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| **Radiocommunication Study Groups** |  |
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| Annex 21 to Working Party 5A Chairman’s Report |
| Working Document towards a preliminary draft new RECOMMENDATION ITU-R M.[AUTO] |
| Systems characteristics of automotive radars operating in the frequencyband 76-81 GHz for intelligent transport systems applications |

ec. ITU-R M.1466

Scope

This Recommendation specifies the systems characteristics of automotive radars operating under the radiolocation service in the frequency band 76-81 GHz. These technical and operational characteristics should be used in compatibility studies between automotive radars operating in the radiolocation service with systems operating within other services.

The ITU Radiocommunication Assembly,

considering

*a)* that antenna, signal propagation, target detection, and large bandwidth characteristics for automotive radars are needed to optimally achieve their functions in certain frequency bands;

*b)* that the technical characteristics of radars operating in the radiodetermination service are determined by the needs of the system and may vary widely from band to band;

*c)* that representative technical and operational characteristics of systems operating in bands allocated to the radiodetermination service are necessary to determine the feasibility of introducing new types of systems;

*d)* that procedures and methodologies are needed to analyse compatibility between radars operating in the radiodetermination service and systems operating in other services;

*e)* that an integrated system consisting of sensors and data exchange systems is beneficial for driver security;

*f)* that portions of the millimetre wave frequencies provide strong absorption due to atmospheric oxygen and water vapour and has the potential to mitigate interference between the automotive radars operating in the radiolocation service and other stations in different radio services operating in the frequency band 76-81 GHz;

*g)* that radio astronomy stations observing in the 76-81 GHz band can only do so at
a limited number of high and dry sites in relatively remote areas on Earth or under exceptionally dry conditions, and that absorption by oxygen and water vapour at these sites is considerably lower than elsewhere on Earth,

noting

*a)* that the band 77.5-78 GHz is allocated worldwide on a primary basis to the amateur and amateur-satellite services;

*b)* that the bands 76-77.5 GHz and 79-81 GHz are allocated worldwide on a primary basis to the radiolocation and radio astronomy services;

*c)* that the band 78-79 GHz is allocated worldwide on a primary basis to the radiolocation service;

*d)* that Recommendation ITU-R M.1452 on millimetre wave vehicular collision avoidance radars and radiocommunication systems for intelligent transport system applications provides further information on automotive radars operating in the band 76-81 GHz,

recommends

1 that the systems characteristics for automotive radars operating in the frequency band 76‑81 GHz for ITS applications as described in Annex 1 should be used for compatibility studies.

ANNEX 1

Systems characteristics of automotive radar systems operating in the
frequency band 76-81 GHz for ITS applications

# 1 Introduction

In the band 76-81 GHz radar systems in support of enhanced road safety are operated. Evolving demands related to automotive safety applications, including the reduction of traffic fatalities and accidents require a range resolution for automotive radar systems leading to a technical requirement for a necessary bandwidth of up to 4 GHz.

# 2 Technical characteristics of automotive radar systems operating in the frequency band 76-81 GHz

Automotive radar systems operating in the 76-81 GHz frequency range are separated in 2 categories with the technical characteristics given in Table 1:

Category 1: Adaptive Cruise Control (ACC) and collision avoidance (CA) radar, for measurement ranges up to 250 m typical technical characteristics are listed as Radar A. Such radars are considered to add additional comfort functions for the driver, giving support for more stress-free driving.

Category 2: Sensors for high resolution applications such as Blind Spot Detection (BSD), Lane-Change Assist (LCA) and Rear-Traffic-Crossing-Alert (RTCA), detection of pedestrians and bicycles in close proximity to a vehicle, for measurement ranges up to 100 m typical technical characteristics are listed as Radars and C. Such radars directly add to the passive and active safety of a vehicle and are therefore an essential benefit towards improved traffic safety.

TABLE 1

Automotive radar characteristics in the band 76-81 GHz

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Radar A****Automotive radar** | **Radar B****Automotive high-resolution radar** | **Radar C****Automotive high-resolution radar** |
| Sub-band used | 76-77 GHz  | 77-81 GHz | 77-81 GHz |
| Typical operating range | Up to 250 m | Up to 100 m | Up to 100 m |
| Target separation capability | 75 cm | 7.5 cm | 15 cm |
|  |  |  |  |
| Emission type | FMCW | FMCW | Not specified |
| RF emission bandwidth (GHz) | Max 0.8 | Max 3.8 | Max 4 |
|  |  |  |  |
| Duty cycle | [TBD] | [TBD] | [TBD] |
| Maximum e.i.r.p. (dBm) | 36over entire bandwidth | 33over entire bandwidth |  |
| Maximum transmit power to antenna (mW) |  |  | 10 over entire bandwidth |
| Mean power density e.i.r.p. (dBm/MHz) | +8 RMS | –3 RMS |  |
| Mean power density (dBm/MHz) |  |  | -26  |
| Receiver IF bandwidth (–20 dB) (MHz) | 0.5-20 | 0.5-20 | Not specified |
| Receiver noise figure (dB) | 15 | 15 | Not specified |
| Antenna type | Patch feeds with dielectric lens | Patch Array | Not specified |
| Antenna main beam gain (dBi) | 30 | 25 | 35 |

# 3 Operational characteristics of automotive radar systems operating in the frequency bands 76-77 GHz and 77-81 GHz

Automotive radar applications are evolving from providing additional comfort functions, such as Adaptive Cruise Control (ACC) and Collision Avoidance (CA) radar, to functions that significantly add to the passive and active vehicle safety. This requires systems that can detect objects in the close proximity of the vehicle, such as pedestrians or bicycles. Such applications require radar sensors that have a target separation capability of less than 10 cm. Radar sensors that provide this resolution require operating bandwidths of 4 GHz.

Radar A type sensors detect relevant road traffic in order to adapt the speed of the vehicle to that of other vehicles ahead. To satisfy the demands for increased car safety, and depending on the application, one or more radar A type systems may be combined with additional radar B and C type sensors in one vehicle. Based on the sensor information, the data processing system in the vehicle will trigger the appropriate radar.

Radar B and C type sensors cover the close proximity of a vehicle and will add additional active and passive safety functions e.g. autonomous emergency breaking, active blind spot assistant, lane change assistant.