

# ETSI EN 303 883-1 V1.2.1 (2021-02)



**Short Range Devices (SRD) and  
Ultra Wide Band (UWB);  
Part 1: Measurement techniques  
for transmitter requirements**

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## Foreword

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

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

- Part 1:** "Measurement techniques for transmitter requirements";  
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## Modal verbs terminology

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## Introduction

Ultra Wide Band (UWB) radio technology enables a new generation of high-speed data devices for short-range communication purposes as well as location tracking and Sensor devices and opens new markets with a variety of innovative applications.

UWB devices may form an integral part of other portable electronic equipment such as future generation cellular phones or laptops equipped with UWB enabled short-range air interfaces.

In addition, UWB devices with an operating frequency range of several hundreds of MHz up to several GHz allow tens of centimetre-level accuracy real time localization and positioning even in the presence of severe multipath effects caused by walls, furniture or any other harsh radio propagation environments.

Based on the broad variety of different applications and the broad possible frequency range of operation the number of possible deployed physical signal formats can be very large. The existing range of physical signal and modulation formats range from traditional carrier based systems like OFDM over spread spectrum based system to carrier less systems based on base band pulses. The frequency regulation on the other side only defines a single set of transmission limits and values, which have to be fulfilled by all systems under the UWB regulation. Furthermore, the very high channel bandwidth of a UWB signal gives a specific challenge to the needed measurement setup and the procedures. Existing measurement methods need to be extended and new possible techniques should be described in the present document.

The present document is structured as follows:

- Clauses 1 through 3 provide a general description on the types of equipment covered by the present document and the definition of terms, symbols and abbreviations used.
- Clause 4 provides an overview on the technical and technology basics which were considered during the preparation of the present document.
- Clause 5 specifies EUT TX requirements and the related conformance procedure.
- Annex A provides information on test conditions, used test sites and procedures.
- Annex B provides necessary information on radiated test procedures.
- Annex C provides information on TX signal types.
- Annex D provides information on the all emission concept.
- Annex E provides information for a pre-scan radiated power measurement test procedure.
- Annex F provides information on differences between the different emission power measurements.
- Annex G provides a change history table containing the major technical changes.

# 1 Scope

The present document summarizes the available information of possible measurement techniques and procedures for the conformance measurement of various signal formats (e.g. Ultra Wide Band) in order to comply with the given transmission limits given in the current regulation.

The present document could be used as a reference for existing and future ETSI standards covering UWB and other technologies.

## 2 References

### 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

- [1] ETSI TS 102 754: "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 102 321: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Normalized Site Attenuation (NSA) and validation of a fully lined anechoic chamber up to 40 GHz".

### 2.2 Informative references

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- [i.1] ETSI TS 103 060: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Method for a harmonized definition of Duty Cycle Template (DCT) transmission as a passive mitigation technique used by short range devices and related conformance test methods".
- [i.2] ITU Radio Regulations.

NOTE: Available at <https://www.itu.int/pub/R-REG-RR/en>.

- [i.3] ECC/DEC/(06)04: "ECC Decision of 24 March 2006 on the harmonised conditions for devices using UWB technology in bands below 10.6 GHz, amended 9 December 2011 and amended 8 March 2019".

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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

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

**All Emissions (AE):** related UWB Emission of the transmitter (RP), Transmitter Unwanted Emissions (TXUE) and Other Emissions (OE) of the EUT

NOTE: See emission concept in clause 5.1.2.1.

**antenna cycle:** one complete sweep of a mechanically or electronically scanned antenna beam along a predefined spatial path

**antenna scan duty factor:** ratio of the solid angle of the antenna beam (measured at its 3 dB point) to the total solid angle scanned by the antenna

**associated antenna:** antenna and all its associated components which are designed as an indispensable part of the equipment

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

**burst:** emitted signal whose time duration ( $T_{on}$ ) is not related to its bandwidth

**co-located receiver:** receiver is located in the same device housing as the transmitter

**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

**Duty Cycle:** the ratio, expressed as a percentage, of  $\Sigma(T_{on})/(T_{obs})$  where  $T_{on}$  is the "on" time of a single transmitter device and  $T_{obs}$  is the observation period, see ETSI TS 103 060 [i.1]

**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)

NOTE: See ITU Radio Regulations [i.2], RR 1.161.

**far field measurement:** measurement at a distance from an antenna sufficient to ensure that the electro-magnetic field approximates a plane wave (see clause B.2.1)

**frequency span:** frequency range between the start and stop frequency of the RP measurement set-up

**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 equipment:** 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

**indirect emissions:** emissions radiated in all directions in a specified scenario (see clause 5.7, including direct emissions from the housing/structure of the equipment and emissions reflected or passing through a media under inspection or through a scenario)

NOTE: These emissions are sometimes also named an exterior limit or unwanted emissions.

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

**main beam direction:** direction of maximum gain of a directional antenna

NOTE: EUT may have different main beam direction for TX and RX antennas.

**mean power:** power during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation envelope

**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:  $T_{avail, Time}$

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

**operating frequency range:** frequency range over which the EUT is intentionally transmitting

NOTE 1: The operating frequency range of the EUT is determined by the lowest ( $f_L$ ) and highest frequency ( $f_H$ ).

NOTE 2: For analogue or discrete frequency modulated systems (FSK, FMCW) the operating frequency range covers the difference between minimum and maximum of all carrier frequencies on which the equipment can be adjusted.

**peak power:** power measured with the peak detector using a filter the width and shape of which is sufficient to accept the signal bandwidth (see Recommendation ITU-R SM.1541-6 [i.27])

**permitted frequency range(s):** frequency range(s) within which the device is authorized to operate

**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

**Power Spectral Density (PSD):** ratio of the amount of power within a specified bandwidth

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

**(mean) Pulse Repetition Frequency (PRF):** inverse of the Pulse Repetition Interval, averaged over a time sufficiently long as to cover all PRI variations

**Pulse Repetition Interval (PRI):** time between the rising edges of the transmitted (pulsed) output power

**Radar Cross Section (RCS):** cross-sectional area of a perfectly reflecting sphere that would produce the same strength reflection as would the object in question

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

**scanning (steerable) antenna:** directional antenna which can move its beam along a predefined spatial path

NOTE: Scanning can be realized by mechanical, electrical or combined means. The antenna beamwidth may stay constant or change with the steering angle, dependent on the steering method.

**second (2<sup>nd</sup>) harmonic:** twice the frequency of the fundamental (e.g. 48 GHz for a 24 GHz device)

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

**signal off time ( $T_{off}$ ):** one or more time periods within the signal repetition time, where no transmission occurs

**signal repetition time:** length of the time between subsequent transmission patterns of the system

NOTE: Also known as cycle time, frame repetition time or frame duration.

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

**transmission:** sequence of emissions separated by intervals shorter than  $T_{dis}$ , ETSI TS 103 060 [i.1]

**transmitter timeout functionality:** internal functionality that switches off the system in order to reduce power consumption or for regulatory reasons

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

**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:

|                        |   |
|------------------------|---|
| $\Omega$               | ohm   |
| $\lambda$              | wavelength  |
| $\sigma$               | standard deviation  |
| $\Theta$               | elevation angle   |
| $\Phi$                 | azimuth angle   |
| $B_{wrel}$             | relation of the bandwidth   |
| $C_{ATT\ total}$       | attenuation from the EUT reference plane to the spectrum analyser |
| $D$                    | detection threshold   |
| dB                     | decibel   |
| dBc                    | decibel below the maximum   |
| dB <sub>i</sub>        | gain in decibels relative to an isotropic antenna                 |
| dB <sub>m</sub>        | gain in decibels relative to one milliwatt                        |
| $f$                    | frequency   |
| $f_c$                  | centre frequency for the filter                                   |
| $f_L$                  | lowest frequency of the operating frequency range                 |
| $f_H$                  | highest frequency of the operating frequency range                |
| $f_C$                  | centre frequency of the operating frequency range                 |
| $f_M$                  | frequency for peak power measurement                              |
| $f[t]$                 | filter coefficients at time $t$ , centred on $f_M$                |
| $G$                    | gain  |
| $G_{ATT}$              | attenuator loss   |
| $G_{LNA}$              | gain low noise amplifier  |
| $I$                    | isolation in dB   |
| $P$                    | power in dBm  |
| $P_{av}$               | mean e.i.r.p. power spectral density                              |
| $P_{peak,filtered}$    | peak power in filter bandwidth                                    |
| $P_{peak,max}$         | maximum peak power in filter bandwidth                            |
| $P_{pk}$               | peak e.i.r.p. spectral density power                              |
| $R$                    | distance  |
| $T_{avail\_time\_min}$ | minimum initial channel availability check time                   |
| $T_{avoid}$            | detect and avoid time   |

NOTE: Actual Detect and Avoid time of a EUT, can be negative.

|                  |   |
|------------------|---|
| $T_{avoid\_max}$ | maximum allowed Detect and avoid time   |
| $T$              | time  |
| $t$              | discrete time variable  |
| $T_{dis}$        | time interval below which interruptions within a transmission are considered part of $T_{on}$ (disregard time), ETSI TS 103 060 [i.1] |
| $T_{obs}$        | reference interval of time (observation period, ETSI TS 103 060) [i.1]  |
| $T_{off}$        | time interval between two consecutive bursts when the UWB emission is kept idle   |

NOTE:  $T_{off}$  is defined as "the time duration between two consecutive transmissions", ETSI TS 103 060 [i.1].