



**Short Range Devices (SRD)
using Ultra Wide Band technology (UWB);
Harmonised Standard for access to radio spectrum;
Part 4: Material Sensing devices;
Sub-part 1: Building material analysis below 10,6 GHz**

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Foreword

ETSI EN 302 065-4-1 V2.1.0 (2021-07)

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.8] 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.6].

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).

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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.6].

For the case of the present document, the applicable harmonised standard has been ETSI EN 302 065-4 [i.17], 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 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: "Building material analysis below 10,6 GHz".
- ETSI EN 302 065-4-2: Void.
- ETSI EN 302 065-4-3: "Ground humidity and condition sensor".
- ETSI EN 302 065-4-4: "Exterior material sensing applications for ground based vehicle".
- 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.

More details on the changes of the present document to previous versions are provided in Annex F.

1 Scope

The present document specifies technical characteristics and methods of measurements for Material Sensing devices for building material analysis (BMA) below 10,6 GHz.

Material Sensing devices for building material analysis below 10,6 GHz within the scope of the present document are covered by UWB or SRD or both UWB and SRD regulations:

- 1) In case of UWB the relevant ECC and EC regulations are:
 - ECC/DEC(07)01 [i.1]; and
 - Commission Decision 2019/785/EC [i.2] for equipment using ultra-wideband technology in a harmonized manner in the Community.

The present document only covers UWB devices that only switch on when in direct contact with the material under investigation (see ECC/DEC(07)01 [i.1] contact-based sensors and imaging devices).

- 2) In case of SRD the relevant ECC and EC regulations are:
 - ERC/REC 70-03 [i.3], Annex 6 (2,4 to 2,4835 GHz), Annex 1 (5,725 to 5,875 GHz); and
 - Commission Implementing Decision (EU) 2019/1345 [i.4] for SRD, band no. 57b and 61.

NOTE 1: Detailed description of Material Sensing devices categories and sub-categories are provided in clause 4.2.5, table 2a and table 2b.

The radio equipment within scope of the present document is capable of operating in all or part of the frequency bands given in table 1.

Table 1: Permitted range of operation

Permitted range of operation for EUT based on UWB regulation [i.2]	
Transmit	30 MHz to 10,6 GHz
Receive	30 MHz to 10,6 GHz
Permitted range of operation for EUT based on SRD regulation [i.4]	
Transmit	2,4 GHz to 2,4835 GHz
	5,725 GHz to 5,875 GHz
Receive	2,4 GHz to 2,4835 GHz
	5,725 GHz to 5,875 GHz

NOTE 2: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.6] 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] EN 520:2004 + A1:2009: "Gypsum plasterboards - Definitions, requirements and test methods"; (produced by CEN).
- [4] EN 10080:2005: "Steel for the reinforcement of concrete - Weldable reinforcing steel - General"; (produced by CEN).
- [5] KVH® structural timber: "Environmental product declaration", 18.09.2018, from Überwachungsgemeinschaft Konstruktionsvollholz e.V.

NOTE: Available at

https://www.kvh.eu/fileadmin/downloads/Vereinbarungen_und_Zulassungen/KVH_structural_timber.pdf.

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] 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] ERC/REC 70-03 (June 2020): "ERC Recommendation of 1997 on relating to the use of Short Range Devices (SRD)".

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

- [i.4] Commission Implementing Decision (EU) 2019/1345 of 2 August 2019 amending Decision 2006/771/EC updating harmonised technical conditions in the area of radio spectrum use for short-range devices (notified under document C(2019) 5660).
- [i.5] ETSI TR 102 495-1 (V1.1.1) (01-2006): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics for SRD equipment using Ultra Wide Band Sensor technology (UWB); System Reference Document Part 1: Building material analysis and classification applications operating in the frequency band from 2,2 GHz to 8 GHz".
- [i.6] 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.7] 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.8] 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.9] Recommendation ITU-R SM.1755: "Characteristics of ultra-wideband technology".
- [i.10] ETSI TR 103 181-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band (UWB); Transmission characteristics Part 2: UWB mitigation techniques".
- [i.11] DIN EN 206:2013+A1:2016/prA2:2020: "Concrete - Specification, performance, production and conformity"; German and English version.
- [i.12] ETSI TS 103 361 (V1.1.1): "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] 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.14] 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.15] ETSI EG 203 336 (V1.2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".
- [i.16] ECO Frequency Information System.
- NOTE: Available at <https://efis.cept.org/> (standards.iteh.ai)
- [i.17] 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".

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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:

active mitigation techniques: mitigation techniques, like listen before talk and detect and avoid

NOTE: For more details see ETSI TR 103 181-2 [i.10].

material sensing devices for Building Material Analysis (BMA): building material sensing devices which are designed to detect the location of objects within a building structure or to determine the physical properties of a building material

measurement side: side of the EUT which will be pointed to the material/building structure

user side: side of the EUT with the user interfaces to operate the EUT and to display the measurement results to the user

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:

d, d_1, d_2	measurement distance
d_{TXW}	thickness of the test wall
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_{HS}	higher frequency border between OOB and spurious domain
f_{LS}	lower frequency border between OOB and spurious domain
g_{wall}	attenuation of the test structure for TX measurements; in [dB]
P_{Thresh}	threshold for the duty cycle measurement
R_{DR}	distance of the specified object within the RX-conformance test scenario for the RBR requirement
R_{DS}	distance of the specified object within the RX-conformance test scenario for the RBS requirement
th	reference point for the assessment of the power level at the EUT
thl	assessed power levels for the LBT test
X	parameter in dB to specify the OFR of the EUT in relation to the TX emission
X_{TXUE}	parameter in percentage to specify the OOB and spurious domain in relation to OFR of the EUT

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:

BMA	Building Material Analysis
WTPC	Wanted Technical Performance Criteria

[ETSI EN 302 065-4-1 V2.1.0 \(2021-07\)](https://standards.iteh.ai/catalog/standards/sist/346d7a7b-a1d0-4e2d-b59b-065-4-1-v2-1-0-2021-07)

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 Material Sensing devices for building material analysis below 10,6 GHz. This category is named as Building Material Analysis (BMA) EUT.

More details about the use-case, wanted technical performance criteria and the RX-test conditions of the BMA category is provided in Annex D.

The specified BMA 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 BMA 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 BMA EUT sub-categories is provided in clause 4.2.5, table 2a and table 2b.

4.2.2 Categorization by Regulation

The following regulations were considered for sub-categorization of BMA EUT:

- SRD regulations: ERC/REC 70-03 [i.3] and 2019/1345/EU [i.4] for BMA EUT based on narrowband technologies.
- UWB regulations: ECC/DEC/(07)01 [i.1] and 2019/785/EU [i.2] for BMA EUT based on UWB technology with or without active mitigation techniques.

4.2.3 Categorization by Modulation

The following categorization of BMA 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)):

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

4.2.5 Summary BMA EUT sub-categories

5 sub-categories of the BMA EUT are identified:

- BMA1: based on narrowband technologies (SRD regulations)
- BMA2: based on UWB technology without active mitigation techniques using TX1 (UWB regulations)
- BMA3: based on UWB technology without active mitigation techniques using TX2 (UWB regulations)
- BMA4: based on UWB technology with active mitigation techniques using TX1 (UWB regulations)
- BMA5: based on UWB technology with active mitigation techniques using TX2 (UWB regulations)

An overview of requirements for each BMA EUT sub-categories is given in:

- table 2a for BMA EUT sub-category designed to detect the location of objects within a building structure and covered by the ERC/REC 70-03 [i.3] and 2019/1345/EU [i.4]; and
- table 2b for BMA EUT sub-categories designed to detect the location of objects within a building structure and covered by ECC/DEC/(07)01 [i.1] and 2019/785/EU [i.2].

Table 2a: BMA EUT sub-category designed to detect the location of objects within a building structure and covered by ERC/REC 70-03 [i.3] and 2019/1345/EU [i.4]

Sub-category	Modulation	TX requirements		RX-requirements	
		Emission requirements			
			clause		clause
BMA1	TX1 & TX2	OFR	4.3.2	TWPC	D.2.1
		Mean e.i.r.p.	4.3.3	RBS	4.4.3 & D.2.2
		TXUE	4.3.5	RBR	4.4.4 & D.2.3

Table 2b: BMA EUT sub-categories designed to detect the location of objects within a building structure and covered by ECC/DEC/(07)01 [i.1] and 2019/785/EU [i.2]

Sub-category	Modulation	TX requirements					RX-requirements		
		Emission requirements		Additional requirements		Active mitigation			
			clause		clause		clause		clause
EUT without any active mitigation technique									
BMA2	TX1	OFR	4.3.2	DC	4.3.8	Not applicable		TWPC	D.2.1
		Indirect emissions	4.3.4	TRP	4.3.6			RBS	4.4.3 & D.2.2
		TXUE	4.3.5					RBR	4.4.4 & D.2.3
BMA3	TX2	OFR	4.3.2	DC	4.3.8	Not applicable		TWPC	D.2.1
		Indirect emissions	4.3.4	TRP	4.3.6			RBS	4.4.3 & D.2.2
		TXUE	4.3.5					RBR	4.4.4 & D.2.3
EUT implemented the active mitigation technique LBT									
BMA4	TX1	OFR	4.3.2	DC	4.3.8	LBT	4.3.7	TWPC	D.2.1
		Indirect emissions	4.3.4	TRP	4.3.6			RBS	4.4.3 & D.2.2
		TXUE	4.3.5					RBR	4.4.4 & D.2.3
BMA5	TX2	OFR	4.3.2	DC	4.3.8	LBT	4.3.7	TWPC	D.2.1
		Indirect emissions	4.3.4	TRP	4.3.6			RBS	4.4.3 & D.2.2
		TXUE	4.3.5					RBR	4.4.4 & D.2.3

4.3 Transmitter requirements

4.3.1 General

Based on the different possible TX signal modulations for the EUT categories covered by the present documents there are different related conformance test- set-ups necessary. This relation between conformance test- set-ups and TX signal modulation will be specified in clause 5 of the related documents.

4.3.2 Operating Frequency Range (OFR)

4.3.2.1 Applicability

This requirement applies to all BMA sub-categories, see clause 4.2.5, table 2a and table 2b.

4.3.2.2 Description Operating Frequency Range

See ETSI EN 303 883-1 [1], clause 5.2.1.

4.3.2.3 Limits for Operating Frequency Range

4.3.2.3.1 Limit requirement for BMA based on UWB regulations

The OFR for the BMA sub-categories BMA2, BMA3, BMA4 and BMA5 (see clause 4.2.5, table 2b) shall be in the permitted range of operation as given in table 1 and the OFR shall be equal or larger than 50 MHz.

4.3.2.3.2 Limit requirement for BMA based on SRD regulations

The OFR for the BMA sub-category BMA1 (see clause 4.2.5, table 2a) shall be in the permitted range of operation as given in table 1.

4.3.2.4 Conformance

The conformance test for OFR shall be as defined in clause 5.4.1.

4.3.3 Mean e.i.r.p.

4.3.3.1 Applicability

This requirement applies to the following BMA sub-category:

- BMA1, see clause 4.2.5, table 2a.

NOTE: This is not applicable for equipment based on the UWB regulation (see table 2b), because such equipment is only allowed to be used in contact to a wall or a material under investigation. Emission requirements for equipment based on the UWB regulation are in clause 4.3.4 on "indirect emissions". Tests for such equipment are performed in contact with the material under investigation, see Commission Implementing Decision (EU) 2019/785 [i.2].

4.3.3.2 Description Mean e.i.r.p.

See ETSI EN 303 883-1 [1], clause 5.3.1.1.

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

The limits for the mean e.i.r.p. requirement within the OFR, see table 3.

Table 3: Mean e.i.r.p. for BMA sub-category BMA1

Frequency Range [MHz]	Mean e.i.r.p. [mW]
2 400 to 2 483,5	25
5 725 to 5 875	25

4.3.3.4 Conformance

The conformance test for Mean e.i.r.p. shall be as defined in clause 5.4.2.

4.3.4 Indirect Emissions

4.3.4.1 Applicability

This requirement applies to the following BMA sub-categories:

- BMA2, BMA3, BMA4 and BMA5, see clause 4.2.5, table 2b.

In some frequency ranges the limit for the indirect emission depends on the used/not used mitigation techniques.

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 requirements in relation to the BMA sub-categories is provided in table 4.

Table 4: Possible applicable requirements

OFR is partly or full overlapping with frequency range [GHz]	Additional requirement for BMA without any active mitigation technique	Additional requirements for BMA implementing the mitigation technique LBT
	Sub-categories: BMA2 & BMA3	Sub-categories: BMA4 & BMA5
1,215 to 1,73		LBT see clause 4.3.7
2,5 to 2,69	TRP, see clause 4.3.6	TRP, see clause 4.3.6
		LBT see clause 4.3.7
2,69 to 2,7	DC, see clause 4.3.8	DC, see clause 4.3.8
	TRP, see clause 4.3.6	TRP, see clause 4.3.6
2,7 to 2,9		LBT see clause 4.3.7
2,9 to 3,4		LBT see clause 4.3.7
3,4 to 3,8	DC, see clause 4.3.8	DC, see clause 4.3.8
4,8 to 5,0	DC, see clause 4.3.8	DC, see clause 4.3.8
	TRP, see clause 4.3.6	TRP, see clause 4.3.6

4.3.4.2 Description Indirect Emission

See ETSI EN 303 883-1 [1], clause 5.7.

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

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

4.3.4.3 Limits for Indirect Emission

<https://standards.iteh.ai/catalog/standards/sist/346d7a7b-a1d0-4e2d-b59b-841fbc44263/etsi-en-302-065-4-1-v2-1-0-2021-07>

4.3.4.3.1 Limits for Indirect Emissions for BMA sub-categories BMA2 and BMA3

The limits for the indirect emission requirement for BMA sub-categories BMA2 and BMA3 which operate without any active mitigation techniques are listed in table 5.