Draft ETSI EN 302 372 V3.0.0 (2025-03)

**Short Range Devices (SRD)
using Ultra Wide Band technology (UWB);
Harmonised standard for access to radio spectrum;
Tank Level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz**

Reference
REN/ERM-TGUWB-151

Keywords
EHF, harmonised standard, radar, regulation, SHF, short range, SRD, testing, UWB

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Sous-Préfecture de Grasse (06) N° w061004871

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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 Standardisation Request deliverable Approval Procedure(SRdAP).

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.

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

In order to cover the requirements concerning the receiver requirements communicated by the European Commission the present document is a revision of ETSI EN 302 372 V2.1.1 [i.13] a harmonised standard for Tank Level Probing Equipment within the scope of the Directive 2014/53/EU [i.1]. The standard has been published in the OJEU without restrictions on 10 March 2017 [i.6].

Unlike LPRs [i.7] the TLPRs are always configured to pre-drilled harmonised openings and flanges of the tanks. Thus, with very small openings of e.g. a few centimetres most of the TLPR antennae cannot fulfil the characteristics as required by ETSI EN 302 729-1 [i.7]. Since TLPRs are always installed on metallic tanks, TLPR manufactures have greater freedom creating a TLPR architecture in order to suit the needs of its customers.

1 Scope

The present document specifies technical requirements, limits and test methods for Tank Level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz and 75 GHz to 85 GHz.

Tank Level Probing Radars in the scope of the present document consist of a combined transmitter and receiver and are equipped with an integral or dedicated antenna provided and specified by the EUT manufacturer.

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

Technical and regulatory requirements for TLPR are provided in European Commission Implementing Decision (EU) 2025/105 [i.5].

NOTE: 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.

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 in the ETSI docbox.

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) (2024-08): "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) (2024-08): "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] CEPT ERC Recommendation 74-01 (May 2022): "Unwanted emissions in the spurious domain".

[i.4] Void.

[i.5] Commission Implementing Decision (EU) 2025/105 of 22 January 2025 amending Decision 2006/771/EC updating harmonised technical conditions in the area of radio spectrum use for short-range devices and repealing Implementing Decision 2014/641/EU on harmonised technical conditions of radio spectrum use by wireless audio programme making and special events equipment in the Union.

[i.6] Official Journal of the European Union, 13.7.2018: "Commission communication in the framework of the implementation of Directive 1999/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity and Directive 2014/53/EU of the European Parliament and of the Council 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.7] ETSI EN 302 729-1 (V3.1.0) (2025-03): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised standard for access to radio spectrum; Part 1: Level Probing Radar (LPR) equipment operating in the frequency ranges 6 GHz to 8,5 GHz, 24,05 GHz to 26,5 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz for strictly vertical downward installation".

[i.8] Void.

[i.9] 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.10] ETSI TS 103 567 (V1.1.1) (2019-09): "Requirements on signal interferer handling".

[i.11] CEPT ERC Recommendation 70-03 (June 2024): "Relating to the use of Short Range Devices (SRD)".

[i.12] 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.13] ETSI EN 302 372 (V2.1.1): "Short Range Devices (SRD); Tank Level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

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 measurement period (DC_T_{on}): ratio of the sum of all the pulse durations t_{pulse} to the active measurement period T_{on}

duty cycle over signal repetition period (DC_T_{rep}): ratio of the sum of all active measurement periods T_{on} (bursts, sweeps, scans) to the signal repetition period T_{rep}

Equipment Under Test (EUT): TLPR under test

Frequency Modulated Continuous Wave (FMCW) radar: modulation scheme based on a periodically linear frequency sweep of the transmit signal (see also clause E.2 and ETSI EN 303 883-1 [1], clause C.2.2)

pulsed radar (or here simply "pulsed TLPR"): modulation scheme based on a periodically transmission of short RF pulses (see also clause E.1and ETSI EN 303 883-1 [1], clause C.2.1)

radiation: signals emitted intentionally for level measurements

step response time (of an 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:

t_{pulse}	pulse duration time in pulsed modulation schemes and dwell time or sweep time for FMCW modulation schemes

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
EFTA	European Free Trade Association
FMCW	Frequency Modulated Continuous Wave
HPBW	Half Power BeamWidth
ITU-R	International Telecommunication Union - Radio sector
LPR	Level Probing Radar
TLPR	Tank Level Probing Radar

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 be 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 Equipment categories

4.2.1 General

The present document covers Tank Level Probing Radar (TLPR) devices for operation on tanks as outlined in the scope (clause 1) of the present document.

Receive-only devices, equipment exhibiting a receive only mode or a standby mode are not covered by the scope of the present document.

NOTE: In addition, the manufacturer should consider further installation requirements as specified in Annex F and should provide this information to the user/installer. These installation requirements, however, are not subject to Annex A of the present document.

A categorization of this TLPR equipment category has been conducted based on:

- the used Operating Frequency Range (OFR), see clause 4.2.2;
- the used antenna connection, see clause 4.2.3.

4.2.2 Categorization by Operating Frequency Range (OFR)

The categorization of TLPR Equipment by the Operating Frequency Range is used as given by Table 1.

Table 1: Categorization by frequency ranges

EUT category	Frequency range
OFR 1	4,5 GHz ≤ f ≤ 7 GHz
OFR 2	8,5 GHz ≤ f ≤ 10,6 GHz
OFR 3	24,05 GHz ≤ f ≤ 27 GHz
OFR 4	57 GHz ≤ f ≤ 64 GHz
OFR 5	75 GHz ≤ f ≤ 85 GHz

This categorization has been conducted, reflecting the different permitted frequency ranges which can be used for Tank Level Probing Radars in accordance with Commission Implementing Decision (EU) 2025/105 [i.5].

4.2.3 Categorization by antenna connection

Each of the TLPR equipment may or may not be equipped with an antenna connector, therefore the second categorization is done by the kind of antenna connection:

- ANT1: TLPR equipment features an antenna connector - the equipment is equipped with a dedicated antenna (AUT).
- ANT2: TLPR equipment has no antenna connector-the equipment is equipped with an integral antenna.

4.2.4 Summary of TLPR equipment categories

All of the categories are subject to these clause 4 requirements. Differentiation is made by test cases under clause 5.

An overview of the applicability of transmitter requirements and receiver requirements for the different TLPR equipment categories is shown in Table 2 and Table 3.

Table 2: Applicability of transmitter requirements for the different TLPR equipment categories

TX requirements	Clause	Categorization	
		Operating Frequency Range	antenna connection
		OFR1 to OFR5	ANT1 and ANT2
Operating frequency range	4.3.2	applicable to any category (OFR1 to OFR5)	applicable to any category (ANT1 and ANT2)
Indirect emissions measured as mean e.i.r.p. spectral density	4.3.4		
Peak e.i.r.p. spectral density	4.3.3		
Transmitter unwanted emissions (TXUE)	4.3.5		

Table 3: Applicability of receiver requirements for the different TLPR equipment categories

RX requirements	Clause	Categorization	
		Operating Frequency Range	antenna connection
		OFR1 to OFR5	ANT1 and ANT2
Receiver Baseline Sensitivity (RBS)	4.4.3	applicable to any category (OFR1 to OFR5)	applicable to any category (ANT1 and ANT2)
Receiver Baseline Resilience (RBR)	4.4.4		

The categories which are supported by the TLPR equipment shall be stated in the technical documentation of the equipment (TLPR1 to TLPR10, see Table 4).

Table 4: TLPR equipment categories based on the categorization listed in clauses 4.2.2 and 4.2.3

TLPR Equipment category	Categorization	
	Operating Frequency Range	antenna connection
TLPR1	OFR1	ANT1
TLPR2	OFR1	ANT2
TLPR3	OFR2	ANT1
TLPR4	OFR2	ANT2
TLPR5	OFR3	ANT1
TLPR6	OFR3	ANT2
TLPR7	OFR4	ANT1
TLPR8	OFR4	ANT2
TLPR9	OFR5	ANT1
TLPR10	OFR5	ANT2

4.3 Transmitter Requirements

4.3.1 General

The transmitter requirements for TLPR equipment covered by the scope of the present document are justified in Table B.1 in Annex B.

4.3.2 Operating Frequency Ranges (OFR)

4.3.2.1 Applicability

The Operating Frequency Range requirement applies to all TLPR equipment categories as defined in clause 4.2, Table 4.

4.3.2.2 Description and general requirements

The Operating Frequency Range is described in clause 5.2 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 (all frequencies between f_L and f_H) shall be within one of the permitted frequency ranges (see Table 5).

Table 5: Permitted frequency ranges for the different EUT categories

Mode of operation	EUT category	Frequency range
Transmit and receive	TLPR1, TLPR2	4,5 GHz ≤ f ≤ 7 GHz
Transmit and receive	TLPR3, TLPR4	8,5 GHz ≤ f ≤ 10,6 GHz
Transmit and receive	TLPR5, TLPR6	24,05 GHz ≤ f ≤ 27 GHz
Transmit and receive	TLPR7, TLPR8	57 GHz ≤ f ≤ 64 GHz
Transmit and receive	TLPR9, TLPR10	75 GHz ≤ f ≤ 85 GHz
NOTE: The limits are in accordance with Commission Implementing Decision (EU) 2025/105 [i.5], bands No. 60, 64, 68, 74b and 78b.		

4.3.2.4 Conformance

The conformance test for the OFR shall is defined in clause 5.4.1.

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

4.3.3.1 Applicability

The peak e.i.r.p. spectral density requirement applies to all TLPR equipment categories as defined in clause 4.2, Table 4.

4.3.3.2 Description

The peak e.i.r.p. spectral density is described in ETSI EN 303 883-1 [1], clause 5.3.4.

4.3.3.3 Limits

Within the OFR the peak e.i.r.p. spectral density shall not exceed the limits in Table 6.

Table 6: Peak e.i.r.p. spectral density limits

EUT category	Maximum peak e.i.r.p. (measured in 50 MHz within the antenna main beam)
TLPR1, TLPR2	+24 dBm
TLPR3, TLPR4	+30 dBm
TLPR5, TLPR6	+43 dBm
TLPR7, TLPR8	+43 dBm
TLPR9, TLPR10	+43 dBm
NOTE: The limits are in accordance with Commission Implementing Decision (EU) 2025/105 [i.5], bands No. 60, 64, 68, 74b and 78b.	

4.3.3.4 Conformance

The conformance test for peak e.i.r.p. spectral density is defined in clause 5.4.2.

4.3.4 Transmitter Indirect Emissions

4.3.4.1 Applicability

The transmitter indirect emissions requirement applies to all TLPR equipment categories as defined in clause 4.2, Table 4.

4.3.4.2 Description

The transmitter indirect emissions are leakage signals from a tank structure including an installed TLPR. Leakage emissions from the test setup include all emissions: TX, and other spurious emissions. They are measured as maximum mean power spectral density (specified as e.i.r.p.) of the radio device under test. Transmitter unwanted emission limits are given in clause 4.3.5.

The transmitter indirect emissions of TLPR devices are described in ETSI EN 303 883-1 [1], clause 5.7.1, Figure 19.

The mean e.i.r.p. spectral density is described in ETSI EN 303 883-1 [1], clause 5.3.2.

4.3.4.3 Limits

The effectively radiated power within the Operating Frequency Ranges shall not exceed the values given in Table 7.

Table 7: Transmitter indirect emissions inside the assigned frequency band

Assigned frequency band (GHz) Equipment category	Maximum emissions outside the tank enclosure structure inside the assigned frequency band
TLPR1, TLPR2, TLPR3, TLPR4, TLPR5, TLPR6, TLPR7, TLPR8, TLPR9, TLPR10	-41,3 dBm/MHz
NOTE: The limits are in accordance with Commission Implementing Decision (EU) 2025/105 [i.5], bands No. 60, 64, 68, 74b and 78b.	

4.3.4.4 Conformance

The conformance test for indirect emissions (mean e.i.r.p. spectral density) inside the assigned frequency band is defined in clause 5.4.3.

4.3.5 Transmitter Unwanted Emissions (TXUE)

4.3.5.1 Applicability

The transmitter unwanted emissions requirement applies to all TLPR equipment categories as specified in clause 4.2, Table 4.

4.3.5.2 Description

The transmitter unwanted emissions are described in clause 5.5.1 of ETSI EN 303 883-1 [1].

As requested in ETSI EN 303 883-1 [1], clause 5.5.1 the limit for the parameter X_{TXUE} for all TLPR equipment categories see clause 4.2.4, Table 4) is specified to:

X_{TXUE}: 50 %

4.3.5.3 Limits

The Transmitter Unwanted Emissions (TXUE) for TLPR equipment shall not exceed the limits in Table 8.

Table 8: Transmitter unwanted emissions limits in the spurious domain

Frequency range	Limit values for TXUE
87,5 MHz ≤ f ≤ 118 MHz	-54 dBm/100 kHz
174 MHz ≤ f ≤ 230 MHz	-54 dBm/100 kHz
470 MHz ≤ f ≤ 694 MHz	-54 dBm/100 kHz
otherwise in band 30 MHz ≤ f ≤ 1 000 MHz	-36 dBm/100 kHz
1 000 MHz < f ≤ F_{UPPER} (see Table 9)	-30 dBm/1 MHz
10,6 GHz ≤ f ≤ 10,7 GHz (see note1)	-60 dBm/1 MHz
NOTE 1: CEPT ERC Recommendation 70-03 [i.11], Table 6, line f2. NOTE 2: The limits are in accordance with CEPT ERC Recommendation 74-01 [i.3] for all equipment categories.	

Table 9: Upper frequency boundary for the spurious domain based on the EUT Operating Frequency Range (OFR)

EUT sub-category	Frequency range which contains the OFR of the EUT (defined by f_L and f_H) (note 1)	Upper frequency (F_{UPPER})
TLPR1, TLPR2 TLPR3, TLPR4	5,2 GHz ≤ f < 13 GHz	26 GHz
TLPR5, TLPR6, TLPR7, TLPR8, TLPR9, TLPR10	13 GHz ≤ f ≤ 150 GHz	2nd harmonic (note)
NOTE 1: For F_{UPPER} the value of f_H shall be used (f_H is the upper edge of the Operating Frequency Range (OFR), which is assessed in clause 4.3.2). NOTE 2: The limits are in accordance with CEPT ERC Recommendation 74-01 [i.3].		

4.3.5.4 Conformance

The conformance test for transmitter unwanted emissions is defined in clause 5.4.4.

4.3.6 TX-behaviour under the complete environmental profile

4.3.6.1 Applicability

This requirement shall apply to all TLPR equipment categories as specified in Table 4.

For the TLPR equipment categories TLPR2, TLPR4, TLPR6, TLPR8, TLPR10 (radiated assessment as equipment features no antenna connector), the limits in clause 4.3.6.3.1 apply.

For the TLPR equipment categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (conducted assessment as equipment features an antenna connector), the limits in clause 4.3.6.3.2 apply.

4.3.6.2 Description

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

For more information on the TX behaviour under the complete environmental profile, see ETSI TS 103 941 [4], clause 4.3.1.

4.3.6.3 Limits

4.3.6.3.1 Limits for radiated assessment of the TX behaviour

The TX behaviour is obtained by measuring the peak e.i.r.p. spectral density (P_{step}) across the complete environmental profile (as specified in clause 5.1.3) and assessing the variation with respect to a peak e.i.r.p. spectral density adjusted reference limit (Adjusted_RL).

The procedure to adjusted reference limit (Adjusted_RL) is descripted by the procedure in clause 6.2.1.5 of ETSI TS 103 941 [4].

In other words, if for each environmental measurement point (T_{step}) over the complete environmental profile the measured values for P_{step} are below the adjusted reference value (Adjusted_RL) the TX behaviour assessment is passed.

4.3.6.3.2 Limits for conducted assessment of the TX behaviour

The TX behaviour is obtained by measuring the peak e.i.r.p. spectral density (P_{step}) across the complete environmental profile (as specified in clause 5.1.3) and assessing the variation with respect to the peak e.i.r.p. spectral density Regulated Limit (RL).

The procedure to adjust the Regulated Limit (RL) is described by the procedure CASE 1 in clause 7.2.1 of ETSI TS 103 941 [4].

In other words, if for each environmental measurement point (T_{step}) over the complete environmental profile the measured values for P_{step} are below the reference values the TX behaviour assessment is passed.

4.3.6.4 Conformance

The conformance test shall be done under the complete environmental profile (see clause 5.1.3); the parameters are measured as described in clause 5.4.2.

4.4 Receiver requirements

4.4.1 General

The following receiver requirements apply for the TLPR equipment covered by the present document:

- Receiver Baseline Sensitivity (RBS), see clause 4.4.2.
- Receiver Baseline Resilience (RBR), see clause 4.4.3.

The receiver requirements for EUT covered by the scope of the present document are justified in Table B.1.

4.4.2 Wanted performance criteria

The wanted performance criterion for Receiver Baseline Sensitivity (RBS) is defined as the detection probability of a specified static radar target during a distance measurement over a defined period of time (see clauses 4.4.3.2 and 4.4.3.3).

The wanted performance criterion for receiver baseline resilience (RBR) is defined as the detection probability of a specified static radar target during a distance measurement over a defined period of time under the influence of an interfering signal (see clauses 4.4.4.2 and 4.4.4.3).

4.4.3 Receiver Baseline Sensitivity (RBS)

4.4.3.1 Applicability

The receiver baseline sensitivity requirement shall apply to all TLPR equipment categories as specified in Table 4.

4.4.3.2 Description

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

This quality of the TLPR equipment enables the reduction of interference as it allows the corresponding transmitter power to be decreased for a particular link budget and thus demonstrates the efficient use of radio spectrum by way of a reduced generation of harmful interference against other spectrum users.

The use of a static radar target is adequate as TLPR equipment is used to measure the distance to a liquid or solid material (see clause 1), in order to determine its filling level. The level changes in these environments occur very slowly by nature so that quasi-static conditions can be assumed.

4.4.3.3 Limits

For the RBS test, a static radar target shall be detected with at least 99 % detection probability. In this case a sufficient receiver sensitivity of the EUT can be ensured. The static radar target shall produce a maximum echo signal power at the TLPR receiver of -53,8 dBm (see derivation of the test scenario in Annex C).

The radar target is deemed to be detected, if the EUT measures and displays the correct distance value to the target. This means in the present case, that the measured distance value to the Radar target shall stay within the maximum allowed measurement value variation of $\Delta d = \pm 50$ mm for at least 99 % of the conducted measurements in a measurement period of at least 120 seconds or 40 times the step response time of the EUT, whichever is longer. This applies to all TLPR equipment categories.

EXAMPLE: A category OFR 3 TLPR equipment operating in the frequency range 24,05 GHz to 26,5 GHz with 0 dBm conducted peak output power and 23 dBi antenna gain requires a radar target with a maximum RCS of -9,3 dBm² for example in 3 m distance (see clause C.3) in order to evaluate the receiver baseline sensitivity in the radiated test setup outlined in clause 5.5.2.1. A detection probability of this radar target of 99 % is demanded. The test is conducted for at least 120 seconds provided that the LPR sensor exhibits a step response time of 2,5 seconds.

4.4.3.4 Conformance

The conformance test for Receiver Baseline Sensitivity (RBS) is defined in clause 5.5.2.

4.4.4 Receiver Baseline Resilience (RBR)

4.4.4.1 Applicability

The receiver baseline resilience requirement shall apply to all TLPR equipment categories as specified in Table 4.

4.4.4.2 Description

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

This quality of the TLPR equipment 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 harmful interference.

The performance criterion for receiver baseline resilience is therefore defined as the detection probability of a static radar target during a distance measurement over a defined period of time under the influence of an interfering signal.

The use of a static radar target is adequate as TLPR equipment is used to measure the distance to a liquid or solid material (see clause 1), in order to determine its filling level. The level changes in these environments occur very slowly by nature so that quasi-static conditions can be assumed.

4.4.4.3 Limits

For the RBR test, the static radar target shall be detected with a defined minimum detection probability under the influence of an interfering signal. In this case a sufficient receiver resilience of the EUT against interference from other spectrum users can be ensured. The static radar target shall produce a maximum echo signal power at the LPR receiver of -53,8 dBm (see derivation of the test scenario in Annex C).

The radar target is deemed to be detected, if the TLPR equipment measures and displays the correct distance value to the target. This means in the present case, that the measured distance value to the radar target shall stay within the maximum allowed measurement value variation of $\Delta d = \pm 50$ mm for (see ETSI EN 303 883-2 [2], clause 5.3.2 for radiodetermination applications):

- at least 50 % of the conducted measurements (detection probability at least 50 %) if the interferer is located inside the OFR (co-channel interference);
- at least 85 % of the conducted measurements (detection probability at least 85 %) if the interferer is located at $f_c \pm$ OFR (adjacent channel interference);
- at least 95 % of the conducted measurements (detection probability at least 95 %) if the interferer is located at $f_c \pm 2 \times$ OFR (blocking);

in a measurement period of at least 120 seconds or 40 times the step response time of the EUT, whichever is longer. This applies to all equipment categories.

EXAMPLE: A category TLPR9, TLPR10 operating in the frequency range 75 GHz to 85 GHz with 2 dBm conducted peak output power and 32 dBi antenna gain requires a radar target with a maximum RCS of -20,4 dBm² for example in 5 m distance (see clause C.3) in order to evaluate the receiver baseline resilience in the radiated test setup outlined in clause 5.5.3.1.1. A detection probability of this radar target of 85 % is demanded under interference conditions, when the interferer is located at fc ± OFR. The test shall be conducted for at least 120 seconds provided that the TLPR equipment sensor exhibits a step response time of 2,5 seconds.

4.4.4.4 Conformance

The conformance test for Receiver Baseline Sensitivity (RBS) is defined in clause 5.5.3 and shall be done under normal conditions as defined in clause 5.1.2.

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 test conditions

Normal test conditions shall be as defined in ETSI TS 103 941 [4], clause 4.5.3.1.

Hence, the temperature for testing under normal temperature conditions shall be within +15 °C to +35 °C as specified in ETSI TS 103 941 [4], clause 4.5.3.1.1.

5.1.3 Complete environmental profile test conditions

The complete environmental profile test conditions cover both the normal (see clause 5.1.2) and extreme test conditions.

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

NOTE: The nominal supply voltage is provided in the user manual or technical specification file of the TLPR EUT.

5.2 General conditions for testing

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

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

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

General information on test set-up for measurements under environmental profile are given respectively in ETSI TS 103 941 [4], clause 5.1. More detailed test solutions are provided in:

- ETSI TS 103 941 [4], clause 5.2 with the usage of a temperature chamber; and
- ETSI TS 103 941 [4], clause 5.3 with the usage of a climate dome and anechoic chamber.

5.3 Conformance test suites

Unless otherwise noted, the radiated conformance tests described in clause 5.4 for the transmitter and clause 5.5 for the receiver shall be performed on the test site according to ETSI EN 303 883-1 [1], clause B.2.2.2 under far field conditions according to ETSI EN 303 883-1 [1], clause B.2.3.5.

Unless otherwise noted, the conducted conformance tests described in clause 5.4 for the transmitter and clause 5.5 for the receiver shall be performed according to the provisions in ETSI EN 303 883-1 [1], clause B.3.

ETSI EN 303 883-1 [1], clause B.2 provides additional information on test setups for radiated and conducted measurements and clause B.3 for conducted measurements.

The following classification of testing is applicable, see [i.5].

Table 10: TLPR EUT configuration for testing

Conformance test		EUT-configuration
Transmitter indirect emissions	Clause 5.4.3	EUT mounted on a test tank (see note)
Transmitter unwanted emissions	Clause 5.4.4	EUT mounted on a test tank (see note)
Operating Frequency Range (OFR)	Clause 5.4.1	EUT without a test tank
Peak e.i.r.p. spectral density	Clause 5.4.2	
Receiver Baseline Sensitivity (RBS)	Clause 5.5.2	EUT without a test tank
Receiver Baseline Resilience (RBR)	Clause 5.5.3	
NOTE: The test tank is described in Annex G, Information on field tanks are given by Annex H.		

5.4 Conformance test methods of measurement for transmitter

5.4.1 Operating Frequency Range (OFR)

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

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 5.4.2 in the present document. The procedure shall be used with an RBW set to 3 MHz.

Additionally, for EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4) the provisions for conducted measurements in ETSI EN 303 883-1 [1], clause 5.1.1 shall be considered.

The measurement shall be made with a TLPR EUT without a test tank, see Table 10.

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

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

For all EUT the peak e.i.r.p. spectral density conformance test shall use the procedure described in ETSI EN 303 883-1 [1], clause 5.3.4.1.3 for EUTs using pulse modulation techniques and ETSI EN 303 883-1 [1], clause 5.3.4.1.4 for EUTs using FMCW or other swept frequency modulation techniques. These swept frequency signals are instantaneously narrowband signals with full power within the resolution bandwidth of the spectrum analyser.

Additionally, for TLPR equipment categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4) the provisions for conducted measurements in ETSI EN 303 883-1 [1], clause B.3 shall be considered.

The gain of the EUT 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 5.4.5.2.

The measurement shall be made with a TLPR EUT without a test tank, see Table 10.

5.4.3 Transmitter indirect emissions

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

The transmitter indirect emission inside the OFR shall be determined as described in ETSI EN 303 883-1 [1], clause 5.3.2.5.

The needed signal repetition time and duty cycle of the EUT to assess the indirect emissions shall be assessed according to ETSI EN 303 883-1 [1], Annex C and clause 5.4.6 in the present document.

The measurement shall be made with a EUT mounted on a test tank, see Table 10. Requirements on the test tank are given by Annex G.

Indirect emissions of clause 4.3.4 shall be carried out at normal environmental test conditions. This is well justified as the temperature effect on the indirect emission would be the same as those on the direct emissions of clause 4.3.3 which are indeed tested under extreme environmental test conditions.

5.4.4 Transmitter Unwanted Emissions (TXUE)

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

The transmitter unwanted emissions shall be determined in a two-step approach according to the setup (combination of the EUT and the test tank) described in ETSI EN 303 883-1 [1], Figure B.12 in clause B.4.2.

All measurement shall be made with a TLPR EUT mounted on a test tank. Requirements on the test tank are given by Annex G.

In the first step a spherical fast scan is conducted in order to determine the spatial direction in which the EUT produces the highest emissions. This is achieved by applying a fast scan technique in the spectrum analyser.

The measurement 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], Figure B.12 in clause B.4.2).

In this position of the EUT the measurement antenna shall be raised and lowered through the specified height range applicable to the used test site until the maximum signal level is detected in the test receiver.

The procedure described above shall be repeated with horizontal polarization of the measurement antenna.

For the fast scan the following spectrum analyser settings shall be used:

- For measurement below the OFR:
  - Start frequency: F_{LOWER}
  - Stop frequency: f_L
- For measurement above the OFR:
  - Start frequency: f_H
  - Stop frequency: F_{UPPER}

NOTE: There could be a need to split the measurement into different frequency ranges depending on the measurement setup (e.g. due to external mixers, bandwidth of antennas and waveguides, RBW).

- Resolution Bandwidth (RBW): ≥ 100 kHz between 30 MHz and 1 GHz
  ≥ 1 MHz above 1 GHz
- Video Bandwidth (VBW): Equal or greater than RBW
- Detector mode: Peak
- Trace mode: Max hold
- Sweep time: AUTO; wait for each position of the EUT until the reading in the display is stable

The orientation and configuration of the EUT and the measurement antenna determined in step 1, producing the highest emissions towards the measurement antenna, shall be used to conduct the second step where the TX unwanted emissions are determined using the procedure described in ETSI EN 303 883-1 [1], clause 5.5.3. The assessment shall be done using the procedure 2a of ETSI EN 303 883-1 [1], clause 5.5.3.1.3.

For the procedure 2a the EUT Burst duration (Ton time), see ETSI EN 303 883-1 [1], clause C.3. is necessary.

For the assessment of the EUT Burst duration, the same T_{dis} and P_{thresh} limits as for the Duty Cycle assessment, see clause 5.4.6 shall be used. The P_{thresh} is related to the measured power level at the frequency f_M (frequency with the max emission within OFR, see ETSI EN 303 883-1 [1], clause 5.2.2).

5.4.5 Antenna parameters

5.4.5.1 General

Generally, TLPR EUT devices can be equipped either with integral antennas or dedicated antennas (see clause 4.2.3). Integral antennas often do not exhibit an antenna connector and can therefore not be accessed from the outside for measurement purposes. Dedicated antennas (AUT) on the contrary are always equipped with a connector which can also be used for measurement purposes. Therefore, EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 shall use the procedure described in clause 5.4.5.2.

The measurement shall be conducted at the centre frequency fc of the Operating Frequency Range (OFR) as defined in ETSI EN 303 883-1 [1], clause 5.2.2.

NOTE: Other than LPRs the TLPRs do not have to comply with antenna parameters required by the regulators. But assessing requirements of the document on hand by conducted measurement require the knowledge of the antenna gain. Thus, the antenna gain can be derived by application of the clause 5.4.5.2.

5.4.5.2 Conformance test for TLPR EUT with antenna connector

For the EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4) the conformance test for antenna gain shall use the procedure described in ETSI EN 303 883-1 [1] clause 5.12.2.2.

5.4.6 Duty cycle over signal repetition period

For all EUT categories the duty cycle over measurement period (DC_Trep) conformance test shall use the procedure described in ETSI EN 303 883-1 [1], clause 5.11.2.3.3.

The required parameters T_{obs}, T_{dis} and P_{thresh} are specified as follows:

- $T_{obs} \geq T_{rep}$
- $T_{dis} = 1$ µs
- P_{thresh} = 20 dB below the maximum peak e.i.r.p. spectral density.

NOTE: The maximum peak e.i.r.p. spectral density is measured during the evaluation of the Operating Frequency Range (OFR) of the EUT (see clause 4.3.2).

Additionally, for EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4) the provisions for conducted measurements in ETSI EN 303 883-1 [1], clause 5.1.1 shall be considered.

5.4.7 TX behaviour under the complete environmental profile

5.4.7.1 General

The test set-up shall be chosen based on the selection criteria in ETSI TS 103 941 [4], Figure 1 in clause 4.3.1.

For the EUT categories TLPR2, TLPR4, TLPR6, TLPR8, TLPR10 (radiated assessment as EUT features no antenna connector), the conformance test procedure in clause 5.4.7.2 shall be used.

For the EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (conducted assessment as EUT features an antenna connector), the conformance test procedure in clause 5.4.7.3 shall be used.

The environmental profile test conditions and the general test procedure are shown in ETSI TS 103 941 [4] clause 4.5.4. The parameters for the assessment procedure are specified in clause 5.1.3.

5.4.7.2 EUT without antenna connector

Conformance shall be assessed based on the test setup assessment in clause 5.4.7.1 The assessment procedure shall be conducted according to ETSI TS 103 941 [4], clause 6.2.

The measurement shall be made with a EUT without a test tank, see Table 10.

5.4.7.3 EUT with antenna connector

Conformance shall be assessed based on the test-set assessment in clause 5.4.7.1 The assessment procedure shall be conducted according to ETSI TS 103 941 [4], clause 7.

The measurement shall be made with a EUT without a test tank, see Table 10.

5.5 Conformance test methods of measurement for receiver

5.5.1 General

ETSI EN 303 883-2 [2], clause 5.1 gives general guidance on RX measurements applicable to all EUT categories. For EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4) the conformance tests for receiver baseline sensitivity (see clause 5.5.2) and receiver baseline resilience (see clause 5.5.3) shall be performed conducted as described in clauses 5.5.2.2 and 5.5.3.1.2 and as indicated in ETSI EN 303 883-1 [1], clause 5.1.1.

5.5.2 Receiver baseline sensitivity (RBS)

5.5.2.1 Radiated test setup for EUTs without antenna connector

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

This conformance test is only applicable to EUT categories TLPR2, TLPR4, TLPR6, TLPR8, TLPR10, only (see clause 4.2.3 and Table 4).

Figure 1 shows the radiated test setup for the equivalent scenario for the Receiver Baseline Sensitivity (RBS) test. The test setup descripted in Figure 1 shall be realized inside a FAR, see ETSI EN 303 883-1 [1], clause B.2.2.2.

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 in Annex C.

The echo signal produced by the reflection at the radar target with specific Radar Cross Section (RCS) σ in a distance R_T shall deliver the power $P_{r\_equivalent} \leq P_{r\_real}$ to the LPR receiver (see Annex C and particularly clause C.3). The RCS can be calculated by following the procedure in clause C.3.

In the radiated test setup according to Figure 1 the EUT antenna and the radar target shall be ideally aligned facing towards each other. The conditions in ETSI TS 103 789 [3], clauses B.2 and B.3 shall be considered to ensure far field conditions and to fulfil the point target condition.

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

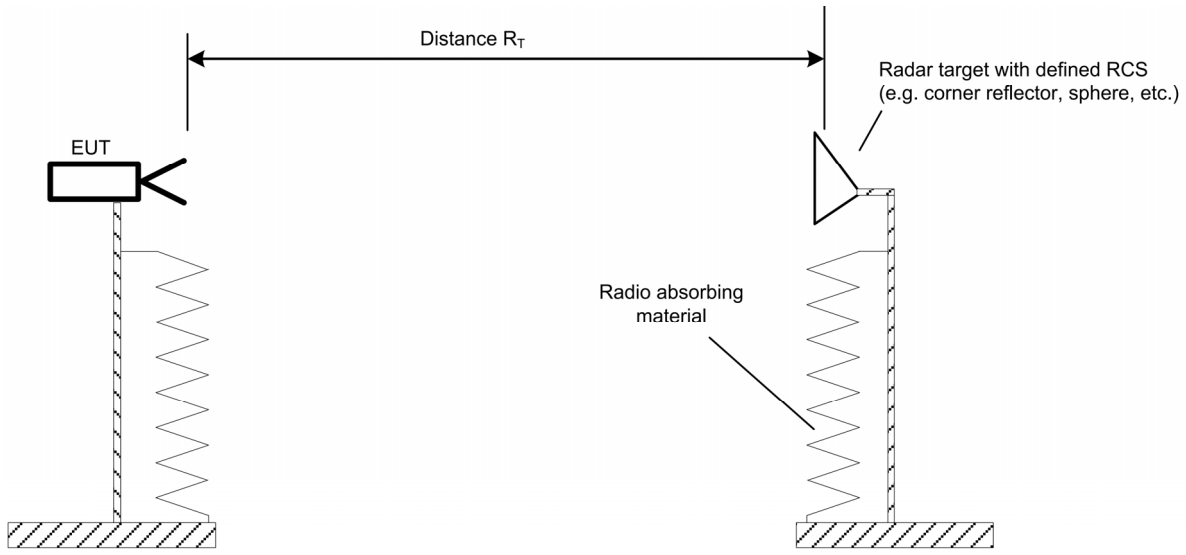

Figure 1: Radiated test setup providing a defined echo signal to the EUT

It should be mentioned that EUT often can be equipped with antennas of different size and gain. However, the radiated sensitivity test is independent of the EUT antenna as its gain is compensated in the radar target RCS (see clause C.3 and clause C.4 for the reference device defined in Table D.1). Thus, all available EUT antennas can be used to conduct the radiated RBS test.

The attenuation in the signal path from the EUT antenna to the radar target and back again to the EUT receiver can be influenced by adjusting the RCS of the radar target and/or varying the distance R_T (see clause C.3). Thus, the desired echo signal power $P_{r\_equivalent} \leq P_{r\_real}$ can be provided to the receiver of the EUT.

5.5.2.2 Conducted test setup for EUTs with antenna connector

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

This conformance test is only applicable to EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4). Figure 2 shows the conducted test setup for the equivalent scenario for the Receiver Baseline Sensitivity (RBS) test using coaxial or hollow waveguide components.

The test setup features the generation of a defined echo signal power which is provided to the LPR receiver.

The echo signal produced by the reflection at the short-circuited transmission line shall deliver the power $P_{r\_equivalent} \leq P_{r\_real}$ to the EUT receiver (see Annex C and particularly clause C.3).

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

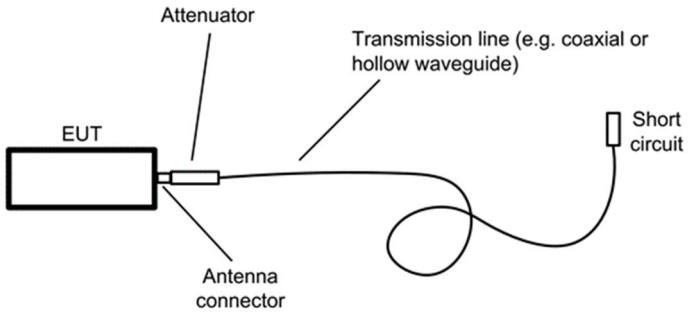

Figure 2: Conducted test setup providing a defined echo signal to the EUT

The desired attenuation in the signal path from the antenna connector over the transmission line to the short circuit and back again to the antenna connector can be further adjusted by selecting a suitable attenuation in the employed attenuator (see Figure 2). Thus, the desired echo signal power $P_{r\_equivalent} \leq P_{r\_real}$ can be provided to the receiver of the EUT.

5.5.2.3 Test procedure

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

- The measurement setup for the radiated equivalent scenario is arranged according to Figure 1. If the equipment under test provides an antenna connector the test shall be carried out in the conducted equivalent scenario according to Figure 2.
- The corresponding Radar Cross Section (RCS) σ of the radar target with the corresponding distance R_T can be determined according to clause C.3 for the radiated setup in clause 5.5.2.1 delivering the desired echo power to the EUT receiver.
- For the conducted setup in clause 5.5.2.2 the desired echo power delivered to the EUT receiver can be adjusted by selecting a suitable attenuation in the employed attenuator (see Figure 2).
- The resulting received echo power $P_{r\_equivalent}$ provided to the EUT receiver shall be equal or less than the received echo power P_{r_real} = -53,8 dBm in the real scenario (see clause C.2).
- The distance measurement is carried out against the radar target in the radiated setup (Figure 1) or against the short circuit in the conducted setup (Figure 2).
- The test is passed if the radar target/short circuit can be detected with the required detection probability as specified in clause 4.4.3.3. In this case a sufficient receiver sensitivity of the EUT can be ensured.

5.5.3 Receiver Baseline Resilience (RBR)

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

5.5.3.1.1 Radiated test setup for EUTs without antenna connector

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

This conformance test is only applicable to EUT categories TLPR2, TLPR4, TLPR6, TLPR8, TLPR10 (see clause 4.2.3 and Table 4).

Figure 3 and Figure 4 show the radiated test setup for the equivalent scenario for the receiver baseline resilience (RBR) test. The test setup descripted with Figure 3 and Figure 4 shall be realized inside a FAR, see ETSI EN 303 883-1 [1], clause B.2.2.2.

The equivalent scenario is derived from the defined real scenario in 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 Annex C and particularly clause C.3).

2) The interferer signal(s) which shall be determined according to the procedure outlined in Annex D.

The interferer signals (see Annex D) are generated by means of a microwave signal generator which is connected to a test antenna with gain G_T. The test antenna is placed in a certain distance R from the EUT and shall also be positioned within the EUT antenna main lobe.

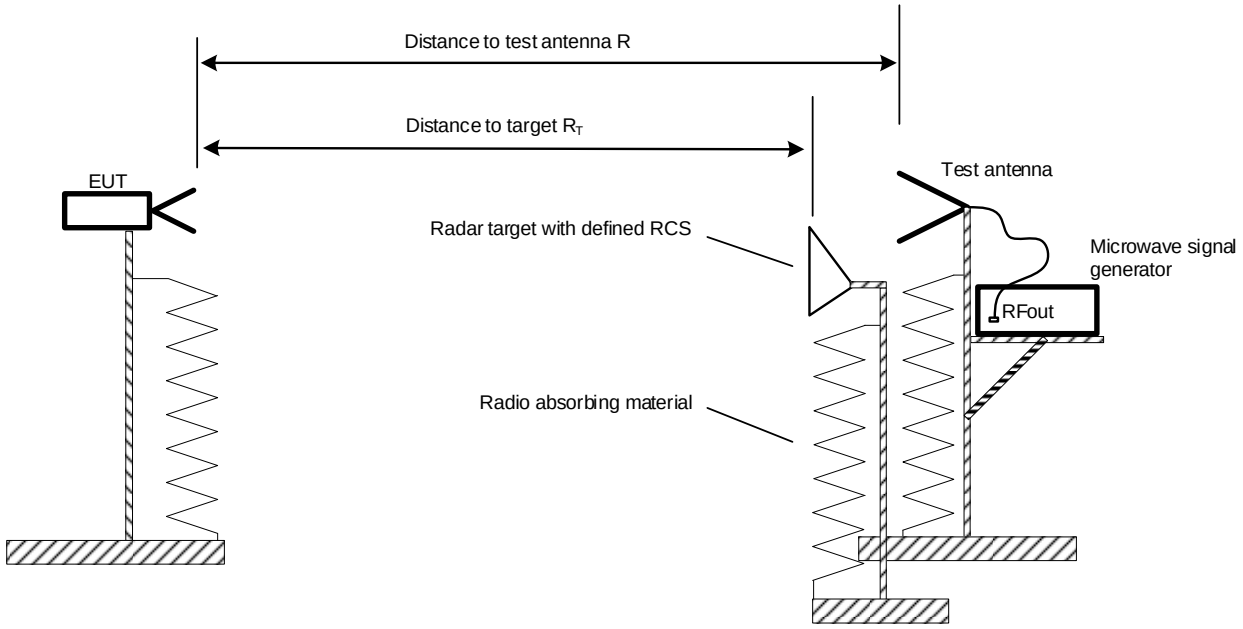

Figure 3: Radiated test setup providing a defined echo signal and an interferer signal to the EUT

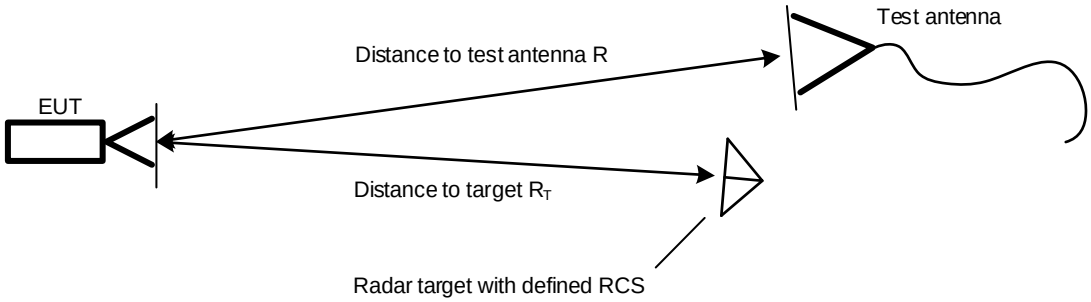

Figure 4: Radiated test setup providing a defined echo signal and an interferer signal to the EUT (top view of Figure 3 drawn without measurement instrumentation)

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

The test antenna and the radar target shall not provide exactly the same distances R_T and R to the EUT ($R > R_T + 1$ m), so that the EUT can separate the desired radar target (see Figure 4) from the unwanted echo signal generated by the test antenna support. The EUT sensor has then to be adjusted to measure the distance to the desired radar target.

NOTE: In general, there are built in functions and techniques which enable TLPR 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.

In the radiated test setup according to Figure 3 and Figure 4 it is necessary to place both, the test antenna and the radar target within the Half Power BeamWidth (HPBW) of the main lobe of the EUT antenna. In this case the interferer signal from the microwave generator and the echo signal from the Radar target reach the TLPR receiver over the main lobe of the EUT antenna. Therefore, it is valid to use the EUT antenna gain G in the direction of main radiation (main lobe axis) for further evaluation.

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

It should be mentioned that TLPR devices often can be equipped with antennas of different size and gain. However, the radiated resilience test is independent of the TLPR antenna as its gain is compensated in the radar target RCS (see clause C.3 and clause C.4 for the reference device 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 attenuation in the signal path from the EUT antenna to the radar target and back again to the EUT receiver can be influenced by adjusting the RCS of the radar target and/or varying the distance R_T (see clause C.3). Thus, the desired echo signal power $P_{r\_equivalent} \leq P_{r\_real}$ can be provided to the receiver of the EUT.

The employed power level at the microwave signal generator (see Figure 3 and Figure 4) has to be aligned with the EUT antenna gain and the test antenna gain in order to result in the correct interferer power level $P_{r\_interferer}$ at the receiver of the EUT.

The interferer power level $P_{r\_interferer}$ which shall be applied to the receiver of the EUT shall be determined by following the procedure outlined in Annex D.

The transmitted power level of the interfering signal $P_{t\_interferer}$ which shall be fed into the test antenna in order to generate the wanted interferer power level $P_{r\_interferer}$ at the EUT receiver shall be determined using the well-known Friis transmission equation. A description of this equation related to the case under consideration can be found in ETSI TS 103 789 [3], Annex C. Thus, the correct interferer power of $P_{r\_interferer}$ and the desired echo power $P_{r\_equivalent}$ can simultaneously be provided to the receiver of the EUT.

5.5.3.1.2 Conducted test setup for EUTs with antenna connector

This conformance test is only applicable to EUT categories TLPR1, TLPR3, TLPR5, TLPR7, TLPR9 (see clause 4.2.3 and Table 4). Figure 5 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:

- The echo signal from a short-circuited transmission line which produces the power $P_{r\_equivalent} \leq P_{r\_real}$ to the EUT receiver (see Annex C and particularly clause C.3).
- The interferer signal(s) which can be extracted from Annex D.

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

Transmission line A and line B (see Figure 5) shall have a difference in cable length of > 1 m, 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 Figure 5). The EUT has then to be adjusted to measure the distance to the short circuit.

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

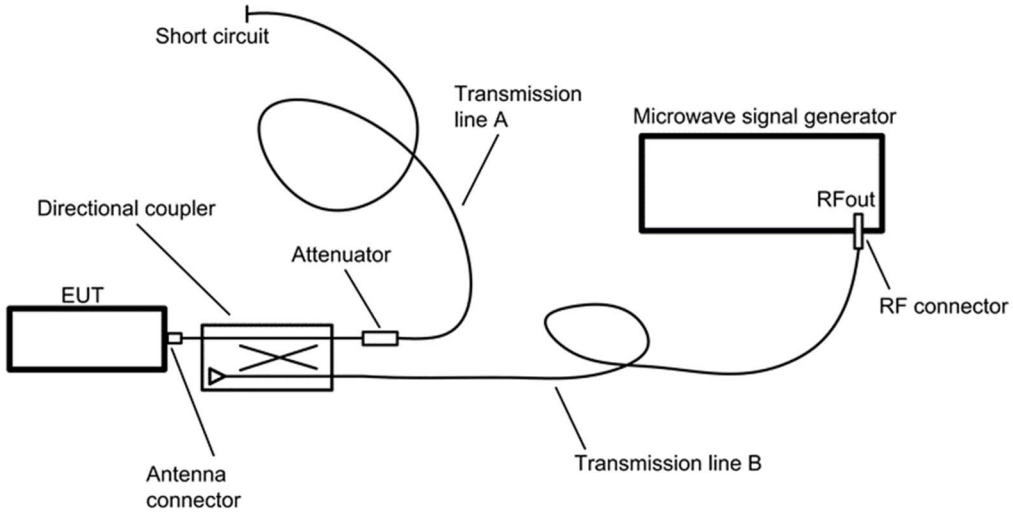

Figure 5: Conducted test setup providing a defined echo signal and an interferer signal to the EUT

The attenuation in the signal path from the EUT antenna connector to the short circuit and back again to the antenna connector can be adjusted by selecting a suitable attenuation in the employed attenuator. Thus, the desired echo signal power $P_{r\_equivalent} \leq P_{r\_real}$ can be provided to the receiver of the EUT.

The exact interferer power level $P_{r\_interferer}$ which shall be applied to the receiver of the EUT can be extracted from Annex D.

The transmitted power level of the interfering signal $P_{t\_interferer}$ which shall be fed into coaxial cable B at the RF-connector of the signal generator in order to generate the wanted interferer power level $P_{r\_interferer}$ at the EUT receiver shall be calculated by considering the attenuation of transmission line B and the coupling factor of the used directional coupler. Thus, the correct interferer power of $P_{r\_interferer}$ and the desired echo power of $P_{r\_equivalent}$ will simultaneously be provided to the EUT.

5.5.3.1.3 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 3 and Figure 4. If the equipment under test provides an antenna connector the test shall be carried out in a conducted arrangement according to Figure 5.

- The interferer frequencies $f_{interferer}$ and power levels $P_{r\_interferer}$ can be extracted from Annex D. The respective test shall be repeated for all applicable interferer signals.
- The transmitted interferer power levels (microwave signal generator output power) $P_{t\_interferer}$ shall be determined by means of the approaches outlined in clause 5.5.3.1.1 for the radiated test setup or clause 5.5.4.1.2 for the conducted test setup.
- The corresponding Radar Cross Section (RCS) σ of the radar target with the corresponding distance R_T shall be determined according to clause C.3 for the radiated setup in clause 5.5.3.1.1 delivering the desired echo power to the EUT receiver.
- For the conducted setup in clause 5.5.3.1.2 the desired echo power delivered to the EUT receiver can be adjusted by selecting a suitable attenuation in the employed attenuator (see Figure 5).
- The resulting received echo power $P_{r\_equivalent}$ provided to the EUT receiver shall be equal or less than the received echo power P_{r_real} = -53,8 dBm in the real scenario (see clause C.2).
- The distance measurement is carried out against the radar target in the radiated setup (Figure 3 and Figure 4) or against the short circuit in the conducted setup (Figure 5) with the interferer signal turned on.
- The test is passed if the radar target/short circuit can be detected with the required detection probability as specified in clause 4.4.4.3. In this case a sufficient resilience of the EUT receiver against interferer signals can be ensured.

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

5.5.3.2.1 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, the test for RBR shall be carried out without a simultaneous distance measurement against a radar target. If the EUT does not provide this feature the procedure in clause 5.5.3.1 shall be applied for testing.

The interfering signal is directly coupled into 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 sensor, no matter what frequency or type of modulation is used.

The EUT signal processing algorithms however need a stable echo and a minimum echo signal-to-noise ratio SNR_{min} shall be maintained in order 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 the following test procedure.

The received echo power P_{r_real} = -53,8 dBm is determined according to clause C.2 assuming a reference device in a real environment measuring against an oil 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 SNR_{min} from the echo power P_{r_real} = -53,8 dBm.

$$max.allowed\ noise\ level\ (in\ dBm) = P_{r\_real} - SNR_{min}\ (in\ dB) \quad (1)$$

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.

The measurement for SNR_{min} shall be carried out in a radiated setup according to Figure 1 if the EUT provides no antenna connector. 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 R_T to this artificial target. If the EUT provides an antenna connector this measurement shall be carried out in a conducted setup according to Figure 2 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 EUT stays permanently below the maximum allowed noise level under interference conditions.

5.5.3.2.2 Test procedure

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

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

- The measurement setup for the radiated approach is arranged according to Figure 3 and Figure 4 but without the radar target. The test antenna and EUT antenna shall be placed in the distance R and shall be ideally aligned for main beam direction and polarization.

  If the equipment under test provides an antenna connector the test shall be carried out in a conducted arrangement according to Figure 5 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 Annex D. The respective test shall be repeated for all applicable interferer signals (see Annex D).

- The transmitted interferer power levels (microwave signal generator output power) $P_{t\_interferer}$ shall be determined by means of the approaches outlined in clause 5.5.3.1.1 for the radiated test setup or clause 5.5.3.1.2 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 5.5.3.2.1 and recorded in the test report.

- The maximum allowed noise level is calculated by means of Equation (1) in clause 5.5.3.2.1.

- 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 $f_c \pm$ OFR (adjacent channel interference);
  - 95 % of the measurement period if the interferer is located at $f_c \pm 2 \times$ OFR (blocking);

  as specified in clause 4.4.4. In this case a sufficient resilience of the EUT receiver against interferer signals can be ensured.

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 302 372					
Requirement				Requirement Conditionality	
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	Peak e.i.r.p. spectral density	3.2	4.3.3	U	
3	Transmitter Indirect Emissions	3.2	4.3.4	U	
4	Transmitter Unwanted Emissions (TXUE)	3.2	4.3.5	U	
5	TX behavior under the complete environmental profile	3.2	4.3.6	U	
6	Receiver Baseline Sensitivity (RBS)	3.2	4.4.3	U	
7	Receiver Baseline Resilience (RBR)	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".

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

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

Annex B (informative): Selection of technical parameters

ETSI EG 203 336 [i.9], 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 B.1 contains the parameters listed in ETSI EG 203 336 [i.9], 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.9]

ETSI EG 203 336 [i.9]		Present document		Justification
Clause	**Parameter**	**Clause**	**Parameter**	
5.2.2	Transmitter power limits	4.3.3	Peak e.i.r.p. spectral density	As specified in European Commission Decision (EU) 2025/105 [i.5].
		4.3.4	Transmitter indirect emissions	As specified in European Commission Decision (EU) 2025/105 [i.5].
5.2.3	Transmitter power accuracy	-	-	From the latest version of ETSI EG 303 336 [i.9] "*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	-	-	*See note.*
5.2.6	Transmitter intermodulation attenuation	-	-	From latest version of ETSI EG 303 336 [i.9] 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	-	-	Not required by European Commission Decision (EU) 2025/105 [i.5].
5.2.7.3	Transmitter unwanted emissions in the spurious domain	4.3.5	TX Unwanted emissions	
5.2.8	Transmitter time domain characteristics	-	-	*Not required by European Commission Decision (EU)* 2025/105 *[i.5].*
5.2.9	Transmitter transients	-	TX Unwanted emissions	
	Other mitigation, spectrum access requirements not specified in the ETSI Guide but specified in related ECC/EC framework	Annex F	Installation requirements	As specified in European Commission Decision (EU) 2025/105 [i.5].
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	-	-	

ETSI EG 203 336 [i.9]		Present document		Justification
Clause	**Parameter**	**Clause**	**Parameter**	
5.3.4.5	Receiver radio-frequency intermodulation	-	-	
5.3.5	Receiver unwanted emissions in the spurious domain	-	-	Not applicable as the present document does not cover receive-only devices or transceivers with receive-only mode (see clause 1).
5.3.6.1	Receiver dynamic range	4.4.3	Receiver dynamic range or partly by RBS	See ETSI EN 303 883-2 [2], Table C.1 for more information.
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	4.4.3 4.4.4	Receiver Baseline Sensitivity (RBS) Receiver Baseline Resilience (RBR)	Signal interferer handling (ETSI EG 203 336 [i.9], 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.10] and ETSI EN 303 883-2 [2].
NOTE: Not applicable for UWB/wideband devices based on the nature of the used modulation.				

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

C.1 Introduction

An equivalent test scenario (see Figure D.1) is applied which accurately reflects the conditions set out in the typical real scenario (see clause C.2) for the EUT setup at much shorter measurement distances. 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 ETSI TS 103 789 [3], Annex B.

A detailed description 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 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.

C.2 Definition of the real scenario

In the typical real scenario, the received echo power is derived from the reflection of the transmit signal generated by a sub-category OFR 3 reference TLPR device operating at a centre frequency f_c = 25,275 GHz at a reference material surface with permittivity ε_r = 2,0 (e.g. oil) in a distance of R_{meas} = 20 m.

Table D.1 lists the technical parameters of the reference TLPR device in detail.

Table D.1: Technical parameters of the reference TLPR device

EUT category	Frequency range which contains the OFR of the EUT	Centre frequency fc	Peak power (conducted)	Antenna gain	Peak e.i.r.p.
OFR 3	24,05 to 26,5 GHz	25,275 GHz	−2 dBm (0,631 mW)	28 dBi (631)	26 dBm

The received power P_{r_real} fed back into the EUT receiver can be calculated according to the following equation (see ETSI TS 103 789 [3], clause A.2.4), assuming a specular reflection at the above defined flat oil surface.

$$P_{r\_real} = \frac{P_{t\_ref} G_{ref}^2 \lambda^2 |r|^2}{(8\pi R_{meas})^2} \quad \text{(C.1)}$$

P_{r_real} : received echo power in the real measurement scenario (in Watt)

P_{t_ref} : maximum conducted peak power of the reference TLPR device (0,631 mW)

G_{ref}: antenna gain of the reference TLPR device in main lobe direction (631)

λ: wavelength of the transmit signal at centre frequency f_c

R_{meas}: measurement distance in the real scenario (R_{meas} = 20 m)

r: reflection coefficient of the reference surface (r = -0,172 with ε_r = 2,0)

The reflection coefficient of the transition from air to the surface material with relative permittivity ε_r can be approximated by:

$$r \approx \frac{1-\sqrt{\varepsilon_r}}{1+\sqrt{\varepsilon_r}} \quad \text{(C.2)}$$

ε_r : relative permittivity of the considered surface material

Consequently, for the typical real scenario the power P_{r_real} = -53,8 dBm is returned back into the receiver of the EUT.

C.3 Derivation of the radiated equivalent scenario

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

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 R_T ($R_T < R_{meas}$) and thus to facilitate testing.

In order to ensure the same echo signal power at the TLPR receiver as in the defined real scenario (i.e. P_{r_real} = −53,8 dBm), a suitable radar target with a certain Radar Cross Section (RCS) σ is used (see clause C.4) which is placed at a convenient distance R_T (often at standard distances of 3 m, 5 m or 10 m depending on the used anechoic chamber) from the EUT (Figure D.1).

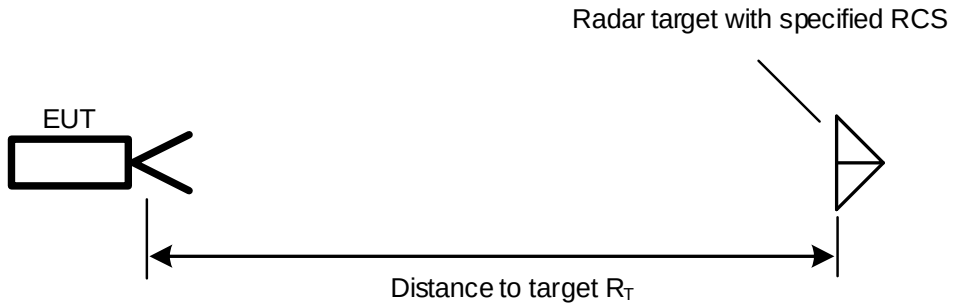

Figure D.1: Radiated measurement setup of the equivalent scenario

The measurement at this shorter distance R_T is valid as the variation of the measured distance value and thus also the detection probability (performance criterion) of the TLPR sensor solely depends on the signal-to-noise ratio of the echo signal and not on the distance to the radar target itself.

The power level of the echo signal in the equivalent scenario $P_{r\_equivalent}$ at the receiver during the measurement against the radar target with RCS σ shall be determined by following the provisions in ETSI TS 103 789 [3], clause A.2.4.

The shape and size of a radar target depends on the desired Radar Cross Section (RCS) σ. The equations for the radar cross sections of different reflectors in boresight direction can be found in ETSI TS 103 789 [3], clause A.1.

C.4 Evaluation of the Radar Cross Section (RCS) of standard radar targets

In order to evaluate the Radar Cross Section (RCS) of standard radar targets the approach described in ETSI TS 103 789 [3], clause 7 shall be followed.

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

D.1 General

The approach defined in ETSI EN 303 883-2 [2], clause A.2.1.0 option 2 shall be used.

D.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 shall be used (see ETSI EN 303 883-2 [2], clause A.2.1.2) using the following 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;
- 50 dB additional loss.

NOTE 1: 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 ETSI TS 103 361 [i.12], clause 7.7.

NOTE 2: The value for additional loss is 50 dB = 40 dB + 10 dB compared to the value given by ETSI EN 302 729-1 [i.7]. This to reflect the tank wall attenuation of 40 dB since TLPRs are mounted on metallic tanks. The value of 40 dB has been derived by ETSI TS 103 361 [i.12].

D.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 also the procedure in ETSI EN 303 883-2 [2], clause A.2.1.2 using the same parameters listed in clause D.2.

Annex E (informative): Range of modulation parameters

E.1 Pulse modulation schemes

In pulse modulation schemes, the transmitter periodically transmits a pulse train containing of pulses with individual pulse durations. Typical examples of pulse modulation schemes are shown in ETSI EN 303 883-1 [1], clause C.2.1.

E.2 FMCW modulation schemes

In FMCW modulation schemes, the transmitter periodically transmits a pulse train containing of frequency modulated sweeps or ramps with individual sweep durations. Typical examples of FMCW modulation schemes are shown in ETSI EN 303 883-1 [1], clause C.2.2.

Annex F (informative): Installation requirements of Tank Level Probing Radar (TLPR) equipment

This annex provides the information for TLPR equipment manufacturers to design the equipment and the installation in the tank in such a way, that the essential requirements of article 3.2 of the directive 2014/53/EU [i.1] are fulfilled.

The following installation requirements should be fulfilled:

a) TLPR are required to be installed at a permanent fixed position at a closed (not open) metallic tank or reinforced concrete tank, or similar enclosure structure made of comparable attenuating material;

b) flanges and attachments of the TLPR equipment should provide the necessary microwave sealing by design;

c) sight glasses should be coated with a microwave proof coating when necessary (i.e. electrically conductive coating);

d) manholes or connection flanges at the tank should be closed to ensure a low-level leakage of the signal into the air outside the tank;

e) mounting of the TLPR equipment should be on top-level of the tank structure to fulfil the intended use in the tank structure with the orientation of the antenna to point in a downward direction;

f) installation and maintenance of the TLPR equipment should be performed by professionally trained individuals only.

The manufacturer is required to inform the users and installers of TLPR equipment about the installation requirements and, if applicable, the additional special mounting instructions (e.g. by putting it in the product manual).

Annex G (normative): Requirements on test tank

The following requirements shall apply for a test tank:

- The test tank material shall be metal to demonstrate worst case for resonances.
- Test tank shall provide at least one mechanical connection for installing the TLPR. The method of mounting including the recommended product sealing used during the measurement shall be described in the Test report.
- The test tank shall be of cubic or cylinder shape with height/diameter ratio of 2 to 3 and volume shall not exceed 500 litres to demonstrate worst case power density inside the tank.

NOTE 1: The dimension of a real-life tank is several orders of magnitude larger than the wavelength and thereby minimizes any resonance effect in the tank. The TLPR manufacturers have not experienced high narrow band resonance effects for test tanks.

NOTE 2: The test tank specified is used as a worst-case scenario for measuring the total emission outside the tank including the flange coupling and/or any potential tank resonance.

Annex H (informative): Electromagnetic leakage from a EUT

H.1 General

EUT is defined as a tank with an installed TLPR.

The most common mounting of a TLPR is a flange on a top of a tank with the antenna lobe pointing downwards (in order to allow the vertical line to be contained within the main lobe of the antenna). The main part of the discussion below is around leakage of the radar frequency and its harmonics but leakage at lower frequency (clock frequencies, etc.) is measured as a part of the EMC-testing.

H.2 Survey of sources of leakage

Generally, the electromagnetic leakage measured outside the EUT can conceptually be divided as coming from four sources:

1) Leakage from the TLPR enclosure and cabling including components measured in a standard EMC test. Most leakage here is at frequencies below the radar frequency:

   a) Leakage around the mounting flange of the TLPR. Typically, this is the dominating part of the total leakage for the radar frequency and its harmonics as there will be comparatively strong fields close to the antenna. The flange gasket typically allows some leakage. Frequencies far below radar frequency have small possibilities to be radiated by the radar antenna.

   b) Leakage through other flanges on the tank than the mounting flange of the TLPR. The radar beam will bounce around inside the tank, be scattered and soon absorbed by the tank content or the tank walls. Some scattered radar beam may hit other flanges. However, the bigger the tank the less leakage will occur. This can be understood by a comparison between the areas of the flange gasket (as seen from the inside) with the total area of the inside of the tank.

   c) Leakage through the tank wall. For a metal tank this is negligible as the attenuation through a metal is 5 dB to 10 dB per µm. For a tank made of concrete with or without reinforcement the attenuation in the wall, according to experience, make the leakage negligible. This is explained by the thickness of the material and the high attenuation not the least due to the natural moisture content in the concrete.

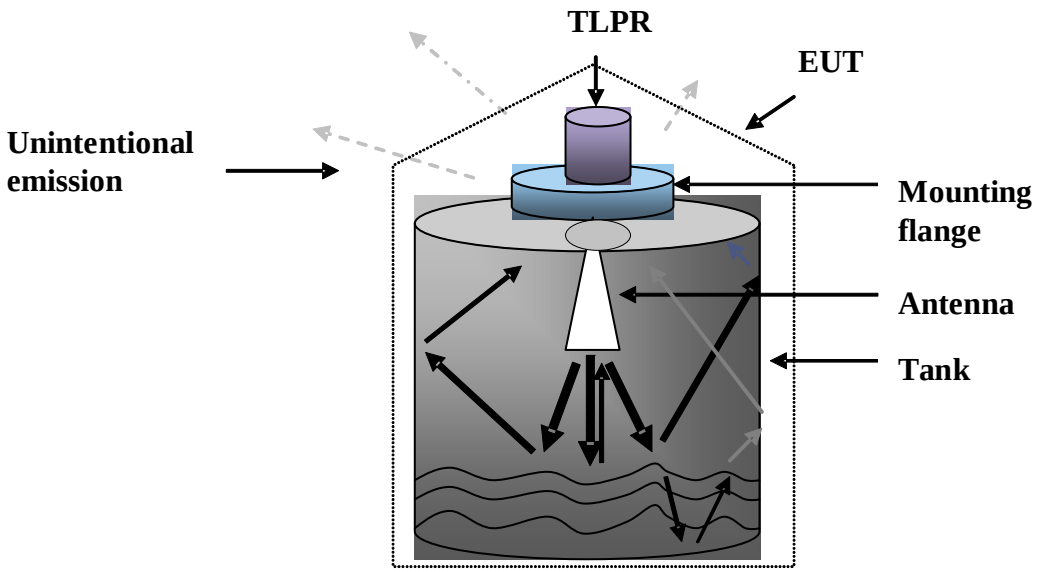

Figure H.1: A typical unintentional emission pattern from the EUT

Thus, the total leakage outside of the tank will have the character of a diffuse leakage with small directivity. During the test procedure the total leakage can be measured essentially following standard EMC-procedures (with extended frequency range) searching for the direction of maximum radiation where the e.i.r.p. is measured.

Annex I (informative): Bibliography

- Recommendation ITU-R SM.329-12 (2012): "Unwanted emissions in the spurious domain".
- Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".
- ETSI TR 102 347: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Equipment for Detecting Movement; Radio equipment operating around e.g. 5,8 GHz, 10 GHz, 25 GHz, 61 GHz, 77 GHz; System Reference Document for Tank Level Probing Radar (TLPR)".

Annex J (informative): Change history

Version	Information about changes
1.2.1	Last publication as a two part HS under R&TTE
2.1.1	• Revision for compliance with Directive 2014/53/EU • Merge of ETSI EN 302 372-1/-2 into a single EN covering the essential requirement of the Directive 2014/53/EU • Out-sourcing of some standard measurement procedures into a separate ETSI EN 303 883 (V1.1.1) • New requirement on receiver interferer signal handling • New Annex B "Application form for testing" • Annex K "Atmospheric absorptions and material dependent attenuations" deleted • New Annex M "Radar targets for radiated measurements" • New Annex N "Boundary conditions for the radar equation"
3.1.1	Revision of ETSI EN 302 372 V2.1.1 on request of the EC to improve the standard, especially regarding receiver requirements (more information is given in the introduction of the present document). The main changes compared to the previous version are: • Clear categorization of EUTs covered by the present document based on regulation, technical implementations and intended use-case requirements. • Receive-only devices, EUTs exhibiting a receive only mode or a standby mode have been removed from the scope of the present document. • Addition of a TX-requirement over the complete environmental profile. • Introduction of the new UWB emission concept as described in ETSI EN 303 883-1 V2.1.0 (2024-01) clause 5.1.2. • All manufacturer declarations have been removed.

History

Document history		
V1.1.1	April 2006	Publication as EN 302 372 part 1 and part 2
V1.2.1	February 2011	Publication as ETSI EN 302 372 part 1 and part 2
V2.1.1	December 2016	Publication
V3.0.0	March 2025	SRdAP process EV 20250612: 2025-03-14 to 2025-06-12