



# SLOVENSKI STANDARD

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Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Road Transport and Traffic Telematics (RTTT); Radar equipment operating in the 76 GHz to 77 GHz range; Part 1: Technical characteristics and test methods for radar equipment operating in the 76 GHz to 77 GHz range

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*European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Short Range Devices;  
Road Transport and Traffic Telematics (RTTT);  
Radar equipment operating in the 76 GHz to 77 GHz range;  
Part 1: Technical characteristics and test methods for  
radar equipment operating in the 76 GHz to 77 GHz range**

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# Contents

Intellectual Property Rights .....	6
Foreword.....	6
1 Scope .....	7
2 References .....	7
3 Definitions, symbols and abbreviations .....	8
3.1 Definitions .....	8
3.2 Symbols.....	10
3.3 Abbreviations .....	10
4 Technical requirements specifications .....	11
4.1 Presentation of equipment for testing purposes.....	11
4.1.1 Choice of model for testing .....	11
4.2 Mechanical and electrical design.....	11
4.3 Auxiliary test equipment .....	11
4.4 Interpretation of the measurement results .....	11
5 Test conditions, power sources and ambient temperatures .....	12
5.1 Normal and extreme test conditions .....	12
5.2 External test power source.....	12
5.3 Normal test conditions.....	12
5.3.1 Normal temperature and humidity .....	12
5.3.2 Normal test power source .....	12
5.3.2.1 Mains voltage .....	12
5.3.2.2 Other power sources .....	12
5.4 Extreme test conditions .....	13
5.4.1 Extreme temperatures .....	13
5.4.1.1 Procedure for tests at extreme temperatures .....	13
5.4.1.2 Extreme temperature ranges .....	13
5.4.2 Extreme test source voltages.....	13
5.4.2.1 Mains voltage .....	13
5.4.2.2 Other power sources.....	13
6 General conditions.....	13
6.1 Test fixture .....	13
6.1.1 Calibration .....	14
6.1.2 General requirements for RF cables and waveguides .....	15
6.1.3 Shielded anechoic chamber.....	15
7 Methods of measurement and limits for transmitter parameters .....	16
7.1 Permitted range of operating frequencies .....	17
7.1.1 Definition.....	17
7.1.2 Method of measurement .....	17
7.1.3 Limits.....	17
7.2 Radiated spatial power density .....	18
7.2.1 Definition.....	18
7.2.2 Method of measurement .....	18
7.2.2.1 Equipment with a fixed beam antenna (i.e. non-steerable by either mechanical or electronic means) .....	18
7.2.2.2 Equipment with (electronically or mechanically) steerable antenna(s).....	18
7.2.3 Limits.....	19
7.2.3.1 Equipment with fixed beam antenna .....	19
7.2.3.2 Equipment with (electronically or mechanically) steerable antennas .....	19
7.3 Out-of-band emissions .....	19
7.3.1 Definitions .....	19
7.3.2 Measuring receiver .....	19
7.3.3 Method of measurement .....	20

7.3.4	Limits.....	20
7.4	Radiated spurious .....	21
7.4.1	Definition.....	21
7.4.2	Measuring receiver .....	21
7.4.3	Method of measurement for radiated spurious.....	21
7.4.4	Limits.....	22
8	Receiver.....	22
8.1	Receiver spurious and out-of-band emissions .....	22
8.1.1	Definition.....	22
8.1.2	Method of measurement - radiated spurious and out-of-band emissions.....	22
8.1.3	Limit .....	23
9	Measurement uncertainty .....	23
<b>Annex A (normative): Radiated measurements .....</b>		<b>24</b>
A.1	Test sites and general arrangements for measurements involving the use of radiated fields.....	24
A.1.1	Open Area Test Site (OATS) .....	24
A.1.2	Test antenna.....	25
A.1.3	Standard position.....	25
A.1.4	Indoor Test Site .....	25
A.2	Guidance on the use of radiation test sites .....	26
A.2.1	Measuring distance.....	26
A.2.2	Test antenna.....	26
A.2.3	Substitution antenna .....	27
A.2.4	Auxiliary cables.....	27
A.3	Alternative test site using a fully anechoic RF chamber .....	27
A.3.1	Example of the construction of a shielded anechoic chamber.....	27
A.3.2	Influence of parasitic reflections in anechoic chambers.....	28
A.3.3	Calibration of the shielded RF anechoic chamber.....	28
<b>Annex B (normative): General description of measurement methods.....</b>		<b>30</b>
B.1	Radiated measurements.....	30
<b>Annex C (informative): Maximum safe level of radiated power density.....</b>		<b>32</b>
C.1	Definition .....	32
C.2	Method of measurement.....	32
C.2.1	Equipment with a fixed beam antenna(s) (i.e. non-steerable by either mechanical or electronic means) .....	32
C.2.2	Equipment with (electronically or mechanically) steerable antenna .....	32
C.3	Limit.....	32
<b>Annex D (informative): Examples of modulation schemes.....</b>		<b>33</b>
D.1	Pulse modulation .....	33
D.1.1	Definition .....	33
D.1.2	Typical operating parameters .....	33
D.2	Frequency modulated continuous wave .....	34
D.2.1	Definition .....	34
D.2.2	Typical operating parameters .....	34
D.3	Frequency Shift Keying (FSK).....	35
D.3.1	Definition .....	35
D.3.2	Typical operating parameters .....	36
D.4	PN-ASK (Pseudo-Noise Amplitude Shift Keying) 77 GHz.....	36
D.4.1	Definition .....	36
D.4.2	Typical operating parameters .....	37
<b>Annex E (informative): Conversion of power density to e.i.r.p.....</b>		<b>38</b>

E.1 Assumptions .....	38
E.2 Example .....	38
<b>Annex F (informative): Bibliography .....</b>	<b>39</b>
History .....	40

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SIST EN 301 091-1 V1.2.1:2006

<https://standards.iteh.ai/catalog/standards/sist/8e87a9c2-5915-47f3-9ba7-a11991dbb0cf/sist-en-301-091-1-v1-2-1-2006>

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## Foreword

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

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

Where equipment compliant with the present document is intended for fitment into vehicles, then it is subject to automotive EMC type approval and has to comply with directive 95/54/EC [6]. For use on vehicles outside the scope of 95/54/EC [6] compliance with an EMC directive/standard appropriate for that use is required.

The present document is part 1 of a multi-part deliverable covering Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Road Transport and Traffic Telematics (RTTT); Radar equipment operating in the 76 GHz to 77 GHz range, as identified below:

**Part 1: "Technical characteristics and test methods for radar equipment operating in the 76 GHz to 77 GHz range";**

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Part 2: "Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive".

### National transposition dates

Date of adoption of this EN:	5 November 2004
Date of latest announcement of this EN (doa):	28 February 2005
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2005
Date of withdrawal of any conflicting National Standard (dow):	31 August 2005



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# 1 Scope

The present document specifies the requirements for Short Range Devices (SRD) operating in the frequency range from 76 GHz to 77 GHz intended for Road Transport and Traffic Telematics (RTTT) applications such as Automotive Cruise Control (ACC), Collision Warning (CW), Anti-Collision (AC) systems, obstacle detection, Stop and Go, blind spot detection, parking aid, backup aid and other automotive applications.

The document applies to:

- a) transmitters operating in range from 76 GHz to 77 GHz;
- b) receivers operating in the range from 76 GHz to 77 GHz.

The present document contains the technical characteristics and test methods for radar equipment fitted with integral antennas operating in the frequency range from 76 GHz to 77 GHz and references CEPT/ERC/ECC Recommendation for SRDs, CEPT/ERC/ECC Recommendation 70-03 [1] and CEPT/ECC Decision (02)01 [2].

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.

The present document covers radars for mobile applications in the frequency range from 76 GHz to 77 GHz. It covers integrated transceivers and separate transmit/receive modules.

The present document covers only equipment for road vehicles.

NOTE: It is necessary for the equipment to comply with the current regulations regarding safe levels for radiated power. Information is given in the informative annex C.

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# 2 References

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The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- 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.
- For a non-specific reference, the latest version applies.

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

- [1] CEPT/ERC Recommendation 70-03 (Latest edition): "Relating to the use of Short Range Devices (SRD)".
- [2] CEPT/ECC/DEC(02)01: "ECC Decision of 15 March 2002 on the frequency bands to be designated for the coordinated introduction of Road Transport and Traffic Telematic Systems".
- [3] CISPR 16-1: "Specifications for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".
- [4] ETSI TR 100 028 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [5] Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz).

- [6] Commission Directive 95/54/EC of 31 October 1995 adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.
- [7] ETSI TR 102 273-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".
- [8] CEPT/ERC Recommendation 01-06: "Procedure for mutual recognition of type testing approval for radio equipment".

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

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

**assigned frequency band:** frequency band within which the device is authorized to operate

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

**average time:** time interval on which a mean measurement is integrated

**blanking period:** time period where no intentional emission occurs

**channel dwell duty:** ratio of the time of uninterrupted continuous transmission within a given frequency channel to the channel repetition interval (= channel dwell time/channel repetition interval)

**channel dwell time:** accumulated amount of transmission time of uninterrupted continuous transmission within a single given frequency channel and within one channel repetition interval

**duty cycle:** the ratio of the total on time of the "message" to the total off-time in any one hour period

**Equipment Under Test (EUT):** radar sensor including the integrated antenna together with any external antenna components which affect or influence its performance

**equivalent isotropically radiated power (e.i.r.p.):** total power or power density transmitted, assuming an isotropic radiator

NOTE: e.i.r.p. is conventionally the product of "power or power density into the antenna" and "antenna gain".  
e.i.r.p. is used for both peak or average power and peak or average power density.

**equivalent pulse power duration:** duration of an ideal rectangular pulse which has the same content of energy compared with the pulse shape of the EUT with pulsed modulation or time gating

**far field measurements:** distance "X" should be a minimum of  $2d^2/\lambda$ , where d = largest dimension of the antenna aperture of the EUT

**maximum safe level for radiated power density:** level which can be transmitted in accordance with the current recommended safety levels in EN 50166-2 should be done on the vehicle

**mean power:** supplied from the antenna during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions (see Radio Regulations [8])

NOTE: For pulsed systems the mean power is equal the peak envelope power multiplied by the time gating duty factor. For CW systems without further time gating the mean power is equal the transmission power without modulation.

**on-off gating:** methods of transmission with fixed or randomly quiescent period that is much larger than the PRF

**operating frequency (operating centre frequency):** nominal frequency at which equipment is operated

NOTE: Equipment may be able to operate at more than one operating frequency.

**operating frequency range:** range of operating frequencies over which the equipment can be adjusted through switching or reprogramming or oscillator tuning

NOTE 1: For pulsed or phase shifting systems without further carrier tuning the operating frequency range is fixed on a single carrier line.

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

**peak envelope power:** mean power (round mean square for sinusoidal carrier wave type) supplied from the antenna during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions (see Radio Regulations)

**Power Spectral Density (PSD):** ratio of the amount of power to the used radio measurement bandwidth

NOTE: It is expressed in units of dBm/Hz or as a power in unit dBm with respect to the used bandwidth. In case of measurement with a spectrum analyser the measurement bandwidth is equal the RBW.

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

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

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**quiescent period:** time instant where no emission occurs

**radiated spurious emissions:** emissions at frequencies other than those of the carrier and sidebands associated with normal modulation

**radome:** external protective cover which is independent of the associated antenna, and which may contribute to the overall performance of the antenna (and hence, the EUT)

**spatial radiated power density:** power per unit area normal to the direction of the electromagnetic wave propagation

NOTE: It is expressed in units of W/m<sup>2</sup>.

**spread spectrum:** modulation technique in which the energy of a transmitted signal is spread throughout a relatively large portion of the frequency spectrum

## 3.2 Symbols

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

$\lambda$	Wavelength
1/P	repetition rate of the modulation wave form
ac	alternating current
B	Bandwidth
d	largest dimension of the antenna aperture
D	antenna scan Duty factor
dB	decibel
dBi	gain in decibels relative to an isotropic antenna
df	spectral distance between 2 lines with similar power levels
$\Delta f_{\max}$	maximum frequency shift between any two frequency steps
$\Delta f_{\min}$	minimum frequency shift between any two frequency steps
E	Field strength
$E_o$	Reference field strength
G	Blank time period
P	Period of time during in which one cycle of the modulation wave form is completed
$P_a$	mean power within the BW
$P_L$	Power of an individual spectral Line
$P_{\text{rad}}$	Radiated power
R	distance
$R_o$	Reference distance
$\tau$	Pulse width
$T_c$	Chip period

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## 3.3 Abbreviations

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

ASK	Amplitude Shift Keying
CW	Continuous Wave
DSS	Direct Sequence Signal
e.i.r.p.	equivalent isotropically radiated power
ECC	Electronic Communications Committee
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunication Committee
EUT	Equipment Under Test
FM	Frequency Modulation
FMCW	Frequency Modulated Continuous Wave
FMICW	Frequency Modulated Interrupted Continuous Wave
FSK	Frequency Shift Keying
IF	Intermediate Frequency
IFSK	Interrupted Frequency Shift Keying
OATS	Open Area Test Site
PN	Pseudo Noise
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Resolution BandWidth
RF	Radio Frequency
RMS	Root Mean Square
Rx	Receiver
SRD	Short Range Device
Tx	Transmitter
VSWR	Voltage Standing Wave Ratio

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## 4 Technical requirements specifications

### 4.1 Presentation of equipment for testing purposes

Each equipment submitted for testing, where applicable, shall fulfil the requirements of the present document on all frequencies over which it is intended to operate. EMC type approval testing to Directive 95/54/EEC [6] shall be done on the vehicle.

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 submitted for testing shall be representative of the performance of the corresponding production model. In order to avoid any ambiguity in that assessment, the present document contains instructions for the presentation of equipment for testing purposes, conditions of testing (see clause 5) and the measurement methods (see clauses 7 and 8).

Stand alone equipment for testing 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.

The EUT will comprise the sensor, antenna and radome if needed and will be tested as a stand alone assembly. The EUTs test fixtures may be supplied by the provider to facilitate the tests (see clause 6.1).

These clauses are intended to give confidence that the requirements set out in the document have been met without the necessity of performing measurements on all frequencies.

#### 4.1.1 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 Mechanical and electrical design

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.

Transmitters and receivers may be individual or combination units.

### 4.3 Auxiliary test equipment

All necessary test signal sources and set-up information shall accompany the equipment when it is submitted for testing.

### 4.4 Interpretation of the measurement results

The interpretation of the results recorded on the appropriate test report for the measurements described in the present document shall be as follows:

- the measured value relating to the corresponding limit shall be used to decide whether an equipment meets the requirements of the present document;
- the measurement uncertainty value for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall, for each measurement, be equal to, or lower than, the figures in the table of measurement uncertainty (see clause 9).