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HARMONISED EUROPEAN STANDARD

Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised standard for access to radio spectrum; Part 2: Level Probing Radar (LPR) equipment operating in the frequency range 75 GHz to 85 GHz for tilted downward installation

Reference
REN/ERM-TGUWB-590

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Foreword

This final 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 Vote phase of the ETSI 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.

The present document is part 2 of a multi-part deliverable covering Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised standard for access to radio spectrum, as identified below:

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";

Part 2: "Level Probing Radar (LPR) equipment operating in the frequency range 75 GHz to 85 GHz for tilted downward installation".

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 302 729 for all Level Probing Radar (LPR) devices, this multi-part deliverable was initiated in order to reflect the intended use in relation to different aspects of the corresponding regulation ECC Decision (11)02 [i.3].

Part 1 covers the original provisions made in ECC Decision (11)02 [i.3] of 11 March 2011 for LPR equipment with strictly vertical downward installation (see ECC Decision (11)02 [i.3], first four lines of Table 1 for strictly vertical antenna orientation).

Part 2 covers the amendments made in ECC Decision (11)02 [i.3] on 5 July 2019 for LPR equipment with tilted downward installation (see ECC Decision (11)02 [i.3], last three lines of Table 1 for tilted antenna orientation).

Due to the amendment of ECC Decision (11)02 [i.3] on 5 July 2019, ETSI ERM TGUWB decided to follow henceforth a two-part structure and to only reflect the amendments made in 2019 in part 2 of the series.

More information on the conducted changes in previous versions of the present document can be found in the change history in Annex H.

1 Scope

The present document specifies technical requirements, limits and test methods for Tilted Level Probing Radar (LPR) equipment using a downward tilted orientation of the LPR antenna in the three tilting ranges ±15°, ±30° and ±45° in relation to the strictly vertical downward direction and operating in the frequency range 75 GHz to 85 GHz in outdoor as well as indoor environments.

Tilted LPR equipment in the scope of the present document consist of a combined transmitter and receiver and are equipped with an integral or dedicated antenna provided also by the equipment manufacturer. Equipment intended to be equipped with antennas from a third-party are not covered by the scope of the present document.

Equipment exhibiting a receive only mode or a standby mode are also not covered by the scope of the present document. Furthermore, the present document is limited to tilted LPR equipment with FMCW modulation.

Tilted LPR equipment and the related categorization is further specified in clause 4.2.

NOTE: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.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) (08-2024): "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) (08-2024): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 2: Measurement techniques for receiver requirements".

[3] ETSI TS 103 789 (V1.1.1) (05-2023): "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) (01-2024): "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.

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[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 Decision (11)02 (11 March 2011):"Industrial Level Probing Radars (LPR) operating in frequency bands 6-8.5 GHz, 24.05-26.5 GHz, 57-64 GHz and 75-85 GHz".

[i.4] ECC Report 139: "Impact of Level Probing Radars Using Ultra-Wideband Technology on Radiocommunications Services", Rottach-Egern, February 2010.

[i.5] CEPT ERC Recommendation 74-01 (May 2022): "Unwanted emissions in the spurious domain".

[i.6] ETSI TR 102 601 V1.1.1 (12-2007): "Electromagnetic compatibility and Radio spectrum Matters (ERM); System reference document; Short Range Devices (SRD); Equipment for Detecting Movement using Ultra Wide Band (UWB) radar sensing technology; Level Probing Radar (LPR)-sensor equipment operating in the frequency bands 6 GHz to 8,5 GHz; 24,05 GHz to 26,5 GHz; 57 GHz to 64 GHz and 75 GHz to 85 GHz".

[i.7] 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.8] Void.

[i.9] Void.

[i.10] ETSI EG 203 336 (V1.2.1) (05-2020): "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.11] ETSI TS 103 567 (V1.1.1) (09-2019): "Requirements on signal interferer handling".

[i.12] ETSI TS 103 361 (V1.1.1) (03-2016): "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 TR 102 273-2 (V1.2.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".

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:

Adaptive Power Control (APC): automatic mechanism to reduce interference to other radio services and applications

NOTE: The Adaptive Power Control (APC) is sometimes also called transmit power control.

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

Equipment Under Test (EUT): Level Probing Radar (LPR) under test

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

NOTE: See Annex F of the present document and ETSI EN 303 883-1 [1], clause C.2.2.

main beam direction: measurement direction of the tilted level probing radar

NOTE: See Annex G of the present document.

radiation: signals emitted intentionally for level measurements

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

tilting angle: angle formed between the main beam direction of the device which is installed in the application and the vertical axis

NOTE: See Annex G of the present document.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

t_{On}	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:

EFTA	European Free Trade Association
HPBW	Half Power BeamWidth
IEC	International Electrotechnical Commission
ITU-R	International Telecommunication Union - Radiocommunication Sector
LPR	Level Probing Radar
RB	Reference Bandwidth
UK	United Kingdom

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

Technical and regulatory requirements for Tilted LPR equipment are provided in general in European Commission Implementing Decision (EU) 2025/105 [i.7] and ECC Decision (11)02 [i.3], which are based on ECC Report 139 [i.4]. The present document covers only the essential technical requirements set out in the last three rows in Table 1 of ECC Decision (11)02 [i.3] for LPR equipment using a tilted vertical downward orientation of the equipment antenna.

In addition, the manufacturer needs to consider further installation requirements as specified in Annex E and will have to provide this information to the user/installer. These installation requirements, however, are not subject to Annex A of the present document.

The following criteria were considered for equipment categorization of the tilted LPR equipment covered by the present document:

- the tilting angle of the tilted LPR antenna, see clause 4.2.2;
- the used antenna connection, see clause 4.2.3.

An overview of the covered equipment categories is provided in clause 4.2.4, Table 3.

4.2.2 Categorization by tilting angle

The tilting angle is the angle between the vertical direction and the main beam direction of the equipment. It depends on the mounting orientation of the device in the application, see Annex G. The permitted tilting angle shall be stated in the technical documentation of the device.

The following equipment categorization by the tilting angle is used:

- TIL1: Tilting angle downward up to ±15°;
- TIL2: Tilting angle downward up to ±30°;
- TIL3: Tilting angle downward up to ±45°.

This equipment categorization has been conducted, covering the permitted tilting angles of tilted LPRs of ECC Decision (11)02 [i.3].

NOTE: The TIL categorization defines the maximum tilting angle in degree in relation to the transmit power see clause 4.3.3. In other words if a lager tilting angle is required, the transmit power level of the equipment has to be reduced.

4.2.3 Categorization by antenna connection

The following equipment categorization by the antenna connection is used:

- ANT1: Tilted LPR features an antenna connector: the tilted LPR is equipped with a dedicated antenna;
- ANT2: Tilted LPR has no antenna connector: the tilted LPR is equipped with an integral antenna.

4.2.4 Summary equipment categories

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

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

TX requirements	Clause	Category	
		tilting angle	antenna connection
Operating frequency range	4.3.2	applicable to all TIL categories	applicable to all ANT categories
Mean e.i.r.p. spectral density	4.3.3		
Peak e.i.r.p. spectral density	4.3.4		
Transmitter Unwanted Emissions (TXUE)	4.3.5		
Antenna requirements	4.3.6		
Mitigation techniques	4.3.7.1		

Table 2: Applicability of receiver requirements for the different Equipment categories

RX requirements	Clause	Category	
		tilting angle	antenna connection
Receiver Baseline Sensitivity (RBS)	4.4.3	applicable to all TIL categories	applicable to all ANT categories
Receiver Baseline Resilience (RBR)	4.4.4		

The categories which are supported by the equipment shall be stated in the technical documentation of the equipment (TiltLPR1 to TiltLPR6, see Table 3).

Table 3: Equipment categories based on categorization listed in clause 4.2.1

Equipment category	Category	
	tilting angle	antenna connection
TiltLPR1	TIL1	ANT1
TiltLPR2	TIL1	ANT2
TiltLPR3	TIL2	ANT1
TiltLPR4	TIL2	ANT2
TiltLPR5	TIL3	ANT1
TiltLPR6	TIL3	ANT2

4.3 Transmitter requirements

4.3.1 General

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

4.3.2 Operating Frequency Range (OFR)

4.3.2.1 Applicability

The operating frequency range requirement applies to all equipment categories as specified in clause 4.2.4, Table 3.

4.3.2.2 Description

The operating frequency range is described in ETSI EN 303 883-1 [1], clause 5.2.1. According to this description and the specification in ECC/DEC/(11)02 [i.3], note (5), 20 dB is specified for the parameter X. This parameter takes precedence over any other values mentioned in ETSI EN 303 883-1 [1], clause 5.2.1.

4.3.2.3 Limits

The OFR (all frequencies between f_L and f_H) shall be within the permitted frequency range (see Table 4).

Table 4: Permitted frequency range for tilted LPR devices

Mode of operation	Frequency range
Transmit and receive	75 GHz ≤ f ≤ 85 GHz
NOTE: The limits are in accordance with ECC/DEC/(11)02 [i.3], Annex 1, Table 1.	

4.3.2.4 Conformance

The conformance test for the OFR is specified in clause 5.4.1.1.

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 equipment categories as specified in clause 4.2.4, Table 3.

4.3.3.2 Description

For the description of the mean e.i.r.p. spectral density, see ETSI EN 303 883-1 [1], clause 5.3.2.1.

4.3.3.3 Limits

Within the OFR, the mean e.i.r.p. spectral density shall not exceed the limits in Table 5.

Table 5: Mean e.i.r.p. spectral density limits for tilted LPR equipment

Equipment category	Maximum mean e.i.r.p. spectral density (within the antenna main beam)
TiltLPR1, TiltLPR2	-3 dBm/MHz
TiltLPR3, TiltLPR4	-10 dBm/MHz
TiltLPR5, TiltLPR6	-20 dBm/MHz
NOTE: The limits are in accordance with ECC/DEC/(11)02 [i.3], Annex 1, Table 1.	

NOTE: The regulated antenna pattern requirement is specified in clause 4.3.6.

4.3.3.4 Conformance

The conformance test for mean e.i.r.p. spectral density is specified in clause 5.4.2.1.

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 equipment categories as specified in clause 4.2.4, Table 3.

4.3.4.2 Description

For the description of the peak e.i.r.p. spectral density, see ETSI EN 303 883-1 [1], clause 5.3.4.1.

4.3.4.3 Limits

Within the OFR, the peak e.i.r.p. spectral density shall not exceed the limits in Table 5.

Table 6: Peak e.i.r.p. spectral density limits for tilted LPR equipment

Equipment category	Maximum peak e.i.r.p. (measured in 50 MHz within the antenna main beam)
TiltLPR1, TiltLPR2	34 dBm
TiltLPR3, TiltLPR4	34 dBm
TiltLPR5, TiltLPR6	20 dBm
NOTE: The limits are in accordance with ECC/DEC/(11)02 [i.3], Annex 1, Table 1.	

4.3.4.4 Conformance

The conformance test for peak e.i.r.p. spectral density is specified in clause 5.4.3.1.

4.3.5 Transmitter Unwanted Emissions (TXUE)

4.3.5.1 Applicability

The transmitter unwanted emissions requirement applies to all equipment categories as specified in clause 4.2.4, Table 3.

4.3.5.2 Description

The transmitter unwanted emissions are described in ETSI EN 303 883-1 [1], clause 5.5.1. According to this description, a value of 250 % is used for the parameter X_{TXUE} in order to define the boundaries f_{LS} and f_{HS} between the Out-Of-Band (OOB) domain and the spurious domain.

4.3.5.3 Limits

Tilted LPR equipment shall not exceed the limits indicated in Table 7 for the out-of-band domain and in Table 8 for the spurious domain.

Table 7: Transmitter unwanted emissions limits in the out-of-band (OOB) domain for tilted LPR equipment

Equipment category	Maximum mean e.i.r.p. spectral density
TiltLPR1, TiltLPR2	-23 dBm/MHz
TiltLPR3, TiltLPR4	-30 dBm/MHz
TiltLPR5, TiltLPR6	-40 dBm/MHz
NOTE: The limit is in accordance with ECC/DEC/(11)02 [i.3], Annex 1, Table 1 and note (5).	

Table 8: Transmitter unwanted emissions limits in the spurious domain for tilted LPR equipment

Equipment category	Frequency range	Limit values for TXUE/RB
All	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 10)	-30 dBm/1 MHz
NOTE: The limits are in accordance with ERC/REC 74-01 [i.5], Annex 2, Table 6, Row 2.1.2.		

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

Equipment category	Frequency range which contains the OFR of the equipment (defined by f_L and f_H) (note 1)	Upper frequency (F_{UPPER})
All	13 GHz ≤ f < 150 GHz	2nd harmonic (note 1)
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 ERC/REC 74-01 [i.5], Table 1.		

4.3.5.4 Conformance

The conformance test for Transmitter Unwanted Emissions (TXUE) is specified in clause 5.4.4.1.

4.3.6 Radiation pattern

4.3.6.1 Applicability

The radiation pattern requirement applies to all equipment categories as specified in clause 4.2.4, Table 3.

4.3.6.2 Description

ECC Decision (11)02 [i.3], Table 1 and note (6) include requirements for mean e.i.r.p. spectral density limits and the corresponding antenna parameters which are listed below:

- limitation of mean e.i.r.p. spectral density in elevation angles below 24° related to the vertical axis for the tilted equipment;
- limitation of mean e.i.r.p. spectral density in elevation angles between 24° and 60° related to the vertical axis for the tilted equipment;
- limitation of mean e.i.r.p. spectral density in elevation angles above 60° related to the vertical axis for the tilted equipment.

NOTE: According to ECC Decision (11)02 [i.3] the equipment in the scope of the present document is limited to a defined tilted downward orientation of the equipment antenna main beam. This requirement of the use and installation of the equipment is not in the scope of the present document. However, the manufacturer should provide a clear guidance in the technical documentation on how the equipment is properly operated and installed.

4.3.6.3 Limits

The mean e.i.r.p. spectral density in elevation angels of tilted LPR equipment shall not exceed the limits in Table 10, where α is the direction of radiation and α = 0° means vertically downwards.

Table 10: Limits for mean e.i.r.p. spectral density in elevation angels for tilted LPR equipment

Equipment category	Elevation angle	Mean e.i.r.p. spectral density (in dBm/MHz)
TiltLPR1, TiltLPR2	0°≤ α < 24°	-3
TiltLPR3, TiltLPR4	0°≤ α < 24°	-10
TiltLPR5, TiltLPR6	0°≤ α < 24°	-20
All equipment categories	24°≤ α ≤ 60°	-35
All equipment categories	60°< α ≤ 180°	-41,3
NOTE: The limits are in accordance with ECC/DEC/(11)02 [i.3], Annex 1, Table 1 and note (6).		

Illustrative graphics for Table 10 are shown below. Devices of category TiltLPR1 and TiltLPR2, which means a device tilting angle up to ±15°, shall comply with the limit mask in Figure 1.