Project Documentation | UMRR Automotive Sensor Data Sheet

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1 Sensor Data Sheet

Smartmicro offers a family of traffic Radar sensors called UMRR – Universal Medium Range Radar.

A number of different antennas are available - so the permanent fixed field of view and max. range can be selected by the customer.

This data sheet describes the type 31 antenna model (all model specific values are highlighted).

Type 31 Antenna aims at short range with very wide horizontal angular coverage.

Figure 1: Automotive Sensor Type 31 – front and rear view.

Also available:

- Other versions of the housing for OEM integration.
- Other solution for connector and cable stump.
- Other physical interface options.

For more details please contact us.

1.1 General Performance Data

Parameter	Value	Unit
Sensor Performance		
Max. Range on Pedestrian	20[I]	m
Max. Range on Passenger Car	45[I]	m
Minimum Range	1[VI]	m
Range accuracy	Typ. < ±2.5% or < ±0.25m (bigger of)	%, m
Radial Speed Interval	-20 …+20[V]	m/s
Minimum abs. Radial Speed	0.1	m/s
Speed accuracy	Typ. < ±0.28	m/s
Angle Interval (total field of view)	-8 …+8 (El.); -50 …+50 (Az.)[II]	degree
Update time	<= 50	ms
Environmental		
Ambient Temperature	-40 ... +85	degree C
Shock	100	g_{rms}
Vibration	14	g_{rms}
IP	67	
Pressure / Transport altitude	0…10.000	m
Mechanical		
Weight	295	g
Dimensions	See 1.7	
Model No.	**0A0601-1F0600**	
DSP Board – Antenna Identification	0A0601-1F0600	
Housing Identification	030600	
General		
Power Supply	7 ... 32[III] 3.7	V DC W
Frequency Band	24.0…24.25 FCC15.245, EN300440 compliant	GHz
Bandwidth	< 100	MHz
Max. Transmit Power (EIRP)	20	dBm
Interfaces	CAN V2.0b (passive)[IV] RS485 half-duplex	
Connector	8 Pin plug Binder Series 712	CAN, Power, RS485

[I] Typical values; may vary to higher or lower values depending on clutter environment. All values given for bore sight. Please note that the Radar system – like any other sensor system – although being well optimized and providing excellent performance, will not achieve a 100% detection probability and will not achieve a false alarm rate equal to zero.

[II] Total field of view is angle interval where reflectors can be detected; 3dB field of view is narrower.

III measured at connector; min. voltage slew rate 500V/s or max. voltage rise time 15ms; supply source impedance 0.5Ohms.
IV Also available: Ethernet, Relay contacts, see interfaces. It is recommended to use an external surge protection for power, CAN, RS485 and other interface ports.
V Interval may be increased depending on s/w configuration and/or application specific.
VI Presence detection below is available. Minimum range may be reduced customer specific depending on local frequency regulations.

1.2 Applications

The sensor is perfectly suited for all kind of blind spot detection (**BSD**) applications. Secondly it can be applied for short range (vehicles maneuvering at slower speed) collision warning (**CW**) applications. Generally it is very versatile and can be used for other purposes as well - stand alone or in a network (see also section 2). Typical applications are listed below.

Automotive OEM applications:
In such applications one or multiple sensors are specifically integrated into vehicle models of automotive OEMs – carmakers. Usually there is a specific engineering effort required for the adaptation to specific vehicle models and the rigorous test procedures which will be applied. Customer specific CAN interfaces, warning algorithms or other custom software packages can be included.

Examples:
- Blind Spot Detection (**BSD**).
- Rear and front Cross Traffic Alert (**CTA**).
- Warning to open door if object approaches from behind.
- Rear and side **Pre-Crash**/**Pre-Safe** applications.

General applications:
Based on the **object list** (see section 1.3) as a generic data interface a number of applications are possible. A selection is listed below. Please note that these applications can either be made part of the software embedded in the sensor or can be implemented by the customer:

Examples:
- Blind spot detection (**BSD**)
- Front, rear and side Collision Warning (**CW**), 360degree collision warning
- Reverse collision warning

Applications:
- Construction vehicles
- Mining vehicles
- Waste trucks
- Utilities vehicles
- Robotics and autonomous driving vehicles

The key feature is the capability of the sensor to measure range and angle of multiple targets simultaneously. This enables high performance for many applications, see 2.3.

1.3 Function Description

The sensor is a small, lightweight, very robust low cost 24GHz Radar for automotive applications. It is intended for the applications listed in section 1.2 and can be used almost worldwide in this frequency band.

It works in adverse conditions, almost unaffected by weather, and independent of sunlight, in a wide temperature interval. The radar withstands high shock and vibration levels, is maintenance free and made for a long lifetime.

The customer can select from a number of antennas that determine the permanent fixed field of view and range. Type 31 Antenna aims at short range with very wide horizontal angular coverage (see section 1.4).

Using a patented transmit signal waveform, each individual sensor measures range, radial speed and angle, reflectivity and other parameters of multiple stationary and moving reflectors (**targets**) simultaneously. Having multi target capability, the sensor will report many reflectors at a time being within the field of view (**target list**):

- Range
- Angle
- Radial Speed
- Reflectivity
- Other…

Additional filter algorithms are implemented for the tracking of all detected reflectors over time, those tracking algorithms are integrated in the sensor. Multiple **objects** are tracked simultaneously; the individual reflectors are separated in the detection algorithms by having a different radial speed value and/or different range value, as well as by the tracking algorithms and data base. The result of the tracking is an **object list** with the following parameters:

- x position
- y position
- x component of the velocity
- y component of the velocity
- other…

Finally based on all detected targets and tracked objects in the field of view a function/application algorithm can be implemented, like a **blind spot warning** or **collision warning** signal.

Hence the sensor reports such a list of all tracked objects, including stationary objects, inside its field of view in every measurement cycle of typ. 50ms length.

In addition to that, status and diagnose data from the sensor are reported.

1.4 Antenna Field of View

The figures below show typical single and multiple sensor configurations for rear collision warning or blind spot detection.

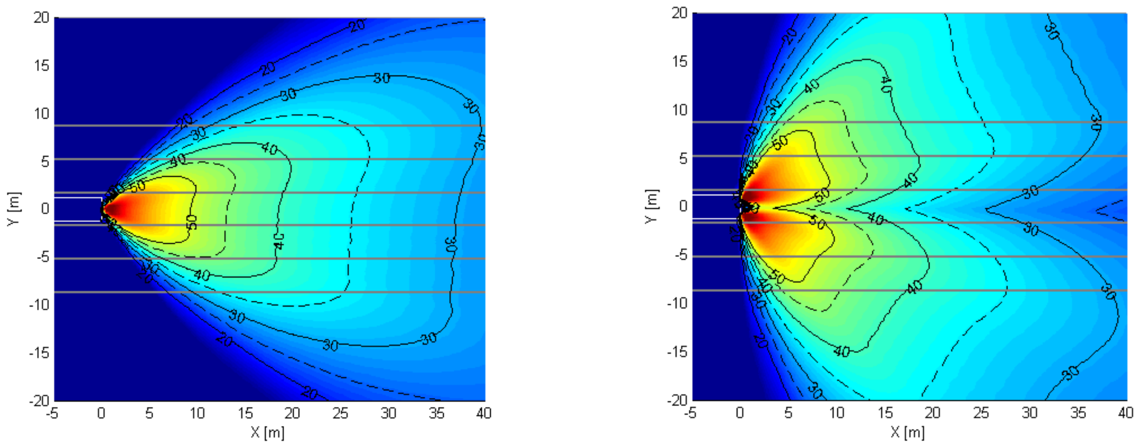

Figure 2: Single sensor and dual sensor configuration field of view for rear collision warning.

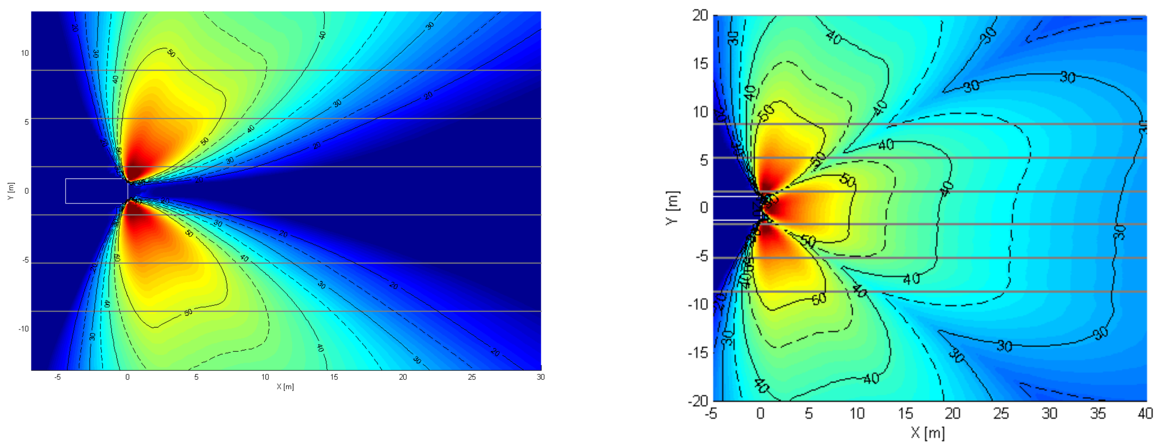

Figure 3: Dual sensor blind spot detection and triple sensor configuration for BSD plus rear collision warning.

1.5 Application Parameters

Feature	Details
Track (object) initialization time	6...10 cycles typical
Simultaneous Object Tracking	Up to 32 objects (single sensor) Up to 128 objects (typ., multi sensor system)
Mounting Height	0,3...3[I]
Sensor az. mounting angle on vehicle	any
Sensor elevation mounting angle	+3…-5 degree to ground[II]

[I] May affect max. detection range. The best performance for the applications listed in 1.2 is typically achieved for mounting heights between 0.4…0.8m, sensor looking parallel to ground plane (driving plane).
[II] Smaller angles allow longer detection range along a road.

1.6 On-board diagnostics (BIT)

The UMRR sensor cyclically reports a status message providing the following information (Continuous BIT)

- Sensor run time
- Sensor cycle time
- Sensor mode
- Other status bits

Initiated BIT is available. Sensor will send BIT results when it receives a command to do so.

1.7 Sensor Dimensions

All values given in mm.

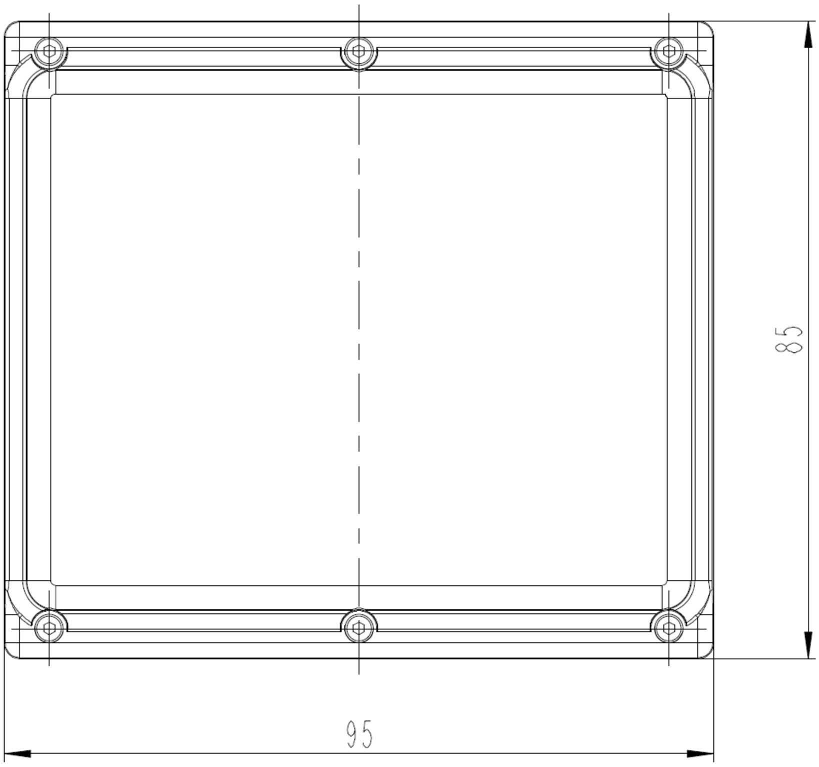

Figure 4: Sensor Front Side

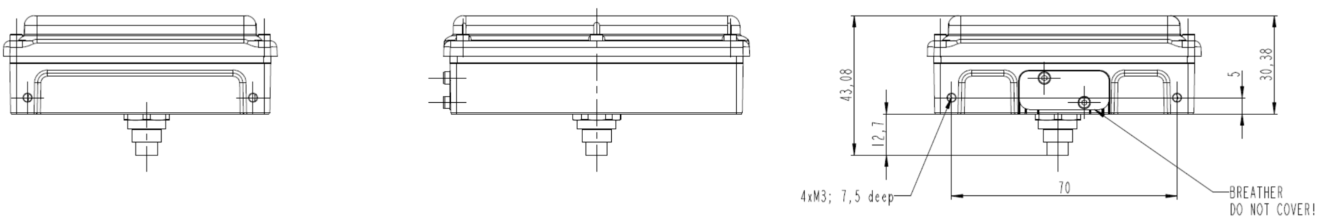

Figure 5: Sensor Left, Top and Right Side

Also available:

- Other versions of the housing for OEM integration.
- Other solution for connector and cable stump.
- Other physical interface options.

For more details please contact us.

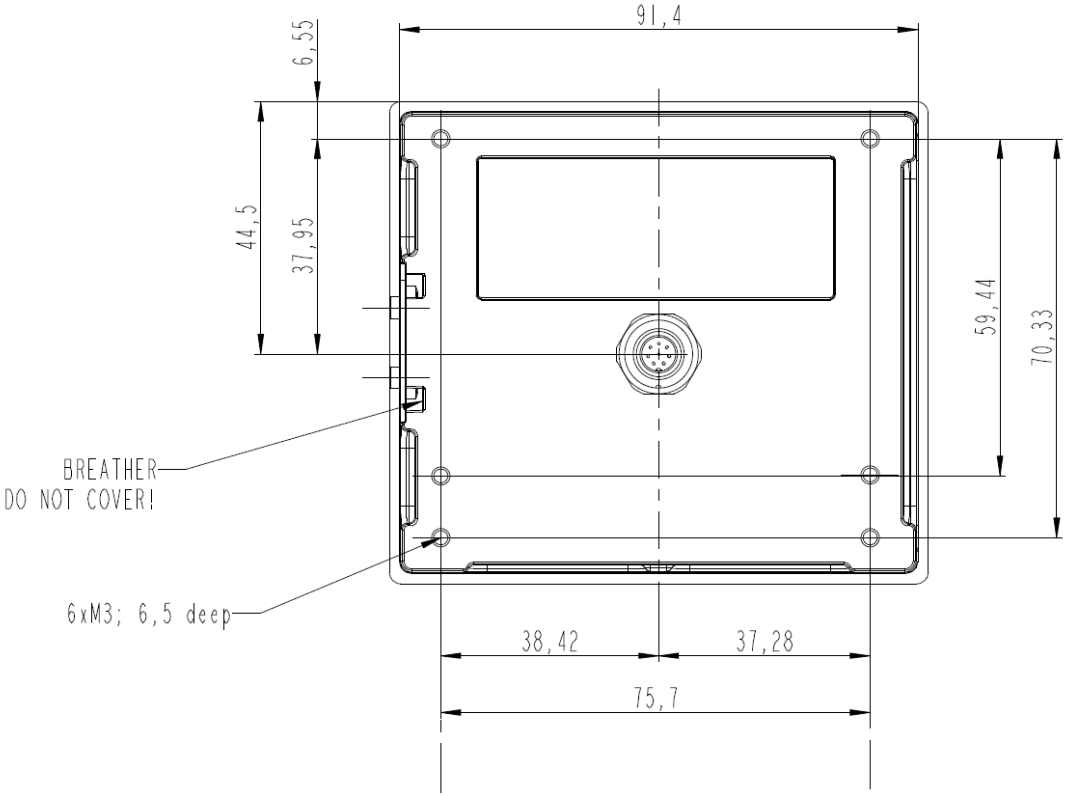

Figure 6: Sensor Rear Side

1.8 Connector

The used sensor connector is an 8-pin male circular connector (water proof IP67, series 712, manufacturer Binder GmbH, Germany). A female counterpart has to be used to connect to the sensor. The pin numbering of the female connector is shown in Figure 7 the pin out of the connector is shown in Table 1.

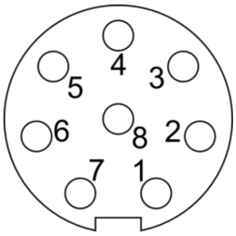

Figure 7: View on solder cup side of socket (rear view of female counterpart to be connected to sensor)

Pin	Function	Wire color
1	RS485 L	Pink = RS_485_L
2	Ground	Blue = GND
3	RS485 H	Grey = RS_485_H
4	CAN_L	Yellow = CAN_L
5	CAN_H	Green = CAN_H
6	not connected	Brown = n.c.
7	+7V…+32V	Red = Vcc (+7V…+32V)
8	not connected	White = n.c.

Table 1: Sensor connector pin out Model UMRR-0Axxxx, UMRR-0Bxxxx

Please note that in the standard configuration the sensor has no 120Ohms resistor on board (CAN bus termination between CAN_L and CAN_H). The resistor is nevertheless required at either end of a CAN bus and is in most cases integrated in the cable delivered along with the sensor (if cable is manufactured by Smartmicro).

2 Multi Sensor Systems

2.1 Configurations

The sensor may be used standalone or multiple sensors can be connected in a network. Such networks are only possible using CAN interface (not possible via RS485, Ethernet, WiFi). Networks work plug and play, free of mutual interference.

A network of multiple sensors can be established by connecting to a sensor data fusion and tracking controller (see Figure 8, read data sheet), or using two sensors in a master slave setup (see Figure 9).

In all configurations, the detection algorithms are run on the sensor (output data: **target list**). In single sensor configuration and in master-slave configuration, the tracking and function/application algorithms are also embedded in the sensor (output data: **object list** plus **functional/application results**). In a configuration with more than two sensors in a network, the sensor data fusion and tracking controller will accomplish tracking and function/application algorithms.

Customer specific configurations are possible.

2.2 Data logging and visualization tools

Visualization of all data (i.e. **target lists, object lists**, other) is possible using the Drive Recorder software on any PC, as well as data logging, associated video documentation, play back and analysis functions and more.

Instead of the Drive Recorder, other customer specific visualization, logging, or function/application software products may be applied; the radar system's data interface is easy to integrate.

2.3 Additional Information

For more information on Smartmicro automotive Radars see also:
Automotive sensor system architectures.pdf
ACC and S&G technical Information.pdf
LCA and BSD Technical Information.pdf
Blind Spot Detection Function description.pdf

2.3.1 Front cross traffic alert (CTA) configuration with tracking controller

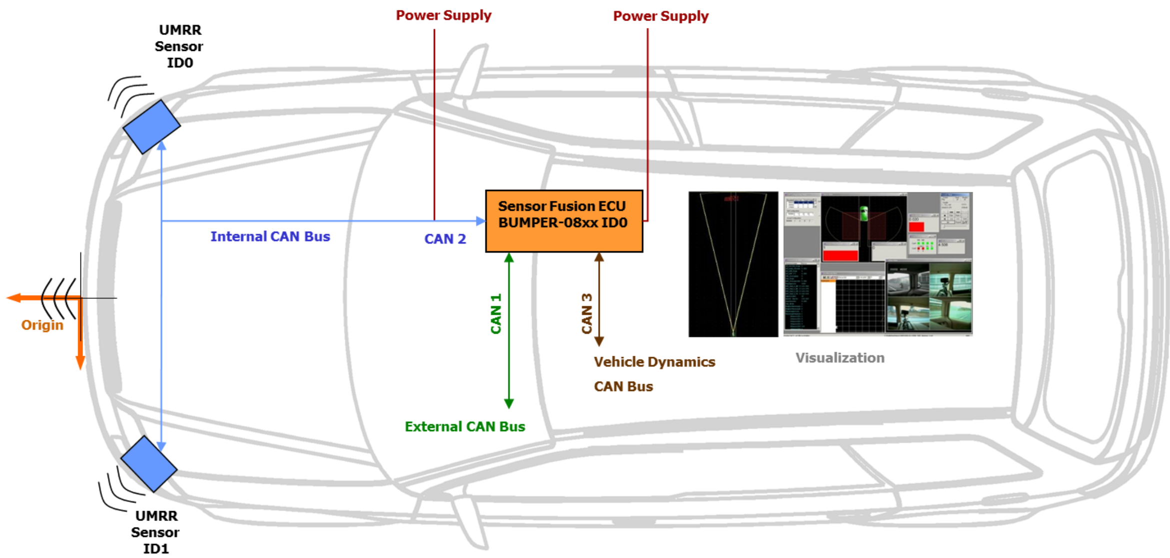

Figure 8: Front cross traffic alert (CTA) configuration with tracking controller.

2.3.2 Typical Sensor Setup for blind spot detection (BSD) and rear cross traffic alert (CTA).

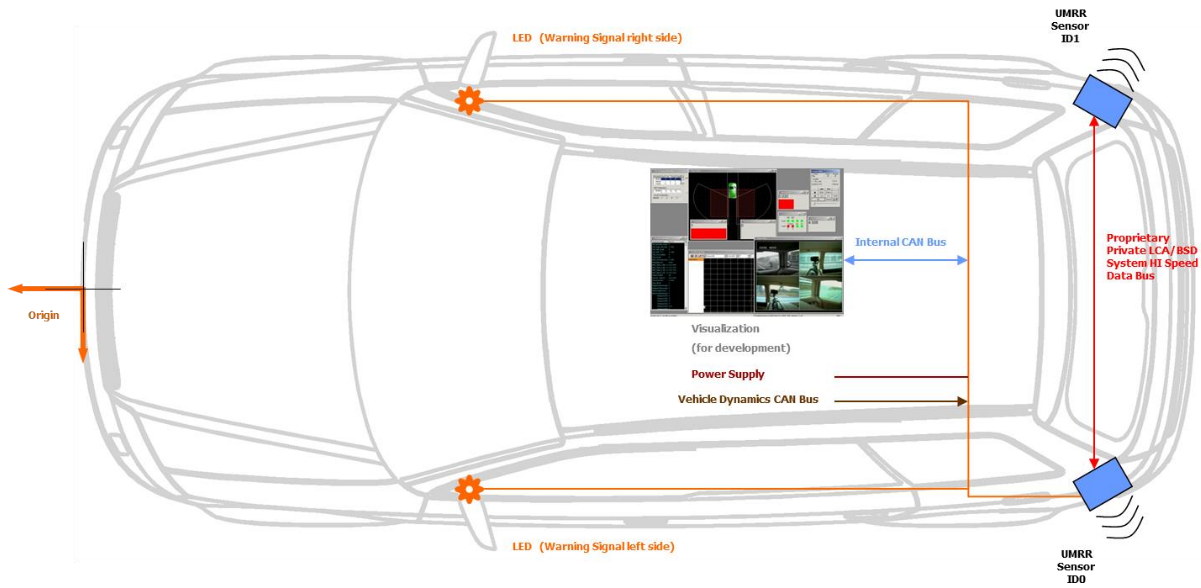

Figure 9: Typical Sensor Setup for blind spot detection (BSD) and rear cross traffic alert (CTA).

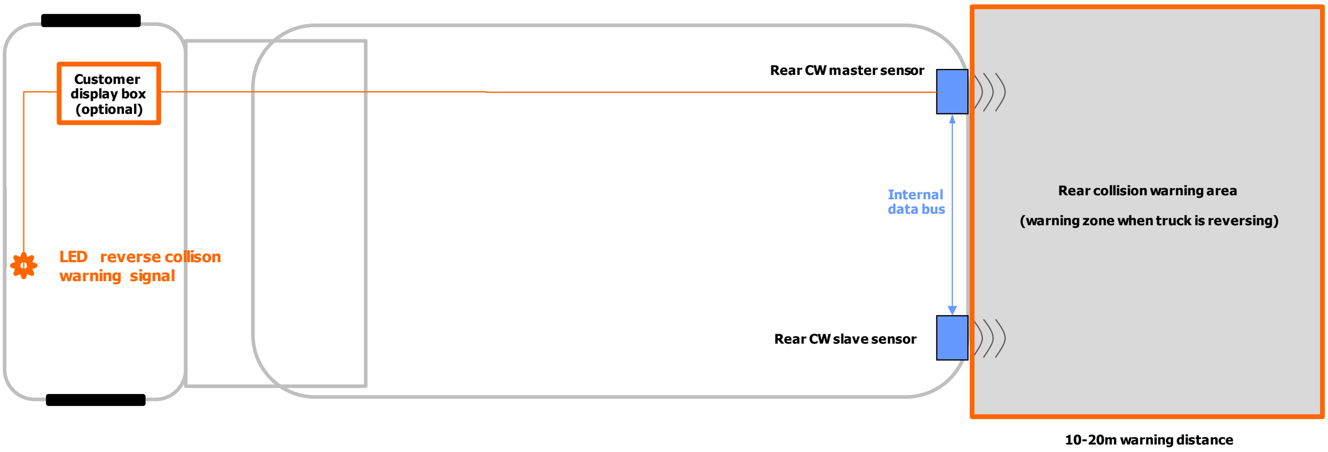

Figure 10: Truck application: rear collision warning for reversing truck.

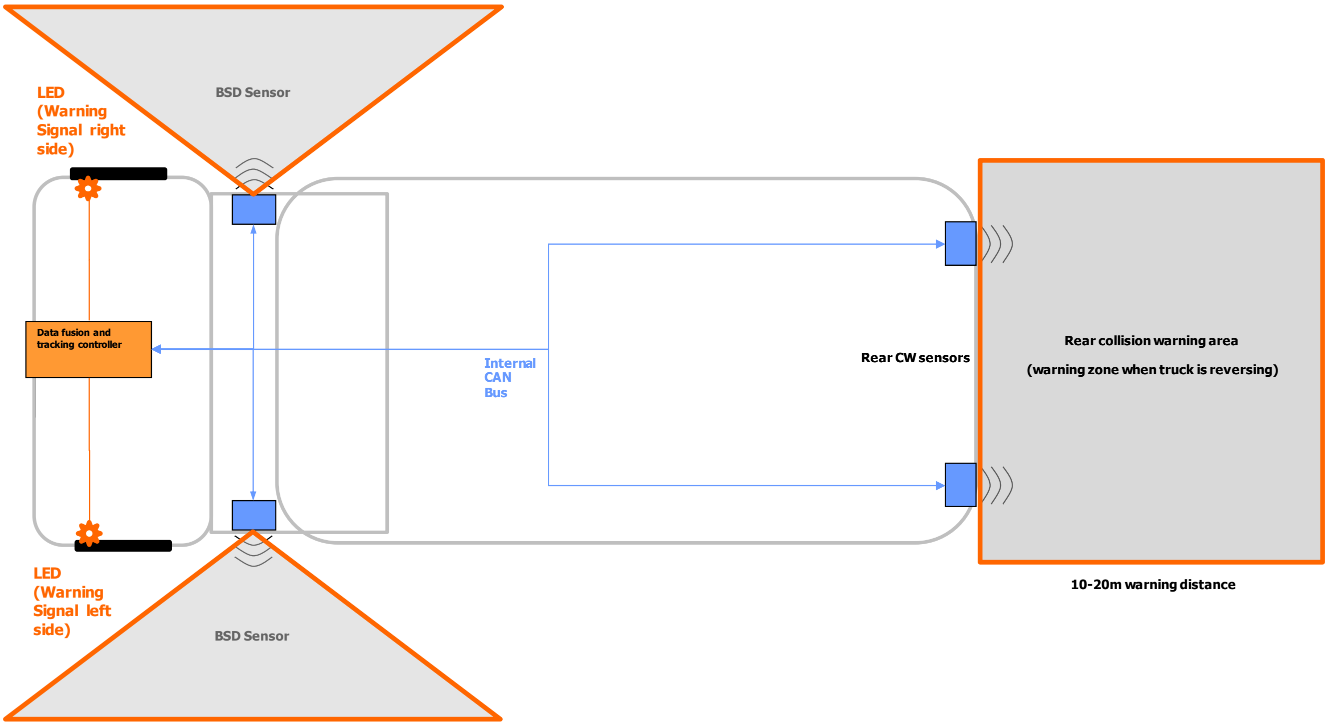

Figure 11: Truck application: blind spot detection and rear collision warning combined.

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