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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.2] 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.3].

See article 5.1 of Directive 1999/5/EC [i.3] 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.3] are summarized in annex A.

Equipment covered by the present document operates in accordance with ECC/DEC(06)04 [i.4] "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 2 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".

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Date of adoption of this EN:	8 April 2014
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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.3]. 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 location tracking purposes. These UWB 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. In both cases, measurements of the UWB signals can be used to determine location-related properties of the signal, such as time-of-arrival, angle-of-arrival and signal strength, which can be used in turn to ascertain the location of a transmitter relative to the receiver.

- **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 data information to the receiver and can consist of a series of single hopping frequencies or multi-tone carriers.

1 Scope

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

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

The present document applies to fixed, mobile or portable applications, e.g.:

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

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

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

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

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

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

A summary of the radio bands in which these radio equipment types are capable of operating is given in table 1.

Table 1: Operating frequency bands

Device type	Mode	Operating frequency bands
LT1	Transmit	6,0 GHz to 9 GHz
	Receive	6,0 GHz to 9 GHz
LT2	Transmit	3,1 GHz to 4,8 GHz
	Receive	3,1 GHz to 4,8 GHz
LAES	Transmit	3,1 GHz to 4,8 GHz
	Receive	3,1 GHz to 4,8 GHz

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 102 754 (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".
- [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".

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] 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.3] 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.4] CEPT ECC/DEC/(06)04 of 24 March 2006 amended 9 December 2011: "The harmonised conditions for devices using Ultra-Wideband (UWB) technology in bands below 10.6 GHz".
- [i.5] Commission Decision 2007/131/EC of 21 February 2007 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community (notified under document number C(2007) 522).

NOTE: This EC Decision is currently under revision based on CEPT Report 45 [i.13] and amended ECC/DEC(06)04 [i.4]. The new EC/DEC revision is expected within 2014.

- [i.6] ECC Report 120 (March 2008): "ECC Report on Technical requirements for UWB DAA (Detect and avoid) devices to ensure the protection of radiolocation in the bands 3.1-3.4 GHz and 8.5-9 GHz and BWA terminals in the band 3.4 - 4.2 GHz".
- [i.7] Decision 2009/343/EC amending decision 2007/131/EC on allowing the use of radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community.
- NOTE: This EC Decision is currently under revision based on CEPT Report 45 [i.13] and amended ECC/DEC(06)04 [i.4]. The new EC/DEC revision is expected within 2014.
- [i.8] ECC Recommendation (11)09 on UWB Location Tracking Systems Type 2 (LT2), October 2011.
- [i.9] ECC Recommendation (11)10 on Location Tracking Application for Emergency and Disaster Situations, October 2011.
- [i.10] ECC Report 167 (May 2011): "The Practical Implementation of Registration/Coordination Mechanism for UWB LT2 (Location Tracking Type 2) Systems".
- [i.11] ECC Report 170 (October 2011): "ECC Report on Specific UWB Applications in the Bands 3.4 - 4.8 GHz and 6 - 8.5 GHz Location Tracking Applications for Emergency Services (LAES), Location Tracking Applications Type 2 (LT2) and Location Tracking and Sensor Applications for Automotive and Transportation Environments (LTA)".
- [i.12] 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:

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

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)

fixed-mounted station: station which is fixed mounted and which is not intended to be operated while in motion; however, it behaves otherwise in the system like a mobile station

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

impulsive UWB signal: radiated, short transient Ultra Wideband signal whose occupied bandwidth is defined by its time duration

integral antenna: antenna designed to be connected to the equipment without the use of a standard connector and considered to be part of the equipment

NOTE: An integral antenna may be fitted internally or externally to 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

Mobile Station (MS): station intended to be used while in motion or during halts at unspecified points

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

portable station: mobile station that is portable but cannot comfortably be carried around by a person due to weight and/or size or having relatively high power consumption

provider: manufacturer or his authorized representative or the person responsible for placing on the market

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

radiated measurements: measurements which involve the absolute measurement of a radiated field

rf carrier: fixed radio frequency prior to modulation

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 location tracking equipment and that is normally used on a stand-alone basis

Ultra WideBand (UWB): equipment incorporating, as an integral part or as an accessory, technology for short-range radiocommunication, involving the intentional generation and transmission of radio-frequency energy that spreads over a frequency range wider than 50 MHz, which may overlap several frequency bands allocated to radiocommunication services

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