



**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Short Range Devices (SRD) using  
Ultra Wide Band technology (UWB);  
Harmonized EN covering the essential requirements  
of article 3.2 of the R&TTE Directive;  
Part 1: Requirements for Generic UWB applications**

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**Reference**

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## Foreword

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

The present document has been produced by ETSI in response to mandate M/407 issued from the European Commission under Council Directive 98/34/EC [i.14] as amended by Directive 98/48/EC [i.16].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.15].

See article 5.1 of Directive 1999/5/EC [i.15] for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

The requirements relevant to Directive 1999/5/EC [i.15] are summarized in Annex A.

The present document is part 1 of a multi-part deliverable covering Short Range Devices (SRD) using Ultra Wide Band technology (UWB), as identified below:

**Part 1: "Requirements for Generic UWB Applications";**

Part 2 "Requirements for UWB location tracking";

Part 3: "Requirements for UWB devices for road and rail vehicles".

| Proposed national transposition dates                                                  |                                  |
|----------------------------------------------------------------------------------------|----------------------------------|
| Date of latest announcement of this EN (doa):                                          | 3 months after ETSI consultation |
| 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              |

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# Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [i.15]. The modular structure is shown in EG 201 399 [i.1].

## UWB Technologies

The present document provides a generic set of technical requirements covering many different types of UWB technologies used for short range communications. These technologies can be broken down into two groups:

- Impulse based technologies; and
- RF carrier based technologies.

The following clauses give a brief overview of these UWB technologies and their associated modulation techniques.

### Impulse technology

Impulse derived UWB technology consists of a series of impulses created from a dc voltage step whose rise time can be modified to provide the maximum useful number of spectral emission frequencies. This derived impulse can then be suitably modified by the use of filters to locate the resulting waveform within a specific frequency spectrum range. This filter can be a standalone filter or incorporated into an antenna design to reduce emissions outside the designated frequency spectrum.

Modulation techniques include pulse positioning in time, pulse suppression and other techniques to convey information.

### RF carrier based technology

RF carrier based UWB technology is based upon classical radio carrier technology suitably modulated by a baseband modulating process. The modulating process should produce a bandwidth in excess of 50 MHz to be defined as UWB.

Different modulating processes are used to transmit the data information to the receiver and can consist of a series of single hopping frequencies or multi-tone carriers.

This technology can be used for both direct and non-direct line of sight communications, any reflected or time delayed emissions being suppressed by the receiver input circuits.

# 1 Scope

The present document applies to transceivers, transmitters and receivers utilizing Ultra WideBand (UWB) technologies and used for short range applications.

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

The present document applies to fixed (indoor only), mobile or portable applications, e.g.:

- 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.

NOTE: As per the ECC/DEC/(06)04 [i.2], CEPT report 45 [i.17] and Decision 2007/131/EC [i.8] and its amendment the UWB transmitter equipment conforming to the present document is not to be installed at a fixed outdoor location, for use in flying models, aircraft and other forms of aviation. The present document applies to UWB equipment with an output connection used with a dedicated antenna or UWB equipment with an integral antenna.

Equipment covered by the present document operates in accordance with ECC/DEC(06)04 [i.2] "The harmonised conditions for devices using Ultra-Wideband (UWB) technology in bands below 10.6 GHz".

These radio equipment types are capable of operating in all or part of the frequency bands given in Table 1.

**Table 1: Operating frequency bands**

| Operating frequency bands                                                                                                                                                  |                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Transmit                                                                                                                                                                   | 3,1 GHz to 4,8 GHz |
| Receive                                                                                                                                                                    | 3,1 GHz to 4,8 GHz |
| Transmit                                                                                                                                                                   | 6,0 GHz to 9 GHz   |
| Receive                                                                                                                                                                    | 6,0 GHz to 9 GHz   |
| NOTE: The UWB radio device can also operate outside of the operating frequency bands shown in the present table provided that the limits in clause 4.2.3, Table 2 are met. |                    |

The present document does not apply to radio equipment for which a specific Harmonized EN applies as such Harmonized EN may specify additional EN requirements relevant to the presumption of conformity under article 3.2 of the R&TTE Directive [i.15].

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## 2 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 <http://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.

### 2.1 Normative references

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

- [1] Void.
- [2] ETSI TS 102 883 (V1.1.1) (08-2012): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band (UWB); Measurement Techniques".
- [3] 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".
- [4] ETSI TR 100 028 (V1.4.1) (all parts) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [5] ETSI EN 301 489-33 (V1.1.1) (02-2009): "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 33: Specific conditions for Ultra Wide Band (UWB) communications devices".

### 2.2 Informative references

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] 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.3] Void.
- [i.4] Void.
- [i.5] ETSI TR 103 086: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Conformance test procedure for the exterior limit tests in EN 302065-3 UWB applications in the ground based vehicle environment".
- [i.6] Void.
- [i.7] 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.8] 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).

NOTE: This EC Decision is currently under revision based on CEPT report 45 [i.17] and amended ECC/DEC(06)04 [i.2]. The new EC/DEC revision is expected within 2014.

- [i.9] Void.
- [i.10] Void.
- [i.11] CEPT/ERC Recommendation 74-01: "Unwanted emissions in the spurious domain".
- [i.12] ETSI TS 102 902 (02-2011): "Electromagnetic compatibility and radio spectrum matters (ERM); Methods, parameters and test procedures for cognitive interference mitigation towards ER-GSM for use by UHF RFID using Detect-And-Avoid (DAA) or other similar techniques".
- [i.13] Void.
- [i.14] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.
- [i.15] 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.16] 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.
- [i.17] 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.

---

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**avoidance level:** maximum amplitude to which the UWB transmit power is set for the relevant protection zone

**combined equipment:** any combination of non-radio equipment and a plug-in radio device that would not offer full functionality without the radio device

**dedicated antenna:** removable antenna supplied and tested with the radio equipment, designed as an indispensable part of the equipment

**default avoidance bandwidth:** portion of the victim service bandwidth to be protected if no enhanced service bandwidth identification mechanisms are implemented in the DAA enabled devices

**detect and avoid time:** time duration between a change of the external RF environmental conditions and adaptation of the corresponding UWB operational parameters

**detection probability:** probability that the DAA enabled UWB radio device reacts appropriately to a signal detection threshold crossing within the detect and avoid time

**effective radiated power (e.r.p.):** product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction (RR 1.162)

**equivalent isotropically radiated power (e.i.r.p.):** product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain) (RR 1.161)

**gating:** transmission that is intermittent or of a low duty cycle referring to the use of burst transmissions where a transmitter is switched on and off for selected time intervals

**hopping:** spread spectrum technique whereby individual radio links are continually switched from one subchannel to another

**host:** host equipment is any equipment which has complete user functionality when not connected to the radio equipment part and to which the radio equipment part provides additional functionality and to which connection is necessary for the radio equipment part to offer functionality

**impulse:** pulse whose width is determined by its dc step risetime and whose maximum amplitude is determined by its dc step value

**integral antenna:** permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

**maximum avoidance power level:** UWB transmit power assuring the equivalent protection of the victim service

**minimum avoidance bandwidth:** portion of the victim service bandwidth requiring protection

**minimum initial channel availability check time:** minimum time the UWB radio device spends searching for victim signals after power on, Parameter:  $T_{avail, Time}$

**narrowband:** equipment to be used in a non-channelized continuous frequency band with an occupied bandwidth of equal or less than 25 kHz, or equipment to be used in a channelized frequency band with a channel spacing of equal or less than 25 kHz

**Non-Interference mode operation (NIM):** operational mode that allows the use of the radio spectrum on a non-interference basis without active mitigation techniques

**plug-in radio device:** radio equipment module intended to be used with or within host, combined or multi-radio equipment, using their control functions and power supply

**pulse:** short transient signal whose time duration is nominally the reciprocal of its -10 dB bandwidth

**rf carrier:** fixed radio frequency prior to modulation

**signal detection threshold:** amplitude of the victim signal which defines the transition between adjacent protection zones, Parameter:  $D_{thresh}$

NOTE: The threshold level is defined to be the signal level at the receiver front end of the UWB DAA radio device and assuming a 0 dBi receive antenna.

**signal detection threshold set:** set of amplitudes of the victim signal which defines the transition between adjacent protection zones

**stand-alone radio equipment:** equipment that is intended primarily as communications equipment and that is normally used on a stand-alone basis

**transmitter on time ( $T_{on}$ ):** duration of a burst irrespective of the number of pulses contained

**transmitter off time ( $T_{off}$ ):** time interval between two consecutive bursts when the UWB emission is kept idle

**victim signal:** signal(s) of the service to be detected and protected by the DAA mitigation technique

**zone model:** flexible DAA concept based on the definition of different zones as defined in TS 102 754 [3]

## 3.2 Symbols

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

|           |                      |
|-----------|----------------------|
| $\alpha$  | elevation angle      |
| d         | distance             |
| $\Theta$  | elevation angle      |
| f         | frequency            |
| $\lambda$ | wavelength           |
| k         | coverage factor      |
| $\phi$    | azimuth angle        |
| Ton       | transmitter on time  |
| Toff      | transmitter off time |

## 3.3 Abbreviations

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

|          |                                                                      |
|----------|----------------------------------------------------------------------|
| CEPT     | European Conference of Postal and Telecommunications Administrations |
| DAA      | Detect And Avoid                                                     |
| DC       | Direct Current                                                       |
| DUT      | Device Under Test                                                    |
| e.i.r.p. | equivalent isotropically radiated power                              |
| e.r.p.   | equivalent radiated power                                            |
| EC       | European Commission                                                  |
| ECC      | European Communication Commission                                    |
| EN       | European Norm                                                        |
| EUT      | Equipment Under Test                                                 |
| LDC      | Low Duty Cycle                                                       |
| LNA      | Low Noise Amplifier                                                  |
| NF       | Noise Figure                                                         |
| REC      | RECommendation                                                       |
| RF       | Radio Frequency                                                      |
| RX       | Receiver                                                             |
| TR       | Technical Report                                                     |
| TS       | Technical Specification                                              |
| TX       | Transmitter                                                          |
| UWB      | Ultra WideBand                                                       |
| VSWR     | Voltage Standing Wave Ratio                                          |

---

## 4 Technical requirements specification

### 4.1 Operating bandwidth

#### 4.1.1 Definition of operating bandwidth for test procedure

The operating bandwidth is the -13 dBc bandwidth of intended UWB signal transmitted by the equipment.

#### 4.1.2 Test procedure

For the purposes of the present document the measurements are made at the -13 dB points.

This test shall be performed using a radiated test procedure as specified in clause 7.5.

For UWB devices which are intended to operate at a mean power spectral density of -65 dBm/MHz or less, the test shall be performed using a conducted test procedure as given in TS 102 883 [2], clause 6.

### 4.1.3 Limit

The operating bandwidth shall be greater than 50 MHz (at -13 dB relative to the maximum spectral power density).

### 4.1.4 Measurement uncertainty

The interpretation of the results for the measurements uncertainty shall be as given in TS 102 883 [2], clause 5.7, Table 1.

## 4.2 Maximum value of mean power spectral density

### 4.2.1 Definition

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.

### 4.2.2 Test procedure

This test shall be performed using the method of measurement as specified in clause 7.2 and the radiated test procedure as specified in clause 7.3 for the frequencies as shown in Table 2.

### 4.2.3 Limit

The maximum mean power spectral density measured using the above test procedure shall not exceed the limits given in Table 2. The limit applies to the highest value found for this power (converted to an e.i.r.p.) over all frequencies, times and operating modes. It is also the highest value found over all directions, either as part of the e.i.r.p. measurement method or by using the maximum antenna gain with a conducted power measurement [2].

**Table 2: Maximum value of mean power spectral density limit (e.i.r.p.) [i.17]**

| Frequency range [GHz]  | Without mitigation techniques | With mitigation techniques    |
|------------------------|-------------------------------|-------------------------------|
| $f \leq 1,6$           | -90 dBm/MHz                   | -90 dBm/MHz                   |
| $1,6 < f \leq 2,7$     | -85 dBm/MHz                   | -85 dBm/MHz                   |
| $2,7 < f \leq 3,1$ GHz | -70 dBm/MHz                   | -70 dBm/MHz                   |
| $3,1 < f \leq 3,4$     | -70 dBm/MHz                   | -41,3 dBm/MHz (notes 1 and 2) |
| $3,4 < f \leq 3,8$     | -80 dBm/MHz                   | -41,3 dBm/MHz (notes 1 and 2) |
| $3,8 < f \leq 4,2$     | -70 dBm/MHz                   | -41,3 dBm/MHz (notes 1 and 2) |
| $4,2 < f \leq 4,8$     | -70 dBm/MHz                   | -41,3 dBm/MHz (notes 1 and 2) |
| $4,8 < f \leq 6$       | -70 dBm/MHz                   | -70 dBm/MHz                   |
| $6 < f \leq 8,5$       | -41,3 dBm/MHz                 | -41,3 dBm/MHz                 |
| $8,5 < f \leq 9$       | -65 dBm/MHz                   | -41,3 dBm/MHz (note 2)        |
| $9 < f \leq 10,6$      | -65 dBm/MHz                   | -65 dBm/MHz                   |
| $10,6 < f$             | -85 dBm/MHz                   | -85 dBm/MHz                   |

NOTE 1: Within the band 3,1 GHz to 4,8 GHz, devices implementing **Low Duty Cycle (LDC) mitigation technique** [3] and [i.17] are permitted to operate with a maximum mean e.i.r.p. spectral density of -41,3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz.

NOTE 2: Within the bands 3,1 GHz to 4,8 GHz and 8,5 GHz to 9 GHz, devices implementing **Detect And Avoid (DAA) mitigation technique** [3] and [i.17] are permitted to operate with a maximum mean e.i.r.p. spectral density of -41,3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz.

NOTE: Table 2 is based upon CEPT 45 [i.17]. The EC/DEC on UWB [i.8] is currently under revision. The amended EC/DEC is expected within 2014.

## 4.2.4 Measurement uncertainty

The interpretation of the results for the measurements uncertainty shall be as given in TS 102 883 [2], clause 5.7, Table 1.

## 4.3 Maximum value of peak power

### 4.3.1 Definition

The 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.

### 4.3.2 Test procedure

This test shall be performed using the method of measurement as specified in clause 7.2 and the radiated test procedure as specified in clause 7.4.

### 4.3.3 Limit

The maximum peak power limit measured using the above test procedure shall not exceed the limits given in Table 3. The limit applies to the highest value found for this power (converted to an e.i.r.p.) over all frequencies, times and operating modes. It is also the highest value found over all directions, either as part of the e.i.r.p. measurement method or by using the maximum antenna gain with a conducted power measurement [2].

**Table 3: Maximum peak power limit [i.17]**

| Frequency range [GHz]                                                                                                                                                                                                                                                                                    | Without mitigation techniques<br>(defined in 50MHz) | With mitigation techniques<br>(defined in 50MHz) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------|
| $f \leq 1,6$                                                                                                                                                                                                                                                                                             | -50 dBm                                             | -50 dBm                                          |
| $1,6 < f \leq 2,7$                                                                                                                                                                                                                                                                                       | -45 dBm                                             | -45 dBm                                          |
| $2,7 < f \leq 3,1$ GHz                                                                                                                                                                                                                                                                                   | -45 dBm                                             | -45 dBm                                          |
| $3,1 < f \leq 3,4$                                                                                                                                                                                                                                                                                       | -36 dBm                                             | 0 dBm (notes 1 and 2)                            |
| $3,4 < f \leq 3,8$ (notes 1 and 2)                                                                                                                                                                                                                                                                       | -40 dBm                                             | 0 dBm (notes 1 and 2)                            |
| $3,8 < f \leq 4,2$ (notes 1 and 2)                                                                                                                                                                                                                                                                       | -30 dBm                                             | 0 dBm (notes 1 and 2)                            |
| $4,2 < f \leq 4,8$ (notes 1 and 2)                                                                                                                                                                                                                                                                       | -30 dBm                                             | 0 dBm (notes 1 and 2)                            |
| $4,8 < f \leq 6$                                                                                                                                                                                                                                                                                         | -30 dBm                                             | -30 dBm                                          |
| $6 < f \leq 8,5$                                                                                                                                                                                                                                                                                         | 0 dBm                                               | 0 dBm                                            |
| $8,5 < f \leq 9$ (note 2)                                                                                                                                                                                                                                                                                | -25 dBm                                             | 0 dBm (note 2)                                   |
| $9 < f \leq 10,6$                                                                                                                                                                                                                                                                                        | -25 dBm                                             | -25 dBm                                          |
| $10,6 < f$                                                                                                                                                                                                                                                                                               | -45 dBm                                             | -45 dBm                                          |
| NOTE 1: Within the band 3,1 GHz to 4,8 GHz, devices implementing <b>Low Duty Cycle (LDC) mitigation technique</b> [3] and [i.17] are permitted to operate with a maximum mean e.i.r.p. spectral density of -41,3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz.                         |                                                     |                                                  |
| NOTE 2: Within the bands 3,1 GHz to 4,8 GHz and 8,5 GHz to 9 GHz, devices implementing <b>Detect And Avoid (DAA) mitigation technique</b> [3] and [i.17] are permitted to operate with a maximum mean e.i.r.p. spectral density of -41,3 dBm/MHz and a maximum peak e.i.r.p. of 0 dBm defined in 50 MHz. |                                                     |                                                  |

NOTE: Table 3 is based upon CEPT 45 [i.17]. The EC/DEC on UWB [i.8] is currently under revision. The amended EC/DEC is expected within 2014.

For pulse based modulation the power reading on the spectrum analyser can be directly related to the peak power limit when a spectrum analyser resolution bandwidth of 50 MHz is used for the measurements. If a spectrum analyser resolution bandwidth of X MHz is used instead, the maximum peak power limit shall be scaled down by a factor of  $20 \log (50/X)$ , where X represents the measurement bandwidth used.

EXAMPLE: If the maximum peak power in a particular frequency band is 0 dBm/50 MHz, and a 3 MHz resolution bandwidth is used in case of an impulsive technology, then the measured value should not exceed -24,4 dBm (see [2], clause A.3).

For rf carrier based modulation using multi-tone carriers and not having gating techniques implemented, the maximum peak power limit shall be scaled down by a different factor of  $10 \log(50/X)$ , where X represents the measurement bandwidth used.

Details for the correction factor, see TS 102 883 [2], clause A.3.

#### 4.3.4 Measurement uncertainty

The interpretation of the results for the measurements uncertainty shall be as given in TS 102 883 [2], clause 5.7, Table 1.

### 4.4 Receiver spurious emissions

#### 4.4.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode. Consequently, receiver spurious emission testing applies only when the equipment can work in a receive-only mode.

#### 4.4.2 Test procedure

The radiated test procedures as defined in clause 7.6 shall be used.

#### 4.4.3 Limit

The narrowband spurious emissions of the receiver shall not exceed the values in Table 4 in the indicated bands (see CEPT/ERC/REC 74-01 [i.11]).

**Table 4: 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 5.

**Table 5: 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.) |

#### 4.4.4 Measurement uncertainty

The interpretation of the results for the measurements uncertainty shall be as given in TS 102 883 [2], clause 5.7, Table 1.

### 4.5 Detect And Avoid (DAA)

#### 4.5.1 Definition

Detect And Avoid (DAA) is a technology used to protect radio communication services by avoiding co channel operation.

NOTE: Before transmitting, a system should sense the channel within its operative bandwidth in order to detect the possible presence of other systems. If another system is detected, the first system should avoid transmission until the detected system disappears [i.12].

## 4.5.2 Test procedure

DAA Test Procedure shall be done as given in TS 102 754 [3], Annex D.

## 4.5.3 Limit

Limits DAA parameters sets shall be as given in TS 102 754 [3], Annexes A to C.

## 4.5.4 Measurement Tolerance

Measurement tolerance for detection probabilities shall be as given in TS 102 754 [3], Annexes A to C.

# 4.6 Low Duty Cycle (LDC)

## 4.6.1 Definition

Duty Cycle is the defined as the cumulative transmitter on time over a defined period of time, which is the observation period.

## 4.6.2 Test procedure

The manufacturer shall provide sufficient information for determining compliance with the limits given in Table 6.

## 4.6.3 Limit

The baseline limits for LDC shall be as given in Table 6. These values are defined in [i.2].

**Table 6: Baseline limits for low duty cycle**

| Parameter                   |             | Limit                            |
|-----------------------------|-------------|----------------------------------|
| Maximum transmitter on time | Ton max     | 5 ms                             |
| Mean transmitter off time   | Toff mean   | $\geq 38$ ms (averaged over 1 s) |
| Sum transmitter off time    | $\sum$ Toff | $> 950$ ms per second            |
| Sum transmitter on time     | $\sum$ Ton  | $< 18$ s per hour                |

# 4.7 Equivalent mitigation techniques

## 4.7.1 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 the 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.7]).

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.7].

The manufacturer shall provide compliance with the transmission emission limits in Tables 2 and 3 when using equivalent mitigation techniques.

NOTE: Regulations in the EC decision 2007/131/EC [i.8] 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.17] the combinations of LDC limits and the transmitter emission limits as shown in Table 7, may give an equivalent protection as the current baseline LDC limits (see Table 6, [i.2]).

#### 4.7.1.1 Test procedure

The manufacturer shall provide sufficient information for determining compliance with the limits given in Table 7.

#### 4.7.1.2 Limit

The limits for equivalent LDC shall be as given in Table 7. These values are defined in [i.17].

**Table 7: 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] | $\sum T_{on} / 1\text{sec}$ [ms] | min $\sum T_{off} / 1\text{sec}$ [ms] | Long term LDC [sec in 1hr] |
|--------------------------------------------------------|-------------------------------------------|--------------------------|----------------------------|----------------------------------|---------------------------------------|----------------------------|
| -41,3                                                  | 5                                         | 5                        | $\geq 38$                  | $< 50$                           | $> 950$                               | 18                         |
| -44,3                                                  | 10                                        | 10                       | $\geq 38$                  | $< 100$                          | $> 900$                               | 36                         |
| -47,3                                                  | 20                                        | 20                       | $\geq 38$                  | $< 200$                          | $> 800$                               | 72                         |
| -50,3                                                  | 40                                        | 40                       | $\geq 38$                  | $< 400$                          | $> 600$                               | 144                        |
| -51,3                                                  | 50                                        | 50                       | $\geq 38$                  | $< 500$                          | $> 500$                               | 180                        |

## 5 Test Requirements

### 5.1 Product information

See TS 102 883 [2], clause 5.2.

### 5.2 Requirements for the test modulation

See TS 102 883 [2], clause 5.3.

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

See TS 102 883 [2], clause 5.4.

### 5.4 Choice of equipment for test suites

See TS 102 883 [2], clause 5.5.

#### 5.4.1 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.



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

See TS 102 883 [2], clause 5.6.

## 5.6 Interpretation of the measurement results

The interpretation of the results for the measurements described in the present document shall be as follows:

- 1) the measured value related to the corresponding limit shall be used to decide whether equipment meets the requirements of the present document;
- 2) the measurement uncertainty value for the measurement of each parameter shall be recorded;
- 3) the recorded value of the measurement uncertainty shall be wherever possible, for each measurement, equal to or lower than the figures in Table 8, and the interpretation procedure specified in clauses 5.6.1 and 5.6.2 shall be used.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with the guidance provided in TR 100 028 [4] and shall correspond to an expansion factor (coverage factor)  $k = 1,96$  or  $k = 2$  (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 8 is based on such expansion factors.

**Table 8: Maximum measurement uncertainty [2]**

| Parameter                                                                                                                                                                                                                                                                                                                                                                                                                    | Uncertainty            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Radio Frequency                                                                                                                                                                                                                                                                                                                                                                                                              | $\pm 1 \times 10^{-5}$ |
| all emissions, radiated                                                                                                                                                                                                                                                                                                                                                                                                      | $\pm 6$ dB (see note)  |
| Conducted                                                                                                                                                                                                                                                                                                                                                                                                                    | $\pm 3$ dB             |
| temperature                                                                                                                                                                                                                                                                                                                                                                                                                  | $\pm 1$ °C             |
| Humidity                                                                                                                                                                                                                                                                                                                                                                                                                     | $\pm 5$ %              |
| DC and low frequency voltages                                                                                                                                                                                                                                                                                                                                                                                                | $\pm 3$ %              |
| NOTE: For radiated emissions measurements below 2,7 GHz and above 10,6 GHz it may not be possible to reduce measurement uncertainty to the levels specified in Table 1 (due to the very low signal level limits and the consequent requirement for high levels of amplification across wide bandwidths). In these cases alone it is acceptable to employ the alternative interpretation procedure specified in clause 5.6.2. |                        |

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

The interpretation of the results when comparing measurement values with specification limits shall be as follows:

- a) When the measured value exceeds the limit value within the range of the measurement uncertainty the equipment under test meets the requirements of the present document.
- b) The measurement uncertainty calculated by the test technician carrying out the measurement shall be recorded in the test report.
- c) The measurement uncertainty calculated by the test technician may be a maximum value for a range of values of measurement, or may be the measurement uncertainty for the specific measurement undertaken. The method used shall be recorded in the test report.

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

The interpretation of the results when comparing measurement values with specification limits shall be as follows:

- a) When the measured value plus the difference between the maximum acceptable measurement uncertainty and the measurement uncertainty calculated by the test technician does not exceed the limit value plus the maximum acceptable measurement uncertainty the equipment under test meets the requirements of the present document.
- b) When the measured value plus the difference between the maximum acceptable measurement uncertainty and the measurement uncertainty calculated by the test technician exceeds the limit value within the range of the measurement uncertainty the equipment under test does not meet the requirements of the present document.
- c) The measurement uncertainty calculated by the test technician carrying out the measurement shall be recorded in the test report.
- d) The measurement uncertainty calculated by the test technician may be a maximum value for a range of values of measurement, or may be the measurement uncertainty for the specific measurement undertaken. The method used shall be recorded in the test report.

## 5.7 Emissions

UWB transmitters emit very low power radio signals, comparable with the power of spurious emissions from digital and analogue circuitry. If it can be clearly demonstrated that an emission from the ultra-wideband radio device is not the ultra-wideband emission identified in clause 7.6 (e.g. by disabling the radio device's UWB transmitter or disconnecting and terminating, internally or externally the antenna of the device) or it can clearly be demonstrated that it is impossible to differentiate between other emissions and the UWB transmitter emissions, that emission or aggregated emissions shall be considered against the receiver spurious emissions limits defined in the relevant harmonized standard.

See TS 102 883 [2], clauses 7.2.5 and 7.2.6 and [5].

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## 6 Test setups and procedures

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

### 6.1 Introduction

See TS 102 883 [2], clause 6.1.

### 6.2 Initial Measurement steps

See TS 102 883 [2], clause 6.2.

### 6.3 Radiated measurements

#### 6.3.1 General

See TS 102 883 [2], clause 6.3.1.

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

See TS 102 883 [2], clause 6.3.2.

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

See TS 102 883 [2], clause 6.3.3.

#### 6.3.3.1 Range length

The range length for all these types of test facility shall be adequate to allow for testing in the far field of the EUT i.e. it shall be equal to or exceed:

$$\frac{2(d_1 + d_2)^2}{\lambda}$$

Where:

$d_1$  is the largest dimension of the EUT/dipole after substitution (m);

$d_2$  is the largest dimension of the test antenna (m);

$\lambda$  is the test frequency wavelength (m).

It should be noted that in the substitution part of this measurement, where both test and substitution antennas are half wavelength dipoles, this minimum range length for far-field testing would be:

$$2\lambda$$

It should be noted in test reports when either of these conditions is not met so that the additional measurement uncertainty can be incorporated into the results.

NOTE 1: For the fully anechoic chamber, no part of the volume of the EUT should, at any angle of rotation of the turntable, fall outside the "quiet zone" of the chamber at the nominal frequency of the test.

NOTE 2: The "quiet zone" is a volume within the anechoic chamber (without a ground plane) in which a specified performance has either been proven by test, or is guaranteed by the designer/manufacture. The specified performance is usually the reflectivity of the absorbing panels or a directly related parameter (e.g. signal uniformity in amplitude and phase). It should be noted however that the defining levels of the quiet zone tend to vary.

It is not necessary to measure at ranges larger than 3 m, because sufficient accuracy is achieved even for a whole car. Larger distances lead to sensitivity issues for the exterior limit, which need to be taken into account. More information about the impact of the distance on the measurement accuracy can be found in TR 103 086 [i.5].

### 6.3.4 Coupling of signals

See TS 102 883 [2], clause 6.3.4.

### 6.3.5 Standard test methods

Three test methods are defined for determining the radiated power of a radio device. Each method is further divided into two procedures for calibrated and not calibrated measurement setups.

#### 6.3.5.1 Generic measurement method

##### 6.3.5.1.1 Calibrated setup

The measurement receiver, test antenna and all associated equipment (e.g. cables, filters, amplifiers, etc.) shall have been recently calibrated against known standards at all the frequencies on which measurements of the equipment are to be made. A suggested calibration method is given in clause 6.3.6.

If an anechoic chamber with conductive ground plane is used, the ground shall be covered by absorbing material in the area of the direct ground reflection from the DUT to the test antenna.

On a test site according to clause 6.3, the equipment shall be placed at the specified height on a support, and in the position closest to normal use as declared by the provider. If the maximum of the antenna/transmission pattern is not known a full spherical scan according to clause 6.3.5.2 or 6.3.5.3 shall be performed.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser via whatever (fully characterized) equipment is required to render the signal measurable (e.g. amplifiers).

The transmitter shall be switched on, if possible without modulation, and the spectrum analyser shall be tuned to the frequency of the transmitter under test.

The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the spectrum analyser.

The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the spectrum analyser.

The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the spectrum analyser.

The test antenna shall be rotated to horizontal polarization and the measurement procedure shall be repeated.

The maximum signal level detected by the spectrum analyser shall be noted and converted into the radiated power by application of the pre-determined calibration coefficients for the equipment configuration used.

#### 6.3.5.1.2 Substitution method

On a test site, selected from clause 6.3.2, the equipment shall be placed at the specified height on a support, as specified in clause 6.3.2, and in the position closest to normal use as declared by the provider. If the maximum of the antenna/transmission pattern is not known a full spherical scan according to clause 6.3.5.2 or 6.3.5.3 shall be performed.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser.

The transmitter shall be switched on, if possible without modulation, and the measuring receiver shall be tuned to the frequency of the transmitter under test.

The test antenna shall be raised and lowered through the specified range of height until a maximum signal level is detected by the spectrum analyser.

The transmitter shall then be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the spectrum analyser.

The test antenna shall be raised and lowered again through the specified range of height until a maximum signal level is detected by the spectrum analyser.

The maximum signal level detected by the spectrum analyser shall be noted.

The transmitter shall be replaced by a substitution antenna as defined in clause 6.3.2.4 in [2].

The substitution antenna shall be orientated for vertical polarization. The substitution antenna shall be connected to a calibrated signal generator.

If necessary, the input attenuator setting of the spectrum analyser shall be adjusted in order to increase the sensitivity of the spectrum analyser.

The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received. When a test site according clause 6.3.2.1 in [2] is used, the height of the antenna shall not be varied.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the spectrum analyser, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the spectrum analyser.

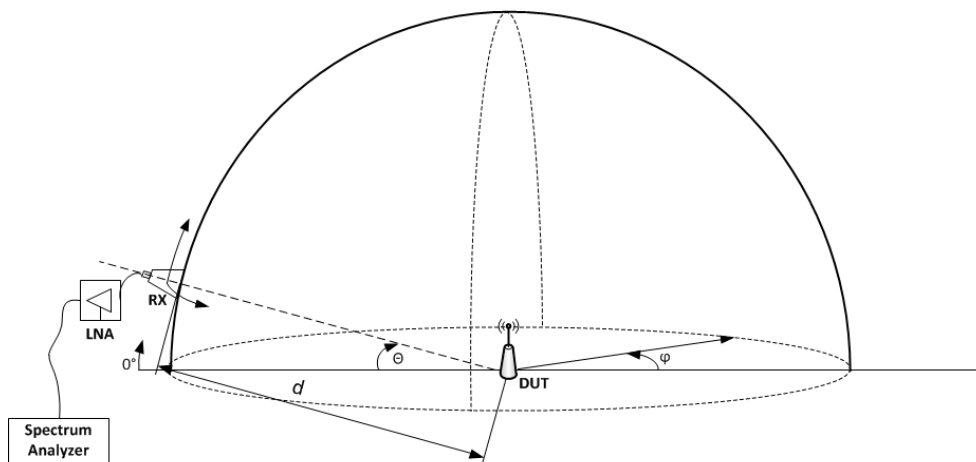
The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the spectrum analyser.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the radiated power of the radio device is the larger of the two levels recorded at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

### 6.3.5.2 Spherical scan with automatic test antenna placement

Figure 1 shows the spherical measurement method using automatic test antenna placement. The RX antenna moveable and it is mounted for example on an automatic arm, which moves the antenna stepwise on a sphere around the DUT.



**Figure 1: Spherical scan setup using automatic test antenna placement**

The maximum measurement step size for the azimuth angle  $\varphi$  and for the elevation angle  $\Theta$  is smaller or equal to  $5^\circ$ . In a half sphere scan  $\varphi$  is varied from  $0^\circ$  to  $360^\circ$  and  $\Theta$  is changed from  $0^\circ$  to  $90^\circ$ . Therefore the DUT has to be mounted according to the typical usage in the application. If a full sphere scan shall be performed, then the device can be tilted by  $180^\circ$  and the half sphere shall be measured again. The scan shall be performed at a distance given by clause 6.3.3.1.

NOTE: Another relation of the angles is possible, but the coverage of the whole spheres should be ensured.

#### 6.3.5.2.1 Calibrated setup

The measurement receiver, test antenna and all associated equipment (e.g. cables, filters, amplifiers, etc.) shall have been recently calibrated against known standards at all the frequencies on which measurements of the equipment are to be made. A suggested calibration method is given in clause 6.3.6.

If an anechoic chamber with conductive ground plane is used, the ground shall be covered by absorbing material in the area of the direct ground reflection from the DUT to the test antenna.

The equipment shall be placed in an anechoic chamber (compare clauses 6.3.2.1 and 6.3.2.2 in [2]), which allows the spherical scan. The DUT shall be placed closest to the orientation of normal operation.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser via whatever (fully characterized) equipment is required to render the signal measurable (e.g. amplifiers).

The transmitter shall be switched on, if possible without modulation, and the spectrum analyser shall be tuned to the frequency of the transmitter under test.

The RX antenna shall be moved stepwise on the sphere and in each location the signal level shall be noted.

After all locations have been reached, the measurement procedure shall be repeated for horizontal polarized test antenna orientation.

The maximum signal level detected by the spectrum analyser shall be noted and converted into the radiated power by application of the pre-determined calibration coefficients for the equipment configuration used.

#### 6.3.5.2.2 Substitution method

The equipment shall be placed in an anechoic chamber, which allows the spherical scan (compare clauses 6.3.2.1 and 6.3.2.2 in [2]). The DUT shall be placed closest to the orientation of normal operation.

If an anechoic chamber with conductive ground plane is used, the ground shall be covered by absorbing material in the area of the direct ground reflection from the DUT to the test antenna.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser.

The transmitter shall be switched on, if possible without modulation, and the measuring receiver shall be tuned to the frequency of the transmitter under test.

The RX antenna shall be moved stepwise on the sphere and in each location the signal level and its coordinates shall be noted.

After all locations have been reached, the maximum signal level and its coordinates shall be determined.

The transmitter shall be replaced by a substitution antenna as defined in clause 6.3.2.4 in [2].

The substitution antenna shall be orientated for vertical polarization.

The substitution antenna shall be connected to a calibrated signal generator.

If necessary, the input attenuator setting of the spectrum analyser shall be adjusted in order to increase the sensitivity of the spectrum analyser.

If an anechoic chamber with a conductive ground plane is used, then the substitution antenna shall be moved to the position of the previous maximum. The test antenna shall be moved around this position of the substitution antenna within at least five times the wavelength of the center frequency on the sphere to find the local maximum.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the spectrum analyser, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the spectrum analyser.

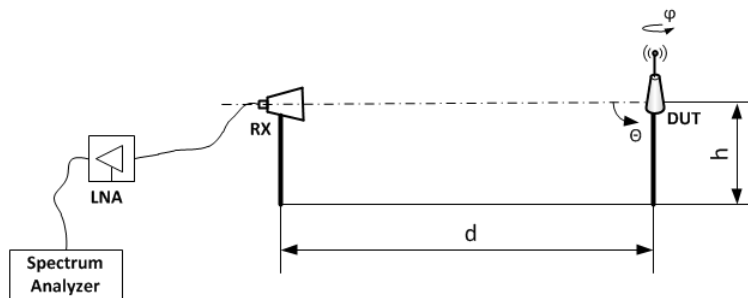
The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the spectrum analyser.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the radiated power of the radio device is the larger of the two levels recorded at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

#### 6.3.5.3 Spherical scan with rotating device

Instead of using an automatic arm, it is also possible to rotate and tilt the DUT (see Figure 2). Thus, the same sphere can be measured as with the automatic arm. In contrast to the previous method  $\Theta$  is changed from  $0^\circ$  to  $-90^\circ$  for the half sphere measurement. The distance  $d$  is given by clause 6.3.3.1.



**Figure 2: Spherical scan setup with rotation and tilt of the DUT**

#### 6.3.5.3.1 Calibrated setup

The measurement receiver, test antenna and all associated equipment (e.g. cables, filters, amplifiers, etc.) shall have been recently calibrated against known standards at all the frequencies on which measurements of the equipment are to be made. A suggested calibration method is given in clause 6.3.6.

If an anechoic chamber with conductive ground plane is used, the ground shall be covered by absorbing material in the area of the direct ground reflection from the DUT to the test antenna.

The equipment shall be placed in an anechoic chamber (compare clauses 6.3.2.1 and 6.3.2.2 in [2]), which allows the rotation and tilt of the DUT. The DUT shall be placed closest to the orientation of normal operation.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser via whatever (fully characterized) equipment is required to render the signal measurable (e.g. amplifiers).

The transmitter shall be switched on, if possible without modulation, and the spectrum analyser shall be tuned to the frequency of the transmitter under test.

The TX antenna shall be stepwise rotated and tilted that the sphere of interest is covered. The signal level shall be noted in each location.

After all locations have been reached, the measurement procedure shall be repeated for horizontal polarized test antenna orientation.

The maximum signal level detected by the spectrum analyser shall be determined and converted into the radiated power by application of the pre-determined calibration coefficients for the equipment configuration used.

#### 6.3.5.3.2 Substitution method

The equipment shall be placed in an anechoic chamber, which allows the rotation and tilt of the DUT. The DUT shall be placed closest to the orientation of normal operation.

The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.

The output of the test antenna shall be connected to the spectrum analyser.

The transmitter shall be switched on, if possible without modulation, and the measuring receiver shall be tuned to the frequency of the transmitter under test.

The TX antenna shall be stepwise rotated and tilted that the sphere of interest is covered. The signal level shall be noted in each orientation.

After all locations have been reached, the maximum signal level and the orientation of the DUT shall be noted.

The transmitter shall be replaced by a substitution antenna as defined in clause 6.3.2.4 in [2].

The substitution antenna shall be orientated for vertical polarization and the length of the substitution antenna shall be adjusted to correspond to the frequency of the transmitter.

The substitution antenna shall be connected to a calibrated signal generator.

If necessary, the input attenuator setting of the spectrum analyser shall be adjusted in order to increase the sensitivity of the spectrum analyser.

If an anechoic chamber with a conductive ground plane is used, then the test antenna shall be raised and lowered through the specified range of height that the maximum signal level is received.

The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the spectrum analyser, that is equal to the level noted while the transmitter radiated power was measured, corrected for the change of input attenuator setting of the spectrum analyser.

The input level to the substitution antenna shall be recorded as power level, corrected for any change of input attenuator setting of the spectrum analyser.

The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

The measure of the radiated power of the radio device is the larger of the two levels recorded at the input to the substitution antenna, corrected for gain of the substitution antenna if necessary.

#### 6.3.5.4 Spherical scan other methods

Other methods for spherical scans are allowed but it has to be ensured that the relevant sphere is full covered. Then again the calibrated or substitution method shall be applied. The exact method for the scanning shall be described in the measurement report.

#### 6.3.6 Standard calibration method

See TS 102 883 [2], clause 6.3.6.

### 6.4 Conducted measurements

See TS 102 883 [2], clause 6.4.

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## 7 Test procedures for essential radio test suites

### 7.1 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);
- Detect and avoid.

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



## 7.2 Method of measurements of the Ultra Wideband Emissions

Method of measurements of the Ultra Wideband Emissions shall be as given in TS 102 883 [2], clause 7.3.

## 7.3 Mean power spectral density measurements

Mean power spectral density measurements shall be as given in TS 102 883 [2], clause 7.4.3.

## 7.4 Peak power spectral density measurements

Peak power spectral density measurements shall be as given in TS 102 883 [2], clause 7.4.4.

## 7.5 Operating bandwidth

Operating bandwidth measurements shall be performed as given in TS 102 883 [2], clause 7.4.2.

## 7.6 Receiver spurious emissions

Receiver spurious emissions measurements shall be as given in TS 102 883 [2], clause 7.4.5.

## 7.7 Low Duty Cycle

Low Duty Cycle shall be as given in clause 4.6.2 of the present document.

## 7.8 Test Procedures for Detect and Avoid Mechanisms

Test Procedures for Detect and Avoid Mechanisms shall be as given in TS 102 883 [2], clause 7.4.7.

## Annex A (normative): HS Requirements and conformance Test specifications Table (HS-RTT)

The HS Requirements and conformance Test specifications Table (HS-RTT) in Table A.1 serves a number of purposes, as follows:

- it provides a statement of all the requirements in words and by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it provides a statement of all the test procedures corresponding to those requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
  - Unconditional: meaning that the requirement applies in all circumstances; or
  - Conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule.
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;
- it qualifies each test procedure to be either:
  - Essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;
  - Other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.

**Table A.1: HS Requirements and conformance Test specifications Table (HS-RTT)**

| Harmonized Standard EN 302 065-1                                                                                                                     |                                              |                      |                            |                                                                                             |                    |                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------|----------------------------|---------------------------------------------------------------------------------------------|--------------------|----------------------|
| The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.15] |                                              |                      |                            |                                                                                             |                    |                      |
| Requirement                                                                                                                                          |                                              |                      | Requirement Conditionality |                                                                                             | Test specification |                      |
| No                                                                                                                                                   | Description                                  | Reference: clause No | U/C                        | Condition                                                                                   | E/O                | Reference: clause No |
| 1                                                                                                                                                    | Operating bandwidth                          | 4.1                  | U                          |                                                                                             | E                  | 7.5                  |
| 2                                                                                                                                                    | Maximum value of mean power spectral density | 4.2                  | U                          |                                                                                             | E                  | 7.3                  |
| 3                                                                                                                                                    | Maximum value of peak power                  | 4.3                  | U                          |                                                                                             | E                  | 7.4                  |
| 4                                                                                                                                                    | Receiver spurious emissions                  | 4.4                  | C                          | Applies only to equipment that can be operated in a receive-only mode                       | E                  | 7.6                  |
| 5a                                                                                                                                                   | Detect-and-avoid                             | 4.5                  | C                          | Applies only to equipment operating in the frequency band 3,1 GHz to 4,8 GHz and having DAA | E                  | 7.8                  |
| 5b                                                                                                                                                   | Detect-and-avoid                             | 4.5                  | C                          | Applies only to equipment operating in the frequency band 8,5 GHz to 9 GHz and having DAA   | E                  | 7.8                  |

| <b>Harmonized Standard EN 302 065-1</b><br>The following requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive [i.15] |                                  |                             |                                   |                                                                                                                                                   |                           |                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------|
| <b>Requirement</b>                                                                                                                                                                              |                                  |                             | <b>Requirement Conditionality</b> |                                                                                                                                                   | <b>Test specification</b> |                             |
| <b>No</b>                                                                                                                                                                                       | <b>Description</b>               | <b>Reference: clause No</b> | <b>U/C</b>                        | <b>Condition</b>                                                                                                                                  | <b>E/O</b>                | <b>Reference: clause No</b> |
| 6                                                                                                                                                                                               | Low Duty Cycle                   | 4.6                         | C                                 | <b>For generic:</b><br>Applies only to equipment with LDC implemented in the frequency range: 3,1 GHz to 4,8 GHz (alternative to DAA-1 and DAA-2) | O                         | 7.7                         |
| 7                                                                                                                                                                                               | Equivalent Mitigation Techniques | 4.7                         | C                                 | Applies only to equipment using equivalent mitigation techniques                                                                                  | X                         |                             |

**Key to columns:****Requirement:**

**No** A unique identifier for one row of the table which may be used to identify a requirement or its test specification.

**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 is to 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 technical requirement which is classified "conditional".

**Test Specification:**

**E/O** Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).

**NOTE:** All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "O" or "X" is a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.

**Clause Number** Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.

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

The radiated measurements set-up in Annex B 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 B.1 gives examples of recommended data and features for the horn antenna and preamplifier to be used for the test set-up.

**Table B.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 C (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".

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## History

| Document history |               |                                           |
|------------------|---------------|-------------------------------------------|
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| V1.2.1           | October 2010  | Publication as EN 302 065                 |
| V1.3.1           | February 2014 | Vote V 20140408: 2014-02-07 to 2014-04-08 |
|                  |               |                                           |
|                  |               |                                           |