

TENDER DOCUMENT FOR RADAR SENSORS AND INTERFACES

UMRR-A4 Type 171 TOPGRD + COM HUB Relay 8/24

The following text describes in a neutral way the specifications of the smartmicro TOPGRD Stop+Advance radar sensor for signalized intersection control and the COM HUB Relay 8/24 interface. You can copy-paste this text in tenders.

General System Description

This specification covers the purchase, installation, configuration, and operations of an above ground Microwave Vehicle Detection System (MVDS) for presence detection of vehicles at the stop bar and at distance from the stop bar, using a radar, and covering multiple lanes. Vehicle detection information will be communicated to a traffic signal controller.

The microwave vehicle detection system (MVDS) is non-intrusive (i.e. above ground) and consists of a **radar sensor containing a radar module, a connection box, a mounting bracket, and an interface module** with on-board radar detection software. In one or more predefined detection zones (virtual radar loops"), the radar detection software detects both moving and stationary vehicles on multiple lanes. It processes raw targets supplied by one or more connected radars, conducts object tracking, facilitates radar-radar fusion, presents the fused objects and provides detection information to the traffic light controller. Via an onboard user interface software, the interface module facilitates radar sensor configuration, simulation, and finetuning.

The radar module shall be forward-fire Frequency-Modulated Continuous Wave (FMCW), with an operating frequency of 77-80GHz (frequency range not more than 1.000MHz, average EIRP transmit power not more than 35dBm under normal configuration).

It shall contain at least 6 TX (transmitter) and 8 RX (receiver) channels operating simultaneously and not in a rotating sequence. It shall have an on-board acceleration sensor to directly measure pitch and roll angle of the radar sensor for accurate alignment when mounted on a pole or gantry.

The radar detection software shall detect and classify vehicles on a minimum of 6 lanes, both approaching and receding, from 15m to a minimum of 180m away from the radar sensor.

System Components

The **radar sensor** shall communicate to the interface via power line communications, which supports power and communications over 2 wires and a separate protective earth connection. The radar sensor shall operate at 24VDC and 48VDC, and the operational temperature range shall be -40°C to +85°C. Its

power consumption shall not exceed 7.2W (or 300mA at 24VDC) during regular operations. The radar sensor shall not require maintenance (no cleaning and/or adjustments needed during normal operations) and shall comply with the required FCC Part 15 and/or EU/EN certifications. The radar sensor housing protects the radar sensor. It shall be compact, esthetic, UV-resistant, NEMA TS2 shock and vibration compliant, NEMA TS2 operating temperature compliant (-34C to +74C), and waterproof to IP67. The front (i.e. radome cover) shall be black. The rest of the housing shall be aluminum, with black anodized coating for optimized protection against corrosion and for minimized noticeability.

The **connection box** shall be black anodized aluminum, allowing simple connection of an AWG18-20 branch cable back to the interface in the traffic signal controller cabinet. It shall be IP67, shall contain a power line communications chipset, surge and lightning protection, and shall be connected to the rear back plate of the radar sensor via a bullet connector and 4 locked screws.

The **mounting bracket** shall allow horizontal and vertical mounting, small corrections on roll, pan and tilt, with etched markings for accurate radar sensor alignment, and shall be made of stainless steel. To attach the radar sensor to existing or new infrastructure, 2 stainless steel bands shall be used. The total mass of the MVDS (excl. cabling) shall be less than 1kg.

There shall be a DIN-rail clickable, compact **interface module** for connecting 2 radar sensors and providing 8 relay outputs ($U_{max}=48VDC$, $I_{max}=150mA$) to the traffic light controller. There shall be a version for connecting 4 radar sensors and providing 24 relay outputs, with the ability to add 32 extra relay outputs by adding an expansion module. The interface shall have a power line communications chipset onboard for connectivity to those radars. It must also be possible to provide detection information and other relevant system data via LAN port over MQTT, and via an RS-485 connection. The interface module shall facilitate VPN connectivity for remote access and connect to a cloud-based system for traffic data reporting and visualization. The interface module shall communicate with a laptop or tablet via LAN or Wi-Fi, for system configuration and detection verification. A documented REST API shall be available.

User Interface / System Configuration

The configuration of the system shall be done using the standard web browser on a laptop or tablet, and via web-based **software** on the interface, which shall be user-friendly and graphical, with a top-down menu structure. It shall use a Google maps image or a technical intersection drawing to place the direction sensitive lanes, the detection zones ("virtual radar loops"), the outputs and the radar sensor beam on the road's surface in a simple and accurate way.

Each virtual radar loop shall have the ability to be linked to following configurable event triggers: presence detection (moving and stationary), speed detection (with min/max settings), Estimated Time of Arrival (ETA), vehicle class, wrong way driving, Queue Length Estimation (QLE), Custom trigger (a combination of above events).

The program must incorporate integrated verification to detect critical configuration conditions, such as inadequate coverage of detection zones and significant deviation in the sensor's viewing angle from the direction of traffic flow.

It shall be possible to set-up, add, change, delete and combine (logical function OR) for up to 64 virtual radar loops on a lane-by-lane basis, providing minimum 8 detection outputs.

The radar sensor's field of view display shall be separate for the detection range of different object classes (like pedestrians, passenger cars or trucks) to allow a comprehensive visualization of the effective field of view for a certain class of object.

When a radar sensor is connected to the interface, a simulation tool embedded in the configuration web application on the interface shall be available for visual verification/validation of the system configuration on a laptop or tablet, via simulated traffic. Additionally, statistical data from the radar sensor shall be visualized using that user interface. The user interface shall have the capability of pre-defining all sensor configuration attributes without the need for the actual radar sensor to be present or connected. In that case, the configuration file shall be able to be saved and downloaded to the radar sensor later. It shall also be possible to do the radar configuration online, where configuration must be possible while normal operation is not disrupted.

Fail-Safe Features

The MVDS shall include a fail-safe feature that directs a sensor blind output to the traffic management system, enabling the intersection controller to switch to an alternative operation mode (e.g., time-based) when the MVDS is unable to detect traffic, and seamlessly return to normal operation once the condition is resolved. Additionally, the MVDS shall incorporate interference detection and mitigation functionality. Radar misalignment detection and notification shall also be present.

Lifetime Expectancy / Maintenance

The lifetime expectancy of the MVDS shall be a minimum of 10 years. The mean time to replace any of the subsystems shall be less than 15 minutes, once a technician and the necessary equipment is on-site.

General

The MVDS provider shall have more than 50.000 vehicle presence detection systems operational in at least 25 different countries. Assuming a best-class radar mounting position, alignment, configuration, and line of sight, the MVDS shall detect vehicle presence at the stop bar with $\geq 98\%$ accuracy under non-extreme weather conditions, both day and night. The radar system operational availability must be $>99\%$ in normal operating conditions, and the radar cycle time must be lower or equal to 100 milliseconds.

The supplier of the radar sensor shall provide a limited warranty (free from manufacturing defects and workmanship) for two years from the date of shipment. Extending the product warranty to 5 years must be possible.

The manufacturer of the radar system shall operate under ISO 9001 quality control procedures. This certificate shall be available upon written request.