



**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 2: Requirements for UWB location tracking**

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Reference

REN/ERM-TGUWB-139

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Keywords

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## Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.18] 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.15].

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

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.17].

<b>Proposed national transposition dates</b>	
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## Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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# 1 Scope

The present document applies to transceivers, transmitters and receivers utilizing Ultra WideBand (UWB) technologies and used for location tracking purposes.

The present document applies to impulse, modified impulse and RF carrier based UWB communication technologies.

The present document applies to fixed, mobile or portable applications, e.g. the present document applies to the following equipment types:

- stand-alone radio equipment with or without its own control provisions;
- plug-in radio devices intended for use with, or within, a variety of host systems, e.g. personal computers, hand-held terminals, etc.;
- plug-in radio devices intended for use within combined equipment, e.g. cable modems, set-top boxes, access points, etc.;
- combined equipment or a combination of a plug-in radio device and a specific type of host equipment.

The present document applies to UWB equipment with an output connection used with a dedicated antenna or UWB equipment with an integral antenna.

The present document covers three different types of location tracking system, which may use either of the UWB technologies listed previously:

- **LT1 systems:** These systems, operating in the 6 GHz to 9 GHz region (see CEPT Report 45 [i.13]), are intended for general location tracking of people and objects. They operate on an unlicensed basis. The transmitting terminals in these systems are mobile (indoors or outdoors), or fixed (indoors only). Fixed outdoor LT1 transmitters are not permitted. Typically, LT1 transmitters are mobile location tracking tags which are attached to people or objects, and tags are tracked using a fixed receiver infrastructure to only receive the UWB emission emitted by the tags, ETSI EG 201 399 [i.1].
- **LT2 systems:** These systems, operating in the 3,1 GHz to 4,8 GHz region (see ECC/REC(11)09 [i.8]), are intended for person and object tracking and industrial applications at well-defined locations. The transmitting terminals in these systems may be located indoors or outdoors, and may be fixed or mobile. They operate at fixed sites and may be subject to registration and authorization, provided local coordination with possible interference victims has been performed, ECC Report 167 [i.10] and ECC Report 170 [i.11].
- **LAES systems:** These systems, operating in the 3,1 GHz to 4,8 GHz region (see ECC/REC(11)10 [i.9]), are intended for tracking staff belonging to the fire and other emergency services, who need to work in dangerous situations. Being able to track such people, even when deep inside a building, provides an important enhancement to command and control and to their personal safety. Typically, an LAES system is deployed temporarily at the scene of a fire or other emergency in a building. Licences may be required for user organization, ECC Report 167 [i.10] and ECC Report 170 [i.11].

Some individual location tracking devices may be able to operate within different kinds of location tracking systems, and therefore may meet (in different modes) the requirements of any or all of LT1, LT2 and LAES.

The present document does not cover UWB transmitters whose authorization to operate depends solely on the tests set out in the present document and which are installed or used in flying models, aircraft and other forms of aviation. Furthermore, it does not cover LT1 UWB transmitters that are operated on board a road or rail vehicle running on a public network or highway.

The permitted frequency ranges of operation for the various device types covered by the present document are given in table 1.

Table 1: Operating frequency bands

Device type	Mode	Permitted range of operation	Intended range of operation (preferred range of Operational Bandwidth) (see note 1)
LT1	Transmit	30 MHz to 10,6 GHz (note 2)	6,0 GHz to 9 GHz
	Receive	30 MHz to 10,6 GHz	6,0 GHz to 9 GHz
LAES	Transmit	30 MHz to 10,6 GHz (note 3)	3,1 GHz to 4,8 GHz
	Receive	30 MHz to 10,6 GHz	3,1 GHz to 4,8 GHz
LT2	Transmit	30 MHz to 10,6 GHz (note 4)	3,1 GHz to 4,8 GHz
	Receive	30 MHz to 10,6 GHz	3,1 GHz to 4,8 GHz

NOTE 1: This is the preferred range for the operating bandwidth, as defined in clause 4.3.1.  
NOTE 2: Limits in table 2 (clause 4.3.2.3) and table 5 (clause 4.3.3.3) are to be met.  
NOTE 3: Limits in table 3 (clause 4.3.2.3) and table 6 (clause 4.3.3.3) are to be met.  
NOTE 4: Limits in table 4 (clause 4.3.2.3) and table 7 (clause 4.3.3.3) are to be met.

## 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.

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

- [1] ETSI TS 102 754 (V1.3.1) (03-2013): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics of Detect And Avoid (DAA) mitigation techniques for SRD equipment using Ultra Wideband (UWB) technology".
- [2] ETSI EN 303 883 (V1.1.0) (02-2016): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Measurement Techniques".
- [3] ETSI TS 103 361 (V1.1.1) (03-2016): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the Directive 2014/53/EU".
- [4] Void.

### 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] ETSI EG 201 399 (V2.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".
- [i.2] Void.

- [i.3] Void.
- [i.4] CEPT ECC/DEC/(06)04 of 24 March 2006 amended 9 December 2011: "The harmonised conditions for devices using Ultra-Wideband (UWB) technology in bands below 10.6 GHz".
- [i.5] Commission Decision 2007/131/EC of 21 February 2007 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document number C(2007) 522).
- [i.6] ECC Report 120 (March 2008): "ECC Report on Technical requirements for UWB DAA (Detect and avoid) devices to ensure the protection of radiolocation in the bands 3.1-3.4 GHz and 8.5-9 GHz and BWA terminals in the band 3.4 - 4.2 GHz".
- [i.7] Void.
- [i.8] ECC Recommendation (11)09 on UWB Location Tracking Systems Type 2 (LT2), October 2011.
- [i.9] ECC Recommendation (11)10 on Location Tracking Application for Emergency and Disaster Situations, October 2011.
- [i.10] ECC Report 167 (May 2011): "The Practical Implementation of Registration/Coordination Mechanism for UWB LT2 (Location Tracking Type 2) Systems".
- [i.11] ECC Report 170 (October 2011): "ECC Report on Specific UWB Applications in the Bands 3.4 - 4.8 GHz and 6 - 8.5 GHz Location Tracking Applications for Emergency Services (LAES), Location Tracking Applications Type 2 (LT2) and Location Tracking and Sensor Applications for Automotive and Transportation Environments (LTA)".
- [i.12] Void.
- [i.13] 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.14] Commission Decision 2014/702/EU of 7 October 2014 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document C(2014) 7083).
- [i.15] 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.16] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- [i.17] ETSI EN 302 065-1 (V.2.1.0): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Requirements for Generic UWB applications".
- [i.18] 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.

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

**transmitter off time:** time interval between two consecutive bursts when the UWB emission is kept idle

**transmitter on time:** duration of a burst irrespective of the number of pulses contained

## 3.2 Symbols

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

d	distance
k	coverage factor
$\varphi$	azimuth angle
T <sub>off</sub>	transmitter off time
T <sub>on</sub>	transmitter on time

## 3.3 Abbreviations

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

CEPT	European Conference of Postal and Telecommunications Administrations
NF	Noise Figure

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# 4 Technical requirements specifications

## 4.1 Environmental conditions

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the supplier. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

The normal test conditions are defined in clause 5.4.3 of ETSI EN 303 883 [2].

## 4.2 General

UWB devices in the scope of the present document can operate in a broad permitted range of frequencies from 30 MHz to 10,6 GHz, as defined in table 1 of the present document. The intended range of operation gives the preferred range of operating frequencies for the UWB operation based on the allowed spectrum mask with increase permitted emission levels in the intended range of operation. In order to clearly identify the required limits and thus measurement procedures it is essential to define the operating bandwidth of the UWB equipment under test, The operating bandwidth of the UWB equipment under test shall be the -10 dBc bandwidth of the intended UWB signal under normal operational conditions as defined in ETSI EN 303 883 [2], clause 5.4.3. A single UWB device can have more than one operating bandwidth.

The basic concept is depicted in figure 1. Here two separate operating bandwidths are depicted, one with a UWB operating bandwidth in the lower frequency range and one in the upper frequency range. All UWB related emissions shall be measured in the identified operating bandwidth of the UWB device under test. The required mitigation techniques are only valid in the operating bandwidth.

The RX interference signal handling is focused in the operating bandwidth and some clearly identified frequencies outside the operating bandwidth(s).

The operating bandwidth(s) is/are parts of the permitted range of operation, see table 1.

The test of required mitigation techniques are only relevant inside the operating bandwidth(s).

RX interference signal handling on the operating bandwidth and at defined frequencies below and above the operating range limits.

TE: Total emission including UWB emission (mean power spectral density) and Other Emissions (OE) (e.g. RX spurious, TX spurious and unwanted emission not belonging to the UWB emissions).

TE peak power is only to be measured at the frequency and the direction with the highest mean TE power.

OE shall only be considered in the operating bandwidth if the given UWB limits (UE limits for mean power and peak power) are not met. In this case OE shall be clearly identified.



Figure 1: Concept of operating bandwidth including the relevant UWB related parameter

## 4.3 Transmitter Conformance Requirements

### 4.3.1 Operating Bandwidth

#### 4.3.1.1 Applicability

This shall apply to all transmitters under test.

#### 4.3.1.2 Description

Operating Bandwidth(s) is/are the frequency range(s) bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna (as per ETSI EN 303 883 [2], clause 7.2.2). The upper boundary is designated  $f_H$  and the lower boundary is designated  $f_L$ .

The frequency at which the highest radiated mean power spectral density emission occurs is designated  $f_M$ .

A UWB device could have one or more "operating bandwidths" provided that the maximum mean power spectral density (clause 4.3.2) and maximum peak power (clause 4.3.3) requirements are fulfilled in each operating bandwidth.

#### 4.3.1.3 Limits

Any operating bandwidth of the DUT shall lie within one permitted frequency range of operation of the device (see table 1) and shall be > 50 MHz.

#### 4.3.1.4 Conformance

The conformance test suite for Operating Bandwidth shall be as defined in clause 6.5.3.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

### 4.3.2 Maximum Value of Mean Power Spectral Density

#### 4.3.2.1 Applicability

This shall apply to all transmitters under test.

#### 4.3.2.2 Description

The maximum mean power spectral density (specified as e.i.r.p.) of the radio device under test, at a particular frequency, is the average power per unit bandwidth (centred on that frequency) radiated in the direction of the maximum level under the specified conditions of measurement (as per ETSI EN 303 883 [2], clause 7.2.3).

#### 4.3.2.3 Limits

The maximum mean power spectral density measured shall not exceed the limits given in table 2 (for LT1 equipment defined in Commission Decision 2014/702/EU [i.14]), table 3 (for LAES equipment defined in ECC/REC(11)10 [i.9]), or table 4 (for LT2 equipment defined in ECC/REC(11)09 [i.8]).

Additionally, for LT2 fixed outdoor terminals, within the RF range 4,2 GHz to 4,4 GHz the maximum mean EIRP spectral density in any upwards direction within 30 degrees of the identified vertical axis (see clause 4.6.1) shall be -47,3 dBm/MHz or less, measured using the above test procedures.

**Table 2: Maximum value of mean power spectral density (e.i.r.p) limit for LT1 equipment (Commission Decision 2014/702/EU [i.14])**

Frequency (GHz)	Maximum Value of Mean Power Spectral Density (e.i.r.p) (dBm/MHz)	
	Without DAA	With DAA
$f \leq 1,6$		-90
$1,6 < f \leq 2,7$		-85
$2,7 < f \leq 3,1$		-70
$3,1 < f \leq 3,4$		-70
$3,4 < f \leq 3,8$		-80
$3,8 < f \leq 4,8$		-70
$4,8 < f \leq 6$		-70
$6 < f \leq 8,5$		-41,3
$8,5 < f \leq 9$	-65	-41,3
$9 < f \leq 10,6$		-65
$f > 10,6$		-85

**Table 3: Maximum value of mean power spectral density (e.i.r.p) limit for LAES equipment (ECC/REC(11)10 [i.9])**

Frequency (GHz)	Mean power spectral density (e.i.r.p) (dBm/MHz)	
	Without DAA	With DAA
$f \leq 1,6$		-90
$1,6 < f \leq 2,7$		-85
$2,7 < f \leq 3,1$		-70
$3,1 < f \leq 3,4$	-70	-41,3 (see note)
$3,4 < f \leq 4,2$		-21,3 (see note)
$4,2 < f \leq 4,8$		-41,3 (see note)
$4,8 < f \leq 6$		-70
$6 < f \leq 10,6$		-70
$f > 10,6$		-85

NOTE: A maximum duty cycle of 5 % per transmitter on time (Ton) per second shall apply.

**Table 4: Maximum value of mean power spectral density (e.i.r.p) limit for LT2 equipment (ECC/REC(11)09 [i.8])**

Frequency (GHz)	Mean power spectral density (e.i.r.p) (dBm/MHz)			
	Fixed outdoor		Mobile and fixed indoor	
	Without DAA	With DAA	Without DAA	With DAA
$f \leq 1,6$				-90
$1,6 < f \leq 2,7$				-85
$2,7 < f \leq 3,1$				-70
$3,1 < f \leq 3,4$	-70	-41,3 (see note 1)	-70	-41,3 (see note 1)
$3,4 < f \leq 3,8$	-41,3 (see note 1)		-41,3 (see notes 1 and 2)	
$3,8 < f \leq 4,8$	-41,3 (see notes 1 and 3)		-41,3 (see notes 1 and 2)	
$4,8 < f \leq 6$				-70
$6 < f \leq 10,6$				-70
$f > 10,6$				-85
NOTE 1: A maximum duty cycle of 5 % per transmitter per second and a maximum $T_{on} = 25$ ms also apply.				
NOTE 2: The duty cycle should also be limited to 1,5 % per transmitter on time ( $T_{on}$ ) per minute, or equipment should implement an alternative mitigation technique that provides at least equivalent protection.				
NOTE 3: The maximum mean e.i.r.p. spectral density in the band 4,2 GHz to 4,4 GHz for emissions that appear 30° or greater above the horizontal plane should be less than -47,3 dBm/MHz, see clause 4.6.1.4 (ECC/REC(11)09 [i.8]).				

#### 4.3.2.4 Conformance

The conformance test suite for maximum value of mean power spectral density shall be as defined in clause 6.5.4.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

#### 4.3.3 Maximum value of peak power

##### 4.3.3.1 Applicability

This shall apply to all transmitters under test.

##### 4.3.3.2 Description

The maximum peak power specified as e.i.r.p. contained within a 50 MHz bandwidth at the frequency at which the highest mean radiated power occurs, radiated in the direction of the maximum level under the specified conditions of measurement (as per ETSI EN 303 883 [2], clause 7.2.4).

##### 4.3.3.3 Limits

The maximum peak power limit measured shall not exceed the limits given in table 5 (for LT1 equipment Commission Decision 2014/702/EU [i.14]), table 6 (for LAES equipment ECC/REC(11)10 [i.9]), or table 7 (for LT2 equipment ECC/REC(11)09 [i.8]).

**Table 5: Maximum peak power limit for LT1 equipment  
(Commission Decision 2014/702/EU [i.14])**

Frequency (GHz)	Maximum value of peak power spectral density (dBm/50 MHz)	
	Without DAA	With DAA
$f \leq 1,6$	-50	
$1,6 < f \leq 2,7$	-45	
$2,7 < f \leq 3,1$	-36	
$3,1 < f \leq 3,4$	-36	
$3,4 < f \leq 3,8$	-40	
$3,8 < f \leq 4,8$	-30	
$4,8 < f \leq 6$	-30	
$6 < f \leq 8,5$	0	
$8,5 < f \leq 9$	-25	0
$9 < f \leq 10,6$	-25	
$f > 10,6$	-45	

**Table 6: Maximum peak power limit for LAES equipment  
(ECC/REC(11)10 [i.9])**

Frequency (GHz)	Maximum value of peak power spectral density (dBm/50 MHz)	
	Without DAA	With DAA
$f \leq 1,6$	-50	
$1,6 < f \leq 2,7$	-45	
$2,7 < f \leq 3,1$	-36	
$3,1 < f \leq 3,4$	-36	0 (see note)
$3,4 < f \leq 4,2$	20 (see note)	
$4,2 < f \leq 4,8$	0 (see note)	
$4,8 < f \leq 6$	-30	
$6 < f \leq 10,6$	-30	
$f > 10,6$	-45	

NOTE: A maximum duty cycle of 5 % per transmitter per second also applies.

**Table 7: Maximum peak power limit for LT2 equipment  
(ECC/REC(11)09 [i.8])**

Frequency (GHz)	Maximum value of mean power spectral density (dBm/50 MHz)			
	Fixed outdoor LT2 transmitters		Mobile and fixed indoor LT2 transmitters	
	Without DAA	With DAA	Without DAA	With DAA
$f \leq 1,6$	-50			
$1,6 < f \leq 2,7$	-45			
$2,7 < f \leq 3,1$	-36			
$3,1 < f \leq 3,4$	-36	0 (see note 1)	-36	0 (see note 1)
$3,4 < f \leq 3,8$	0 (see note 1)		0 (see notes 1 and 2)	
$3,8 < f \leq 4,8$	0 (see notes 1 and 3)		0 (see notes 1 and 2)	
$4,8 < f \leq 6$	-30			
$6 < f \leq 10,6$	-30			
$f > 10,6$	-45			

NOTE 1: A maximum duty cycle of 5 % per transmitter per second and a maximum  $T_{on} = 25$  ms also apply.  
NOTE 2: The duty cycle should also be limited to 1,5 % per transmitter per minute, or equipment should implement an alternative mitigation technique that provides at least equivalent protection.  
NOTE 3: The maximum mean e.i.r.p. spectral density in the band 4,2 GHz to 4,4 GHz for emissions that appear 30° or greater above the horizontal plane should be less than -47,3 dBm/MHz, see clause 4.6.1.4 (ECC/REC(11)09 [i.8]).

#### 4.3.3.4 Conformance

The conformance test suite for maximum value of peak power shall be as defined in clause 6.5.5.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

#### 4.3.4 Exterior Limits

This test is not applicable for any device covered by the present document.

#### 4.3.5 Total Power

This test is not applicable for any device covered by the present document.

#### 4.3.6 Other Emissions

##### 4.3.6.1 Applicability

This shall apply to all transmitters under test.

##### 4.3.6.2 Description

The emission levels of a UWB device are characterised by the maximum mean spectral power density and by the maximum peak power. The following emission definitions are equally valid for both values (maximum mean spectral density and maximum peak power).

The total measured emissions in transmit mode (TE mean power spectral density, TE peak power) of the equipment are the sum of:

- 1) UWB Emissions (UE) from the transmitter.
- 2) Other Emissions (OE) from the transmitter, receiver and other analogue or digital circuitry.

The UWB emissions (UE) are the UWB emissions into free space during the transmit mode operation and is equivalent to the mean power spectral density or peak power depending on the deployed measurement procedure, see clauses 4.3.2 and 4.3.3.

The UWB emissions cannot be measured directly because the Other Emissions (OE) (e.g. narrow-band spurious emissions and the analogue or digital control circuitry emissions) are simultaneously present and emitted.

UE and OE from the equipment for the purpose of the test are defined as the total emissions (TE).

The Other Emissions OE can be determined by disabling the UWB emissions. The UWB device is operating in the transmit mode. Both UE and TE are measured and recorded.

In some frequency ranges the regulated UWB emissions (UE) are very low power radio signals, comparable to the power limits of emissions from digital and analogue circuitry. If it can be clearly demonstrated (e.g. by disabling the radio device's UWB transmitter or disconnecting and terminating, internally or externally the antenna of the device) that an emission from the UWB device is not the UWB emission (UE) limited in the relevant harmonised standards or similarly it can clearly be demonstrated that it is impossible to differentiate between other emissions (OE) and the UWB emissions (UE) within the measurement uncertainty, then the emission shall be considered as other emissions (OE).

If after optimization of the measurement set-up, it is not possible to identify any OE or UE emission above the noise floor of the measurement system, it is considered that the UE limits are fulfilled.

In ETSI EN 303 883 [2], see clauses 7.2.5 and 7.3 for further information.

##### 4.3.6.3 Limits

The equivalent isotropic radiated power of any of these other emissions (OE) in the spurious domain shall not exceed the values given in table 8.

**Table 8: Other Emission limits (radiated)**

Frequency range	Limit values for OE
47 MHz to 74 MHz	-54 dBm/100 kHz
87,5 MHz to 118 MHz	-54 dBm/100 kHz
174 MHz to 230 MHz	-54 dBm/100 kHz
470 MHz to 862 MHz	-54 dBm/100 kHz
otherwise in band 30 MHz to 1 000 MHz	-36 dBm/100 kHz
1 000 MHz to 40 000 MHz (see note)	-30 dBm/1 MHz
NOTE: Not applicable for UE emissions within the permitted range of frequencies.	

#### 4.3.6.4 Conformance

The conformance tests for Other Emissions (OE) shall be as defined in clause 6.5.4.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

#### 4.3.7 Transmitter Unwanted Emissions

This test is not applicable for any transmitter covered by the present document.

### 4.4 Receiver Conformance Requirements

#### 4.4.1 Receiver Requirements

For detailed discussion of UWB receiver requirements relating to equipment covered by the present document see ETSI TS 103 361 [3].

#### 4.4.2 Receiver spurious emissions

##### 4.4.2.1 Applicability

Receiver spurious emission testing applies only when the equipment can operate in a receive-only mode or is a receive-only device.

NOTE: Otherwise receiver spurious emissions are measured as part of the other emissions, see clause 4.3.8.

##### 4.4.2.2 Description

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

##### 4.4.2.3 Limits

The narrowband spurious emissions of the receiver shall not exceed the values in table 9 in the indicated bands.

**Table 9: Narrowband spurious emission limits for receivers**

Frequency range	Limit
30 MHz to 1 GHz	-57 dBm (e.r.p.)
above 1 GHz to 40 GHz	-47 dBm (e.i.r.p.)

The above limit values apply to narrowband emissions, e.g. as caused by local oscillator leakage.

Wideband spurious emissions shall not exceed the values given in table 10.

**Table 10: Wideband spurious emission limits for receivers**

Frequency range	Limit
30 MHz to 1 GHz	-47 dBm/MHz (e.r.p.)
above 1 GHz to 40 GHz	-37 dBm/MHz (e.i.r.p.)

#### 4.4.2.4 Conformance

The conformance test suite for receiver spurious emissions shall be as defined in clause 6.6.1.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

### 4.4.3 Receiver interference handling

#### 4.4.3.1 Applicability

This requirement shall apply to all receiving DUT.

#### 4.4.3.2 Description

Interferer signal handling, defined as the capability of the device to operate as intended in coexistence with interferers, is the receiver parameter for UWB applications.

Operation as intended is evaluated using a performance criterion. For common applications, recommended performance criteria and test cases are defined in clause 9.4 of ETSI TS 103 361 [3]. For other applications, the manufacturer shall choose an appropriate performance criterion according to clause 9.2.1 of ETSI TS 103 361 [3]. The performance criterion shall be stated in the user manual (see clause 9.2.2 of ETSI TS 103 361 [3]).

#### 4.4.3.3 Limits

The level of performance of the chosen performance criterion shall meet the minimum requirement defined in clause 9 of ETSI TS 103 361 [3].

#### 4.4.3.4 Conformance

The conformance test suite for receiver interference handling shall be as defined in clause 6.6.2.

Conformance shall be established under normal test conditions; see clause 4.1.

The interpretation of the results for the measurements uncertainty shall be as given in clause 5.3.

## 4.5 Requirements for Spectrum Access

### 4.5.1 Detect and Avoid (DAA)

#### 4.5.1.1 Applicability

This requirement shall apply to all devices that implement the DAA mitigation technique to avail themselves of the relaxed limits in tables 3, 4 and 5 (clause 4.3.2.3) and/or tables 6, 7 and 8 (clause 4.3.3.3).

#### 4.5.1.2 Description

The description given in ETSI EN 303 883 [2], clause 7.2.8 applies.

#### 4.5.1.3 Limits

Limits for the DAA parameter sets shall be as given in ETSI TS 102 754 [1], annexes A to C.

#### 4.5.1.4 Conformance

The conformance test suite for the Detect and Avoid shall be as defined in clause 6.7.1.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

## 4.5.2 Listen-Before-Talk (LBT)

This test is not applicable for any device covered by the present document.

## 4.5.3 Low Duty Cycle (LDC)

### 4.5.3.1 Applicability

LT2 and LAES systems shall respect restrictions on the "on" time and duty cycle of their transmissions.

These tests are not applicable to LT1 equipment.

### 4.5.3.2 Description

Duty cycle limits are indicated by a fraction or a percentage, a time interval, and in some cases a maximum of transmitter "on" time (Ton). See CEPT Report 45 [i.13] for further information.

The limit always applies to a single terminal or device.

### 4.5.3.3 Limits

The Ton and duty cycle of the equipment shall not exceed the limits in table 11 (for LAES ECC/REC(11)10 [i.9]) or table 12 (for LT2 ECC/REC(11)09 [i.8]) unless the equipment implements an equivalent mitigation technique (see clause 4.1.7).

**Table 11: Duty cycle and Ton limits for LAES (ECC/REC(11)10 [i.9]) equipment**

Parameter	Limit
Maximum Duty cycle per second	5 %
NOTE: Annex C provides guidance on equivalent mitigation techniques involving alternative duty cycle limitations.	

**Table 12: Duty cycle and Ton limits for LT2 (ECC/REC(11)09 [i.8]) equipment**

Parameter	Limit
Maximum Duty cycle per second	5 %
Maximum Duty cycle per minute	1,5 %
Maximum transmitter on time (Ton)	25 ms
NOTE: Annex C provides guidance on equivalent mitigation techniques involving alternative duty cycle limitations.	

### 4.5.3.4 Conformance

The conformance test suite for Low Duty Cycle shall be as defined in clause 6.7.3.

Conformance shall be established under normal test conditions, see clause 4.1.

The interpretation of the results and their measurement uncertainty shall be as given in clause 5.3.

## 4.6 Antenna Requirements

### 4.6.1 Characteristics and orientation

#### 4.6.1.1 Applicability

This test shall apply to fixed LT2 equipment. Terminals for LT2 equipment (ECC/REC(11)09 [i.8]) shall be declared by the manufacturer to be for either fixed or mobile use.

#### 4.6.1.2 Description

An LT2 terminal declared to be for fixed use shall have a clearly identified vertical axis and upward direction, and should be installed such that the unit's fixed orientation matches that axis and direction.

#### 4.6.1.3 Limits

There are no quantitative limits for this requirement.

#### 4.6.1.4 Conformance

The conformance test suite for Antenna Characteristics and Orientation shall be as defined in clause 6.8.

### 4.7 Other Requirements and Mitigation techniques

#### 4.7.1 Adaptive / Transmit Power Control (TPC)

This test is not applicable for any device covered by the present document.

#### 4.7.2 Activity Factor

This test is not applicable for any device covered by the present document.

#### 4.7.3 Frequency Domain Mitigation

This test is not applicable for any device covered by the present document.

#### 4.7.4 Shielding Effects

This test is not applicable for any device covered by the present document.

#### 4.7.5 Thermal Radiation

This test is not applicable for any device covered by the present document.

#### 4.7.6 Site Registration

##### 4.7.6.1 Applicability

Additional site registration requirements shall apply to LT2 terminals and LAES terminals.

##### 4.7.6.2 Description

The site registration requirements are set out for LT2 terminals in ECC/REC(11)09 [i.8] and ECC Report 167 [i.10], and for LAES terminals in ECC/REC(11)10 [i.9].

##### 4.7.6.3 Limits

There are no quantitative limits for this requirement.

##### 4.7.6.4 Conformance

The conformance requirement for Site Registration shall be as defined in clause 6.9.6.

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## 5 Testing for compliance with technical requirements

### 5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at one or more representative point(s) within the boundary limits of the declared operational environmental profile.

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 declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

## 5.2 General conditions for testing

### 5.2.1 Product information

The requirements for the product information shall be as given in ETSI EN 303 883 [2], clause 5.2.

An application form for the DUT testing is provided in annex B.

### 5.2.2 Requirements for the test modulation

The provisions of ETSI EN 303 883 [2], clause 5.3 shall apply.

### 5.2.3 Test conditions, power supply and ambient temperatures

The provisions of ETSI EN 303 883 [2], clause 5.4 shall apply.

### 5.2.4 Choice of equipment for test suites

The provisions of ETSI EN 303 883 [2], clause 5.5 shall apply.

### 5.2.5 Multiple operating bandwidths and multiband equipment

Where equipment has more than one operating bandwidth (e.g. 500 MHz and 1 300 MHz), a minimum of two operating bandwidths shall be chosen such that the lower and higher limits of the operating range(s) of the equipment are covered (see clause 4.2). All operating bandwidths of the equipment shall be declared by the equipment manufacturer.

In case of multiband equipment (i.e. equipment that can operate with an operating bandwidth below 4,8 GHz and above 6,0 GHz), the lowest and highest channel in operation of each band shall be tested.

### 5.2.6 Testing of host connected equipment and plug-in radio devices

Testing of host connected equipment and plug-in radio devices measurements shall be as given in ETSI EN 303 883 [2], clause 5.6.

## 5.3 Interpretation of the measurement results

### 5.3.0 General

Interpretation of the measurement results shall be as given in ETSI EN 303 883 [2], clause 5.7.

#### 5.3.1 Measurement uncertainty is equal to or less than maximum acceptable uncertainty

If measurement uncertainty is equal to or less than maximum acceptable uncertainty the interpretation shall be as given in ETSI EN 303 883 [2], clause 5.7.2.

#### 5.3.2 Measurement uncertainty is greater than maximum acceptable uncertainty

If measurement uncertainty is greater than maximum acceptable uncertainty the interpretation shall be as given in ETSI EN 303 883 [2], clause 5.7.3.

### 5.3.3 Emissions

The provisions of ETSI EN 303 883 [2], clause 5.8 shall apply.

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## 6 Conformance methods of measurement for transmitters

### 6.1 Introduction

In this clause the general setup of a test bed for the test of UWB equipment will be described.

A detailed introduction shall be considered as in ETSI EN 303 883 [2], clause 6.1.

### 6.2 Initial Measurement steps

In initial measurement steps shall be done as described in ETSI EN 303 883 [2], clause 6.2.

### 6.3 Radiated measurements

#### 6.3.1 General

The provisions of ETSI EN 303 883 [2], clause 6.3.1 shall apply.

#### 6.3.2 Test sites and general arrangements for measurements involving the use of radiated fields

The provisions of ETSI EN 303 883 [2], clause 6.3.2 shall apply.

#### 6.3.3 Guidance on the use of a radiation test site

##### 6.3.3.1 General

The provisions of ETSI EN 303 883 [2], clause 6.3.3 shall apply.

##### 6.3.3.2 Range length

The provisions of ETSI EN 303 883 [2], clause 6.3.3.5 shall apply.

#### 6.3.4 Coupling of signals

The provisions of ETSI EN 303 883 [2], clause 6.3.4 shall apply.

#### 6.3.5 Standard test methods

##### 6.3.5.1 Generic measurement method

###### 6.3.5.1.1 Calibrated setup

The provisions of ETSI EN 303 883 [2], clause 6.3.5.2 shall apply.

###### 6.3.5.1.2 Substitution method

The provisions of ETSI EN 303 883 [2], clause 6.3.5.3 shall apply.

#### 6.3.6 Standard calibration method

The provisions of ETSI EN 303 883 [2], clause 6.3.6 shall apply.

### 6.4 Conducted measurements

#### 6.4.1 General Setup

The provisions of ETSI EN 303 883 [2], clause 6.4 shall apply.

## 6.4.2 Specific Setup

This requirement does not apply to any DUT covered by the present document.

# 6.5 Conformance methods of measurement for transmitter

## 6.5.1 General

First the complete signal device shall be measured for:

- the maximum mean power spectral density (e.i.r.p.);
- the maximum peak power (e.i.r.p.);
- the operating bandwidth(s);
- the receiver spurious emissions;
- Other emissions (OE);
- Low duty cycle (LDC), when applicable;
- Detect and avoid (DAA), when applicable.

The following methods of measurement shall apply to the testing of stand-alone units and to the equipment configurations identified in clause 5.5.

## 6.5.2 Method of measurements of the Ultra Wideband Emissions

Method of measurements of the Ultra Wideband Emissions shall be as given in ETSI EN 303 883 [2], clause 7.3.

## 6.5.3 Operating Bandwidth

Operating Bandwidth measurements shall be performed as given in ETSI EN 303 883 [2], clause 7.4.2.

The results for  $f_L$ ,  $f_H$ ,  $f_M$ , OBW, and  $f_C$  shall be reported in the test report.

## 6.5.4 Mean power spectral density measurements

Mean power spectral density measurements shall be as given in ETSI EN 303 883 [2], clause 7.4.3.

To classify the Ultra wide band part (clause 4.3.2) and the other emissions (clause 4.3.6) of the radiated emission the initial measurement steps given in ETSI EN 303 883 [2], clause 7.3.2 shall be used.

The measurement method used and the maximum observed value for the mean power spectral density shall be recorded in the test report.

## 6.5.5 Peak power measurements

Peak power measurements shall be as given in ETSI EN 303 883 [2], clause 7.4.4.

To classify the Ultra wide band part (clause 4.3.3) and the other emissions (clause 4.3.6) of the radiated emission the initial measurement steps given in ETSI EN 303 883 [2], clause 7.3.2 shall be used.

The measurement method used and the maximum value for the peak power shall be recorded in the test report.

## 6.5.6 Exterior limit measurement

Not applicable.

## 6.5.7 Total Power

Not applicable.

## 6.5.8 Transmitter unwanted emissions

Not applicable.

## 6.6 Conformance methods of measurement for receiver

### 6.6.1 Receiver spurious emissions

Receiver spurious emissions measurements shall be as given in ETSI EN 303 883 [2], clause 7.4.5.

The measurement method, level and type (narrowband or wideband) of spurious emissions shall be recorded in the test report.

### 6.6.2 Receiver interference handling

Interference signal handling measurements shall be as given in clause 9 of ETSI TS 103 361 [3].

The interferer test frequency range, interferers and interferer power levels, test scenario, performance criterion and level of performance shall be recorded in the test report.

## 6.7 Conformance test suites for spectrum access

### 6.7.1 Detect and Avoid Mechanisms

Test Procedures for Detect and Avoid Mechanisms shall be as given in ETSI EN 303 883 [2], clause 7.4.7.

The following test parameter values shall be used:

$$\begin{aligned}m &= 10 \\n &= 5\end{aligned}$$

### 6.7.2 Listen Before Talk

Not applicable.

### 6.7.3 Low Duty Cycle

Test Procedures for Low Duty Cycle shall be as given in ETSI EN 303 883 [2], clause 7.4.8.

## 6.8 Conformance test suites for antenna requirements

Conformance shall be achieved by making available instructions which clearly identify a vertical axis and upwards orientation of the equipment, and which direct the user to install the equipment such that the unit's fixed orientation matches that axis and direction.

## 6.9 Other Test Suites

### 6.9.1 Transmit Power Control

Not applicable.

### 6.9.2 Activity Factor

Not applicable.

### 6.9.3 Frequency Domain Mitigation

Not applicable.

#### 6.9.4 Shielding Effects

Not applicable.

#### 6.9.5 Thermal Radiation

Not applicable.

#### 6.9.6 Installation requirements / site registration

The site registration conformance processes set out for LT2 terminals in ECC/REC(11)09 [i.8] and ECC Report 167 [i.10], and for LAES terminals in ECC/REC(11)10 [i.9] shall be followed.

## Annex A (normative): 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.18] 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.15].

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 302 065-2				
The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.15]				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	Operating Bandwidth	4.3.1	C	All transmitters under test
2	Maximum value of Mean Power Spectral Density	4.3.2	C	All transmitters under test
3	Maximum value of peak power	4.3.3	C	All transmitters under test
4	Other emissions	4.3.6	C	All transmitters under test
5	Receiver spurious emissions	4.4.2	C	Equipment which can operate in a receive-only mode or which is a receiver-only device
6	Receiver interference handling	4.4.3	C	Equipment with any receive capability
7	Detect-And-Avoid	4.5.1	C	Equipment which uses Detect-And-Avoid capability only
8	Low Duty Cycle	4.5.3	C	LT2 and LAES equipment only
9	Antenna characteristics and orientation	4.6.1	C	Fixed LT2 equipment only
10	Site Registration requirements	4.7.6	C	LT2 and LAES terminals only

### 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.

**Clause Number** 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 shall be unconditionally applicable (U) or is conditional upon the manufacturers claimed functionality of the equipment (C).

**Condition** Explains the conditions when the requirement shall or shall not be 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): Application form for testing

### B.1 Introduction

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the application form proforma in this annex so that it can be used for its intended purposes and may further publish the completed application form.

The form contained in this annex may be used by the supplier to comply with the requirement contained in clause X.Y.Z to provide the necessary information about the equipment to the test laboratory prior to the testing. It contains product information as well as other information which might be required to define which configurations are to be tested, which tests are to be performed as well the test conditions.

This application form should form an integral part of the test report.

### B.2 General information as required by ETSI EN 302 065-2, clause 5.2.1

#### B.2.1 Type of equipment (stand-alone, combined, plug-in radio device, etc.)

- Stand-alone
- Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
- Plug-in radio device (Equipment intended for a variety of host systems)
- Other .....

#### B.2.2 The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices

Details provided are for the:  stand-alone equipment  
 combined (or host) equipment  
 test jig

Supply Voltage  AC mains    State AC voltage    ..... V  
 DC                    State DC voltage    ..... V

In case of DC, indicate the type of power source

- Internal Power Supply
- External Power Supply or AC/DC adapter
- Battery
- Other: .....

## B.3 Signal-related information as required by ETSI EN 302 065-2, clause 4.3

### B.3.1 Introduction

In accordance with ETSI EN 302 065-2, clause 4.3, the following information should be provided by the supplier.

### B.3.2 Operating Bandwidth(s) of the equipment

- Operating Bandwidth 1: ..... MHz to ..... MHz
- Operating Bandwidth 2: ..... MHz to ..... MHz

NOTE: Add more lines if more Operating Bandwidths are supported.

### B.3.3 The worst case mode for each of the following tests

NOTE: In this clause specify the Operational mode and not the measured value. E.g. test mode 1...

- Operating Bandwidth(s)  
.....
- Mean Power Spectral Density / Peak Power Spectral Density / Exterior Limits / Total Power / Other Emissions / Transmitter unwanted emissions  
.....

## B.4 RX test Information as required by ETSI EN 302 06-2, clause 4.4

### B.4.1 Introduction

In accordance with ETSI EN 302 065-2, clause 4.4, the following information should be provided by the supplier.

### B.4.2 Performance criterion and level of performance

- performance criterion (e.g. accuracy, sensitivity)  
.....
- level of performance (e.g. for accuracy  $\pm 10\%$ , level of sensitivity)  
.....

### B.4.4 Interfering signals

Frequency [MHz]	Power [dBm]	Type of signal (e.g. CW, CW with DC, other modulation)

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## B.5 Information on spectrum access techniques as required by ETSI EN 302 065-2, clause 4.5

### B.5.1 Introduction

In accordance with ETSI EN 302 065-2, clause 4.5, the following information should be provided by the supplier.

### B.5.2 Spectrum access

NOTE 1: If a specific mode is used for testing these spectrum access techniques, it should be declared by the supplier.

NOTE 2: The table presented by the supplier will have different parameters for different mitigation techniques.

DAA

LDC

a)  Frequency range A

Frequency range B

Frequency range C

b) Ton, max

c) Toff, mean

d)  $\sum$ Toff in 1 s

e)  $\sum$ Ton in 1 h

f) Tdis

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## B.6 Information on antenna requirements as required by ETSI EN 302 065-2, clause 4.6

### B.6.1 Introduction

In accordance with ETSI EN 302 065-2, clause 4.6, the following information should be provided by the supplier for LT2 equipment.

### B.6.2 Antenna Requirements

Fixed use

Mobile use

For Fixed LT2 equipment:

Description of, and method of identification of vertical axis and upward direction of equipment: .....

## B.7 Additional information provided by the applicant

### B.7.1 About the UUT

- The equipment submitted are representative production models
- If not, the equipment submitted are pre-production models?
- If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested
- If not, supply full details  
 .....  
 .....
- The equipment submitted is CE marked
- In addition to the CE mark, the Class-II identifier (Alert Sign) is affixed

### B.7.2 Additional items and/or supporting equipment provided

- Spare batteries (e.g. for portable equipment)
- Battery charging device
- External Power Supply or AC/DC adapter
- Test Jig or interface box
- RF test fixture (for equipment with integrated antennas)
- Host System           Manufacturer: .....
- Model #: .....
- Model name: .....
- Combined equipment   Manufacturer: .....
- Model #: .....
- Model name: .....
- User Manual
- Technical documentation (Handbook and circuit diagrams)

## Annex C (normative): Equivalent mitigation techniques

### C.1 Equivalent mitigation techniques and LDC limits

Different mitigation techniques and mitigation factors can be taken into account for the calculation of the maximum allowed TX power of a UWB radio device as long as they reached mitigation factors are equivalent or higher than the mitigation factors reached using the presented techniques which have been accepted by the CEPT/ECC (e.g. ECC report 120 [i.6]).

**EXAMPLE:** Deployment of the radio device on a vehicle, which operates only in a restricted indoor area with higher wall attenuation, shielding or the deployment and installation of the UWB system in a controlled manner. The additional mitigation factors need to be weighed against the specific services to be protected and a similar approach has to be taken like e.g. in ECC report 120 [i.6].

The manufacturer shall provide compliance with the transmission emission limits in tables 2, 3, 4, 5, 6 and 7 when using equivalent mitigation techniques.

**NOTE:** Regulations in the Commission Decision 2007/131/EC [i.5] and its amendment allow for other equivalent mitigation techniques to be used across all frequency bands, where these offer at least equivalent protection to that provided by the limits in the decision.

Based on CEPT report 45 [i.13] the combinations of LDC limits and the transmitter emission limits as shown in table C.1, may give an equivalent protection as the current baseline LDC limits (see ECC/DEC/(06)04 [i.4], table 6).

### C.2 Test Procedure

The manufacturer shall provide sufficient information for determining compliance with the limits given in table C.1.

### C.3 Limit

The limits for equivalent LDC shall be as given in table C.1. These values are defined in CEPT report 45 [i.13].

**Table C.1: Limits for low duty cycle to have appropriate mitigation**

mean power spectral density limit (e.i.r.p.) [dBm/MHz]	Maximum transmitter on time % in 1 second	T <sub>on</sub> max [ms]	T <sub>off</sub> mean [ms]	∑ T <sub>on</sub> / 1sec [ms]	min ∑ T <sub>off</sub> / 1 sec [ms]	Long term LDC [sec in 1 hr]
-41,3	5	5	≥ 38	< 50	> 950	18
-44,3	10	10	≥ 38	< 100	> 900	36
-47,3	20	20	≥ 38	< 200	> 800	72
-50,3	40	40	≥ 38	< 400	> 600	144
-51,3	50	50	≥ 38	< 500	> 500	180

## Annex D (informative): Measurement antenna, preamplifier and cable specifications

The radiated measurements set-up in annex B of ETSI EN 303 883 [2] specifies the use of a horn antenna and a wide-band high gain preamplifier above 1 GHz in order to measure the very low radiated power density level from UWB equipment.

Table D.1 gives examples of recommended data and features for the horn antenna and preamplifier to be used for the test set-up.

**Table D.1: Recommended Hardware**

Device	Parameter	Value
Preamplifier LNA	Bandwidth	< 1 GHz to > 15 GHz
	NF	< 2,5 dB
	Gain	> 30 dB
	Gain flatness across band	±1,5 dB
	VSWR in/out across band	< 2:1
	Nominal impedance	50 Ω
RX Horn Antenna	3 dB bandwidth	< 1 GHz to > 15 GHz
	VSWR across band	< 1,5:1
	Gain (10GHz)	> 16 dBi
	Gain (8GHz)	> 14 dBi
	Gain (6GHz)	> 12,5 dBi
	Gain (2-5GHz)	> 10 dBi
Cable	Nominal impedance	50 Ω
	VSWR	< 1,2:1
	Shielding	> 60 dB
	Losses	Take losses into account for total gain calculations
NOTE:	The noise floor of the combined equipment should be at least 6 dB below the specified limits, but 10 dB would be optimal.	

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## Annex E (informative): Bibliography

ERA Report 2006-0713: "Conducted and radiated measurements for low level UWB emissions".

ETSI TR 102 070-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide to the application of harmonized standards to multi-radio and combined radio and non-radio equipment; Part 2: Effective use of the radio frequency spectrum".

ETSI TR 102 273 (V1.2.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".

ETSI TR 101 538: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); UWB location tracking devices in the railroad environment".

ETSI TS 103 085 (10-2012): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band (UWB) for Location and Tracking railroad applications; RF conformance testing".

ETSI TS 103 060: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Method for a harmonized definition of Low Duty Cycle transmission (LDC) as a passive mitigation technique used by short range devices and related conformance test methods".

ETSI EN 301 489-33 (V2.1.0): "ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Harmonised Standard covering the essential requirements of article 3.1b of the Directive 2014/53/EU; Part 33: Specific conditions for Ultra Wide Band (UWB) devices".

Commission Decision 2009/343/EC of 21 April 2009 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document number C(2009) 2787).

Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.

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## History

<b>Document history</b>		
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V2.1.0	April 2016	EN Approval Procedure AP 20160717: 2016-04-18 to 2016-07-18