Draft ETSI EN 305 550-6 V1.1.0 (2024-10)

Short Range Devices (SRD) to be used in the 40 GHz to 260 GHz frequency range; Harmonised Standard for access to radio spectrum; Part 6: Specific radiodetermination applications - Tank Level Probing Radar (TLPR) and Level Probing Radar (LPR) equipment operating in the frequency ranges 116 GHz to 148,5 GHz; 167 GHz to 182 GHz and 231,5 GHz to 250 GHz

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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 Standardisation Request deliverable Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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.1].

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.

The present document is part 6 of a multi-part deliverable covering Short Range Devices (SRD) to be used in the 40 GHz to 260 GHz frequency range; Harmonised standard for access to radio spectrum, as identified below:

Part 1: "Communication devices within 57 GHz to 64 GHz, 122 GHz to 123 GHz or 244 GHz to 246 GHz";

Part 2: "Radiodetermination for industrial applications (RDI & RDI-S) equipment operating within 116 GHz to 260 GHz";

Part 3: "Radiodetermination for consumer applications within 57 GHz to 64 GHz, 122 GHz to 130 GHz, 134 GHz to 148,5 GHz or 244 GHz to 246 GHz";

Part 4: "Radiodetermination devices at vehicles within 57 GHz to 64 GHz";

Part 5: "Ultra Short Range Communication Device (USRCD) within 57 GHz to 64 GHz";

Part 6: "Specific radiodetermination applications - Tank Level Probing Radar (TLPR) and Level Probing Radar (LPR) equipment operating in the frequency ranges 116 GHz to 148,5 GHz; 167 GHz to 182 GHz and 231,5 GHz to 250 GHz".

NOTE: The list above shows the planned multi-part deliverable, at the time, when the present document was finalized.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or 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 (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

ETSI ERM TGUWB decided to develop more specific standards; this means instead of one generic ETSI EN 305 550 for generic SRD within 40 GHz to 260 GHz, a standard family was started to reflect the intended use in relation to the wanted technical performances in more detail.

The present document is the first version of the harmonised standard ETSI EN 305 550-6 for Level Probing Radar (LPR) and Tank Level Probing Radar (TLPR) equipment using UWB technology in the frequency ranges 116 GHz to 148,5 GHz, 167 GHz to 182 GHz and 231,5 GHz to 250 GHz, and it is part of the standard family ETSI EN 305 550-x which covers Short Range Devices (SRD) to be used in the 40 GHz to 260 GHz frequency range in general.

1 Scope

The present document specifies technical requirements, limits and test methods for SRD radiodetermination equipment using Ultra Wide Band technology (UWB) in the frequency ranges from 116 GHz to 148,5 GHz, from 167 GHz to 182 GHz, and from 231,5 GHz to 250 GHz for Level Probing Radar (LPR) and Tank Level Probing Radar (TLPR).

Level Probing Radars and Tank Level Probing Radars consist of a combined transmitter and receiver and are equipped with an integral or dedicated antenna provided also by the EUT manufacturer. EUTs intended to be equipped with antennas from third-party manufacturers are not covered by the scope of the present document.

Furthermore, the present document is limited to LPR and TLPR devices with FMCW modulation (see clause C.2.2 of ETSI EN 303 883-1 [1]).

Further details of the covered LPR and TLPR EUT can be found in clause 4.2 of the present document.

NOTE 1: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in annex A.

NOTE 2: Equipment covered by the present document operates in accordance with clause 2.3 and clause 2.5 of ECC Decision(22)03 [i.3] and the upcoming EC framework for UWB/SRDs for the range 116 GHz to 260 GHz, which is based on the results of ECC Report 334 [i.9].

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.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

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 (V2.1.1) (2024-06): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 1: Measurement techniques for transmitter requirements".

[2] ETSI EN 303 883-2 (V2.1.1) (2024-06): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 2: Measurement techniques for receiver requirements".

[3] ETSI TS 103 789 (V1.1.1) (2023-05): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Radar related parameters and physical test setup for object detection, identification and RCS measurement".

[4] ETSI TS 103 941 (V1.1.1) (2024-01): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Measurement setups and specifications for testing under full environmental profile (normal and extreme environmental conditions)".

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] 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 (RE-Directive).

[i.2] 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.3] ECC/DEC/(22)03 of 18 November 2022 on technical characteristics, exemption from individual licensing and free circulation and use of specific radiodetermination applications in the frequency range 116-260 GHz, amended 8 March 2024.

[i.4] CEPT ERC Recommendation 74-01 (October 2021): "Unwanted emissions in the spurious domain".

[i.5] European Commission Implementing Decision (EU) 2022/180 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.6] IEC 61298-2:2008-10: "Process measurement and control devices - General methods and procedures for evaluating performance - Part 2: Tests under reference conditions".

[i.7] ETSI EG 203 336 (V1.2.1) (2020-05): "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.8] ETSI TS 103 567 (V1.1.1) (2019-09): "Requirements on signal interferer handling".

[i.9] ECC Report 334: "UWB radiodetermination applications in the frequency range 116-260 GHz", January 2022, amended 2023.

[i.10] ETSI TS 103 361 (V1.1.1) (2016-03): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the Directive 2014/53/EU".

[i.11] ETSI TS 103 060 (V1.1.1) (2013-09): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Method for a harmonized definition of Duty Cycle Template (DCT) transmission as a passive mitigation technique used by short range devices and related conformance test methods".

[i.12] Committee on Radio Astronomy Frequencies (CRAF), European Science Foundation.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

Duty Cycle over signal repetition period (DC_Trep): ratio of the sum of all the active sweep durations T_{on} (sweeps, scans) within the signal repetition period T_{rep}

NOTE: The signal repetition time T_{rep} here is equivalent to the $T_{meas,cycle}$ in the measurement standard ETSI EN 303 883-1 [1].

Frequency Modulated Continuous Wave (FMCW) radar: modulation scheme which is based on a periodically linear frequency sweep of the transmit signal

NOTE: See also clause E.1 and ETSI EN 303 883-1 [1], clause C.2.2.

step response time (of an LPR or TLPR): time span after a sudden distance change until the output value (distance value) reaches 90 % of the final value for the first time

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

f_{H_EUT}	Higher frequency of the EUT's actual operating frequency range
f_{L_EUT}	Lower frequency of the EUT's actual operating frequency range
f_{Rmin}	Regulated lower frequency limit of an operating frequency range
f_{Rmax}	Regulated upper frequency limit of an operating frequency range
T_{on}	ramp duration time for FMCW modulation schemes, i.e. it is the active radar sweep duration when the transmitter of the EUT is active

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

AUT	Antenna Under Test
e.i.r.p.	equivalent isotropically radiated power
EFTA	European Free Trade Union
IEC	International Electrotechnical Commission
ITU-R	International Telecommunication Union - Radio Sector
RCS	Radar Cross Section
SGA	Standard Gain Antenna

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, but as a minimum, shall include that specified in the test conditions contained in the present document. 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 general requirements applicable for all TLPR and LPR are:

- Installation requirements from ECC/DEC/(22)03 [i.3] as listed in clause F for information.
- Receive-only devices, EUTs exhibiting a receive-only mode or a standby mode are not covered by the scope of the present document. Hence, Rx spurious emission is not covered by the present document.

The WTPC to cover the intended use for all EUTs addressed by the present document are defined in clause 4.4.2.

In order to provide a clear EUT categorization regarding the wanted performance criteria (as specified in clause 4.4.2), technical requirements, limits and test methods, the following sub-categories have been defined by:

- the used Operating Frequency Range (OFR), see clause 4.2.2;
- the used device type (T/LPR), see clause 4.2.3;
- the available antenna gain (GAIN), see clause 4.2.4;
- the used antenna connection (ANT), see clause 4.2.5.

4.2.2 Categorization by Operating Frequency Range (OFR)

The following categorization of LPR and TLPR EUTs by the Operating Frequency Range is used:

- OFR1: OFR of the EUT is contained in the frequency range 116 GHz to 148,5 GHz;
- OFR2: OFR of the EUT is contained in the frequency range 167 GHz to 182 GHz;
- OFR3: OFR of the EUT is contained in the frequency range 231,5 GHz to 250 GHz.

This categorization has been conducted, reflecting the different permitted frequency ranges which can be used for Level Probing Radars and Tank Level Probing Radars in accordance with ECC/DEC/(22)03 [i.3].

4.2.3 Categorization by device type

The following categorization of LPR and TLPR EUTs by the antenna connection is used:

- LPR: EUT intended to be installed and operated according to clause F.1;
- TLPR: EUT intended to be installed and operated within a tank according to clause F.2.

This categorization has been conducted, reflecting the two equipment types in accordance with ECC/DEC/(22)03 [i.3], clauses A.2.3 and A.2.5.

4.2.4 Categorization by antenna gain

The following categorization of LPR and TLPR EUTs by the antenna connection is used:

- GAIN1: EUT features an antenna with a high gain of $\geq$ 20 dBi;
- GAIN2: EUT features an antenna with a low gain of < 20 dBi.

This categorization has been conducted, reflecting the additional conducted peak power limit of 15 dBm for antenna gain < 20 dBi in accordance with ECC/DEC/(22)03 [i.3].

4.2.5 Categorization by antenna connection

The following categorization of LPR and TLPR EUTs by the antenna connection is used:

- ANT1: EUT features an antenna connector, e.g. the EUT is equipped with a dedicated antenna;
- ANT2: EUT has no antenna connector, e.g. the EUT is equipped with an integral antenna.

4.2.6 Summary of EUT categories

An overview of the applicability of transmitter requirements and receiver requirements for the different LPR and TLPR sub-categories is shown in Table 1 and Table 2, respectively.

Table 1: Applicability of transmitter requirements for the different EUT categories

TX requirements	Clause	Categorization by			
		operating frequency range (clause 4.2.2)	device type (clause 4.2.3)	antenna gain (clause 4.2.4)	antenna connection (clause 4.2.5)
		OFR1 to OFR3	TLPR and LPR	GAIN1 and GAIN2	ANT1 and ANT2
Operating frequency range	4.3.2	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
Mean e.i.r.p. spectral density	4.3.3				
Peak e.i.r.p. spectral density	4.3.4				
Maximum conducted peak power	4.3.5	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable only to GAIN2	applicable to any category (ANT1 to ANT2)
Unwanted emission	4.3.6	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
Antenna gain requirement	4.3.7	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
Antenna pattern requirement	4.3.8	applicable to any category (OFR1 to OFR3)	applicable only to LPR	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
Duty Cycle requirement	4.3.9	applicable to any category (OFR1 to OFR3)	applicable only to LPR	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
TX behaviour under the complete environmental profile	4.3.10	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable to any category (GAIN1 to GAIN2)	applicable only to ANT2 (see note)
NOTE: For EUTs with an antenna connector (ANT1), the maximum peak e.i.r.p. spectral density is considered under the complete environmental profile in clause 4.3.4.					

Table 2: Applicability of receiver requirements for the different categories

RX requirements	Clause	Categorization by			
		operating frequency range (clause 4.2.2)	device type (clause 4.2.3)	antenna gain (clause 4.2.4)	antenna connection (clause 4.2.5)
		OFR1 to OFR3	TLPR and LPR	GAIN1 and GAIN2	ANT1 and ANT2
Receiver baseline sensitivity (RBS)	4.4.3	applicable to any category (OFR1 to OFR3)	applicable to any category (TLPR and LPR)	applicable to any category (GAIN1 to GAIN2)	applicable to any category (ANT1 to ANT2)
Receiver baseline resilience (RBR)	4.4.4				

4.2.7 EUT device sub-category index

All possible EUT sub-categories are defined in Table 3 together with their corresponding device category index. The manufacturer shall choose from each category one sub-category. Each EUT shall have only one option from every category and belongs to one index only.

Table 3: EUT categories based on the sub-categories listed in clause 4.2

EUT device category index	EUT sub-category			
L1HI	LPR	OFR1	GAIN1	ANT1
L1HC	LPR	OFR1	GAIN1	ANT2
L1LI	LPR	OFR1	GAIN2	ANT1
L1LC	LPR	OFR1	GAIN2	ANT2
L2HI	LPR	OFR2	GAIN1	ANT1
L2HC	LPR	OFR2	GAIN1	ANT2
L2LI	LPR	OFR2	GAIN2	ANT1
L2LC	LPR	OFR2	GAIN2	ANT2
L3HI	LPR	OFR3	GAIN1	ANT1
L3HC	LPR	OFR3	GAIN1	ANT2
L3LI	LPR	OFR3	GAIN2	ANT1
L3LC	LPR	OFR3	GAIN2	ANT2
T1HI	TLPR	OFR1	GAIN1	ANT1
T1HC	TLPR	OFR1	GAIN1	ANT2
T1LI	TLPR	OFR1	GAIN2	ANT1
T1LC	TLPR	OFR1	GAIN2	ANT2
T2HI	TLPR	OFR2	GAIN1	ANT1
T2HC	TLPR	OFR2	GAIN1	ANT2
T2LI	TLPR	OFR2	GAIN2	ANT1
T2LC	TLPR	OFR2	GAIN2	ANT2
T3HI	TLPR	OFR3	GAIN1	ANT1
T3HC	TLPR	OFR3	GAIN1	ANT2
T3LI	TLPR	OFR3	GAIN2	ANT1
T3LC	TLPR	OFR3	GAIN2	ANT2

The category index is composed in the following sub-category order:

1) Device type
   - **L**: **L**PR
   - **T**: **T**LPR
2) Operating frequency
   - **1**: OFR**1**
   - **2**: OFR**2**
   - **3**: OFR**3**
3) Antenna gain
   - **H**: GAIN1, i.e. **H**igh gain antenna, with ≥ 20 dBi
   - **L**: GAIN2, i.e. **L**ow gain antenna, with < 20 dBi
4) Antenna connection
   - **C**: ANT1, i.e. with an antenna **connector**
   - **I**: ANT2, i.e. with an **integral** antenna, i.e. without an antenna connector

Hence, using a placeholder 'x' all LPR devices covered by the present document have EUT sub-category index Lxxx, and all TLPR devices covered by the present document devices have EUT sub-category index Txxx.

EXAMPLE 1: All devices with an integral antenna can be addressed by EUT sub-category index xxxI.

EXAMPLE 2: An L2HI device is a LPR EUT of OFR2 with an integral high-gain antenna.

4.3 Transmitter Requirements

4.3.1 General

An overview of the transmitter requirements is given in Table 4. The transmitter requirements for EUT covered by the scope of the present document are justified in Table B.1 in annex B.

Table 4: Overview of TX requirements, conformance test and the regarding device types

TX requirement	Requirements in	Conformance tests in	Device type
Operating frequency range	clause 4.3.2	clause 5.3.2	All EUT sub-categories, see clause 4.2.7
Mean e.i.r.p. spectral density	clause 4.3.3	clause 5.3.3	All EUT sub-categories, see clause 4.2.7
Peak e.i.r.p. spectral density	clause 4.3.4	clause 5.3.4	All EUT categories, see clause 4.2.7
Maximum conducted peak output power	clause 4.3.5	clause 5.3.5	Low gain EUT, corresponding to device sub-category index xxLx defined in clause 4.2.7
TX unwanted emissions	clause 4.3.6	clause 5.3.6	All EUT sub-categories, see clause 4.2.7
Antenna gain	clause 4.3.7	clause 5.3.7	All EUT sub-categories, see clause 4.2.7
Antenna pattern	clause 4.3.8	clause 5.3.8	LPR EUT, corresponding to device sub-category index Lxxx of clause 4.2.7
Transmitter duty cycle	clause 4.3.9	clause 5.3.9	Only EUTs of sub-category Lxxx, see clause 4.2.7
TX behaviour under the complete environmental profile	clause 4.3.10	clause 6.3.1 in ETSI TS 103 941 [4]	Only EUTs of sub-category xxxI, see clause 4.2.7, and the note below
NOTE: For EUTs with an antenna connector (xxxC, defined in Table 3 in clause 4.2.7) the maximum peak e.i.r.p. spectral density is considered under the complete environmental profile in clause 4.3.4.			

4.3.2 Operating Frequency Range (OFR)

4.3.2.1 Applicability

The Operating Frequency Range (OFR) requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.3.2.2 Description

The Operating Frequency Range shall be determined as described in clause 5.2.1 of ETSI EN 303 883-1 [1]. According to this description, a value of 20 dB shall be used for the parameter X.

4.3.2.3 Limits

The OFR of an EUT shall be within one of the permitted frequency ranges as given in Table 5 below.

Table 5: Permitted frequency ranges for the different Level Probing Radar (LPR) and Tank Level Probing Radar (TLPR) categories (see ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Frequency range
x1xx	116 GHz ≤ f ≤ 148,5 GHz
x2xx	167 GHz ≤ f ≤ 182 GHz
x3xx	231,5 GHz ≤ f ≤ 250 GHz
NOTE: The frequency ranges are based on ECC/DEC/(22)03 [i.3], clause 2, Table 6 (LPR) and Table 9 (TLPR).	

4.3.2.4 Conformance

The conformance test for the OFR shall be as defined in clause 5.3.2 and not exceed the limits in clause 4.3.2.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.3.3 Mean e.i.r.p. spectral density

4.3.3.1 Applicability

The mean e.i.r.p. spectral density requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.3.3.2 Description

The mean e.i.r.p. spectral density shall be determined as described in clause 5.3.2.1 of ETSI EN 303 883-1 [1].

For LPR devices, 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_{rep} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver (on ECC/DEC/(22)03 [i.3], clause 2, Table 6 (LPR)).

4.3.3.3 Limits

Within the OFR the mean e.i.r.p. spectral density shall not exceed the limits in Table 6 (LPR sub-category, index Lxxx) and Table 7 (sub-category, index Txxx).

Table 6: Mean e.i.r.p. spectral density limits for LPR devices (see ECC/DEC/(22)03 [i.3] and the note)

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Frequency range	Maximum mean e.i.r.p. spectral density (averaged over T_{rep}, see note)
L1xx	116 GHz ≤ f ≤ 148,5 GHz	-8,0 dBm/MHz
L2xx	167 GHz ≤ f ≤ 182 GHz	-6,0 dBm/MHz
L3xx	231,5 GHz ≤ f ≤ 250 GHz	-6,0 dBm/MHz
NOTE: For LPR devices, 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_{rep} of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver (on ECC/DEC (22)03 [i.3], clause 2, Table 6 (LPR)).		

Table 7: Mean e.i.r.p. spectral density limits for TLPR devices (see ECC/DEC/(22)03 [i.3] and the note)

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Frequency range	Maximum mean e.i.r.p. spectral density (averaged over T_{rep}, see note)
T1xx	116 GHz ≤ f ≤ 148,5 GHz	+12,0 dBm/MHz
T2xx	167 GHz ≤ f ≤ 182 GHz	+12,0 dBm/MHz
T3xx	231,5 GHz ≤ f ≤ 250 GHz	+12,0 dBm/MHz
NOTE: For TLPR devices, a maximum duty cycle of 100 % is possible, see ECC/DEC/(22)03 [i.3].		

4.3.3.4 Conformance

The conformance test for mean e.i.r.p. spectral density shall be as defined in clause 5.3.3 and not exceed the limits in clause 4.3.3.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.3.4 Peak e.i.r.p. spectral density

4.3.4.1 Applicability

The peak e.i.r.p. spectral density requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.3.4.2 Description

The peak e.i.r.p. spectral density shall be determined as described in clause 5.3.4.2.3 of ETSI EN 303 883-1 [1].

4.3.4.3 Limits

Within the OFR the peak e.i.r.p. spectral density shall not exceed the limits in Table 8 (LPR sub-category, index Lxxx) and Table 9 (TLPR sub-category, index Txxx).

Table 8: Peak e.i.r.p. spectral density limits for LPR devices (see ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum peak e.i.r.p. [dBm defined in 1 GHz]
Lxxx	+37 dBm

Table 9: Peak e.i.r.p. spectral density limits for TLPR devices (see ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum peak e.i.r.p. [dBm defined in 1 GHz]
Txxx	+42 dBm

4.3.4.4 Conformance

The conformance test for peak e.i.r.p. spectral density shall be as defined in clause 5.3.4 and not exceed the limits in clause 4.3.4.3.

For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) the conformance test shall be done as specified in clause 5.3.4.2 under the complete environmental profile as given in clause 5.1.3.

For EUTs with an integral antenna (sub-category index xxxI, defined in Table 3 in clause 4.2.7) the conformance test shall be done as specified in clause 5.3.4.3 under normal environmental condition as given in clause 5.1.2.

NOTE: The conformance test for integral antenna (sub-category index xxxI, defined in Table 3 in clause 4.2.7) under complete environmental profile is given in clause 4.3.10.

4.3.5 Maximum conducted peak power for devices with low gain antennas

4.3.5.1 Applicability

The maximum conducted peak power requirement applies only to EUTs with an antenna gain below 20 dBi (sub-category index xxLx, defined in Table 3 in clause 4.2.7). The result of clause 4.3.7 shall be used for this categorization.

4.3.5.2 Description

In case of low antenna gain of below 20 dBi, ECC/DEC/(22)03 [i.3] requests that the maximum conducted peak output power shall be limited to 15 dBm.

NOTE: In general, LPR and TLPR devices exhibit low conducted output power levels of below 5 dBm in combination with high gain antennas. The low radiation power is usually caused by the power supply limitation in LPR and TLPR applications, as well as by the used semiconductor technology, which is not capable of exhibiting higher power levels at the used OFRs.

4.3.5.3 Limits

In the case of using an antenna gain smaller than 20 dBi, the maximum conducted peak output power shall be limited to 15 dBm (see also Table 10).

Table 10: Maximum conducted peak output power (see ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum conducted peak output power (see note)
xxLx	+15 dBm
NOTE: Only applicable if antenna gain is below 20 dBi (see clause 4.2.4).	

4.3.5.4 Conformance

The conformance test for the maximum conducted peak output power shall be as defined in clause 5.3.5 and not exceed the limits in clause 4.3.5.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.3.6 Transmitter Unwanted Emissions (TXUE)

4.3.6.1 Applicability

The TX Unwanted Emissions (TXUE) requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.3.6.2 Description

TX Unwanted Emissions (TXUE) are emissions on frequencies outside the Operating Frequency Range (OFR). TXUE include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products related to the RP emissions. TXUE can be split into out-of-band emissions and spurious emissions.

The unwanted maximum mean e.i.r.p. spectral density limit within 116 GHz < f < f_L and f_H < f < 260 GHz shall be at least 20 dB less than the density inside the OFR specified in Table 6 (LPR) and Table 7 (TLPR).

According to ECC/DEC/(22)03 [i.3] the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} (which is T_{rep} in the present document) of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.

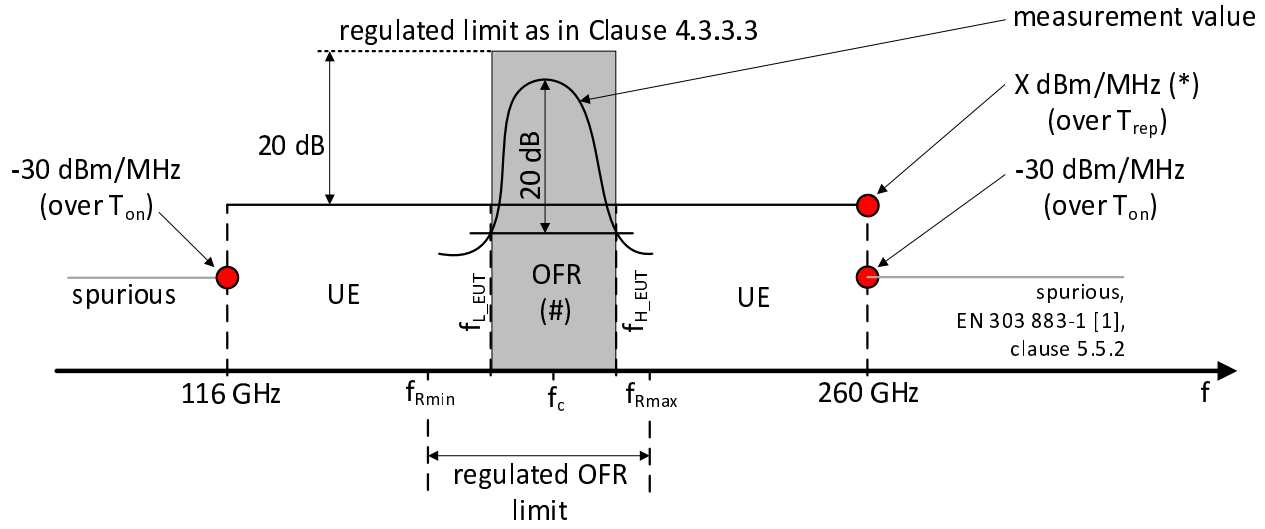
4.3.6.3 Limits

According to ECC/DEC/(22)03 [i.3], Table 6 and Table 9, note 1, the unwanted emission level shall be at least 20 dB below the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. inside the OFR. These limits apply from 116 GHz to 260 GHz.

In compliance with clause 5.5.2 of ETSI EN 303 883-1 [1], I spurious emission limits of ERC/REC 74-01 [i.4] do apply below 116 GHz and above 260 GHz.

NOTE: Based on ECC Report 334 [i.9] and ECC/DEC/(22)03 [i.3] the unwanted emission limits specified in ECC/DEC/(22)03 only apply in the range from 116 GHz to 260 GHz.

Figure 1 provides an overview of the applied concept for unwanted emissions. The frequencies f_{Rmin} and f_{Rmax} denote the upper and lower regulated limit of the respective OFR. It is important to note that the UE extends to the actual measured lower and upper 20 dB bandwidth of the device, f_{L_EUT} and f_{H_EUT}, respectively.



NOTE: (*) The X dBm/MHz values are provided in the unwanted emission column of Tables 11 to 14.
(#) OFR refers to the actual 20 dB bandwidth of a measured EUT.

Figure 1: Overview of UE [i.3] and spurious limits [1] for all TLPR and LPR devices

The unwanted emission limits for frequencies f in the range of 116 GHz $\leq f \leq f_L$ and $f_H \leq f \leq 260$ GHz, are provided for LPR devices in Table 11 and Table 12, and for TLPR devices, the limits are provided in Table 13 and Table 14. These tables are based on Table 6 and Table 9 in ECC/DEC/(22)03 [i.3], and are in line with Table G.3 and Table G.5 in ETSI EN 303 883-1 [1].

Table 11: Limits for the unwanted maximum mean e.i.r.p. spectral density for LPR devices within 116 GHz to 260 GHz covered by ECC/DEC/(22)03 [i.3]

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Permitted range [GHz]	Limit for maximum mean e.i.r.p. spectral density within OFR (e.i.r.p)	Unwanted maximum mean e.i.r.p. spectral density limit within 116 GHz < f < f_L and f_H < f < 260 GHz	
			Limit (see note 1)	For conformance test (see note 2)
Lxxx	116 ≤ f ≤ 148,5	-8 dBm/MHz	-28 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
	167 ≤ f ≤ 182	-6 dBm/MHz	-26 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
	231,5 ≤ f ≤ 250	-6 dBm/MHz	-26 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
NOTE 1: At least 20 dB less than the density inside the OFR specified in Table 6 (LPR) and Table 7 (TLPR). NOTE 2: According to ECC/DEC/(22)03 [i.3] the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} (which is T_{rep} in the present document) of the device including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.				

Table 12: Limits for the unwanted maximum peak e.i.r.p. for LPR devices within 116 GHz to 260 GHz covered by ECC/DEC/(22)03 [i.3]

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Permitted range [GHz]	Limit for maximum peak e.i.r.p. within OFR (see note 2)	Unwanted maximum peak e.i.r.p. limit within 116 GHz < f < f_L and f_H < f < 260 GHz	
			Limit (see note 1)	For conformance test (see note 2)
Lxxx	116 ≤ f ≤ 148,5	+37 dBm peak	+17 dBm peak	Peak measured with 1 MHz
	167 ≤ f ≤ 182	+37 dBm peak	+17 dBm peak	Peak measured with 1 MHz
	231,5 ≤ f ≤ 250	+37 dBm peak	+17 dBm peak	Peak measured with 1 MHz
NOTE 1: At least 20 dB less than the density inside the OFR specified in Table 6 (LPR) and Table 7 (TLPR). NOTE 2: Peak e.i.r.p. for the wanted emission within OFR shall be evaluated in 1 GHz bandwidth.				

Table 13: Limits for the unwanted maximum mean e.i.r.p. spectral density for TLPR device within 116 GHz to 260 GHz covered by ECC/DEC/(22)03 [i.3]

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Permitted range [GHz]	Limit for maximum mean e.i.r.p. spectral density within OFR (e.i.r.p)	Unwanted maximum mean e.i.r.p. spectral density limit within 116 GHz < f < f_L and f_H < f < 260 GHz	
			Limit (see note 1)	for conformance test (see note 2)
Txxx	116 ≤ f ≤ 148,5	+12 dBm/MHz	-8 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
	167 ≤ f ≤ 182	+12 dBm/MHz	-8 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
	231,5 ≤ f ≤ 250	+12 dBm/MHz	-8 dBm/MHz	RMS with 1 MHz RBW, averaged over T_{rep}
NOTE 1: At least 20 dB less than the density inside the OFR specified in Table 6 (LPR) and Table 7 (TLPR). NOTE 2: According to ECC/DEC/(22)03 [i.3], the given maximum mean e.i.r.p. spectral density is valid for averaging over the whole measurement cycle T_{meas_cycle} (which is T_{rep} the present document) of the device, including any T_{off} times in 1 MHz resolution bandwidth of the measuring receiver.				

Table 14: Limits for the unwanted maximum peak e.i.r.p. for TLPR devices within 116 GHz to 260 GHz covered by ECC/DEC/(22)03 [i.3]

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Permitted range [GHz]	Limit for maximum peak e.i.r.p. within OFR (see note 2)	Unwanted maximum peak e.i.r.p. limit within 116 GHz < f < f_L and f_H < f < 260 GHz	
			Limit (see note 1)	Measured
Txxx	116 ≤ f ≤ 148,5	+42 dBm peak	+22 dBm peak	Peak measured with 1 MHz
	167 ≤ f ≤ 182	+42 dBm peak	+22 dBm peak	Peak measured with 1 MHz
	231,5 ≤ f ≤ 250	+42 dBm peak	+22 dBm peak	Peak measured with 1 MHz
NOTE 1: At least 20 dB less than the density inside the OFR specified in Table 6 (LPR) and Table 7 (TLPR). NOTE 2: Peak e.i.r.p. for the wanted emission within OFR shall be evaluated in 1 GHz bandwidth.				

The spurious emission limits applicable for the frequency ranges below 116 GHz and above 260 GHz are provided in ETSI EN 303 883-1 [1], clause 5.5.2.

Table 15: Transmitter unwanted emissions limits in the spurious domain for LPR and TLPR devices (see note below, and clause 2 in ERC/REC 74-01 [i.4])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum mean e.i.r.p. spectral density averaged over T_{on} (see note)
Lxxx	-36 dBm/100 kHz below 1 GHz and -30,0 dBm/MHz above 1 GHz
Txxx	
NOTE: The spurious emissions according to ERC/REC 74-01 [i.4] are to be measured over the burst duration T_{on}; this is in the measurement procedure in clause 5.3.6.	

4.3.6.4 Conformance

The conformance test for Transmitter Unwanted Emissions (TXUE) shall be as defined in clause 5.3.6 and not exceed the limits in clause 4.3.6.3.

The conformance test shall be done under normal environmental conditions as given in clause 5.1.2.

4.3.7 Antenna gain requirements

4.3.7.1 Applicability

The antenna gain requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7). This antenna requirement is independent of the antenna requirement in clause 4.3.8.

4.3.7.2 Description

In general, the antenna gain determination is needed for all device types (defined in Table 3 in clause 4.2.7) as it is needed for the test of the receiver's Wanted Technical Performance Criteria (WTPC).

In addition, the requirement as specified in Table 6 (LPR devices) and Table 9 (TLPR devices) of ECC/DEC/(22)03 [i.3] include a limitation requirement for maximum conducted peak output power in case of a low antenna gain. This clause is to find out whether the low antenna gain case applies for the EUT. Further explanation of the conducted peak output power is provided in clause 4.3.5.

4.3.7.3 Limit

EUTs with an antenna gain of below 20 dBi shall be considered as a low-gain antennas (sub-category index xxLx, defined in Table 3 in clause 4.2.7). Then, ECC/DEC/(22)03 [i.3] requires a maximum conducted peak output power of 15 dBm. The maximum conducted peak power requirement is provided in clause 4.3.5.

In case of an antenna gain of at least 20 dBi, the antenna is considered a high gain antenna (sub-category index xxHx, defined in Table 3 in clause 4.2.7). Then, there is no maximum conducted peak power measurement required.

4.3.7.4 Conformance

The conformance tests for antenna gain requirement shall be as defined in clause 5.3.7 and not exceed the limits in clause 4.3.7.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.3.8 Antenna pattern requirements

4.3.8.1 Applicability

The antenna pattern requirement applies to the LPR category (sub-category index Lxxx, defined in Table 3 in clause 4.2.7). This antenna requirement is independent of the antenna requirement in clause 4.3.7.

4.3.8.2 Description

ECC/DEC/(22)03 [i.3] Table 6 gives an antenna requirement for LPR devices regarding their side lobe suppression. That is, the peak e.i.r.p. is limited for elevations above 90 degrees relative to the maximum antenna gain in main beam direction.

NOTE: According to ECC/DEC/(22)03 [i.3], clause A.2.3, LPR equipment is limited to a downward orientation of the EUT antenna main beam towards the ground. However, the manufacturer should provide a clear guidance in the user manual how the equipment is properly operated and installed. See also clause F.1.

4.3.8.3 Limit

In compliance with ECC/DEC/(22)03 [i.3], the limit for sufficient side lobe suppression is that the peak e.i.r.p. is limited to 0 dBm within the back half-sphere, i.e. for radiation angles from 90 degrees to 180 degrees related to the bore side axis, as given in Table 16.

Table 16: Maximum radiation limit for LPR for elevation angles above 0° (see ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum peak e.i.r.p. for the back half sphere (see note)
Lxxx	0 dBm
NOTE: Back half-sphere refers to angles from 90 degrees to 180 degrees related to the direction of the maximum emission of the Mean e.i.r.p. spectral density measurement (main lobe), see clause 4.3.3, and as specified in ETSI EN 303 883-1 [1], clause 5.12.	

4.3.8.4 Conformance

The conformance tests for antenna requirements shall be as defined in clause 5.3.7 and not exceed the limits in clause 4.3.8.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.3.9 Transmitter Duty Cycle Requirements

4.3.9.1 Applicability

The transmitter duty cycle requirement applies to the LPR category (sub-category index Lxxx, defined in Table 3 in clause 4.2.7).

4.3.9.2 Description

For LPR devices, the ECC/DEC/(22)03 [i.3] defines a maximum duty cycle. The duty cycle definition for DC_Trep shall be used here according to clause 5.3.9.1.

4.3.9.3 Limit

In compliance with ECC/DEC/(22)03 [i.3] Table 6 (LPR), the limits are as in Table 17.

Table 17: Maximum duty cycle limits for LPR devices (defined in ECC/DEC/(22)03 [i.3])

EUT sub-category index (defined in Table 3 in clause 4.2.7)	Maximum duty cycle for LPR devices
Lxxx	5 %

4.3.9.4 Conformance

The conformance test for the duty cycle shall be as defined in clause 5.3.9 and not exceed the limits in clause 4.3.9.3.

The conformance test shall be done under normal environmental conditions as given in clause 5.1.2.

4.3.10 TX behaviour under the complete environmental profile

4.3.10.1 Applicability

The TX behaviour requirements under the complete environmental profile apply to EUTs with an integral antenna (sub-category index xxxI, defined in Table 3 in clause 4.2.7).

NOTE: For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) maximum peak e.i.r.p. spectral density is considered under the complete environmental profile in clause 4.3.4.

4.3.10.2 Description

The TX behaviour under the complete environmental profile verifies the conformance of the peak e.i.r.p. spectral density over the complete environmental profile as specified in clause 5.1.3.

4.3.10.3 Limits

The limits of peak e.i.r.p. spectral density from clause 4.3.4 are applied indirectly over the complete environmental profile with relative measurements. The difference between each environmental profile relative measurement point (P_{step}) and the relative reference value REF_{power} at normal condition, both expressed in decibels, shall be smaller than the difference $DELTA_{power}$ between the individual regulated peak e.i.r.p. spectral density limit in Table 8 (LPR) and Table 9 (TLPR) and the maximum measured value ($NORM_{abs}$) obtained in an absolute measurement according to clause 4.3.4, which is according to ETSI TS 103 941 [4], clause 6.2.1. The following formula also describes the requirement.

$$P_{step} - REF_{power} \leq \text{peak e.i.r.p. spectral density limit} - NORM_{abs}$$

4.3.10.4 Conformance

The conformance test for the TX-behaviour under the complete environmental profile shall be as defined in clause 6.2.1 of ETSI TS 103 941 [4] and shall be done under the complete environmental profile as specified in clause 5.1.3 of the present document.

4.4 Receiver Requirements

4.4.1 General

An overview of the receiver requirements is given in Table 18.

Table 18: Overview of RX requirements and the regarding device types

RX requirement	Requirements in	Conformance tests in	Device Type
Receiver Baseline Sensitivity (RBS)	clause 4.4.3	clause 5.4.3	all EUT categories, see clause 4.2.7
Receiver Baseline Resilience (RBR)	clause 4.4.4	clause 5.4.4	all EUT categories, see clause 4.2.7

Justification for the receiver requirements for EUT in the scope of the present document is provided in annex B. According to ETSI EN 303 883-2 [2], clause 5.2, the Receiver Spurious Emissions are not in the present document as these are only applicable for receive only EUTs (TX not present) or for EUTs which have a receive only mode (TX inactive). This is also mentioned in clause 4.2.

4.4.2 Wanted Technical Performance Criteria (WTPC)

In accordance with ETSI EN 303 883-2 [2], clause 5.3 for radiodetermination applications, the wanted technical performance criteria in Table 19 are selected for the present document. The measurement period for both assessments, RBS and RBR, shall be at least 120 seconds or 40 times the step response time of the EUT, whichever is longer.

Table 19: Wanted Technical Performance Criteria

	RBS	RBR
Minimum detection probability	≥ 99 %	• 50 % if the interferer is located inside the OFR (co-channel interference); • 85 % if the interferer is located at fc ± 0,6 × OFR (adjacent channel interference); • 95 % if the interferer is located at fc ± 1,5 × OFR (blocking);
Measurement accuracy of the distance measurement	Δd = ±50 mm	Δd = ±50 mm

The EUT has to fulfil the above performance criteria in specified test scenario as provided in further details in clause D.3. The conformance tests for RBS are specified in clause 5.4.3, and the requirements for RBR is specified in clause 5.4.4 of the present document.

4.4.3 Receiver Baseline Sensitivity (RBS)

4.4.3.1 Applicability

The RBS requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.4.3.2 Description

Receiver baseline sensitivity is the capability of the EUT to receive a wanted signal at application related defined input signal levels while maintaining a minimum level of performance.

The performance criterion for receiver baseline sensitivity (see clause 4.4.2) has to be fulfilled in a defined test scenario which includes a static target (e.g. representing a liquid or solid material) and a distance to the target (see derivation of the test scenario in clause D.2).

4.4.3.3 Limits

The RBS limits as provided by Table 19 in clause 4.4.2 shall be applied.

4.4.3.4 Conformance

The conformance test for Receiver Baseline Sensitivity (RBS) shall be as defined in clause 5.4.3 and not exceed the limits in clause 4.4.3.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

4.4.4 Receiver Baseline Resilience (RBR)

4.4.4.1 Applicability

The RBR requirement applies to all EUT sub-categories (defined in Table 3 in clause 4.2.7).

4.4.4.2 Description

Receiver Baseline Resilience (RBR) is the capability of the EUT to maintain a minimum level of performance in the presence of interfering signals in the Operating Frequency Band (OFR), in adjacent bands and in remote frequency bands.

This quality of the EUT ensures a proper operation in an environment where other spectrum users are present and demonstrates the efficient use of radio spectrum by way of an increased resilience against interference.

Here the RBS requirement from clause 4.4.3 is applied for RBR under the influence of interfering signals with slightly adapted performance criteria (see clause 4.4.2).

4.4.4.3 Limits

A static radar target producing a signal power at the EUT receiver of -54,8 dBm or less shall be detected in the presence of the interfering signals defined in Table 20, while fulfilling the RBR performance criteria provided by Table 19 in clause 4.4.2.

NOTE: The limits are calculated based on ETSI EN 303 883-2 [2], clause A.2.1.2, assuming a 20 dBm e.i.r.p. interferer at 2 m distance in the sidelobe of the LPR/TLPR (0 dBi) at a frequency of 116 GHz (not applying the 10 dB additional attenuation as done in ETSI EN 303 883-2 [2], clause 2.1.2).

4.4.4.4 Conformance

The conformance test for Receiver Baseline Resilience (RBR) shall be as defined in clause 5.4.4 and not exceed the limits in clause 4.4.4.3.

The conformance test shall be done under normal environmental condition as given in clause 5.1.2.

Table 20: Test settings for the RBR interferer test

	Test frequencies	Power level at EUT antenna port	modulation
Within OFR	fc fc + 0,3 x OFR fc - 0,3 x OFR	-59 dBm	CW
Outside OFR	fc + 0,6 x OFR fc - 0,6 x OFR fc + 1,5 x OFR fc - 1,5 x OFR	-59 dBm	CW

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 (within the boundary limits of the operational environmental profile defined by its intended use) to give confidence of compliance for the affected technical requirements.

5.1.2 Normal Conditions

Normal test conditions shall be as defined in clause A.5.3 of ETSI EN 303 883-1 [1].

The measurements shall be realized in compliance with ETSI TS 103 941 [4]. Radiated measurements shall be done within a climate chamber according to Figure 5 in clause 5.2.3 of ETSI TS 103 941 [4]. Details on the test-setup and measurement procedures specifically for LPR and TLPR devices are given in ETSI TS 103 941 [4], clause B.2.

5.1.3 Complete environmental profile test conditions

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

According to clause A.5.3 of ETSI EN 303 883-1 [1] normal test conditions shall be as defined in clause 4.5.3.1 of ETSI TS 103 941 [4], and extreme test conditions shall be as defined in clause 4.5.3.2 of ETSI TS 103 941 [4]. The temperature range shall vary between -20 °C to +60 °C in 20 °C temperature steps; the primary supply voltage varies from 90 % to 110 % of the nominal value.

NOTE: The supply voltage is usually provided by the EUT user manual.

5.2 General conditions for testing and conformance test suites

5.2.1 General conditions for testing

General guidance for measurements is given 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, respectively.

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

5.2.2 Conformance test suites

ETSI EN 303 883-1 [1], annex B provides additional information on test setups for radiated and conducted measurements.

Unless otherwise specified, the conformance tests described in clause 5.3 for the transmitter and clause 0 for the receiver shall be done on a test site according to ETSI EN 303 883-1 [1], clause B.2.2 under far field conditions according to ETSI EN 303 883-1 [1], clause B.2.3.5. Radiated emission measurements, unless otherwise specified, shall in addition use the test method from ETSI EN 303 883-1 [1], clause B.2.5.

5.3 Conformance test methods of measurement for transmitter

5.3.1 General

An overview of the conformance tests is provided in Table 4.

5.3.2 Operating Frequency Range (OFR)

The OFR conformance test shall use the procedure described in ETSI EN 303 883-1 [1], clause 5.2.2 using the peak e.i.r.p. spectral density measurement as defined in clause 5.3.4 in the present document, except that the RBW of the analyser shall be set to 1 MHz as requested in note 1 of Table 6 and Table 9 of ECC/DEC/(22)03 [i.3]. For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) the conformance test for OFR shall be conducted as indicated in ETSI EN 303 883-1 [1], clause 5.1.1.

5.3.3 Mean e.i.r.p. spectral density

The mean e.i.r.p. spectral density conformance test shall use the procedure for known T_{rep} as described in ETSI EN 303 883-1 [1], clause 5.3.2.5.

For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7), the conformance test for mean e.i.r.p. spectral density shall be performed conducted as indicated in ETSI EN 303 883-1 [1], clause 5.1.1.

The needed signal repetition time of the EUT shall be assessed according to ETSI EN 303 883-1 [1], clause C.2.

The antenna gain of the LPR and TLRP devices, which is required to calculate the mean e.i.r.p. spectral density when performing conducted measurements (without the antenna), shall be determined according to the described procedure in clause 5.3.7.2.

5.3.4 Peak e.i.r.p. spectral density

5.3.4.1 General

As all EUTs shall use FMCW modulation only, the swept frequency radar signals are instantaneously narrowband signals as described in ETSI EN 303 883-1 [1], clause 5.3.4.2 and therefore a resolution bandwidth of 1 MHz is sufficient to cover the full signal shape (e.g. even larger RBW setting would not result in higher peak e.i.r.p. spectral density measurement values).

5.3.4.2 Peak e.i.r.p. spectral density for EUTs with a connector

For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) the conformance test for peak e.i.r.p. spectral density shall be conducted as indicated in ETSI EN 303 883-1 [1], clause 5.1.1, and clause 5.3.4.2 of the present document.

The antenna gain of the LPR and TLPR antenna, which is required to calculate the peak e.i.r.p. spectral density when performing conducted measurements (without the antenna), shall be determined according to the described procedure in clause 5.3.7.2.

5.3.4.3 Peak e.i.r.p. spectral density for EUTs with integral antenna

For EUTs without an antenna connector (sub-category index xxxI, defined in Table 3 in clause 4.2.7) the conformance test for peak e.i.r.p. spectral density shall be performed radiated as indicated in ETSI EN 303 883-1 [1], clause 5.1.1, and clause 5.3.4.3 of the present document. In addition, further guidance for radiated measurements is provided in ETSI EN 303 883-1 [1], annex B.

5.3.5 Maximum Conducted Peak Output Power

5.3.5.1 General

This test is required to ensure that the LPR or TLRP device does not exhibit too much output power in case of a low antenna gain of below 20 dBi (sub-category index xxLx, defined in Table 3 in clause 4.2.7).

LPR and TLPR devices can be equipped either with integral antennas or dedicated antennas. However, conducted output power can only be directly measured with an available antenna connector for a dedicated antenna.

In case an antenna connector is available (sub-category index xxLC, defined in Table 3 in clause 4.2.7), the maximum conducted peak output power shall be measured with a conducted measurement in compliance with ETSI EN 303 883-1 [1], clause B.3, as described in clause 5.3.5.2.

If this is not possible, i.e. because of an integrated antenna, an indirect method shall be applied as provided in clause 5.3.5.3.

5.3.5.2 Conducted peak output power measurement

The conducted peak output power measurement shall be done for EUTs with a low-gain antenna and an antenna connector (sub-category index xxLC, defined in Table 3 in clause 4.2.7) according to clause 5.3.7.2 and ETSI EN 303 883-1 [1], clause 5.3.4 and clause B.3.

The signal level detected by the spectrum analyser shall be recorded for the entire OFR, and the maximum power value shall be used as the measurement value.

5.3.5.3 Peak output power evaluation for integral antennas

The peak output power evaluation for integral antennas shall be applied for EUTs with low-gain antenna and an integral antenna (sub-category index xxLI, defined in Table 3 in clause 4.2.7). Due to the lack of an antenna connector, the indirect evaluation of the maximum conducted peak output power is needed.

Hence, for the radiated assessment of the peak power the TRP_{pp} method in ETSI EN 303 883-1 [1], clause 5.6.4.3 shall be used, which is summarized in clause 5.3.7.3 in the present document.

The final TRP_{PP} value shall be less than the maximum conducted peak power limit of clause 4.3.5.3.

5.3.6 Transmitter Unwanted Emissions (TXUE)

The transmitter unwanted emissions shall be determined in accordance with ETSI EN 303 883-1 [1], clause 5.5.3 with the setup described in ETSI EN 303 883-1 [1], clause B.4.1.4.

The test antenna shall initially be oriented for vertical polarization, and the EUT shall be rotated horizontally through 360° in at least 15° angular steps until a maximum signal level is detected in the test receiver (see ETSI EN 303 883-1 [1], clause B.4.1.4, Figure B.16).

In accordance with the limits in Tables 11, 12, 13, 14 and 15, the following parameters shall be used:

- for measurements between 116 GHz and f_{L_EUT}:
  - averaging time: T_{rep}
  - start frequency F_{LOWER}: 116 GHz
  - stop frequency F_{UPPER}: f_{L_EUT}
- for measurements between f_{H_EUT} and 260 GHz:
  - averaging time: T_{rep}
  - start frequency F_{LOWER}: f_{H_EUT}
  - stop frequency F_{UPPER}: 260 GHz
- for measurements below 116 GHz:
  - averaging time: T_{ON}
  - start frequency F_{LOWER}: 30 MHz
  - stop frequency F_{UPPER}: 116 GHz
- for measurements above 260 GHz:
  - averaging time: T_{ON}
  - start frequency F_{LOWER}: 260 GHz
  - stop frequency F_{UPPER}: 300 GHz

Important is that the maximum mean e.i.r.p. spectral density and the maximum peak e.i.r.p. spectral density are determined with an active transmitter. A typical signal scheme is provided in ETSI EN 303 883-1 [1], clause C.2.2.2, for single sweeps and multiple sweeps during T_{rep}. respectively. To correctly measure the maximum mean e.i.r.p. with the RMS detector, it is important to set the sweep time of the spectrum analyser to a value of at least the value of T_{rep}, i.e. $SWT \geq T_{rep}$.

For EUT sub-category devices indexed with Txxx (defined in Table 3 in clause 4.2.7) the active radar sweep time T_{on} shall be assessed according to clause 5.3.9.

5.3.7 Antenna gain

5.3.7.1 General

Generally, LPR and TLPR devices can be equipped either with integral antennas or dedicated antennas using an antenna connector. Integral antennas usually do not provide an antenna connector and can, therefore, not be accessed on their feed point for measurement purposes. However, if the EUT has a dedicated antenna connector, it shall be used for measurement purposes.

The antenna gain determination is needed for all devices as it is needed for the receiver's Wanted Technical Performance Criteria (WTPC).

Antennas Under Test (AUTs) with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) shall use the procedure described in clause 5.3.7.2. For integral AUTs without an antenna connector (sub-category index xxxI, defined in Table 3 in clause 4.2.7) the procedure described in clause 5.3.7.3 shall be used.

The measurement of the antenna gain shall be done at the centre frequency f_c of the Operating Frequency Range (OFR), see clause 4.3.2.

5.3.7.2 Conformance test for antenna gain of AUTs with antenna connector

This conformance test is applicable to EUT sub-categories with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7).

The antenna gain tests shall be done in accordance with ETSI EN 303 883-1 [1], clause 5.12.2.

The transmit antenna is mounted on a fixed mast at the same height as the SGA and the output of the transmit antenna is connected to the signal source, as illustrated in Figure 40 of clause 5.12.2.2 of ETSI EN 303 883-1 [1]. Both polarizations need to be measured.

The measurement equipment requirements and settings for the spectrum analyser, the signal generator, and the measurement antenna are provided in ETSI EN 303 883-1 [1], clause 5.12.2.2.3. The only exception here in the present document is that the RBW of the SA shall use maximum available bandwidth equal to or greater than 3 MHz and less or equal 50 MHz.

5.3.7.3 Conformance test for antenna gain of AUTs without antenna connector

For EUTs without antenna connector the Total Radiated Peak Power (TRP_{PP}) shall be determined by measuring the EUTs transmit signal radiated over the integral antenna at its centre frequency f_c while the EUT itself is being rotated on the turntable as shown in Figure B.16 in clause B.4.2 of ETSI EN 303 883-1 [1].

The complete test procedure is provided in ETSI EN 303 883-1 [1], clause 5.12.3. in addition, details on the used TRP method are provided in ETSI EN 303 883-1 [1], clause 5.6.3.

Clause B.4 of ETSI EN 303 883-1 [1] provides with Figure B.15 the general spherical scan setup with the rotation of the EUT over two axes, and ETSI EN 303 883-1 [1] Figure B.16 shows a concrete TRP scan setup within an anechoic chamber.

Both antennas shall be located at a distance D between them, so that far field conditions apply according to ETSI EN 303 883-1 [1], clause B.2.3.5.

The procedure shall be split into two half-sphere scans with an angular resolution as provided in ETSI EN 303 883-1 [1], clause 5.4.6.3 and clause 5.12.2.1. The EUT is rotated horizontally in the defined angular measurement range (±90°), supporting the desired step width of the angular resolution. Both polarizations shall be measured.

NOTE 1: Angular steps of 15° are sufficient to provide a TRP_{PP} result with an error less than 0,1 dB (as noted in Table 6 in clause 5.6.3 of ETSI EN 303 883-1 [1]).

The measurement equipment requirements and settings for the spectrum analyser, the signal generator, and the measurement antenna are provided in ETSI EN 303 883-1 [1], clause 5.12.2.2.3. The only exception here in the present document is that the RBW of the SA shall use the maximum available bandwidth equal to or greater than 3 MHz and less or equal 50 MHz.

NOTE 2: The characteristics of the receive antenna need not precisely to be known. However, it is recommended to use a receive antenna with a gain of > 15 dBi.

Once the TRP_{PP} result of the full-sphere scan is available, the antenna gain in boresight can be indirectly calculated (clause 5.3.5.3) as specified in ETSI EN 303 883-1 [1], clause 5.12.3 as the difference between the radiated power in the direction of the highest emission and the calculated TRP_{PP} of the EUT.

In addition, the antenna's peak e.i.r.p. above 0° elevation can be determined from the TRP_{PP} measurement data.

Guidance for the assessment of emission levels above regulated elevations is provided in ETSI EN 303 883-1 [1] in clause 5.12.4.

5.3.8 Antenna radiation patterns

5.3.8.1 General

This conformance test is only applicable to devices under EUT sub-category with index Lxxx (defined in Table 3 in clause 4.2.7). The antenna pattern tests shall be done in accordance with ETSI EN 303 883-1 [1], clause 5.12.

The measurement equipment requirements and settings for the spectrum analyser, the signal generator, and the measurement antenna are provided in ETSI EN 303 883-1 [1], clause 5.12.2.2.3. The only exception here in the present document is that the RBW of the SA shall use maximum available bandwidth equal to or greater than 3 MHz and less or equal 50 MHz.

5.3.8.2 Conformance test for AUTs with an antenna connector

The conformance test shall be done as described in ETSI EN 303 883-1 [1], clause 5.12.2.2.

5.3.8.3 Conformance test for integral AUTs without antenna connector

The conformance test shall be done as described in ETSI EN 303 883-1 [1], clause 5.12.3.

5.3.9 Duty Cycle

5.3.9.1 Duty cycle over signal repetition period DC_Trep

The present document uses DC_T_{rep} only in accordance with ETSI EN 303 883-1 [1], clause 5.11.2.3, and ETSI EN 303 883-1 [1], clauses C.1 and C.2.2. The duty cycle over signal repetition period (DC_Trep) conformance test shall use the procedure described in ETSI EN 303 883-1 [1], clause 5.11.2.3. using the signal repetition time T_{rep} as observation period.

Duty cycle over signal repetition period (DC_T_{rep}) is defined as the ratio of the sum of all active sweep periods T_{on} to the signal repetition period T_{rep}, i.e.

$$DC\_T_{rep} = \frac{\sum T_{on}}{T_{rep}} \quad (1)$$

where:

- T_{on} is the active radar sweep period, i.e. when the transmitter of the EUT is on.
- T_{rep} is the overall measurement cycle of the EUT including any off times (blanking time) of the transmitter.

NOTE 1: Duty cycle over signal repetition period is also sometimes referred to as "duty cycle resulting from user" in some sources dealing with UWB devices Further information on LPR modulation schemes is given in ETSI EN 303 883-1 [1], clause C.2.2, and clause E of the present document.

According to ETSI EN 303 883-1 [1], clause 5.11.2, T_{obs}, T_{dis} and P_{thresh} are specified as follows:

T_{obs}: The observation time is defined as T_{rep}, which is equivalent to $T_{meas,cycle}$ in the measurement standard ETSI EN 303 883-1 [1].

T_{dis}: The disregard time shall be set to 1 µs.

NOTE 2: This value for disregard time T_{dis} is large enough to span pulse-based symbols and include them in the on-time T_{on}, but small enough to differentiate packets and account the time between as off-time T_{off}.

P_{thresh}: The threshold level P_{Thresh} as defined in ETSI TS 103 060 [i.11] shall be set to 10 dB below the max emission limit according to ETSI EN 303 883-1 [1], clause 5.11.2.4.1.

NOTE 3: As RF detectors have a video output which is connected to an oscilloscope with usually linear voltage scales, the "mV/mW" characteristic given in the detector's datasheet is usually used for the power-to-voltage conversion. Accordingly, the 10 dB threshold would translate into a linear voltage trigger level of 10 % of the peak values shown on the oscilloscope's voltage scale.

Examples of repetitive FMCW ramps within a complete measurement cycle $T_{rep} = \sum T_{on} + \sum T_{off}$, are provided in ETSI EN 303 883-1 [1], clause C.2.2.

5.3.9.2 Duty Cycle Measurement Method

According to the conformance procedures in ETSI EN 303 883-1 [1], clause 5.11.2.3, the method in this clause is intended for duty cycle requirements for FMCW systems only. As shown in Figure 2, a diode detector with an oscilloscope shall be used for all applicable EUT sub-categories provided in the present document (defined in Table 3 in clause 4.2.7). This shall be in accordance with clause 5.11.2.3.2 in ETSI EN 303 883-1 [1].

For radiated measurements, a linear polarized horn antenna can be directly connected to the diode connector, for conducted measurements, the diode connector is connected to the EUT antenna connector.

For EUTs with an antenna connector (xxxC, defined in Table 3 in clause 4.2.7) the conformance test for duty cycle over signal repetition period (DC_Trep) shall be conducted as indicated in ETSI EN 303 883-1 [1], clause 5.1.1.

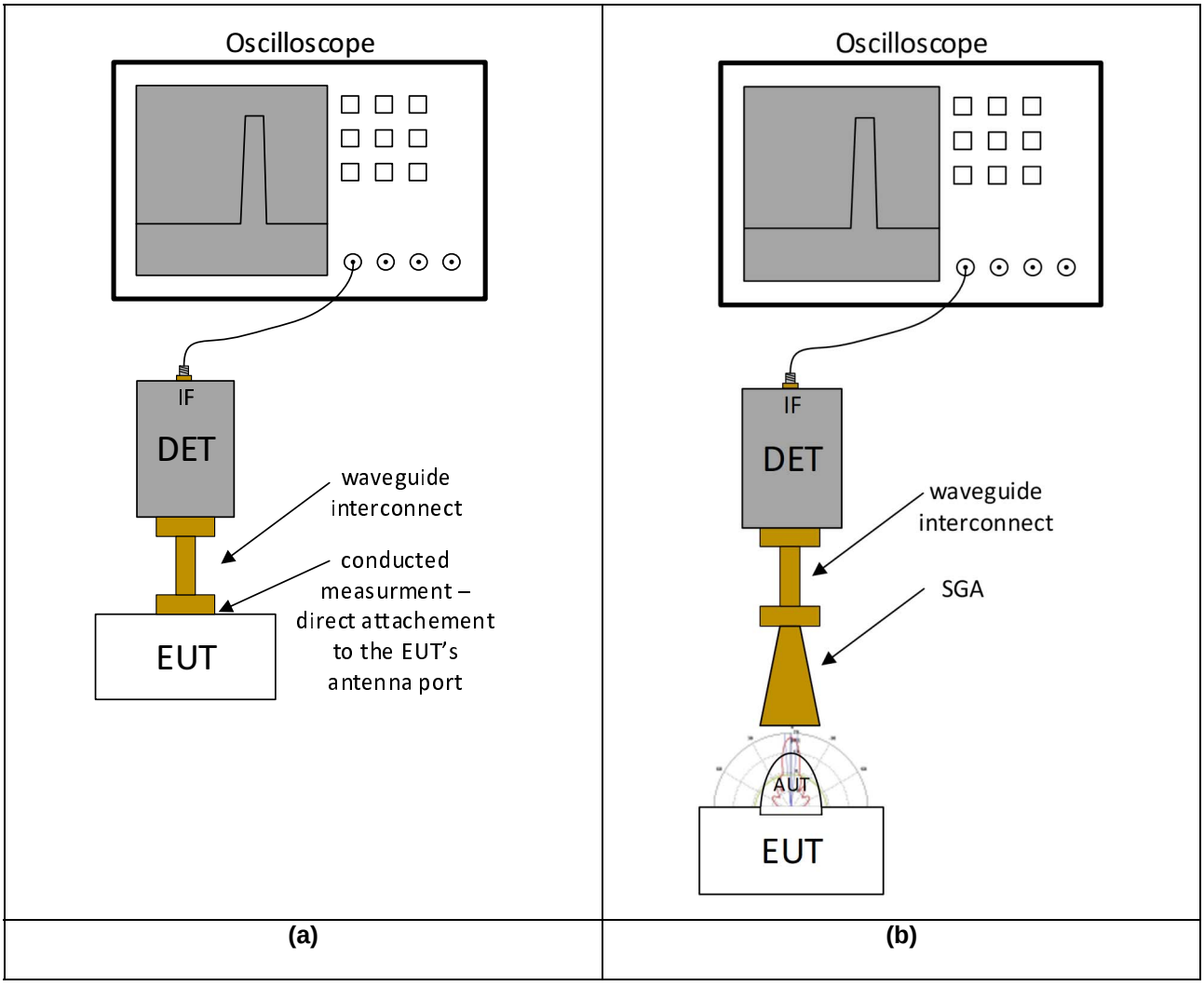


Figure 2: Duty cycle measurement using
(a) a conducted setup for devices with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7), and
(b) a radiated setup for devices with an integral antenna (sub-category index xxxI, defined in Table 3 in clause 4.2.7)

5.4 Conformance test methods of measurement for receiver

5.4.1 General

ETSI EN 303 883-2 [2], clause 5.1 gives general guidance on RX measurements. For EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) the conformance tests for receiver baseline sensitivity (see clause 5.4.2) and receiver baseline resilience (see clause 5.4.4) shall be performed conducted as described in clauses 5.4.3.1 and 5.4.4.1, respectively, and as indicated in ETSI EN 303 883-1 [1], clause 5.1.1.

The RX requirements shall be measured for:

- Receiver Baseline Sensitivity (RBS), see clause 5.4.3.
- Receiver Baseline Resilience (RBR), see clause 5.4.4.

5.4.2 Wanted Technical Performance Criteria (WTPC)

WTPC test procedures are provided in clause 5.4.3 for sufficient RBS, and in clause 5.4.4 for minimum RBR performance.

5.4.3 Receiver Baseline Sensitivity (RBS)

5.4.3.1 Radiated test setup for EUTs without antenna connector

The RBS tests shall be done in accordance with ETSI EN 303 883-2 [2], clause 5.4.3.5.

ETSI EN 303 883-2 [2], clause 5.4.3.5 Figure 12 shows the radiated test setup for the equivalent scenario for the Receiver Baseline Sensitivity (RBS) test. The test setup for the equivalent scenario includes a specific radar target and features the generation of a defined echo signal power. The equivalent scenario is derived from the defined real scenario as described in clause D.

In the radiated test setup, according to Figure 12 in clause 5.4.3.5.3 of ETSI EN 303 883-1 [1], the EUT antenna and the radar target shall be aligned and facing towards each other. The conditions in ETSI TS 103 789 [3], clause B.2 shall be considered in order to ensure far-field conditions and ETSI TS 103 789 [3], clause B.3 shall be considered to fulfil the point target condition.

The EUT has to be adjusted to measure the distance to the radar target.

NOTE: In general, there are built-in functions and techniques that enable LPR and TLPR devices to suppress echoes from unwanted reflections, like the unwanted reflections from the mounting support of the radar target or the walls of the anechoic chamber.

It should be mentioned that LPR and TLPR devices (sub-category index Lxxx and Txxx, defined in Table 3 in clause 4.2.7) often can be equipped with antennas of different sizes and gain. However, the radiated sensitivity test is independent of the EUT antenna as its gain shall be compensated in the radar target RCS and distance D (see clause D.3) for the reference device defined in Table D.1.

Thus, all EUTs with an integral antenna (sub-category index xxxI, defined in Table 3 in clause 4.2.7), can be used to conduct the radiated RBS test.

The test is passed if the technical wanted performance criteria and the RBS limits are met, which are provided in clause 4.4.3.3.

5.4.3.2 Conducted test setup for EUTs with antenna connector

The RBS tests shall be done in accordance with ETSI EN 303 883-2 [2], clause 5.4.3.6.

Based on ETSI EN 303 883-2 [2], clause 5.4.3.6, Figure 3 shows the conducted test setup for the equivalent scenario for the Receiver Baseline Sensitivity (RBS) test using coaxial or hollow waveguide components. The coupler is not necessary for RBS assessment but is later required for the RBR test (see clause 5.4.4). The spectrum analyser is optional and not mandatory.

The test setup features the generation of a defined echo signal power as described in clause D which is provided to the EUT receiver.

The EUT has to be adjusted to measure the distance to the short circuit.

NOTE: In general, there are built in functions and techniques which enable LPR devices to suppress echoes from unwanted reflections, like the unwanted reflection originating from the transition of the antenna connector to the attenuator for example.

The test is passed, if the technical wanted performance criteria and the RBS limits are met, which are provided in clause 4.4.3.3.

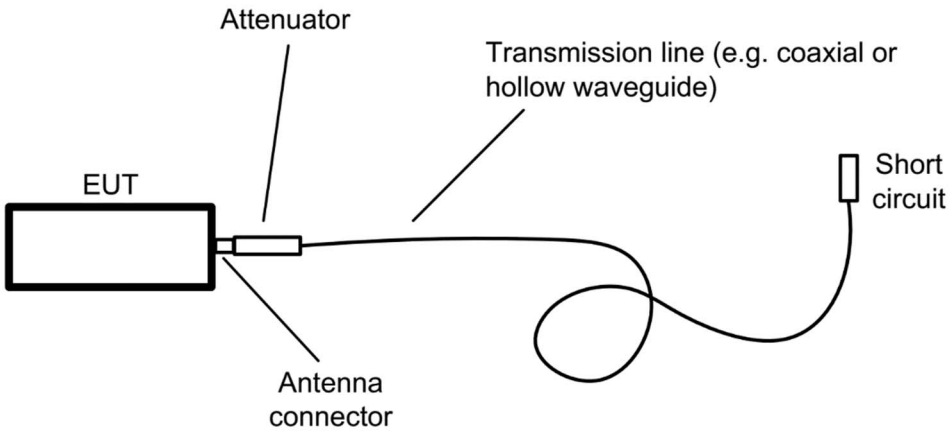


Figure 3: Conducted test setup providing a defined echo signal to the EUT

5.4.4 Receiver Baseline Resilience (RBR)

5.4.4.1 Test setups for EUTs providing no access to the noise level of the receiver

5.4.4.1.1 Radiated test setup for EUTs without antenna connector

The RBR tests shall be done in accordance with ETSI EN 303 883-2 [2], clause 5.5.3.5.

ETSI EN 303 883-2 [2], clause 5.5.3.5 Figure 21 shows the radiated test setup for the equivalent scenario for the Receiver Baseline Resilience (RBR) test. The equivalent scenario is derived from the defined real scenario in clause D. For the RBR test, there are two signals which have to be provided to the EUT receiver simultaneously:

1) The echo signal of the radar target with specific RCS σ which produces the power $P_{r\_equivalent} \leq P_{r\_real}$ to the EUT receiver (see clause D.3).

2) The interferer signal(s) from Table 20.

It is recommended to use slightly different distances for D and D_{INT}, so that the EUT can separate the desired radar target (see ETSI EN 303 883-2 [2], clause 5.5.3.5 Figure 21) from the unwanted echo signal generated by the test antenna support. The EUT device has then to be adjusted to measure the distance to the desired radar target.

NOTE: In general, there are built-in functions and techniques that enable EUT devices to suppress echoes from unwanted reflections, like the unwanted reflections from the mounting support of the test antenna or the walls of the anechoic chamber.

The conditions in ETSI TS 103 789 [3], annex B.2 shall be considered in order to ensure far-field conditions and ETSI TS 103 789 [3], clause B.3 shall be considered to fulfil the point target condition.

For the radiated resilience test the actual antenna gain of the EUT needs to be compensated in the radar target RCS. The reference device is defined in Table D.1.

In addition, the EUT antenna gain is considered when determining the interferer power level at the EUT (see Equation (C.1) in ETSI TS 103 789 [3], annex C). Thus, all available EUT antennas can be used to conduct the radiated RBR test.

The test is passed, if the technical wanted performance criteria and the RBR limits are met, which are provided in clause 4.4.4.3.

5.4.4.1.2 Conducted test setup for EUTs with antenna connector

This conformance test is applicable to EUTs with an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7).

The conformance of the wanted technical performance criteria, the sensitivity requirement, and the measurement procedure are provided in ETSI EN 303 883-2 [2], clause 5.5.3.

ETSI EN 303 883-2 [2], clause 5.5.3.6 Figure 24 shows the conducted test setup for the equivalent scenario of the Receiver Baseline Resilience (RBR) test using coaxial or hollow waveguide components. There are two signals which have to be provided to the EUT receiver simultaneously:

1) The echo signal from a short-circuited transmission line which produces the power $P_{r\_equivalent} \leq P_{r\_real}$ to the LPR receiver (see clause D.3).

2) The appropriate interferer signal(s) which can be extracted from Table 20.

The interferer signals are generated by a microwave signal generator that is connected to the EUT via the transmission line and the directional coupler.

It is recommended to use different cable lengths of transmission lines, so that the EUT can separate between the desired echo of the short-circuited line and the unwanted reflection of the RF output stage of the microwave signal generator (see ETSI EN 303 883-2 [2], clause 5.5.3.6 Figure 24). The EUT device has then to be adjusted to measure the distance to the short circuit.

NOTE: In general, there are built-in functions and techniques that enable LPR devices to suppress echoes from unwanted reflections, like the unwanted reflections of the RF output stage of the microwave signal generator.

The test is passed, if the technical wanted performance criteria and the RBR limits are met, which are provided in clause 4.4.4.3.

5.4.4.2 Test setups for EUTs providing access to the noise level of the receiver

5.4.4.2.1 General

If the EUT provides information about the noise level of the implemented receiver and the possibility to monitor changes in the noise level over time, for example, in an echo curve graph, it is possible to carry out the test for RBR without a simultaneous distance measurement against a radar target. If the EUT does not provide this feature, the procedure in clause 5.4.4.1 shall be applied for testing.

The interfering signal is directly coupled to the receiver of the EUT, and the response of the noise floor is being monitored. An interfering signal will cause a rise of the noise floor in the receiver of the EUT device, no matter what frequency or type of modulation is used.

The LPR signal processing algorithms, however, need a stable echo and a minimum echo signal-to-noise ratio SNR_{min} needs to be maintained to ensure a measurement value variation $\Delta d \leq \pm 50$ mm over time during a distance measurement. Echoes with smaller signal to noise ratios than SNR_{min} cannot be processed by the EUT with the predefined accuracy. This correlation is used to define a test procedure which is equivalent to the procedure described in clause 5.4.4.1.

The received echo power P_{r_real} = -54,8 dBm is determined according to clause D.2 assuming a reference device in a real environment measuring against a flat liquid surface. The maximum allowed noise level which still ensures a measurement value variation $\Delta d \leq \pm 50$ mm of the device, is then determined by subtracting the minimum allowed echo signal-to-noise ratio SNRmin from the echo power P_{r_real} = -54,8 dBm.

$$max.\,allowed\,noise\,level\,(in\,dBm) = P_{r\_real} - SNR_{min}\,(in\,dB) \quad (2)$$

The relation between the measurement value variation Δd and the signal-to-noise-ratio SNR of the corresponding echo signal, and thus the minimum signal-to-noise-ratio SNR_{min}, shall be determined by providing different echo signal power levels to the EUT and recording the measured distance value over a period of 120 seconds or 40 times the step response time of the EUT, whichever is longer. If the step response time of the EUT is not known, it can be determined according to the procedure described in clause 5.4.4.1.

The measurement for SNR_{min} shall be carried out in a radiated setup according to Figure 12 (in clause 5.4.3.5.3 of ETSI EN 303 883-2 [2]) if the EUT provides no antenna connector (sub-category index xxxI, defined in Table 3 in clause 4.2.7). The different echo power levels used to determine SNR_{min} can be realized by varying the RCS of the used radar target and/or the distance *D* to this artificial target. If the EUT provides an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7), this measurement shall be carried out in a conducted setup according to Figure 3. The different echo power levels used to determine SNR_{min} can be realized by varying the attenuation in the attenuator employed in the signal path from the EUT to the short circuit and back into the receiver of the EUT.

The minimum required signal-to-noise-ratio SNR_{min} and the maximum allowed noise level shall be noted in the test report.

The RBR test is passed if the noise floor of the (T)LPR under test stays permanently below the maximum allowed noise level under interference conditions as defined in equation (2).

5.4.4.2.2 Test procedure

The test procedure for receiver baseline resilience shall be conducted as follows:

- The measurement setup for the radiated approach is arranged according to Figure 21 in clause 5.5.3.5.2 of ETSI EN 303 883-2 [2] but without the radar target. The test antenna and EUT antenna shall be placed in the distance R and shall be aligned for the main beam direction and polarization.

  If the EUT provides an antenna connector (sub-category index xxxC, defined in Table 3 in clause 4.2.7) the test shall be carried out in a conducted arrangement according to Figure 21 in clause 5.5.3.5.2 of ETSI EN 303 883-2 [2] where the signal generator is directly connected to the antenna connector of the EUT by means of the transmission line B, i.e. the directional coupler, the attenuator and the transmission line A are not used in this test setup.

- The interferer frequencies $f_{interferer}$ and power levels $P_{r\_interferer}$ can be extracted from ETSI EN 303 883-2 [2], annex A. The respective test shall be repeated for all applicable interferer signals.

- The transmitted interferer power levels (microwave signal generator output power) $P_{t\_interferer}$ can be determined by means of the approaches outlined in clause 5.4.4.1.1 for the radiated test setup or clause 5.4.4.1 for the conducted test setup.

- The minimum echo signal-to-noise ratio SNR_{min} which ensures a measurement value variation $\Delta d \leq \pm 50$ mm shall be determined according to the procedure described in clause 5.4.4.1.1 and recorded in the test report.

- The maximum allowed noise level is calculated by means of Equation (2) in clause 5.4.4.1.2.

- The interfering signal is activated and the noise level of the EUT is continuously monitored for example in an echo curve graph.

- The test is passed if the noise floor of the EUT stays below the maximum allowed noise level for a fraction of

  - 50 % of the measurement period if the interferer is located inside the OFR (co-channel interference);

  - 85 % of the measurement period if the interferer is located at fc ± 0,6 x OFR (adjacent channel interference);

- 95 % of the measurement period if the interferer is located at fc ± 1,5 × OFR (blocking);

as specified in clause 4.4.4.3 (the frequency steps are as recommended in ETSI EN 303 883-2 [2], clause A.2.1.2). In this case a sufficient resilience of the EUT receiver against interferer signals can be ensured.

- During the test, the EUT shall be configured for the fastest possible step response time. The configuration of the device under test in this regard shall be noted in the test report.

NOTE: The step response time of an LPR sensor is defined according to IEC 61298-2 [i.6], clause 5.3 and can often be extracted from the manufacturer's datasheet or product manual. However, if the step response of the EUT is not known, it can be determined by introducing a sudden change of the measurement distance of maximum 2 m. This can be achieved by changing the distance to the radar target in the radiated equivalent scenario or changing the length of the transmission line to the short circuit in the conducted equivalent scenario. The step response time is the time span until the new distance value reaches 90 % of the final value for the first time.

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] 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.1].

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.

Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 305 550-6					
Requirement				Requirement Conditionally	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Operating Frequency Range (OFR)	3.2	4.3.2	U	
2	Mean e.i.r.p. spectral density	3.2	4.3.3	U	
3	Peak e.i.r.p. spectral density	3.2	4.3.4	U	
4	Conducted peak output power	3.2	4.3.5	C	Low gain EUT, corresponding to device sub-category index xxLx defined in clause 4.2.7.
5	TX Unwanted Emissions (TXUE)	3.2	4.3.6	U	
6	Antenna gain requirements	3.2	4.3.7	U	
7	Antenna pattern requirements	3.2	4.3.8	C	LPR EUT, corresponding to device sub-category index Lxxx of clause 4.2.7.
8	Transmitter Duty Cycle	3.2	4.3.9	C	LPR EUT, corresponding to device sub-category index Lxxx of clause 4.2.7.
9	TX behaviour under the complete environmental profile	3.2	4.3.10	C	EUT with integrated antenna, corresponding to device sub-category index Lxxx of clause 4.2.7.
10	Receiver Baseline Sensitivity	3.2	4.4.3	U	
11	Receiver Baseline Resilience	3.2	4.4.4	U	

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".

Annex B (informative): Selection of technical parameters

ETSI EG 203 336 [i.7], clause 5 lists the technical parameters applicable to transmitters and receivers that should be considered when producing Harmonised Standards and that are intended to cover the essential requirements in article 3.2 of Directive 2014/53/EU [i.1]. 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 G.1 contains the parameters listed in ETSI EG 203 336 [i.7], 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 B.1: Cross reference of clauses in the present document to technical parameters for transmitter and receiver listed in ETSI EG 203 336 [i.7]

ETSI EG 203 336 [i.7]		Present document		Justification
Clause	**Parameter**	**Clause**	**Parameter**	
5.2.2	Transmitter power limits	4.3.3	Mean e.i.r.p. spectral density	As specified in European Commission Implementing Decision (EU) 2022/180 [i.5] and ECC/DEC/(22)03 [i.3].
		4.3.4 4.3.10	Peak e.i.r.p. spectral density	
		4.3.5	Maximum conducted peak output power	
		4.3.7 4.3.8	Antenna parameters	As specified in ECC/DEC/(22)03 [i.3].
5.2.3	Transmitter power accuracy	-	-	From the latest version of ETSI EG 203 336 [i.7] "When regulatory limits imply only a maximum emission limit (e.g. products that operate under a general licence regime), this parameter need not to be considered for inclusion in an HS."
5.2.4	Transmitter spectrum mask	4.3.2	Operating Frequency Range (OFR)	
5.2.5	Transmitter frequency stability	-	-	NOTE 1: Not applicable for UWB/wideband devices based on the nature of the used modulation.
5.2.6	Transmitter intermodulation attenuation	-	-	From latest version of ETSI EG 203 336 [i.7] This parameter is only applicable "where high levels of quality services are required". This is not the case for generic short-range devices which are operating on the "no interference, no protection" principle under a licence exempt 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	4.3.6	TX Unwanted emissions	
5.2.7.3	Transmitter unwanted emissions in the spurious domain	4.3.6	TX Unwanted emissions	
5.2.8	Transmitter time domain characteristics	4.3.9	Duty cycle over signal repetition period (DC_Trep)	
5.2.9	Transmitter transients	-	-	Not applicable.

ETSI EG 203 336 [i.7]		Present document		Justification
Clause	**Parameter**	**Clause**	**Parameter**	
	Other mitigation, spectrum access requirements not specified in the ETSI Guide but specified in related ECC/EC framework	-	Adaptive power control	Not applicable.
		-	Duty Cycle over signal repetition period (DC_Trep)	Not applicable.
		-	Frequency Domain Mitigation (FDM)	Not applicable.
		-	Low Power Level Probing Radar (LPLPR)	Not applicable.
5.3.2	Receiver sensitivity	-	-	Covered by RBS See justification in ETSI EN 303 883-2 [2], annex C.
5.3.2.3	Desensitization	-	-	
5.3.3	Receiver co-channel rejection	-	-	
5.3.4.2.1	Receiver adjacent channel selectivity	-	-	
5.3.4.2.2	Receiver adjacent band selectivity	-	-	
5.3.4.3	Receiver blocking	-	-	
5.3.4.4	Receiver spurious response rejection	-	-	
5.3.4.5	Receiver radio-frequency intermodulation	-	-	
5.3.5	Receiver unwanted emissions in the spurious domain	-	-	NOTE 2: Only if the EUT covered by the EN has a receive-only mode or is a receive-only device. Both is not covered by the scope of the present document.
5.3.6.1	Receiver dynamic range	4.4.2 4.4.3	Receiver dynamic range or partly by RBS	NOTE 3: If EN has a dedicated dynamic range test, if not, see ETSI EN 303 883-2 [2], Table C.1.
5.3.6.2	Reciprocal mixing	-	-	Covered by RBR See justification in ETSI EN 303 883-2 [2], annex C.
5.3.1	Signal interferer handling	4.4.2 4.4.3 4.4.4	Receiver Baseline Sensitivity (RBS) Receiver Baseline Resilience (RBR)	Signal interferer handling ([i.7], clause 5.3.1) is an alternative method for specifying receiver parameters intended for receivers such as UWB and certain types of radar equipment. The present document is following this concept, see ETSI TS 103 567 [i.8] and ETSI EN 303 883-2 [2].

Annex C (normative): Interferer signals for receiver baseline resilience

C.1 General

In ETSI TS 103 361 [i.10] an approach was developed in order to fulfil the requirements of Directive 2014/53/EU [i.1] article 3.2 in terms of receiver performance. For this purpose particularly for UWB applications the receiver parameter "interferer signal handling" has been specified. The proper operation of level probing radars in the presence of interfering signals is key to ensure coexistence and thus to effectively use and support the efficient use of radio spectrum. However, the provisions in ETSI TS 103 361 [i.10] for the selection of frequencies and power levels for interfering signals have turned out to be very complex and require huge efforts (see ETSI EN 303 883-2 [2], clause A.2.1.0). Therefore, a simplified and thus a more appropriate approach has been developed in ETSI EN 303 883-2 [2], annex A which shall be used for level probing radar equipment as shown in the following clauses C.2 and C.3.

This approach ensures that the resulting power levels of the interferer test signals are consistently higher than the levels assessed in Table 9 in ETSI TS 103 361 [i.10] and thus is future-proof and ensures that potential future interferers are also sufficiently covered by this course of action.

C.2 Interferer within the OFR

To determine the interferer test signals within the OFR, the provisions in ETSI EN 303 883-2 [2], clause A.2.1 shall be followed. For the purpose of the present document, option 2 from ETSI EN 303 883-2 [2], clause A.2.1.2 shall be used here with the provided parameters in order to determine the interferer power level at the EUT receiver:

- 100 mW e.i.r.p. interferer power;
- 10 m distance under line-of-sight conditions;
- 10 dB additional loss.

NOTE: The deviation from the distance value of 2 m in ETSI EN 303 883-2 [2], clause A.2.1.2 is sensible as level probing radar equipment is usually operated in remote industrial areas. The 10 m minimum distance is thus also reflected in clause 7.7 of ETSI TS 103 361 [i.10].

C.3 Interferer outside of the OFR

To determine the interferer test signals outside of the OFR, the provisions in ETSI EN 303 883-2 [2], clause A.2.2 shall be followed. For the purpose of the present document, the power level of the interfering signals shall be determined following the procedure in ETSI EN 303 883-2 [2], clause A.2.1.2 using the parameters listed in clause C.2.

Annex D (normative): Test scenarios for receiver parameters measurements

D.1 Introduction

Choosing a typical test scenario for the receiver parameters RBS (see clause 4.4.3) and RBR (see clause 4.4.4) in a real (T)LPR measurement environment (real scenario) when measuring against a flat and smooth surface consisting of a material with relative permittivity ε_r at typical (T)LPR measurement distances (e.g. 10 m as described in clause D.2 in the real scenario) is not feasible in practice for the conformance assessment. This would lead to complex test setups requiring overwhelming testing effort.

Therefore, an equivalent test scenario (see Figure D.1) is applied, which accurately reflects the conditions set out in the typical real scenario (see clause D.2) for the EUT setup at much shorter measurement distances to facilitate measurements in typical test chambers. The radiated test can then conveniently be conducted in the limited space provided in an anechoic chamber described, for example, in ETSI EN 303 883-1 [1], clause B.2.2.2 under the boundary conditions specified in ETSI TS 103 789 [3], annex B. Specifically, necessary far-field conditions are provided in ETSI TS 103 789 [3], clauses B.2 and B.3.

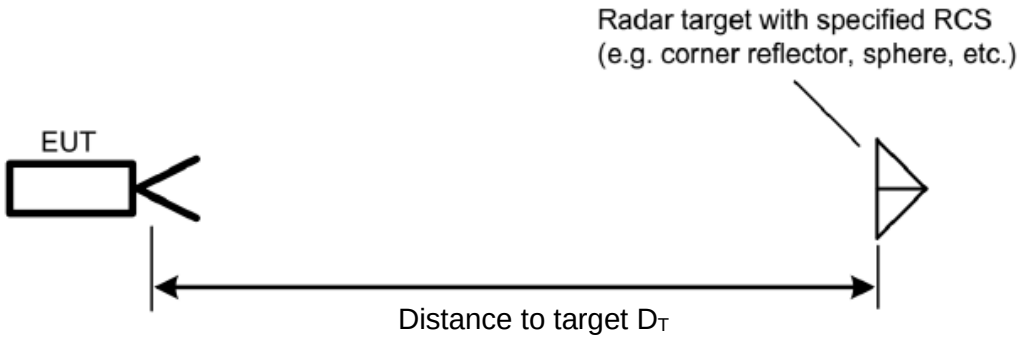


Figure D.1: Radiated measurement setup of the equivalent scenario

A detailed description of how to transfer a real measurement scenario against a material surface in distance D_{meas} into a radiated equivalent scenario using an artificial radar target (e.g. sphere, corner reflector etc.) located in an arbitrary test distance $D_{T,}$ which produces exactly the same Rx power at the EUT's receiver can be found in ETSI TS 103 789 [3], clause A.2.4.

D.2 Definition of a real scenario

In the typical real scenario, the received echo power is derived from the reflection of the transmit signal generated by a LPR device of sub-category L2xx (i.e. a L2HI device or L2HC device according Table 3 in clause 4.2.7) operating at a centre frequency f_c = 174,5 GHz at a reference material surface with permittivity ε_r = 4,0 (e.g. water-based liquid) in a distance of D_{meas} = 10 m.

The received power P_{r_real} fed back into the EUT receiver can be calculated according to the radar equation (A.18) in ETSI TS 103 789 [3], clause A.2.4.

With the parameters given in Table D.1, and assuming a specular reflection at the above defined flat water-based liquid surface for a typical real scenario the power P_{r_real} = -54,8 dBm is returned back into the receiver of the EUT.

Table D.1: Technical parameters of the reference EUT

EUT sub-category index (defined in Table 3 in clause 4.2.7)	OFR of the EUT	Centre frequency fc	Peak power (conducted)	Antenna gain GA	Peak e.i.r.p.
OFR2	167,0 GHz to 182,0 GHz	174,5 GHz	2 dBm (1,58 mW)	28 dBi (631)	30 dBm

NOTE: The conducted peak power and the antenna gain of the reference device are defined in a way, that the resulting peak e.i.r.p. value hits a typical level for such radar devices which is usually below the regulated level of 37 dBm.

D.3 Derivation of the radiated equivalent scenario

The real scenario, outlined in clause D.2, can be translated into a radiated equivalent test scenario using an artificial radar target (e.g. sphere, corner reflector, etc.) located in an arbitrary distance D_T which produces the same Rx power at the EUT's receiver as the above defined reference surface obtained with the respective reference device.

A suitable measurement setup within an anechoic chamber is provided in Figure 7 in clause 6.1 in ETSI TS 103 789 [3] as a scenario equivalent to the real scenario outlined in clause D.2. The aim of the equivalent scenario is to enable the possibility to carry out the radiated measurements in the limited space provided in an anechoic chamber (described for example in ETSI EN 303 883-1 [1], clause B.2.2.2) at a much shorter measurement distance D_T ($D_T < D_{meas}$) and thus to facilitate testing.

In order to ensure the same echo signal power at the EUT receiver as in the defined real scenario (i.e. P_{r_real} = - 54,8 dBm), a suitable radar target with a certain Radar Cross Section (RCS) σ is used (see ETSI EN 303 883-2 [2], clause C.4) which is placed at a convenient distance D_T (often at standard distances of 3 m, 5 m or 10 m depending on the used anechoic chamber) from the EUT (ETSI TS 103 789 [3], clause 6.1 Figure 7).

With the given echo power level $P_{r\_real} = P_{r\_equivalent}$ = -54,8 dBm (clause D.2) the needed RCS σ can be calculated according to the RCS-based radar equation (A.19) in ETSI TS 103 789 [3], clause A.2.4. The reference EUT device (with peak power and antenna gain as shown in Table D.1) would result in the following Radar Cross Sections (RCS) for the standard distances of 3 m, 5 m and 10 m as provided in Table D.2.

Table D.2: Radar cross sections for the reference EUT device in different distances in the equivalent measurement scenario

Distance DT	RCS in dBm²
3 m	-5,5
5 m	+3,4
10 m	+15,4

The measurement at this shorter distance D_T is valid as the variation of the measured distance value and thus also the detection probability (performance criterion) of the EUT receiver solely depends on the signal-to-noise ratio of the echo signal and not on the distance to the radar target itself. The shape and size of radar targets depend on the desired Radar Cross Section (RCS) σ. Conducting spheres as well as square or triangular shaped corner reflectors of different sizes and other standard targets are most suitable for this purpose. The equations for the radar cross sections of these different reflectors in boresight direction are simple and can be found in ETSI TS 103 789 [3], clause A.1.

These radar cross sections in Table D.2 of the artificial radar target in 3 m, 5 m and 10 m distance would consequently produce the same RX power in the receiver of the reference device as the reflection at the reference surface (water-based liquid with permittivity ε_r = 4,0) in D_{meas} = 10 m distance of the real scenario in clause D.2.

D.4 Radar cross sections of suitable targets

The equations for the radar cross sections of these different reflectors in boresight direction are simple and can be found in ETSI TS 103 789 [3], clause A.1.

D.5 Evaluation of the Radar Cross Section (RCS) of standard radar targets

Different methods and test set-ups for evaluating the Radar Cross Section (RCS) of standard radar targets can be extracted from ETSI TS 103 789 [3], clause 7.

Annex E (informative): Range of modulation parameters

E.1 FMCW modulation schemes

The duty cycle over signal repetition period (DC_Trep) is determined as the sum of all active sweep durations T_{on} during one signal repetition period T_{rep} (see clause 5.3.9). This duty cycle is also sometimes referred to as "duty cycle resulting from user" in some sources dealing with UWB devices. Further details for FMCW signals are provided in ETSI EN 303 883-1 [1], clause C.2.2.

Annex F (informative): Installation requirements

F.1 LPR installation requirements

This clause is to inform that the ECC/DEC/(22)03 [i.3] already includes the following clear installation requirements for Lxxx devices (as defined in Table 3 in clause 4.2.7):

- The operation of LPR sensors is envisaged for industrial purposes only.
- Installation and maintenance of LPR equipment needs to be performed by professionally trained individuals only.
- Level probing radars are required to be installed at a permanent fixed position pointing in a downwards direction towards the ground. The equipment is not allowed to operate while being moved, or while inside a moving container.
- Installers have to ensure that there are no unwanted obstacles in the main beam of the antenna in order to minimize unintentional reflections and scattering.
- The manufacturer is required to inform the users and installers of LPR equipment about the installation requirements and additional special mounting instructions.

In addition, in reference to ECC/DEC/(22)03 [i.3] the location of radio astronomy stations needs to be considered and the station can be protected as follows:

- LPR EUT`s cannot be installed and operated inside an RAS exclusion zone of 13 km unless a special authorization has been provided by the responsible national administration.

A list of presently known radio astronomy sites is provided in Table F.1.

The manufacturer should make the users and installers of LPR equipment aware of the installation requirements listed above.

Table F.1: List of European radio astronomy sites exclusion zones for operating in the frequency range of 116 GHz to 260 GHz according to ECC/DEC/(22)03 [i.3]

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°25'55" W

Table F.1 is based on available information at the time of creation of the present document. Additional information on the list of radio astronomy stations with exclusion zones may be available under CRAF [i.12].

F.2 TLPR installation requirements

This clause is to inform that the ECC/DEC (22)03 [i.3] already includes the following clear installation requirements for Txxx devices (as defined in Table 3 in clause 4.2.7):

"...

- *The operation of TLPR sensors is envisaged for industrial purposes only.*
- *Installation and maintenance of TLPR equipment shall be performed by professionally trained individuals only.*
- *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.*

- *Flanges and attachments of the TLPR equipment shall provide the necessary microwave sealing by design.*
- *Sight glasses shall be coated with a microwave-proof coating when necessary (i.e. electrically conductive or microwave absorbing coating).*
- *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.*

..."

The manufacturer should make the users and installers of TLPR equipment aware about the installation requirements listed above.

Annex G (informative): Bibliography

ERC/REC 70-03: "ERC Recommendation on relating to the use of Short Range Devices (SRD)", Tromsø 1997 and subsequent amendments.

Commission Decision 2013/752/EU on harmonisation of the radio spectrum for use by short-range devices as amended by subsequent Commission Decisions.

Recommendation ITU-R SM.329-12 (2012): "Unwanted emissions in the spurious domain".

Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".

Annex H (informative): Change history

Version	Information about changes
V0.0.1	First draft after discussion in the TGUWB#64 meeting.
V0.0.2	Revision following up of ERMTGUWB-Drafting ETSI EN 305 550-6 drafting during TGUWP#64.
	Also the new draft version of ETSI EN 303 883-1, ETSI EN 303 883-2, and ETSI TS 103 941 are referenced.
V0.0.3	Outcome from the TGUWB#65.
V0.0.4	Revision according to comments from TGUWB#65, and new draft version of ETSI EN 303 883-1, ETSI EN 303 883-2, ETSI TS 103 941.
V0.0.5	Outcome of TGUWB#66.
V0.0.6	Changes according to TGUWB#66 discussion (EUT annotation, simplified tables, implement updates in all four normative references [1-4] - shorten clauses/annexes and remove redundant figures, TX complete behaviour, new clause F, general consistency revision).
V0.0.7	Further editorial revision done according to the discussion in the rapporteur meeting "ETSI EN 305 550-6 M#1".
	Further editorial revision done according to the discussion in the rapporteur meeting "ETSI EN 305 550-6 M#2".
V0.0.8	Further editorial revision done according to the discussion in the rapporteur meeting "ETSI EN 305 550-6 M#2".
V0.0.9	Outcome TG UWB#67, Modifications and comments according to TGUWB#67 discussion.
V0.1.0	Several modifications according to the discussion in TGUWB#67:
	In 4.3.6 (TXUE) , Fig. 1 is revised, and OFR based on peak measurement only was agreed.
	Rearranged antenna conformance test clauses 5.3.7 and 5.3.8.
	Moved clause B into clause 5.2.1, and clause G into clause B position.
	Modifications in version 0.0.8 are accepted.
	Further editorial modifications, like Work Item or Keywords are added.
V0.1.1	Revision according to ETSI peer review assessment (DEN/ERM-TGUWB-627 (ETSI EN 305 550-6) Peer Review Assessment Request).
V0.1.2	Clean version regarding pre-assessment, with tracked changes according to editHelp.
V0.2.0	Clean version regarding editHelp changes.
V0.2.1	Revision according to the 1st HASTAC resolution report. In addition, rearranging the appendix clauses (C to F, D to E, E to C, F to D).
V1.1.1	First version of ETSI EN 305 550-6: "Tank Level Probing Radar (TLPR) and Level Probing Radar (LPR) equipment operating in the frequency ranges 116 GHz to 148,5 GHz; 167 GHz to 182 GHz and 231,5 GHz to 250 GHz".

History

Document history			
V1.1.0	October 2024	SRdAP process	EV 20250105: 2024-10-05 to 2025-01-06