



**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**

Reference

REN/ERM-TGUWB-150-4-1

Keywords

harmonised standard, SRD, UWB

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2021.
All rights reserved.

Contents

Intellectual Property Rights	6
Foreword.....	6
Modal verbs terminology.....	7
Introduction	7
1 Scope	8
2 References	8
2.1 Normative references	8
2.2 Informative references.....	9
3 Definition of terms, symbols and abbreviations.....	10
3.1 Terms.....	10
3.2 Symbols.....	11
3.3 Abbreviations	11
4 Technical requirements specifications	11
4.1 Environmental profile.....	11
4.2 EUT categories.....	11
4.2.1 General.....	11
4.2.2 Categorization by Regulation	12
4.2.3 Categorization by Modulation	12
4.2.4 Categorization by Active Mitigation Techniques	12
4.2.5 Summary BMA EUT sub-categories	12
4.3 Transmitter requirements	13
4.3.1 General.....	13
4.3.2 Operating Frequency Range (OFR).....	13
4.3.2.1 Applicability.....	13
4.3.2.2 Description Operating Frequency Range	13
4.3.2.3 Limits for Operating Frequency Range.....	14
4.3.2.3.1 Limit requirement for BMA based on UWB regulations	14
4.3.2.3.2 Limit requirement for BMA based on SRD regulations.....	14
4.3.2.4 Conformance.....	14
4.3.3 Mean e.i.r.p.....	14
4.3.3.1 Applicability.....	14
4.3.3.2 Description Mean e.i.r.p.....	14
4.3.3.3 Limits for Mean e.i.r.p.	14
4.3.3.4 Conformance.....	14
4.3.4 Indirect Emissions	14
4.3.4.1 Applicability.....	14
4.3.4.2 Description Indirect Emission.....	15
4.3.4.3 Limits for Indirect Emission	15
4.3.4.3.1 Limits for Indirect Emissions for BMA sub-categories BMA2 and BMA3	15
4.3.4.3.2 Indirect Emissions for BMA sub-categories BMA4 and BMA5	16
4.3.4.4 Conformance.....	17
4.3.5 TX Unwanted Emissions (TXUE).....	17
4.3.5.1 Applicability.....	17
4.3.5.2 Description TX unwanted emissions.....	17
4.3.5.3 Limits for TXUE.....	17
4.3.5.3.1 TXUE limit for BMA sub-categories BMA2, BMA3, BMA4 and BMA5	17
4.3.5.3.2 TXUE limit for BMA sub-category BMA1.....	18
4.3.5.4 Conformance.....	18
4.3.6 Total Radiated Power (TRP).....	18
4.3.6.1 Applicability.....	18
4.3.6.2 Description Total Radiated Power	19
4.3.6.3 Limits for Total Radiated Power.....	19
4.3.6.3.1 TRP limit for BMA sub-categories BMA2 and BMA3.....	19
4.3.6.3.2 TRP limit for BMA sub-categories BMA4 and BMA5.....	19

4.3.6.4	Conformance.....	19
4.3.7	Listen Before Talk (LBT).....	19
4.3.7.1	Applicability.....	19
4.3.7.2	Description of Listen Before Talk.....	20
4.3.7.3	Limits for Listen Before Talk.....	20
4.3.7.4	Conformance.....	20
4.3.8	Duty Cycle.....	20
4.3.8.1	Applicability.....	20
4.3.8.2	Description of Duty Cycle.....	21
4.3.8.3	Limits for Duty Cycle.....	21
4.3.8.4	Conformance.....	21
4.4	Receiver requirements.....	21
4.4.1	General.....	21
4.4.2	Wanted technical performance criteria.....	22
4.4.3	Receiver Baseline Sensitivity (RBS).....	22
4.4.3.1	Applicability.....	22
4.4.3.2	Description for the RBS requirements.....	22
4.4.3.3	Limits.....	22
4.4.3.4	Conformance.....	22
4.4.4	Receiver Baseline Resilience (RBR).....	22
4.4.4.1	Applicability.....	22
4.4.4.2	Description.....	22
4.4.4.3	Limits.....	22
4.4.4.4	Conformance.....	22
5	Testing for compliance with technical requirements.....	22
5.1	Environmental conditions for testing.....	22
5.2	General conditions for testing.....	23
5.3	Conformance test suites.....	23
5.3.1	General.....	23
5.3.2	EUT orientation and reference points.....	23
5.3.3	Test scenarios and setup for transmitter conformance tests.....	23
5.3.3.1	For BMA sub-category BMA1.....	23
5.3.3.2	For BMA sub-categories BMA2, BMA3, BMA4 and BMA5.....	24
5.4	Conformance methods of measurement for TX requirements.....	25
5.4.1	Operating Frequency Range (OFR).....	25
5.4.1.1	Specification parameter X from ETSI EN 303 883-1.....	25
5.4.1.2	OFR conformance test BMA sub-category BMA1.....	25
5.4.1.3	OFR conformance test BMA sub-categories BMA2, BMA3, BMA4 and BMA5.....	26
5.4.2	Mean e.i.r.p.....	26
5.4.3	Indirect emissions.....	26
5.4.4	TX unwanted emissions.....	28
5.4.4.1	General and specification parameter X _{TXUE} from ETSI EN 303 883-1.....	28
5.4.4.2	TXUE conformance test for BMA sub-category BMA1.....	28
5.4.4.3	TXUE conformance test for BMA sub-categories BMA2, BMA3, BMA4 and BMA5.....	28
5.4.5	Total Radiated Power (TRP).....	28
5.4.6	Listen Before Talk (LBT).....	29
5.4.7	Duty Cycle.....	30
5.5	Conformance methods of measurement for receiver.....	31
5.5.1	General for RBS and RBR conformance tests.....	31
5.5.2	RBS.....	32
5.5.2.1	RBS test for BMA category.....	32
5.5.3	RBR.....	33
5.5.3.1	RBR test for BMA category.....	33

Annex A (informative):	Relationship between the present document and the essential requirements of Directive 2014/53/EU.....	35
-------------------------------	--	-----------

Annex B (informative):	General conditions for testing, measurement uncertainty and interpretation of the measurement results.....	37
-------------------------------	---	-----------

Annex C (normative):	Definition of the representative test structure for TX measurements.....	38
-----------------------------	---	-----------

C.1	Attenuation of the TX-test structure.....	38
C.2	Procedure to measure the attenuation.....	39
C.3	Absorbing materials with lower attenuation.....	41
Annex D (normative): BMA Category: Use-Case, wanted technical performance criteria and RX-test conditions		42
D.1	Description	42
D.2	Wanted Technical Performance Criteria (WTPC) and RX - requirement.....	42
D.2.1	General	42
D.2.2	RBS-requirement and limit.....	42
D.2.3	RBR requirement and limit	43
D.3	Test-wall for RX-Measurement.....	43
D.3.1	Description test-wall for RX-measurement.....	43
D.3.2	Technical Details for RX Test-wall.....	44
D.3.2.1	Specification of the Gypsum board.....	44
D.3.2.2	Specification of the Rebar.....	44
D.3.2.3	Specification of the Wood Frame	44
Annex E (normative): Interferer for RBR test.....		45
E.1	Interferer requirements for RBR tests	45
E.1.1	General test frequencies for RBR tests.....	45
E.1.2	Test frequencies for EUT with OFR < 500 MHz	45
E.1.3	Test frequencies for EUT with OFR ≥ 500 MHz	46
E.1.4	Interferer power levels and modulation.....	46
E.2	Interferer test signals for BMA sub-category BMA1	47
E.3	Interferer test signals for BMA sub-category BMA2, BMA3, BMA4 and BMA5.....	48
E.3.1	Interferer test signals	48
E.3.2	Assessment if no interferer test signal provided at calculated test signals	49
E.4	List of interferer for RBR test; assessment procedure.....	50
E.4.1	General	50
E.4.2	Assessment list of relevant interferer	51
E.4.2.1	Basic considerations	51
E.4.2.2	Several interferer within the same frequency range.....	51
E.4.2.3	Interferer overlapping in frequency range	51
E.4.2.4	Status of interferer	52
E.4.3	Kind of interferer signal	52
Annex F (informative): Change history		53
History		54

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™** and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners. **oneM2M™** logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners. **GSM®** and the GSM logo are trademarks registered and owned by the GSM Association.

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.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).

"**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.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_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/>.
- [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".

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

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

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.

Table 5: Emission Limit for BMA sub-categories BMA2 and BMA3

Frequency range [GHz]	Maximum mean e.i.r.p. spectral density [dBm/MHz]	Maximum peak e.i.r.p. [dBm defined in 50 MHz]	Remarks
Below 1,73	-85	-45	
1,73 to 2,2	-65	-25	
2,2 to 2,5	-50	-10	
2,5 to 2,69	-65	-25	note 1
2,69 to 2,7	-55	-15	note 1, note 2, note 3
2,7 to 2,9	-70	-30	
2,9 to 3,4	-70	-30	
3,4 to 3,8	- 50	-10	note 2, note 3
3,8 to 4,8	- 50	-10	
4,8 to 5,0	-55	-15	note 1, note 2, note 3
5,0 to 5,25	-50	-10	
5,25 to 5,35	-50	-10	
5,35 to 5,6	-50	-10	
5,6 to 5,65	-50	-10	
5,65 to 5,725	-50	-10	
5,725 to 6,0	-50	-10	
6,0 to 8,5	-41,3	-0	
8,5 to 9,0	-65	-25	
9,0 to 10,6	-65	-25	
Above 10,6	-85	-45	

NOTE 1: An additional requirement on TRP applies, see clause 4.3.6.
NOTE 2: An additional requirement on DC applies, see clause 4.3.8.
NOTE 3: Reduced limits for mean e.i.r.p. spectral density do apply in case of trading DC and power according to clause 4.3.8.3, table 14.

4.3.4.3.2 Indirect Emissions for BMA sub-categories BMA4 and BMA5

The limits for the indirect emission requirement for BMA sub-categories BMA4 and BMA5 which operate with active mitigation technique LBT are listed in table 6.

Table 6: Emission Limit for BMA sub-categories BMA4 and BMA5

Frequency range [GHz]	Maximum mean e.i.r.p. spectral density [dBm/MHz]	Maximum peak e.i.r.p. [dBm defined in 50 MHz]	Remarks
Below 1,215	-85	-45	
1,215 to 1,73	-70	-30	note 3
1,73 to 2,2	-65	-25	
2,2 to 2,5	-50	-10	
2,5 to 2,69	-50	-10	note 1, note 4
2,69 to 2,7	-55	-15	note 1, note 2, note 3
2,7 to 2,9	-50	-10	note 4
2,9 to 3,4	-50	-10	note 4
3,4 to 3,8	- 50	-10	note 2, note 3
3,8 to 4,8	- 50	-10	
4,8 to 5,0	-55	-15	note 1, note 2, note 3
5,0 to 5,25	-50	-10	
5,25 to 5,35	-50	-10	
5,35 to 5,6	-50	-10	
5,6 to 5,65	-50	-10	
5,65 to 5,725	-50	-10	
5,725 to 6,0	-50	-10	
6,0 to 8,5	-41,3	0	
8,5 to 9,0	-65	-25	
9,0 to 10,6	-65	-25	
Above 10,6	-85	-45	

NOTE 1: An additional requirement on TRP applies, see clause 4.3.6.
NOTE 2: An additional requirement on DC applies, see clause 4.3.8.
NOTE 3: Reduced limits for mean e.i.r.p. spectral density do apply in case of trading DC and power according to clause 4.3.8.3, table 14.
NOTE 4: An additional requirement on LBT applies, see clause 4.3.7.

4.3.4.4 Conformance

The conformance test for indirect emission shall be as defined in clause 5.4.3.

4.3.5 TX Unwanted Emissions (TXUE)

4.3.5.1 Applicability

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

4.3.5.2 Description TX unwanted emissions

See ETSI EN 303 883-1 [1], clause 5.5.1.

4.3.5.3 Limits for TXUE

4.3.5.3.1 TXUE limit for BMA sub-categories BMA2, BMA3, BMA4 and BMA5

The TXUE for the all BMA sub-categories BMA2, BMA3, BMA4 and BMA5, see clause 4.2.5, table 2b shall be assessed based on ETSI EN 303 883-1 [1], clause 5.5.2.

- Spurious Emission:

For the spurious emissions following limit shall apply: ETSI EN 303 883-1 [1], clause 5.5.2, table 2.

- Out-Of-Band Emission:

Based in TXUE specification of 50 % (see clause 5.4.4.1) there is no OOB-domain. Therefore, an OOB domain is not applicable.

4.3.5.3.2 TXUE limit for BMA sub-category BMA1

The TXUE for this BMA sub-category BMA1 shall be assessed based ETSI EN 303 883-1 [1], clause 5.5.2.

- Spurious Emission:

For the spurious emissions following limit shall apply: ETSI EN 303 883-1 [1], clause 5.5.2, table 2 and figure 1.

- Out-Of-Band Emission:

For the OOB-domain following limit shall apply, see table 7 and figure 1.

Table 7: Limits for OOB domain

Frequency range	Maximum mean e.i.r.p. spectral density dBm/MHz
f_H	14
f_H to f_{HS}	straight line between 14 and -30 (note)
f_{HS}	-30
f_L	14
f_L to f_{LS}	straight line between 14 and -30 (note)
f_{LS}	-30

NOTE: For example the limit at $f_H + (f_{HS} - f_H)/2$ is -8 dBm/MHz; also visible in figure 1.

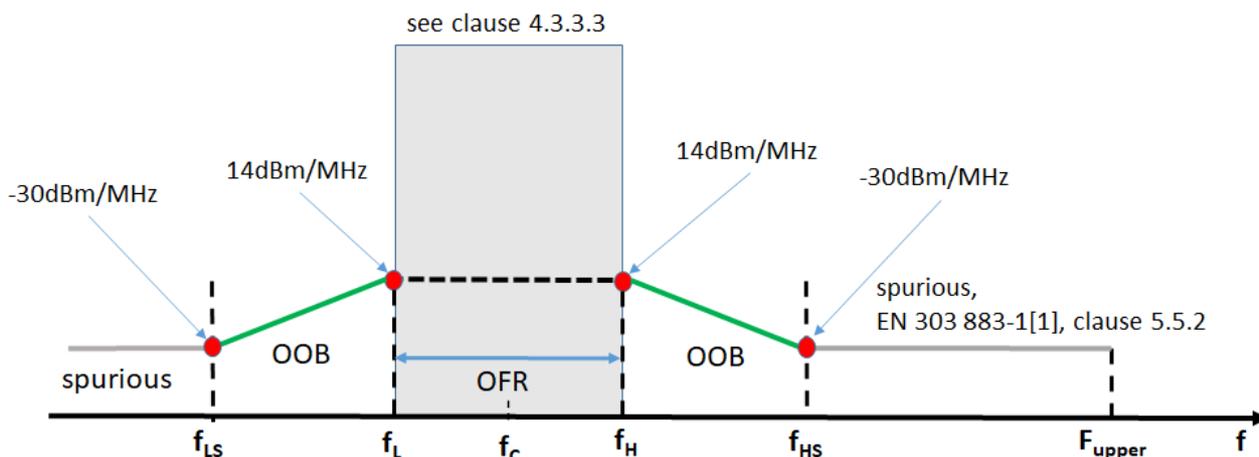


Figure 1: Overview limits for OOB and spurious domain for BMA sub-category BMA1

4.3.5.4 Conformance

The conformance test for TXUE emission shall be as defined in clause 5.4.4.

4.3.6 Total Radiated Power (TRP)

4.3.6.1 Applicability

This requirement applies to the following BMA sub-categories:

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

And the additional requirements apply:

- OFR requirement assessment is partly or fully overlapping with the frequency ranges listed in table 8
- Measured indirect emission level (see clause 4.3.4) is above the value specified in table 8

Table 8: Frequency ranges for which the TRP mitigation apply

Frequency range [GHz]	If indirect emission measurement result is above	
	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
2,5 to 2,69	-85 dBm/MHz	-45 dBm
2,69 to 2,7	-85 dBm/MHz	-45 dBm
4,8 to 5,0	-70 dBm/MHz	-30 dBm

4.3.6.2 Description Total Radiated Power

See ETSI EN 303 883-1 [1], clause 5.6.

4.3.6.3 Limits for Total Radiated Power

4.3.6.3.1 TRP limit for BMA sub-categories BMA2 and BMA3

The limits for the TRP requirement in table 9 applies for the BMA EUT covered the BMA sub-categories BMA2 and BMA3.

Table 9: TRP Limit for EUT BMA sub-categories BMA2 and BMA3

Frequency range [GHz]	Total radiated power [dBm/MHz]
2,5 to 2,69	-75
2,69 to 2,7	-65
4,8 to 5,0	-65

4.3.6.3.2 TRP limit for BMA sub-categories BMA4 and BMA5

The limits for the TRP requirement in table 10 apply for the BMA EUT covered the related BMA sub-categories BMA4 and BMA5.

Table 10: TRP Limit for EUT BMA sub-categories BMA4 and BMA5

Frequency range [GHz]	Total radiated power [dBm/MHz]
2,5 to 2,69	-60
2,69 to 2,7	-65
4,8 to 5,0	-65

NOTE: The LBT mitigation technique will be tested separately in clause 4.3.7.

4.3.6.4 Conformance

The conformance test for TRP requirement shall be as defined in clause 5.4.5.

4.3.7 Listen Before Talk (LBT)

4.3.7.1 Applicability

This requirement applies to the following BMA sub-categories:

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

And the additional requirements apply:

- OFR is partly or fully overlapping with the frequency ranges listed in table 11 and if the measured indirect emission level (see clause 4.3.4) is above the value specified in table 11.

Table 11: Frequency ranges for which LBT active mitigation technique apply

Frequency range [GHz]	If indirect emission measurement result is above	
	Maximum mean e.i.r.p. spectral density [dBm/MHz]	Maximum peak e.i.r.p. (dBm defined in 50 MHz)
1,215 to 1,73	-85	-45
2,5 to 2,69	-65	-25
2,7 to 2,9	-70	-30
2,9 to 3,4	-70	-30

4.3.7.2 Description of Listen Before Talk

See ETSI EN 303 883-1 [1], clause 5.10.1.

4.3.7.3 Limits for Listen Before Talk

The limits for the LBT requirement for the BMA sub-categories BMA4 and BMA5 are provided in table 12.

Table 12: Requirement for active mitigation technique LBT [i.2]

Frequency range [GHz]	Following LBT requirement shall be fulfilled	Test signal
1,215 to 1,73	ETSI EN 303 883-1 [1] clause 5.10.2, table 6	ETSI EN 303 883-1 [1], clause 5.10.3.4
2,5 to 2,69		ETSI EN 303 883-1 [1], clause 5.10.3.3.1
2,7 to 2,9		ETSI EN 303 883-1 [1], clause 5.10.3.3.2
2,9 to 3,4		ETSI EN 303 883-1 [1], clause 5.10.3.4

4.3.7.4 Conformance

The conformance test for LBT mitigation technique shall be as defined in clause 5.4.6.

4.3.8 Duty Cycle

4.3.8.1 Applicability

This requirement applies to the following BMA sub-categories:

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

And the additional requirements apply:

- OFR requirement assessment is partly or fully overlapping with the frequency ranges listed in table 13
- Measured indirect emission level (see clause 4.3.4) is above the value specified in table 13

Table 13: Frequency ranges for which the DC mitigation requirement apply

Frequency range [GHz]	If indirect emission measurement result is above	
	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (defined in 50 MHz)
2,69 to 2,7	-85 dBm/MHz	-45 dBm
3,4 to 3,8	-80 dBm/MHz	-40 dBm
4,8 to 5,0	-70 dBm/MHz	-30 dBm

4.3.8.2 Description of Duty Cycle

See ETSI EN 303 883-1 [1], clause 5.11.

4.3.8.3 Limits for Duty Cycle

The limits for the Duty Cycle requirement shall be as given in table 14.

Table 14: Requirement for Duty Cycle [i.2]

Frequency range [GHz]	Duty Cycle requirement	Related Maximum mean e.i.r.p. spectral density from tables 5 and 6
2,69 to 2,7	10 %/second	-55 dBm/MHz
3,4 to 3,8	10 %/second	-50 dBm/MHz
4,8 to 5,0	10 %/second	-55 dBm/MHz

According to CEPT report 45 [i.7], clause 3.1.1 and Annex 2, a trading between power and duty cycle is possible and this may give an equivalent limitation to the original limits in the regulation. Table 15 shows the resulting relaxed duty cycle requirements when reducing accordingly the mean power spectral density limits.

Table 15: Requirement for Duty Cycle trade off

Frequency range [GHz]	If indirect emission measurement assessment results (see clause 5.4.3)	Following Duty Cycle requirement apply
2,69 to 2,7	< -58 dBm/MHz	20 %/second
	< -60 dBm/MHz	30 %/second
	< -61 dBm/MHz	40 %/second
3,4 to 3,8	< -53 dBm/MHz	20 %/second
	< -55 dBm/MHz	30 %/second
	< -56 dBm/MHz	40 %/second
4,8 to 5,0	< -58 dBm/MHz	20 %/second
	< -60 dBm/MHz	30 %/second
	< -61 dBm/MHz	40 %/second

4.3.8.4 Conformance

The conformance test for DC requirement shall be as defined in clause 5.4.7.

4.4 Receiver requirements

4.4.1 General

The receiver requirements for all BMA sub-categories covered by the scope of the present document are justified in ETSI EN 303 883-2 [2], Annex C.

The requirement "Receiver Spurious Emissions", as described in ETSI EN 303 883-2 [2], clause 5.1 is not applicable for the following reasons:

- TX and RX are co-located in the same device which is typical for such radiodetermination devices (monostatic radars).
- It is impossible to put the equipment to a receive only mode.

Based on this justification following Receiver requirements apply for the EUT covered by the present document.

- Receiver Baseline Sensitivity (RBS), see clause 4.4.3.
- Receiver Baseline Resilience (RBR), see clause 4.4.4.

4.4.2 Wanted technical performance criteria

The basic wanted technical performance criteria for the all BMA EUT sub-categories covered by the present document are described in clause D.3.1.

4.4.3 Receiver Baseline Sensitivity (RBS)

4.4.3.1 Applicability

This requirement applies to all BMA sub-categories.

4.4.3.2 Description for the RBS requirements

See ETSI EN 303 883-2 [2], clause 5.4.1.

4.4.3.3 Limits

The RBS requirements for all BMA sub-categories, object distance and the kind of object and limits shall be as specified in clause D.2.2, table D.1 (object distance) and table D.2 (kind of object).

4.4.3.4 Conformance

The conformance test for all BMA sub-categories for the RBS requirement shall be as defined in clause 5.5.2.1.

4.4.4 Receiver Baseline Resilience (RBR)

4.4.4.1 Applicability

This requirement shall apply to all BMA sub-categories.

4.4.4.2 Description

See ETSI EN 303 883-2 [2], clause 5.5.1.

4.4.4.3 Limits

The RBR requirements for all BMA sub-categories, object distance, the kind of object and limits shall be as specified in clause D.2.3, table D.3 (object distance). For the object the same object as specified for the RBS test shall be used, see table D.2. The interfering signals are specified in clause E.2 for BMA1 and in clause E.3 for BMA2, BMA3, BMA4, BMA5.

4.4.4.4 Conformance

The conformance test for all BMA sub-categories for the RBR requirement shall be as defined in clause 5.5.3.1.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

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.

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.

5.2 General conditions for testing

General guidance on conditions for testing, measurement uncertainty and interpretation of the measurement results are given in Annex B.

5.3 Conformance test suites

5.3.1 General

ETSI EN 303 883-1 [1], Annex B provides additional 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.

Complementary information to the conformance tests in clause 5.4 is provided in ETSI EN 303 883-1 [1], clause 5.1.1 for TX measurements and in ETSI EN 303 883-2 [2], clause 5.1 for RX measurements.

5.3.2 EUT orientation and reference points

For all EUT covered by the BMA categories, see clause 4.2.5, table 2a and table 2b. are developed in such a way that one side need to be directed to the "building structure" for analysisation. Another side is to handle the EUT and to provide the "information" to the user, see figure 2. This information will be provided in the EUT user manual.

Clause 5.3.3.1 and clause 5.3.3.2 providing the information on test suite, orientation and the reference points for the transmitter requirement measurements in the test suite. The details are on the reference points are summarized in:

- Figure 3 (see clause 5.3.3.1) is for the EUT covered by BMA sub-category BMA1.
- Figure 4 and figure 5 (see clause 5.3.3.2) is for EUT covered by BMA sub-category BMA2, BMA3, BMA4 and BMA5.

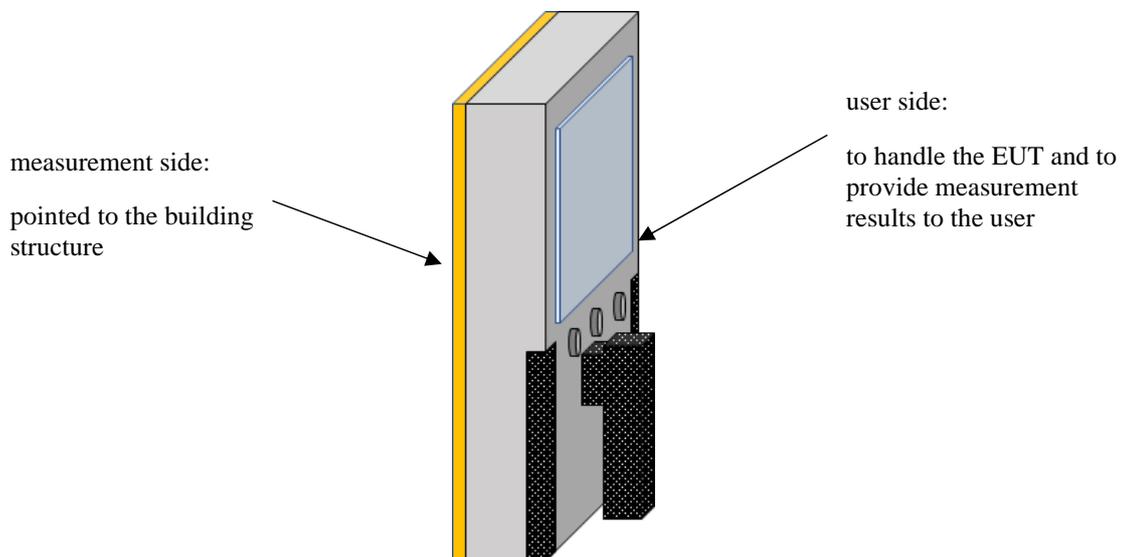


Figure 2: Example for a BMA EUT

5.3.3 Test scenarios and setup for transmitter conformance tests

5.3.3.1 For BMA sub-category BMA1

The transmitter conformance tests shall be inside a chamber, see ETSI EN 303 883-1 [1], clause B.2.2.2 (anechoic chamber) and the test setup shall be based on the standard test method as described in ETSI EN 303 883-1 [1], clause B.4. For the assessment of the measurement distance and the orientation of the EUT, see the reference point and horizontal plane in figure 3.

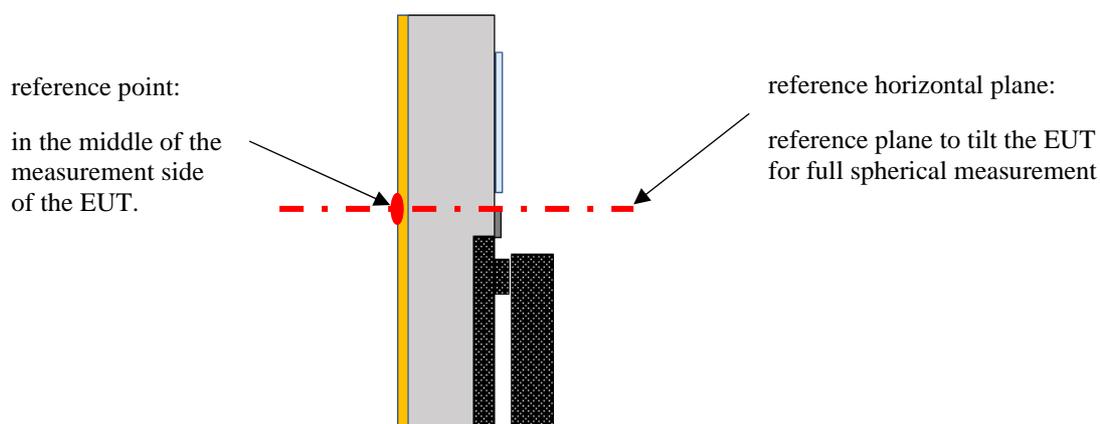


Figure 3: Reference point and horizontal plane for transmitter requirement measurements for EUT covered by sub-category BMA1

5.3.3.2 For BMA sub-categories BMA2, BMA3, BMA4 and BMA5

The transmitter conformance tests shall be inside a chamber, see ETSI EN 303 883-1 [1], clause B.2.2.2 (anechoic chamber) and the test setup shall be based on the standard test method as described in ETSI EN 303 883-1 [1], clause B.4.

Based on the requirements in ECC/DEC/(07)01 [i.1] that the EUT based on sub-category BMA2-1/2, BMA3-1/2, BMA4-1/2 and BMA5-1/2 shall be tested on a representative building structure. Based on the regulatory requirement in ECC/DEC/(07)01 [i.1] this representative structure for a TX-test structure for the conformance test of the transmitter requirements is specified in clause C.1.

The combination of the EUT and the TX-test structure is shown on figure 4. Figure 5 specifies the reference point and reference plane for the tests.

The attenuation assessment result (see clause C.2) of the TX-test structure shall be recorded.

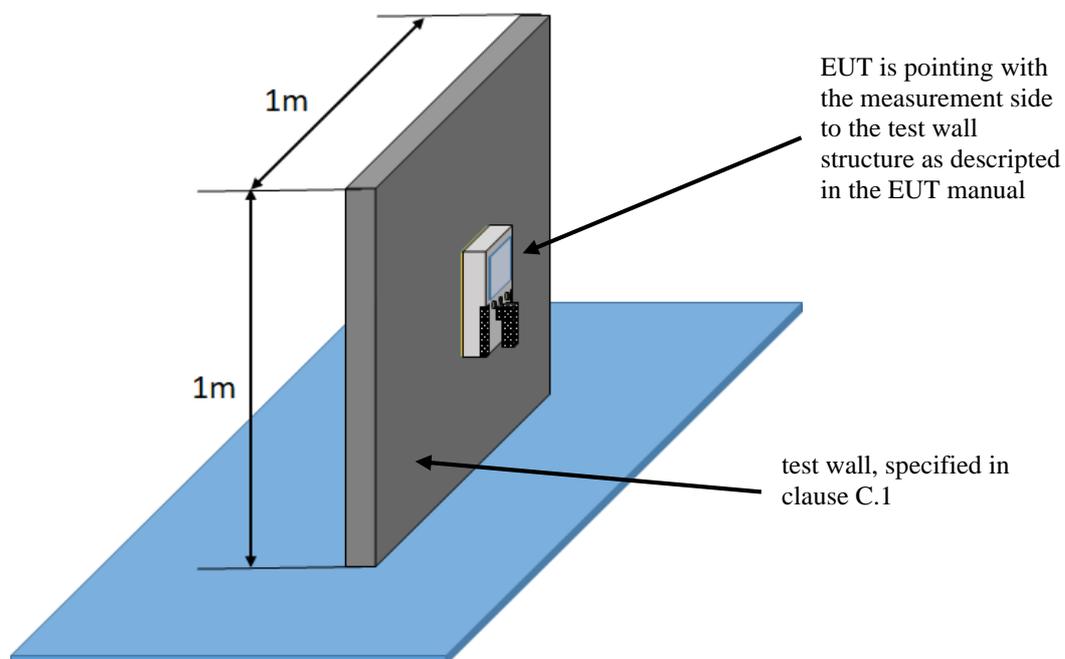


Figure 4: Test set-up for EUT covered by BMA sub-categories BMA2, BMA3, BMA4 and BMA5

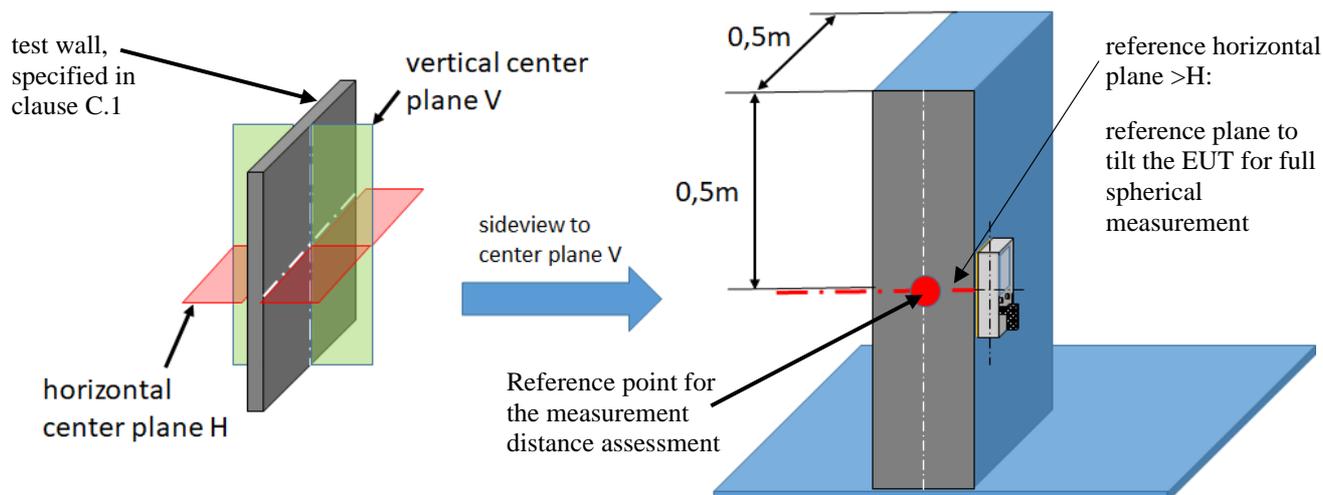


Figure 5: Reference point and horizontal plane for transmitter requirement measurements for EUT covered by BMA sub-categories BMA2, BMA3, BMA4 and BMA5

5.4 Conformance methods of measurement for TX requirements

5.4.1 Operating Frequency Range (OFR)

5.4.1.1 Specification parameter X from ETSI EN 303 883-1

As requested in ETSI EN 303 883-1 [1], clause 5.2.1 the limit for the parameter X for EUT covered by the sub-category BMA1 is specified to:

X:	23
----	----

As requested in ETSI EN 303 883-1 [1], clause 5.2.1 the limit for the parameter X for EUT covered by the sub-category BMA2, BMA3, BMA4 and BMA5 is specified to:

X:	10
----	----

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.9].

The value for the parameter X shall be noted in the test report in relation to the of the EUT category.

5.4.1.2 OFR conformance test BMA sub-category BMA1

For the OFR conformance test the set-up as specified in clause 5.3.3.1 shall be used.

OFR measurement should be done in the direction with the highest mean e.i.r.p. emission (see clause 4.3.3) using the conformance test in ETSI EN 303 883-1 [1], clause 5.2.2 in combination with mean e.i.r.p. conformance test (see clause 5.4.2).

For the OFR conformance assessment, at the direction of the highest mean e.i.r.p., the conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.2.2 shall be used.

The measurement distance d is specified from the reference point (as specified in clause 5.3) to the test antenna.

For the measurement distance $d = 3$ m shall be used.

The measured results of the OFR shall be recorded.

5.4.1.3 OFR conformance test BMA sub-categories BMA2, BMA3, BMA4 and BMA5

For the OFR conformance test the set-up as specified in clause 5.3.3.2 shall be used.

OFR measurement should be done in the direction of the highest radiated emissions of the indirect emission (see clause 4.3.4 and figure 6) using the conformance test in ETSI EN 303 883-1 [1], clause 5.2.2.

The measurement distance d is specified from the reference point (as specified in clause 5.3.3.2 and figure 5) to the test antenna. For the measurement distance $d = 3$ m shall be used. If based on the low emission levels of EUT under these sub-categories (UWB technology) a smaller measurement distance d is necessary, then the range length assessment as described in ETSI EN 303 883-1 [1], clause B.2.3.5 shall be used.

A visualization of the OFR conformance assessment is shown in figure 6.

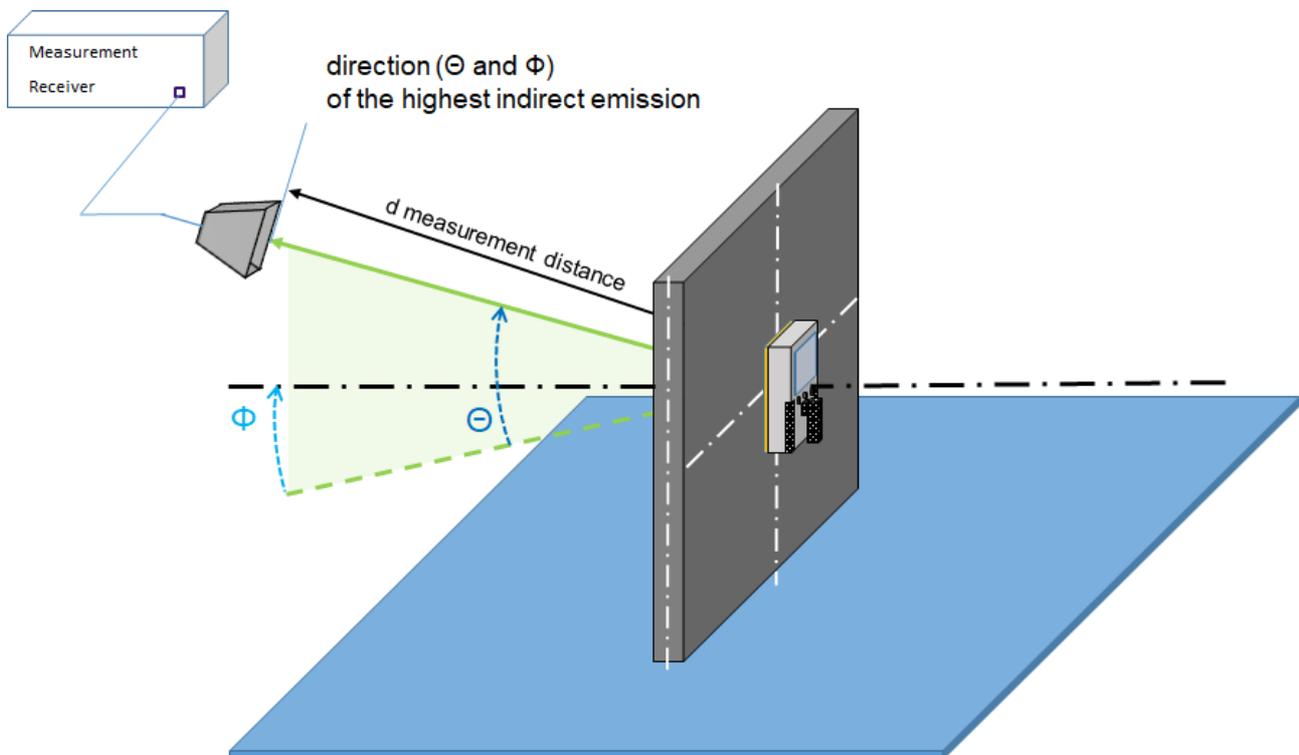


Figure 6: OFR conformance test assessment

The measured results of the OFR shall be recorded.

5.4.2 Mean e.i.r.p.

For the mean e.i.r.p. conformance test the set-up as specified in clause 5.3.3.1 and the conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.3.1.3 shall be used.

The measured results of the mean e.i.r.p. and the measurement distance shall be recorded.

5.4.3 Indirect emissions

For the indirect emissions conformance test the set-up as specified in clause 5.3.3.2 shall be used.

The measurement distance d is specified from the reference point (as specified in clause 5.3) to the test antenna. For the measurement distance $d = 3$ m shall be used. If based on the low emission levels of EUT a smaller measurement distance d is necessary, then the range length assessment as described in ETSI EN 303 883-1 [1] clause B.2.3.5 shall be used.

The complete set-up is shown in figure 7.

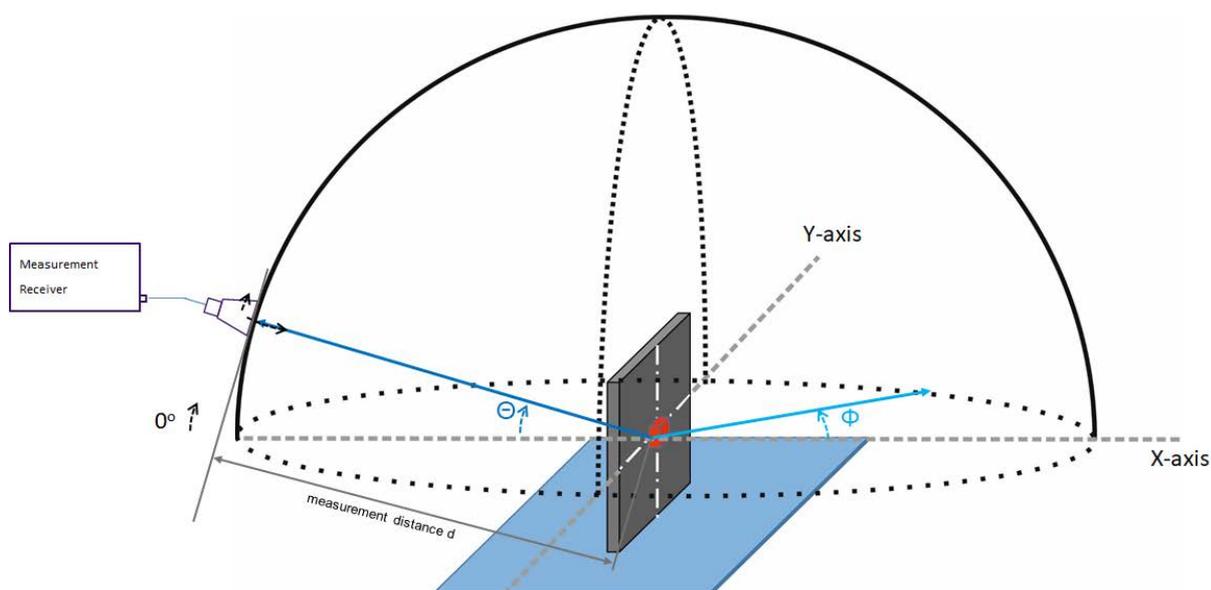


Figure 7: Set-up for indirect emission conformance assessment

For a full spherical assessment, the EUT need to be turned by 180 degrees around the horizontal plane H (see figure 5 and ETSI EN 303 883-1 [1], clause B.4).

For angular steps $\Delta\Theta$ and $\Delta\Phi$ a value of 15 degrees shall be used.

The applicable conformance test procedures are provided for mean power spectral density in table 16 and for peak power in table 17.

Table 16: Conformance test procedure for the mean power spectral density limit

EUT sub-category	Conformance test procedure	Signal repetition time assessment
BMA2 and BMA4	ETSI EN 303 883-1 [1], clause 5.3.2.4 and signal repetition time assessment	ETSI EN 303 883-1 [1], clause C.3
	ETSI EN 303 883-1 [1], clause 5.3.2.3 without signal repetition time assessment	Not applicable
BMA3 and BMA5	ETSI EN 303 883-1 [1], clause 5.3.2.3	
NOTE 1: ETSI EN 303 883-1 [1], clause 5.4 and Annex D, are providing guidance how to differentiate between emissions in the scope of the present document (article 3.2 of Directive 2014/53/EU [i.6]) and other sources (e.g. EMC).		
NOTE 2: For the step 2 as described in ETSI EN 303 883-1 [1], clause D.3 the conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.3.2.3 shall be used.		

Table 17: Conformance test procedure for peak power spectral density limit

EUT sub-category	Conformance test procedure
BMA2 and BMA4	ETSI EN 303 883-1 [1], clause 5.3.4.2
	ETSI EN 303 883-1 [1], clause 5.3.4.3 (note)
BMA3-1/2 and BMA5-1/2	ETSI EN 303 883-1 [1], clause 5.3.4.2
NOTE: This procedure is only applicable if one spectral line applies within 50 MHz. Therefore, the assessment procedure in ETSI EN 303 883-1 [1], Annex E and the measurement of the mean power spectral density (see table 16) shall be used.	

The measured results of the indirect emissions and the measurement distance shall be recorded.

5.4.4 TX unwanted emissions

5.4.4.1 General and specification parameter X_{TXUE} from ETSI EN 303 883-1

The specific sub-category dependent conformance test for:

- TX unwanted emission conformance test for EUT covered by sub-categories listed in table 2a (SRD regulation), see clause 5.4.4.2.
- TX unwanted emission conformance test for EUT covered by sub-categories listed in table 2b (UWB regulation), see clause 5.4.4.3.

As requested in ETSI EN 303 883-1 [1], clause 5.5.1 the limit for the parameter X_{TXUE} for EUT covered by [1] the sub-categories listed in table 2a is specified to:

X_{TXUE} :	250 %
--------------	-------

As requested in ETSI EN 303 883-1 [1], clause 5.5.1 the limit for the parameter X_{TXUE} for EUT covered by the sub-categories listed in table 2b is specified to:

X_{TXUE} :	50 %
--------------	------

5.4.4.2 TXUE conformance test for BMA sub-category BMA1

For the TX unwanted emission conformance test the set-up as specified in clause 5.3.3.1 and the conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.5.3 shall be used.

NOTE: There are different limits specified for the out-of-band and spurious domain, see clause 4.3.5.3.2.

For the measurement distance d , the same distance than for the mean e.i.r.p. conformance test shall be used (see clause 5.4.2).

The measured results of the TX unwanted emission measurement shall be recorded.

5.4.4.3 TXUE conformance test for BMA sub-categories BMA2, BMA3, BMA4 and BMA5

For the TX unwanted emission conformance test the set-up as specified in clause 5.3.3.2 and the conformance test procedure as specified in ETSI EN 303 883-1 [1], clause 5.5.3 shall be used.

For the measurement distance d , the same distance than for the indirect emission conformance test shall be used.

The measured results of the TX unwanted emission measurements shall be recorded.

5.4.5 Total Radiated Power (TRP)

The Total Radiated Power (TRP) assessment shall be based on indirect emissions conformance test results, see clause 5.4.3.

For the TRP conformance test the procedure specified in ETSI EN 303 883-1 [1], clause 5.6.2 shall be used (see clause 5.4.3).

For angular steps $\Delta \Theta$ and $\Delta \Phi$ a value of 15 degrees shall be used.

The calculated results of the total radiated power shall be recorded.

5.4.6 Listen Before Talk (LBT)

For the Listen Before Talk conformance test the set-up as specified in clause 5.3.3.2 shall be used. The signal source with the related test antenna to generate the victim signal shall be placed in the direction of the highest indirect emission (for the LBT frequency ranges) and the test antenna shall be pointing to the test wall. The test antenna shall be placed in centreline of the test wall. The arrangement of the test set-up is shown in figure 8.

NOTE: For each LBT frequency range (see clause 4.3.7, table 11) the direction of the highest indirect emission could be different, see indirect emission conformance test (clause 5.4.3).

For the LBT conformance test the procedure specified in ETSI EN 303 883-1 [1], clause 5.10.3 shall be used.

The reference point for the assessment of the power level at the EUT (th) is shown in figure 9.

For test signal in Bands 1 and 4 (see ETSI EN 303 883-1 [1], clause 5.10.3.4) a test signal with more than 5 pulses can be used if the requirement: "switch off within 10 ms" after the 5th pulse of the test signal is fulfilled.

The assessed power levels (thl), related distance d and direction (see figure 8) and the LBT detection result shall be recorded.

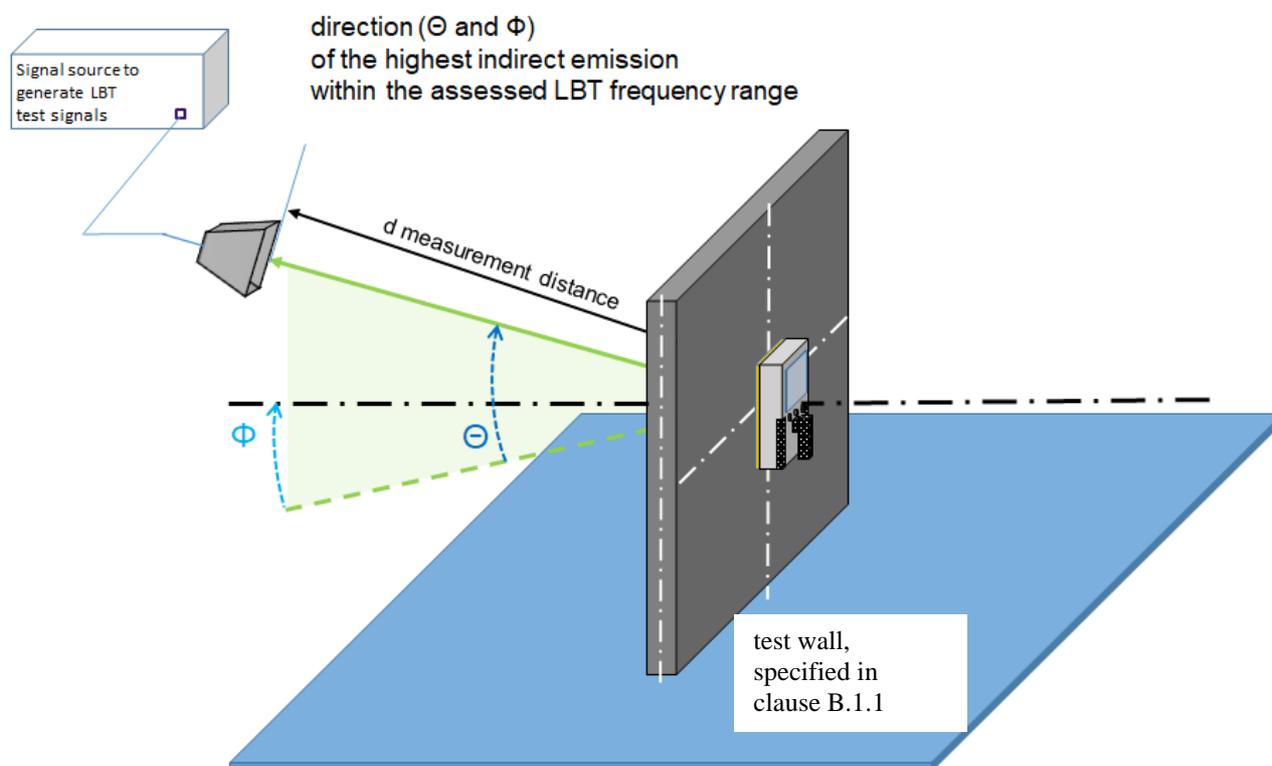


Figure 8: Set-up for LBT conformance test

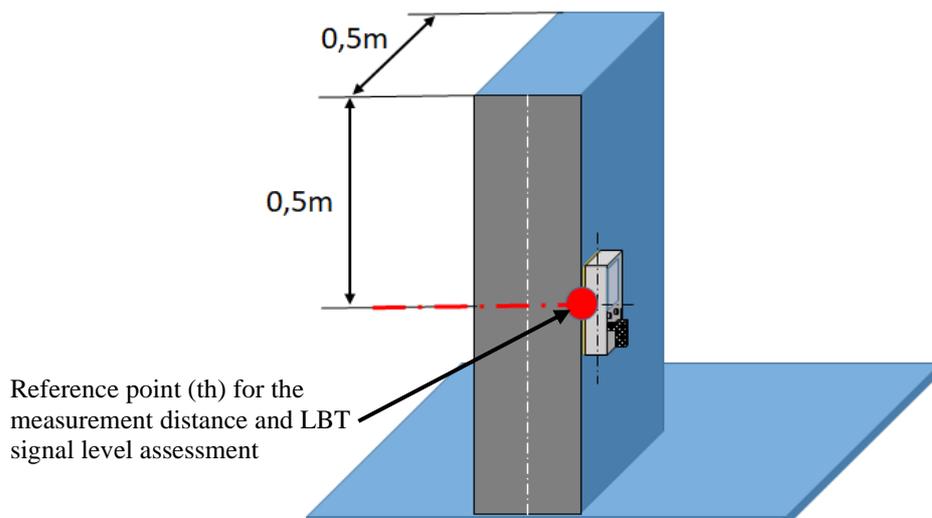


Figure 9: Reference point (th) for the LBT measurement and for the assessment of the LBT test signal level (thl)

If the antenna for LBT test signal is pointing from the backside of the test wall to the EUT (see figure 8), the attenuation of the test wall needs to be considered for the calculation of the LBT victim power at the EUT. For such situations formula (22) of ETSI EN 303 883-1 [1], (see clause B.2) needs to correct by the wall attenuation:

$$thl = p_{\text{victim}} + g_A - 20 \times \log \left(4 \times r \times \pi \times \frac{f}{c_0} \right) - g_{\text{wall}}$$

with:

- g_{wall} attenuation of the test structure for TX measurements; in [dB].

5.4.7 Duty Cycle

For the Duty Cycle conformance test the set-up as specified in clause 5.3.3.2 shall be used.

The measurement receiver with the related measurement antenna shall be placed on the backside of the test and the measurement antenna shall be pointing to the test wall. The measurement antenna shall be placed in the direction of highest indirect emission within the frequency range which shall be assessed for the duty cycle.

Each frequency range with a DC requirement (see clause 4.3.8.3) shall be assessed separately. The arrangement of the test set-up is shown in figure 10.

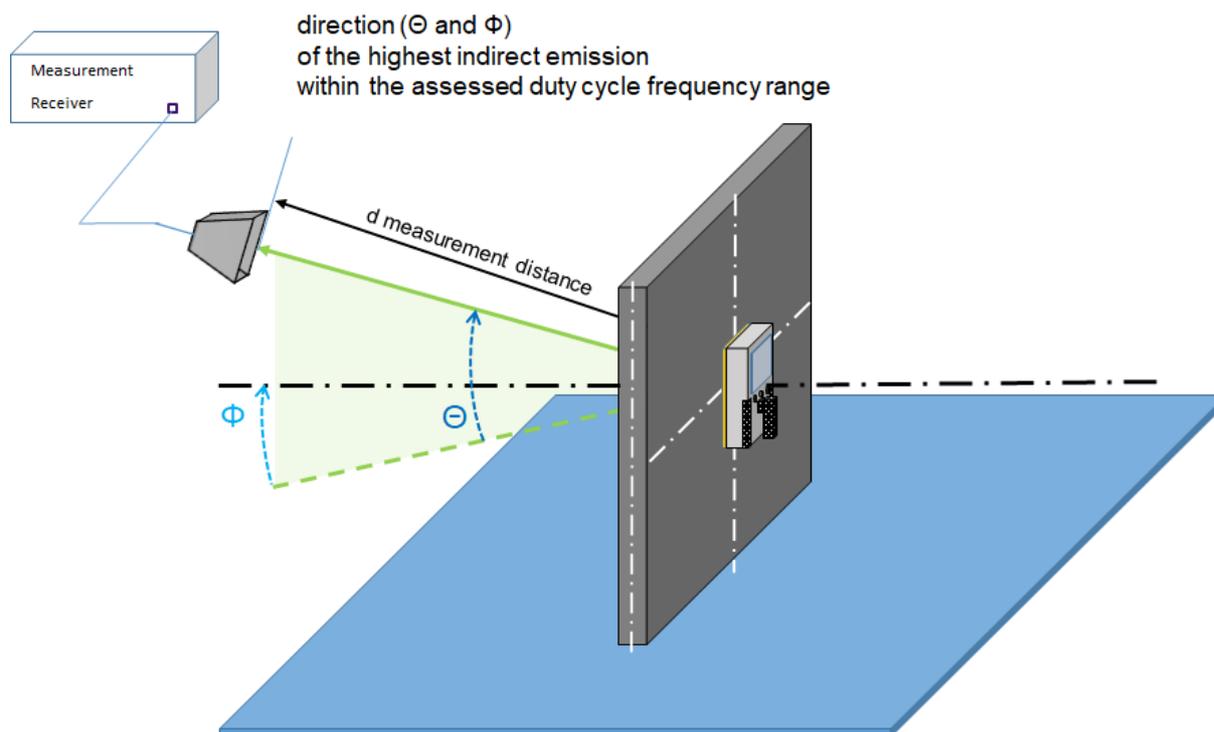


Figure 10: Set-up for Duty Cycle conformance test

NOTE: Duty Cycle conformance assessment is only necessary in the direction of the highest indirect emission, because with this test the nature of the TX-signal will be tested and not the complete emission of the EUT (see clause 5.4.3).

For the Duty Cycle conformance test the procedures as listed in table 18 shall be used. For the measurement distance d , the same distance than for the indirect emission conformance test shall be used (see clause 5.4.3).

Table 18: Conformance test procedure for the DC limit

EUT sub-category	Conformance test procedure	replaceable test procedure
BMA2 and BMA4	ETSI EN 303 883-1 [1], clause 5.11.2.4	
BMA3 and BMA5	ETSI EN 303 883-1 [1], clause 5.11.2.1	ETSI EN 303 883-1 [1], clause 5.11.2.2

The threshold level P_{Thresh} shall be set to 10 dB below the measured indirect emission (see clause 5.4.3) in the DC measurement direction (see figure 10).

The measured results of the Duty Cycle shall be recorded.

5.5 Conformance methods of measurement for receiver

5.5.1 General for RBS and RBR conformance tests

BMA EUT equipment in the scope of the present document have to be moved over the wall/building structure to detect objects inside the structure.

To perform the receiver tests the handling has to simulate an intended operation. Therefore, the RX-test shall be performed like a "normal" intended use as described for the intended use in the EUT user manual.

For this purpose, a test person/operator shall use the device on the specified test wall (see Annex D).

NOTE: To get experience "how" to handle such EUT and in which way the user interface is implemented (e.g. to provide the measurement results to the use) the test person/operator normally runs 5 tests on the test wall (performed before the conformance tests).

5.5.2 RBS

5.5.2.1 RBS test for BMA category

For all EUT covered by the BMA category (designed to detect the location of objects within a building structure), see clause 4.2.5, table 2a and table 2b, the RX-test structure as specified in clause D.3.1 shall be used.

The test object (see table D.2) shall be placed at the distance R_{DS} (see table D.1) for each BMA sub-category inside the RX-test wall (see clause D.3.1) The set-up is shown in figure 11.

NOTE 1: The RBS procedure is similar to the procedure as described in ETSI EN 303 883-2 [2], clause 5.4.3.5.3.

Test Procedure:

- Step 1: Place (as described in the user manual) the EUT onto the RX-test structure (left from the test object).
- Step 2: Perform the measurement to locate the object inside the RX-test structure with the EUT as described in the user manual.
- Step 3: The test person/operator shall check if the object was detected and the information provided by EUT are in accordance with the user manual.
- Step 4: Assess the measurement procedure result.

To pass the test:

- The test object shall be detected at least in 2 of 3 test procedures.

NOTE 2: Detect means: the BMA EUT was able to detect and provide the info about the object inside the RX-test structure to the test operator.

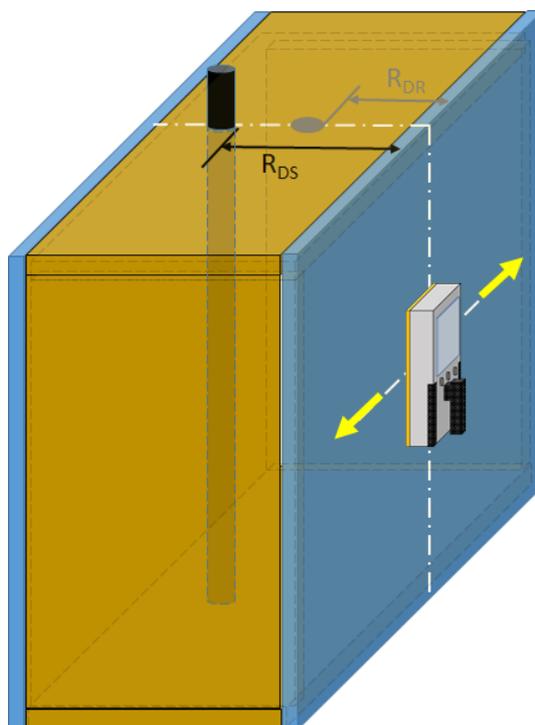


Figure 11: RBS conformance set-up for BMA EUT designed to detect the location of objects within a building structure

5.5.3 RBR

5.5.3.1 RBR test for BMA category

For all EUT covered by the BMA EUT sub-categories (designed to detect the location of objects within a building structure), see clause 4.2.5, table 2a and table 2b, the RX-test structure as specified in clause D.3.1 shall be used.

The object (see table D.2) shall be placed at the distance R_{DR} (see table D.3) for each BMA sub-category inside the RX-test structure as specified for each BMA EUT sub-category. The set-up is shown in figure 12.

NOTE 1: The RBR procedure is similar to the procedure described in ETSI EN 303 883-2 [2], clause 5.5.3.5.

Test Procedure:

Step 1: Assessment of the interfering signals for RBR test:

- take OFR and f_c from the OFR measurement, see clause 5.4.1;
- for the interferer information (frequency, signal, power), see clause E.2 for BMA1 and clause E.3 for BMA2, BMA3, BMA4 and BMA5;
- consider for the interferer assessment the LBT requirement. If the test frequency assessment would consider the same interferer which was tested during the LBT requirement this interferer is not applicable for the RBR test. If the LBT requirement was passed the EUT will not operate as intended (EUT will be not able to detect the object, because if signal is detected the EUT is not allowed to transmit), see LBT requirement description in ETSI EN 303 883-1 [1], clause 5.10.1.

Step 2: Arrange the set-up with the RX-test structure (see RBS test), a signal generator for the interfering signals and a test antenna to radiate the interfering signal to the RX-test scenario(see figure 12). Set the output power of the signal generator so that the interfering power level at the EUT from Annex E are fulfilled; use the guidance provided in ETSI EN 303 883-2 [2], clause A.3 to calculate the output power of the signal generator.

Step 3: Switch on Interferer source with one interferer signal as assessed in step 1.

Step 4: Place (as described in the manual) the BMA EUT onto the RX-test structure (left from the object).

Step 5: Perform the measurement procedure to locate the object inside the RX-test structure with the BMA EUT as described in the EUT manual.

Step 6: After the measurement procedure the test operator shall check the information on the EUT if the object was detected and the information provided from EUT is similar as specified in the device manual.

Step 7: Assess the measurement procedure result.

To pass the test:

- The EUT shall operate as intended at least in 2 of 3 test procedures (see manual of the EUT),

NOTE 2: Operate as intended means:

- either the BMA EUT was able to detect and provide the info about the specified test object inside the RX-test structure to the test operator; or the BMA EUT was not able to detect the specified test object inside the RX-test structure under the presence of the interferer, but the EUT provides information to the operator (as described in the manual) that the measurement was not valid.

Step 8: Repeat from step 3 for each interfering signal assessed in step 1.

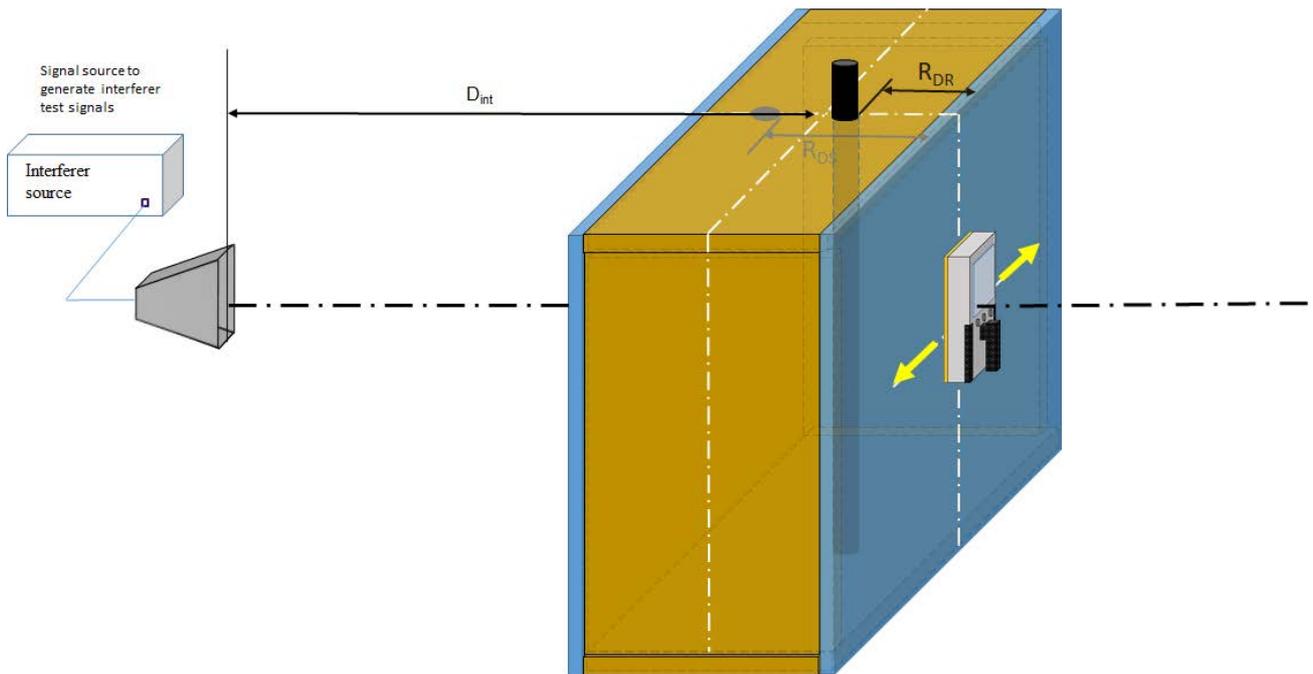


Figure 12: RBR conformance set-up for BMA EUT designed to detect the location of objects within a building structure

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.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.

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

Harmonised Standard ETSI EN 302 065-4-1					
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	Mean e.i.r.p.	3.2	4.3.3	C	All EUT sub-categories based on the SRD regulation
3	Indirect Emissions	3.2	4.3.4	C	All EUT sub-categories based on the UWB regulation
4	TX Unwanted Emissions (TXUE)	3.2	4.3.5	U	
5	Total Radiated Power (TRP)	3.2	4.3.6	C	All EUT sub-categories based on the UWB regulation
6	Listen Before Talk (LBT)	3.2	4.3.7	C	All EUT sub-categories based on the UWB regulation and implemented active mitigation LBT
7	Duty Cycle	3.2	4.3.8	C	All EUT sub-categories based on the UWB regulation
8	Receiver Baseline Sensitivity (RBS)	3.2	4.4.3	U	
9	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): General conditions for testing, measurement uncertainty and interpretation of the measurement results

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 additional 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.

Annex C (normative): Definition of the representative test structure for TX measurements

C.1 Attenuation of the TX-test structure

ECC/DEC(07)01 [i.1] provides the following definition of a representative test structure: "The radiations into the air as a result of the operation of material sensing devices are highly dependent on the operational conditions and are only meaningful if coupled with the material being investigated; therefore a measurement scenario with a representative structure is necessary and is defined within the related document for material sensing devices investigating wall structures; the representative wall has to meet the wall attenuation values within table 4 of this Decision ECC/DEC(07)01 [i.1]". The wall attenuation values from [i.1] are given in table C.1.

Table C.1: Representative TX-test structure attenuation values

Frequency (GHz)	Attenuation values for the representative test structure in dB		
	Minimum	average	maximum
1	5	7,00	9,00
2	8	10,00	12,00
3	10	12,00	14,00
4	12	14,00	16,00
5	14	16,00	18,00
6	16	18,00	20,00
7	18	20,00	22,00
8	20	22,00	24,00

If the attenuation of the TX-test structure is lower than the minimum value given in table C.1 the provisions of clause C.3 apply.

The size of the representative wall shall be 1×1 meter, see figure C.1.

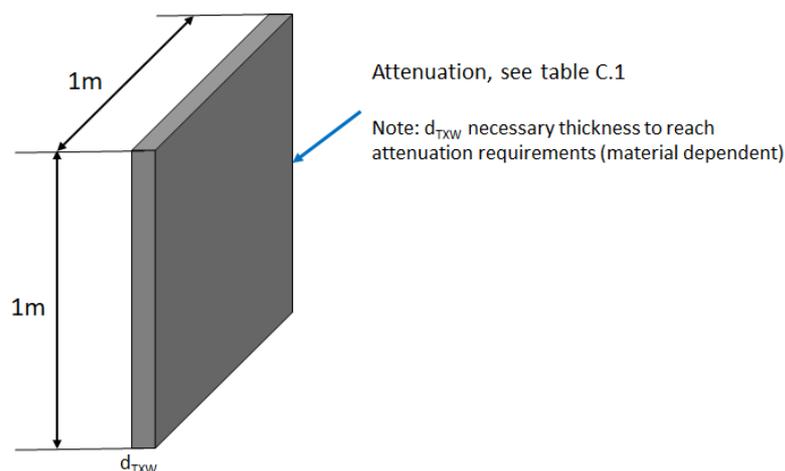


Figure C.1: Dimensions test wall

C.2 Procedure to measure the attenuation

The measurement principle is shown in figures C.2 and C.3. The measurement of the attenuation of the representative structure shall be inside an anechoic chamber, see ETSI EN 303 883-1 [1] clause B.2.2.2.

In a first step, calibration is performed using the setup shown in figure C.2.

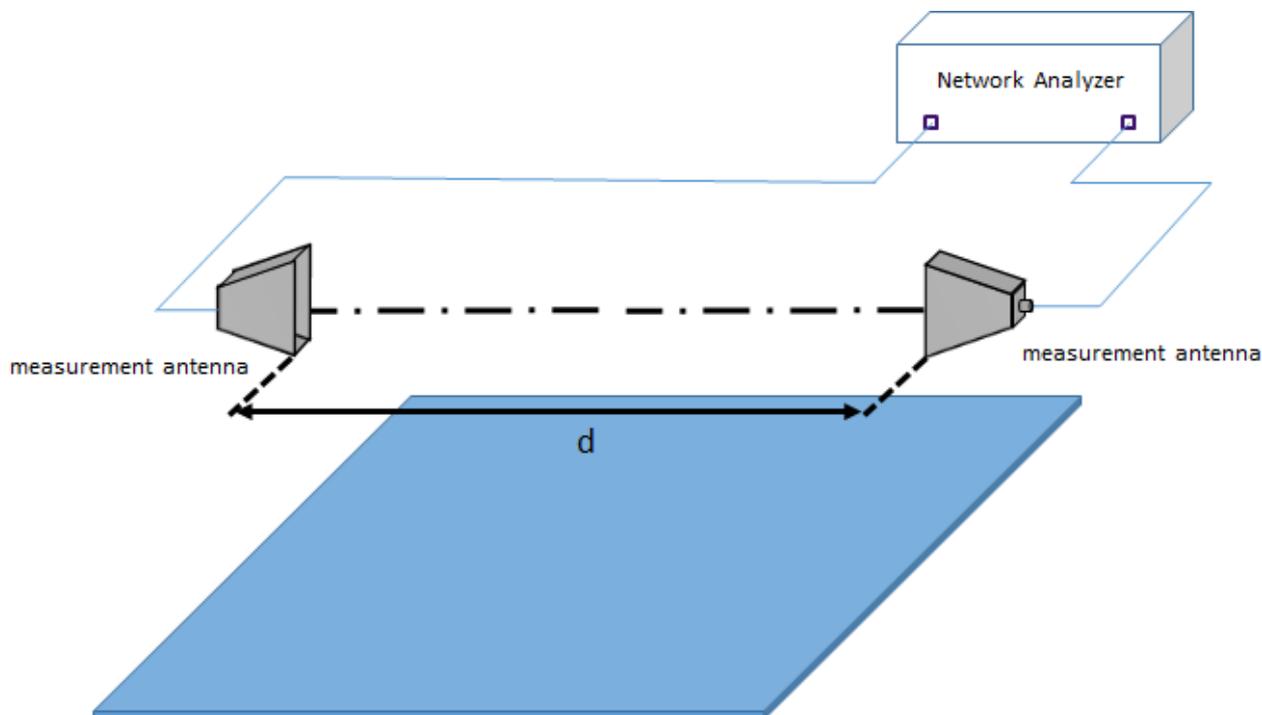


Figure C.2: Calibration setup

It is important that the antenna main beam of both measurement antennas are exactly aligned to each other and the distance (d) between the two identical antennas shall be larger than $2 \times$ minimal far field distance (see ETSI EN 303 883-1 [1] clause B.2.3.5).

The beamwidth "ant_beam" of the measurement antennas shall be lower than:

$$ant_beam < 2 * \arctan\left(\frac{size_of_wall}{d}\right) \quad (C.1)$$

Calibration Steps:

- 1) Set the start and stop frequencies of the network analyser to f_L and f_H as derived from the OFR measurements (see clause 4.3.2) The frequency range depends on the measurement antennas.
- 2) Calibrate the system in the S21 Mode.

After calibration of the setup, the representative wall shall be placed between the two antennas, with $d_1 = d_2$, see figure C.3.

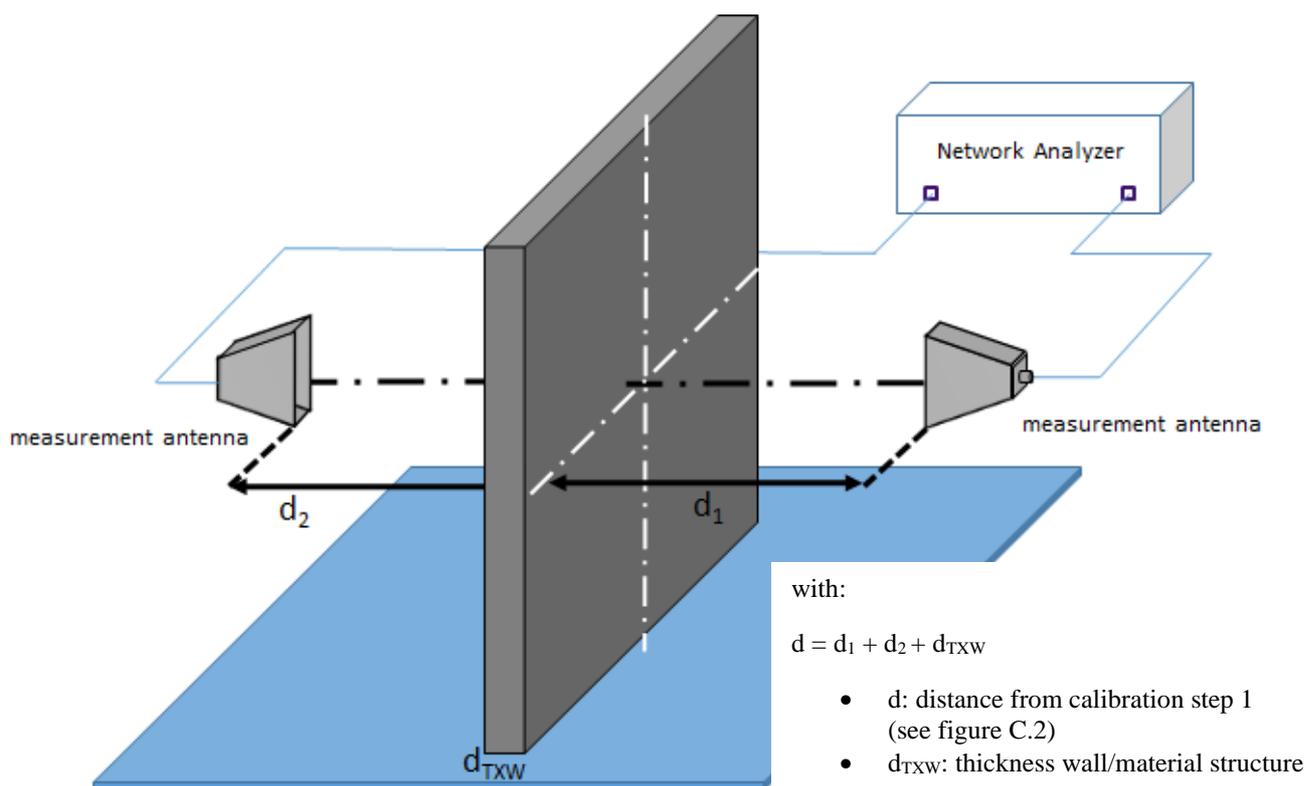


Figure C.3: Attenuation measurement of the wall/material structure

The network analyser shows now the attenuation of the wall (g_{wall}) in dB.

The network analyser shall then be used with the time gating option. This is important because with this option it is possible to obtain the necessary signal parts for the attenuation measurement (more signal components or more signal reflexions can yield to wrong results).

Other setups can be used if the presented method in this clause is not feasible for the typical absorbing material used for the measurements of the devices under test.

An example of a measurement result of a representative wall, as described in clause C.1 is shown in figure C.4.

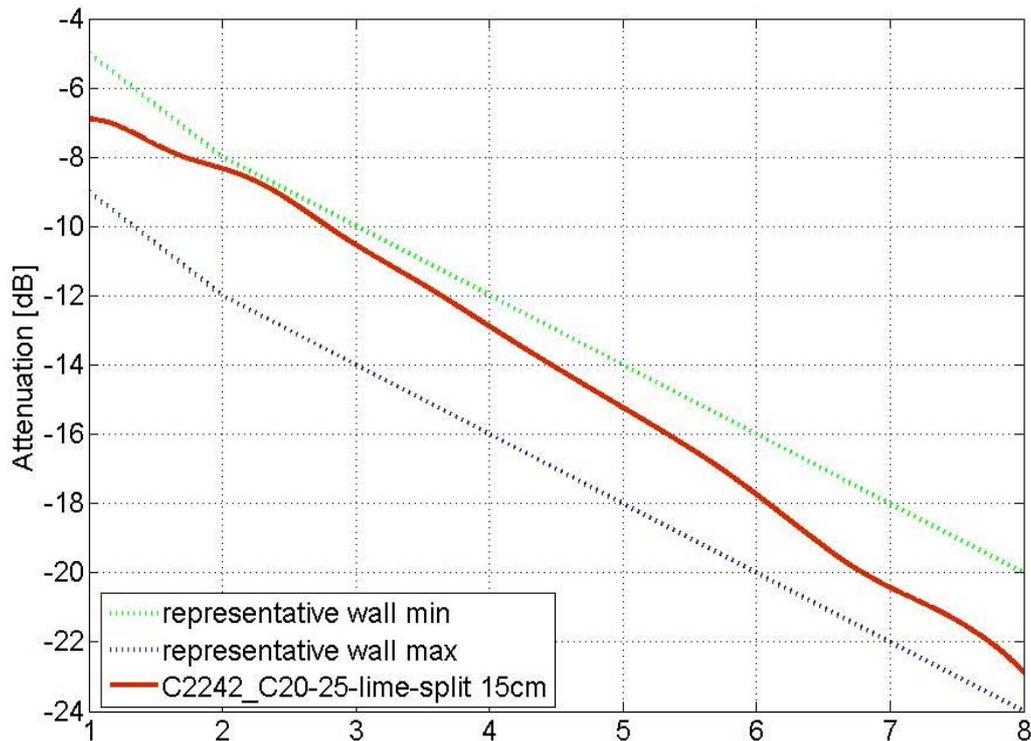


Figure C.4: Typical result for a typical absorbing material, here as example: concrete as specified in DIN EN 206 [i.11] with a thickness d_{TXW} of 15 cm

C.3 Absorbing materials with lower attenuation

For other absorbing material the attenuation characteristics as exemplified in table C.1 of the representative TX-test structure used in the measurements specified in the present document shall match the characteristics of the typical target absorbing material. Justifications shall be provided in the test report.

If it is impractical to match the absorption characteristics for the TX-test structure, lower attenuation values can be utilized.

In this case:

- for the indirect emission requirement, the limit values in clause 4.3.4; and
- for the total power requirement, the limit value in clause 4.3.6 can be increased by the difference between the real attenuation of the TX-test structure (see clause C.2) and requested average attenuation values, see table C.1;
- for the DC conformance assessment (see clause 4.3.8), the limit values for the indirect emissions can be increased by the difference between the real attenuation of the TX-test structure (see clause C.1.2) and requested average attenuation values, see table C.1.

Higher attenuation values than requested in table C.1 are not permitted.

Annex D (normative): BMA Category: Use-Case, wanted technical performance criteria and RX-test conditions

D.1 Description

The Building Material Analysis (BMA) category covered by this Annex D are designed to detect the location of objects within a building structure.

NOTE 1: More details for this EUT use-case category is provided in ETSI TR 102 495-1 [i.5].

NOTE 2: The measurement procedure/handling of the device is explained in the user-manual of the EUT.

D.2 Wanted Technical Performance Criteria (WTPC) and RX - requirement

D.2.1 General

The minimum requirement for all BMA EUT shall be to detect a specified object within the specified test-wall (see clause D.3).

This object detection performance offers the possibility to implement additional operational functions into the EUT (e.g. object separation, object depth information). The performance of these additional functions is based on the mode (SRD or UWB) but require the basic detection possibility of the hidden object as specified in the present document.

Therefore, the wanted technical performance criteria for all EUT is the detection of a specified object within a specified RBS scenario (clause D.2.2) and an RBR scenario (clause D.2.3).

D.2.2 RBS-requirement and limit

The limits for the distance (R_{DS}) of the object are provided in table D.1, the kind of object is specified in table D.2.

Table D.1: Requirement for object distance (R_{DS}) for the RBS test

BMA sub-category	R_{DS} [cm]
BMA1	5
BMA2, BMA3, BMA4 and BMA5	7

NOTE 1: The distance is based on typical detection depths for EUT on "unknown" or "light construction" building structure. For some specific scenarios as deeper detection could be possible, but this is EUT specific. The specified light construction wall is for the object detection the worst-case scenario (wave propagation, multi reflection) and therefore provides the worst case.

Table D.2: Requirement for kind of object for RBS test

BMA sub-category	kind
BMA1	Steel rebar, 12 mm diameter
BMA2, BMA3, BMA4 and BMA5	Steel rebar, 12 mm diameter

For the detailed specification of the object, see clauses D.3.1 and D.3.2.2.

NOTE 2: ETSI EN 303 883-2 [2] allows for RBS requirement a scaling of the limit. The present document will not consider scaling for the RBS requirement.

D.2.3 RBR requirement and limit

Based on the specified RBS scenario (see clause D.2.2) and the related RBR requirement, ETSI EN 303 883-2 [2], clause 5.4.1, the limits for the distance (R_{DR}) for the RBR test are provided in table D.3.

Table D.3: Requirement for object distance R_{DR} for RBR test

BMA sub-category	R_{DR} [cm]
BMA1	3,5
BMA2, BMA3, BMA4 and BMA5	4,5

NOTE: ETSI EN 303 883-2 [2] allows for RBR requirement a scaling of the limit. The present document does not consider scaling for the RBR requirement.

D.3 Test-wall for RX-Measurement

D.3.1 Description test-wall for RX-measurement

The test-wall for the assessment of the RX-requirements shall be set-up as described in figure D.1. The test wall consists of the following parts:

- Envelope with wood frame (see clause D.3.2.3) and two gypsum boards (see clause D.3.2.1)
- Two holes in the wood frame for the rebar at distance R_{DS} (see clause 4.4.3.3) and R_{DR} (see clause 4.4.4.3)
- Rebar (see clause D.3.2.2)

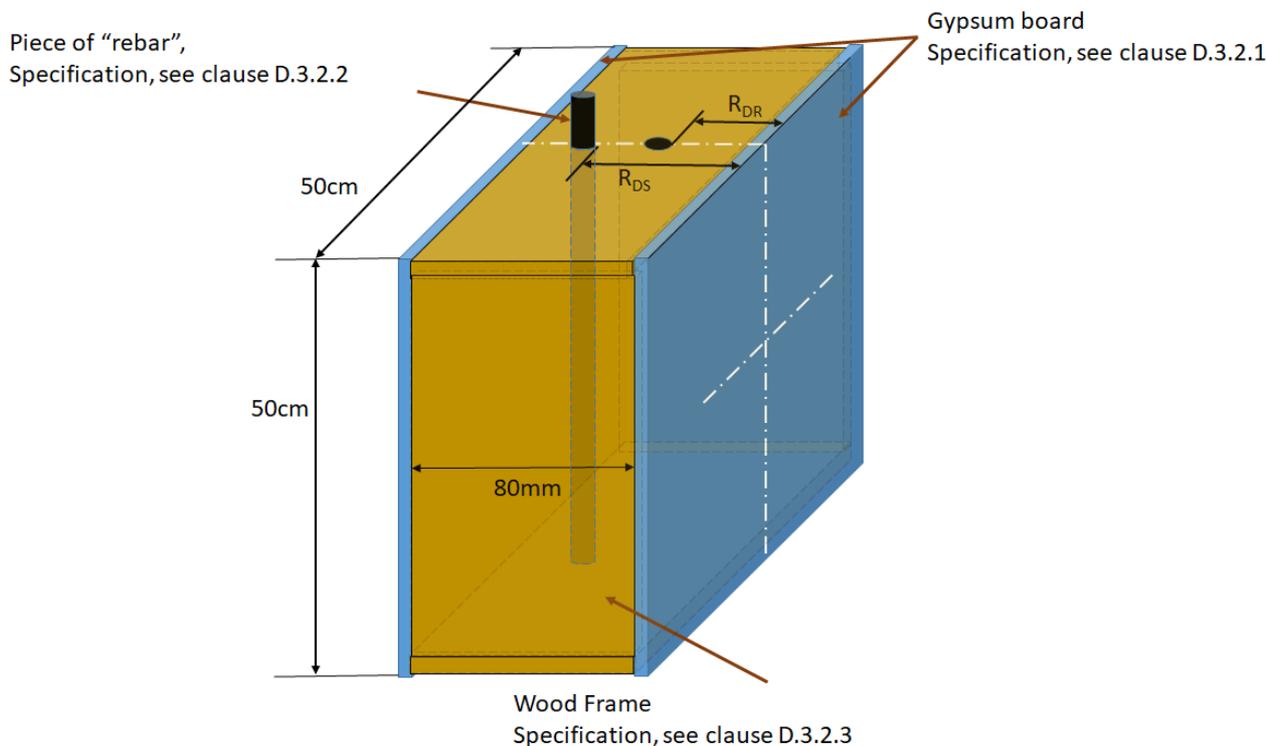


Figure D.1: Test-wall for RX-assessment

D.3.2 Technical Details for RX Test-wall

D.3.2.1 Specification of the Gypsum board

- Dimension: see clause D.3.1
- Thickness: 12,50 mm
- Gypsum board type: Type A see clause 3.2.2 in EN 520 [3]

D.3.2.2 Specification of the Rebar

- Thickness: see table D.4 and table D.2
- Length: same than dimension Test-wall, see clause D.3.1
- Specification: table 6 in EN 10080 [4]

Table D.4: Requirement for rebar

Nominal diameter [mm]	Nominal mass per meter (kg/m)	Nominal Diameter (mm)	Nominal cross sectional area [mm ²]
12,0	0,888	12	113

D.3.2.3 Specification of the Wood Frame

- Cross-section: 80 mm x 80 mm
- Length: see dimension RX-test wall, see clause D.3.1
- Type of the wood frame: KVH® structural timber, for non-exposed areas
- Specification: see KVH® structural timber [5]

Annex E (normative): Interferer for RBR test

E.1 Interferer requirements for RBR tests

E.1.1 General test frequencies for RBR tests

ETSI EN 303 883-2 [2], clause A.2.1, usually defines the test frequencies inside and outside the OFR. One of two methods is selected depending on the OFR of the EUT. However, EUT covered by the present document operate over potentially very large bandwidths and therefore, to get realistic receiver test within the adjacent and blocking domain of the receiver, the test frequencies for the RBR tests shall be adjusted as follows:

- for EUT with OFR < 500 MHz: see clause E.1.2
- for EUT with OFR \geq 500 MHz: see clause E.1.3

Despite the adjustment of the RBR test frequencies, the justification in terms of the of receiver requirements from ETSI EG 203 336 [i.15] given in ETSI EN 303 883-2 [2], clause C.1 is still valid for the EUT covered by the present document.

E.1.2 Test frequencies for EUT with OFR < 500 MHz

- Inband: one interferer test at frequency: $f_L = f_C$
- Outside OFR, four interferer tests at:
 - frequency $f_{L2} = f_C - 2 \times \text{OFR}$
 - frequency $f_{L1} = f_C - 0,6 \times \text{OFR}$
 - frequency $f_{H1} = f_C + 0,6 \times \text{OFR}$
 - frequency $f_{H2} = f_C + 2 \times \text{OFR}$

For EUT with OFR < 500 MHz the interferer test frequencies in relation to the EUT OFR are shown in figure E.1.

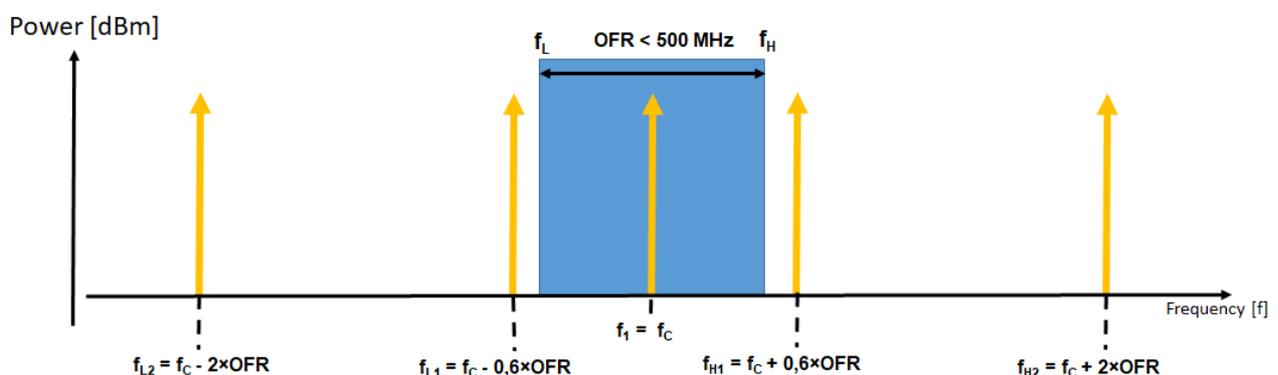


Figure E.1: Interferer test frequencies in relation to the OFR (for EUT OFR < 500 MHz)

For BMA sub-category BMA1, which are covered by the SRD regulation (see [i.2]), the factor 1 instead 0,6 shall be used. This is necessary based on the max OFR of 83 MHz and to be with the interfering test signal within the adjacent frequency range.

E.1.3 Test frequencies for EUT with OFR ≥ 500 MHz

- Inband: three interferer test at:
 - frequency $f_1 = f_C$
 - frequency $f_2 = f_C - 0,4 \times \text{OFR}$
 - frequency $f_3 = f_C + 0,4 \times \text{OFR}$
- Outside OFR, four interferer tests at:
 - frequency $f_{L2} = f_C - 1 \times \text{OFR}$
 - frequency $f_{L1} = f_C - 0,6 \times \text{OFR}$
 - frequency $f_{H1} = f_C + 0,6 \times \text{OFR}$
 - frequency $f_{H2} = f_C + 1 \times \text{OFR}$

For EUT with OFR ≥ 500 MHz the interferer test frequencies in relation to the EUT OFR are shown in figure E.2.

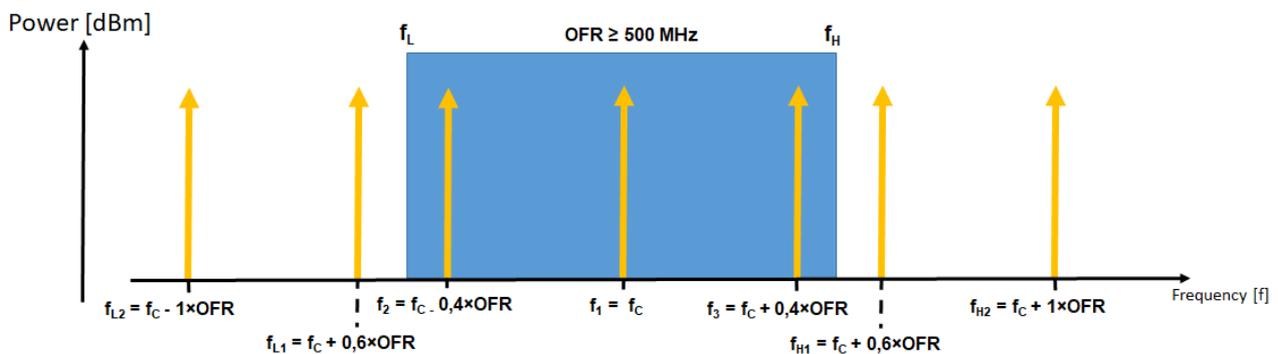


Figure E.2: Interferer test frequencies in relation to the OFR (for EUT OFR ≥ 500 MHz)

E.1.4 Interferer power levels and modulation

For the specification of the interfering signals and power levels which shall be used for BMA category RBR tests, following documents were assessed:

- ETSI EN 303 883-2 [2], clause A.2.1.1.
- Application class according to ETSI TS 103 361 [i.12]: BMA devices can be used indoor and outdoor, therefore table 7 in ETSI TS 103 361 [i.12] provides the necessary information for the interferer assessment.
- Power level and duty-cycle according the interferer assessment in ETSI TS 103 361 [i.12], table 7.

The assessment of the documents is described in clause E.4.

The outcome of the assessment is provided in table E.1. Table E.1 provides the necessary information for the RBR tests inside and outside the OFR in relation with the calculated test frequency.

Table E.1: List of interferers for BMA category RBR test

Calculated test frequency within range [MHz]	Radio application	max. EIRP [dBm]	Power @ device [dBm]	Duty cycle
30 to 34,995	Active Medical Membrane Implants	0	-19	6 min On, 54 min Off
34,995 to 35,225	SRD	20	1	100 %
40 to 40,25	On-site paging systems/Pocket device	17	-4	100 %
40,6 to 40,7	SRD/Model control	20	-1	1 % within 1 s
47 to 68	T-DAB	60	-18	100 %
138,2 to 138,45	Generic SRD	10	-21	100 %
169,4 to 169,8	SRD/Meter reading	27	-6	100 %
174 to 240	T-DAB	60	-29	100 %
400,15 to 406	Meteorological Aids (radiosondes)	23	-18	100 %
433,05 to 434,79	Generic SRD/Non- specific use	41	-14	100 %
450,4 to 457,6	GSM450 UE	39	-3	100 %
457,6 to 460	On-site paging systems/Pocket device	17	-25	100 %
460 to 496	GSM480 UE	39	-3	100 %
703 to 748	LTE E-UTRA UE	23	-24	10 % within 1 s
758 to 821	LTE E-UTRA BS	55	-45	100 %
823 to 832	Wireless Microphones	20	-27	100 %
832 to 862	LTE-E-UTRA UE	23	-24	100 %
863 to 870	SRD	27	-20	100 %
870 to 915	GSM 900 UE	39	-8	100 %
915 to 921	Generic SRD/RFID	36	-12	100 %
921 to 960	GSM 900 BS	58	-44	100 %
1 452 to 1 492	T-DAB	60	-46	100 %
1 710 to 1 785	LTE (E-UTRA UE)	23	-30	10 % within 1 s
1 785 to 1 805	Wireless Microphones	17	-37	100 %
1 805 to 1 880	LTE (E-UTRA BS)	55	-53	100 %
1 920 to 1 980	IMT	24	-30	100 %
2 010 to 2 025	IMT (UTRA UE)	24	-31	10 % within 1 s
2 025 to 2 110	PMSE	23	-66	100 %
2 110 to 2 170	IMT (UTRA BS)	55	-54	100 %
2 200 to 2 290	PMSE	23	-66	100 %
2 300 to 2 400	IMT (E-UTRA UE)	23	-33	10 % within 1 s
2 400 to 2 483,5	Wideband data transmission	20	-36	50 %, 5 ms On, 5 ms Off
2 500 to 2 570	IMT (UTRA UE)	24	-33	10 % within 1 s
2 585 to 2 600	IMT (UTRA BS)	55	-56	100 %
2 570 to 2 620	IMT (E-UTRA UE)	23	-34	10 % within 1 s
2 570 to 2 620	IMT (UTRA UE)	24	-33	10 % within 1 s
2 620 to 2 690	IMT (BS)	55	-56	100 %
3 400 to 3 600	IMT (E-UTRA UE)	26	-31	10 % within 1 s
3 600 to 3 800	IMT (E-UTRA UE)	23	-34	10 % within 1 s
4 400 to 4 800	PMSE	23	-73	100 %
4 800 to 4 990	BBDR-PPDR Terminal	26	-70	100 %
4 990 to 5 000	PMSE	12	-73	100 %
5 150 to 5 875	RLAN	27	-36	5 % within 1 s
5 875 to 5 945	ITS	33	-45	5 ms On, 50 ms Off
5 945 to 6 425	RLAN	23	-39	5 % within 1 s
6 425 to 8 500	Fixed links	85	-75	100 %
8 500 to 10 150	Radiodetermination applications	30	-92	100 %
10 150 to 10 300	Fixed	85	-78	100 %
10 300 to 10 500	PMSE	67	-56	100 %
10 500 to 10 650	BFWA	85	-38	100 %

E.2 Interferer test signals for BMA sub-category BMA1

The OFR for sub-category BMA1 is between 2,4 GHz to 2,4835 GHz or 5,725 GHz to 5,875 GHz (see table 1, permitted ranges of operation) and therefore, much less than 500 MHz. Accordingly clause E.1.2 applies with one interferer test signal inside OFR and four interferer test frequencies outside the OFR.

Therefore, table E.2 and table E.3 providing all requirements for the RBR test; these requirements shall be used for the RBR test of BMA sub-category BMA1 EUT.

Table E.2: List of interferers test signals for RBR tests for BMA sub-category BMA1 within 2,4 GHz to 2,4835 GHz

Radio Service	Test frequency [MHz]	Power @ device	Signal modulation	Duty Cycle
Interferer within OFR	$f_1 = f_c$	-36 dBm	CW	5 ms On, 5 ms Off
Interferer outside OFR	$f_{L2} = f_c - 2 \times \text{OFR}$	-33 dBm for OFR < 75 MHz (note 2)	CW	100 %
		-66 dBm for 75 MHz \leq OFR \leq 83,5 MHz (note 2)	CW	100 %
	$f_{L1} = f_c - 1 \times \text{OFR}$	-33 dBm	CW	10 % within 1 s
	$f_{H1} = f_c + 1 \times \text{OFR}$	-33 dBm	CW	10 % within 1 s
	$f_{H2} = f_c + 2 \times \text{OFR}$	-33 dBm for OFR < 60 MHz (note 3)	CW	100 %
		-56 dBm for 60 MHz \leq OFR \leq 83,5 MHz (note 3)	CW	100 %
NOTE 1: The related test frequencies can be calculated based on the measured f_c and OFR (see clause 4.3.2). The power levels for the interfering signals are derived from the interferer table E.1, clause E.1.4.				
NOTE 2: This difference comes from the adjacent IMT 2 300 MHz to 2 400 MHz and PMSE below 2 300 MHz.				
NOTE 3: This differentiation comes from the adjacent IMT UE from 2 500 MHz to 2 620 MHz and IMT BS above 2 620 MHz.				

Table E.3: List of interferers test signals for RBR tests for BMA sub-category BMA1 within 5,725 GHz to 5,875 GHz

Radio Service	Test frequency [MHz]	Power @ device	Signal modulation	Duty Cycle
Interferer within OFR	$f_1 = f_c$	-36 dBm	CW	5 % within 1 s
Interferer outside OFR	$f_{L2} = f_c - 2 \times \text{OFR}$	-36 dBm	CW	5 % within 1 s
		$f_{L1} = f_c - 1 \times \text{OFR}$	-36 dBm	CW
	$f_{H1} = f_c + 1 \times \text{OFR}$	-45 dBm for OFR < 140 MHz (note)	CW	5 ms On, 50 ms Off
		-39 dBm for 140 MHz \leq OFR \leq 150 MHz (note)	CW	5 % within 1 s
	$f_{H2} = f_c + 2 \times \text{OFR}$	-39 dBm	CW	5 % within 1 s
NOTE: This differentiation comes from the adjacent ITS from 5 875 MHz to 5 945 MHz and RLAN above 5 945 MHz.				

E.3 Interferer test signals for BMA sub-category BMA2, BMA3, BMA4 and BMA5

E.3.1 Interferer test signals

The OFR for sub-categories BMA2, BMA3, BMA4 and BMA5 is between 30 MHz and 10,6 GHz (see table 1) and can be below 500 MHz or above 500 MHz. Accordingly either clause E.1.2 or clause E.1.3 applies depending on the OFR of the EUT.

Table E.4 provides the requirements for the RBR test if the OFR is < 500 MHz.

Table E.5 provides the requirements for the RBR test if the OFR is \geq 500 MHz.

Table E.4: List of interferers test signals for RBR tests with OFR < 500 MHz

Radio Service	Test frequency [MHz]	Power @ device [dBm]	Signal modulation	Duty Cycle
Interferer within OFR	$f_1 = f_c$	See table E.1	CW	See table E.1
Interferer outside OFR	$f_{L2} = f_c - 2 \times \text{OFR}$ (notes 1 and 2)	See table E.1	CW	See table E.1
	$f_{L1} = f_c - 0,6 \times \text{OFR}$ (notes 1 and 2)	See table E.1	CW	See table E.1
	$f_{H1} = f_c + 0,6 \times \text{OFR}$ (note 1)	See table E.1	CW	See table E.1
	$f_{H2} = f_c + 2 \times \text{OFR}$ (note 1)	See table E.1	CW	See table E.1
NOTE 1: If no requirements are provided in table E.1 for interferer at the calculated test frequencies, then choose the following approach: <ul style="list-style-type: none"> – f_1: choose in table E.1 the strongest of both adjacent interferer in frequency. – f_{L2}, f_{L1}: next interferer below the calculated frequency, see clause E.3.2. – f_{H1}, f_{H2}: next interferer higher the calculated frequency, see clause E.3.2. 				
NOTE 2: If based on calculation the test frequency would be below 0 Hz, then this test is not applicable.				

Table E.5: List of interferers test signals for RBR tests of OFR \geq 500 MHz

Radio Service	Test frequency [MHz] (note 1)	Power @ device [dBm] (note 3)	Signal modulation	Duty Cycle (note 3)
Interferer within OFR	$f_1 = f_c$	See table E.1	CW	See table E.1
	$f_2 = f_c - 0,4 \times \text{OFR}$	See table E.1	CW	See table E.1
	$f_3 = f_c + 0,4 \times \text{OFR}$	See table E.1	CW	See table E.1
Interferer outside OFR	$f_{L2} = f_c - 1 \times \text{OFR}$ (note 2)	See table E.1	CW	See table E.1
	$f_{L1} = f_c - 0,6 \times \text{OFR}$ (note 2)	See table E.1	CW	See table E.1
	$f_{H1} = f_c + 0,6 \times \text{OFR}$	See table E.1	CW	See table E.1
	$f_{H2} = f_c + 1 \times \text{OFR}$	See table E.1	CW	See table E.1
NOTE 1: If no requirements are provided in Tale E.1 for interferer at the calculated test frequencies, choose the following approach: <ul style="list-style-type: none"> – f_1: choose the strongest of both adjacent interferer in frequency. – f_2: next interferer higher the calculated frequency, see clause E.3.2. – f_3: next interferer lower the calculated frequency, see clause E.3.2. – f_{L2}, f_{L1}: next interferer lower the calculated frequency, see clause E.3.2. – f_{H1}, f_{H2}: next interferer higher the calculated frequency, see clause E.3.2. 				
NOTE 2: If based on calculation the test frequency would be below 0 Hz, then this test is not applicable.				
NOTE 3: If the calculated test frequency would be below 30 MHz or above 10,6 GHz following interferer test signals shall be taken: <ul style="list-style-type: none"> – for test frequencies < 30 MHz: power at the EUT: -30 dBm; signal CW with DC 100 %. – for test frequencies > 10,6 GHz: power at the EUT: -30 dBm; signal CW with DC 100 %. 				

NOTE: The related test frequencies can be calculated based on the measured f_c and OFR (see clause 4.3.2). The power levels for the interfering signals are derived from the interferer table E.1, clause E.1.4.

E.3.2 Assessment if no interferer test signal provided at calculated test signals

If no requirements are provided in table E.1 for interferer at the calculated test frequencies, choose the next interferer requirements from table E.1 and adjust the test frequency in relation to the frequency range of the interferer.

Figures E.3 and E.4 show the assessment procedure for the cases:

- Figure E.3 for the case "next interferer higher the calculated frequency"
- Figure E.4 for the case "next interferer lower the calculated frequency"

For the frequency $f_1 = f_c$ it is requested to choose closest interferer in frequency, here the distance in frequency to the next interferer is relevant. The "closest" range shall be chosen. This could lead either to the case next interferer higher (see figure E.3) or the next interferer lower (see figure E.4) the calculated frequency.

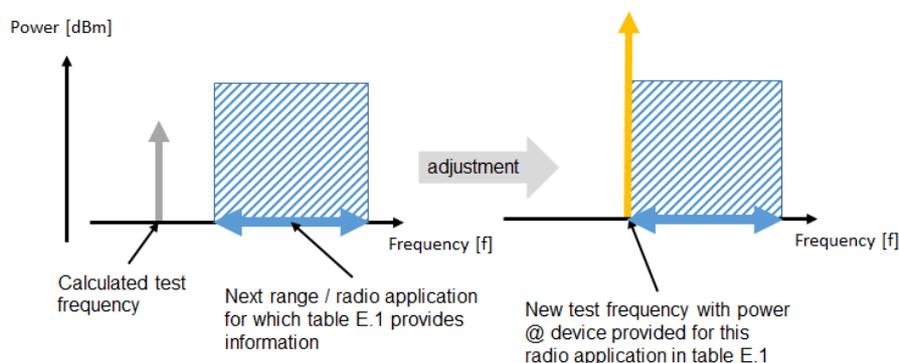


Figure E.3: Interferer test signal adjustment for the case "next interferer higher the calculated frequency"

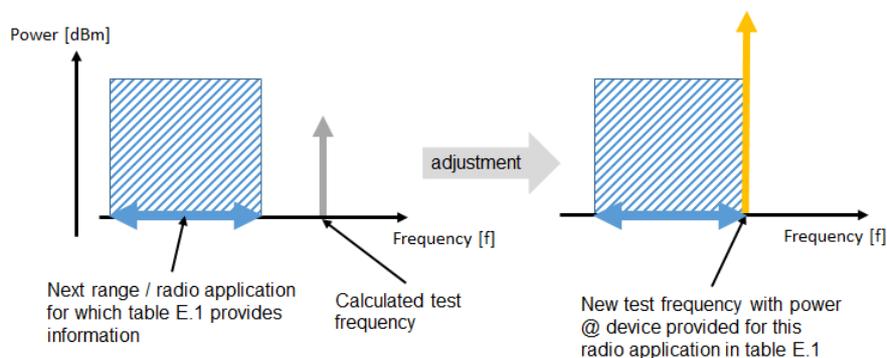


Figure E.4: Interferer test signal adjustment for the case "next interferer lower the calculated frequency"

E.4 List of interferer for RBR test; assessment procedure

E.4.1 General

The RBR limits in the present document are derived based on ETSI EN 303 883-2 [2], clause A.2.1.1.

Clause A.2.1.1 of ETSI EN 303 883-2 [2] is referencing to ETSI TS 103 361 [i.12], which includes the list of interferers from which the highest interferer for the in-band and out-of-band test are chosen.

The list of interferers from table 1 and specified for the indoor usage in table 7 of ETSI TS 103 361 [i.12] clause 7.6 ("Interferers for mobile (indoor and outdoor) applications") have been evaluated for the two permitted frequency bands of the present document and the highest level was taken as the limit. Even though there are several interferers present in some frequency ranges, only the highest interferer inside a frequency range is applicable. Therefore, the possible list of interferers was revised and amended, the result of the assessment is provided in clause E.1.4, table E.1.

The assessment procedure for the interference power level at the EUT is described in ETSI TS 103 361 [i.12] and was used for the new interferer added to the list of possible interferer, see clause E.4.2.4.

E.4.2 Assessment list of relevant interferer

E.4.2.1 Basic considerations

To consider only the relevant interferers the tables provided in ETSI TS 103 361 [i.12] were reviewed.

The following points were considered:

- If several interferers are present within the same frequency range, only the highest shall be considered for the RBR test, see clause E.4.2.2 for details.
- If there is a partial overlap in the frequency ranges of interferers, the range of the interferer with the lower power level at the EUT has been adjusted, see clause E.4.2.3 for details.
- Review of the list of possible interferers, deletion of interferers which are no longer present or addition of newly allocated services, see clause E.4.2.4 for details.

E.4.2.2 Several interferer within the same frequency range

In case several interferers could be present in one frequency range, only the interferer with the highest power of interference at the EUT (based on the usage scenario) was kept.

As an example, table E.6 shows an excerpt from the "complete" list of the possible interferers (ETSI TS 103 361 [i.12], table 1 and table 7).

Table E.6: Excerpt from ETSI TS 103 361 [i.12], table 1 and table 7

Radio Service	Frequency [MHz]		Power @ device [dBm]
SRD, Radiodetermination	2 400	2 483,5	-42
Wideband data transmission	2 400	2 483,5	-36
RFID	2 446	2 454	-43
RFID (in building only)	2 446	2 454	-43

After the amendment, based on power level and probability of interference this is in table E.7.

Table E.7: Example result after assessment considering highest interferer within a frequency range

Radio Service	Frequency [MHz]		Power @ device [dBm]
Wideband data transmission	2 400	2 483,5	-36

E.4.2.3 Interferer overlapping in frequency range

In case of a (partial) overlap of interferers in frequency, the frequency range of the interferer with the higher emissions was kept, while the range with the lower level was reduced.

As an example, table E.8 shows an excerpt from the "complete" list of the possible interferers (ETSI TS 103 361 [i.12], table 1 and table 7).

Table E.8: Excerpt from ETSI TS 103 361 [i.12], table 1 and table 7

Radio Service	Frequency [MHz]	Test Frequency [MHz]	max. EIRP [dBm]	Power @ device [dBm]	Radio Service
IMT (UTRA FDD Band XVI UE)	2 010 - 2 025	2 017,5	24	-31	3,84
PMSE	2 015 - 2 110	2 062	23	-66	10

After the assessment, the overlapping frequency range was removed, see table E.9.

Table E.9: Example result after assessment considering frequency range overlap of interferer

Radio Service	Frequency [MHz]	Power @ device [dBm]	Radio Service
IMT (UTRA FDD Band XVI UE)	2 010 - 2 025	-31	3,84
PMSE	2 025 - 2 110	-66	10

E.4.2.4 Status of interferer

During the revision of the list of possible interferers ("complete" list (ETSI TS 103 361 [i.12], table 1 and table 7), the following changes were considered:

- GSM, CDMA, UMTS, DCS, PCS and WIMAX systems are or soon will be no longer in service, I-UTRA, LTE systems will be considered instead.
- New RLAN allocation in 5 945 MHz to 6 425 MHz (see ECC/DEC/(20)/01 [i.13]) was added.
- Changes in the usage of 3 400 MHz to 3 800 MHz, frequency range is still not used by WIMAX, in this range I-UTRA, LTE systems will be considered, see ETSI TS 136 101 [i.14].

E.4.3 Kind of interferer signal

Based on the fact the OFR of the EUT categories covered by the present document are mostly broader than the bandwidth of a possible interfering signal, it can be assumed that in the interference case the bandwidth of the interfering signal will be completely within the OFR of the UWB EUT. Therefore, only the power level and the duty cycle of the interfering signal would be relevant. Therefore, a CW signal with the related DC shall be taken for the RBR tests within the OFR.

For the DC requirement the related ECC compatibility reports were considered to choose the typical transmission behavior, see EFIS; ECO Frequency Information System [i.16].

Annex F (informative): Change history

Version	Information about changes
ETSI EN 302 065-4 (V1.1.1)	<p>First version of ETSI EN 302 065-4 for Material Sensing devices using UWB technology below 10,6 GHz; listed in the OJEU for Art. 3.2 of 2014/53/EU without restriction at 12 April 2017. It was a merge of ETSI EN 302 435-1/-2 and ETSI EN 302 498 -1/-2 into one EN. The main changes compared to the previous version(s) are:</p> <ul style="list-style-type: none"> • Out-sourcing of standard measurement procedures into a separate ETSI EN 303 883 (V1.1.1). • Harmonization of description of material sensing, building material sensing and object discrimination applications. • New requirement on receiver interferer signal handling. • New Annex B "Application form for testing". • New Annex C "Equivalent Mitigation techniques".
ETSI EN 302 065-4-1	<p>First version of ETSI EN 302 065-4-1 for Material Sensing devices for building material analysis below 10,6 GHz; Revision on request of the EC to improve the standard, especially regarding receiver requirements; see more details in the introduction. The main changes compared to the previous version are:</p> <ul style="list-style-type: none"> • Add a measurement mode for BMA devices based on SRD regulation. • Change the EN structure to allow other use-cases with other intended use-case requirements than BMA. • Clear categorization of EUT covered by the present document based on regulation, technical implementations and intended use-case requirements. • RX-requirements based on the signal interferer handling concept.

History

Document history		
V1.1.1	November 2016	Publication as ETSI EN 302 065-4
V2.1.0	July 2021	EN Approval Procedure AP 20211024: 2021-07-26 to 2021-10-25