



**Electromagnetic compatibility  
and Radio spectrum Matters (ERM);  
Short Range Devices;  
Transport and Traffic Telematics (TTT);  
Radar equipment operating in the 76 GHz to 77 GHz range;  
Part 3: Harmonized EN covering the essential requirements of  
article 3.2 of the R&TTE Directive for Railway/Road Crossings  
obstacle detection system applications  
operating in the 76 GHz to 77 GHz range**

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**ETSI**

650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
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## Foreword

This draft Harmonized 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 produced by ETSI in response to mandate M/284 issued from the European Commission under Directive 98/34/EC [i.2] as amended by Directive 98/48/EC [i.3].

The title and reference to the present document are intended to be included in the publication in the Official Journal of the European Union of titles and references of Harmonized Standard under the Directive 1999/5/EC [i.1].

The requirements relevant to Directive 1999/5/EC [i.1] are summarized in annex A.

The present document is part 3 of a multi-part deliverable covering Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Transport and Traffic Telematics (TTT); Radar equipment operating in the 76 GHz to 77 GHz range, as identified below:

- Part 1: "Technical characteristics and test methods for ground based vehicular radar equipment operating in the 76 GHz to 77 GHz range";
- Part 2: "Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for ground based vehicular radar equipment operating in the 76 GHz to 77 GHz range";
- Part 3: "**Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for Railway/Road Crossings obstacle detection system applications operating in the 76 GHz to 77 GHz range**".

<b>Proposed national transposition dates</b>	
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## Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**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).

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# 1 Scope

The present document specifies the requirements for Short Range Devices (SRD) used for obstacle detection at Railway/Road Crossings such as defined in CEPT/ERC Recommendation 70-03 annex 4 [i.10].

The present document applies to:

- a) transmitters operating in the 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 Recommendation 70-03 [i.10] and the EC SRD Decision 2013/752/EU [i.11].

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 integrated transceivers and separate transmit/receive modules in the range from 76 GHz to 77 GHz, see table 1.

**Table 1: 76 GHz frequency bands**

	Frequency bands
Transmit	76 GHz to 77 GHz
Receive	76 GHz to 77 GHz

The present document is intended to cover the provisions of Directive 1999/5/EC [i.1] (R&TTE Directive) article 3.2, which states that "... radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".

In addition to the present document, other ENs that specify technical requirements in respect of essential requirements under other parts of article 3 of the R&TTE Directive [i.1] may apply to equipment within the scope of the present document.

NOTE: A list of such ENs is included on the web site <http://www.newapproach.org>.

## 2 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 <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 necessary for the application of the present document:

- [1] ETSI TR 100 028 (all parts) (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [2] CISPR 16-2-3:2010+AMD1:2010+AMD2:2014 CSV: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements".



## 2.2 Informative references

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 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.2] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.
- [i.3] Directive 98/48/EC of the European Parliament and of the Council of 20 July 1998 amending Directive 98/34/EC laying down a procedure for the provision of information in the field of technical standards and regulations.
- [i.4] ETSI TR 102 704 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Radar sensors for non-automotive; ground based vehicular applications in the 76 GHz to 77 GHz frequency range".
- [i.5] Commission Directive 2004/104/EC of 14 October 2004 adapting to technical progress Council Directive 72/245/EEC relating to the radio interference (electromagnetic compatibility) of 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.
- [i.6] 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".
- [i.7] CEPT/ERC Recommendation 74-01, Cardiff 11: "Unwanted emissions in the spurious domain".
- [i.8] Recommendation ITU-R SM.1754: "Measurement techniques of ultra-wideband transmissions".
- [i.9] Recommendation ITU-R SM.329-12 (09-2012): "Unwanted emissions in the spurious domain, SM Series, Spectrum management".
- [i.10] CEPT/ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD), Annex 4: Railway Applications".
- [i.11] Commission Decision 2013/752/EU, amending Decision 2006/771/EC on Radiocommunication of the radio spectrum for use by short-range devices.
- [i.12] CEPT/ERC Recommendation 01-06: "Procedure for mutual recognition of type testing and type approval for radio equipment".

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in the R&TTE Directive [i.1] and the following apply:

**antenna cycle:** one complete sweep of a mechanically or electronically scanned antenna beam along a predefined spatial path

**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

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

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

**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:** measurement distance should be a minimum of  $2d^2/\lambda$ , where  $d$  = largest dimension of the antenna aperture of the EUT and  $\lambda$  is the operating wavelength of the EUT

**ground based vehicle:** includes but is not limited to passenger cars, busses, trucks, rail engines, ships, aircraft while taxiing, details see TR 102 704 [i.4]

**mean power:** 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

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.

**Out-Of Band (OOB) emission:** Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but exclude spurious emission

**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

**power spectral density:** 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 analyzer the measurement bandwidth is equal to the RBW.

**pulse repetition frequency:** inverse of the Pulse Repetition Interval, averaged over a time sufficiently long as to cover all PRI variations

**pulse repetition interval:** time between the rising edges of the transmitted (pulsed) output power

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

**radar sensor:** device, system or assembly which monitors the defined supervision area especially when used for obstacle detection

**radiated spurious emissions:** emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

**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)

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

**steerable antenna:** directional antenna which can sweep its beam along a predefined spatial path

NOTE: Steering can be realized by mechanical, electronic or combined means. The antenna beamwidth may stay constant or change with the steering angle, dependent on the steering method.

**supervision area:** area of the railway/road crossing zone which is supervised by the radar sensor

## 3.2 Symbols

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

$\lambda$	wavelength
$\lambda$	1/Prepetition rate of the modulation wave form
ac	alternating current
B	bandwidth
d	largest dimension of the antenna aperture
D	antenna scan duty factor
$D_{fb}$	distance between ferrite beads
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
$P_{rad}$	radiated power
R	distance
$R_o$	reference distance
$\tau$	pulse width
$T_c$	chip period

## 3.3 Abbreviations

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

BW	BandWidth
CW	Continuous Wave
e.i.r.p.	equivalent isotropically radiated power
e.r.p.	equivalent 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
FSK	Frequency Shift Keying
IF	Intermediate Frequency
LNA	Low Noise Amplifier
OATS	Open Area Test Site
OBW	Occupied BandWidth
OOB	Out Of Band
OWB	Occupied BandWidth
PFD	Power Flux Density
PRF	Pulse Repetition Frequency
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Resolution Bandwidth
RF	Radio Frequency
RMS	Root Mean Square
SM	Spectrum Management
SRD	Short Range Device
Tx	Transmitter
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio

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## 4 Technical requirements specifications

### 4.1 Equipment requirements 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 2004/104/EC [i.5] shall be done on system level.

The applicant shall provide at least 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 applicant along with any ancillary equipment needed for testing (see activation signals clause 4.5). The provider shall declare the frequency range(s), the range of operation conditions and power requirements, necessary installations informations, as applicable, in order to establish the appropriate test conditions.

The EUT will comprise the radar 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).

The clauses below 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 separate or a combination of units.

## 4.3 Auxiliary test equipment

All necessary additional test equipment and set-up information shall be prepared and provided when the equipment 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).

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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 to be negligible for its effect on the test results.

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;