects or workers whilst reversing manoeuvres are taking place.

The Reverse Smart system is only powered on once a vehicle is placed in reverse gear. When the systems radar sensors detect an object or worker that is within the danger zone behind the vehicle, the unit will immediately and automatically activate the vehicles brakes – without any driver input required.

This device actively protects the vehicle and personnel working at the rear of the vehicle without interfering with the vehicles intended daily operation.

When reversing, the Reverse Smart system uses the Radar sensor to detect objects behind the vehicle. (See Radar Operating Manual Section 2 &3). When objects are within the radars detection zone, the Reverse Smart system automatically applies the vehicles brakes.

How to Use Reverse Smart.

NOTE: The Reverse Smart System is only in operation when the vehicle is in Reverse Gear. The only way to deactivate the entire system it to take the vehicle out of reverse gear.

STEP A

The operator places the vehicle in reverse gear to complete a reverse manoeuvre.

When the Radar has detected an object within the rear danger zone, the Reverse Smart system will automatically apply the vehicles brake. The vehicles brakes will only be held for a short period of time (a matter of seconds). Also in the cabin the visual display and audible proximity alarms (See Radar Operating Manual Section 4) will be alerting the operator to the presence of an object behind.



STEP B

At this stage the operator should do all of the required checks to ensure that there is no objects behind the vehicle. It would be prudent at this stage to take the vehicle out of reverse gear, park the vehicle, and exit the vehicle to complete a manual check of the rear surroundings. Once re-entering the vehicle, and again placing it in reverse gear, the system is once again activated. At this stage the same process as is outlined in STEP A is followed.

STEP C

Once the short period of time outlined in STEP A has elapsed, the vehicles brakes will be released, and the operator will be able to continue the reversing manoeuvre. The operator will still be alerted to the presence of the object behind the vehicle by the visual display and audible proximity alarms.

WARNING: In this scenario the brakes will not be automatically activated again whilst objects detected in STEP A are still being detected by the radar.

For the brakes to automatically apply again in STEP C, any objects would need to be completely cleared from the detection zone – ensuring the visual display and audible proximity alarms aren't sending any warning alarms, and NEW objects would now need to enter the detection zone.

ALTERNATE OPERATION MODE.

If the operator is fully aware of the object behind the vehicle, and does not want the Brakes to automatically apply, then the Braking component of the Reverse Smart system can be put into a timed "Sleep" mode by depressing the LARGE RED BUTTON near the visual display (as shown below). In "Sleep" mode the visual display and audible proximity alarms will still operate whilst the vehicle is in reverse, but the brakes will not be applied under any circumstances, until the "Sleep" mode timer has expired.

"Sleep" mode can be activated at any time during a reversing manoeuvre.

REVERSE "SMART"

Examples of "Sleep" Mode – Large Red Buttons.



FOR OPERATIONAL VIDEO PLEASE SCAN THE QR CODE ON YOUR VEHICLES SUN VISOR OR GO TO www.reversesmart.com.au/training

RADAR OPERATION MANUAL

1 Introduction

Brigade's Backsense® uses FMCW (Frequency Modulated Continuous Wave) radar system technology and is designed to detect people and objects in blind spots, significantly reducing collisions. They detect stationary and moving objects, providing the driver with in-cab visual and audible warnings – alerting the operator whose attention cannot be focused on all risk areas. Backsense® works effectively in harsh environments and in poor visibility including darkness, smoke, fog and dust.

Operators of the vehicle to which the Brigade Backsense® System is fitted must be made fully aware of how to interpret the system so they will not be distracted by or rely completely on it. Distraction can cause collisions.

The system is intended as an aid only. The operator must still concentrate on operating the vehicle, obeying traffic and local regulations and continuing to use his/her own training, senses and other vehicle aids, such as mirrors, as if the system were not in place. Nothing removes the responsibility of the operator to operate the vehicle in a proper and lawful manner.



2. Object Detection Capability

- There is no detection of objects or part of an object closer than approx. 0.3m to the sensor.
- Object detection between approx. 0.3m to 1.3m from the sensor requires a minimum relative speed of around 2km/h between the object and sensor. Same for re- detection of objects after a stationary condition.
- Brigade Backsense® radar beam angle has a 120° horizontal angle out to the maximum designated width. The vertical angle is 12°. Both angles are symmetrically perpendicular to the sensor front surface.
- All dimensions for detection of objects are nominal and vary significantly depending on many parameters. For more details, see section “1.2.2 Factors Influencing the Detection of Objects”.
- An object will cause a detection alert in less than 0.5 second.
- After turning on the power the system takes around 6 seconds to be active. Time from standby to active state is less than 0.2 second.

Notes:

- For distances below 1.3m (detection with relative speed only) or below 0.3m (no detection) the space covered in general by radar systems is very small so this system might not be a suitable solution. Brigade therefore recommends adding a Brigade Backsense® System based on ultrasonic sensing technology, which offers better detection at close ranges as applicable.
- Brigade Backsense® system is not affected if multiple systems are operating in the same area or on the same vehicle, even if they are installed in close proximity with overlapping detection ranges.

Tip: Brigade Backsense® detection is generally better when there is relative speed between the sensor and the objects.



3. Factors Influencing the Detection of Objects

Brigade Backsense® shares in principle the advantages and limitations of all radar-based systems when compared to other sensing technologies. In general, it can reliably detect most objects in most environmental conditions such as dirt, dust, rain, snow, sun, fog, darkness, acoustic noise, mechanical vibration, electromagnetic noise or similar.

However, there are some occasions when an object could stay undetected. Radar works on the principle of line of sight and relies on some of the electromagnetic energy transmitted by the sensor being reflected back from the object to the sensor. If an object does not reflect enough electromagnetic energy back to the sensor it will not be detected.

In the case where there are multiple objects in the detection area at various distances and/or angles, the sensor detects the closest object, which is the most important one for collision avoidance.

The object properties, location and direction are key influences in determining if an object is detected or not. The influencing factors are listed below.

- **Size:** Larger surfaces are detected better than smaller surfaces. If there are small and large objects in the detection area, the smaller object might only register in Detection Zones closer to the sensor.
- **Material:** Metal is detected better than non-metal materials, e.g. wood, plastic.
- **Surface:** A smooth and solid surface is detected better than rough, uneven, porous, fragmented or liquid surfaces, e.g. bushes, brick work, gravel, water.
- **Shape:** A flat object is better detected than a complex shape. Variation in relative location and direction can influence detection significantly.
- **Angle:** An object facing directly towards the sensor (perpendicular, orientation head on to the sensor) is detected better than an object that is located towards the edges of the detection area or at an angle.
- **Distance:** An object closer to the sensor is better detected than one that is further away.
- **Relative speed to sensor:** Detection is better if there is a relative speed between object and sensor.
- **Ground condition:** Objects on flat, mineral material ground are better detected than on rough or metal surfaces.
- **Weather conditions:** Dense dust or very strong rain or snowfall will reduce the detection capability.

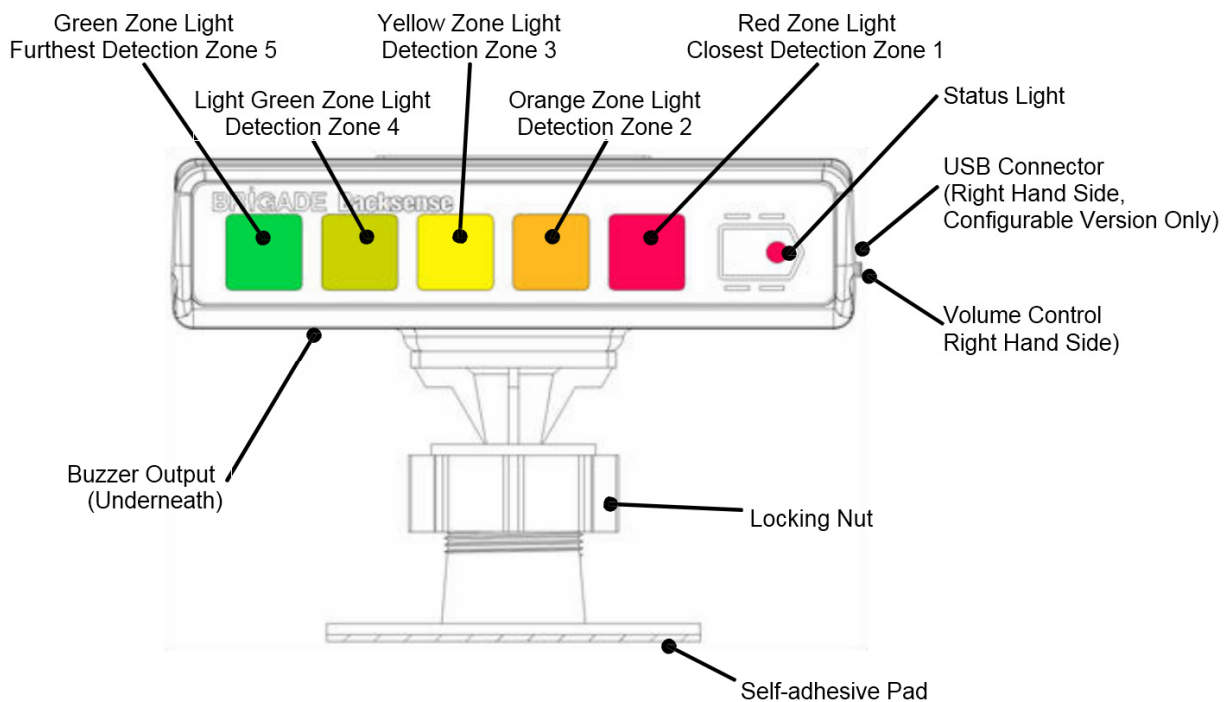
4. Display

The display should be mounted so the vehicle operator has good visibility in all environments and situations. The display should be fixed in a suitable location in line with any current legislation/regulations.

The base is fixed to the display with a keyway locking method and locked with a machine screw. The base can be separated from the display by removing the screw and sliding back and down if the display is used for any flush mounting.

The base has a self-adhesive pad applied for mounting e.g. on the dashboard. Additional drilling and fixing with screws may be required in some applications.

The neck is adjustable in all directions up to 30° and is secured with a locking nut. Locking nut should only be tightened by hand and excessive torque should be avoided. The volume is adjustable from 65 to 90dB measured at 1m distance.





Function	Location	Zone Lights or Status Light flash frequency	Buzzer alert Interval
System off (not powered or Configuration Tool in connected state BS-8000 only)	Status Light	off	off
System power on <u>Self Test</u> (after applying power supply)	all Zone Lights	constant for 1 second	constant for 1 seconds
	Status Light	red / constant for 5 seconds	
System Standby (after <u>Self Test</u>)	Status Light	red / constant	off
System Active and no object detection (via Activation Input)	Status Light	green / constant	off
Detection in Zone 5 (Furthest Detection Zone)	Green Zone Light	constant	1.5 times per second
Detection in Zone 4	Green & Light Green Zone Lights	constant	2 times per second
Detection in Zone 3	Green & Light Green & Yellow Zone Lights	constant	2.5 times per second
Detection in Zone 2	Green & Light Green & Yellow & Orange Zone Lights	constant	3 times per second
Detection in Zone 1 (Closest Detection Zone)	Green & Light Green & Yellow and Orange & Red Zone Lights	constant	constant
System Error occurred with System Active	all Zone Lights	constant for 5 seconds	constant for 5 seconds
	Status Light	red / 1 time per second	
System Error with System Active	Status Light	red / 1 time per second	0.5 seconds, repeated in 5 seconds
System Error with System Standby	Status Light	red / 1 time per second	off



4.1 Initial System Power Up and Test

Once the sensor and display are installed and connected, power should be applied to test correct system operation. On power up, the display will go through its self-test by sounding the buzzer and illuminating the Status Light red and all Zone Lights. After about 5 seconds only the Status Light should show red colour. When the activation input becomes active (e.g. reverse gear is selected to apply power to the activation input) the status light turns green and the system is in detection mode. Check the system is operating correctly in an open area with no obstructions.

If the display indicates an error mode (see section “4 Display”) check section “5 Error States” for possible resolutions.

If any or all of the Zone Lights remain constantly lit, check for any obstruction in the detection area, which may be detected by the sensor, and remove it. If the system is working as described, follow section 6 “Testing and Maintenance”.

5 Error States

If the display shows an error state (see section “4 Display”) check for the following potential issue below. If the error is resolved the display will return automatically after a few seconds and the self test to normal operation.

- Sensor or extension cable not connected.

Action: Check all connectors are plugged together fully.

- No data connection between sensor and display. Action: Check for damage on connectors and cable.
- No power connection to sensor.

Action: Check for damage on connectors and cable.

- CAN communication error with sensor.

Cable is routed or system is installed too close to an electric noise source in vehicle. Action: Try to relocate affected part of the system.

- Data corruption in sensor.

Action: Consult Reseller for advice.

The Brigade Backsense® Systems cannot self-diagnose potential sensor detection issues caused by the build up of ice, dirt, mud, heavy rain or immersion in water, which may impede system performance. Therefore, follow section “6 Testing and Maintenance”



6 Testing and Maintenance

6.1 Operator Instructions

This information is addressed to the operator of the vehicle where a Brigade Backsense® System is installed:

- 1) The Brigade Backsense® is intended as an Object Detection System and should not be relied upon as your primary defence for the safe operation of the vehicle. It is an aid to contribute in conjunction with other established safety programs and procedures to ensure a safe operation of the vehicle in relation to surrounding persons and objects.
- 2) Testing and inspection of the system should be carried out in accordance with this manual. The driver or operator is responsible for ensuring the Brigade Backsense® System is working as intended.
- 3) Operators using this equipment are strongly recommended to check the system's proper operation at the beginning of every shift.
- 4) Improved safety depends on the proper function of this product in conformance with these instructions. It is necessary to read, understand and follow all instructions received with the Brigade Backsense® System.
- 5) The Brigade Backsense® System for object detection is intended for use on commercial vehicles and machinery equipment. Correct installation of the system requires a good understanding of vehicle electrical systems and procedures along with proficiency in installation.
- 6) Store these instructions in a safe place and refer to them when maintaining and / or reinstalling the product.

6.2 Maintenance and Testing

This information is addressed to the operator for maintenance and testing of a vehicle with the Brigade Backsense® System installed. This is also to familiarise the operator with the detection area and behaviour of the system. More frequent inspections should be performed in cases where:

- The vehicle is operating in a particularly dirty or harsh environment.
- The operator has reason to suspect the system is not working or has been damaged



Procedure:

- 1) Clean the sensor housing of any accumulation of dirt, mud, snow, ice or any other debris.
- 2) Visually inspect the Sensor and Display and verify that they are securely attached to the vehicle and are not damaged.
- 3) Visually inspect the system's cables as well as possible and verify that they are properly secured and not damaged.
- 4) The location of the test should ensure the area in front of the sensor is clear of obstacles and is larger than the detection range of the installed Brigade Backsense® System.

If any of the following tests fail, follow the fault finding guidance in section "4 Initial System Power Up and Test" of the installation guide.

For the following tests, the operator requires objects to be placed in the detection area or an assistant (to observe the display indications).

- 5) Activate the Brigade Backsense® System (ensure the vehicle cannot move) and verify the Status Light is illuminated constant green on the display within less than 7 seconds.
- 6) If the display shows any of the 5 Zone Lights activated, this indicates there are likely to be one or more objects in the detection area interfering with the test. Move the vehicle to a clear area and proceed.
- 7) Verify each detection zone's distance: Starting from the outside of the detection area, the operator should check several points along the centre line of the detection width down to around 0.4m distance from the sensor. The display should show the detection alerts via the lit Zone Lights, the buzzer pulsing speed and, if the trigger output is used, the connected device or function. The operator should note down the distance at which each detection zone is activated and if it is in line with the installed system or the configuration for this vehicle.
- 8) Close detection behaviour: Verify objects in between 0.3m and 1.3m distance are only detected if they move relative to sensor. All Zone Lights except for red should be constantly active. The red colour Zone Light should stay active for systems covering more than 1.1m distance with the closest detection zone 1.
- 9) Very close detection awareness: Verify objects less than 0.3m from the sensor are not detected. All the Zone Lights and buzzer output should switch off after less than 3 seconds with only the Status Light remaining illuminated constant green.
- 10) Similar to the previous tests the operator should scan all the edges of the detection area according to the installed system or configuration for this vehicle. He should note down the detected locations and check if they match with the detection area set when this Brigade Backsense® System was installed on this vehicle.

END OF REVERSE SMART USER MANUAL.