Project Documentation | 77 GHz UMRR Traffic Management Sensor Data Sheet

---

Project Number:

SMS Project Number:

Project Title:
Traffic Management Sensor

Keyword(s):
UMRR Traffic Management Sensor Data Sheet
4D/HD+

Date:
September 13, 2019

Document:
UMRR-11_Type_132_TM_Data_Sheet.doc

1 Content

2 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.

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 (junction box) or SRO (sensor relay option – both available as accessory) 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.

3 Sensor Data Sheet

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

UMRR-11 T132 is a 77 GHz multi-lane, multi-object tracking traffic Radar and features **4D/HD$^+$** capabilities.

For each Radar generation, several 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 132 antenna model (all model specific values are highlighted).

Type 132 antenna aims at long range and wide horizontal angular coverage. It features wide beam mode with medium range and long-range mode with narrower field of view.

3.1 Sensor Photograph

Figure 1: Traffic Sensor Type 132 - Front.

Figure 2: Traffic sensor Type 132 - Rear.

3.2 Function Description

The sensor is a robust low cost **4D/HD+** 77GHz Radar for traffic management applications.

It works in adverse conditions, almost unaffected by weather, and independent of sunlight, in a wide temperature interval.

The customer can select from several antenna and housing models which determine the permanent fixed field of view and range. Type 132 Antenna aims at long range and wide horizontal angular coverage. It features a wide beam mode with medium range and a long-range mode with narrower field of view.

One individual sensor measures range, radial speed, horizontal angle, vertical angle, reflectivity and other parameters of multiple stationary and moving reflectors (**targets**) simultaneously. The following detection principle is integrated:

4D/HD+

4-dimensional Doppler based radial motion detection (> 0.1m/s), including:

a) Direct Doppler measurement
b) Direct Range measurement
c) Direct Azimuth Angle measurement
d) Direct Elevation Angle measurement

Reflectors having a radial speed component of typ. abs. >0.1m/s are detected.

Having multi target capability, the sensor may detect many reflectors at a time (128 or max. 256) (depending on configuration) being within the field of view. Depending on the selected communication interface, the number of reported targets may be limited. Targets are sorted by range and short-range targets are reported first.

Additionally, filter algorithms are implemented for the tracking of all detected reflectors over time, those tracking algorithms are integrated in the sensor. **Multiple objects** (64 or max. 126) (depending on configuration) are tracked simultaneously. Depending on the selected communication interface, the number of reported objects may be limited. Objects are sorted by range; short range objects are reported first.

The result of the tracking is an **object** list with the following parameters:

- x position
- y position
- absolute velocity
- heading angle
- other…

Hence the sensor reports such a list of all tracked objects inside its field of view in every measurement cycle of typ. 55ms length (depending on configuration).

The field of view typically covers up to six lanes.

The sensor can detect stationary objects.

Object Separation Performance

Measuring object co-ordinates of multiple objects simultaneously in 4D, i.e. range speed, azimuth and elevation angle, or x, y and speed vector, is state of the art.

However, what counts even more is the object separation capability where many vehicles are closely spaced, i.e. in multi-lane scenarios with dense traffic, like traffic jams, stop-and-go traffic and busy intersections

The sensor provides excellent target/object separation capabilities (4D/HD⁺).
Individual reflectors are separated in the detection algorithms by:

a) having a different radial speed value (difference > 0.25m/s) **OR**
b) having a different range value by 0.66m or 1.8m (depending on selected bandwidth)
having a different range value by 2.2ft or 5.9ft (depending on selected bandwidth)

Tracking algorithms and data base further support the separation of objects.

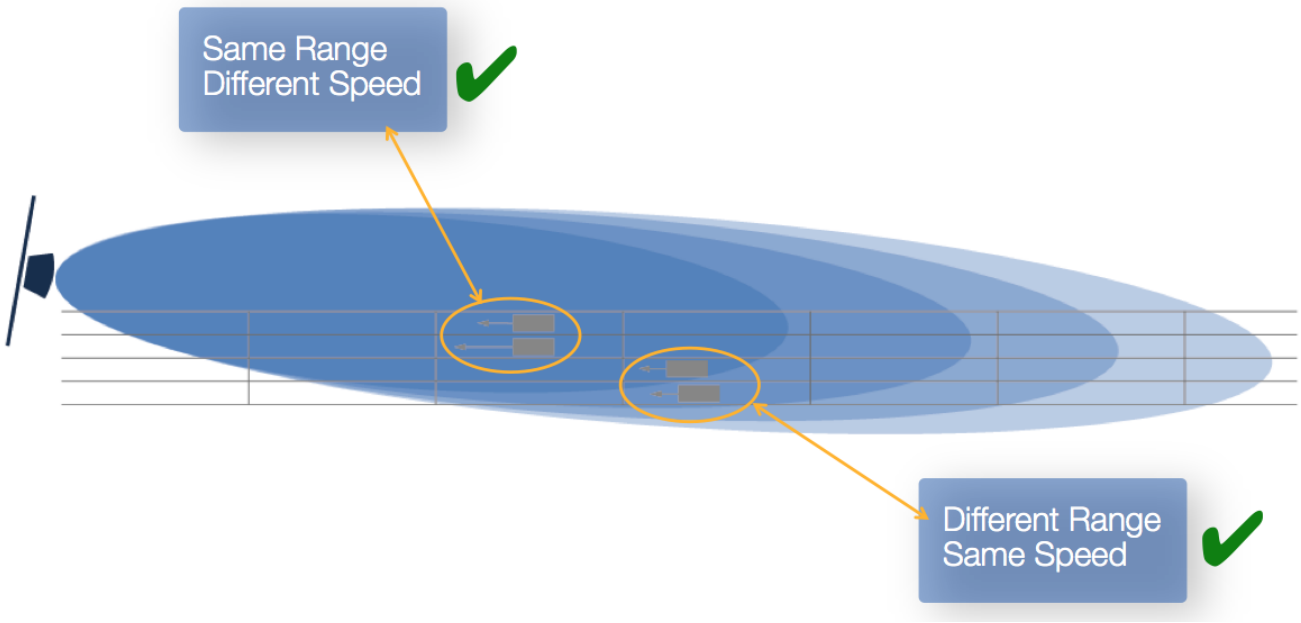


Figure 3: Object Separation Capability.

UMRR-11 features 4D/HD⁺ technology. For each reflector, there is a true measurement of the **4 dimensions** range, Doppler, horizontal and vertical angle.

UMRR-11 can now accomplish range gate specific detection of moving and even stationary vehicles. In each of these gates a separate Doppler detection is possible, including stationary detectors. Figure 3 explains the principle.

Due to the operation at the 76-77GHz band, a significantly wider frequency bandwidth is available, and the Doppler frequency is increased.

As a result, compared to 24GHz (UMRR 11 T44/45) sensors:

- The range separation capability is improved by ~factor 3 (depending on selected bandwidth);
- The speed separation capability is improved by ~factor 3 (due to the higher Doppler frequency at 76-77GHz band).

3.3 Application Characteristics

3.3.1 Intersection Management

At intersections, the sensor is typically used for combined stop bar and advance detection.

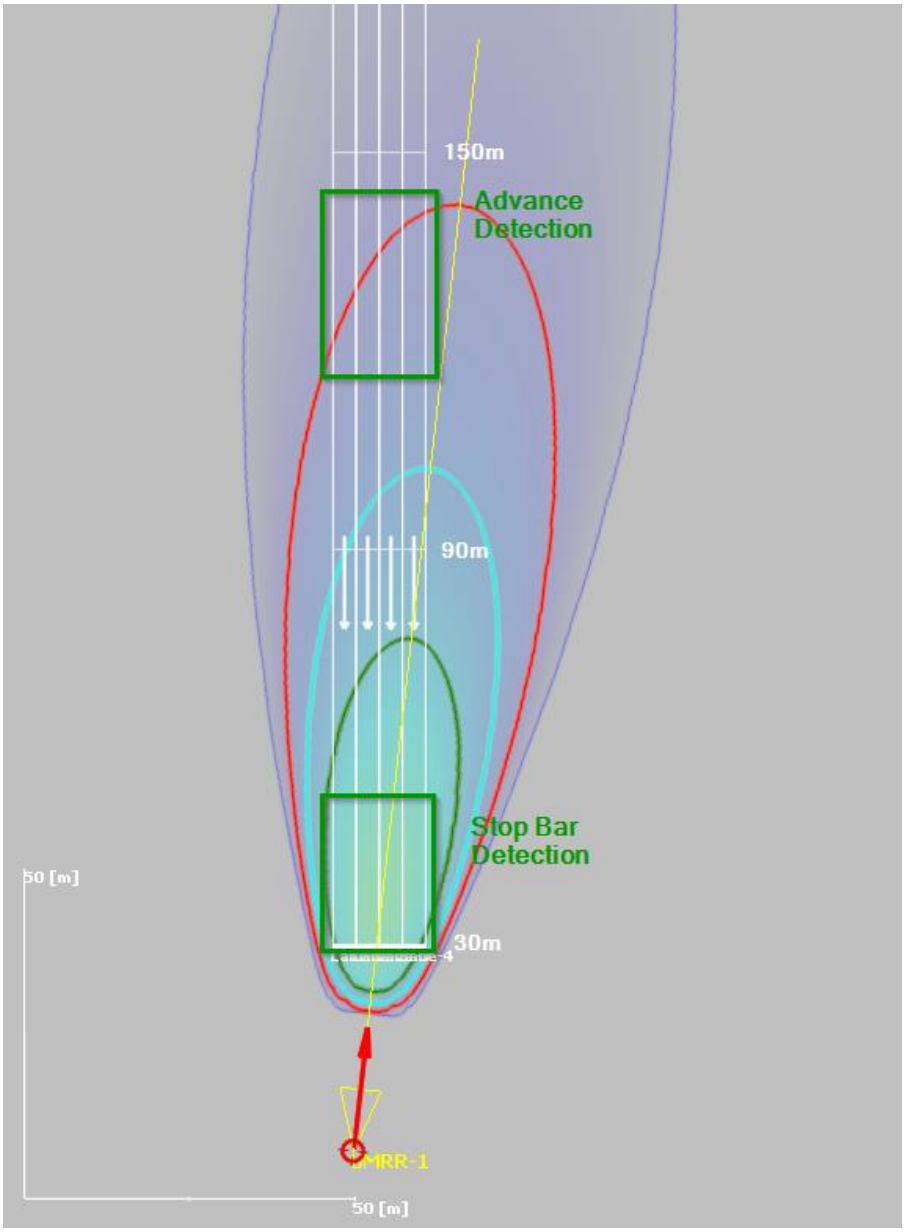


Figure 4: Stop Bar Detection Type 132

The sensor is usually mounted at the corner of an intersection on a vertical pole. Other mounting positions (gantry, mast arm, luminaire) may be possible. The **standard configuration** for Type 132 sensor for intersection applications is shown in Figure 4 and its parameters are given in Table 1.

Table 1: Standard Configuration for Stop Bar Detection Type 132

Parameter	Value
Traffic Direction	Typ. Approaching
Mounting Height	Typ. 6m (1...10m)[I] Typ. 20ft (3...33ft)[I]
Sensor Azimuth angle	Typ. -12° (-15 ...+15 deg.)[II]
Sensor Elevation angle	Typ. -6° (-9...0 deg.)[II, III]
Stop Bar Distance	Typ. 30m (30m … 50m)[IV] Typ. 985ft (66 … 164ft)[IV]

[I] May affect max. detection range. The best performance is typically achieved for mounting heights between 2-8m. Occlusion needs to be considered.
[II] Smaller absolute angles allow longer detection range along a road.
[III] Application specific. Gantry mount: steeper e. angle possible, with limitations of maximum range. Negative elevation angle means sensor pointing towards road.
[IV] Outside the recommended range, vehicle drops are more likely.

Note: Do not use stop bar distances below 30m (at max. sensor elevation mounting angle -9°).

The cycle time is set to 55ms.

The sensor is typically used standalone. Up to four sensors can usually be mounted at or around an intersection using separate configurable frequency channels, avoiding mutual interference.

UMRR-11 Type 132 Stop + Advance	• **Stop bar detection** (true presence detection) • Lane specific **Advance detection** (exploiting the long range) • **Loop replacement** (non-intrusive detection) • **Queue length** measurement • **Custom trigger** conditions (e.g. location, vehicle speed, classification) • **ETA** measurement • **Speed** measurement

3.3.2 Arterial Management

On highways and country roads, the sensor is typically used to count and classify traffic. Usually are selected and reported in configurable counting /statistics intervals.

The sensor delivers the following data:

- Volume
- Occupancy
- Average Speed
- Vehicle Presence

The data can be retrieved in Push Mode

a) in low data volume as aggregated statistics output
b) as per vehicle record (PVR)

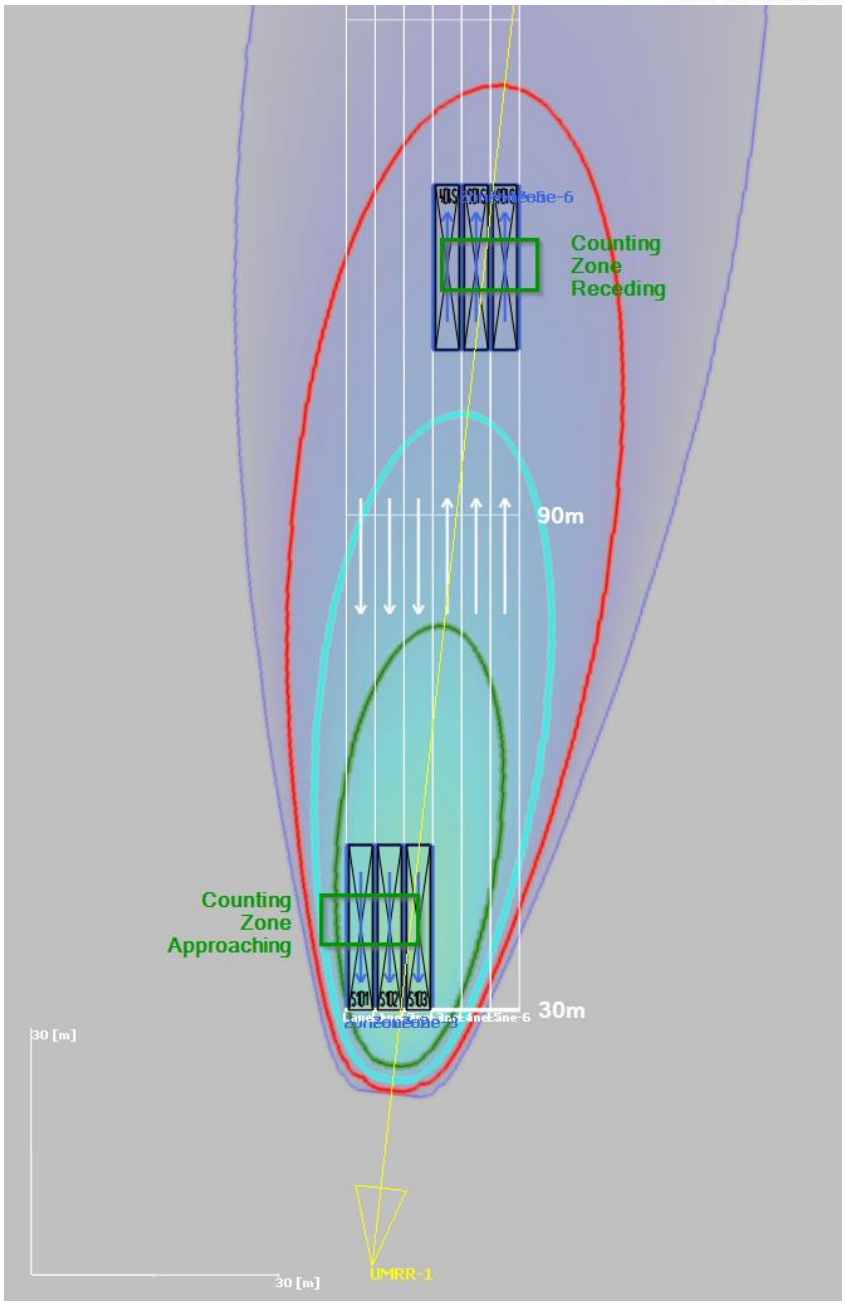


Figure 5: Standard Configuration Type 132

Because of the forward-looking principle, the sensor provides the significant higher speed accuracy / general speed-based information, compared to other traffic counting equipment.

The sensor is usually mounted at the roadside on a vertical pole. No setback is required. Other mounting positions (gantry, mast arm, luminaire) may be possible. The **standard configuration** for Type 132 sensor for counting applications is shown in Figure 5 and its parameters are given in the table below.

Table 2: Standard Configuration for Counting and Statistics Type 132

Parameter	Value
Traffic Direction	Typ. Approaching & Receding
Mounting Height	Typ. 6m (4...10m)[I] Typ. 20ft (13...33ft)[I]
Sensor Azimuth angle	Typ. -12° (-15 ...+15 deg.)[II]
Sensor Elevation angle	Typ. -6° (-9...0 deg.)[II, III]
Counting Line Distance (Approaching)	Typ. 30m (20m … 50m)[IV] Typ. 98ft (66 … 164ft)[IV]
Counting Line Distance (Receding)	Typ. 90m (50m … 105m)[IV] Typ. 295ft (164… 344ft)[IV]
Setback	Typ. 1m (0… 10m) Typ. 3ft (0 … 33ft)
Counting Accuracy	Typ. > 95%[V]
Classification Accuracy	Typ. > 80%[V]
Classes	*Information asap available*

[I] May affect max. detection range. Occlusion needs to be considered.
[II] Smaller absolute angles allow longer detection range along a road.
[III] Application specific. Gantry mount: steeper el. angle possible, with limitations of maximum range. Negative elevation angle means sensor pointing towards road.
[IV] Outside the recommended range, vehicle drops are more likely.
[V] Typical value when properly installed at suitable location. The counting and classification accuracy typically depend on the following main (and other) factors: mounting height, traffic density

The cycle time is set to 55ms.

The sensor is typically used standalone. Multiple sensors may however be used in close vicinity using separate configurable frequency channels, avoiding mutual interference.

UMRR-11 Type 132 Forward+ 4D/HD+	• **Counting and Classification** • **Wrong Way Detection** (vehicle moving opposite to the defined direction of traffic) • **Incident Detection** supported • **Speed** measurement

3.3.3 Traffic Enforcement

The high speed and range accuracy of the UMRR sensor makes it very suitable for lane specific speed and red-light enforcement applications. According to the specification of the enforcement application, the sensor can be used either in approaching or in receding traffic mode.

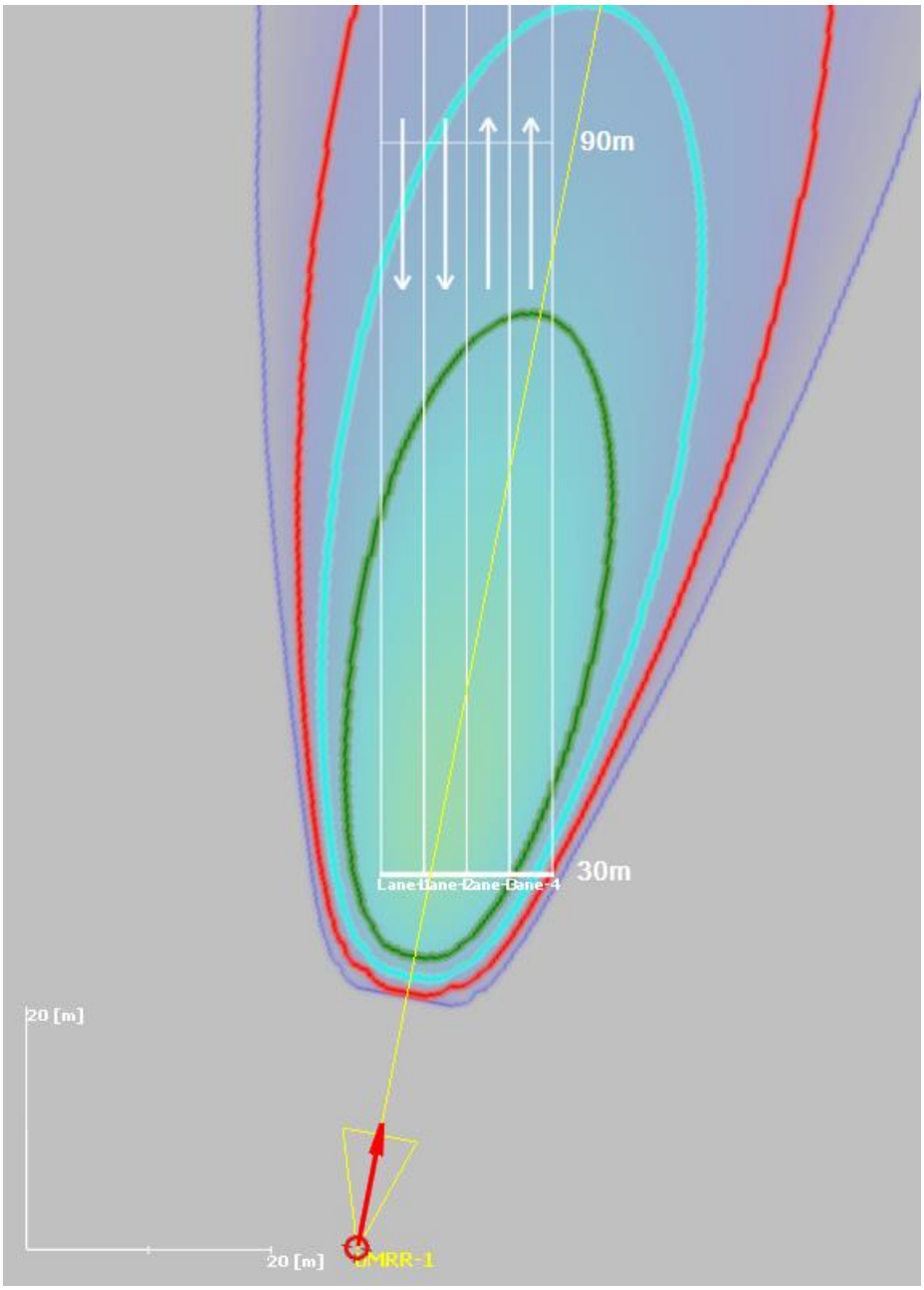


Figure 6: 4 Lane Speed / Red Light Enforcement in Approaching Mode Type 132

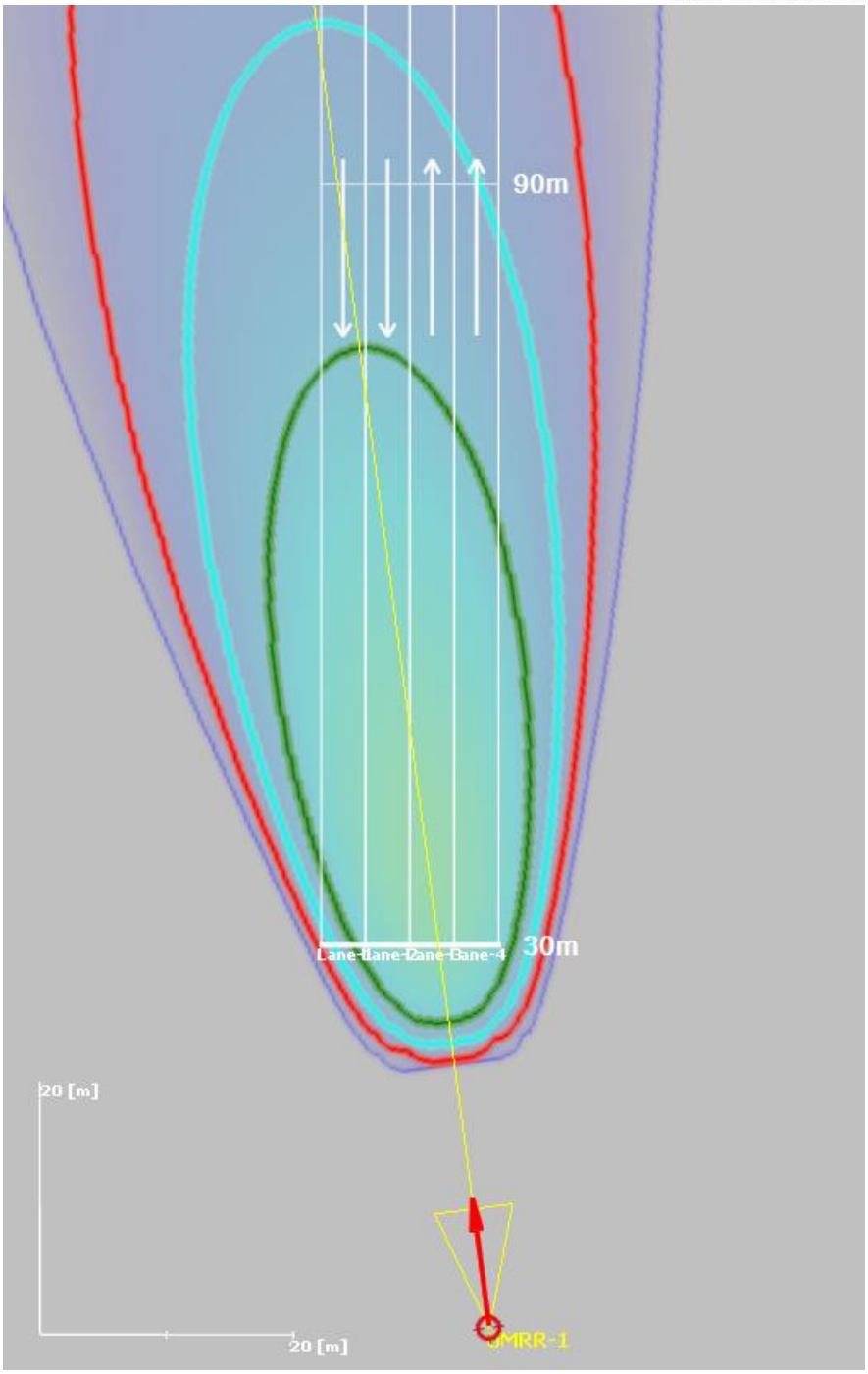


Figure 7: 4 Lane Speed / Red Light Enforcement in Receding Mode Type 132

The sensor is usually mounted at the roadside on a vertical pole. Other mounting positions (gantry, mast arm, luminaire) may be possible. The **standard configuration** for Type 132 sensor for speed enforcement applications is shown in Figure 6 and Figure 7. The parameters are given in **Table** 3.

Table 3: Standard Configuration for Traffic Enforcement Type 132

Parameter	Approaching Mode	Receding Mode
Traffic Direction	Approaching	Receding
Mounting Height	Typ. 4m/6m (1...10m)[I] Typ. 13/20ft (0 … 33ft)	Typ. 4m (1...10m)[I] Typ. 13ft (0 … 33ft)
Sensor Azimuth angle	Typ. -12° (-35 ...+35 deg.)[II]	Typ. 12° (-35 ...+35 deg.)[II]
Sensor Elevation angle	Typ. -6° (-9...0 deg.)[II, III]	Typ. -6° (-9...0 deg.)[II, III]
Measurement Line Distance	Typ. 30m (20m … 50m)[IV] Typ. 98ft (66 … 164ft)[IV]	Typ. 45m (20m … 50m)[IV] Typ. 148ft (66 … 164ft)[IV]
Speed accuracy	Typ.< ±0.28 m/s or ±1% (bigger of) [V]	
Track initialization time	6...10 cycles typical	
Traffic Direction	Approaching, receding	
Simultaneous Object Tracking	64 objects[VI]	

[I] May affect max. detection range. Occlusion needs to be considered.
[II] Smaller absolute angles allow longer detection range along a road.
[III] Application specific. Gantry mount: steeper el. angle possible, with limitations of maximum range. Negative elevation angle means sensor pointing towards road.
[IV] Outside the recommended range, vehicle drops are more likely.
[V] Measured on object having const. radial speed, at bore sight.
[VI] Up to 126 objects by special firmware. Please contact smartmicro for more information.

The cycle time is set to 55ms.

The sensor is typically used standalone. Multiple sensors may however be used in close vicinity using separate configurable frequency channels, avoiding mutual interference.

UMRR-11 Type 132 Enforcement 4D/HD+	**For Speed Enforcement** **Short distance** measurement for both directions possible **Certified speed accuracy**
UMRR-11 Type 132 Enforcement RL 4D/HD+	For **Red Light Enforcement** For combined **Red Light** & **Speed Enforcement** **Short distance** measurement for both directions possible **High speed accuracy**

3.4 General Performance Data

Parameter	Value	Unit
Sensor Performance		
Max. Range on Passenger Car	64 (Medium Range Mode)[IX] 175 (Long Range Mode)	m
Max. Range on Truck	64 (Medium Range Mode) [IX] 175 (Long Range Mode)	m
Instrumented Range	64 (Medium Range Mode) [IX] 175 (Long Range Mode)	m
Minimum Range	0.5 (Medium Range Mode) [IX] 1.0 (Long Range Mode)	m
Range accuracy	Typ. < 1% or < 0.25m (bigger of) Typ. < ±2.5% or < ±0.82ft (bigger of)	%, m %, ft
Radial Speed Interval	-320…+320	km/h
Minimum abs. Radial Speed	0.1 0.36	m/s km/h
Speed accuracy	Typ. ≤ 0.1 [II] Typ.< ±1km/h or ±1% (bigger of) [II]	m/s km/h
Angle Interval (total field of view)	-7.5 ...+7.5 (El.); -50 ...+50 (Az. Medium Range Mode)[III, IX] -16 ...+16 (Az. Long Range Mode)[III]	degree
Angle Accuracy (horizontal)	≤ 0.5 (Medium Range Mode) [IV, IX] ≤ 0.25 (Long Range Mode) [IV]	degree
Update time	≤ 55	ms
Environmental		
Ambient Temperature	-40 ... +85	degree C
Shock	100	g_{rms}
Vibration	14	g_{rms}
IP	67[V]	
Pressure / Transport altitude	0…10.000 0…32800	m ft
Mechanical		
Weight	≤ 200 ≤ 7	g oz
Dimensions	See 3.6	
Model No.	**11xxxx-84xxxx**	
DSP Board – Antenna Identification	11xxxx-84xxxx	
Housing Identification	03xxxx	
General		
Power Supply	8 ... 32[VI]	V DC

	<5[VII]	W
Frequency Band	76.0…77.0	GHz
Bandwidth	< 1000	MHz
Max. Transmit Power (EIRP)	<25	dBm
Interfaces [VII]	CAN V2.0b (passive) RS485 full duplex 10/100 Ethernet	
Connector	12 Pin plug Hirose LF10WBRB-12PD	CAN, Power, RS485, Ethernet

[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] Typical value; measured at target output level at bore sight, for a point reflector showing >23dB SNR. Error may increase towards larger angles.
[V] IP 67 only when connector or cap attached.
[VI] measured at connector.
[VII] Power consumption at 20°C.
[VIII] It is recommended to use an external surge protection for power, CAN, RS485, Ethernet and other interface ports.
[IX] Medium range not ready for use yet.

3.4.1 Start-up time

After power up or reset, the sensor readings are within specified performance within <4s.

3.4.2 Self-Diagnose

The UMRR sensor cyclically reports a status message providing the following information

- Sensor run time
- Sensor cycle time
- Sensor mode
- Diagnose information

The sensor features certain self-diagnose to allow limited fail-safe capabilities:

- Detection of sensor blindness
- Detection of rain
- Misalignment in roll- or pitch angle
- Detection and suppression of interference

Note that there is no completely fail-safe operation available.

3.4.3 Sensor Network

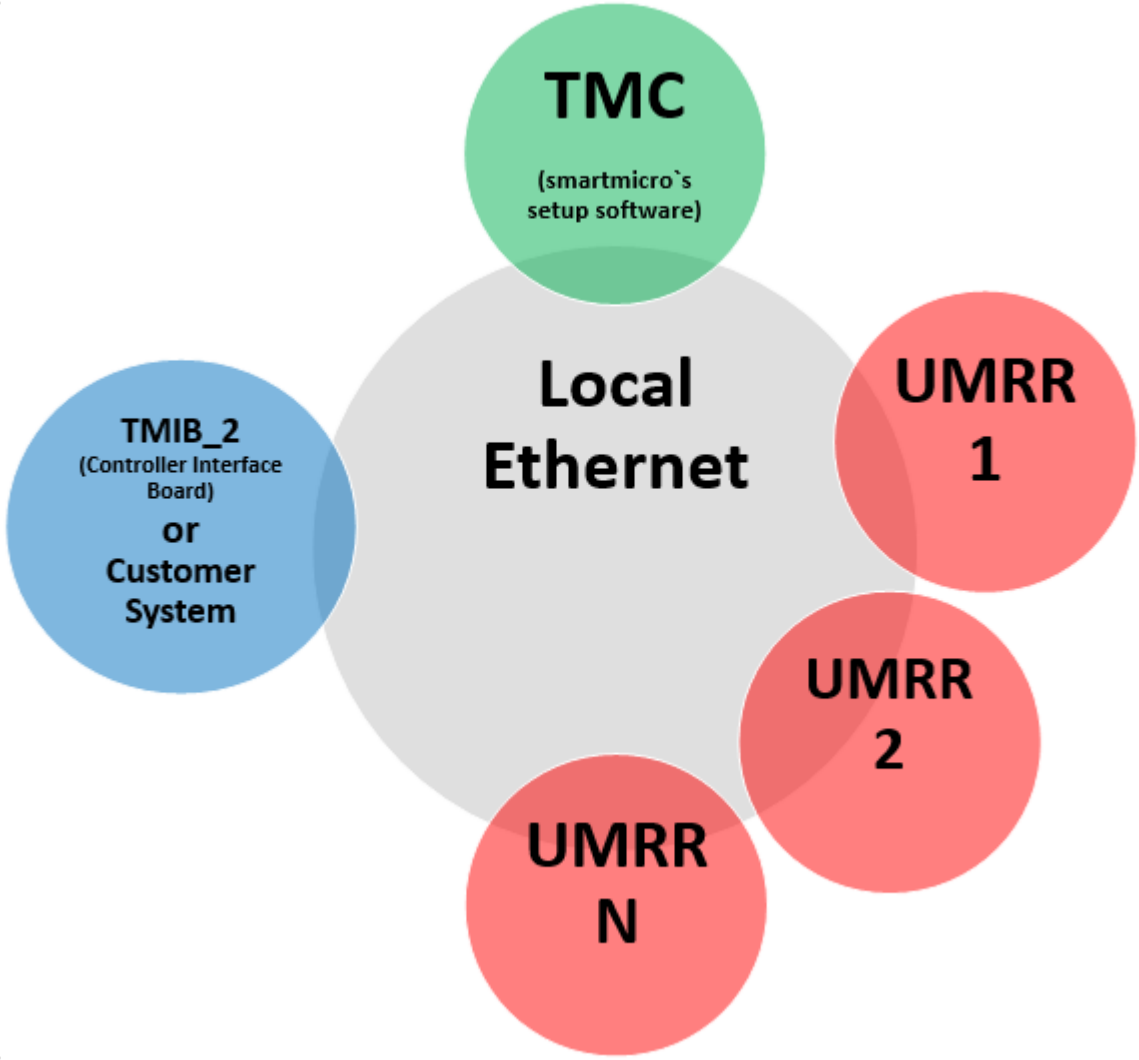
The sensor is typically used standalone. At intersections, typically up to four sensors are connected to one TMIB (interface board to intersection controllers, available as accessory) and can be operated interference-free.

3.4.4 Ethernet connection

The sensor supports UDP over Ethernet in a Local Area Network (LAN). Communication over low bandwidth environments or routed networks e.g. the world wide web is not supported.

Features:

1. Ethernet standards IPv4, ARP, IGMP, IP multicast and UDP
2. Supports DHCP
3. Smartmicro proprietary communication protocol "smartmicro transport protocol" with:
   - IP/UDP Multicast based discovery protocol
   - Client ID based setup
   - Sensor data transmission



3.4.5 Compliance

The sensor model complies with the following EU directives:

- RED 2014/53/EU
- RoHS 2011/65/EU
- EC 1907/2006 REACH

Applied Standards:

- Spectrum Usage:
  - EN 301 091-1 V2.1.1
  - EN 301 091-2 V2.1.1
- EMC:
  - EN 301 489-1 V2.2.0
  - EN 301 489-51 V2.1.0
- Health and Safety:
  - EN 62311: 2008
  - EN 62368-1: 2014 + AC: 2015

Regarding spectrum usage, this sensor model was tested and certified by independent test labs:

- EU RED directive (formally approved by test lab or notified body),
- FCC part 95M (formally approved by test lab or notified body),
- ISED RSS-251 (formally approved by test lab or notified body),

Note: This sensor must not be used for non-automotive (stationary) operation in the US.

This sensor model is also generally compliant with the following regional regulations (but may not be formally tested/approved):

- SRRC,
- KCC,
- MIIT,
- NCC.

Note: This statement of compliance means that the sensor device allows operation compliant to the listed standards. However, not all standards are certified through test labs and not for all countries formal frequency approval/registration is accomplished.

In certain countries or regions, a customer-specific local frequency approval is reasonable. Smartmicro supports customers for this process.

For certain configurations of this sensor the accuracy of the speed (and other) measured values was tested and certified by the Swiss Federal Institute of Metrology METAS (certificates available on request under NDA). [I]

[I] Available in Q1,2020

3.5 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.

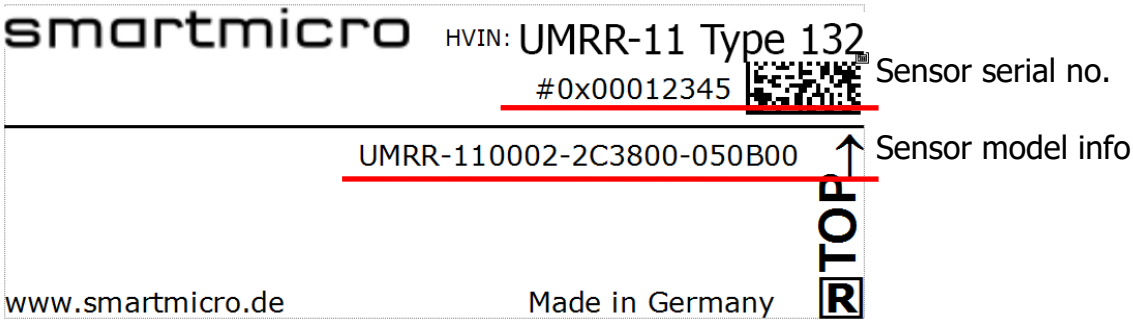


Figure 6: Type sticker example

The individual sensors are referred to as **UMRR-xxyyzz-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.

3.6 Sensor Dimensions

All values given in mm.

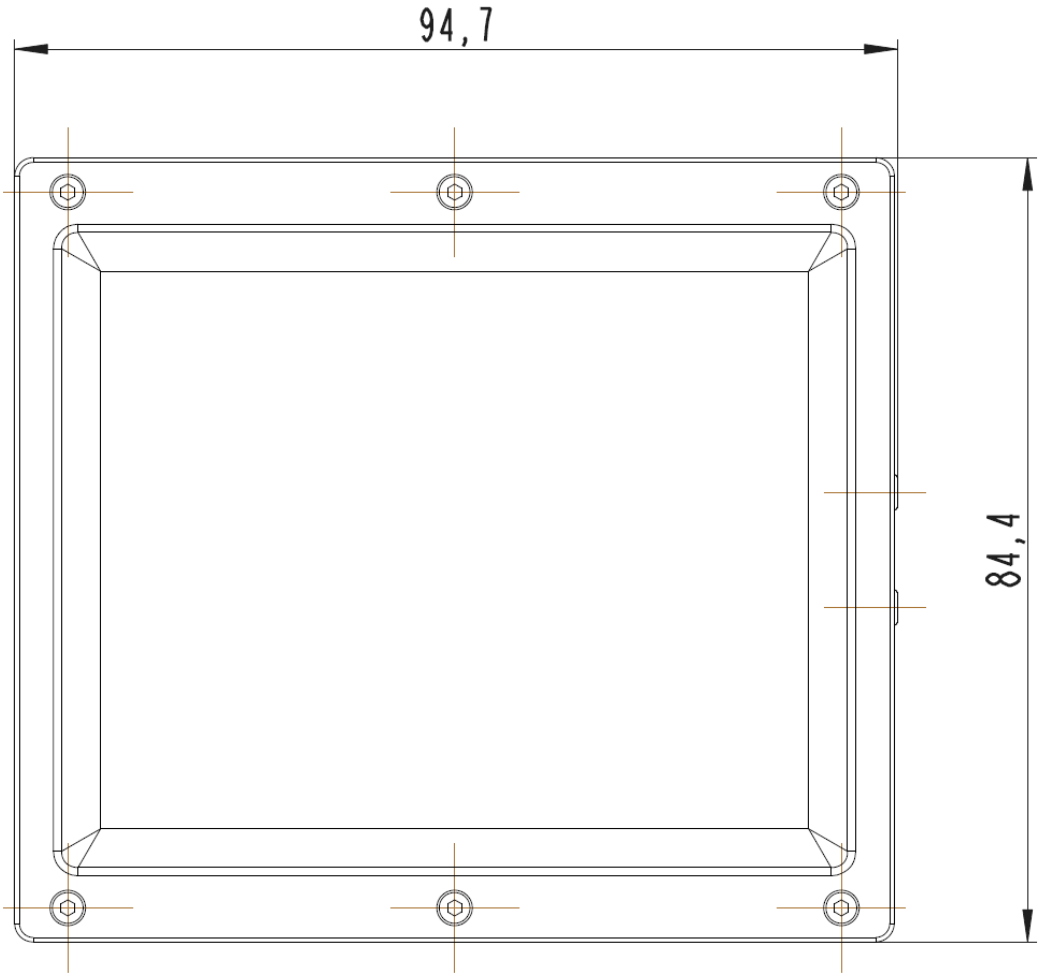


Figure 7: Sensor Front side.

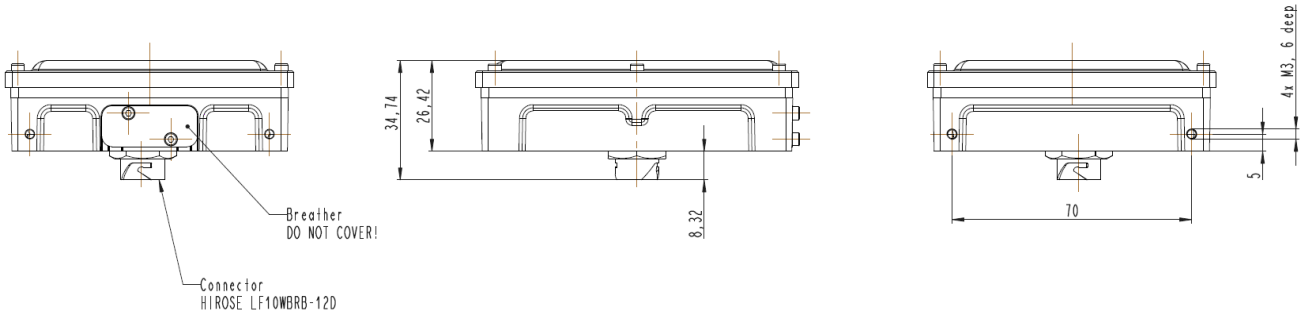


Figure 8: Sensor Top, Left and Right Side.

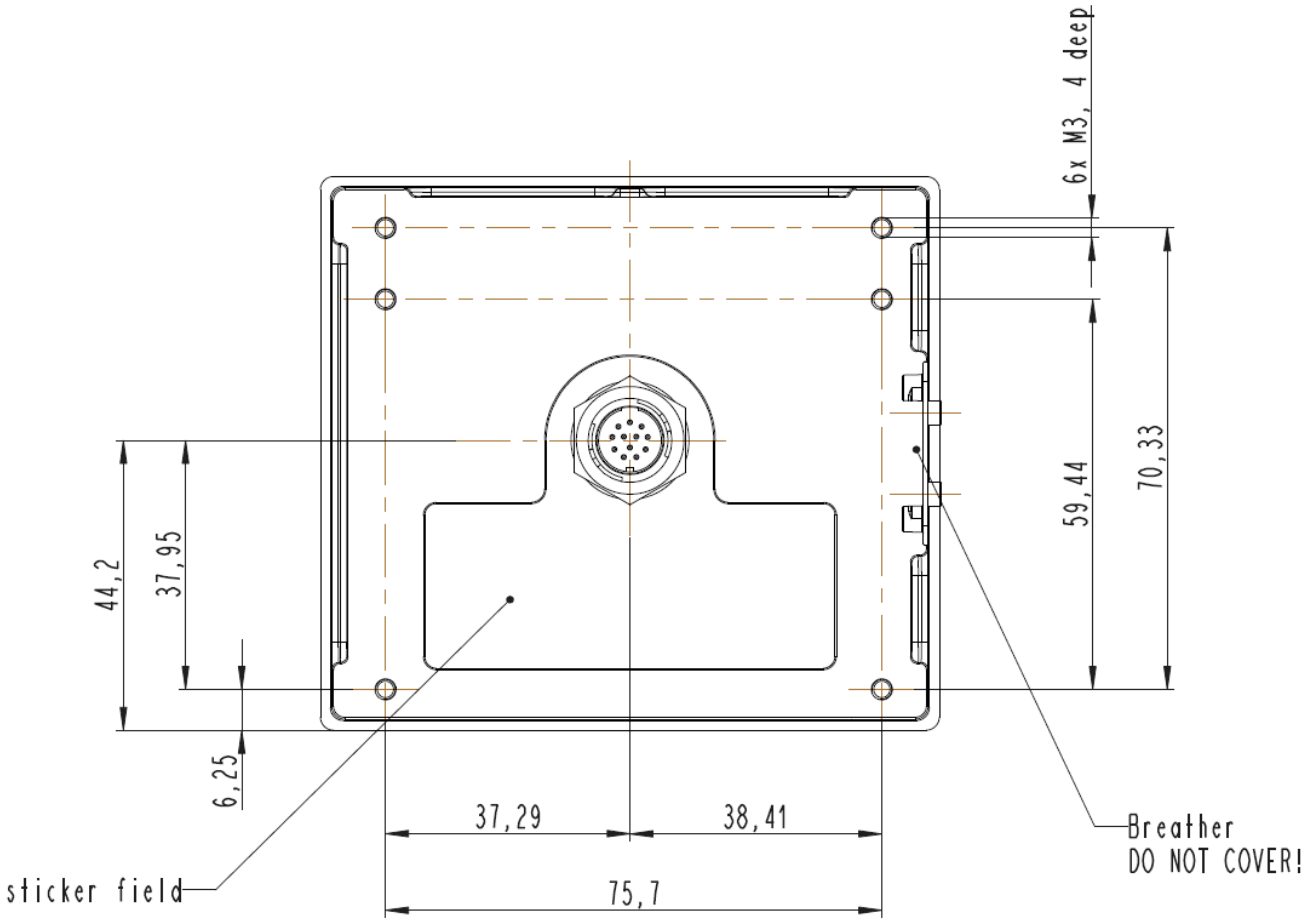


Figure 9: Sensor Rear Side.

3.7 Connector

The 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, must be used to connect to the sensor. The pin numbering of the socket is shown in Figure 10 the pin description is given in Table 3.

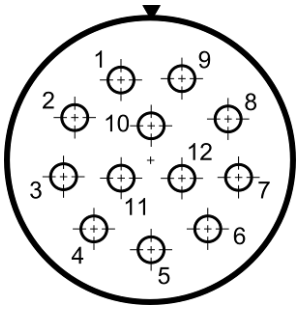


Figure 10: View on solder cup side of socket (rear view of female counterpart to be connected to sensor)

Table 3: 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.

Several 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.

4 Important Legal Disclaimer Notice

All Product, Product specifications and data in this Product / project documentation or data sheet are subject to change without notice to improve reliability, function, design or otherwise.

Not all Products and/or Product features may be available in all countries and regions. For legal reasons, features may be deleted from Products or smartmicro may refuse to offer Products.

The statements, technical information and recommendations contained herein are believed to be accurate as of the date hereof. smartmicro disclaims any and all liability for any errors, inaccuracies or incompleteness contained in this datasheet or in any other disclosure relating to the Product.

To the extent permitted by applicable law, smartmicro disclaims (i) any and all liability arising out of the application or use of the Product or the data contained herein, (ii) any and all liability of damages exceeding direct damages, including - without limitation – indirect, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of suitability of the Product for a particular purpose.

Statements regarding the suitability of Products for certain types of applications are based on smartmicro' knowledge of typical requirements that are often placed on smartmicro' Products in generic/general applications. Such statements are, however, not binding statements about the suitability of Products for a particular/specific application. It is the customer/user's own responsibility to validate that the Product with the specifications described herein is suitable for use in its particular/specific application. Parameters and performance of the Products may due to particular/specific applications and due to particular/specific surroundings deviate from the statements made herein. Therefore, it is important that customer/user has thoroughly tested the Products and has understood the performance and the limitations of the Products before installing the Products for the final applications or before commercialization. Although Products are well optimized to be used for the intended applications stated herein, it must also be understood by the customer/user that the detection probability may not be 100 % and the false alarm rate may not be zero.

The information provided herein, relates only to the specific Product designated and may not be applicable when such Product is used in combination with other materials or in any process not defined herein. All operating parameters, including typical parameters, must be validated for each customer application by the customer/user's technical experts. Customers using or selling smartmicro products not expressly indicated for use in such applications do so at their own risk.

This Product specification or data sheet does not expand or otherwise modify smartmicro terms and conditions of purchase, including but not limited to the warranty expressed therein. Except as expressly indicated in writing by smartmicro, the Products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Product could result in personal injury or death.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of smartmicro Product names and markings noted herein may be trademarks of their respective owners.

Please note that the application of the Product may be subject to standards or other regulations that may vary from country to country. smartmicro does not guarantee that the use of Products in the applications described herein will comply with such regulations in any country. It is the customer/user's responsibility to ensure that the use and incorporation of Products complies with the regulatory requirements of their markets.

If any provision of this Disclaimer is, or is found to be, void or unenforceable under applicable law, that will not affect the validity or enforceability of the other provisions of this Disclaimer.

5 Contact

Address:

smart microwave sensors GmbH
In den Waashainen 1
38108 Braunschweig
Germany

Phone / Fax numbers:

Phone: +49-531-39023-0
Fax: +49-531-39023-599

Web / Email address:

Web: www.smartmicro.de
Email: info@smartmicro.de