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Harmonized European Standard (Telecommunications series)

Electromagnetic compatibility and Radio spectrum Matters (ERM); Ultra WideBand (UWB) technologies for communication purposes; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive

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Foreword

This Harmonized European Standard (Telecommunications series) 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 Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the 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 ("the R&TTE Directive ").

NOTE: A list of such Harmonized European Standards is included on the web site http://www.newapproach.org.

Technical specifications relevant to Directive 1999/5/EC are given in annex A.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

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. The modular structure is shown in EG 201 399 (see bibliography).

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:

1) Impulse based technologies; and

2) 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 risetime 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 stand alone 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. The transmitted energy is summed at the receiver to reproduce the transmitted pulse.

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

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 must 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.

Test and measurement limitations

The ERA report 2006-0713 (see bibliography) has shown that there are practical limitations on measurements of RF radiated emissions. The minimum radiated levels that can be practically measured in the lower GHz frequency range by using a radiated measurement setup with a horn antenna and pre-amplifier are typically in the range of about -70 dBm/MHz to -75 dBm/MHz (e.i.r.p) to have sufficient confidence in the measured result (i.e. UWB signal should be at least 6 dB above the noise floor of the spectrum analyser and the measurement is performed under far-field conditions at a one meter distance). However, RF conducted measurements with a pre-amplifier can be carried out to somewhere around -100 dBm/MHz.

For equipment that have detachable antennas and provide a 50 Ω antenna port, measurements can be made providing suitable antenna calibrations can be provided.

For integrated antenna equipment, previous ETSI testing standards have allowed equipment modification to provide a 50 Ω adaptor to be added to provide the necessary test port. However, UWB integral equipment and particularly impulse based technology does not use classical radio techniques and as such is unlikely to have matched 50 Ω antenna port impedances.

The present document therefore recognizes these difficulties and provides a series of test methods suitable for the different UWB technologies.

1 Scope

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

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;
- equipment for use in road and rail vehicles.

The present document does not cover UWB transmitter equipment to be installed at a fixed outdoor location or for use in flying models, aircraft and other forms of aviation as per the ECC/DEC/(06)04 (see bibliography).

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

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

Table 1: Radiocommunications frequency bands

	Radiocommunications frequency bands
Transmit	3,4 GHz to 4,8 GHz
Receive	3,4 GHz to 4,8 GHz
Transmit	6,0 GHz to 8,5 GHz
Receive	6,0 GHz to 8,5 GHz

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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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 indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

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

[2] ANSI C63.5 (2006): "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electro Magnetic Interference".

[3] ITU-R Recommendation SM 329-10 (2003): "Unwanted emissions in the spurious domain".

[4] ETSI TS 102 321 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Normalized Site Attenuation (NSA) and validation of a fully lined anechoic chamber up to 40 GHz".

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

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

narrowband: See test in clause 5.8.5.

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

wideband: emission whose occupied bandwidth is greater than the test equipment measurement bandwidth

3.2 Symbols

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

f	frequency
f_H	highest frequency of the power envelope
f_L	lowest frequency of the power envelope
R	Distance
Ω	ohm
λ	wavelength

3.3 Abbreviations

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

AC	Alternate Current
ATT	ATTenuator/ATTenuation
dB	deciBel
dBi	gain in decibels relative to an isotropic antenna
dBm	gain in decibels relative to one milliwatt
DC	Direct Current
e.i.r.p.	equivalent isotropically radiated power
e.r.p.	effective radiated power
EUT	Equipment Unter Test
LDC	Low Duty Cycle
LNA	Low Noise Amplifier
OFDM	Orthogonal Frequency Division Multiplexing
PRF	Pulse Repetition Frequency
RBW	Resolution BandWidth

R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RMS	Root Mean Square
RR	Radio Regulations
Rx	Receiver
SNR	Signal to Noise Ratio
SRD	Short Range Device
TPC	Transmit Power Control
Tx	Transmitter
UWB	Ultra WideBand
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio

4 Technical requirements specification

4.1 Technical requirements

4.1.1 Operating bandwidth

4.1.1.1 Definition

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a percentage of 0,5 % of the total mean power of a given emission.

For the purposes of the present document the measurements are made at the -23 dB points.

4.1.1.2 Test procedure

This test shall be performed using a radiated or conducted test procedure (see clause 5.8.4).

4.1.1.3 Limit

The operating bandwidth shall be greater than 50 MHz (at -23 dB relative to the maximum spectral power density).

4.1.1.4 Measurement uncertainty

See table 9.

NOTE: The operating bandwidth is calculated from the two measured frequencies for which the uncertainty figure for frequency applies. However, the uncertainty of either radiated or conducted power will need to be taken into account when deriving the uncertainty value for frequency measurements at the -23 dB points.

4.1.2 Maximum value of mean power spectral density

4.1.2.1 Definition

The maximum mean power spectral density (specified as e.i.r.p.) of the 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.

4.1.2.2 Test procedure

This test shall be performed using a radiated or conducted test procedure (see clause 5.8.2) for the frequencies as shown in table 2.

This test shall be repeated at the frequencies as shown in table 3 including the frequency band edges at 1,6 GHz, 2,7 GHz, 3,4 GHz, 3,8 GHz, 4,2 GHz, 4,8 GHz, 6,0 GHz and 8,5 GHz and 10,6 GHz as shown in table 3.

4.1.2.3 Limit

The maximum mean power spectral density measured using the above test procedure shall not exceed the limits given in tables 2 and 3.

Table 2: Maximum value of mean power spectral density limit

Frequency (GHz)	Maximum value of mean power spectral density (dBm/MHz)
3,4 < f ≤ 4,8	≤ -41,3 (see note 1)
4,2 < f ≤ 4,8	≤ -41,3 (see note 2)
6 < f ≤ 8,5	≤ -41,3 (see note 2)
NOTE 1: LDC is required (see clause 4.1.7). If LDC is not implemented then the following applies: - 3,4 GHz to 3,8 GHz ≤ -80 dBm/MHz; - 3,8 GHz to 4,2 GHz ≤ -70 dBm/MHz. NOTE 2: In case of devices installed in road and rail vehicles, operation is subject to the implementation of Transmit Power Control (TPC) with a range of 12 dB with respect to the maximum value of mean power spectral density. If TPC is not implemented then the following applies: - 4,2 GHz to 4,8 GHz ≤ -53,3 dBm/MHz; - 6 GHz to 8,5 GHz ≤ -53,3 dBm/MHz.	

Table 3: Maximum value of mean power spectral density limit at frequency band edges

Frequency (GHz)	Maximum value of mean power spectral density (dBm/MHz)
f ≤ 1,6	-90
1,6 < f ≤ 2,7	-85
2,7 < f ≤ 3,4	-70
3,4 < f ≤ 3,8 (applies for equipment not using LDC)	-80
3,8 < f ≤ 4,8 (applies for equipment not using LDC)	-70
4,8 < f ≤ 6	-70
8,5 < f ≤ 10,6	-65
f > 10,6	-85

4.1.2.4 Maximum allowable measurement uncertainty

See table 9.

4.1.3 Maximum value of peak power

4.1.3.1 Definition

The 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.

4.1.3.2 Test procedure

This test shall be performed using a radiated or conducted test procedure (see clause 5.8.3).

4.1.3.3 Limit

The maximum peak power limit measured using the above test procedure shall not exceed the limits given in table 4.