

Project Documentation | UMRR Automotive Sensor Data Sheet

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Automotive Radar Sensor

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1 User Safety Warning Information

Read the instructions carefully before you start to work.

Installation

Please observe the following advices when installing and connecting the sensors:

- Only use provided or approved equipment for installation. Use stainless screws with metric thread M3x8. Screw length must be adapted if the customer uses own brackets.
- Only skilled and instructed persons shall install and connect the devices. Proper experience in working with mains voltage, electrical and electronic devices is required.
- **Don't connect the devices directly to mains voltage, instead** use the voltage given in the manual.
- **Don't wire any connections while power is applied to the device.**
- Ground the devices carefully to prevent electrical shock.
- All connectors are pin-coded and fit in only one position. Also note the arrows indicating the top side of the sensor.
- Only use fully functional equipment (ladders, aerial work platform, ...) **when working** above ground. Staff shall be capable of working at heights.
- Use caution when installing the devices on or around active roadways. Pay attention to moving traffic.
- Mount the devices carefully to prevent them from shifting or dropping.
- The devices must be mounted to a stiff and solid support. Vibration, oscillation or any kind of movement will reduce the sensor performance.
- Make sure that your installation methods are in accordance with local safety policy and procedures and company practices.

Technical service

Only use provided or approved equipment for operation.

Persons other than authorized and approved electrical technicians shall NOT attempt to connect this unit to a power supply, Traffic Management Interface Board and/or other controllers, as there is a risk of electrical shock by unsafe handling of the power source.

Do not attempt to service or repair this unit.

- No user-maintainable parts are contained within the device.
- To avoid electrical shock, do not remove or open the cover.
- Unauthorized opening will void all warranties.
- Smartmicro is not liable for any damages or harms caused by unauthorized attempts to open or repair the device.

Radiation

This product has been tested and found to comply with Part 15 Subpart C of the Federal Communications Commission (FCC) or the European RED directive, or other national rules, depending on the country where it may be in use.

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Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This device generates radio frequency energy.

There are strict limits on continuous emission power levels. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

- Human exposure to transmitted waves from this device is generally considered as safe.
- Nevertheless, it is considered good practice that humans are not subject to higher radiation levels than necessary.
- This device may interfere with other devices using the same frequency band.

Operation

Transmission of radio frequency waves starts after the sensor is powered up and stops when disconnecting it from power.

Using a JBOX or SRO does not influence sensor performance.

For testing purposes, the sensor may be laid on its face when it is powered up, given that the surface or connectors will not be damaged by doing so. Please note that this position is not intended for permanent use.

It is recommended that only one connection interface is used at a time.

Do not operate the device if the device itself or any cables are damaged.

The sensors may become hot during operation, so proper hand protection is recommended for maintenance work.

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2 Sensor Data Sheet

Smartmicro offers a family of automotive Radar sensors called UMRR – Universal Medium Range Radar. Within this family, different Radar generations exist: UMRR-0A, UMRR-11, UMRR-8x and UMRR-0C.

UMRR-11 is a High Definition, multi-object tracking automotive Radar and features **4D/HD** capabilities.

For each Radar generation, 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 UMRR-11 Type 44 antenna model (all model specific values are highlighted).

Type 44 Antenna aims at medium range with wide horizontal angular coverage.



Figure 1: Automotive sensor type 44 – 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](#).

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2.1 General Performance Data

Parameter	Value	Unit
Sensor Performance		
Max. Range on Pedestrian	55 ^I (@20dBm) / 42 ^I (@12.7dBm)	m
Max. Range on Motor Bike	80 ^I (@20dBm) / 60 ^I (@12.7dBm)	m
Max. Range on Passenger Car	120 ^I (@20dBm) / 85 ^I (@12.7dBm)	m
Max. Range on Truck	180 ^I (@20dBm) / 120 ^I (@12.7dBm)	m
Instrumented Range	180	m
Minimum Range	1	m
Range accuracy	Typ. < ±1% or < ±0.25m (bigger of)	%, m
Radial Speed Interval	-88.8...+88.8	m/s
Minimum abs. Radial Speed	0.0	m/s
Speed Discrimination	0.35	m/s
Speed accuracy	Typ. < ±0.28m/s or ±1% (bigger of) ^{II}	m/s
Angle Interval (total field of view)	-12 ...+12 (El.); -40 ...+40 (Az.)^{III}	degree
Angle Accuracy (Az.)	≤0.5	degree
Update time	< 75	ms
Environmental		
Ambient Temperature	-40 ... +85	°C
Shock	100	G _{rms}
Vibration	14	G _{rms}
IP	67 ^{IV}	
Pressure / Transport altitude	0...10.000	m
Mechanical		
Weight	340	g
Dimensions	See Section 1.8	
Model No.		
DSP Board – Antenna Identification	11xxxx-2Cxxxx	
Housing Identification	050Bxx	
General		
Power Supply	8 ... 32 ^V < 5 ^{VI}	V DC W
Frequency Band	24.0...24.25	GHz
Bandwidth	< 250	MHz
Max. Transmit Power (EIRP)	<12.7 / <20 depending on country	dBm
Interfaces ^{VII}	CAN V2.0b (passive) RS485 full-duplex, 10/100 Ethernet	
Connector	12 Pin plug Hirose LF10WBRB-12PD	CAN, Power, RS485, Eth.

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^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} Measured on object having const. radial speed, at bore sight.

^{III} Total field of view is angle interval where reflectors can be detected; 3dB field of view is narrower.

^{IV} IP 67 only when connector or cap attached.

^V measured at connector.

^{VI} Power consumption at 20°C.

^{VII} It is recommended to use an external surge protection for power, CAN, RS485, Ethernet and other interface ports.

2.2 Applications

The sensor is very versatile and can be used for all kind of 360 degree short- and medium range applications.

The sensor is especially well suited for all kind of short- and medium range collision warning (CW) applications for **autonomous driving**.

One or multiple sensors are specifically integrated into vehicle models of automotive OEMs. Usually there is a certain OEM-specific engineering effort required for the adaptation to specific vehicle models and the test and qualification procedures to be applied. Customer specific connectors, CAN(FD)/Ethernet interfaces, tracking algorithms, warning algorithms or other custom software packages can be included.

Examples:

- Forward collision warning (**FCW**).
- Rear collision warning.
- Front and rear **Pre-Crash/Pre-Safe** applications.
- Adaptive cruise control (**ACC**) with Stop & Go handling.
- Traffic jam assist.

Applications:

- Passenger cars
- Buses
- Trucks
- Robotics and autonomous driving vehicles

Functional Safety:

This sensor can optionally be compliant to ASIL Level B in customer specific projects (requirements and safety concept to be agreed between OEM and smartmicro).

AUTOSAR:

This sensor can optionally be offered with AUTOSAR compliant software in customer specific projects (specification to be agreed between OEM and smartmicro).

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2.3 Function Description

The sensor is a small, lightweight, very robust low cost 24GHz Radar for automotive applications. It is intended for multiple applications 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.

Using a patented transmit signal waveform, each individual sensor measures range, radial speed, azimuth and elevation 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
- Az. and El. Angle
- Radial Speed
- Reflectivity
- **Other...**

Additional (optional) filter algorithms are implemented (for certain applications) 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 and/or by different az. angles, 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 optionally be implemented, like a **collision warning** signal.

Hence the sensor optionally reports such a list of all tracked objects, including stationary objects, inside its field of view in every measurement cycle of typ. 75ms length.

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2.4 Object Separation Performance

UMRR-11 features the latest technology automotive radar sensors: **4D/HD**. For each reflector, there is a true **4D** measurement of range, Doppler, azimuth and elevation angle.

UMRR-8F can accomplish range gate specific and even angular gate specific detection of moving and even stationary vehicles. In each of these gates a separate Doppler detection is possible, including stationary detectors.

The sensor provides excellent target separation (HD). Individual reflectors are separated in the detection algorithms by:

- a) having a different radial speed value **OR**
- b) having a different range value **OR**
- c) (optional) having a different azimuth angular position.

Optionally tracking algorithms and data base further support the separation of objects.

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2.5 Field of View

The sensor features one single straight antenna.

Straight antennas have their max. range at bore sight. A typical configuration is shown below.

The figures below show typical multiple sensor automotive configuration with a field of view for front and rear collision warning.

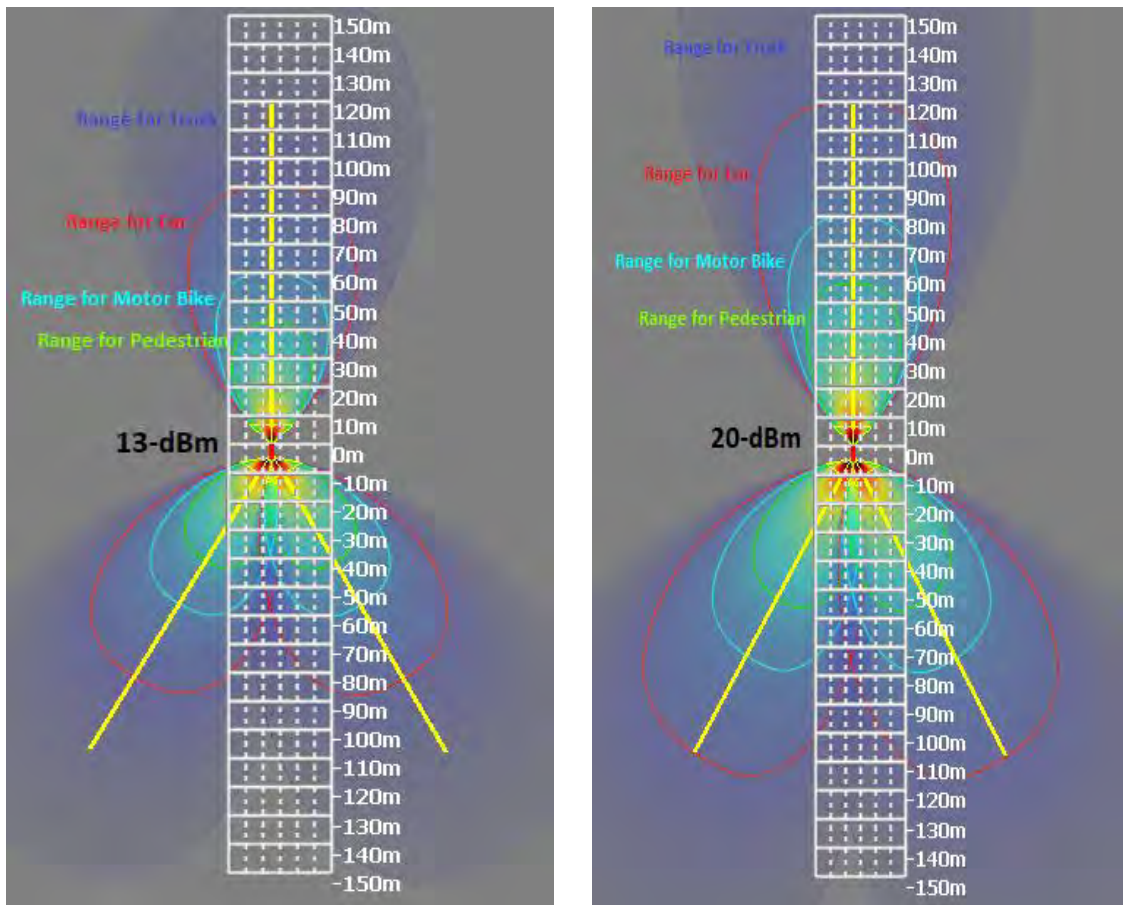


Figure 2: Three sensor configuration, one central at the front and two at rear corners.

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2.6 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.

2.7 Ethernet Connection

The sensor supports point-top-point connection or connections via switches inside an intranet. Connections involving the world wide web are not natively supported.

2.8 Compliance

EU RED directive,
ETSI EN 300-440,
FCC part 15,
RSS-310,
RSS-210,
SRRC,
KCC,
NCC
CE
ROHS

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2.9 Sensor Description and Hardware ID

Every UMRR sensor housing is tagged with a type sticker containing the product description and the serial number. It also contains a mark which side of the sensor is top.

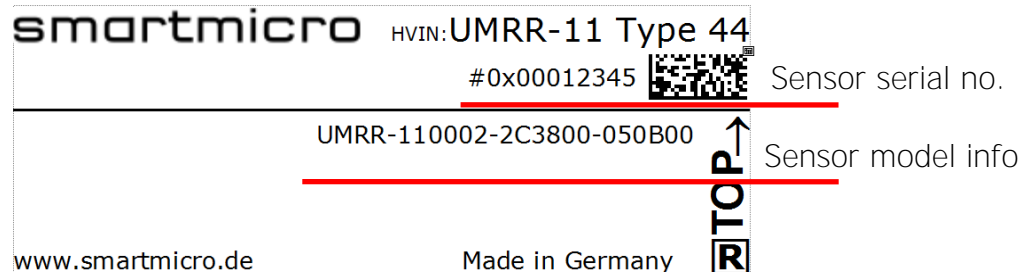


Figure 3: Type sticker example

The individual sensors are referred to as **UMRR-xyyyzz-aabbcc-ddeeff**

- xx** (DSP Board Generation xx)
- yy** (DSP Board Derivative/Version yy)
- zz** (DSP Board Revision zz)

- aa** (RF Board (Antenna) aa)
- bb** (RF Board Derivative/Version bb)
- cc** (RF Board Revision cc)

- dd** (Housing type dd)
- ee** (Housing Version ee)
- ff** (Housing Revision ff)

UMRR means Universal Medium Range Radar platform developed by Smartmicro.

The number in the top right corner is the unique serial number of the sensor. In addition to that the used DSP board and the RF board got their own unique serial numbers.

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2.10 Sensor Dimensions

All values given in mm.

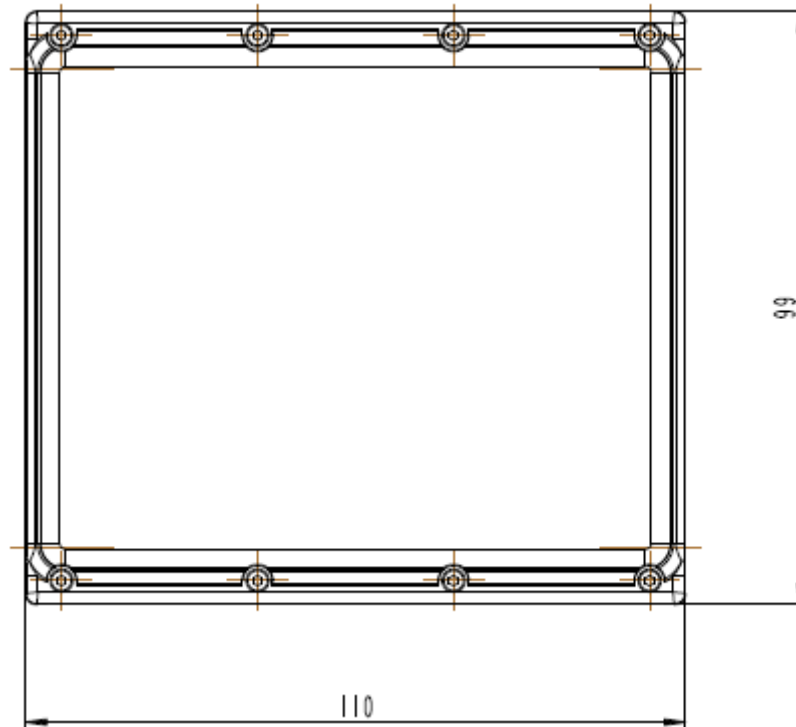


Figure 4: Sensor Front side.

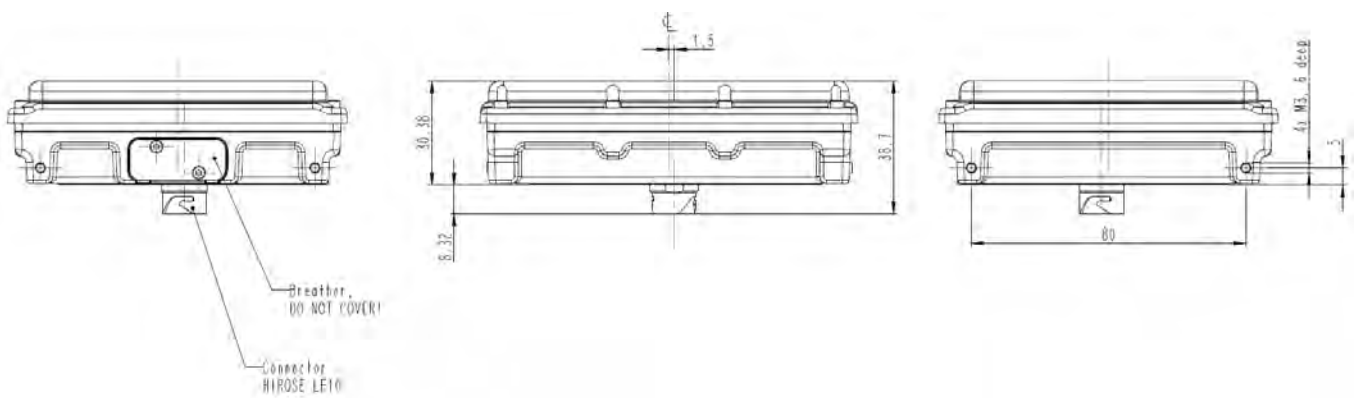


Figure 5: Sensor Top, Left and Right Side.

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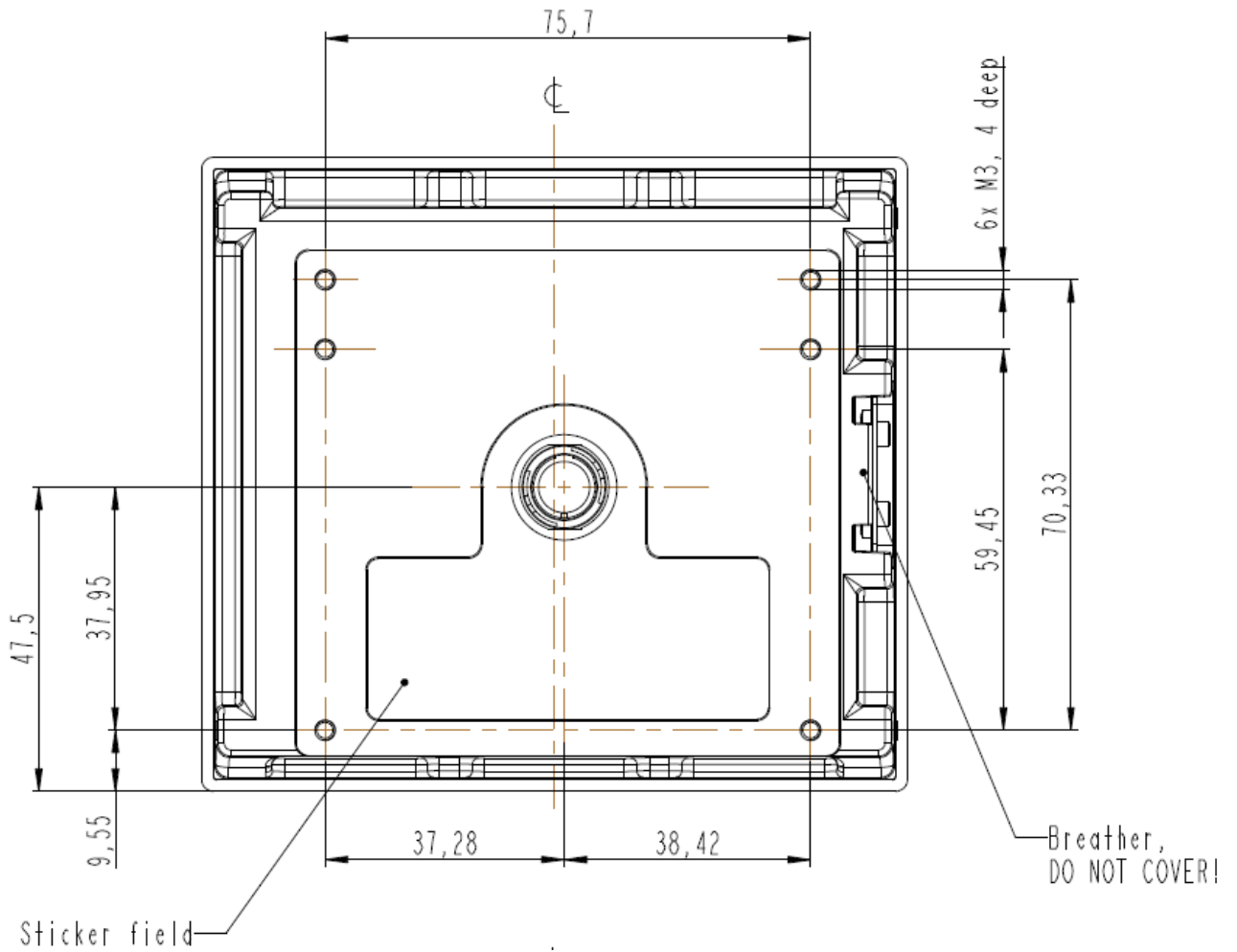


Figure 6: Sensor Rear Side.

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2.11 Connector

The used sensor connector is a 12-pin male (plug) circular bayonet type connector (water proof IP67, series LF10WBRB-12PD, manufacturer Hirose, Japan). A female counterpart (socket), e.g. LF10WBP-12S, has to be used to connect to the sensor. The pin numbering of the socket is shown below. The pin description is given in Table 1.

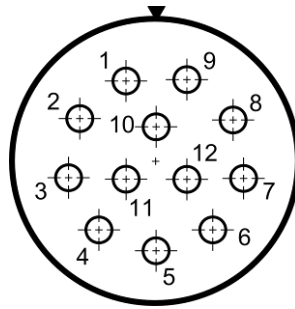


Figure 7: View on solder cup side of socket (rear view of female counterpart to be connected to sensor)

Table 1: Sensor connector pin out model UMRR-11xxxx

Pin No.	Function	Wire Color (MEDI type #KU110C12J002)
1	Sensor Ethernet TX H	gray / red
2	Sensor Ethernet TX L	red / blue
3	Sensor RS485 RX L	pink
4	Sensor RS485 RX H	gray
5	Sensor RS485 TX L	brown
6	Sensor RS485 TX H	white
7	Sensor_GND	blue
8	Sensor_Vcc	red
9	Sensor Ethernet RX L	black
10	Sensor Ethernet RX H	purple
11	CAN H	green
12	CAN L	yellow

Please note that in the standard configuration the sensor has no 120 Ohms resistor on board (CAN bus termination between CAN L and CAN H). The resistors are nevertheless required at either end of a CAN / RS485 bus and is in most cases integrated in the cable delivered along with the sensor (if cable is manufactured by Smartmicro).

For the RS485 data interface there is a 120 Ohms resistor on board of the sensor.

A number of cable sets for initial operation and test purposes are offered by Smartmicro, to deliver a fast set-up of a sensor system. Among those preconfigured ready-to-run cables as well as cable stumps (pig tail cables or various lengths) which carry the connector on one side and open wires on the other.

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3 Multi Sensor Systems

3.1 Configurations

The sensor may be used standalone or multiple sensors can be connected in a network. Such networks are only possible using CAN(FD) interface. Sensors in the network work plug and play, free of mutual interference.

Customer specific configurations are possible.

3.2 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.

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