Draft ETSI EN 302 065-3-1 V3.1.0 (2021-07)

Short Range Devices (SRD)
using Ultra Wide Band technology (UWB);
Harmonised standard for access to radio spectrum;
Part 3: UWB devices installed in motor and railway vehicles
Sub-part 1: Requirements for UWB devices
for vehicular access systems

Reference
REN/ERM-TGUWB-150-3-1

Keywords
harmonised standard, SRD, UWB

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Sous-Préfecture de Grasse (06) N° w061004871

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in Table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

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

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

For the case of the present document, the applicable harmonised standard has been ETSI EN 302 065-3 [i.12], for UWB devices for ground based vehicular applications, which was published in the OJEU without restriction at 10 March 2017 [i.9] and then published at 5 February 2020 [i.10] with the following restriction:

- *"This harmonised standard does not set out technical specifications for 'trigger before-transmit techniques'. Implementing Decision (EU) 2019/785, however, imposes, as of 16 November 2019, technical requirements to be used within the bands 3,8-4.2 GHz and 6-8,5 GHz for vehicular access systems using trigger-before transmit. Therefore compliance with this harmonised standard does not ensure compliance with Decision (EU) 2019/785 and accordingly does not confer a presumption of conformity with those essential requirements set out in Article 3 (2) of Directive 2014/53/EU which relate to 'trigger-before-transmit techniques'".*

In order to consider the above points, ETSI ERM TGUWB decided to develop more specific standards; for the present document this means instead of a generic ETSI EN 302 065-3 standard for all road and rail vehicles applications, an ETSI EN 302 065-3-1 for UWB devices for vehicular access systems. Other sub-parts for UWB devices installed in motor and railway vehicles may follow (ETSI EN 302 065-3-x).

More details on the changes of the present document to previous versions are provided in Annex F.

1 Scope

The present document specifies technical characteristics and methods of measurements for equipment employing UWB devices for vehicle access systems, which use pulse based, packet oriented UWB signals for data transfer and/or distance bounding and/or localization purpose.

EXAMPLE: Radio equipment employing UWB technology for vehicle access systems is equipment intended to be utilized for vehicle access, vehicle immobilization and extended vehicle access control functionalities (like closing windows or remotely starting the car).

Following types of equipment are covered by the present document:

1) Equipment Type 1: Vehicle transceivers, which meet the conditions below:
   a) Vehicle transceivers communicate on a "trigger-before-transmit" basis with:
      i) vehicle ID devices (equipment type 2); and/or
      ii) other vehicle transceivers (equipment type 1); and/or
      iii) other UWB devices (e.g. smartphones).
   b) Vehicle transceivers are installed in the vehicle.
   c) Vehicle transceivers are capable of operating in the permitted frequency range as specified in Table 1 with either an integral antenna or a Radio Frequency (RF) output connection and dedicated antenna.
2) Equipment type 2: Vehicle ID devices (e.g. key fobs), which meet the conditions below:
   a) Vehicle ID devices are handheld devices.
   b) Vehicle ID devices communicate with vehicle transceivers (equipment type 1).
   c) Vehicle ID devices are paired with one specific vehicle and are an accessory to this vehicle.
   d) Vehicle ID devices are capable of operating in the permitted frequency range as specified in Table 1 using an integral antenna.

NOTE 1: Other UWB devices - like UWB enabled smartphones - are not covered by the present document.

The permitted frequency bands are defined in Table 1.

Table 1: Permitted frequency bands for vehicular access systems

	Frequency Band	Application
Transmit and Receive	3,8 GHz to 4,2 GHz	vehicular access
Transmit and Receive	6,0 GHz to 8,5 GHz	vehicular access

NOTE 2: Permitted frequency bands are based on ECC/DEC/(06)04 [i.4], Annex 1.2, Table 3.

NOTE 3: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in Annex A.

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.

Referenced documents which are not found to be publicly available in the expected location might be found at https://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.

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

[1] ETSI EN 303 883-1 (V1.2.1) (02-2021): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 1: Measurement techniques for transmitter requirements".

[2] ETSI EN 303 883-2 (V1.2.1) (02-2021): "Short Range Devices (SRD) and Ultra Wide Band (UWB); Part 2: Measurement techniques for receiver requirements".

2.2 Informative 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.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

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] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (RE-Directive).

[i.2] Commission implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.3] ETSI TR 103 416 (V1.1.1) (07-2016): "System Reference document (SRdoc); Short Range Devices (SRD) using Ultra Wide Band (UWB); Technical characteristics and spectrum requirements for UWB based vehicular access systems for operation in the 3,4 GHz to 4,8 GHz and 6 GHz to 8,5 GHz frequency ranges".

[i.4] ECC Decision (06)04 of 24 March 2006 on the Harmonised Use, Exemption From Individual Licensing And Free Circulation Of Devices Using Ultra-Wideband (UWB) Technology In Bands Below 10.6 GHz (ECC/Dec/(06)04). Amended On 6 July 2007, Amended 9 December 2011 and Amended On 8 March 2019.

[i.5] ETSI TS 103 361 (V1.1.1) (03-2016): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the Directive 2014/53/EU".

[i.6] ECC Report 278 (27 April 2018): "Specific UWB applications in the band 3.4-4.8 GHz and 6.0-8.5 GHz: Location tracking and sensor applications (LTA) for vehicular access systems".

[i.7] Commission implementing decision (EU) 2019/785 of 14 May 2019 on the harmonisation of radio spectrum for equipment using ultra-wideband technology in the Union and repealing Decision 2007/131/EC.

[i.8] Directive 1999/5/EC (9 March 1999) on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

[i.9] Official Journal of the European Union, 13.7.2018: "Commission communication in the framework of the implementation of Directive 1999/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity and Directive 2014/53/EU of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC".

NOTE: Available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=uriserv:OJ.C_.2018.246.01.0023.01.ENG.

[i.10] Commission Implementing Decision (EU) 2020/167 of 5 February 2020 on the harmonised standards for radio equipment drafted in support of Directive 2014/53/EU of the European Parliament and of the Council.

NOTE: Available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020D0167&from=EN.

[i.11] ECC/DEC/(20)/01: "ECC Decision of 20 November 2020 on the harmonised use of the frequency band 5945-6425 MHz for Wireless Access Systems including Radio Local Area Networks (WAS/RLAN)".

[i.12] ETSI EN 302 065-3 (V2.1.1): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 3: Requirements for UWB devices for ground based vehicular applications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

control equipment: equipment capable of sending control messages to the EUT, as well as receiving responses to that control command or other status messages, in order to setup the EUT and perform a measurement procedure

control message: one or more commands used to control or configure the EUT

NOTE: Typically submitted on a specific, non-UWB control interface, like CAN-bus interface.

EUT trigger event: trigger event on EUT level

NOTE: Which is used for measurement procedures in the present document.

initiator: EUT role in an UWB transmission sequence: EUT initiates UWB transmissions upon a system trigger event

NOTE: For more details see clause 4.2.7.2.

message: sequence or exchange of two or more packets in order to transfer information, in particular to generate a ranging information (Time-of-Flight between EUT and companion device)

packet: used to refer to an UWB data frame or aggregated pulse sequence, that is sent over the air

NOTE: Typically, one packet represents a continuous T_{on} time.

responder: EUT role in an UWB transmission sequence: EUT responds to an UWB transmission (received UWB packet)

NOTE: For more details see clause 4.2.7.2.

system trigger event: trigger event on system level; usually out of scope for EUT

Time-of-Flight (ToF): travel time of the radio signal between transmitter and receiver

Trigger-Before-Transmit (TBT): mitigation technique as required for vehicular access systems

NOTE: See ECC/DEC/(06)04 [i.4].

vehicle transceiver: UWB enabled unit, installed in the vehicle

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

T_{cease}	cease time, until a transmitter ceases transmission after a trigger event
T_{on_cum}	cumulated Ton time
$TBT_{timeout}$	Trigger-Before-Transmit timeout (cease time after EUT trigger)
$TBT_{On\text{-}Time}$	Trigger-Before-Transmit On-Time within any 10 s window after first EUT trigger
f_L	lowest frequency of the operating frequency range
f_H	highest frequency of the operating frequency range
F_{LOWER}	Lower frequency for the spurious emissions test
F_{UPPER}	Upper frequency for the spurious emissions test
X_{TXUE}	Boundary value for determination of spurious domain

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 303 883-1 [1], ETSI EN 303 883-2 [2] and the following apply:

BLE	Bluetooth® Low Energy
CW	Continuous Wave
EC	European Commission
ECC	European Communication Committee
EFTA	European Free Trade Association
EN	European Norm
ERM	Electromagnetic compatibility and Radio spectrum Matters
EU	European Union
EUT	Equipment Under Test
LDC	Low Duty Cycle
MSR	Message Success Rate
NFC	Near Field Communication
NLOS	Non Line Of Sight
OFR	Operating Frequency Range
OJEU	Official Journal of the European Union
RBR	Receiver Baseline Resilience
RBS	Receiver Baseline Sensitivity
RBW	Resolution BandWidth
RF	Radio Frequency
RP	Radiated Power
RTTE	Radio and Telecommunications Terminal Equipment (Directive 1999/5/EC)
RX	Receiver
s	second (unit)
TBT	Trigger-Before-Transmit
TG	Task Group
TGUWB	Task Group Ultra Wide Band
ToF	Time-of-Flight
TR	Technical Report
TS	Technical Specification
TX	Transmitter
TXUE	Transmitter Unwanted Emission
UWB	Ultra Wide Band
VLP	Very Low Power

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

4.2 Transmitter requirements

4.2.1 General

The transmitter requirements shall be tested per EUT. Assessment of Low Duty Cycle and trigger-before-transmit are related to the transmissions per EUT.

NOTE: EUT is not the vehicle.

4.2.2 Operating Frequency Range (OFR)

4.2.2.1 Applicability

This requirement shall apply to all EUTs with transmit functionality.

4.2.2.2 Description and general requirements

Operating frequency range is defined in clause 5.2.1 of ETSI EN 303 883-1 [1].

4.2.2.3 Limits

The OFR (all frequencies between f_L and f_H) shall be within the permitted frequency range (see Table 1).

The OFR shall be at least 50 MHz.

NOTE: The minimum OFR requirement comes from the EC Decision on UWB [i.7], Article 2 (a).

4.2.2.4 Conformance

The conformance test for OFR shall be as defined in clause 5.4.2.

4.2.3 Mean e.i.r.p. spectral density

4.2.3.1 Applicability

This requirement shall apply to all EUTs with transmit functionality.

4.2.3.2 Description

The mean e.i.r.p. is described in clause 5.3.2 of ETSI EN 303 883-1 [1].

4.2.3.3 Limits

Within the OFR the mean e.i.r.p. spectral density shall not exceed the limits in Table 2.

Table 2: Mean e.i.r.p. spectral density limits

Frequency range	Maximum mean e.i.r.p. spectral density
3,8 GHz to 4,2 GHz	-41,3 dBm/MHz
6,0 GHz to 8,5 GHz	-41,3 dBm/MHz

4.2.3.4 Conformance

The conformance test for mean e.i.r.p. spectral density shall be as defined in clause 5.4.3.

4.2.4 Peak e.i.r.p. spectral density

4.2.4.1 Applicability

This requirement shall apply to all EUTs with transmit functionality.

4.2.4.2 Description

The Peak e.i.r.p. is defined in clause 5.3.4 of ETSI EN 303 883-1 [1].

4.2.4.3 Limits

The Peak e.i.r.p. spectral density shall not exceed the limits in Table 3.

Table 3: Peak e.i.r.p. spectral density limits

Frequency range	Maximum peak e.i.r.p. (defined in 50 MHz)
3,8 GHz to 4,2 GHz	0 dBm
6,0 GHz to 8,5 GHz	0 dBm

4.2.4.4 Conformance

The conformance test for peak e.i.r.p. spectral density shall be as defined in clause 5.4.4.

4.2.5 TX unwanted emissions

4.2.5.1 Applicability

This requirement shall apply to all EUTs with transmit functionality.

4.2.5.2 Description

See ETSI EN 303 883-1 [1], clause 5.5.1.

4.2.5.3 Limits

The TX unwanted emissions shall be assessed based on ETSI EN 303 883-1 [1], clause 5.5.2.

The spurious emission limits are defined in Table 4.

Table 4: Spurious emissions limits

Frequency range	Limit values for TXUE
87,5 MHz ≤ f ≤ 118 MHz	-54 dBm/100 kHz
174 MHz ≤ f ≤ 230 MHz	-54 dBm/100 kHz
470 MHz ≤ f ≤ 694 MHz	-54 dBm/100 kHz
otherwise in band 30 MHz ≤ f < 1 000 MHz	-36 dBm/100 kHz
1 000 MHz ≤ f ≤ F_{upper} (see Table 5)	-30 dBm/1 MHz
NOTE: Not applicable for RP emissions within the OFR.	

The lower and upper frequency for the spurious emissions test based on the EUT OFR shall comply with Table 5.

Table 5: Lower and upper frequency for the spurious emissions test based on the EUT OFR

Fundamental frequency range defined by f_L and f_H (note 2)	Frequency range for measurements	
	Lower frequency (F_{LOWER})	Upper frequency (F_{UPPER})
3,8 GHz to 4,2 GHz	30 MHz	5th harmonic (note 1)
6,0 GHz to 8,5 GHz	30 MHz	26 GHz
NOTE 1: F_{UPPER} is the stated harmonic of f_H (the upper edge of the OFR, which is measured in clause 4.2.2). NOTE 2: F_{LOWER} has to be selected based on f_L and F_{UPPER} based on f_H (f_L and f_H can be measured according to clause 4.2.2); for receive only devices f_H and f_L of the related EUT/companion device shall be used.		

Based in TXUE specification of 50 % (see clause 5.4.5) there is no OOB-domain for EUT in UWB-mode. Therefore, an OOB domain is not applicable.

4.2.5.4 Conformance

The conformance test for TX unwanted emissions shall be as defined in clause 5.4.5.

4.2.6 Duty Cycle

4.2.6.1 Applicability

This requirement shall apply to:

- all equipment Type 1 (vehicle transceivers);
- all equipment Type 2 (vehicle ID devices), if operated in the band 3,8 GHz to 4,2 GHz.

4.2.6.2 Description

See ETSI EN 303 883-1 [1], clause 5.11.1.

4.2.6.3 Limits

The measured Duty Cycle shall comply with the limits in Table 6.

Table 6: Duty Cycle Limits

Limits	Remarks
$T_{on\ max}$ = 5 ms $T_{off\ mean}$ ≥ 38 ms (averaged over 1 s) Σ T_{off} > 950 ms per s	Short-term duty-cycle requirements for T_{obs} = 1 s: • Σ T_{off} > 950 ms sets the duty-cycle limit to 5 % (see note 2 and note 3) • $T_{off\ mean}$ ≥ 38 ms implicitly limits the number of On-Periods and thus the achievable duty-cycle for short T_{on} times
Σ T_{on} < 18 s per hour	Long-term duty-cycle requirement for T_{obs} = 3 600 s • Σ T_{on} < 18 s sets the duty-cycle limit per hour to 0,5 %
NOTE 1: The limits are based on the "Low Duty Cycle" requirements in ECC/DEC/(06)04 [i.4], Annex 2. NOTE 2: 5 % Duty-Cycle can only be achieved with T_{on} times larger than 2 ms (and max. 5 ms). NOTE 3: The limits allow a Short-Term Duty-Cycle of up to 5 %. Devices with T_{on} < 2 ms cannot exploit this Short-Term Duty-Cycle of 5 %, as $T_{off\ mean}$ is the limiting factor. The resulting Short-Term Duty-Cycle for those devices is then considerably smaller than 5 %.	

EXAMPLE:

Examples for the maximum possible Duty-Cycle for a given T_{on} (and shortest feasible T_{off_mean}):

- T_{on} = 5 ms, T_{off_mean} = 95 ms → LDC = 5,0 % (10 On-Periods in 1 s)
- T_{on} = 2 ms, T_{off_mean} = 38,00 ms → LDC = 5,0 % (25 On-Periods in 1 s)
- T_{on} = 1 ms, T_{off_mean} = 39,00 ms → LDC = 2,5 % (25 On-Periods in 1 s)
- T_{on} = 0,2 ms, T_{off_mean} = 38,26 ms → LDC = 0,52 % (26 On-Periods in 1 s)
- T_{on} = 0,1 ms, T_{off_mean} = 38,36 ms → LDC = 0,26 % (26 On-Periods in 1 s)

4.2.6.4 Conformance

The conformance test for Low Duty Cycle shall be as defined in clause 5.4.6.

4.2.7 Trigger-before-transmit

4.2.7.1 Applicability

This requirement shall apply to all Type 1 equipment (vehicle transceivers).

It does not apply to Type 2 equipment (vehicle ID device).

4.2.7.2 Description

4.2.7.2.1 General

"Trigger-before-transmit" follows the objective that the EUT initiates UWB transmissions only if necessary: The EUT shall only transmit, if a "trigger" event indicates that a (companion) UWB device is in range; in particular the trigger indicates the physical proximity of a key fob (as stated in ECC Report 278 [i.6], chapters 2.1.2 and 2.2.2).

NOTE: Further information on "trigger-before-transmit" is given in ECC/DEC/(06)04 [i.4] (Annex 1.2) and in EC Decision for UWB [i.7] (Annex 3).

4.2.7.2.2 Trigger event from use case perspective

From use case perspective a "trigger event" may have various embodiments, like a successful handshake between device and vehicle using non-UWB wireless technologies (e.g. BLE or NFC), or user detection by non-UWB techniques.

In general, the actual "trigger event" involves vehicle system entities that are out of scope for the EUT (like authentication procedures by a Body Control Module, evaluation of vehicle sensors or simply an authenticated user pulling the door handle).

However, the system "trigger event" can be mapped on a trigger scenario at EUT level, to make it measurable in the context of the present document.

4.2.7.2.3 Trigger scenarios on EUT level

Two basic scenarios are conceivable on EUT level:

1) EUT is responder device:
   Upon a system trigger event the EUT is set to listening mode for UWB packets.
   UWB transmission is triggered when EUT receives an UWB packet from a (companion) UWB device.
   → EUT-trigger is a successful UWB packet reception from a companion device

2) EUT is initiator device:
   Upon a system trigger event the EUT is set to UWB transmission mode.
   UWB transmission is triggered when EUT receives a transmit command via its control interface.
   → EUT-trigger is a control command to the EUT, sent via its dedicated control interface

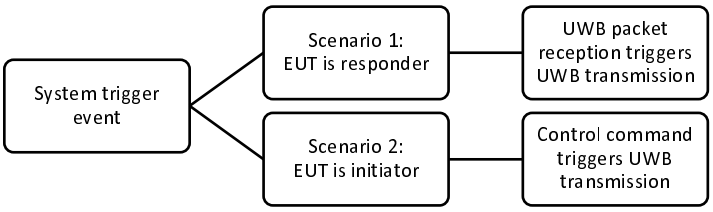

Figure 1: Trigger scenarios

4.2.7.2.4 Trigger Scenario 1: EUT is Responder Device

Figure 2 shows trigger scenario 1.

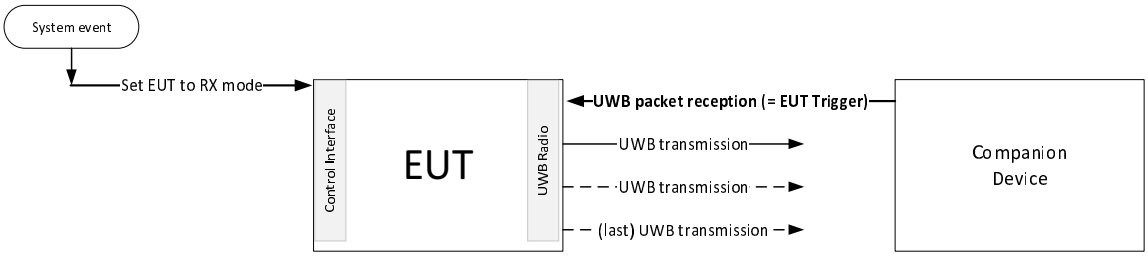

Figure 2: EUT is responder device: UWB transmission is triggered by reception of an UWB signal from a companion device

If the EUT receives an UWB packet from a companion device, it will send one or more UWB transmissions (response message and associated packets).

Receiving further packets from the companion device may trigger further UWB transmissions from the EUT (updated EUT trigger, Re-trigger).

4.5.7.2.5 Trigger Scenario 2: EUT is Initiator Device

Figure 3 shows trigger scenario 2.

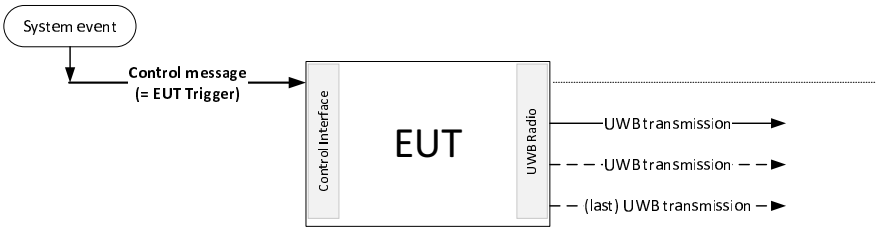

Figure 3: EUT is initiator device: UWB transmission is triggered by a control message upon a system event

The EUT is triggered by a control message and sends one or more UWB transmissions (poll message and associated packets).

Like in scenario 1, receiving packets (responses) from the companion device may trigger further UWB transmissions from the EUT (updated EUT trigger, Re-trigger).

4.2.7.2.6 General requirements

"Trigger-before-transmit" shall be characterized by:

- Trigger-Before-Transmit timeout $TBT_{timeout}$
  - this is the time after the (latest) EUT-trigger, until the EUT ceases all UWB transmissions.
- Trigger-Before-Transmit On-Time $TBT_{On\text{-}Time}$
  - this is the cumulated Ton time within any 10 s window after any trigger event.

For both trigger scenarios, each reception of an UWB packet is considered as a new trigger, and shall reset the "trigger-before-transmit" timeout.

For trigger scenario 2, further control messages without having received a UWB response from a companion device shall not reset the "trigger-before-transmit" timeout, and TBT limits have to be fulfilled with respect to the first control message.

A control message shall be accepted as updated EUT trigger earliest 10 s after the last EUT transmission.

4.2.7.3 Limits

The limits given in Table 7 shall not be exceeded.

Table 7: Trigger-before-transmit Limits

Trigger-Before-Transmit timeout $TBT_{timeout}$ Cease time for UWB transmissions after EUT trigger (reception of UWB packets resets the timeout)	max 10 s
Trigger-Before-Transmit On-Time $TBT_{On\text{-}Time}$ Cumulated Ton time T_{on_cum} within any 10 s window after any trigger event	max 50 ms

Figure 4 is a graphical interpretation of the trigger-before-transmit limits.

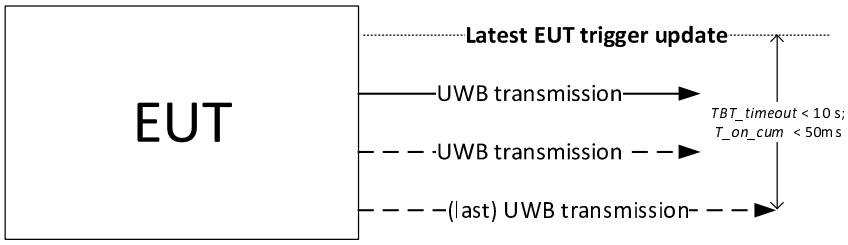

Figure 4: Trigger-before-transmit limits

For the justification of trigger-before-transmit limits see Annex C.

4.2.7.4 Conformance

The conformance test for trigger-before-transmit shall be as defined in clause 5.4.7.

4.3 Receiver requirements

4.3.1 General

Based on this justification the following Receiver requirements apply for the EUT covered by the present document:

- Receiver Baseline Sensitivity (RBS), see clause 4.3.4.
- Receiver Baseline Resilience (RBR), see clause 4.3.5.

NOTE: The receiver requirements for EUT covered by the scope of the present document are justified in ETSI EN 303 883-2 [2], Annex C.

4.3.2 Wanted Technical Performance Criteria

4.3.2.1 Wanted Technical Performance Criterion 1

The wanted technical performance criterion 1 is used for the RBS and RBR tests.

The EUT shall fulfil a Message Success Rate better than 90 %.

For the RBR test the EUT shall meet this requirement also during interferer present, as shown in Figure 5.

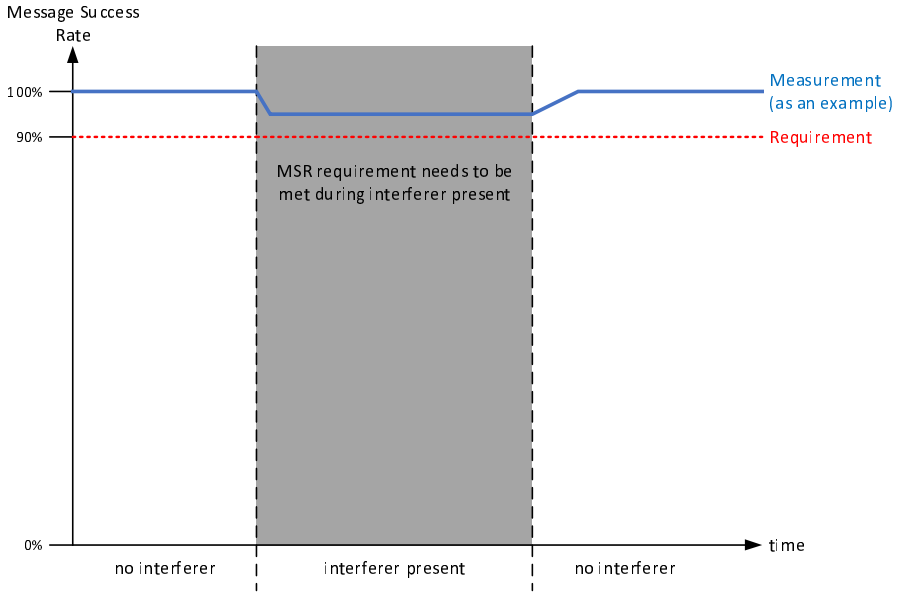

Figure 5: Wanted technical performance criterion 1 for RBR test

The EUT shall support the determination of the MSR for all relevant test setups in the present document.

The MSR shall be determined with at least 20 messages (e.g. 18 successful message detections out of 20).

NOTE 1: The equipment covered by the present document uses a packet-based exchange for distance bounding and/or location tracking and/or data transfer. This exchange is referred to as "message". The performance requirement is based on the successful detection of messages by the EUT. An adequate Message Success Rate (MSR), as specified in the present document, is, therefore, an appropriate wanted technical performance criterion.

NOTE 2: For the general case of proprietary protocols, supporting an MSR measurement will require that the manufacturer provides an appropriate companion device or signal generator configuration to generate a "wanted signal", as well as tools to read out successful message detection from the EUT and calculate MSR.

4.3.2.2 Wanted Technical Performance Criterion 2

The wanted technical performance criterion 2 is used for the RBR tests only.

The wanted technical performance criterion 2 takes into account the non-protected nature of UWB operations.

During the presence of an interferer, the EUT may have a temporary loss of function or degradation of performance.

However, when the interferer is removed, the EUT shall recover its normal performance - which is a message success rate better than 90 % (see clause 4.3.2.1) - without operator intervention.

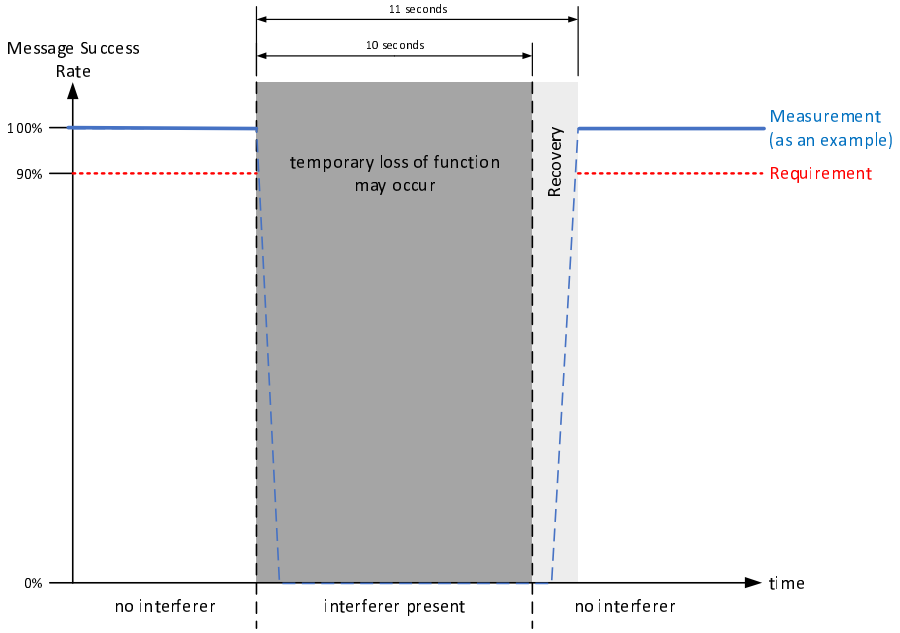

Figure 6: Wanted technical performance criterion 2 for RBR test

The requirements for the wanted technical performance criterion 2 are listed below and are depicted in Figure 6:

- Interference shall be present for 10 seconds.
- Recovery of performance shall be completed 1 second after interference has been removed.
- After 11 seconds the MSR measurement is started and the EUT shall fulfil message success rate better than 90 %.

4.3.3 Receiver spurious emissions

4.3.3.1 Applicability

This requirement shall apply to all EUTs that are RX only devices or comprise an RX only mode (TX inactive).

4.3.3.2 Description

See ETSI EN 303 883-2 [2], clause 5.2.1.

4.3.3.3 Limits

The Receiver spurious emissions shall comply with limits in Table 8.

Table 8: Receiver spurious emission limits

Frequency range	Limit values
F_{LOWER} to 1 000 MHz	-57 dBm
1 GHz < f ≤ F_{UPPER} (see Table 9)	-47 dBm
NOTE: F_{UPPER} and F_{LOWER} are linked with the OFR of the EUT, see Table 9.	

The frequency range for the RX spurious emission test shall be as defined in Table 9.

Table 9: Frequency range for the RX spurious emissions test, linked with EUT OFR

Fundamental frequency range defined by f_L and f_H	Frequency range for measurements	
	Lower frequency (F_{LOWER})	Upper frequency (F_{UPPER})
3,8 GHz to 4,2 GHz	30 MHz	5th harmonic (note 1)
6,0 GHz to 8,5 GHz	30 MHz	26 GHz
NOTE 1: F_{UPPER} is the stated harmonic of f_H (the upper edge of the OFR, which is measured in clause 4.2.2). NOTE 2: F_{LOWER} has to be selected based on f_L and F_{UPPER} based on f_H (f_L and f_H can be measured according to ETSI clause 4.2.2); for receive only devices f_H and f_L of the related EUT/companion device shall be used.		

NOTE: Limits are based on ETSI EN 303 883-2 [2], clause 5.2.2.

4.3.3.4 Conformance

The conformance test for receiver spurious emission shall be as defined in clause 5.5.1.

4.3.4 Receiver Baseline Sensitivity (RBS)

4.3.4.1 Applicability

This requirement shall apply to all EUTs with receive functionality.

4.3.4.2 Description

See ETSI EN 303 883-2 [2], clause 5.4.

4.3.4.3 Limits

The receiver baseline sensitivity (RBS) is defined as the "received power at the EUT" (according to ETSI EN 303 883-2 [2], clause 5.4.3.3) and shall be at least 70 dB below the maximum Mean Spectral Density level of -41,3 dBm/MHz:

Receiver Baseline Sensitivity: $P_{@EUT} \leq$ -111,3 dBm/MHz

NOTE 1: Received power at the EUT includes the RX antenna gain (of the integrated or dedicated EUT antenna).

NOTE 2: Reasoning of baseline sensitivity requirement:
The Keyless Entry use case (see ETSI TR 103 416 [i.3]) requires reliable operation even under heavy human body attenuation or blockage scenarios. This can be achieved with a good link budget and/or installation of additional UWB nodes at the vehicle. Spectrum efficiency is deteriorated, if link budget due to poor RX sensitivity is traded off against node count, as this will add unnecessary air traffic. This justifies the requirement for a "Baseline Sensitivity".

NOTE 3: Baseline sensitivity is defined with the same unit as mean e.i.r.p. power spectral density, and therefore the measurement methods for Mean PSD can be reused for quantifying the received power at the EUT.

The wanted technical performance criteria for all equipment type 1 and type 2 for the RBS tests shall be criterion 1, as defined in clause 4.3.2.1.

4.3.4.4 Conformance

The conformance test for receiver baseline sensitivity (RBS) shall be as defined in clause 5.5.2.

4.3.5 Receiver Baseline Resilience (RBR)

4.3.5.1 Applicability

This requirement shall apply to all EUTs with receive functionality.

4.3.5.2 Description

See ETSI EN 303 883-2 [2], clause 5.5.

4.3.5.3 Limits

The present document considers two interference scenarios:

- Interference Scenario 1: Weak interference (likely): Wanted Technical Performance Criterion 1 (clause 4.3.2.1) shall be fulfilled.
- Interference scenario 2: Strong interference (rare, but possible): Wanted Technical Performance Criterion 2 (clause 4.3.2.2) shall be fulfilled.

Both interference scenarios shall be tested and tested and the EUT shall comply with the limits given in Table 10 and Table 11.

Limits for the interferer within OFR shall be as shown in Table 10.

Table 10: RBR limits within OFR

	Interference Scenario	Interference power level at EUT	Wanted technical performance criterion	Test frequencies	Modulation of test signals
Equipment type 1	Scenario 1	-85 dBm	Criterion 1	• f_L (lower edge of OFR) • f_c (center frequency of wanted signal) • f_H (upper edge of OFR)	CW
	Scenario 2	-50 dBm	Criterion 2		
Equipment type 2	Scenario 1	-75 dBm	Criterion 1		
	Scenario 2	-50 dBm	Criterion 2		

Limits for the interferer outside OFR shall be as shown in Table 11.

Table 11: RBR limits outside OFR

	Interference Scenario	Interference power level at EUT	Wanted technical performance criterion	Test frequencies	Modulation of test signals
Equipment type 1	Scenario 1	-85 dBm	Criterion 1	• f_c - 2 × OFR • f_c - 1 × OFR • f_c + 1 × OFR • f_c + 2 × OFR	CW
	Scenario 2	-50 dBm	Criterion 2		
Equipment type 2	Scenario 1	-75 dBm	Criterion 1		
	Scenario 2	-50 dBm	Criterion 2		

NOTE: Interfering signals and limits are defined in accordance with ETSI EN 303 883-2 [2], Annex A.

4.3.5.4 Conformance

The conformance test for Receiver Baseline Resilience (RBR) shall be as defined in clause 5.5.3.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

Tests defined in the present document shall be carried out at representative points within the boundary limits of the operational environmental profile defined by its intended use.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the operational environmental profile defined by its intended use) to give confidence of compliance for the affected technical requirements.

5.2 General conditions for testing

General guidance on conditions for testing, measurement uncertainty and interpretation of the measurement results are given in Annex B.

5.3 Conformance test suites

5.3.1 General

The choice of equipment shall follow ETSI EN 303 883-1 [1], clause A.6.

Radiated tests shall be carried out in an Anechoic Chamber according to ETSI EN 303 883-1 [1], clause B.2.2.2.

5.3.2 Test scenarios

Setup for equipment type 1 (vehicle transceivers):

- The mounting environment shall be emulated for the measurement, if the antenna performance is depending on the packaging environment.

NOTE 1: Emulation of environment is the case if the environment is intended part of the antenna design and there is one dedicated packaging position for the vehicle transceiver.

EXAMPLE: A roof-top antenna module, where the roof may be emulated by a metal plate in the measurement.

- The vehicle transceiver module shall be measured as a stand-alone component, if the antenna performance is not depending on the mounting environment.

NOTE 2: Measurement as a stand-alone component is the case if the device is intended to be mounted at different packaging positions, and there are packaging rules that prevent any antenna detuning or performance deterioration.

Setup for equipment type 2 (vehicle ID devices):

- for the measurement the ID device shall include any typical accessory, e.g. (removable) metal key blade;
- the ID device shall be measured as a stand-alone component (e.g. no emulation of human body or hand).

5.4 Conformance methods of measurement for transmitter

5.4.1 General

See clause 5.1 of ETSI EN 303 883-1 [1] for general guidance on TX measurements and emission concept.

5.4.2 Operating Frequency Range (OFR)

Conformance shall be tested according clause 5.2.2 of ETSI EN 303 883-1 [1].

The mean e.i.r.p. spectral density measurement (see clause 5.4.3) shall be the reference for the OFR assessment.

OFR shall be determined for the X = 10 dB values below the maximum (parameter X as specified in ETSI EN 303 883-1 [1], clause 5.2.1).

5.4.3 Mean e.i.r.p. spectral density

Conformance shall be tested according to of ETSI EN 303 883-1 [1], clause 5.3.2.3 ("Mean e.i.r.p. spectral density, averaged over 1 ms").

The test setup for the spherical scan shall follow ETSI EN 303 883-1 [1], clause B.4.

5.4.4 Peak e.i.r.p. spectral density

Conformance shall be tested according to ETSI EN 303 883-1 [1], clause 5.3.4.2 ("General method").

RBW of 50 MHz shall be used.

5.4.5 TX unwanted emissions

Conformity shall be tested according to ETSI EN 303 883-1 [1], clause 5.5.3 ("General for Conformance test TX unwanted emission").

As requested in ETSI EN 303 883-1 [1], clause 5.5.1 the limit for the parameter X_{TXUE} for all EUTs (equipment type 1 and type 2) is specified to:

X_{TXUE}: 50 %

5.4.6 Duty Cycle

5.4.6.1 Short-Term Duty Cycle

Conformance of Short-Term Duty-Cycle shall be tested according to ETSI EN 303 883-1 [1], clause 5.11.2.1 ("Duty cycle, spectrum analyser method") or using the equivalent oscilloscope method according to ETSI EN 303 883-1 [1], clause 5.11.2.2 ("Duty cycle, oscilloscope method").

Following parameters shall be used for short-term-duty-cycle tests:

- T_{obs} = 1 s
- T_{dis} = 10 µs

NOTE: This value for disregard time T_{dis} is large enough to span pulse-based symbols and include them in the On-time, but small enough to differentiate packets and account the time between as Off-time.

- RBW $\geq$ 1 MHz, Peak Detector
- P_{thresh} = Pmax - 10 dB
- For improved measurement accuracy (increasing signal-to-noise ratio), the test can be carried out at reduced distance (if radiated) or as conducted measurement

5.4.6.2 Long-Term Duty Cycle

Conformity of Long-Term Duty-Cycle shall be tested according to ETSI EN 303 883-1 [1], clause 5.11.2.1 ("Duty cycle, spectrum analyser method") or using the equivalent oscilloscope method according to ETSI EN 303 883-1 [1], clause 5.11.2.3 ("Duty cycle, oscilloscope method").

Following parameters shall be used for long-term-duty-cycle assessment:

- T_{obs} = 60 s
- T_{dis} = 10 µs

NOTE 1: This disregard time is large enough to span pulse-based symbols and include them in the On-time, but small enough to differentiate packets and account the time between as Off-time.

- RBW ≥ 1 MHz, Peak Detector
- P_{thresh} = Pmax - 10 dB
- For improved measurement accuracy (increasing signal-to-noise ratio), the test can be carried out at reduced distance (if radiated) or as conducted measurement

The measured ΣT_{on} in 60 s shall be used to extrapolate the cumulated on time for 1 hour:

$$\Sigma T_{on} (1 \text{ hour}) = \Sigma T_{on} (60 \text{ s}) \times 60$$

NOTE 2: The Long-Term-Duty-Cycle requirement is implicitly fulfilled, if the EUT is compliant to "trigger-before-transmit".

NOTE 3: The extrapolation from 60 s to 1 hour does not put a harder Long-Term-Duty-Cycle requirement to the EUT, if the T_{on} time of one transmission is less than 190 µs (because the 38 ms $T_{off\ mean}$ requirement is the limiting parameter). This is typically the case for Keyless Entry protocols.

5.4.7 Trigger-before-transmit

5.4.7.1 General

Conformance for "trigger-before-transmit" shall be tested using a procedure as below.

The measurement can be radiated or conducted, using a spectrum analyser in Zero-Span with settings as for clause 4.2.6 ("Duty Cycle") or an oscilloscope - those methods provide equivalent results for the time domain.

Depending on the trigger scenario one of following test setups and procedures shall be used:

- Trigger scenario 1: see clause 5.4.7.2.
- Trigger scenario 2: see clause 5.4.7.3.

5.4.7.2 Setup for Trigger Scenario 1

Figure 7 shows the setup for trigger scenario 1, where EUT is responder, and trigger is a received UWB packet.

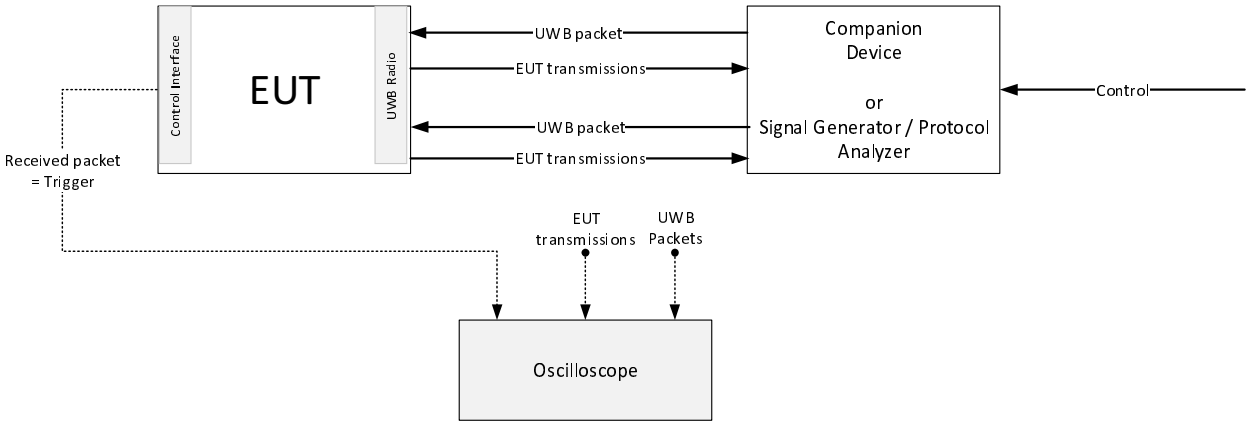

Figure 7: Setup for Trigger Scenario 1

The manufacturer shall provide a companion device including control equipment or provide necessary information how to configure signal generator and protocol analyser. (In the following text, "companion device" will be used for either embodiment.)

Procedure:

1) Companion device sends a single packet:

   a) Verify at EUT control interface that packet has been received.

   b) Measure TBT timeout and cumulated ON-time at EUT UWB radio interface, relative to the sent packet from the companion device.

   c) The measured values shall comply with the trigger-before-transmit limits.

2) Companion device sends repeating packets, repetition time < 10 s:

   a) Measure cumulated ON-time T_{cum_on} within any 10 s.

   b) Vary (reduce) repetition time, to determine the worst case cumulated ON-time T_{cum_on}.

   c) The maximum value for T_{cum_on} shall be recorded and shall comply with the trigger-before-transmit limit.

3) Deactivate repeating packet transmissions:

   a) Verify that EUT stops transmitting.

   b) Measure TBT timeout, relative to the last received UWB packet.

   c) The larger value of 1b or 2b shall be recorded as result for $TBT_{timeout}$ and shall comply with the limit.

The test procedure shall include at least 10 repetitions of the trigger signal, before deactivating the companion device. The repetitions shall confirm identical behaviour of the EUT or reveal worst-case behaviour.

The observation time after the (latest) trigger shall be at least 1 min to confirm that the EUT has ceased UWB transmissions.

The test shall cover all operational modes of the EUT.

5.4.7.3 Setup for Trigger Scenario 2

Figure 8 shows the setup for trigger scenario 2, where EUT is initiator, and trigger is a control message.

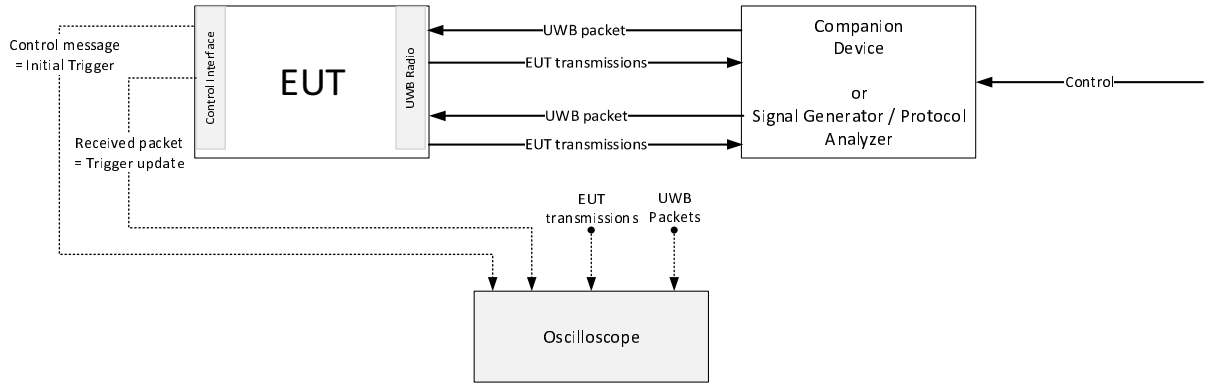

Figure 8: Setup for Trigger Scenario 2

The manufacturer shall provide a companion device including control equipment or provide the necessary information how to configure signal generator and protocol analyser. (In the following text, "companion device" will be used for either embodiment.)

Procedure:

1) Control equipment sends a control message to EUT:

   a) EUT sends one or more transmissions.

b) Measure TBT timeout and cumulated ON-time at EUT UWB radio interface, relative to the start of the first EUT transmission.

c) The measured values shall comply with the trigger-before-transmit limits.

2) Control equipment sends two control messages within cease time to EUT:

a) The second control message shall be sent still within the cease time of the first control message (=EUT trigger).

b) Measure TBT timeout and cumulated ON-time at EUT UWB radio interface, relative to the start of the first EUT transmission.

c) The second control message shall be ignored and shall not lead to further transmissions by the EUT. The measured values shall comply with the trigger-before-transmit limit and are expected to be the same as in 1).

3) Companion device sends response packets:

a) Control equipment sends control message to EUT as initial trigger.

b) EUT sends one or more transmissions.

c) The companion device shall send responses to the EUT.

d) Verify at EUT control interface that response packets are received.

e) Measure cumulated ON-time T_{cum_on} within any 10 s.

f) The maximum value for T_{cum_on} shall be recorded and shall comply with the trigger-before-transmit limit.

4) Deactivate response packet transmissions:

a) Verify that EUT stops transmitting.

b) Measure TBT timeout, relative to the last received UWB packet.

c) The larger value of 1b or 4b shall be recorded as result for $TBT_{timeout}$ and shall comply with the limit.

The test procedure shall include at least 10 response packets, before deactivating the companion device.
Evaluation of at least 10 response packets shall confirm identical behaviour of the EUT or reveal worst-case behaviour.

The observation time after the (latest) trigger shall be at least 1 min to confirm that the EUT has ceased UWB transmissions.

5.5 Conformance methods of measurement for receiver

5.5.1 Receiver Spurious Emissions

Conformance shall be tested according to ETSI EN 303 883-2 [2], clause 5.2.3.

For the test, the EUT shall be set into the RX mode.

Receiver Spurious Emissions shall be measured radiated using a test setup according to ETSI EN 303 883-1 [1], clause B.2 ("Radiated measurements").

5.5.2 Receiver Baseline Sensitivity (RBS)

Conformity of RX Baseline Sensitivity shall be a radiated test with integral or specified antenna according to ETSI EN 303 883-2 [2], clause 5.4.3.3 ("Radiated measurements for radio communication devices with power limit").

All signal levels (P_{out}, $P_{@EUT}$) shall be determined with reference to the mean e.i.r.p. spectral density and therefore documented with the unit "dBm/MHz".

The wanted technical performance criteria for the test are provided in clause 4.3.2.1.

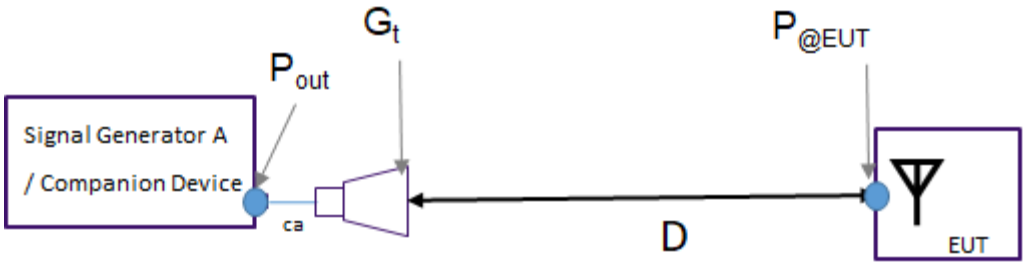

Figure 9: Setup for RBS measurement

The recommended measurement distance D is 3 m.

5.5.3 Receiver Baseline Resilience (RBR)

Conformity of Receiver Baseline Resilience shall be tested according to ETSI EN 303 883-2 [2], clause 5.5.3.3 ("Radiated Measurements for Radio Communication Devices with Power Limit") with the following parameters:

The wanted technical performance criteria for the test are provided in clauses 4.3.2.1 and 4.3.2.2.

The wanted signal level for all RBR tests shall be 10 dB above the RX Baseline Sensitivity (see clause 4.3.4.3).

Sensitivity degradation d_g = 10 dB

The wanted signal shall be at its nominal frequency f_c.

Interfering signals within OFR are given in Table 10 and Interfering signals outside OFR in Table 11.

For interference scenario 2 the interference shall be present for 10 seconds. After 11 seconds the MSR measurement is started again and the EUT shall fulfil message success rate better than 90 %.

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.2] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in Table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 302 065-3-1					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Operating Frequency Range (OFR)	3.2	4.2.2	U	
2	Mean e.i.r.p. spectral density	3.2	4.2.3	U	
3	Peak e.i.r.p. spectral density	3.2	4.2.4	U	
4	TX unwanted emissions	3.2	4.2.5	U	
5	Duty Cycle	3.2	4.2.6	C	For all Type 1; for Type 2 only, if operated in the band 3,8 GHz to 4,2 GHz
6	Trigger-before-transmit	3.2	4.2.7	C	for Type 1 only
7	Receiver spurious emissions	3.2	4.3.3	C	All EUTs that are RX only devices or comprise an RX only mode
8	Receiver Baseline Sensitivity (RBS)	3.2	4.3.4	U	
9	Receiver Baseline Resilience (RBR)	3.2	4.3.5	U	

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

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 unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative): General conditions for testing, measurement uncertainty and interpretation of the measurement results

General guidance on TX and RX measurements are given respectively in ETSI EN 303 883-1 [1], clause 5.1.1 for the TX requirements and ETSI EN 303 883-2 [2], clause 5.1 for the RX requirements.

ETSI EN 303 883-1 [1], Annex A provides additional information on general conditions for testing, e.g. test environment and test conditions, measurement uncertainty and interpretation of the measurement results. An overview is provided in ETSI EN 303 883-1 [1], clause A.1.

Annex C (informative): Trigger-before-transmit

C.1 Trigger behaviour

This clause explains the trigger behaviour of the equipment with respect to category A and B as defined in ETSI TR 103 416 [i.3].

ETSI TR 103 416 [i.3], clause 5.2 defines different categories of vehicular access systems:

- Category A (Proximity Verification)
- Category B (Proximity Monitoring)

ECC Report 278 [i.6] concludes that compatibility with incumbent services can be reached for those categories A and B by using "trigger-before-transmit" mitigation.

Upon a trigger event the behaviour of the EUT can be characterized as follows (and mapped to category A or B equipment, referencing ETSI TR 103 416 [i.3], clauses 5.2.2 and 5.2.3):

- Case A: EUT follows a pre-defined sequence of transmissions, independent whether it receives (further) UWB packets of the companion device or not;
  this will be the typical behaviour of Category A equipment.
- Case B: EUT continues transmitting UWB packets, as long as it receives packets from the companion device; if no packets are received any more (companion device is out of range), EUT will stop UWB transmissions;
  this will be the typical behaviour of Category B equipment.

Figure C.1 gives an overview about the EUT trigger scenarios with respect to case A and case B.

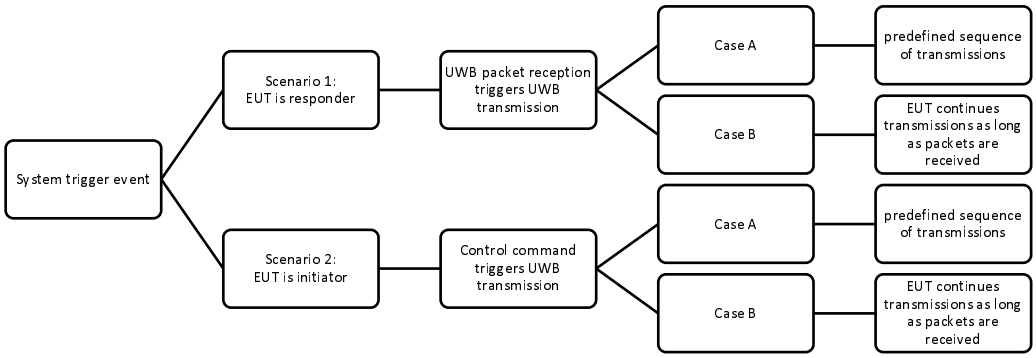

Figure C.1: Trigger behaviour for Category A and Category B

As regulation ECC/DEC/(06)04 [i.4] does not differentiate between categories, limits in clause 4.2.7.3 and conformance test in clause 4.2.7.4 cover both, category A and B.

C.2 Justification for trigger-before-transmit limits

ECC Report 278 [i.6] connects two essential assumptions with "trigger-before-transmit" mitigation:

1) The cumulated transmission time of the EUT upon a trigger event is limited.
2) The overall activity of a "trigger-before-transmit" EUT is lower than for a worst-case LDC device.

Taking these assumptions as requirements to be covered in a measurement procedure, following conclusions can be made:

1) The requirement of a cumulated transmission time can be measured on EUT level.

2) Activity cannot be measured on EUT level, as it is controlled by entities outside the EUT and depends on usage profile. However, a necessary consequence of "trigger-before-transmit" is that the EUT ceases UWB transmissions within a certain time upon a trigger event.
The requirement of a transmission cease time can be measured on EUT level.

ECC Report 278 [i.6], Table 4 defines UWB system parameters used for the studies on the "Trigger-Before-Talk" mitigation. The cumulated Ton time per trigger event is assumed to be:

- 50 ms for Category A devices.
- 750 ms for Category B devices.

Furthermore, EUTs should comply with the LDC regulations:

- Assuming a Duty-Cycle of 5 % (Short-Term Duty-Cycle limit, T_{on} = 50 ms if applied to 1 second observation time) the cumulated T_{on} time is achieved:
  - for Category A (50 ms) within 1 s of operation;
  - for Category B (750 ms) within 15 s of operation.
- Assuming a Duty-Cycle of 0,5 % (Long-Term Duty-Cycle limit, T_{on} = 5 ms if applied to 1 second observation time) the cumulated Ton time is achieved:
  - for Category A (50 ms) within 10 s of operation;
  - for Category B (750 ms) within 150 s of operation.

Thus, a test on ceasing transmission within 10 s AND not exceeding a cumulated T_{on} of 50 ms within 10 s would satisfy the "trigger-before-transmit" as well as the Long-Term Duty-Cycle requirement, and is reflecting the lower activity assumptions for Category A.

Annex D (informative): RBR Limits Derivation

D.1 General

The RBR limits in the present document are derived based on ETSI EN 303 883-2 [2], Annex A.

Clause A.2.1.1 of ETSI EN 303 883-2 [2] is referencing to ETSI TS 103 361 [i.5], which includes the list of interferers from which the highest interferer for the in-band and out-of-band test is chosen.

The interferers from Table 7 of ETSI TS 103 361 [i.5], clause 7.6 ("Interferers for mobile (indoor and outdoor) applications") are evaluated for the two permitted frequency bands of the present document and the highest level is taken as the limit.

This is the worst-case for all possible OFR scenarios.

D.2 Relevant interferers - Frequency Band 3,8 GHz to 4,2 GHz

D.2.1 Relevant interferers

Max. possible OFR: f_L = 3,8 GHz, f_H = 4,2 GHz → OFR_{max} = 0,4 GHz, f_c = 4,0 GHz:

For this OFR Table 1 of ETSI TS 103 361 [i.5], clause 7.2 ("Complete list of interferers") does not list any relevant interferers.

D.2.2 Limits for equipment type 1

Same limit as for frequency band 6,0 GHz to 8,5 GHz is used: $P_{@EUT}$ = -85 dBm.

D.2.3 Limits for equipment type 2

Same limit as for frequency band 6,0 GHz to 8,5 GHz is used: $P_{@EUT}$ = -75 dBm.

D.3 Relevant interferers - Frequency Band 6,0 GHz to 8,5 GHz

D.3.1 Relevant interferers

Max. possible OFR: f_L = 6,0, f_H = 8,5 GHz → OFR_{max} = 2,5 GHz, f_c = 7,25 GHz.

From Table 1 of ETSI TS 103 361 [i.5], clause 7.2 ("Complete list of interferers") the relevant interferers can be identified.

Table D.1 lists the relevant interferers.

Table D.1: List of relevant interferers

Radio Service	Freq. Min [MHz]	Freq. Max [MHz]	Center Freq. [MHz]	max. EIRP [dBm]	Ch. BW [MHz]	Duty cycle
Radiodetermination applications	4 500	7 000	5 725	24	2 500	
Fixed links	5 925	8 500	7 212,5	85	29,65	
Radiodetermination applications	6 000	8 500	7 250	7	2 500	100 %
Fixed (point-to-point)	8 400	8 500	8 450	85		

D.3.2 Limits for equipment type 1

ETSI TS 103 361 [i.5], clause 7.8 ("Interferers for automotive applications") defines interference power for "Devices inside the surface and not in the passenger area" in Table 13 and "Devices outside the surface or within the passenger area" in Table 15.

Table 15 of ETSI TS 103 361 [i.5] provides the tougher values and is used for all equipment type 1 (independent of its packaging location) to derive a worst-case limit.

The interference power levels out of Table 15 of ETSI TS 103 361 [i.5] for the relevant interferers (as determined in Table D.1) are listed in Table D.2.

Table D.2: List of interferers for equipment type 1

Radio Service	Center Freq. [MHz]	max. EIRP [dBm]	Service group	Total attenuation [dB]	Power @ device [dBm]	Ch. BW [MHz]	Duty cycle
Fixed links	7 212,5	85		170	-85	29,65	
Radiodetermination applications	7 250	7	4	132	-125	2 500	1
Fixed (point-to-point)	8 450	85		171	-86		

The worst-case value is -85 dBm which is defined as the limit for equipment type 1 in the frequency band 6,0 GHz to 8,5 GHz.

D.3.3 Limits for equipment type 2

ETSI TS 103 361 [i.5], clause 7.6 ("Interferers for mobile (indoor and outdoor) applications") defines interference power levels for mobile devices in Table 7.

The interference power levels out of Table 7 of ETSI TS 103 361 [i.5] for the relevant interferers (as determined in Table D.1) are listed in Table D.3.

Table D.3: List of interferers for equipment type 2

Radio Service	Center Freq. [MHz]	max. EIRP [dBm]	Service group	Total attenuation [dB]	Power @ device [dBm]	Ch. BW [MHz]	Duty cycle
Radiodetermination applications	5 750	24	4	118	-94	2 500	
Fixed links	7 212,5	85		160	-75	29,65	
Radiodetermination applications	7 250	7	4	120	-113	2 500	1
Fixed (point-to-point)	8 450	85		161	-76		

The worst-case value is -75 dBm which is defined as the limit for equipment type 2 in the frequency band 6,0 GHz to 8,5 GHz.

D.4 Strong interferers

D.4.1 WAS/RLAN in 5 925 MHz to 6 425 MHz

VLP devices may be introduced to the market with maximum e.i.r.p. for in-band emissions of +14 dBm, see ECC/DEC/(20)/01 [i.11].

Applying the conditions for mobile interferers (service group 1) from ETSI TS 103 361 [i.5] for the total attenuation yields:

Total attenuation [dB]	= Path loss for 2 m [dB]	+ Wall loss [dB]	+ Additional loss NLOS [dB]	
	= 54 dB	+ 0 dB	+ 10 dB	= 64 dB

The resulting interferer power at a UWB device with 0 dBi antenna is:

interferer power@device [dBm] = max. e.i.r.p. interferer [dBm] - Total attenuation [dB] = +14 dBm - 64 dB = -50 dBm

D.4.2 Limits for equipment type 1 and equipment type 2

The interference power for VLP devices as derived in clause D.4.1 is considered to be representative for any "strong" interferers that may appear in the field.

This value will be used across all equipment types and frequency bands as test limit, for which the EUT needs to fulfil Wanted Technical Performance Criterion 2: A temporary loss of function may occur, but the EUT automatically recovers its normal performance once the interference has ceased.

The limit for equipment type 1 and type 2 is -50 dBm for frequency bands 3,8 GHz to 4,2 GHz as well as 6,0 GHz to 8,5 GHz.

Annex E (informative): Bibliography

ERC/REC 70-03: "ERC Recommendation of 1997 on relating to the use of Short Range Devices (SRD)".

NOTE: Available at https://efis.cept.org/sitecontent.jsp?sitecontent=srd_regulations.

Commission Decision 2013/752/EC on harmonisation of the radio spectrum for use by short-range devices as amended by subsequent Commission Decisions.

ETSI EG 203 336 (V1.2.1) (05-2020): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

CEPT/ERC/Recommendation 74-01E: "Unwanted emissions in the spurious domain".

Recommendation ITU-R SM.329-12 (2012): "Unwanted emissions in the spurious domain".

ETSI TS 103 060 (V1.1.1): "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".

Annex F (informative): Change history

Date	Version	Information about changes
April 2014	1.1.1	Last publication of ETSI EN 302 065-3 for UWB devices for road and rail vehicles as HS under Directive 1999/5/EC (RTTE).
July 2016	2.1.1	Revision of ETSI EN 302 065-3 for UWB devices for road and rail vehicles for compliance with Directive 2014/53/EU; listed in OJEU at 10 March 2017 and listed with restrictions (not for trigger-before-transmit) at 6 February 2020; main changes to previous version: • Outsourcing of standard measurement procedure into separate ETSI EN 303 883 (V1.1.1) • More detailed description of receiver spurious emission requirements • New requirement on receiver interferer signal handling • New Annex B "Application form for testing" • New Annex C "Equivalent mitigation techniques" • New Annex D "Surface mounted devices example mirror" New Annex E "Device mounted inside the tyre".
ETSI EN 302 065-3-1		
	1.1.1	Revision on request of the EC to improve the standard, especially regarding receiver requirements; to achieve sound an clear standards it was decided in TGUWB to develop more specific standards; for the present document this means instead of one ETSI EN 302 065-3 standard for all for road and rail vehicles a ETSI EN 302 065-3-1 for UWB devices for vehicular access systems. Other sub-parts may follow.

History

Document history		
V1.1.1	April 2014	Publication as ETSI EN 302 065-3
V2.1.1	November 2016	Publication as ETSI EN 302 065-3
V3.1.0	July 2021	EN Approval Procedure AP 20211024: 2021-07-26 to 2021-10-25