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*European Standard (Telecommunications series)*

**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Short Range Devices;  
Road Transport and Traffic Telematics (RTTT);  
Short range radar equipment operating in the 24 GHz range;  
Part 1: Technical requirements and  
methods of measurement**

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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.

Equipment compliant with the present document is intended for fitment into road vehicles, therefore it is subject to automotive EMC type approval and has to comply with Directive 95/54/EC [7]. For use on vehicles outside the scope of Directive 95/54/EC [7] 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); Short range radar equipment operating in the 24 GHz range, as identified below:

**Part 1: "Technical requirements and methods of measurement";**

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

<b>National transposition dates</b>	
Date of adoption of this EN:	10 August 2007
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# 1 Scope

The present document specifies the technical requirements and methods of measurement for Short Range Devices (SRD) working as broadband devices with at least 500 MHz bandwidth in the 22,000 GHz to 26,65 GHz frequency range intended for Road Transport and Traffic Telematics (RTTT) applications, such as automotive 24 GHz Short Range Radar (SRR) for e.g. obstacle detection, stop and go, blind spot detection, parking aid, backup aid, precrash and other automotive applications.

The present document covers transmitters intended to operate in a temporary frequency designation under the 24 GHz ECC decision CEPT/ECC/DEC/(04)10. The application is also subject to the EU Commission decision on 24 GHz SRR 2005/50/EC.

The present document applies to:

- a) Transmitters in the range from 22,000 GHz to 26,65 GHz operating as broadband devices over the specific bandwidth defined for the individual devices.
- b) Receivers operating in the range from 22,000 GHz to 26,65 GHz.
- c) Integrated transceivers.

The present document contains the technical characteristics and test methods for short range radar equipment fitted with integral antennas.

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 short range radar mobile applications. The present document covers only SRR equipment for road vehicles.

The present document complies with field limits for human exposure to electromagnetic fields as provided by the EC Recommendation 1999/519/EC (see bibliography) and the methods for compliance demonstration in EN 50371 (see bibliography).

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# 2 References

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>.

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

- [1] Void.
- [2] CISPR 16 (parts 1-1, 1-4 and 1-5): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".
- [3] CEPT/ERC/REC 01-06: "Procedure for mutual recognition of type testing and type approval for radio equipment".
- [4] Void.

- [5] Void.
- [6] ETSI TR 100 028 (V1.4.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [7] 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.
- [8] ETSI EN 302 288-2 (V1.2.2): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Road Transport and Traffic Telematics (RTTT); Short range radar equipment operating in the 24 GHz range; Part 2: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [9] Void.
- [10] Void.
- [11] Void.
- [12] Void.

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

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

**activity factor:** actual on-the-air time divided by active session time or actual on-the-air emission time within a given time window

**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 either no waveform or a constant waveform within the 24 GHz SRD band occurs

**boresight:** axis of the main beam in a directional antenna

**channel dwell duty cycle:** ratio of the time of uninterrupted continuous transmission within a given frequency channel to the channel repetition interval

NOTE: 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

NOTE: The device may be triggered either automatically or manually, whether the duty cycle is fixed or random depends on how the device is triggered.

**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 on-off gating

**far field measurements:** measurement at a distance "X" of at least  $2d^2/\lambda$ , where d is the 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 Council Recommendation 1999/519/EC

**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.

**power envelope:** power supplied to the antenna by a transmitter during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions

**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 to the RBW.

**precrash:** time before the crash occurs when safety mechanism are deployed

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

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

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

**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: Spatial radiated power density is expressed in units of W/m<sup>2</sup>.

**spread spectrum:** telecommunications techniques in which a [signal](#) is transmitted in a [bandwidth](#) considerably greater than the [frequency](#) content of the original [information](#)

**ultra wideband:** classification of the spectral width of a transmission system

**ultra-wideband bandwidth:** equipment using ultra-wideband technology means equipment incorporating, as an integral part or as an accessory, technology for short-range radiocommunication, involving the intentional generation and transmission of radio-frequency energy that spreads over a frequency range wider than 50 MHz

## 3.2 Symbols

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

$\lambda$	Wavelength
ac	alternating current
B	Bandwidth
$B_{FH}$	Frequency hopping bandwidth
d	largest dimension of the antenna aperture
$D_{fb}$	distance of ferrite beads
E	Field strength
$E_o$	Reference field strength
$f_c$	Carrier frequency
$f_{hop}$	Hopping frequency
$f_h$	highest frequency
$f_l$	lowest frequency
$G_a$	Antenna gain
$P_{rad}$	Radiated power
$P_{PK\ 3\ MHz}$	Radiated peak power measured in 3 MHz bandwidth
$P_s$	Signal generator power
R	Distance
$R_o$	Reference distance
Rx	Receiver
$\tau$	Pulse width
$T_{blk}$	Blank time period
$T_c$	Chip period
$T_{dw}$	Dwell time
$T_{fr}$	Frame time
$T_{pw}$	Pulse power duration
Tx	Transmitter

## 3.3 Abbreviations

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

BPSK	Binary Phase Shift Keying
CW	Continuous Wave
dB	decibel
dB <sub>i</sub>	gain in decibels relative to an isotropic antenna
DSB	Dual Side Band
DSS	Direct Sequence Signal
e.i.r.p.	equivalent isotropically radiated power
ECC	Electronic Communications Committee
EMC	Electro Magnetic Compatibility
ERC	European Radiocommunication Committee
EUT	Equipment Under Test
FH	Frequency Hopping
FHSS	Frequency Hopping Spread Spectrum
FMCW	Frequency Modulated Continuous Wave
FSK	Frequency Shift Keying
IF	Intermediate Frequency
LNA	Low Noise Amplifier
PDCF	Pulse Desensitization Correction Factor
PM	Pulse Modulation
PN	Pseudo Noise
PPM	Pulse Position Modulation (staggered)
PRF	Pulse Repetition Frequency

PRI	Pulse Repetition Interval
PSK	Phase Shift Keying
R&TTE	Radio and Telecommunications Terminal Equipment
RAS	Radio Astronomy Site
RBW	Resolution BandWidth
RF	Radio Frequency
RMS	Root Mean Square
RTTT	Road Transport and Traffic Telematics
Rx	Receiver (Receive)
SA	Spectrum Analyser
SNR	Signal to Noise Ratio
SPM	Staggered Pulse Position Modulated
SRD	Short Range Device
SRR	Short Range Radar
Tx	Transmitter
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio

## 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/EC [7] 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 (clause 5) and the measurement methods (clauses 7 and 8). Instructions for installation of the equipment in a road vehicle are provided in annex D.

Stand alone equipment submitted 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 (clause 6.1).

These clauses are intended to give confidence that the requirements set out in the present 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 (table 7).

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# 5 Test conditions, power sources and ambient temperatures

## 5.1 Normal and extreme test conditions

Testing shall be carried out under normal test conditions, and also, where stated, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2 to 5.4.

## 5.2 External test power source

During tests the power source of the equipment shall be an external test power source, capable of producing normal and extreme test voltages as specified in clauses 5.3.2 and 5.4.2. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible.

The test voltage shall be measured at the point of connection of the power cable to the equipment.

During tests the external test power source voltages shall be within a tolerance of  $\pm 1$  % relative to the voltage at the beginning of each test. The level of this tolerance can be critical for certain measurements. Using a smaller tolerance provides a reduced uncertainty level for these measurements.

## 5.3 Normal test conditions

### 5.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

- temperature: +15 °C to +35 °C;
- relative humidity: 20 % to 75 %.

When it is impracticable to carry out tests under these conditions, a note to this effect, stating the ambient temperature and relative humidity during the tests, shall be added to the test report.