Draft ETSI EN 302 065-4-4 V1.1.0 (2022-02)

Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard for access to radio spectrum; Part 4: Material Sensing devices; Sub-part 4: Exterior material sensing applications for ground based vehicles

Reference
DEN/ERM-TGUWB-601

Keywords
harmonised standard, SRD, UWB

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.5] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.3].

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

The present document is part 4, subpart 4 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.13].

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

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the Directive 2014/53/EU [i.3].

For the case of the present document, the applicable harmonised standard has been ETSI EN 302 065-4 (V1.1.1) [i.8], for Material Sensing devices using UWB technology below 10,6 GHz which was published in the OJEU without restriction at 12 April 2017.

In order to consider the above points, ETSI ERM TGUWB decided to develop more specific standards; this means instead of one generic ETSI EN 302 065-4 [i.8] standard for Material Sensing devices the following standard family ETSI EN 302 065-4-x for material sensing devices:

- ETSI EN 302 065-4-1: "Material Sensing devices; Sub-part 1: Building material analysis below 10,6 GHz".
- ETSI EN 302 065-4-2: "UWB Material Sensing devices for Security Scanning UWB SSC.
- ETSI EN 302 065-4-3: "Ground humidity and condition sensor".
- ETSI EN 302 065-4-4: "Exterior material sensing applications at ground based vehicles".
- ETSI EN 302 065-4-5: "UWB surveillance devices for parking lot sensors below 10,6 GHz".

NOTE: The above list of standards represents the active work items at the time of finalizing the present document and the final structure of the ETSI EN 302 065-4-x family may change later.

1 Scope

The present document specifies the requirements for technical characteristics and methods of measurements for material sensing applications using UWB technology for external material sensing applications for ground-based vehicles.

The present document only covers non-contact based UWB material sensing devices according to ECC/DEC(07)01 [i.1] and Commission Decision 2019/785/EU [i.2].

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

2 References

2.1 Normative references

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

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

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

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

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

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

[3] ETSI EN 302 066 (V2.2.1) (06-2020): "Short Range Devices (SRD); Ground- and Wall- Probing Radio determination (GPR/WPR) devices; Harmonised Standard for access to radio spectrum".

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] ECC/DEC/(07)01: "ECC Decision of 30 March 2007 on the harmonised use, exemption from individual licensing and free circulation of Material Sensing Devices using Ultra-Wideband (UWB) technology, amended on 26 June 2009, corrected on 18 November 2016 and amended on 8 March 2019.

[i.2] 2019/785/EU: "Commission Implementing Decision (EU) 2019/785 of 14 May 2019 on the harmonisation of radio spectrum for equipment using ultra-wideband technology in the Union and repealing Decision 2007/131/EC (notified under document C(2019) 3461)".

[i.3] 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.

[i.4] CEPT Report 45: "Report from CEPT to the European Commission in response to the Fifth Mandate to CEPT on ultra-wideband technology to clarify the technical parameters in view of a potential update of Commission Decision 2007/131/EC"; Report approved on 21 June 2013 by the ECC.

[i.5] 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.6] Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".

[i.7] 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.8] ETSI EN 302 065-4 (V1.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 4: Material Sensing devices using UWB technology below 10,6 GHz".

[i.9] ECC/DEC/(20)/01: "ECC Decision of 20 November 2020 on the harmonised use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN)".

[i.10] ETSI TS 136 101 (V16.8.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 version 16.8.0 Release 16)".

[i.11] 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.12] ECO Frequency Information System (cept.org).

NOTE: Available at https://efis.cept.org/.

[i.13] ETSI EN 302 065-1: "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Requirements for Generic UWB applications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

footsize: outside dimension of the EUT in the horizontal plane

3.2 Symbols

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

c	Velocity of light in a vacuum
d, d_1,d_2	Measurement distance
D_1	Difference between M and N
D_2	Difference between M and I
d_{int}	Interferer distance
f_1	RBR test frequency within the middle of the EUT OFR
f_2	RBR test frequency between f_L and f_C of the EUT OFR

f_3	RBR test frequency between f_C and f_H of the EUT OFR
f_C	Centre frequency of the operating frequency range
f_H	Highest frequency of the operating frequency range
$f_{H1,2}$	RBR test frequency higher f_H of the EUT OFR
f_L	Lowest frequency of the operating frequency range
$f_{L1,2}$	RBR test frequency lower f_L of the EUT OFR
f_M	Frequency at which the peak power emission occurs
$G_{(f)}$	Antenna gain over frequency
G_A	Gain of the measurement antenna
I	Signal recorded by the receiver in presence of the interferer
M	Maximum signal for the receiver in the linear region of operation
N	Receiver noise level
$P_{e.i.r.p.}$	Spectral power density
R	Distance

3.3 Abbreviations

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

CW	Continuous Wave
dB	decibel
dBm	decibel reference to 1 mW
e.i.r.p.	equivalent isotropic radiated power
EC	European Commission
EN	European Norm
EVS	External Vehicular Sensor
LBT	Listen Before Talk
TH	ThresHold
TRP	Total Radiated Power
TS	Technical Specification
WTPC	Wanted Technical Performance Criteria

4 Technical requirements specifications

4.1 Environmental profile

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

4.2 EUT categories

4.2.1 General

The present document covers one category of EUT for exterior material sensing applications at ground based vehicle below 10,6 GHz. This category is named as Exterior Vehicle Sensors (EVSs).

More details about the use-case, wanted technical performance criteria and the RX-test conditions of the EVS category is provided in annex C.

The specified EVS EUT sub-categories provide a clear classification for the wanted technical performance criteria, limits requirements and conformance test procedures.

The following criteria were considered for sub-categorization of EVS category:

- Regulation: ECC and EC recommendations and decisions, see clause 4.2.2.
- Modulation: kind of modulation of the TX signal, see clause 4.2.3.
- Usage of active UWB mitigation techniques (e.g. LBT, DAA), see clause 4.2.4.

An overview of the EVS EUT sub-categories is provided in clause 4.2.5, table 1.

4.2.2 Categorization by Regulation

The following regulation was considered for sub-categorization of EVS EUT:

- UWB regulations: ECC/DEC/(07)01 [i.1] and 2019/785/EU [i.2] for EVS EUT based on UWB technology with or without active mitigation techniques.

4.2.3 Categorization by Modulation

The following categorization of EVS EUT by modulation is used:

- TX1: for EUT with FHSS, sequential hopping/stepping or FMCW modulation.
- TX2: for any other modulation different from TX1.

4.2.4 Categorization by Active Mitigation Techniques

BMA EUT covered by ECC/DEC/(07)01 [i.1] and 2019/785/EU [i.2] can be categorized by use of active mitigation techniques (e.g. Listen Before Transmit (LBT), Detect-and-Avoid (DAA)):

- EVS EUT based on UWB technology without active mitigation techniques.
- EVS EUT based on UWB technology with active mitigation techniques.

4.2.5 Summary EVS EUT sub-categories

4 sub-categories of the EVS EUT are identified:

- EVS1: based on UWB technology without active mitigation techniques using TX1 (UWB regulations)
- EVS2: based on UWB technology without active mitigation techniques using TX2 (UWB regulations)
- EVS3: based on UWB technology with active mitigation techniques using TX1 (UWB regulations)
- EVS4: based on UWB technology with active mitigation techniques using TX2 (UWB regulations)

An overview of requirements for each EVS EUT sub-categories is given in table 1.

Table 1: EUT sub-categories covered by the present document

Category	Modulation	TX requirements						RX-requirements	
		Emission requirements		Additional requirements		Active mitigation			
			Clause		Clause		Clause		Clause
EUT based UWB regulation; EUT without any active mitigation technique									
EVS1	TX1	OFR	4.3.2	DC	4.3.7			WTPC	C.2
		Indirect emissions	4.3.4	TRP	4.3.5			RBS	4.4.3
		TXUE	4.3.5					RBR	4.4.4
EVS2	TX2	OFR	4.3.2	DC	4.3.7			WTPC	C.2
		Indirect emissions	4.3.4	TRP	4.3.5			RBS	4.4.3
		TXUE	4.3.5					RBR	4.4.4
EUT based UWB regulation; EUT implemented the active mitigation technique LBT									
EVS3	TX1	OFR	4.3.2	DC	4.3.7	LBT	4.3.6	WTPC	C.2
		Indirect emissions	4.3.4	TRP	4.3.5			RBS	4.4.3
		TXUE	4.3.5					RBR	4.4.4
EVS4	TX2	OFR	4.3.2	DC	4.3.7	LBT	4.3.6	WTPC	C.2
		Indirect emissions	4.3.4	TRP	4.3.5			RBS	4.4.3
		TXUE	4.3.5					RBR	4.4.4

4.3 Transmitter requirements

4.3.1 General

Based on the different possible operational frequency ranges of the EUT categories covered in the present document different sets of transmitter conformance requirements are applicable. The applicability is governed by the operating frequency range as specified in clause 4.3.2.

4.3.2 Operating Frequency Range (OFR)

4.3.2.1 Applicability

This requirement shall apply to all EVS sub-categories, see clause 4.2.5, table 1.

4.3.2.2 Description

For the description of the Operating Frequency Range (OFR), see ETSI EN 303 883-1 [1], clause 5.2.1.

Requirement for test parameter X as specified in ETSI EN 303 883-1 [1], clause 5.2.1:

X: 10 dB

NOTE: The present document is in accordance with the -10 dB bandwidth for UWB EUT below 10 GHz, as defined in annex 1 of Recommendation ITU-R SM.1755 [i.6].

4.3.2.3 Limits

The radio equipment within scope of the present document is capable of operating in all or part of the frequency bands given in table 2.

Table 2: Permitted frequency range [i.2]

Permitted frequency range	
Transmit	30 MHz to 10,6 GHz
Receive	30 MHz to 10,6 GHz

The OFR shall be in the permitted frequency range of operation as given in table 2 and the OFR shall be equal or larger than 50 MHz.

4.3.2.4 Conformance

The conformance test suite for operating bandwidth shall be as defined in clause 5.4.1.

4.3.3 Indirect emissions

4.3.3.1 Applicability

This requirement shall apply to all EVS sub-categories, see clause 4.2.5, table 1.

For some frequency ranges the EUT shall fulfil additional requirements.

The additional requirements are applicable if the OFR is partly or fully overlapping with the frequency range for which the mitigation is requested.

An overview of the applicable additional requirements is provided in table 3.

Table 3: possible applicable requirements

OFR is partly or full overlapping with frequency range [GHz]	Additional requirement for EUT without any active mitigation technique	Additional requirements for EUT implemented the mitigation technique LBT
	Sub-categories: EVS1 and EVS2	Sub-categories: EVS3 and EVS4
1,215 to 1,73		LBT, see clause 4.3.6
2,5 to 2,69	TRP, see clause 4.3.6	TRP, see clause 4.3.5
		LBT, see clause 4.3.6
2,69 to 2,7	DC, see clause 4.3.7	DC, see clause 4.3.7
	TRP, see clause 4.3.6	TRP, see clause 4.3.5
2,7 to 2,9		LBT, see clause 4.3.6
2,9 to 3,4		LBT, see clause 4.3.6
3,4 to 3,8	DC, see clause 4.3.7	DC, see clause 4.3.7
4,8 to 5,0	DC, see clause 4.3.7	DC, see clause 4.3.7
	TRP, see clause 4.3.6	TRP, see clause 4.3.5

4.3.3.2 Description

For the description of the indirect emissions see ETSI EN 303 883-1 [1], clause 5.7.1.

For the Indirect Emission two power requirements are regulated in Commission Implementing Decision (EU) 2019/785/EU [i.2] for the emission within the OFR:

- Mean Power e.i.r.p. spectral density (defined in 1 MHz)
- Peak e.i.r.p. (defined in 50 MHz)

4.3.3.3 Limits for indirect emissions

4.3.3.3.1 EUT without any active mitigation techniques

The limits for the indirect emission requirement for the EUT without any active mitigation techniques (EVS1 and EVS2, table 1) are listed in table 4.