

Project Documentation | UMRR Traffic Management Sensor Data Sheet

Project Number:

SMS Project Number:

Project Title:

Traffic Management Sensor

Keyword(s):

UMRR Traffic Management Sensor Data Sheet

Date:

February 15, 2013

Document:

UMRR Traffic Sensor Type 31 Data Sheet.doc

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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.

1.1 Sensor Photograph

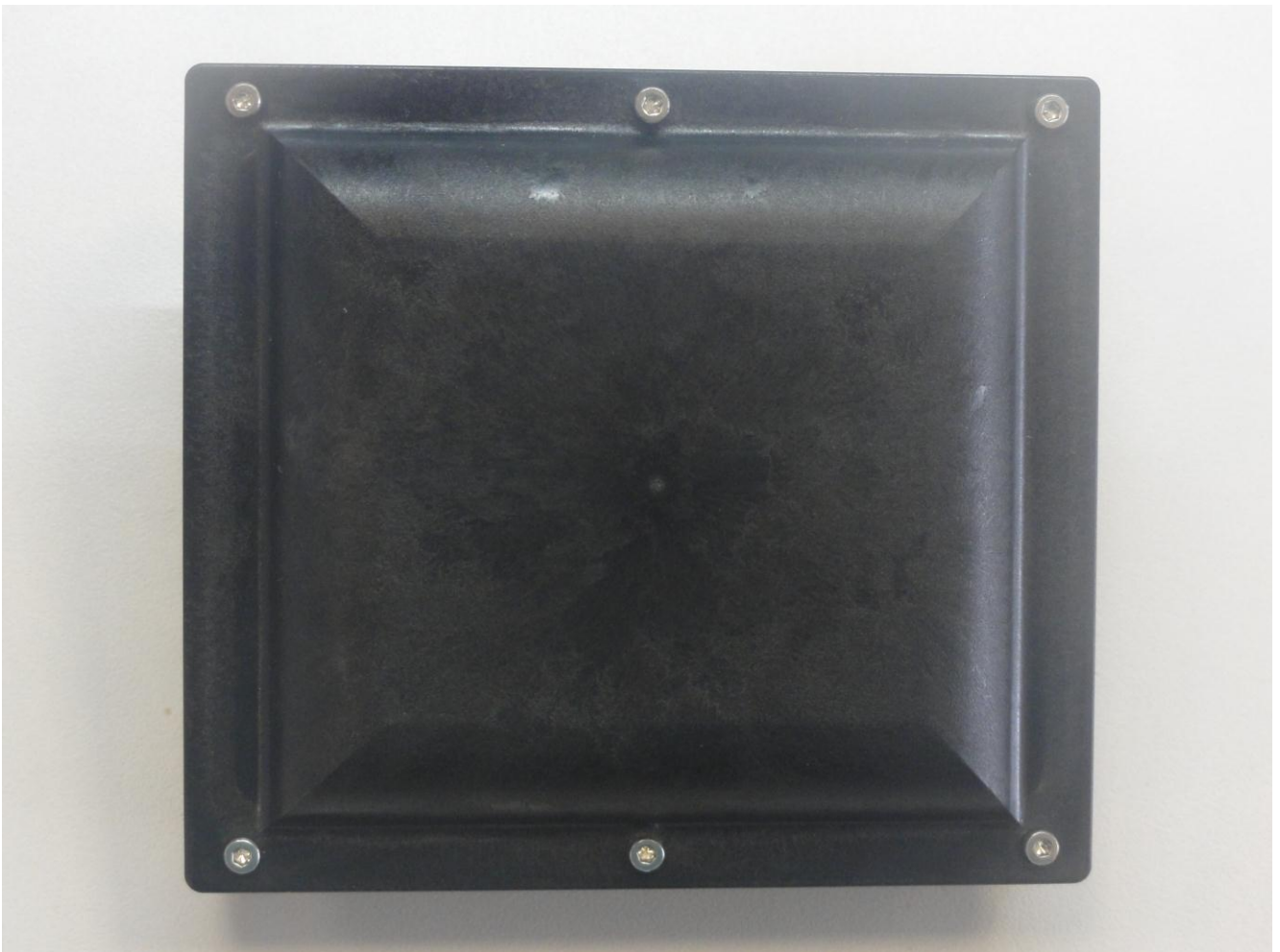


Figure 1: Traffic Sensor Type 31 - front.

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Figure 2: Traffic sensor type 31 - rear.

Also available:

- Other versions of the housing for OEM integration.
- Other physical [interface](#) options.

For more details please [contact us](#).

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1.2 General Performance Data

Parameter	Value	Unit
Sensor Performance		
Max. Range on Pedestrian	27 ^I	m
Max. Range on Passenger Car	60 ^I	m
Minimum Range	1.5	m
Range accuracy	Typ. < ±2.5% or < ±0.25m (bigger of)	%, m
Radial Speed Interval	-68.3 ...+68.3 (±83.9 available)	m/s
Minimum abs. Radial Speed	0.1	m/s
Speed accuracy	Typ. < ±0.28 or ±1% (bigger of) ^{II}	m/s
Angle Interval (total field of view)	-8 ...+8 (El.); -50 ...+50 (Az.) ^{III}	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	275	g
Dimensions	See 1.4	
Model No.		
DSP Board – Antenna Identification	0A0301-1F0302	
Housing Identification	030602	
General		
Power Supply	7 ... 32 ^{IV} 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) ^V 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} Measured on object having const. radial speed, at bore sight.

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

^{IV} measured at connector; min. voltage slew rate 500V/s or max. voltage rise time 15ms; supply source impedance 0.5Ohms.

^V Also available: Ethernet, Relay contacts, see [interfaces](#). It is recommended to use an external surge protection for power, CAN, RS485 and other interface ports.

1.3 Application Characteristics

1.3.1 Function Description

The sensor is a robust low cost 24GHz Radar for traffic management applications. It is intended for the applications listed in 1.3.2.

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

At installation time 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.**

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

- a) Doppler based radial motion detection ($> 0.1\text{m/s}$).

Reflectors having a radial speed component of typ. abs. $>0.1\text{m/s}$ are detected. Having multi target capability, the sensor may report many reflectors at a time being within the field of view.

Additionally filter algorithms are implemented for the tracking of all detected reflectors over time, those tracking algorithms can being integrated in the sensor. Multiple objects (max. 32) are tracked simultaneously, the individual reflectors are separated in the detection algorithms by having a different radial speed value (difference $> 0.25\text{m/s}$) and also 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...

Hence the sensor reports such a list of all tracked objects inside its field of view in every measurement cycle of typ. 50ms length. Stationary reflectors are not reported. Stopped objects are reported, as they remain valid in the tracking data base until they start moving again, for example at a stop bar.

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The field of view typically covers up to four lanes (see Figure 4).

1.3.2 Applications

Based on the object list as a generic data interface a number of applications are possible. A selection is listed below. Please note that these applications are not part of the software embedded in the sensor but must be implemented by the customer:

- Stop bar detection.
- Queue length measurement.
- Advance detection (exploiting the long detection range).
- Loop replacement (non-intrusive detection).
- Speed measurement.

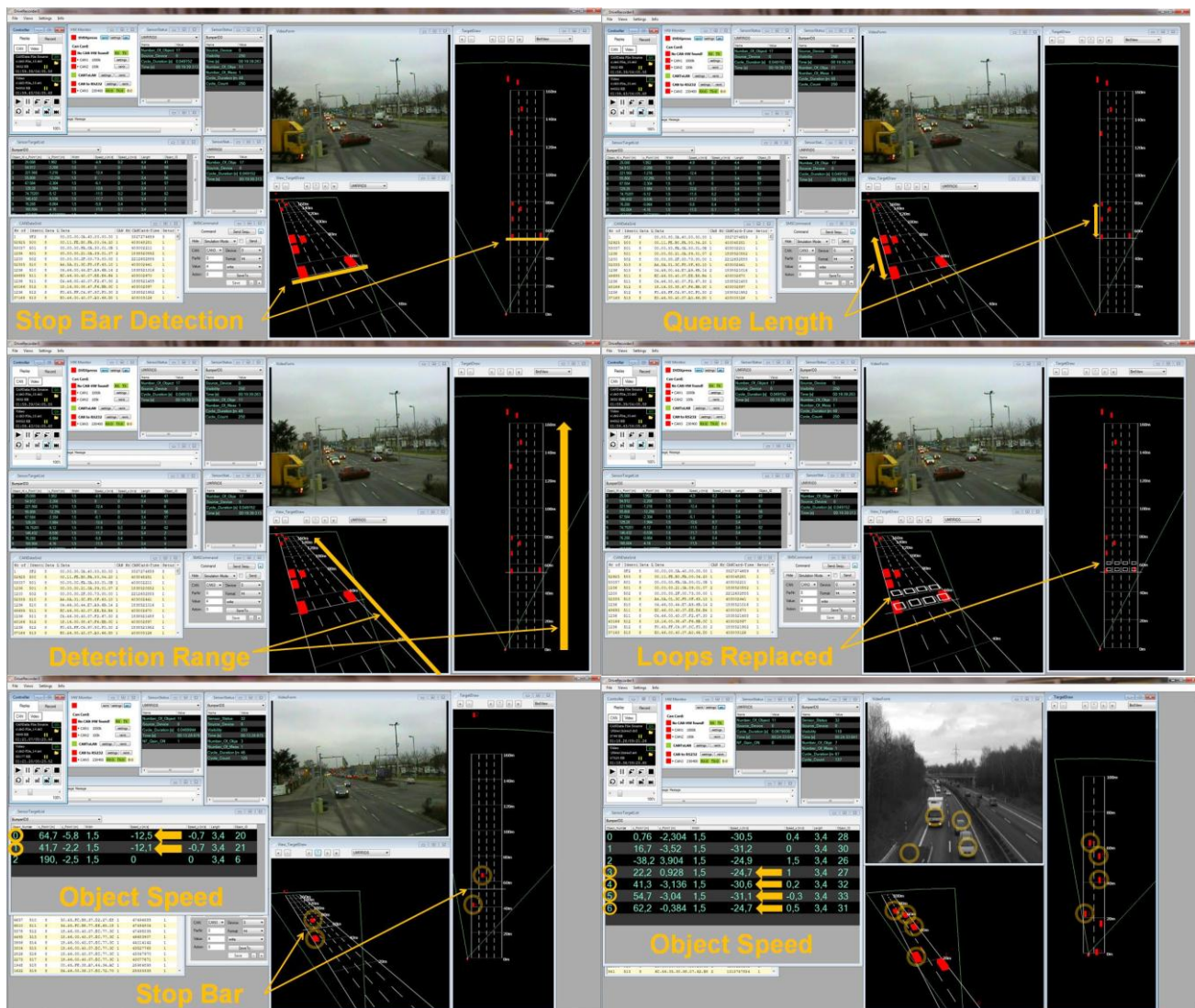


Figure 3: Example applications.

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Based on the detection and/or tracking results of the sensor a number of additional new and other applications may be feasible.

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1.3.3 Start-up time

After power up or reset, the sensor readings are within specified performance within <30 seconds.

1.3.4 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.

1.3.5 Sensor Network

The sensor is typically used standalone.

A network of multiple such sensors connected to a sensor data fusion and tracking controller (see chapter 2) can also be established, but may require customer specific configuration of the individual sensors and the tracking controller.

1.3.6 Classification

Object classification is part of the tracking algorithms.

1.3.7 Application Parameters

Feature	Details
Track initialization time	6...10 cycles typical
Traffic Direction	Approaching, receding, both
Simultaneous Object Tracking	Up to 32 objects (single sensor) Up to 128 objects (typ., sensor system)
Mounting Height	1...10m ^I
Sensor Az. angle	Typ. -15 ...+15 degree ^{II}
Sensor Elevation angle	-3...0 degree to ground ^{III}
Area of interest	Typ. 20m ... 40m ^{IV}

^I May affect max. detection range. The best performance for the applications listed in 1.3.2 is typically achieved for mounting heights between 2-8m. Occlusion needs to be considered.

^{II} Smaller angles allow longer detection range along a road.

^{III} Application specific. Gantry mounted pointing down: larger angles possible with limitations of max. range.

^{IV} Typical value for intersection stop bar applications; may be different for other applications.

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1.3.8 Example Configuration

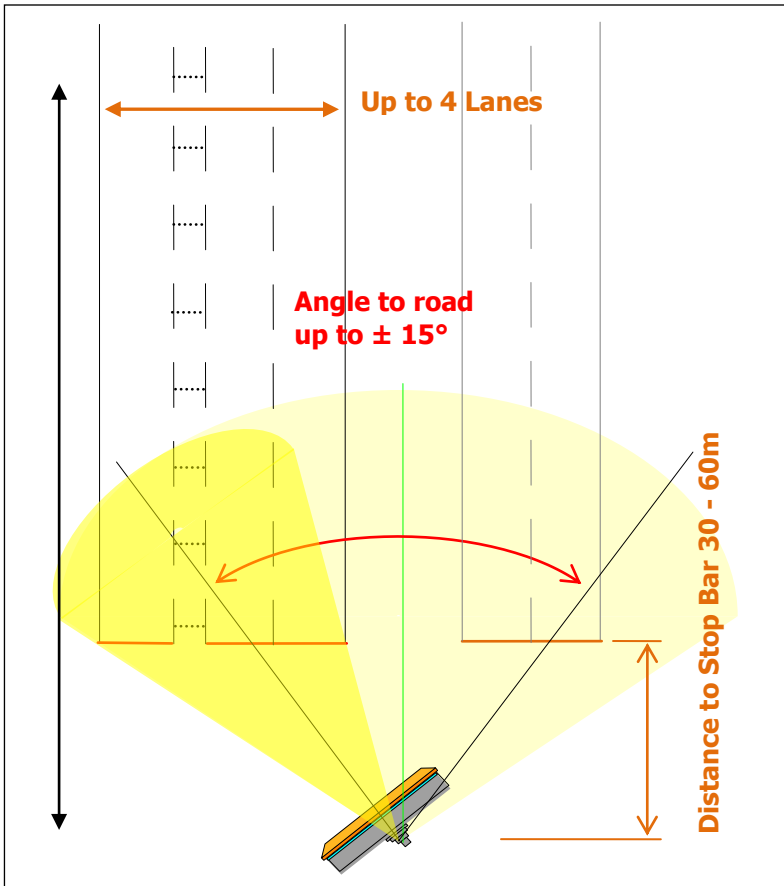


Figure 4: Typical Sensor Setup.

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1.4 Sensor Dimensions

All values given in mm.

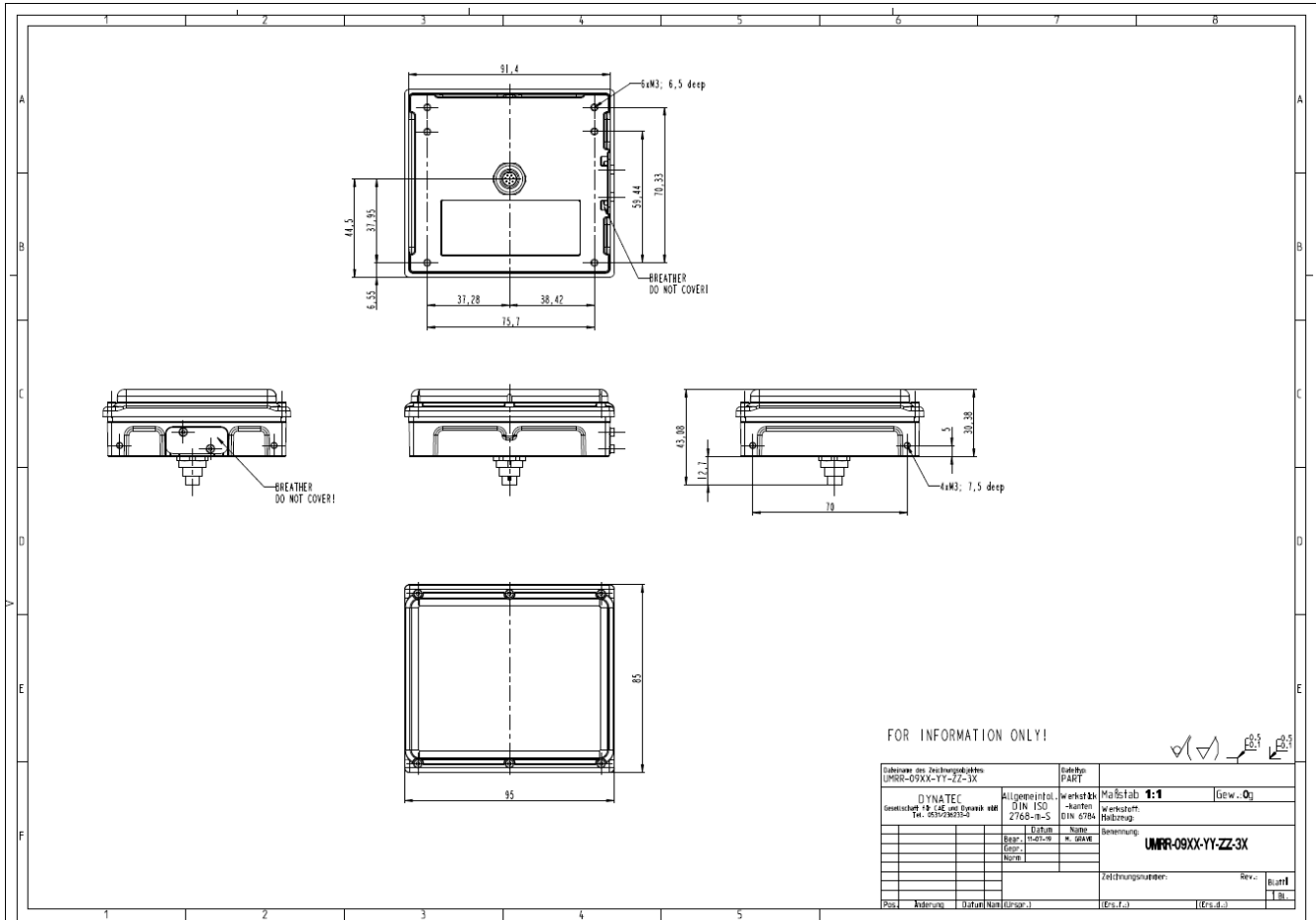


Figure 5: Sensor Dimensions.

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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1.5 Connector

1.5.1 Sensor connector

The used sensor connector is an 8-pin male (plug) circular connector (water proof IP67, series 712, manufacturer Binder GmbH, Germany). A female counterpart (socket) has to be used to connect to the sensor. The pin numbering of the socket is shown in Figure 6 the pin description is given in Table 1.

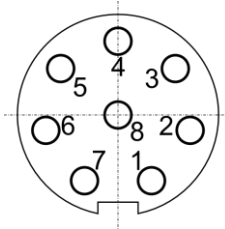


Figure 6: View on solder cup side of socket (rear view of female counterpart to be connected to sensor)

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).

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2 Multi Sensor Systems

Available at the sensor output data interface is – beside the **object** list – also the list of detected **targets** (reflectors) with the parameters

- Range
- Angle
- Radial Speed
- Reflectivity
- Other...

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

Usually the tracking algorithms are embedded in the sensor.

If required, however, the tracking (filtering and tracking of all detected reflectors over time) may be run on an additional unit ([sensor data fusion and tracking controller BUMPER-080201](#), see [data sheet](#)). This may be reasonable when multiple sensors are applied. The data of these sensors will be synchronized and will be subject to data fusion algorithms.

Optionally, those tracking and data fusion algorithms can also be run on a PC in the application SmartFrame.

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

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

In any case, visualization both of the **targets** and the **objects** is possible using the [Traffic Management Configurator](#) software in any PC, as well as data logging, associated video documentation, play back and analysis functions and more.

Instead of the [Traffic Management Configurator](#), other customer specific alarm office software products may be applied; the data interface is easy to integrate.

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2.1.1 Single Sensor Configuration

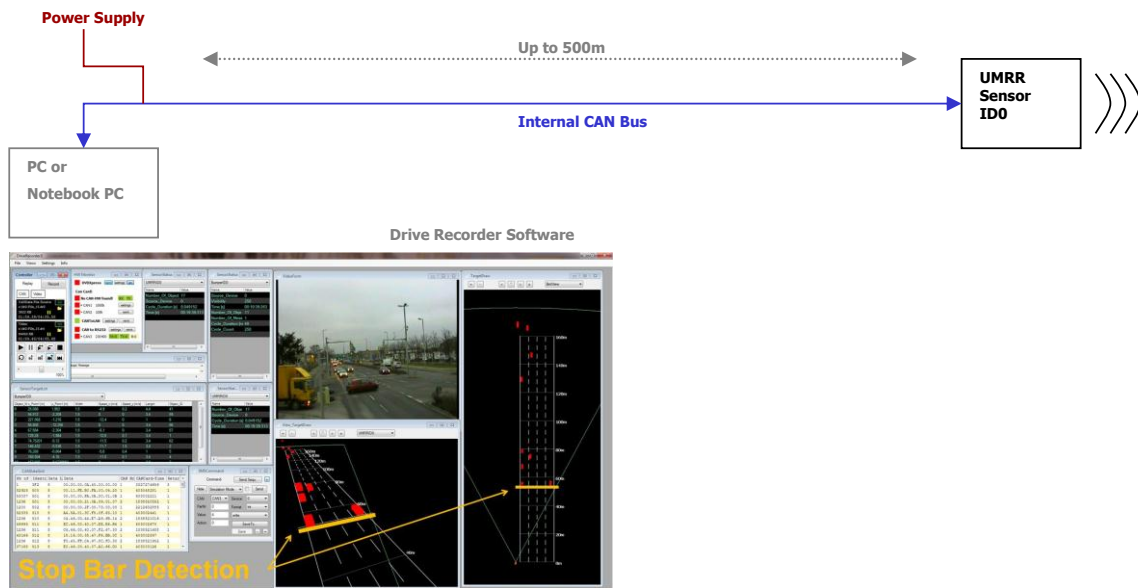


Figure 7: Single Sensor Configuration.

2.1.2 Network Configuration

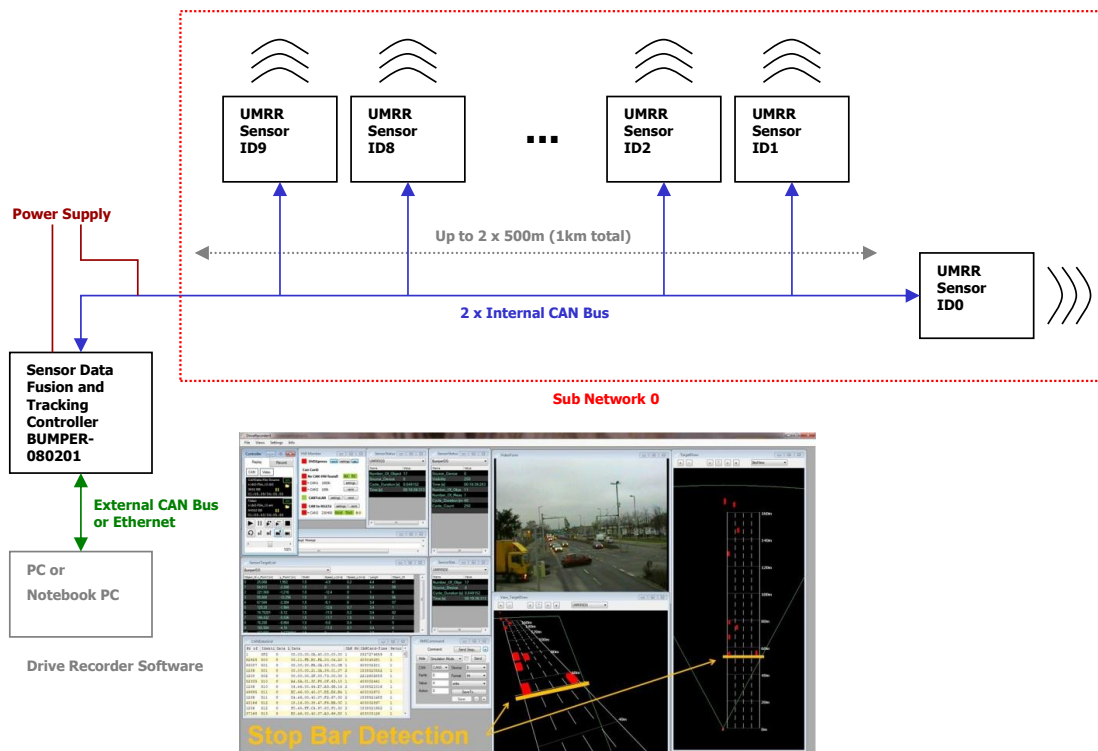


Figure 8: Network Configuration.

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