

**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**

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document contains only the test procedure description, based on the requirement catalogue in annex E and the Technical Specification on DAA enabled UWB devices. The physical test configurations and test results are not included as no DAA UWB devices were available for test during the lifetime of the task force. The report will be updated with the corresponding physical test setups and test results as soon as a stable body of information becomes available.

Introduction

The present document describes a set of tests to evaluate the response of UWB devices equipped with Detect and Avoid algorithms in the presence of Radar signals in the range 3,1 GHz to 3,4 GHz and 8,5 GHz to 9 GHz and BWA systems in the range 3,4 GHz to 3,8 GHz.

The present document identifies the general test criterion and operational states of the UWB device under test as well as the test signal definition for the potential victims, namely radiolocation systems and BWA systems.

1 Scope

The present document provides the description of the test setups and test procedures for the compliance of DAA ("Detect And Avoid") enabled UWB ("Ultra WideBand") devices based on the ECC regulatory framework for DAA enabled UWB devices.

2 References

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

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- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
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2.1 Normative references

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

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [i.1] ECC DEC(06)04: "ECC Decision of 24 March 2006 amended 6 July 2007 at Constanta on the harmonized conditions for devices using Ultra-Wideband (UWB) technology in bands below 10.6 GHz".
- [i.2] ECC DEC(06)12 amended: "ECC Decision of 1 December 2006 amended 31 October 2008 on supplementary regulatory provisions to Decision ECC/DEC/(06)04 for UWB devices using mitigation techniques".
- [i.3] ECC Report 120 (March 2008): "ECC Report on Technical requirements for UWB DAA (Detect and avoid) devices to ensure the protection of radiolocation in the bands 3.1-3.4 GHz and 8.5-9 GHz and BWA terminals in the band 3.4 - 4.2 GHz".
- [i.4] ECC TG3#18-18R0: "Flexible DAA mechanism based on "isolation criteria" between victim service and UWB devices", ECC TG3 Meeting 18, Mainz, March 2007.

- [i.5] ETSI TS 102 754 (V1.2.1): "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".
- [i.6] ICT project WALTER: "Wireless alliances for testing experiment and research".
- NOTE: <http://www.walter-uwband.eu/>.
- [i.7] ETSI TR 102 070-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide to the application of harmonized standards to multi-radio and combined radio and non-radio equipment; Part 2: Effective use of the radio frequency spectrum".
- [i.8] Decision 2008/411/EC: "Commission decision of 21 May 2008 on the harmonization of the 3 400-3 800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community".
- [i.9] ETSI EN 302 065: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wide Band technology (UWB) for communications purposes; Harmonized EN covering essential requirements of Article 3.2 of the R&TTE Directive".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

avoid implementation time: maximum time taken to adjust to a new TX parameter set following signal level measurement and identification, Parameter: $T_{avoid\ impl}$

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

channel availability check interval: maximum time between two consecutive detect operations, Parameter: T_{avail}

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 device reacts appropriately to a signal detection threshold crossing within the detect and avoid time

in operation channel availability check time: minimum time the UWB device spends searching for victim signals during normal operation, Parameter: $T_{in\ op\ avail}$

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

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

minimum initial channel availability check time: minimum time the UWB 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

signal detection threshold: amplitude of the victim signal which defines the transition between adjacent protection zones, Parameter: D_{thresh}

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

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

3.2 Symbols

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

T	time
f	frequency
D	detection threshold
dBm	decibel relative to 1 mW
I	Isolation in dB
P	Power in dBm

3.3 Abbreviations

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

BPSK	Binary Phase Shift Keying
BWA	Broadband Wireless Access
CEPT	European Conference of Postal and Telecommunications Administrations
CON	CONformance test results
CPC	Cognitive Pilot Channels
CW	Continuous Wave
DAA	Detect And Avoid
e.i.r.p.	equivalent isotropically radiated power
ECC	Electronic Communications Committee
ERM	Electromagnetic compatibility and Radio spectrum Matters
FDD	Frequency Division Duplex
ICS	Implementation Conformance Statement
LDC	Low Duty Cycle
LFM	Linear Frequency Modulation
NIM	Non Interference Mode
RF	Radio Frequency
SRD	Short Range Device
TDD	Time Division Duplex
TPC	Transmit Power Control
UWB	Ultra WideBand

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4 Recommended Applicability of Test Descriptions

The test descriptions are derived from the requirement catalogue based on the technical specification TS 102 754 [i.5]. The essential elements of this requirement catalogue have been recorded in annex E.

The applicability of each individual test description is identified in table 1 and cross referenced to the requirements catalogue. The applicability of test descriptions is formally expressed by the use of Boolean expression that is based on (ICS) parameters included in annex F.

NOTE: The applicability is just a recommendation based on the purpose for which the test description was written.

The columns in table 1 have the following meaning:

TD Id: The TD Id column indicates the test description identifier.

RQ Id: The RQ Id column gives the requirement catalogue cross reference.

Summary: The Summary column is the summary field of the test description.

Applicability: The following notations are used for the applicability column:

M mandatory - the test case is mandatory.

O optional - the test case is optional.

N/A not applicable - in the given context, the test case is not recommended.

O.i qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies a unique group of related optional items.

C.i conditional - the test is recommended ("R") or not ("N/A") depending on the support of other items. "i" is an integer identifying a unique conditional status expression which is defined immediately following the table. For nested conditional expressions, the syntax "IF ... THEN (IF ... THEN ... ELSE...) ELSE ..." is used to avoid ambiguities.

Comments: This column contains a verbal description of the condition included in the applicability column.

Table 1: Applicability of tests

TD Id	RQ Id	Summary	Applicability	Comments
Radiolocation System DAA				
TD_RADAR_001	RQ_NM_001, 002, 003	Verify the NIM operation for at least <i>Minimum Initial Channel Availability Check Time</i> in the radiolocation bands when no radiolocation system is present	Mandatory	
TD_RADAR_002	RQ_Detect_008, 009, 010	Verify the radiolocation signal detection capability and avoidance for the selected UWB operational frequency when a radiolocation signal occurs at the beginning of the <i>Minimum Initial Channel Availability Check Time</i>	Mandatory	
TD_RADAR_003	RQ_Detect_008, 009, 010	Verify the radiolocation detection capability and avoidance for the selected UWB operational frequency when a radiolocation signal occurs at the end of the <i>Minimum Initial Channel Availability Check Time</i>	Mandatory	
TD_RADAR_004	RQ_Detect_008, 009, 010	Verify the radiolocation detection and avoidance capability for the selected UWB operational frequency in normal UWB operation using a constant radiolocation test signal	Mandatory	
TD_RADAR_005	RQ_Detect_008, 009, 010	Verify the radiolocation detection and avoidance capability for the selected UWB operational frequency in normal UWB operation using an increasing radiolocation test signal	Mandatory	

BWA System DAA				
TD_BWA_006	RQ_NM_001, 002, 003	Verify the NIM operation for at least <i>Minimum Initial Channel Availability Check Time</i> in the BWA bands when no BWA system is present	Mandatory	
TD_BWA_007	RQ_Detect_008, 009, 010	Verify the BWA signal detection capability and avoidance for the selected UWB operational frequency when a BWA signal occurs at the beginning of the <i>Minimum Initial Channel Availability Check Time</i> . Without the capability of a victim bandwidth identification	Mandatory	
TD_BWA_008	RQ_Detect_008, 009, 010	Verify the BWA signal detection capability and avoidance for the selected UWB operational frequency when a BWA signal occurs at the end of the <i>Minimum Initial Channel Availability Check Time</i> . Without the capability of a victim bandwidth identification	Mandatory	
TD_BWA_009	RQ_Detect_008, 009, 010	Verify the BWA signal detection and avoidance capability for the selected UWB operational frequency in normal UWB operation using a constant BWA test signal	Mandatory	

5 Test Configurations

5.1 Introduction

In this clause the two basic test configurations will be presented and described. The test setup can be split into a conducted and a radiated test setup. A general example for the test set-up for the conducted test is given in figure 1 and for the radiated test in figure 2.

Due to the very low levels to be measured the conducted test setup is the preferred setup up. Nevertheless, a radiated setup will be needed in case of devices with integrated antennas, non accessible antenna connectors and devices deploying antenna techniques as an avoidance technique.

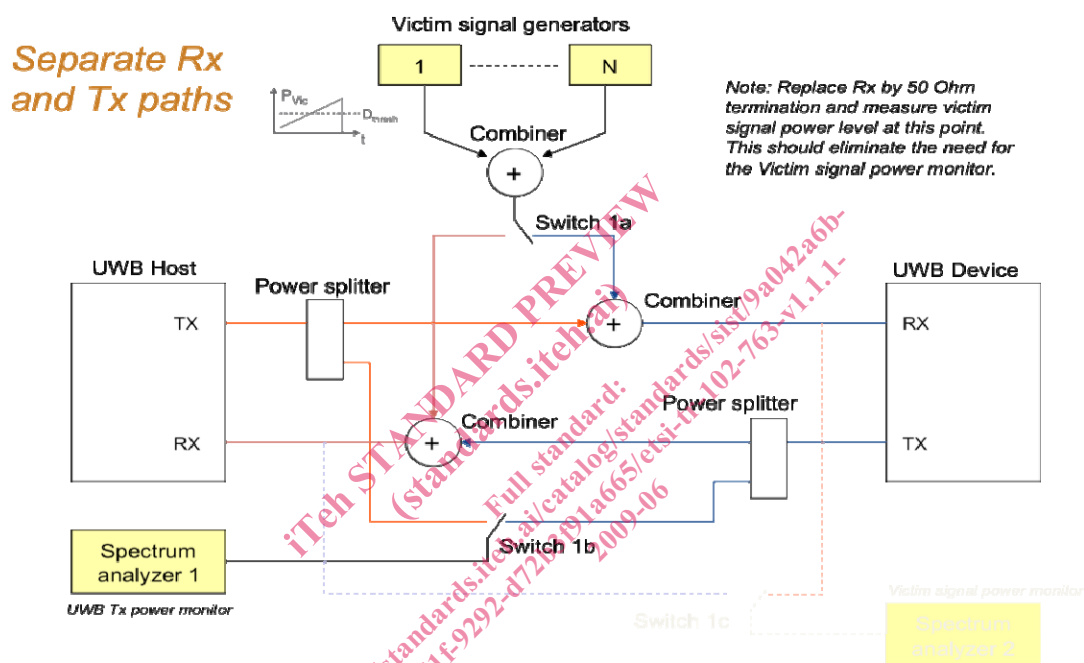


Figure 1: Proposal for a test configuration for a conducted DAA test setup [i.6]

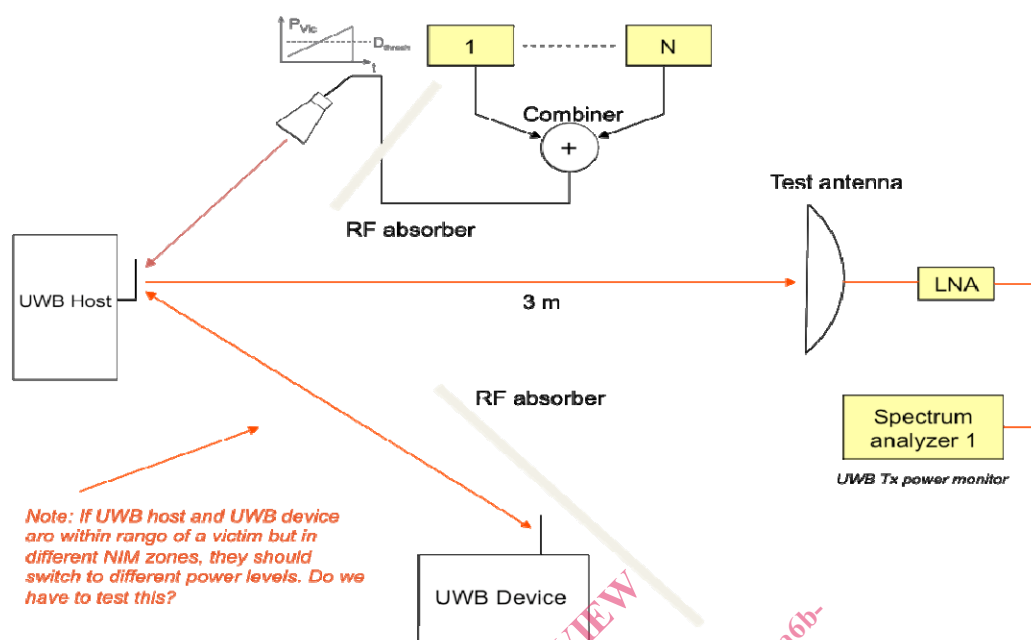


Figure 2: Proposal for a test configuration for a radiated DAA test setup [i.6]

5.2 General Test conditions

This clause covers the general laboratory requirements for power supply, environmental conditions, as well as the operational requirements for the UWB devices under test.

5.2.1 Test conditions

Testing is performed under normal test conditions.

The test conditions and procedures are performed as specified in the following clauses.

5.2.2 Power sources

5.2.2.1 Power sources for stand-alone equipment

During testing, the power source of the equipment is replaced by a test power source capable of producing test voltages as specified in clause 5.2.3.2. The internal impedance of the test power source should be low enough for its effect on the test results to be negligible. For the purpose of tests, the voltage of the power source is measured at the input terminals of the equipment.

For battery operated equipment the battery is removed and the test power source is applied as close to the battery terminals as practicable.

During tests the power source voltages are maintained within a tolerance of $\pm 1\%$ relative to the voltage at the beginning of each test. The value of this tolerance is critical to power measurements; using a smaller tolerance will provide better measurement uncertainty values.

5.2.2.2 Power sources for plug-in radio devices

The power source for testing plug-in radio devices is provided by a test fixture or host equipment.

Where the host equipment and/or the plug-in radio device is battery powered, the battery may be removed and the test power source applied as close to the battery terminals as practicable.