CEPT ECC
Electronic Communications Committee

ECC Decision (22)03

Technical characteristics, exemption from individual licensing and free circulation and use of specific radiodetermination applications in the frequency range 116-260 GHz

approved 18 November 2022

amended 8 March 2024

EXPLANATORY MEMORANDUM

1 INTRODUCTION

The free circulation of radio products and the provision of equipment in Europe for radio determination and communication are only achievable if there are regulations harmonised throughout Europe regarding the availability of frequency bands, harmonised technical conditions, and procedures for cross-border usages. The main requirements for fulfilling these objectives for specific radiodetermination devices are the Europe-wide availability of suitable frequency bands, harmonised technical conditions, and the implementation of national regulations.

The readily available technologies in the frequency range 116-260 GHz provides appropriate sensor performance for a variety of different specific radiodetermination applications, such as (refer to ETSI TR 103 498 [1], clauses 5 and 6):

- Generic indoor surveillance radar;
- Radiodetermination systems for industry automation (RDI);
- Level probing radar (LPR);
- Contour determination and acquisition radar (CDR);
- Tank level probing radar (TLPR);
- Radiodetermination systems for industry automation in shielded environments (RDI-S);
- Exterior vehicular radar (EVR);
- In-cabin vehicular radar (IVR).

The above-mentioned measurement applications are achievable with new spectrum designations for the mentioned specific radiodetermination applications in the range above 116 GHz where larger modulation bandwidths can be realised and the interference potential towards other spectrum users is lower due to the higher free space loss, the higher indoor-outdoor attenuation of a building and the tendentially higher atmospheric attenuation.

This ECC Decision covers the radio regulatory aspects of operation of the aforementioned specific radiodetermination applications.

2 BACKGROUND

ETSI had developed and provided ECC with the TR 103 498 on “Radiodetermination applications within the frequency range 120-260 GHz” [1]. This System Reference Document includes the description of a multiplicity of specific radiodetermination applications and the identification of suitable frequency bands in which they can be operated in the overall considered frequency range of 120-260 GHz.

In order to assess potential interference from specific radiodetermination applications on the radiocommunication services in the frequency range 116-260 GHz, coexistence studies have been conducted which are contained in ECC Report 334 [2] and ECC Report 351 [3]. It is worth to mention that the lower edge of the considered frequency band 116-260 GHz has been changed from originally 120 GHz to 116 GHz during the transaction of the technical coexistence study in order to align with the frequency bands available in the USA for generic use (Code of Federal Regulations Title 47 Chapter I Subchapter A §15.258 [6]).

The study in ECC Report 334 concluded that the following frequency bands may be used by the corresponding specific radiodetermination applications indicated below:

- Generic indoor surveillance radar in the bands 122.25-130 GHz and 134-148.5 GHz;
- Radiodetermination systems for industry automation (RDI) in the bands 174.8-182 GHz, 185-190 GHz and 231.5-250 GHz;
- Level Probing Radar (LPR) and Tank level probing radar (TLPR) in the bands 116-148.5 GHz, 167 - 182 GHz and 231.5-250 GHz;
- Contour determination and acquisition radar (CDR) in the bands 116-148.5 GHz, 167-182 GHz and 231.5 - 250 GHz;

- Radiodetermination systems for industry automation in shielded environments (RDI-S) in the band 116-260 GHz.

ECC Report 334 [2] also concluded that the operation of RDI-S in the band 116-260 GHz might require contiguous spectrum of more than 32.5 GHz in some very specific cases, that could only be realised if passive bands subject to RR No. 5.340 [7] would be used. While RR No. 5.340 prohibits any emissions in these bands, an exception would be required for such cases under the conditions agreed by ECC Plenary #52:

- Very specific type of applications (Type C, according to SRdoc ETSI TR 103 498 [1]);
- Very low number of devices;
- Shall not be understood as precedence for general allowance for using the bands covered by RR No. 5.340;
- Maintained to professional indoor applications (in shielded industrial environments) limited in numbers.

ECC Report 351 [3] built upon the work from ECC Report 334 to further investigate vehicular radio determination applications. The following frequency bands may be used by the corresponding specific vehicular radiodetermination applications indicated below:

- Exterior vehicular radar (EVR) in the bands 122.25-130 GHz, 134-141 GHz and 141-148.5 GHz;
- In-cabin vehicular radar (IVR) in the bands 122.25-130 GHz, 134-148.5 GHz.

An agreed regulatory approach is required to ensure that the spectrum used by specific radiodetermination applications in the frequency range 116-260 GHz can be accessed in any national territory, provided that the systems conform to the agreed power limits, spectrum access and installation requirements in order not to cause harmful interference to the radiocommunication services.

The designation of harmonised frequency bands forms the basis for the free circulation and cross-border use of specific radiodetermination applications within Europe.

3 REQUIREMENT FOR AN ECC DECISION

The allocation or designation of frequency bands for use by a radiocommunication service or an application, respectively, under specified conditions in CEPT administrations is laid down by laws, secondary legislations or administrative measures. ECC Decisions are required to regulate the radio spectrum in order to allow free circulation and use of equipment throughout Europe. The free circulation and cross-border use of the radio equipment will be greatly assisted when all CEPT administrations exempt the same categories of radio equipment from individual licensing and by applying harmonised criteria.

Europe-wide harmonisation of the frequency bands and conditions for use supports the proper implementation of the Radio Equipment Directive 2014/53/EU [4]. A commitment by CEPT administrations to implement this ECC Decision will provide a clear indication that the frequency bands required for specific radiodetermination applications within the frequency range 116-260 GHz are available on a European basis.

ECC DECISION OF 18 NOVEMBER 2022 ON THE HARMONISED FREQUENCY BANDS, TECHNICAL CHARACTERISTICS, EXEMPTION FROM INDIVIDUAL LICENSING AND FREE CIRCULATION AND USE OF SPECIFIC RADIODETERMINATION APPLICATIONS IN THE FREQUENCY RANGE 116 - 260 GHZ (ECC DECISION (22)03), AMENDED 8 MARCH 2024

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that every state has sovereignty on its territory and on the radio spectrum;

b) that harmonised conditions across CEPT/EU help to establish an effective single market for these specific radiodetermination applications, with consequent economies of scale and benefits to this industry in Europe, and avoid difficulties in enforcing divergent national regulations;

c) that the issue of compatibility of specific radiodetermination applications in the frequency range 116-260 GHz with other radio equipment is the responsibility of the relevant national authorities;

d) that coexistence studies considering specific radiodetermination applications in the frequency range 116-260 GHz and radiocommunication services (Radio Astronomy Service (RAS), Fixed Service (FS), Earth Exploration Satellite Service (EESS) passive and Amateur Service) operating in the same frequency bands and in adjacent bands have been conducted by ECC and that the results of these studies are contained in ECC Report 334 [2] and ECC Report 351 [3];

e) that administrations can define exclusion and coordination zones to protect the Radio Astronomy Service (RAS) on a national level;

f) that ECC Report 334 [2] and ECC Report 351 [3] recommend implementing exclusion zones around the radio astronomy stations NOEMA and IRAM-30 m for certain specific radiodetermination applications, as shown in Table 1 in Annex 1 for the protection of the Radio Astronomy Service (RAS);

g) that the specific radiodetermination applications,

- Radiodetermination systems for industry automation (RDI),
- Level Probing Radar (LPR),
- Tank level probing radar (TLPR),
- Contour determination and acquisition radar (CDR),
- Radiodetermination systems for industry automation in shielded environments (RDI-S),

are identified as applications for industrial use appearing with relatively small quantities mainly in industrial areas and are installed, operated and maintained by trained personnel, which provides confidence for proper implementation of the required regulatory provisions;

h) that the manufacturers of specific radiodetermination applications will be required to make relevant provisions in the design of devices and the content of installation manuals (and any respective training material) to achieve the proper implementation of objectives and details of the regulatory requirements set out in this ECC Decision;

i) that there is an industry and user requirement for harmonised usage conditions for the use of radio equipment throughout Europe for specific radiodetermination applications in the frequency range 116-260 GHz;

j) that it would be desirable for administrations to have common regulations at their disposal in order to control free carriage and use of specific radiodetermination applications in the frequency range 116-260 GHz throughout Europe;

k) that RR No. 5.340 states that "all emissions are prohibited" in a number of frequency bands allocated to EESS (passive), RAS and SRS (passive), including the bands 114.25-116 GHz, 148.5-151.5 GHz, 164 - 167 GHz, 182-185 GHz, 190-191.8 GHz, 200-209 GHz, 226-231.5 GHz, 250-252 GHz;

l) that this designation for RDI-S does not establish precedence for generic consent to use the passive bands covered by RR No. 5.340 [7] by any active application and is considered as an exception;

m) that, for tracking and monitoring purposes, manufacturers placing RDI-S equipment to the market that might use the passive bands covered by RR No. 5.340 are encouraged to inform the Office about such use with the information listed in Annex 3;

n) that ETSI is developing the European Standard EN 305 550-2 "Short Range Devices (SRD) to be used in the 40-260 GHz frequency range, Harmonised Standard for access to radio spectrum Part 2: radiodetermination for industrial applications" [8], which includes the specific radiodetermination applications in the frequency range 116-260 GHz subject of this ECC Decision;

o) that changes of the protection of radio astronomy sites (RAS) in Annex 1 will be visible by means of this Decision as well as ETSI EN 305 550-2 and subsequently be implemented under the responsibility of the individual application manufacturer;

p) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the Radio Equipment (RE) Directive. Conformity with the essential requirements of the RE Directive may be demonstrated by compliance with the applicable harmonised European standard(s), cited in the Official Journal (OJ) of the European Union, or by using the other conformity assessment procedures set out in the RE Directive;

DECIDES

1. that the purpose of this ECC Decision is to harmonise the usage conditions for the following specific radiodetermination applications which operate in dedicated bands in the frequency range 116-260 GHz:

   - Generic indoor surveillance radar;
   - Radiodetermination systems for industry automation (RDI);
   - Level probing radar (LPR);
   - Tank level probing radar (TLPR);
   - Contour determination and acquisition radar (CDR);
   - Radiodetermination systems for industry automation in shielded environments (RDI-S);
   - Exterior vehicular radar (EVR);
   - In-cabin vehicular radar (IVR);

2. that CEPT administrations shall designate the frequency bands:

   - 122.25-130 GHz and 134-148.5 GHz for generic indoor surveillance radar, exterior vehicular radar (EVR) and in-cabin vehicular radar (IVR);
   - 174.8-182 GHz, 185-190 GHz and 231.5-250 GHz for radiodetermination systems for industry automation (RDI);
   - 116-148.5 GHz, 167-182 GHz and 231.5-250 GHz for level probing radar (LPR), tank level probing radar (TLPR) and contour determination and acquisition radar (CDR);

3. that CEPT administrations shall also designate the frequency band 116-260 GHz band for radiodetermination systems for industry automation in shielded environments (RDI-S), noting that any overlapping usage within the bands covered by RR No. 5.340 shall be on an exceptional basis when contiguous bandwidth is necessary for proper operation, taking into account *considering k, l, and m)*;

4. that the above mentioned specific radiodetermination applications shall comply with the technical requirements specified in Annex 2;

5. that, subject to *decides 8* (RAS exclusion zone implementation) and *decides 4* (technical requirements), CEPT administrations shall permit free circulation and use of specific radiodetermination applications in the frequency range 116-260 GHz;

6. that, subject to *decides 4*, CEPT administrations shall exempt from individual licensing the specific radiodetermination applications permitted under this ECC Decision;

7. that specific radiodetermination applications permitted under this ECC Decision operate on a non-interference and non-protected basis;

8. that specific radiodetermination applications permitted under this ECC Decision shall not be installed and operated inside a RAS exclusion zone included in Annex 1;

9. that any request for update of the information on radio astronomy sites in Annex 1 (new RAS sites or withdrawal of RAS sites, exclusion zones) shall be notified by administrations to the Office;

10. that changes of protection of radio astronomy sites in Annex 1 shall be effective to specific radiodetermination devices in 116-260 GHz within a timeframe of not more than 12 months after the publication of the specified exclusion zones;

11. that this Decision enters into force on 8 March 2024;

12. that the preferred date for implementation of this Decision shall be 8 September 2024;

13. that CEPT administrations should inform the Office about the national implementation of this Decision by updating their national implementation information in relation to the entry for specific radiodetermination applications in the frequency range 116 to 260 GHz in ERC Recommendation 70-03, annex 6 [5].”

Note:

Please check the Office documentation database https://docdb.cept.org/ for the up to date implementation status of this ECC Decision, as well as for the CEPT deliverables in the list of references.

ANNEX 1: PROTECTION OF RADIO ASTRONOMY SERVICE (RAS) SITES

Table 1 lists the RAS stations in CEPT member countries operating in the range 116-260 GHz. The related exclusion zones to be implemented by different specific radiodetermination applications can be extracted from Table 2.

Table 1: European radio astronomy observatories operating in the frequency range 116-260 GHz

Country / administration	Observatory name and location	Geographic Latitude	Geographic Longitude
France	NOEMA, Plateau de Bure	44°38'02" N	05°54'28" E
Spain	IRAM 30 m, Pico Veleta	37°04'06" N	03°23'55" W

Table 2: Exclusion zones around RAS sites to be implemented by different specific radiodetermination applications

Specific radiodetermination applications	Exclusion zone around RAS site
Hand-held/mobile generic indoor surveillance radar	1.6 km
Fixed generic indoor surveillance radar	10.7 km
Radiodetermination systems for industry automation (RDI)	20.0 km
Level Probing Radar (LPR)	13.0 km
Contour determination and acquisition radar (CDR)	20.0 km
Radiodetermination systems for industry automation in shielded environments (RDI-S)	13.2 km
Exterior vehicular radar (EVR) (Note 1)	3.0 km
In-cabin vehicular radar (IVR)	3.0 km
Note 1: Additional coordination zones are required for exterior vehicular radar applications. Administrations can define these at a national level. A possible framework is suggested in ECC Report 351, Annex 3.	

ANNEX 2: GENERAL TECHNICAL REQUIREMENTS FOR RADIODETERMINATION APPLICATIONS IN THE FREQUENCY RANGE 116-260 GHZ USING SPECIFIC RADIODETERMINATION TECHNOLOGY

A2.1 TECHNICAL REQUIREMENTS FOR GENERIC INDOOR SURVEILLANCE RADAR

Generic indoor surveillance radars are used for measuring and determining physical characteristics like presence, distance, velocity or material properties of a target object. The generic indoor surveillance radar application is intended for private indoor use and has been divided into the two subcategories hand-held/mobile and fixed generic indoor surveillance radar. Devices falling under the hand-held/mobile category are portable and moveable inside the building, whereas fixed generic indoor surveillance radars shall remain in a permanently fixed position.

Table 3: Technical requirements for hand-held/mobile generic indoor surveillance radar in the designated bands

Designated frequency band	Maximum mean e.i.r.p. (Note 1)	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 5)	Spectrum access and mitigation requirements (Note 3)	Minimum unwanted emissions attenuation (Note 4)
	A	B	C	D	E
122.25-130 GHz	10 dBm	-20 dBm/MHz	20 dBm	$\sum T_{meas} \leq 400$ ms within Tobs = 1 s is equivalent to a maximum duty cycle of 40%	20 dB
134-148.5 GHz	10 dBm	-20 dBm/MHz	20 dBm	$\sum T_{meas} \leq 400$ ms within Tobs = 1 s is equivalent to a maximum duty cycle of 40%	20 dB

Note 1: Maximum mean e.i.r.p. within the OFR (see Note 4) and during T_{meas} (time when transmission is on).

Note 2: These limits should be measured with an RMS detector and averaging time of 1 ms.

Note 3: The maximum duty cycle is not included in the maximum mean e.i.r.p. and maximum mean e.i.r.p. spectral density values. Consequently, these values must be reduced by 4 dB when averaging over the observation time T_{obs} = 1 s because of the inclusion of the maximum duty cycle of 40%.

Note 4: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 5: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Table 4: Technical requirements for fixed generic indoor surveillance radar in the designated bands

Designated frequency band	Maximum mean e.i.r.p. (Note 1)	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 5)	Spectrum access and mitigation requirements (Note 3)	Minimum unwanted emissions attenuation (Note 4)
	A	B	C	D	E
122.25-130 GHz	20 dBm and 12 dBm > 0° elevation	-10 dBm/MHz and -18 dBm/MHz > 0° elevation	30 dBm and 22 dBm > 0° elevation	$\sum T_{meas} \leq 100$ ms within Tobs = 1 s is equivalent to a maximum duty cycle of 10%	20 dB
134-148.5 GHz	20 dBm and 12 dBm > 0° elevation	-10 dBm/MHz and -18 dBm/MHz > 0° elevation	30 dBm and 22 dBm > 0° elevation	$\sum T_{meas} \leq 100$ ms within Tobs = 1 s is equivalent to a maximum duty cycle of 10%	20 dB

Note 1: Maximum mean e.i.r.p. within the OFR (see Note 4) and during T_{meas} (time when transmission is on).

Note 2: These limits should be measured with an RMS detector and averaging time of 1 ms.

Note 3: The maximum duty cycle is not included in the maximum mean e.i.r.p. and maximum mean e.i.r.p. spectral density values. Consequently, these values must be reduced by 10 dB when averaging over the observation time T_{obs} = 1 s because of the inclusion of the maximum duty cycle of 10%.

Note 4: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 5: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for generic indoor surveillance radars to allow licence-exempt use:

1. All generic indoor surveillance radars (hand-held/mobile and fixed) shall only be operated indoors (i.e. inside a building) or inside similarly shielded environments;
2. Fixed generic indoor surveillance radars shall be installed at a permanent fixed position indoors (i.e. inside a building) or inside similarly shielded environments;
3. Users and installers have to ensure that fixed generic indoor surveillance radars, although installed inside a building, do not perform a function outside the building structure, such as for example the detection of persons outside the building (e.g. through-wall imaging);
4. For fixed generic indoor surveillance radars, the mean e.i.r.p. above 0° elevation shall be limited to 12 dBm (8 dB below the maximum mean e.i.r.p. of 20 dBm);
5. The provider is required to inform the users and installers of fixed generic indoor surveillance radars about the installation requirements and additional special mounting instructions.

A2.2 TECHNICAL REQUIREMENTS FOR RADIODETERMINATION SYSTEMS FOR INDUSTRY AUTOMATION (RDI)

Radiodetermination systems for industry automation (RDI) are used for measuring and determining physical characteristics like presence, distance, velocity or material properties of a target object located primarily in open-air areas. The RDI application is intended for industrial automation purposes and professional use only.

Table 5: Technical requirements for RDI devices in the designated bands

Designated frequency band	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 3)	Minimum unwanted emissions attenuation (Note 1)
	A	B	C	D
174.8-182 GHz	5%	-13.8 dBm/MHz	31 dBm	20 dB
185-190 GHz	5%	-13.8 dBm/MHz	31 dBm	20 dB
231.5-250 GHz	5%	-25.6 dBm/MHz	31 dBm	20 dB

Note 1: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The maximum duty cycle of 5% is already included in this mean e.i.r.p. limit value. Consequently, the given maximum mean e.i.r.p. spectral density limit is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for radiodetermination systems for industry automation (RDI) to allow licence-exempt use:

1. The operation of RDI sensors is envisaged for industrial purposes only;
2. Installation and maintenance of RDI equipment shall be performed by professionally trained personnel only;
3. RDI equipment shall not be marketed to private end customers;
4. Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimise unintentional reflections and scattering;
5. Outdoor RDI sensors shall only be installed in heights from 0 m to 3 m above ground;
6. The provider is required to inform the users and installers of RDI equipment about the installation requirements and additional special mounting instructions;
7. For RDI devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm.

A2.3 TECHNICAL REQUIREMENTS FOR LEVEL PROBING RADAR (LPR)

Level probing radars (LPR) are used for measuring and determining the distance to the surface of a target material (e.g. liquids and solids) located primarily in open-air areas or inside tanks with non-attenuating shells (e.g. plastic tanks) and thus indirectly the amount or volume of the available material. Furthermore, the measurement of other physical characteristics such as the velocity of the surface or properties of the target material is also provided. The LPR application is intended for industrial and professional use only.

Table 6: Technical requirements for LPR devices in the designated bands

Designated frequency band	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 3)	Minimum unwanted emissions attenuation (Note 1)
	A	B	C	D
116-148.5 GHz	5%	-8.0 dBm/MHz	37 dBm	20 dB
167-182 GHz	5%	-6.0 dBm/MHz	37 dBm	20 dB
231.5-250 GHz	5%	-6.0 dBm/MHz	37 dBm	20 dB

Note 1: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The duty cycle of 5% is already included in this mean e.i.r.p. limit value. Consequently, the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for level probing radars (LPR) to allow licence-exempt use:

1. The operation of LPR sensors is envisaged for industrial purposes only;
2. Installation and maintenance of LPR equipment shall be performed by professionally trained individuals only;
3. LPR equipment shall not be marketed to private end customers;
4. Level probing radars are required to be installed at a permanent fixed position pointing in a downwards direction towards the ground. The equipment shall not operate while being moved, or while inside a moving container;
5. Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimise unintentional reflections and scattering;
6. The provider is required to inform the users and installers of LPR equipment about the installation requirements and additional special mounting instructions;
7. For LPR devices, the peak e.i.r.p. for elevations above 0° shall be limited to 0 dBm;
8. For LPR devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm.

A2.4 TECHNICAL REQUIREMENTS FOR CONTOUR DETERMINATION AND ACQUISITION RADAR (CDR)

Contour determination and acquisition radars (CDR) are used for measuring and determining a plurality of distance values to the surface of a target material located primarily in open-air areas or inside tanks with non-attenuating shells (e.g. plastic tanks). The distance information is used to form a digital contour representation of the bulk material surface and can consequently be used to precisely determine the amount or volume of the available material in the respective measurement scenario. Furthermore, the measurement of other physical characteristics of the target surface is also provided. The CDR application is intended for industrial and professional use only. CDR devices are classified into two categories:

- mechanical- and phased-array CDR (M-CDR and PA-CDR);
- digital beamforming CDR (DBF-CDR).

This classification has been conducted based on the acquisition of the angular direction information which can be realised by mechanical tilting of a single antenna (M-CDR) and/or by electronic beam steering using parallel operation of multiple antenna elements (PA-CDR). In case of a multiplexed operation of the multiple antenna elements a digital beamforming (DBF-CDR) receiver architecture is realised.

Table 7: Technical requirements for DBF-CDR devices in the designated bands

Designated frequency band	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 3)	Minimum unwanted emissions attenuation (Note 1)
	A	B	C	D
116-148.5 GHz	10%	-32.6 dBm/MHz	15 dBm	20 dB
167-182 GHz	10%	-29.0 dBm/MHz	15 dBm	20 dB
231.5-250 GHz	10%	-23.0 dBm/MHz	15 dBm	20 dB

Note 1: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The duty cycle of 10% is already included in this mean e.i.r.p. value. Consequently, the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Table 8: Technical requirements for M-CDR and PA-CDR devices in the designated bands

Designated frequency band	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 3)	Minimum unwanted emissions attenuation (Note 1)
	A	B	C	D
116-148.5 GHz	10%	-12.0 dBm/MHz	28.6 dBm	20 dB
167-182 GHz	10%	-9.0 dBm/MHz	34.6 dBm	20 dB
231.5-250 GHz	10%	-6.0 dBm/MHz	37 dBm	20 dB

Note 1: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The duty cycle of 10% is already included in this mean e.i.r.p. value. Consequently, the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for contour determination and acquisition radars (CDR) to allow licence-exempt use:

1. The operation of CDR sensors is envisaged for industrial purposes only;
2. Installation and maintenance of CDR equipment shall be performed by professionally trained individuals only;
3. CDR equipment shall not be marketed to private end customers;
4. CDR equipment is required to be installed at a permanent fixed position. The equipment shall not operate while being moved;
5. Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimise unintentional reflections and scattering;
6. The provider is required to inform the users and installers of CDR equipment about the installation requirements and additional special mounting instructions;
7. For CDR devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm;

For digital beamforming contour determination and acquisition radar (DBF-CDR) applications the following additional requirement shall apply:

1. DBF-CDRs are required to be pointing vertically downwards towards the ground.

For mechanical- and phased-array contour determination and acquisition radar (M-CDR and PA-CDR) applications the following additional requirements shall apply:

1. M- and PA-CDRs shall have a permanent spatially scanning behaviour of the antenna main beam direction at any time during operation;
2. The maximum tilting angle of the antenna main beam direction in relation to the vertical axis towards the ground shall never exceed 60°;
3. The peak e.i.r.p. for elevations above 0° shall be limited to 0 dBm.

A2.5 TECHNICAL REQUIREMENTS FOR TANK LEVEL PROBING RADAR (TLPR)

Tank level probing radars (TLPR) are used for measuring and determining the distance to the surface of a target material (e.g. liquids and solids) inside shielded tanks and containers and thus indirectly the amount or volume of the available material. Furthermore, the measurement of other physical characteristics such as velocity or properties of the target material is also provided. The TLPR application is intended for industrial and professional use only.

Table 9: Technical requirements for TLPR devices in the designated bands

Designated frequency band	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 3)	Minimum unwanted emissions attenuation (Note 1)
	A	B	C	D
116-148.5 GHz	100%	12 dBm/MHz	42 dBm	20 dB
167-182 GHz	100%	12 dBm/MHz	42 dBm	20 dB
231.5-250 GHz	100%	12 dBm/MHz	42 dBm	20 dB

Note 1: The operating frequency range (OFR) is defined over the 20 dB reduction of the intentional transmission ("20 dB bandwidth") radiated by the equipment into the air. The unwanted emissions attenuation applies to the frequencies outside the OFR and shall be applied to the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for tank level probing radars (TLPR) to allow licence-exempt use:

1. The operation of TLPR sensors is envisaged for industrial purposes only;
2. Installation and maintenance of TLPR equipment shall be performed by professionally trained individuals only;
3. TLPR equipment shall not be marketed to private end customers;
4. TLPRs shall be installed at a permanent fixed position at a closed metallic tank or concrete tank, or a similar enclosure structure made of comparable attenuating material;
5. Flanges and attachments of the TLPR equipment shall provide the necessary microwave sealing by design;
6. Sight glasses shall be coated with a microwave-proof coating when necessary (i.e. electrically conductive or microwave absorbing coating);
7. Manholes or connection flanges attached to the tank shall be closed while the TLPR equipment is in operation to ensure a low-level leakage of the signal into the free space outside the tank;
8. The provider is required to inform the users and installers of TLPR equipment about the installation requirements and additional special mounting instructions;
9. For TLPR devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm.

A2.6 TECHNICAL REQUIREMENTS FOR RADIODETERMINATION SYSTEMS FOR INDUSTRY AUTOMATION IN SHIELDED ENVIRONMENTS (RDI-S)

Radiodetermination systems for industry automation in shielded environments (RDI-S) are used for sensing unique frequency dependent material properties and/or wideband frequency responses (e.g. S-parameters to extract other physical properties) of target objects inside buildings (indoors) or in similarly shielded environments. Examples of RDI-S systems are radar sensors for plastic extrusion thickness measurement or for non-destructive testing. The RDI-S application is intended for industrial and professional use only.

Table 10: Technical requirements for RDI-S devices in the designated band 116-260 GHz

Frequency range	Maximum duty cycle	Maximum mean e.i.r.p. spectral density (Note 2)	Maximum peak e.i.r.p. (Note 4)	Unwanted emission limits (Note 1)
	A	B	C	D
116-122.5 GHz	100%	-5 dBm/MHz	45 dBm	
122.5-123 GHz	100%	-5 dBm/MHz	45 dBm	
123-130 GHz	100%	+10 dBm/MHz	60 dBm	
130-134 GHz	100%	-5 dBm/MHz	45 dBm	
134-141 GHz	100%	+10 dBm/MHz	60 dBm	
141-148.5 GHz	100%	-5 dBm/MHz	45 dBm	
148.5-151.5 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
151.5-158.5 GHz	100%	-5 dBm/MHz	45 dBm	
158.5-164 GHz	100%	-5 dBm/MHz	45 dBm	
164-167 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
167-174.5 GHz	100%	-5 dBm/MHz	45 dBm	-15 dBm/MHz max. mean e.i.r.p. spectral density (Note 2) and 35 dBm max. peak e.i.r.p. (Note 4)
174.5-174.8 GHz	100%	-5 dBm/MHz	45 dBm	
174.8-182 GHz	100%	+10 dBm/MHz	60 dBm	
182-185 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
185-190 GHz	100%	-5 dBm/MHz	45 dBm	
190-191.8 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
191.8-200 GHz	100%	-5 dBm/MHz	45 dBm	
200-209 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
209-226 GHz	100%	-5 dBm/MHz	45 dBm	
226-231.5 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
231.5-235 GHz	100%	-5 dBm/MHz	45 dBm	
235-238 GHz	100%	-5 dBm/MHz	45 dBm	
238-241 GHz	100%	-5 dBm/MHz	45 dBm	
241-244 GHz	100%	-5 dBm/MHz	45 dBm	
244-246 GHz	100%	-5 dBm/MHz	45 dBm	
246-250 GHz	100%	-5 dBm/MHz	45 dBm	
250-252 GHz (Note 3)	100%	-15 dBm/MHz	35 dBm	
252-260 GHz	100%	-5 dBm/MHz	45 dBm	

Note 1: The operating frequency range (OFR) is defined over the 10 dB reduction of the intentional transmission ("10 dB bandwidth") radiated by the equipment into the air. The unwanted emission limits apply to the frequencies outside the OFR. The measurement bandwidth for the unwanted emissions domain is 1 MHz.

Note 2: The given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

Note 3: Sub-band protected by the provision RR No. 5.340 [7].

Note 4: The maximum peak e.i.r.p. shall be measured/evaluated in 1 GHz bandwidth.

Additional requirements for radiodetermination systems for industry automation in shielded environments (RDI-S) to allow licence-exempt use:

1. For RDI-S, the 10 dB contiguous bandwidth shall be equal to or higher than 35 GHz;
2. The operation of RDI-S sensors is envisaged for industrial purposes only;
3. Installation and maintenance of RDI-S equipment shall be performed by professionally trained individuals only;
4. RDI-S equipment shall not be marketed to private end customers;
5. RDI-S equipment shall only be operated indoors (i.e. inside a building) or inside similarly shielded environments;
6. Installers have to ensure that the device main beam is not pointing towards windows or other weak shielded parts of the shielded environment. The direction of main radiation shall be indicated on the specific radiodetermination device;
7. Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimise unintentional reflections and scattering;
8. Slow sweeping RDI-S devices with sweep slopes smaller than 2.5 GHz/ms shall notch-out the frequency bands subject to the provision RR No. 5.340 [7] by at least additional 10 dB reduction in mean and peak power (i.e. limits in Table 10 columns B and C reduced by 10 dB);
9. The provider is required to inform the users and installers of RDI-S equipment about the installation requirements and additional special mounting instructions;
10. For RDI-S devices using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm.

A2.7 TECHNICAL REQUIREMENTS FOR EXTERIOR VEHICULAR RADAR (EVR)

Front and corner radars are used for driving assistance applications requiring long and medium range such as automatic cruise control, lane keep, lane change assist, automatic emergency braking, etc.

Applications providing the vehicle with higher degree of autonomy require short and ultra-short-range radars for front, side and rear-view, such that 360° sensing is enabled. Those radars allow to obtain a wide field of view (elevation and azimuth) in the close proximity of the vehicle and enable features like automated parking assistance or autonomous valet parking.

Table 11: Technical requirements for exterior vehicular radars (EVR)

Designated frequency band	Front radars		Corner and short/ultra-short range radars	
	Maximum mean e.i.r.p. (Note)	Maximum peak e.i.r.p.	Maximum mean e.i.r.p. (Note)	Maximum peak e.i.r.p.
122.25-130 GHz	32 dBm		9 dBm	
134-141 GHz	32 dBm		9 dBm	
141-148.5 GHz	-6 dBm within 1 GHz	-1 dBm within 1 GHz	-6 dBm within 1 GHz	-1 dBm within 1 GHz
Note: Maximum mean e.i.r.p. is the radiated mean power during transmitter signal repetition time as defined in ETSI EN 303 883-1, clause 5.3.1 and Annex C [9] , meaning the effect of duty cycle is included.				

Additional requirements:

1. Unwanted emission limits in the band 116-122.25 GHz for any type of radar depend on the maximum duty cycle and elevation.
   For radars with a maximum duty cycle (measured over the signal repetition time of the radar) up to 50%, for elevations up to 35 degrees, the maximum mean e.i.r.p. density shall stay below -50 dBm/MHz, and

for elevations above 35 degrees, below -76 dBm/MHz.
For radars with a maximum duty cycle higher than 50%, for elevations up to 35 degrees, the maximum mean e.i.r.p. density shall stay below -53 dBm/MHz, and for elevations above 35 degrees, below - 79 dBm/MHz.

2. Unwanted emissions in the band 130-134 GHz shall stay below a maximum mean power spectral density of -33 dBm/MHz e.i.r.p. for front radars and of -36 dBm/MHz e.i.r.p. for corner and short/ultra-short range radars. Additionally, the maximum peak e.i.r.p. within 1 GHz should be below 2 dBm for the front radars and below -1 dBm for the corner and short/ultra-short range radars.
3. Unwanted emission limits in the band 148.5-151 GHz for any type of radar depend on the maximum duty cycle and elevation.
   For radars with a maximum duty cycle (measured over the signal repetition time of the radar) up to 50%, for elevations up to 35 degrees, the maximum mean e.i.r.p. density shall stay below -44 dBm/MHz, and for elevations above 35 degrees, below -70 dBm/MHz.
   For radars with a maximum duty cycle higher than 50%, for elevations up to 35 degrees, the maximum mean e.i.r.p. density shall stay below -47 dBm/MHz, and for elevations above 35 degrees, below - 73 dBm/MHz.

A2.8 TECHNICAL REQUIREMENTS FOR IN-CABIN VEHICULAR RADAR (IVR)

In-cabin applications include contactless gesture control, presence detection (including baby/child detection) and vital sign monitoring such as respiration rate, heart rate and heart rate variation. The use of higher frequency ranges further reduces the risk of interference with other automotive radars (e.g. 77 GHz or 79 GHz radars) or wireless communication devices using the 60 GHz band. With the increasing miniaturisation, angular resolution offers the possibility to discriminate between multiple seats inside a car with a single radar sensor with beamforming or MIMO (multiple input multiple output) capability.

Table 12: Technical requirements for in-cabin vehicular radars (IVR)

Designated frequency band	Maximum mean e.i.r.p. density	Maximum mean e.i.r.p. over the bandwidth	Maximum peak e.i.r.p. over the bandwidth
122.25-130 GHz	-30 dBm/MHz	3 dBm	16 dBm
134-148.5 GHz	-30 dBm/MHz	3 dBm	16 dBm
Note: Maximum mean e.i.r.p. is the radiated mean power during transmitter signal repetition time as defined in ETSI EN 303 883-1, clause 5.3.1 and Annex C [9], meaning the effect of duty cycle is included.			

Additional requirements:

1. Unwanted emissions in the band 116-122.25 GHz shall stay below a maximum mean e.i.r.p. density of -45 dBm/MHz;
2. Unwanted emissions in the 130-134 GHz band shall stay below a maximum mean e.i.r.p. density of -17 dBm/GHz and -4 dBm/GHz peak e.i.r.p;
3. Unwanted emissions in the band 148.5-151 GHz shall stay below a maximum mean e.i.r.p. density of -39 dBm/MHz;
4. Downwards antenna orientation;
5. For convertible cars, emissions above 0-degree elevation outside the car shall be 15 dB lower than the power levels given in Table 12;
6. Minimum 1 GHz bandwidth.

ANNEX 3: INFORMATION REQUIRED FROM MANUFACTURERS OF RDI-S DEVICES USING THE BANDS SUBJECT TO RR NO. 5.340

In order to fulfil the conditional exception on the usage of the frequency bands subject to RR No. 5.340 [7] by very limited number of RDI-S devices, a tracking and monitoring process is required. It is normally difficult to track every device in the market and therefore, the following information to be provided by RDI-S manufacturers could give an indicator of the expected activity levels.

Table 13: Notified information on the RDI-S devices in the designated band 116-260 GHz

Date of notification	Manufacturer name	Type of application	Estimate of overall market	Frequency band(s) of operation

The notified information shall be updated and published on the ECO website on a regular basis. This notification procedure is not intended to be reflected in an ETSI Harmonised Standard.

ANNEX 4: LIST OF REFERENCES

[1] ETSI TR 103 498: "System Reference document (SRdoc); Short Range Devices (SRD) using Ultra Wide Band (UWB); Transmission characteristics; Radiodetermination applications within the frequency range 120 GHz to 260 GHz"

[2] ECC Report 334: “UWB radiodetermination applications in the frequency range 116-260 GHz“, approved January 2022

[3] ECC Report 351: “UWB radiodetermination applications within the frequency range 116 GHz to 148.5 GHz for vehicular use”, approved February 2023

[4] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC

[5] ERC Recommendation 70-03: “Relating to the use of Short Range Devices (SRD)”, approved 1997, latest amended March 2024

[6] "Code of Federal Regulations Title 47"
https://www.fcc.gov/wireless/bureau-divisions/technologies-systems-and-innovation-division/rules-regulations-title-47

[7] ITU Radio Regulations, Edition 2020

[8] ETSI EN 305 550-2: “Short Range Devices (SRD); Radio equipment to be used in the 40 GHz to 246 GHz frequency range”

[9] ETSI EN 303 883-1: “Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 1: Measurement techniques for transmitter requirements”