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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 3: Requirements for UWB devices for road and rail vehicles

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Contents

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Foreword

This Harmonized European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been produced by ETSI in response to mandate M/407 issued from the European Commission under Directive 98/34/EC [i.9] as amended by Directive 98/48/EC [i.12].

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.10].

See article 5.1 of Directive 1999/5/EC [i.10] 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.10] are summarized in Annex A.

Equipment covered by the present document operates in accordance with ECC/DEC(06)04 [i.11] "The harmonised conditions for devices using Ultra-Wideband (UWB) technology in bands below 10,6 GHz" in road and railway vehicles.

The present document is part 3 of a multi-part deliverable covering Short Range Devices (SRD) using Ultra Wide Band technology (UWB) for communication purposes, 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".

National transposition dates	
Date of adoption of this EN:	8 April 2014
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Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 January 2015
Date of withdrawal of any conflicting National Standard (dow):	31 January 2016

1 Scope

The present document applies to transceivers, transmitters and receivers utilizing Ultra WideBand (UWB) technologies and used for short range applications in road and rail vehicles, which includes devices mounted inside or at the surface. The present document applies to impulse, modified impulse and RF carrier based UWB technologies in the main operating frequency ranges from 3,1 GHz to 4,8 GHz or from 6 GHz to 9 GHz.

Examples of applications for road and rail vehicles are:

- 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, etc.;
- plug-in radio devices intended for use within combined equipment, e.g. modems, access points, etc.;
- equipment for telemetry communication inside and outside of road and rail vehicles;
- equipment for the localization of devices inside and outside of road and rail vehicles (e.g. hand-held devices);
- equipment to investigate materials (e.g. fuel).

The present document does not apply to fixed road infrastructure installations. For fixed rail infrastructure tracking applications see TR 101 538 [i.5] and TS 103 085 [i.6].

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 applies to UWB equipment conforming to ECC/DEC/(06)04 amended 9 December 2011 [i.11] and CEPT Report 45 [i.13].

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] 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".

[2] ETSI TS 102 754 (V1.2.1) (11-2008): "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".

[3] ETSI TR 100 028 (all parts) (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

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 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".

[i.2] 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.3] 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.4] 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.13] and amended ECC/DEC(06)04 [i.11]. The new EC/DEC revision is expected within 2014.

[i.5] ETSI TR 101 538: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); UWB location tracking devices in the railroad environment".

[i.6] ETSI TS 103 085: "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".

[i.7] CEPT/ERC Recommendation 74-01: "Unwanted emissions in the spurious domain".

[i.8] Void.

[i.9] Directive 1998/34/EC as amended by 1998/48/EC 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.10] 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.11] 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.12] 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.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.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

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

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

dwell time: duration of a transmission on a particular sub-channel

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

hopping cycle: number of hopping positions for a full frequency hopping sequence

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

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

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

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 following symbols apply:

d	distance
Θ	elevation angle
f	frequency
λ	wavelength
k	coverage factor
φ	azimuth angle
Toff	transmitter off time
Ton	transmitter on 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
FH	Frequency Hopping
LDC	Low Duty Cycle
LNA	Low Noise Amplifier
NF	Noise Figure
OE	Other Emissions
OFDM	Orthogonal Frequency Division Multiple Access
PSD	Power Spectral Density
REC	RECommendation
RF	Radio Frequency
RX	Receiver
TPC	Transmit Power Control
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

This test shall either be performed using a radiated (as given in clauses 7.6, 6.3.1 and 6.3.2 of the present document) or conducted measurement procedure as given in TS 102 883 [1].

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 [1], clause 5.7, Table 1.

4.2 Mean power spectral density

4.2.1 Definition

The maximum mean power spectral density (specified as e.i.r.p.) of the radio device, 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 measurement procedure of clause 7.2 with the method of clause 7.4 for the frequencies as shown in Table 1.

4.2.3 Limit

The maximum mean power spectral density measured using the above test procedure shall not exceed the limits given in Table 1. 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 (TS 102 883 [1]).

Table 1: Maximum value of mean power spectral density limit (e.i.r.p.) (CEPT Report 45 [i.13])

Frequency range [GHz]	Without mitigation techniques	With mitigation techniques
f ≤ 1,6	-90 dBm/MHz	-90 dBm/MHz
1,6 < f ≤ 2,7	-85 dBm/MHz	-85 dBm/MHz
2,7 < f ≤ 3,1	-70 dBm/MHz	-70 dBm/MHz
3,1 < f ≤ 3,4	-70 dBm/MHz	-41,3 dBm/MHz (notes 1 and 2)
3,4 < f ≤ 3,8	-80 dBm/MHz	-41,3 dBm/MHz (notes 1 and 2)
3,8 < f ≤ 4,2	-70 dBm/MHz	-41,3 dBm/MHz (notes 1 and 2)
4,2 < f ≤ 4,8	-70 dBm/MHz	-41,3 dBm/MHz (notes 1 and 2)
4,8 < f ≤ 6	-70 dBm/MHz	-70 dBm/MHz
6 < f ≤ 8,5	-53,3 dBm/MHz	-41,3 dBm/MHz (notes 1 and 3)
8,5 < f ≤ 9	-65 dBm/MHz	-41,3 dBm/MHz (note 2)
9 < f ≤ 10,6	-65 dBm/MHz	-65 dBm/MHz
10,6 < f	-85 dBm/MHz	-85 dBm/MHz

NOTE 1: Within the band 3,1 - 4,8 GHz and 6 - 8,5 GHz, devices implementing Low Duty Cycle (LDC) mitigation technique (see clause 4.8) 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.
Operation is in addition subject to the implementation of an exterior limit (see clause 4.5) of -53,3 dBm/MHz.

NOTE 2: Within the bands 3,1 - 4,8 GHz and 8,5 - 9 GHz, devices implementing Detect And Avoid (DAA) mitigation technique (see clause 4.7) 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.
Operation is in addition subject to the implementation of Transmit Power Control (TPC) mitigation technique (see clause 4.6) and an exterior limit (see clause 4.5) of -53,3 dBm/MHz.

NOTE 3: within the band 6 - 8,5 GHz devices implementing Transmit Power Control (TPC) mitigation technique (see clause 4.6) and an exterior limit (see clause 4.5) of -53,3 dBm/MHz 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.

Table 1 is based upon CEPT Report 45 [i.13]. The Commission Decision 2007/131/EC on UWB [i.4] 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 [1], 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 measurement procedure of clause 7.2 with the method of clause 7.5 for the frequencies as shown in Table 2.

4.3.3 Limit

The maximum peak power limit 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 (TS 102 883 [1]).

Table 2: Maximum peak power limit (CEPT Report 45 [i.13])

Frequency range [GHz]	Without mitigation techniques (defined in 50 MHz)	With mitigation techniques (defined in 50 MHz)
f ≤ 1,6	-50 dBm	-50 dBm
1,6 < f ≤ 2,7	-45 dBm	-45 dBm
2,7 < f ≤ 3,1	-36 dBm	-36 dBm
3,1 < f ≤ 3,4	-36 dBm	0 dBm (notes 1 and 2)
3,4 < f ≤ 3,8	-40 dBm	0 dBm (notes 1 and 2)
3,8 < f ≤ 4,2	-30 dBm	0 dBm (notes 1 and 2)
4,2 < f ≤ 4,8	-30 dBm	0 dBm (notes 1 and 2)
4,8 < f ≤ 6	-30 dBm	-30 dBm
6 < f ≤ 8,5	-13,3 dBm	0 dBm (notes 1 and 3)
8,5 < f ≤ 9	-25 dBm	0 dBm (note 2)
9 < f ≤ 10,6	-25 dBm	-25 dBm
10,6 < f	-45 dBm	-45 dBm

NOTE 1: Within the band 3,1 - 4,8 GHz and 6 - 8,5 GHz, devices implementing Low Duty Cycle (LDC) mitigation technique (see clause 4.8) 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.
Operation is in addition subject to the implementation of an exterior limit (see clause 4.5) of -53,3 dBm/MHz.

NOTE 2: Within the bands 3,1 - 4,8 GHz and 8,5 - 9 GHz, devices implementing Detect And Avoid (DAA) mitigation technique (see clause 4.7) 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.
Operation is in addition subject to the implementation of Transmit Power Control (TPC) mitigation technique (see clause 4.6) and an exterior limit (see clause 4.5) of -53,3 dBm/MHz.

NOTE 3: Within the band 6 - 8,5 GHz devices implementing Transmit Power Control (TPC) mitigation technique (see clause 4.6) and an exterior limit (see clause 4.5) of -53,3 dBm/MHz 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.