RADARXENSE

# RXS-TR-100

Multilane
Multi target
Speed
Enforcement
Radar

- **Measures velocity and the X and Y coordinate of multiple targets simultaneously**
- **Outputs an object list of targets**
- **The measured speeds are according to speed enforcement standard**

**The RXS-TR-100 measures the speed, distance and angle of multiple targets simultaneously. Due to the built-in tracker, target vehicle measurements are filtered which can be used for speed enforcement purposes as well as traffic monitoring. Multiple vehicles are simultaneously measured on multiple lanes with a single radar module. The auto calibration function for the installation angle simplifies alignment.**

## General Description

The RXS-TR-100 radar module measures velocity, range and the angle of arrival with phase comparison monopulse technology. The radar outputs telegrams, containing the speed, X-position and angle (relative to the installation position) and assigns an ID to these tracked targets. This allows interfacing to a data collection system which for example is combined with a camera. A perfect solution for speed enforcement applications, counting and traffic monitoring. This radar consists of one box containing the RF-frontend and the Digital Signal Processing. The system works in the license free 24 GHz ISM-band.

## Application

The radar can be installed on a gantry or on the roadside. For optimal results, the radar should be installed at a height of 4,5 meters. Rain has no influence on the performance of the RXS-TR-100.
The moment the radar is powered up, it starts measuring. When a target enters the antenna beam, the radar initiates the tracker. Details on this target will be presented in the RS422 telegram output when all conditions are met for a reliable speed measurement, according to speed enforcement standard. If the measured speed is not reliable according to this standard, the measurement details are still presented in the telegram but the status bit is set to 'not accurate'. This measurement can still be used for traffic monitoring or counting.

**General Technical Data**

| | |
|---|---|
| Supply voltage: | 6 to 16V (secured against false polarity) |
| Supply current: | 140mA (typical) |
| Transmit frequency: | 24.000 – 24.250GHz |
| Maximum transmit power: | 20dBm (EIRP) |
| FCC and ETSI 300 / 440 compliant with 50MHz bandwidth | |
| Antenna beam: | |
| horizontal: | 70° (+/-35°) (typical) |
| | 50° (+/-25°) (effective) |
| vertical: | 11° (+/-5,5°) (typical) |
| Modulation: | FMCW |
| Detection range: | <70m (for vehicles) |
| Speed range: | -86 to +86m/s |
| Min Speed: | -2,78m/s and +2,78m/s |
| Speed Accuracy: | +/-1km/hr for v<100km/hr |
| | +/-3% for v>100km/hr |
| Installation height: | 4 to 6m, optimized for 4,5m |

| | |
|---|---|
| Output resistance (RS422): | 1360hm |
| Output voltage (RS422): | 5V (diff.) |

The RS422 outputs are short circuit proof.

Dimensions (lxwxh): 100 x 100 x 42 (mm)

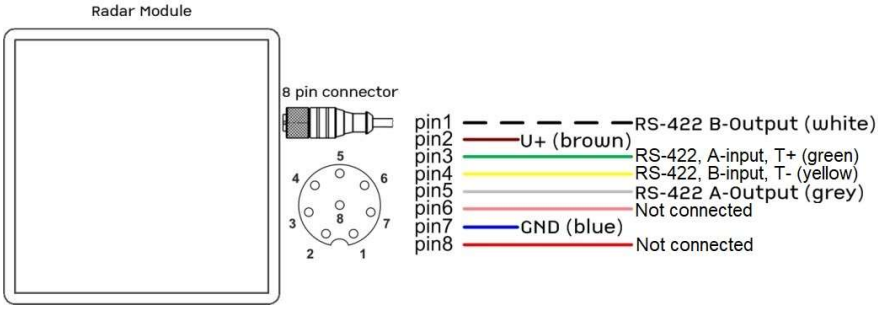
Mounting:
- 4x M4 holes at the back side
- 82 x 82 mm in square

**Environmental:**

| | |
|---|---|
| IP rating: | : IP67 |
| Operating temperature: | -20° to +60° |
| Storage temperature: | -30° to +100°C |

## Module Interface

The 8-pole circular connector used is according to industrial standards, rated IP68.




The radar system has the following interfaces:

- Power supply +6 to 16V (brown wire) and GND (ground, blue wire)
- RS422 serial output interface; A-output (black wire) and B-output (white wire)
- RS422 serial input interface; A-input (green wire) and B-input (yellow wire)

## Readout Description

The RS422 communication interface output and input have the following specification:

- Interface specification: 38400, 8, N, 1

After switching on the radar, the telegram readout will start, but the RF part is switched Off. The telegrams will be empty, all values are set to 0. The RF part should be switched on by a software command to measure target vehicles.
The object telegram contains the normal readout of the Radar and holds 76 bytes. It is repeated every 26,624ms. The telegram structure is as follows:

| Byte | 1 | 2 | 3 | 4 | 5...74 | 75 | 76 |
|---|---|---|---|---|---|---|---|
| Content | 3eh | 5eh | 7eh | 9eh | 7 times 10 bytes for 7 tracks | CRC lower byte | CRC higher byte |

One track contains:
Byte 1: R lower byte in cm
Byte 2: R higher byte in cm
Byte 3: Phi lower byte in degrees (in 0.1 degree increments)
Byte 4: Phi higher byte in degrees (in 0.1 degree increments)
Byte 5: v lower byte in cm/s (real driven speed of vehicle)
Byte 6: v higher byte in cm/s (real driven speed of vehicle)
Byte 7: cosine angle lower byte (in 0.1 degree increments)
Byte 8: cosine angle higher byte (in 0.1 degree increments)
Byte 9: status byte
Byte 10: track ID counter byte

The first track has the following byte numbering:

| Byte | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|
| Content | R lower byte in cm | R higher byte in cm | Phi lower byte in degrees | Phi higher byte in degrees | v lower byte in cm | v higher byte in cm | cosine angle lower byte | cosine angle higher byte | status byte | track ID counter byte |

The second up to the seventh track have consecutive byte numbering on the first track.

The cosine angle is the angle between the movement direction of the vehicle and the line from the Radar to the vehicle. This means the angle for the cosine correction of the measured Doppler for the real driven speed.

The status byte is divided into two parts:
Bit 0…4 are single bits.
Bit 5…7 are 3 bits which gives a value of the quality of the track. 0 is bad and 7 is fine.
Older tracks give a relative higher value for the track quality
Bit 0 is set when the track is a self-test track.
Bit 1 is set when the noise level is bad (power supply problem, moving trees, other Radar,…)
Bit 2 is set when 2 or more cars could not be separated correctly.
Bit 3 is set when the speed accuracy is not safe.
Bit 4: set at auto calibration

The speed accuracy (bit3) can only be safe/used for law enforcement purposes for the following range:
$19 \leq R(m) \leq 60$. Depending on the installation and the actual situation, more or less track information is available for $R(m)$<19 and $R(m)$>60. However, bit 3 will be set to 'not safe'.
More details on the telegram structure can be found in the "RXS-TR-100 User manual v1.5.pdf"

## Road side Installation

The RXS-TR-100 is optimized for an installation height of 4,5m

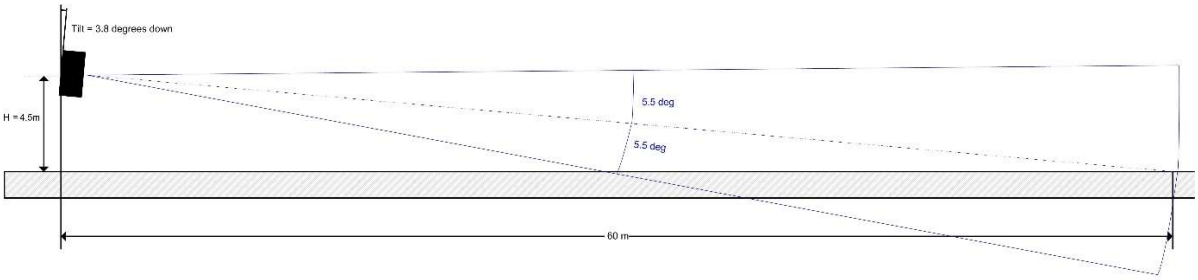



**Figure 1. Side view on an installation with a height of 4,5 m**

The middle of the antenna beam should touch the ground at 60 m in order to reach maximum coverage. At an installation height of 4,5m the tilt should be -4°.

The roll angle for the RXS-TR-100 radar should be 0°.

The advised installation angle or yaw should be between:
15°< angle <28°
However, for highway installations it is recommended not to install the radar with an angle of more than 22 degrees to the road. For urban installations, an installation angle of not more than 28 degrees is recommended.

The automatic installation/yaw angle calibration is carried out after a software command issued by the user. The calculated angle is based on a certain number of vehicles passing by. This value for the installation angle is further used to track the targets. With this installation angle, the position of the radar in relation to the traffic is known.

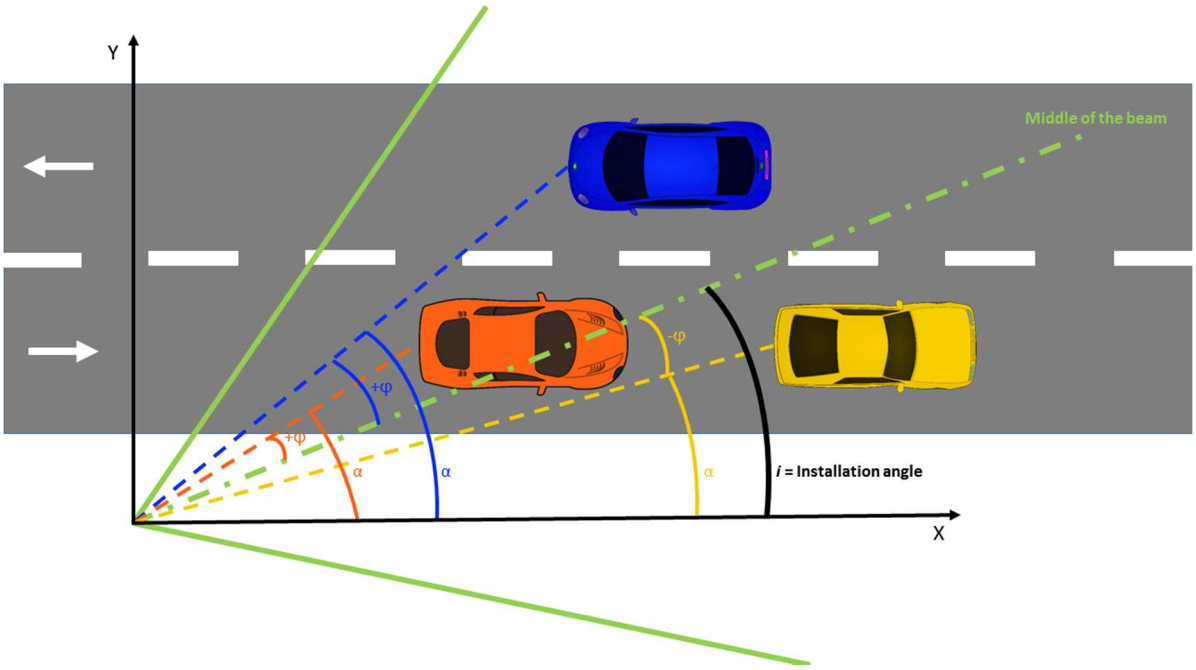



**Figure 2. Top view on the installation**

The installation angle *i*, or yaw angle is the sum of Phi and $\alpha$ :

$$i = \alpha - \varphi$$

Phi is positive on the left side of the centre line of the radar beam and negative on the right side of the centre of the radar beam.

X: along driving direction
Y: width of the road
*i*: Installation angle. This is the angle between the middle of the radar beam towards the driving direction.

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## Drawing and dimensions of the housing in mm