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Electromagnetic compatibility and Radio spectrum Matters (ERM) - Short Range Devices (SRD) - Technical characteristics for SRD equipment using Ultra WideBand technology (UWB) - Building Material Analysis and Classification equipment applications operating in the frequency band from 2,2 GHz to 8,5 GHz - Part 1: Technical characteristics and test methods

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Ta slovenski standard je istoveten z: EN 302 435-1 Version 1.3.1

ICS:

33.060.20	Sprejemna in oddajna oprema	Receiving and transmitting equipment
33.100.01	Elektromagnetna združljivost na splošno	Electromagnetic compatibility in general

SIST EN 302 435-1 V1.3.1:2010 en

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ETSI EN 302 435-1 V1.3.1 (2009-12)

European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Short Range Devices (SRD);
Technical characteristics for SRD equipment using
Ultra WideBand technology (UWB);
Building Material Analysis and Classification equipment applications
operating in the frequency band from 2,2 GHz to 8,5 GHz;
Part 1: Technical characteristics and test methods**

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Reference

REN/ERM-TGUWB-006-1

Keywords

radar, radio, SRD, testing, UWB**ETSI**

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Contents

Intellectual Property Rights	5
Foreword.....	5
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	8
3 Definitions, symbols and abbreviations	8
3.1 Definitions.....	8
3.2 Symbols.....	9
3.3 Abbreviations	10
4 Technical requirement specifications	10
4.1 General requirements	10
4.2 Presentation of equipment for testing purposes.....	10
4.2.1 Choice of model for testing	11
4.2.2 Auxiliary test equipment.....	11
4.2.3 Declarations by the provider.....	11
4.2.4 Marking and equipment identification.....	11
4.3 Mechanical and electrical design.....	11
4.3.1 General.....	11
4.3.2 Controls	11
4.3.3 Transmitter shut-off facility.....	11
4.4 Other device emissions.....	12
5 Test conditions, power sources and ambient temperatures	12
5.1 Test conditions	12
5.2 Test power source.....	12
5.2.1 External test power source.....	12
5.2.2 Internal test power source	12
5.3 Normal test conditions.....	13
5.3.1 Normal temperature and humidity	13
5.3.2 Normal test power source	13
5.3.2.1 Internal battery power source	13
5.3.2.2 Regulated lead-acid battery power sources	13
5.3.2.3 Other power sources.....	13
6 General conditions.....	13
6.1 Radiated measurement arrangements	13
6.2 Modes of operation of the transmitter	14
6.3 Measuring receiver	14
7 Interpretation of results	14
7.1 Measurement uncertainty	14
7.1.1 Measurement uncertainty is equal to or less than maximum acceptable uncertainty.....	15
7.1.2 Measurement uncertainty is greater than the maximum acceptable uncertainty.....	15
7.2 Other Emissions from device circuitry.....	16
8 Methods of measurement and limits for transmitter parameters	16
8.1 General	16
8.2 Permitted range of operating frequencies	16
8.2.1 Definition.....	16
8.2.2 Method of measurement	17
8.2.3 Frequency range.....	18
8.3 Emissions	18
8.3.1 Undesired UWB emissions from the transmitter	18
8.3.1.1 Definitions.....	18

8.3.1.2	Method of measurement.....	18
8.3.1.2.1	Method of measurement of the Total Emissions (TE).....	20
8.3.1.2.2	Method of measurement of the Other Emissions (OE).....	22
8.3.1.2.3	Method of calculation of the maximum mean undesired UWB emission of the equipment (UE).....	24
8.3.1.3	Limits.....	24
8.3.2	Other Emissions (OE).....	24
8.3.2.1	Definition.....	24
8.3.2.2	Method of measurement.....	24
8.3.2.3	Limits.....	25
8.3.3	Total Power spectral density (UE-TP).....	25
8.3.3.1	Definitions.....	25
8.3.3.2	Method of measurement.....	26
8.3.3.3	Limits.....	26
8.4	Pulse Repetition Frequency (PRF).....	26
8.4.1	Definitions.....	26
8.4.2	Declaration.....	26
8.4.3	Limits.....	26
8.5	Listen Before Talk (LBT).....	27
8.5.1	Definition.....	27
8.5.2	Function of LBT.....	27
8.5.3	Method of measurement.....	29
8.5.3.1	Measurement procedure.....	29
8.5.3.2	Test set-up.....	29
8.5.4	Limits.....	31
8.5.5	Test signal definition for LBT-mechanism.....	32
8.5.6	Design requirements.....	33
9	Methods of measurement and limits for receiver parameters.....	33
9.1	Receiver spurious emissions.....	33
Annex A (normative):	Radiated measurements.....	34
A.1	Test sites and general arrangements for measurements involving the use of radiated fields.....	34
A.1.1	Anechoic chamber.....	34
A.1.2	Anechoic chamber with a conductive ground plane.....	35
A.1.3	Test antenna.....	36
A.1.4	Measuring antenna.....	36
A.2	Guidance on the use of radiation test sites.....	37
A.2.1	Verification of the test site.....	37
A.2.2	Preparation of the DUT.....	37
A.2.3	Power supplies to the DUT.....	37
A.2.4	Range length.....	37
A.2.5	Site preparation.....	38
A.2.6	General requirements for RF cables.....	38
Annex B (normative):	Design requirements.....	39
Annex C (informative):	Measurement antenna and preamplifier specifications.....	40
Annex D (normative):	Definition of the representative wall and procedure for measurement of the undesired emissions.....	41
D.1	Representative wall definition for measuring the undesired emissions and LBT function.....	41
D.2	Procedure for measurement the wall attenuation.....	41
D.3	Typical representative wall measurement result.....	43
Annex E (informative):	Bibliography.....	44
History.....		45

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Foreword

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

Equipment covered by the present document operates in accordance with amended ECC Decision ECC/DEC(07)01 on specific Material Sensing devices using Ultra-Wideband (UWB) technology (amended 26 June 2009) [7] and Commission Decision of 21 April 2009 [6] amending Decision 2007/131/EC [5] on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonized manner in the Community (notified under document number C(2009) 2787) (2009/343/EC) [6].

For non EU countries the present document may be used for regulatory (Type Approval) purposes.

The present document is part 1 of a multi-part deliverable covering Ultra WideBand (UWB) Building Material Analysis (BMA) and classification equipment applications operating in the frequency band from 2,2 GHz to 8,5 GHz, as identified below:

- Part 1:** "**Technical characteristics and test methods**"; <https://standards.etsi.org/standards/sist/bdf2376e-90dc-4e9f-a055-83eca212f6e9/sist-en-302-435-1-v1-3-1-2010>
- Part 2:** "Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

Clauses 1 and 3 provide a general description on the types of equipment covered by the present document and the definitions and abbreviations used.

Clauses 4 and 5 provide the technical requirements for the conduction of the tests and information for equipment to be presented.

Clauses 6 and 7 give guidance on the general conditions for testing of the device and the interpretation of results and maximum measurement uncertainty values.

Clause 8 specifies the transmitter spectrum utilization parameters. The clause provides details on how the equipment should be tested and the conditions which should be applied.

Annex A (normative) provides specifications concerning radiated measurements.

Annex B (normative) provides specifications concerning the design requirements.

Annex C (informative) gives information for the measurement antenna and the preamplifier specifications.

Annex D (normative) provides a representative wall definition for emission measurements and the LBT function.

Annex E (informative) Bibliography covers other supplementary information.

National transposition dates	
Date of adoption of this EN:	7 December 2009
Date of latest announcement of this EN (doa):	31 March 2010
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 September 2010
Date of withdrawal of any conflicting National Standard (dow):	30 September 2010

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1 Scope

The present document specifies the requirements for Building Material Analysis (BMA) and classification applications using UWB technology operating in all or part of the frequency band from 2,2 GHz to 8,5 GHz. Additionally, it specifies reduced emissions in the ranges from 0,96 GHz to 2,2 GHz and 8,5 GHz to 10,6 GHz.

The present document applies to:

- a) UWB Building Material Analysis and classification equipment for imaging and object detection applications;
- b) equipment fitted with an integral antenna;
- c) handheld devices.

The present document does not apply to:

- UWB communication devices; and
- Ground penetrating radar devices; and
- Through-wall radar imaging devices;

as defined in ITU-R Recommendation SM.1754 [i.1].

The present document specifies the equipment which is designed to not radiate into the free space. It is designed to function only when positioned such that it radiates directly into the absorptive material such as walls and other building materials which absorb emissions.

The present document does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable.

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2 References

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

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

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

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

2.1 Normative references

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

- [1] CISPR 16-1 (2003): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".

- [2] ETSI TR 100 028 (all parts) (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [3] ETSI TR 102 273 (all parts) (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [4] ANSI C63.5 (2006): " American National Standard for Electromagnetic Compatibility; Radiated Emission Measurements in Electromagnetic Interference (EMI) Control; Calibration of Antennas (9 kHz to 40 GHz)".
- [5] Commission Decision 2007/131/EC of 21 February 2007 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonized manner in the Community (notified under document number C(2007) 522) (Text with EEA relevance).
- [6] Commission Decision 2009/343/EC of 21 April 2009 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonized manner in the Community (notified under document number C(2009) 2787) (Text with EEA relevance).
- [7] ECC/DEC/(07)01: "ECC Decision of 30 March 2007 on specific Material Sensing devices using Ultra-Wideband (UWB) technology (amended 26 June 2009)".

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] ITU-R Recommendation SM.1754: "Measurement techniques of ultra-wideband transmissions".
- [i.2] ITU-R Recommendation SM.1538: "Technical and operating parameters and spectrum requirements for short range radiocommunication devices".
- [i.3] 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.4] CEPT/ERC/REC 74-01E (2005): "Unwanted emissions in the spurious domain".
- [i.5] CENELEC EN 55022: "Information technology equipment; Radio disturbance characteristics; Limits and methods of measurement".
- [i.6] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).
- [i.7] "Antenna Pattern Measurement, Theory and Equations", Michael D. Foegelle, ETS Lindgreen, Compliance Engineering, Annual Reference Guide 2002.ECC/DEC/(07)01 Decision of 30 March 2007 on Building Material Analysis (BMA) devices using UWB technology.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

activity factor: effective transmission time ratio, actual on-the-air time divided by active session time or actual on-the-air emission time within a given time window

clutter: undesired radar reflections (echoes) e.g. from inhomogeneities, interfaces, gravel stones, cavities in building material structures

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

Listen Before Talk (LBT): mechanism to avoid signal transmission in the presence of other radio service signals

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

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

spatial resolution: ability to discriminate between two adjacent targets

Short Range Device (SRD): equipment defined to operate on a non-interference, no protection from interference basis

NOTE: This is also defined in ITU-R Recommendation SM.1538 [i.2].

Total Power (TP): integration of the undesired emissions in the whole area around the Building Material Analysis (BMA) scenario

NOTE: The integration is over a sphere (same procedure as for Total Radiated Power (TRP)). This value is comparable to an equivalent isotropic radiator.

undesired emissions: any emissions into free space during operation of the equipment when equipment is faced to a wall or other absorptive material to be investigated

NOTE: Undesired emissions are:

- leaked emissions from the side or backside of the antenna; and/or
- scattered/reflected emissions from the building material to be investigated; and/or
- residual emissions through the building material.

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3.2 Symbols

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

Ω	resistant value in ohm
c	velocity of light in a vacuum
c_{l1}	cable loss 1
c_{l2}	cable loss 2
E	Electrical field strength
ϵ_R	relative dielectric constant of earth materials
E_{rms}	Average electrical field strength measured as root mean square
f	frequency
f_c	frequency at which the emission is the peak power at maximum
f_H	Highest frequency of the frequency band of operation
f_L	Lowest frequency of the frequency band of operation
$G(f)$	Antenna gain over frequency
G_A	Gain of the measurement antenna
G_{LNA}	Gain of the measurement LNA
P	Power
$P_{e.i.r.p.}$	spectral power density
P_m	measured spectral power
P_{victim}	power of a different device at the BMA
$P_{wall, e.i.r.p.}$	undesired spectral power density
R	Distance
rms	Root mean square
t	time

T_P	pulse rise time
Z_{F0}	Free space wave impedance
δR	range resolution
δt	time interval between the arrivals of two signals from targets separated in range by δR
λ	wavelength

3.3 Abbreviations

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

BMA	Building Material Analysis
BW	BandWidth
CEPT	Conférence Européenne des administrations de Postes et des Télécommunications
CW	Continuous Wave
dB	deciBel
dBi	gain in deciBel relative to an isotropic antenna
dBm	deciBel reference to 1 mW
DUT	Device Under Test
e.i.r.p.	equivalent isotropically radiated power
ECC	Electronic Communications Committee
EMC	Electro-Magnetic Compatibility
ERC	European Radiocommunication Committee
IT	Information Technology
LBT	Listen Before Talk
LNA	Low Noise Amplifier
MSS	Mobile Satellite Service
OE	Other Emissions
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PSD	Power Spectral Density
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Resolution BandWidth
RF	Radio Frequency
rms	root mean square
SRD	Short Range Device
TE	Total maximum Emissions
TH	ThresHold
TP	Total Power
TP-UE	Total Power of Undesired (UWB) Emissions
TRP	Total Radiated Power
UE	Undesired (UWB) Emissions
UMTS	Universal Mobile Telecommunication System
UWB	Ultra WideBand
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio

4 Technical requirement specifications

4.1 General requirements

Equipment to be tested against the present document shall be fitted with an integral antenna.

4.2 Presentation of equipment for testing purposes

Each equipment to be tested shall fulfil the requirements of the present document on all frequencies over which it is intended to operate.

The provider shall provide one or more samples of the equipment, as appropriate for testing.

Additionally, technical documentation and operating manuals, sufficient to allow testing to be performed, shall be supplied.

The performance of the equipment to be tested shall be representative of the performance of the corresponding production model. In order to avoid any ambiguity, the present document contains instructions for the preparation of equipment for testing purposes, conditions of testing (clause 5) and the measurement methods (clause 8).

Equipment shall be offered by the provider complete with any ancillary equipment needed for testing. The provider shall declare the frequency range(s), the range of operation conditions and power requirements, as applicable, in order to establish the appropriate test conditions.

4.2.1 Choice of model for testing

If an equipment has several optional features, considered not to affect the RF parameters then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the provider and agreed by the test laboratory.

4.2.2 Auxiliary test equipment

All necessary set-up information, means for activation and hardware necessary (e.g. standardized wall structure for testing, see annex D) shall accompany the equipment when it is submitted for testing.

4.2.3 Declarations by the provider

The provider shall submit the necessary information regarding the equipment with respect to all technical requirements set by the present document.

4.2.4 Marking and equipment identification

The equipment shall be marked in a visible place. This marking shall be legible and durable.

The marking shall include as a minimum:

- the name of the manufacturer or his trademark;
- the type designation. This is the manufacturer's numeric or alphanumeric code or name that is specific to particular equipment.

4.3 Mechanical and electrical design

4.3.1 General

The equipment submitted by the provider shall be designed, constructed and manufactured in accordance with good engineering practice and with the aim of minimizing harmful interference to other equipment and services.

4.3.2 Controls

The equipment shall be equipped with controls as defined in annex B.

4.3.3 Transmitter shut-off facility

For the automatic transmitter shut-off facility it shall be possible to disable this feature for the purposes of testing.

Controls for testing purposes, which, if maladjusted, may increase the interfering potential of the equipment, shall not be easily accessible to the user.