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Short Range Devices; Transport and Traffic Telematics (TTT); Radar equipment operating in the 76 GHz to 77 GHz range; Harmonised Standard for access to radio spectrum; Part 3: Equipment for railway applications operating within 76 GHz to 77 GHz

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**HARMONISED EUROPEAN STANDARD**

Reference

REN/ERM-TGSRR-578

Keywords

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Contents

Intellectual Property Rights 4

Foreword 4

Modal verbs terminology 5

Executive summary 5

Introduction 5

1 Scope 6

2 References 6

2.1 Normative references 6

2.2 Informative references 6

3 Definition of terms, symbols and abbreviations 7

3.1 Terms 7

3.2 Symbols 7

3.3 Abbreviations 7

<D> Technical requirements specifications 7

<D>.1 Environmental profile 7

<D>.2 Conformance requirements 7

<D>.2.1 <Technical requirement 1> 7

<D>.2.2 <Technical requirement 2> 7

<D>.2.3 <etc.> 8

<D+1> Testing for compliance with technical requirements 8

<D+1>.1 Environmental conditions for testing 8

Annex <L> (informative): Relationship between the present document and the essential requirements of Directive [Reference numbers of legislation] 9

Annex <L+1> (informative): Maximum Measurement Uncertainty 12

Annex <L+2> (normative or informative): Title of annex 13

<L+2.1> First clause of the annex 13

<L+2.1.1> First subdivided clause of the annex 13

Annex <L+3> (informative): Bibliography 14

Annex <L+4> (informative): Change history 15

History 16

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# Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.4] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU 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 [i.3].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

|  |
| --- |
| **Proposed national transposition dates** |
| Date of latest announcement of this EN (doa): | 3 months after ETSI publication |
| Date of latest publication of new National Standardor endorsement of this EN (dop/e): | 6 months after doa |
| Date of withdrawal of any conflicting National Standard (dow): | 18 months after doa |

# Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](https://portal.etsi.org/Services/editHelp%21/Howtostart/ETSIDraftingRules.aspx) (Verbal forms for the expression of provisions).

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# 1 Scope

The present document specifies technical characteristics and methods of measurements for radar equipment for railway applications operating within 76 GHz to 77 GHz

The EUT categories covered by the present document are specified in clause 4.2.

NOTE: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.3] is given in annex A.

# 2 References

## 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] ETSI EN 303 883-1 (V1.2.1) (02-2021): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 1: Measurement techniques for transmitter requirements".

[2] ETSI EN 303 883-2 (V1.2.1) (02-2021): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 2: Measurement techniques for receiver requirements".

[3] ETSI TS 103 789

[4] ETSI TS 103 941

[5] ETSI TS 103 788

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non‑specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ERC/REC 70-03 (June 2023): "ERC Recommendation relating to the use of Short Range Devices (SRD)".

NOTE: Available at <https://efis.cept.org/sitecontent.jsp?sitecontent=srd_regulations>.

[i.2] Commission Implementing Decision (EU) 2022/180 of 8 February 2022 amending Decision 2006/771/EC as regards the update of harmonised technical conditions in the area of radio spectrum use for short-range devices.

[i.3] [Directive 2014/53/EU](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0053&from=FR) 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 (RE-Directive).

[i.4] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.5] ETSI EG 203 336 (V1.2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.6] ETSI TS 103 567 (V1.1.1): "Requirements on signal interferer handling".

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the [following] terms [given in ... and the following] apply:

Measurement cycle:

## 3.2 Symbols

For the purposes of the present document, the [following] symbols [given in ... and the following] apply:

## 3.3 Abbreviations

For the purposes of the present document, the [following] abbreviations [given in ... and the following] apply:

# 4 Technical requirements specifications

## 4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

## 4.2 EUT categories

### 4.2.1 General

The present document covers radar devices for railway applications in the frequency range 76-77 GHz. The differences for the device categories will be based on

* usage (fixed or mobile) which is linked with the related regulation see clause 4.2.2
* wanted technical performance criteria, see clause 4.2.3
* receiver mode (receive only, stand-by/idle), see clause 4.2.4

The summary of the EUT categories is given in clause 4.2.5.

If more than one category applies to an EUT, then the requirements from each category apply.

### 4.2.2 Categorization by Regulation

The categorization based on regulation will be for:

* mobile devices (MD) used for ground-based vehicle and infrastructure systems based on ERC REC 70-03 [i.1] Annex 5 frequency band e1 and Decision (EU) 2022/180 [i.2] band 79a, with the following subcategories:
	+ MD\_01: with a minimum detection distance of 250m
	+ MD\_02: with a minimum detection distance of 100m
	+ MD\_03: with a minimum detection distance of 50m
	+ MD\_04: with a minimum detection distance of 8m
* mobile devices with a cooperative functionality (MC) for ground-based vehicle and infrastructure systems based on ERC REC 70-03 [i.1] Annex 5 frequency band e1 and Decision (EU) 2022/180 [i.2] band 79a; the cooperative functionality is based on a detection of a known active signal with the following subcategories:
	+ MC\_01: the transmitter of the cooperative functionality (transmit only) [an active target ]
	+ MC\_02: the receiving part of the cooperative system installed in a vehicle, which detects the transmit signal from MC\_01 installed in a companion vehicle; MC\_02 shall be able to detect the transmitting part MC\_01 (see clause 4.4.2.2.)
* fixed devices (FD) for Obstruction/Vehicle detection radars at railway level crossings based on ERC REC 70-03 [i.1] Annex 4; frequency band d.

### 4.2.3 Categorization by modulation

The regulations of MD and FD requires the differentiation of pulsed modulation (mean power limit of 23 dBm) and other modulation (mean power limit of 50 dBm). Pulsed signals are defined in EN 303 883-1[1] clause C.

### 4.2.4 Receiver mode

For each EUT-category there could be and additional receiver only operational mode. In this mode transmitter of the EUT will be in “idle mode” and the related receiver requirements are specified in 4.4.2.4. Such EUT-operational mode will be marked with “\_RX” in the EUT abbreviation. It could be that there are receive only devices, in such cases the same requirements in clause 4.4.2.4 apply.

Editors NOTE in Version 0.0.4: currently no EUT with RX-only mode (within the railway environment) all EUT operating TX/RX at the same time or TX only. Therefore, it is proposed to delete RX-only EUT from this EN.

Side-Note: Difficult for RX-only devices: specification of RX-Test signal 🡪 what “radar” signal (FMCW, Pulsed, OFDM) shall be used, see ECC report for 77-81GHz

But Idle Mode is possible: TXoff, RX- has no functionality 🡪 idle mode used for EUT internal calibration….

RX-mode 🡪 EUT used received info for a use-case (wanted technical information, e.g. detection / monitor environment / adjust “noise level”,….

### 4.2.6 Summary of EUT categories

Table 1

| EUT-category | TX-requirements | RX-requirements |
| --- | --- | --- |
| Emission requirements |  |
|  | clause |  | clause |
| MD\_01MD\_02MD\_03MD\_04MD\_01\_PMD\_02\_PMD\_03\_PMD\_04\_PMC\_01MC\_02FDFD\_P | Mobile devices detecting target at a specified minimum distance and modulation is other than pulsed | OFR | 4.3.2 | RX spurious emission | Not applicable |
| Mean e.i.r.p. | 4.3.3 |  |  |
| Peak e.i.r.p. | 4.3.4 | WTPC | 4.4.2.1 |
| TX unwanted emissions | 4.3.5 | RBS | 4.4.4. & Annex E |
| TX behaviour under complete environmental profile | 4.3.6 | RBR | 4.4.5. & Annex E |
|  |  |  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| MC\_01MC\_01\_P | Co-operative EUT (TX only) | OFR | 4.3.2 |  |  |
| Mean e.i.r.p. | 4.3.3 |  |  |
| Peak e.i.r.p. | 4.3.4 |  |  |
| TX unwanted emissions | 4.3.5 |  |  |
| TX behaviour under complete environmental profile | 4.3.6 |  |  |
| MC\_02 | Co-operative EUT detecting part (TX/RX) | OFR | 4.3.2 | RX spurious emission | Not applicable |
| Mean e.i.r.p. | 4.3.3 |  |  |
| Peak e.i.r.p. | 4.3.4 | WTPC | 4.4.2.2 |
| TX unwanted emissions | 4.3.5 | RBS | 4.4.4. & Annex E |
| TX behaviour under complete environmental profile | 4.3.6 | RBR | 4.4.4. & Annex E |
| ~~Mobile EUT with RX-only mode:~~~~MD\_XX\_RX~~~~MC\_02\_RX~~~~Mobile RX-only EUT~~~~MD\_RX~~ | ~~For all MD categories which have an RX only (or TX idle) operational mode~~ | ~~OFR~~ | ~~Not applicable~~ | ~~RX spurious emission~~ | ~~4.4.3~~  |
| ~~Mean e.i.r.p.~~ | ~~Not applicable~~ |  |  |
| ~~Peak e.i.r.p.~~ | ~~Not applicable~~ | ~~WTPC~~ | ~~4.4.2.4~~ |
| ~~TX unwanted emissions~~ | ~~Not applicable~~ | ~~RBS~~ | ~~4.4.4. & Annex E~~ |
| ~~TX behaviour under complete environmental profile~~ | ~~Not applicable~~ | ~~RBR~~ | ~~4.4.4. & Annex E~~ |
|  |  |  |  |  |  |
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## 4.3 Transmitter requirements

### 4.3.1 General

Based on the different possible TX signal modulations for the EUT categories coved by the present documents there a different related conformance test- set-ups necessary. The different categories of EUT (see 4.2) require different test setups due to different modulation techniques. Clause 5 elaborates on these differences.

The transmitter requirements for all XX (sub)-categories covered by the scope of the present document are justified in Annex C.

### 4.3.2 Operating Frequency Range (OFR)

#### 4.3.2.1 Applicability

This requirement applies to all EUT categories, see clause 4.2.6. table 1

#### 4.3.2.2 Description Operating Frequency Range

For the description of the operating frequency range (OFR), see ETSI EN 303 883-1 [1], clause 5.2.1.

As requested in ETSI EN 303 883-1 [1], clause 5.2.1 the limit for the parameter X is 23 dB.

#### 4.3.2.3 Limits for Operating Frequency Range

The OFR for (see clause 4.2, table 1) shall be in the permitted frequency range as given in table 2

Table 2: Permitted frequency range

|  |
| --- |
| Permitted frequency range for EUT based on [i.1] |
| Transmit | 76 - 77 GHz |
| Receive | 76 - 77 GHz |

#### 4.3.2.4 Conformance

The conformance test shall be done under normal conditions as defined in clause 5.1.2; the conformance test suite for OFR shall be as defined in clause 5.4.1.

### 4.3.3 Mean e.i.r.p.

#### 4.3.3.1 Applicability

This requirement applies to all EUT categories, see clause 4.2

#### 4.3.3.2 Description Mean e.i.r.p

For the description of the Mean e.i.r.p, see ETSI EN 303 883-1 [1], clause 5.3.1.1

#### 4.3.3.3 Limits for Mean e.i.r.p

The limits for the mean e.i.r.p. requirement within the OFR for devices with modulations other than pulsed based, see table 3.

Table 3: Mean e.i.r.p. for devices with modulation other than pulsed based

|  |  |  |
| --- | --- | --- |
| EUT category | Mean e.i.r.p. | Averaging time |
| MD\_01, MD\_02, MD\_03, MD\_04  | 50 dBm [i.1] [i.2] | Signal repetition  |
| MC\_01 | 50 dBm | TXon |
| MC\_02 | 50 dBm [i.1] [i.2] | Signal repetition |
| FD | 50 dBm [i.1] | Signal repetition |

The limits for the mean e.i.r.p. requirement within the OFR for devices with pulsed modulations, see table 4.

Table 4: Mean e.i.r.p. for decives with a pulsed based modulation

|  |  |
| --- | --- |
| EUT category | Mean e.i.r.p. |
| MD\_01\_P; MD\_02\_P; MD\_03\_P; MD\_04\_P | 23,5 dBm [i.1] [i.2] |

#### 4.3.3.4 Conformance

The conformance test shall be done under normal conditions as defined in clause 5.1.2; the conformance test suite for Mean e.i..r.p shall be as defined in clause 5.4.2.

### 4.3.4 Peak e.i.r.p.

#### 4.3.4.1 Applicability

This requirement applies to all EUT categories, see clause 4.2

#### 4.3.4.2 Description Peak e.i.r.p

For the description of the Mean e.i.r.p, see ETSI EN 303 883-1 [1], clause 5.3.1.1

#### 4.3.4.3 Limits for Peak e.i.r.p

The limits for the mean e.i.r.p. requirement within the OFR, see table 5.

Table 5: Mean e.i.r.p. for Intrusion radiodetermination equipment

|  |  |
| --- | --- |
| EUT category | Peak e.i.r.p. |
| MD\_XX (all sub\_categories) | 55 dBm [i.1] [i.2] |
| MD\_XX\_P (all sub\_categories) | 55 dBm [i.1] [i.2] |
| MC\_02 | 55 dBm [i.1] [i.2] |
| FD | 55 dBm [i.1] |

#### 4.3.4.4 Conformance

The conformance test shall be done under normal conditions as defined in clause 5.1.2; the conformance test suite for Mean e.i..r.p shall be as defined in clause 5.4.3.

### 4.3.5 TX unwanted emissions

#### 4.3.5.1 Applicability

This requirement applies to all EUT categories, see clause 4.2

#### 4.3.5.2 Description TX unwanted emissions

The description of TX unwanted emissions is given in clause 5.5.1 of ETSI EN 303 883-1 [1].

#### 4.3.5.3 Limits for TX unwanted emissions

Lower and upper frequency for the TX unwanted emissions test are as defined in clause 5.5.1 of ETSI EN 303 883‑1 [1]. Based on the description in clause 4.3.4.2 this would lead to the following TX unwanted emissions in the OOB and Spurious Domain, see figure 1.

 

Figure 1: TX unwanted emissions within the OOB and Spurious Domain for EUT

The limit for the OOB domain is specified based on the measured EUT OFR (see clause 4.3.2) and the regulated limit (see 4.3.3.3, table 3).

Therefore, the limit OOB limit can be derived with equation (1) from the regulated limit (see 4.3.3.3, table 3), see table 6.

 $regulated Limit \left[dBm\right]=10×log\_{10}\left(\frac{regulated limit [mW]}{1[mW]}\right)$ (1)

Table 6: reference specified max emission limit for in band

|  |  |
| --- | --- |
| EUT category | Regulated mean power limit (RLdBm) [dBm] |
| MD\_01, MD\_02, MD\_03, MD\_04  | 50 dBm [i.1] [i.2] |
| MC\_01 | 50 dBm |
| MC\_02 | 50 dBm [i.1] [i.2] |
| FD | 50 dBm [i.1] |

The limits below (see table 7) shall apply to the power of any unwanted emission in the OOB domain. The OOB limits are derived from the reference regulated limit (see table 6), the OFR definition (see clause 4.3.2.2) and the measured EUT OFR (see 4.3.2.4). The contiguity is shown in equation (2).

 $OOB limit \left[dBm/MHz\right]=RL\_{dBm}-23dB-10×log\_{10}\left(\frac{OFR\_{EUT} [MHz]}{RBW [MHz]}\right)$ (2)

with

* RBW [MHz]: resolution BW of 1 MHz for the OFR conformance testing, see clause 5.4.1

Table 7: emission mask in the OOB domain

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUT category | Frequency Range [GHz] | OOB limit [dBm]  | Measurement bandwidth | Averaging time |
| All EUT categories besides MC\_01 | fLS <f <fL | See equation (2) | 1 MHz | Signal repetition  |
| fH <f <fHS | See equation (2) | 1 MHz | Signal repetition |
| MC\_01 | fLS <f <fL | See equation (2) | 1 MHz | TXon |
| fH <f <fHS | See equation (2) | 1 MHz | TXon |

The emissions at fL and fH are part of the OFR and are assessed based on clause 4.3.2. but the measurements at fL and fH shall be below the OOB limit as calculated with equation (2).

The maximum power limits of any EUT category for the unwanted emissions in the spurious domain are given in table 8. Lower (FLOWER) and upper frequency (FUPPER) for the spurious emissions tests are based on the EUT OFR (see clause 4.3.2) and are in line with ERC/REC 74-01 [i.8]

Table 8: Spurious TX unwanted emissions in the spurious domain

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUT category | FLOWER <f ≤fLS | fHS ≤f ≤FUPPER | FLOWER | FUPPER  |
| All EUT categories | See table 9 | -30 dBm (NOTE 2) | 30 MHz | 2ndharmonic(NOTE 1) |
| NOTE 1: FUPPER is the stated harmonic of measured fH (the upper edge of the OFR, which is measured in clause 4.3.2).NOTE 2: The limits are mean power averaged over the burst duration |

Table 9: Spurious TX unwanted emissions in the spurious domain
according to ERC/REC 74-01 [i.8]

|  |  |  |
| --- | --- | --- |
| Frequency range | Limit values for TXUE (NOTE) | Measurement bandwidth |
| 87,5 MHz  f ≤ 118 MHz | -54 dBm | 100 kHz |
| 174 MHz  f ≤ 230 MHz | -54 dBm | 100 kHz |
| 470 MHz  f ≤ 694 MHz | -54 dBm | 100 kHz |
| otherwise in band 30 MHz  f < 1 000 MHz | -36 dBm | 100 kHz |
| 1 000 MHz ≤ f ≤ Fupper (see table 3 in ETSI EN 303 883-1 [1]) | -30 dBm | 1 MHz |
| NOTE: The limits are mean power averaged over the burst duration |

#### 4.3.5.4 Conformance

The conformance test shall be done under normal conditions as defined in clause 5.1.2; the conformance test suite for OFR shall be as defined in clause 5.4.4.

### 4.3.6 TX behaviour under the complete environmental profile

#### 4.3.6.1 Applicability

The requirement applies to all EUT categories, see clause 4.2.X

For EUT categories (radiated XXXX) the limits in clause 4.2.X.3.1 apply

For EUT categories (connected YYYY) the limits in clause 4.2.X.3.2 apply

#### 4.3.6.2 Description

For the description of the TX behaviour under the complete environmental profile, see ETSI TS 103 941 [X], clause 4.3.1

#### 4.3.6.3 Limits

The limits in the resent clause only apply for EUT categories (radiated XXXX), see clause 4.2.X

The TX behaviour is obtained by measuring the [maximum mean e.i.r.p.] (Pstep) [and OFR frequencies] (fL\_step / fH\_step) across the complete environmental profile (see clause for operation of the equipment as specified in clause 5.1.3) and assessing the variation with respect to a [maximum mean e.i.r.p] adjusted reference value (Adjusted\_RL) and for the frequency changes of the OFR to (REFfL / REFfH).

If for each environmental measurement point (Tstep) over the complete environmental profile the measured values for Pstep and fL\_step / fH\_step will be below the adjusted reference values(s) the limit for the TX behaviour assessment is passed

#### 4.3.6.4 Conformance

The conformance test shall be done under normal conditions as defined in clause 5.1.3; the conformance test suite for OFR shall be as defined in clause 5.4.5.

## 4.4 Receiver requirements

### 4.4.1 General

The receiver requirements for all EUT categories are justified in Annex C

### 4.4.2 Wanted technical performance criteria

#### 4.4.2.1 Wanted technical performance criteria for mobile EUT categories

The minimum wanted technical performance criteria is specified based on a minimum radar cross section of the target (RCS in dBm2)and the detection probability (X% over X device measurement cycles) and the minimum distance the device shall be able to detect the target, see tables X1 and X2 and Annex E. The basic intended use is shown in figure X



Figure X: Basic intended use scenario for MD categories in table X1 and table X2

More details are provided in EN 303 883-2 [2] under radiodetermination applications with a distance limit. For RBS see EN 303 883-2 [2] clause 5.4.3.4 and for RBR see EN 303 883-2 [2] clause 5.5.3.4

Table X1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUT category: | Target (minimum RCS) | Detection probability | RBS (Sensitivity) | RBR (Resilience) |
| Min Distance Dsense | Min Distance D |
| MD\_01 | 10dBm2 | 95% over X EUT measurement cycles | 250m | 175m |
| MD\_02 | 10dBm2 | 95% over X EUT measurement cycles | 100m | 70m |
| MD\_03 | 10dBm2 | 95% over X EUT measurement cycles | 50m | 35m |
| MD\_04 | 10dBm2 | 95% over X EUT measurement cycles | 8m | 5,6m |

* See EN 303 883-2, clause 5.5.3.5.3 30% for deltaD was considered.
* But based on 303 883-2 the EN could specify another value!
* Stakeholders (railway) confirmed to keep current values with 30%
* this would lead to a 6dB higher signal at the RX
* 3dB for RBR would be 15% of the RBS distance.

Table X2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUT category: | Target (minimum RCS) | Detection probability | RBS (Sensitivity) | RBR (Resilience) |
| Min Distance Dsense | Min Distance D |
| MD\_01\_P | 10dBm2 | 95% over X EUT measurement cycles | 250m | 175m |
| MD\_02\_P | 10dBm2 | 95% over X EUT measurement cycles | 100m | 70m |
| MD\_03\_P | 10dBm2 | 95% over X EUT measurement cycles | 50m | 35m |
| MD\_04\_P | 10dBm2 | 95% over X EUT measurement cycles | 8m | 5,6m |

#### 4.4.2.2 Wanted technical performance criteria for EUT with cooperative functionality

The minimum wanted technical performance criteria is specified based on the possibility to detect the transmitting part of the cooperative system. The basic functionality is comparable to a radiodetermination/radiolocation application. The basic intended use is shown in figure Y and the related RX requirements are specified in table Y1.



Figure Y: Basic intended use scenario for cooperative systems

More details are provided in EN 303 883-2 [2] under radio communication devices with a power limit. For RBS see EN 303 883-2 [2] clause 5.4.3.3 and for RBR see EN 303 883-2 [2] clause 5.5.3.3

Table Y1

|  |  |  |  |
| --- | --- | --- | --- |
| **EUT category:** | **Wanted technical performance criteria** | **RBS (Sensitivity)** | **RBR (Resilience)** |
| **Min Distance D** | **Min Distance D** |
| **MC\_02** | Detection of the cooperative signal with a detection probability of: [90%] over 10s | $P\_{@EUT}: $-90dBmMinimum requirement which is equivalent with a cooperative TX signal with a TX power of 35dBm e.i.r.p at a distance (Ddetect) of 100m | $P\_{@EUT}: $-87dBmMinimum requirement which is equivalent with a cooperative TX signal with a TX power of 35dBm e.i.r.p at a distance (Ddetect) of 70m) |

Specification of the cooperative signal:

* BW: < XX MHz
* Radiated power mean power of: 35 dBm e.i.r.p. during TXon
* Duty Cycle of: X% [20% – 40%] over an observation time of Z sec,
* TXon of minimum Y ms

#### 4.4.2.3 Wanted technical performance criteria for fixed EUT on road/rail crossings

The minimum wanted technical performance criteria is specified based on a minimum radar cross section of the target (RCS in dBm2) and the detection probability (X% over X device measurement cycles) and the minimum distance the device shall be able to detect the target, see tables Z1 and Annex E. The basic intended use is shown in figure Z



Figure Z: Basic intended use scenario for MD categories in table X1 and table X2

More details are provided in EN 303 883-2 [2] under radiodetermination applications with a distance limit. For RBS see EN 303 883-2 [2] clause 5.4.3.4 and for RBR see EN 303 883-2 [2] clause 5.5.3.4

Table Z1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUT category: | Target (minimum RCS) | Detection probability | RBS (Sensitivity) | RBR (Resilience) |
| Min Distance Dsense | Min Distance D |
| FD | 10 dBm2 | 95% over X EUT measurement cycles | 50m | 35m |

#### 4.4.2.4 Wanted technical performance criteria for EUT with RX-only mode

Question for discussion: what is RX-only mode. If TX in idle the EUT as no wanted technical requirement 🡪 functionality. If the EUT in RX-only mode we have to specify test signals (legal issue). Like DAA requirement for HD-GBSAR devices.

Possible e.g. other vehicular radar signals were specified in

TR 103 593 (SRdoc revision ECC/DEC(04)03), see also ECC report 350,

ECC Report 262 (Studies related to surveillance radar equipment operating in the 76 to 77 GHz range for fixed transport infrastructure),

ECC Report 315 (HD-GBSAR studies), see Annex 6 🡪 ECC/DEC(21)02 Annex 2

ECC report 350 (clause 2.3 general system parameters) or Recommendation ITU-R M.2057

### 4.4.3 Receiver spurious emissions

#### 4.4.3.1 Applicability

This requirement applies for receive only EUT categories see clause 4.2

*Guidance note:* this consequently means that this requirement may not be applicable for the following cases:

* TX and RX are co-located in the same device (example: typical operation mode of monostatic radars).
* It is impossible to put the equipment to a receive only mode.

#### 4.4.3.2 Description

For the description of the RBS requirement, see ETSI EN 303 883-2 [2], clause xxx

#### 4.4.3.3 Limits

#### 4.4.3.4 Conformance

The conformance test for all EUT sub-categories for the RBS requirement shall be as defined in clause 5.5.2.1.

### 4.4.4 Receiver Baseline Sensitivity (RBS)

#### 4.4. 4.1 Applicability

This requirement applies to all….. EUT sub-categories.

#### 4.4.X1.2 Description for the RBS requirements

For the description of the RBS requirement, see ETSI EN 303 883-2 [2], clause 5.4.1.

#### 4.4.X1.3 Limits

The RBS requirements for all EUT sub-categories, ……..XXX or Annex X

#### 4.4.X1.4 Conformance

The conformance test for all EUT sub-categories for the RBS requirement shall be as defined in clause 5.5.2.1.

### 4.4.5 Receiver Baseline Resilience (RBR)

#### 4.4.X2.1 Applicability

#### 4.4.X2.2 Description for the RBR requirement

For the description of the RBR requirement, see ETSI EN 303 883-2 [2], clause 5.5.1.

#### 4.4.X2.3 Limits

The RBS requirements for all EUT sub-categories, ……..XXX or Annex X

#### 4.4.X2.4 Conformance

The conformance test for all BMA sub-categories for the RBR requirement shall be as defined in clause 5.5.3.1.

# 5 Testing for compliance with technical requirements

## 5.1 Environmental conditions for testing

### 5.1.1 General

Tests defined in the present document shall be carried out at representative points within the boundary limits of the operational environmental profile defined by its intended use, which, as a minimum, shall be that specified in the test conditions contained in the present document.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions as specified in the present document to give confidence of compliance for the affected technical requirements.

### 5.1.2 Normal test conditions

Normal test conditions shall be as defined in clause A.5.3.1 of ETSI EN 303 883-1 [1].

### 5.1.3 Complete environmental profile test conditions

The complete environmental profile test conditions includes both the normal and extreme test conditions.

Normal test conditions shall be as defined in clause A.5.3.1 of ETSI EN 303 883-1 [1].

Extreme test conditions shall be as defined in clause A.5.3.2 of ETSI EN 303 883-1 [1] with a temperature range varying between -40 °C to +55 °C; the primary supply voltage varies from 90 to 110 percent of the nominal value.

## 5.2 General conditions for testing

General guidance on conditions for testing, measurement uncertainty and interpretation of the measurement results are given in Annex B.

## 5.3 Conformance test suites

### 5.3.1 General

ETSI EN 303 883-1 [1], Annex B provides additional information on test setups for testing, e.g. radiated and conducted measurements. An overview for radiated measurements is provided in ETSI EN 303 883-1 [1], clause B.2.1.

Complementary information to the conformance tests in clause 5.4 is provided in ETSI EN 303 883-1 [1], clause 5.1.1 for TX measurements and in ETSI EN 303 883-2 [2], clause 5.1 for RX measurements.

+ additional info e.g. for “indirect emission measurements”, specific consideration for EUT category / kind of EUT (size) / wanted performance criteria

For EUT-category specific (different object/scenarios for different EUT categories link with specific Annex E, Annex F,…

+ of for different kind of EUT categories different test suites are necessary (e.g. based on EUT size,..)

## 5.4 Conformance methods of measurement for TX requirements

### 5.4.1 Operating Frequency Range (OFR)

The test shall be done inside an anechoic chamber, see ETSI EN 303 883-1 [1], clause B.2.2.2.

OFR measurement should be done with the same setup of clause 5.4.3 below and in the direction of the highest mean e.i.r.p. emission, using the conformance test in ETSI EN 303 883-1 [1], clause 5.2.2.

For the OFR conformance assessment, the value of 23 shall be as specified in clause 4.3.2.2 of this document.

The measured results of the OFR, fL, fH and the highest emission (Pmax) within the OFR [dBm/MHz] shall be recorded.

### 5.4.2 Mean e.i.r.p.

The mean e.i.r.p. conformance test shall be inside an anechoic chamber, see ETSI EN 303 883-1 [1], clause B.2.2.2 and the test setup shall be based on the standard test method as described in ETSI EN 303 883-1 [1], clause B.4.

The conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.3.1 shall be used.

The difference M between the mean e.i.r.p. limit in Table 4 and the maximum of the measured results for the mean e.i.r.p, shall be calculated for each measurement direction around the device.

The direction of the maximum mean e.i.r.p. (that gives the smallest difference M), the measured results of the mean e.i.r.p. as well as the value of M of shall be recorded.

### 5.4.3 Peak e.i.r.p.

### 5.4.4 TX spurious emissions

Conformance shall be tested according to ETSI EN 303 883-1 [1], clause 5.5.3. If in the ETSI EN 303 883-1 [1], clause 5.5.3.1 step 1 the measurement result are above the limit of clause 4.3.4.3, proceed with step 2 in ETSI EN 303 883-1 [1], clause 5.5.3.1.

### 5.4.5 TX behaviour under the complete environmental profile

#### 5.4.5.1 General

The best test set-up shall be chosen based on clause 4.3.1 and figure 1 in ETSI TS 103 941 [X].

For EUT categories (radiated XXXX) the conformance test procedure in clause 5.4.6.2 shall be used.

For EUT categories (connected YYYY) the conformance test procedure in clause 5.4.6.2 shall be used.

#### 5.4.5.2 EUT with integral or dedicated antenna

Conformance shall be assessed based the test-set assessment in clause 5.4.6.1 and performing the assessment procedure according to ETSI TS 103 941 [X], clause 6.X

For the measurement receiver the set-up as specified in clause 4.3.X.X shall be used

Based on clause 5.1.3 and figure 6 of ETSI TS 103 941 [X] clause 4.5.4 the parameters for the assessment are specified as follow:

* tlow: X °C
* thigh: Y °C
* tsteps: Z °C
* supply voltage:

## 5.5 Conformance methods of measurement for receiver

### 5.5.X RX-spurious

### 5.5.X1 General for RBS and RBR conformance tests

Note: for the RX-tests add a reference to TS 103 788 (target simulator) and TS 103 789 (human target) if applicable.

Or if the test will be performed radiated and/or connected (based on the EUT categories) and/or intended use 🡪 which kind of object/target shall be used. If the EN cover different intended-use cases / categories 🡪 reference to the related Annex`s

“Where” the test shall be performed 🡪 chamber,… Please consider if different environment are necessary based on the EUT categories

### 5.5.X2 RBS

### 5.5.X3 RBR

Interferer ? Is there an “representative” interferer inband (automotive) 🡪 FMCW / OFDM / Hopper or ?

For adjacent and spurious domain, a CW is proposed 🡪 interferer is either FS or vehicle in 77-81GHz but based on ECC REC a CW is accepted in adjacent and spurious (Power)

### 5.5.X4 Other Rx-requirement

Annex A (informative):
Relationship between the present document and the essential requirements of Directive [Reference numbers of legislation]

The annex shall include the following paragraphs:

1. A paragraph referencing to the Commission’s standardisation request:
2. The reference shall be exact with full bibliographical details.
3. This paragraph shall make a general statement on how the relevant standard is supposed to support application of the relevant Union harmonisation legislation.

The present document has been prepared under the {Commission's standardisation request [Full reference if available]} to provide one voluntary means of conforming to the essential requirements of Directive [Reference numbers of legislation] [Full title].

EXAMPLE:

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.x] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU 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 [i.y].

1. A paragraph stating that the legal effect (presumption of conformity or other effect) is conditional and comes only after a reference to a relevant European standard is published in the Official Journal of the European Union:
2. This paragraph is needed when publication of a reference in the OJEU leads to a legal effect.
3. This paragraph shall always make a reference to a table which indicates the relationship between normative clauses (see note 1) and relevant legal requirements aimed to be covered.

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table […] confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

EXAMPLE:

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

NOTE: The above paragraphs has to be repeated in the Foreword.

The annex shall have a table for a clear indication of correspondence between normative clauses of the standard and the legal requirements aimed to be covered.

***It shall be evaluated case by case how detailed correspondence it is possible to indicate, or it is needed to indicate between the normative elements of the Harmonised Standard and legal requirements aimed to be covered. However, where this correspondence is expressed in too general terms, it could lead to a situation where the Commission cannot assess whether the Harmonised Standard satisfies the requirements, which it aims to cover, and subsequently publication of its references in the OJEU according to Article 10(6) of the Regulation is significantly delayed or is not possible at all.***

***EXAMPLE for a table:***

Table A.1: Relationship between the present document and
the essential requirements of Directive YYYY/DD/LL

| Harmonised Standard ETSI EN <NUMBER> |
| --- |
| Requirement | Requirement Conditionality |
| No | Description | Essential requirements of Directive | Clause(s) of the present document | U/C | Condition |
| 1 |  | ***e.g. 3.1b, 3.2, 3.3g*** |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| … |  |  |  |  |  |

**Key to columns:**

**Requirement:**

**No** A unique identifier for one row of the table which may be used to identify a requirement.

**Description** A textual reference to the requirement.

**Essential requirements of Directive**

 Identification of article(s) defining the requirement in the Directive.

**Clause(s) of the present document**

 Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

**Requirement Conditionality:**

**U/C** Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

**Condition** Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

*NOTE 1: The table cannot indicate direct relationship between the relevant legal requirement and* ***other*** *standards or normative clauses contained in* ***other*** *standards.*

*NOTE 2: The order of the first and the second columns can be changed.*

*NOTE 3: The title of this column can be adapted on the basis of specific needs*

*The annex shall have at least the following two warnings.*

1. *A warning stating that presumption of conformity is effective only as long as the reference is maintained in the OJEU by the Commission.* *The following URL-address* [*https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards\_en*](https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards_en) *to consult the latest list of Harmonised Standards published in the OJEU should be provided.*

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

1. *A warning stating that those products or services which are within the scope of a relevant standard may be also subject to other Union legislation.*

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative):
General conditions for testing, measurement uncertainty and interpretation of the measurement results

General guidance on testing TX and RX measurements are given respectively in ETSI EN 303 883-1 [1], clause 5.1.1 for the TX requirements and ETSI EN 303 883-2 [2], clause 5.1 for the RX requirements.

ETSI EN 303 883-1 [1], Annex A provides additional information on general conditions for testing, e.g. test environment and test conditions, measurement uncertainty and interpretation of the measurement results. An overview is provided in ETSI EN 303 883-1 [1], clause A.1.

Annex C (informative):
Requirement mapping

ETSI EG 203 336 [i.X], clause 5 lists the technical parameters applicable to transmitters and receivers that should be considered when producing Harmonised Standards that are intended to cover the essential requirements in article 3.2 of Directive 2014/53/EU [i.Z]. Essential requirements are high level objectives described in European Directives. The purpose of the Harmonised Standard is to translate those high-level objectives into detailed technical specifications. Table X.1 contains the parameters listed in ETSI EG 203 336 [i.X], clause 5 for transmitter and receiver, and cross references these to the clauses within the present document in which the requirements for measurement of such parameters are satisfied or justified.

Table X.1: Cross reference of clauses in the present document to technical parameters for transmitter and receiver listed in ETSI EG 203 336

| EG 203 336 [i.X] | Present document | Justification |
| --- | --- | --- |
| Clause | Parameter | Clause | Parameter |  |
| 5.2.2 | Transmitter power limits | 4.4.X4.4.X4.4.X4.4.X | Mean e.i.r.pPeak e.i.r.pMean power spectral density e.i.r.pPeak power spectral density e.i.r.p | *Note: As specified in related ECC/EC regulation, proposal to add here reference* |
| 5.2.3 | Transmitter power accuracy | - | - | From the latest version of EG 303336 [i.4]“When regulatory limits imply only a maximum emission limit (e.g. products that operate under a general licence regime), this parameter need not be considered for inclusion in an HS.” |
| 5.2.4 | Transmitter spectrum mask | 4.4.X | Operating Frequency Range |  |
| 5.2.5 | Transmitter frequency stability | - | - | *Note: not applicable 🡪 not required shall we specify ???* |
| 5.2.6 | Transmitter intermodulation attenuation | - | - | From latest version of EG 303336 [i.4] this parameters is required only “where high levels of quality services are required”. This is not relevant for generic short range devices which are operating under licence except regime without any kind of regulatory protection. SRDs have to accept interferences.  |
| 5.2.7.2 | Transmitter unwanted emissions in the out of band domain | 4.4.X4.4.X | TX Unwanted emissions |  |
| 5.2.7.3 | Transmitter unwanted emissions in the spurious domain | 4.4.X | TX Unwanted emissions |  |
| 5.2.8 | Transmitter time domain characteristics | ~~4.4.X~~~~4.4.X~~ | ~~Duty cycle~~~~Low Duty Cycle~~ | Not applicable*No requirement in ECC nor EC regulation* |
| 5.2.9 | Transmitter transients | - | - | Not applicable |
|  | Other mitigation, spectrum access requirements not specified in the ETSI Guide but specified in related ECC/EC framework | ~~4.4.X~~~~4.4.X~~~~4.4.X~~~~4.4.X~~ | ~~LBT~~~~DAA~~~~TX - Power Control~~~~Trigger-before-transmit~~ | Not applicable*No requirement in ECC nor EC regulation* |
|  |
| 5.3.2 | Receiver sensitivity | 4.4.X | not specified, superseded by RBS test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.2.3 | Desensitization | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.3 | Receiver co-channel rejection | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.4.2.1 | Receiver adjacent channel selectivity | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.4.2.2 | Receiver adjacent band selectivity | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.4.3 | Receiver blocking | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.4.4 | Receiver spurious response rejection | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.4.5 | Receiver radio-frequency intermodulation | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.5 | Receiver unwanted emissions in the spurious domain | 4.4.X | Unwanted emissions in the spurious domain | Note: if the EUT covered by the EN has “receive only” modes |
| 5.3.6.1 | Receiver dynamic range | 4.4.X | Receiver dynamic range or partly by RBS | Note: or EN has specific dynamic range test, if not see ETSI EN 303 883-2, table C.1 |
| 5.3.6.2 | Reciprocal mixing | 4.4.X | not specified, superseded by RBR test | See justification in ETSI EN 303 883-2, Annex C and the explanation of the interferer signal handling concept, see ETSI TS 103 567 [i.XX] |
| 5.3.1 | Signal interferer handling | 4.4.X4.4.X | Receiver Baseline Sensitivity (RBS)Receiver Baseline Resilience (RBR) | Interferer signal handling ([i.4] clause 5.3.1) is an alternative method for specifying receiver parameters intended for use for receivers such as UWB and certain types of radar equipment. This EN is following this concept, see ETSI TS 103 567 [i.XX] and ETSI EN 303 883-2 [X]. |

Annex D (normative): Interferer for RBR test

Annex to justify the levels for the RBR test, use-case,… shall be considered.

Question: which kind of device from the other “radio-application” would be more critical 🡪 fixed or mobile or??

Basis could be TS 103 361

Annex E (normative):
EUT Category: Use-Case, wanted technical performance criteria and TX and RX-test conditions

# E.1 Description

# E.2 TX-Measurement

# E.3 Wanted Technical Performance Criteria (WTPC) and RX - requirement

## E.3.1 General

Based on the use-case in E.1 considered for EUT within Operating Frequency Range (OFR): within 6 - 10.6 GHz 🡪 could cover INT3, INT4 and INT5

* Target: RCS of 0,85m2; rcs: -0,71 dBm2, mechanical dimension of a triple mirror, see clause TS 103 789 [] A.1.1.1
* Linear movement to EUT: with 0,7 m/s and 1m delta in distance (TS 103 789 [] clause 6.6) in the main measurement direction of the EUT
* Installation height of the target over ground: 0.925 m
* Starting distance (maximum detection distance): see related EN (e.g. specification of sub-categories, like short range, mid-range, long range)
* Wanted technical performance: 95% detection probability. The related standard shall specify the number of test repetitions.

🡪 kind of object, distance, or???

## E.3.2 RBS-requirement and limit

Specific RBS requirements

## E.3.3 RBR requirement and limit

Specific RBS requirements

# E.4 RX-Measurement

Place to consider specific “mechanical” specification of “used object” or scenario “e.g. if indirect emission,..”

Annex F (informative):
Bibliography

*<*Publication*>*:"*<*Title*>". <*Edition*>*. *<*Year*>*, *<*Issue designation*>*, *<*Page location*>*.

Annex G (informative):
Change history

| Version | Information about changes |
| --- | --- |
| 0.0.1 | Initial draft |
| 0.0.2 | Revised draft based on TG SRR discussions (TGSRR#48) |
| 0.0.3 | Outcome rapporteurs meeting#1 11/01/2024 |
| 0.0.4 | Working draft for rapporteurs meeting 05/03/2024 |
| 0.0.5 | Outcome rapporteurs meeting#2 05/03/2024 |

# History

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| --- |
| **Document history** |
| <Version> | <Date> | <Milestone> |
|  |  |  |
|  |  |  |
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*Latest changes made on 2021-04-13*