



**Advanced Surface Movement Guidance  
and Control System (A-SMGCS);  
Part 6: Harmonized EN covering the essential requirements  
of article 3.2 of the R&TTE Directive for  
deployed surface movement radar sensors;  
Sub-part 1: X-band sensors using pulsed signals and  
transmitting power up to 100 kW**

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# Contents

Intellectual Property Rights .....	5
Foreword.....	5
Introduction .....	6
1 Scope .....	7
2 References .....	7
2.1 Normative references .....	7
2.2 Informative references .....	7
3 Definitions, symbols and abbreviations .....	8
3.1 Definitions .....	8
3.2 Symbols .....	8
3.3 Abbreviations .....	9
4 Technical requirements .....	9
4.1 Environmental profile.....	9
4.2 Conformance requirements .....	9
4.2.1 Operating frequency .....	9
4.2.1.1 Definition .....	9
4.2.1.2 Limits .....	10
4.2.1.3 Conformance .....	10
4.2.2 Transmitter power.....	10
4.2.2.1 Definition .....	10
4.2.2.2 Limits .....	10
4.2.2.3 Conformance .....	10
4.2.3 Out-of-band emissions.....	10
4.2.3.1 Definition .....	10
4.2.3.2 Limits .....	11
4.2.3.3 Conformance .....	12
4.2.4 Spurious emissions .....	12
4.2.4.1 Definition .....	12
4.2.4.2 Limits .....	13
4.2.4.3 Conformance .....	14
4.3 Receiver requirements.....	14
4.3.1 Receiver Noise Figure .....	14
4.3.1.1 Limit.....	14
4.3.1.2 Conformance.....	14
4.3.2 Receiver Selectivity .....	14
4.3.2.1 Limit.....	14
4.3.2.2 Conformance.....	14
5 Testing for compliance with technical requirements.....	14
5.1 Test conditions, power supply and ambient temperatures .....	14
5.1.1 Standard operating mode of the radar equipment .....	14
5.2 Normal test conditions.....	15
5.2.1 Introduction.....	15
5.2.2 Normal temperature and humidity .....	15
5.2.3 Normal test power supply .....	15
5.3 Essential radio test suites.....	15
5.3.1 Operating frequency .....	15
5.3.2 Transmitter power.....	15
5.3.3 Out-of-Band-emissions .....	16
5.3.4 Spurious emissions .....	18
5.3.5 System Noise Figure .....	18
5.3.6 Receiver Selectivity .....	19
5.3.6.1 Receiver Out-of-Band selectivity .....	19
5.3.6.2 Receiver spurious response rejection .....	20

<b>Annex A (normative):</b>	<b>HS Requirements and conformance Test specifications Table (HS-RTT)</b> .....	<b>21</b>
<b>Annex B (normative):</b>	<b>Transmission power and unwanted emissions of radar systems with indirect methods</b> .....	<b>23</b>
<b>Annex C (informative):</b>	<b>Bibliography</b> .....	<b>24</b>
<b>Annex D (informative):</b>	<b>Change History</b> .....	<b>25</b>
<b>History</b> .....		<b>26</b>

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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/405 issued from the European Commission under Directive 98/34/EC [i.9] as amended by Directive 98/48/EC [i.11].

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].

See article 5.1 of Directive 1999/5/EC [i.1] for information on presumption of conformity and Harmonized Standards or parts thereof the references of which have been published in the Official Journal of the European Union.

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

The present document is part 6, sub-part 1 of a multi-part deliverable covering Advanced Surface Movement Guidance and Control System (A-SMGCS), as identified below:

- Part 1: "Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004 for A-SMGCS Level 1 including external interfaces";
- Part 2: "Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004 for A-SMGCS Level 2 including external interfaces";
- Part 3: "Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004 for a deployed cooperative sensor including its interfaces";
- Part 4: "Community Specification for application under the Single European Sky Interoperability Regulation EC 552/2004 for a deployed non-cooperative sensor including its interfaces";
- Part 5: "Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for multilateration equipment";
- Part 6: "Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive for deployed surface movement radar sensors":**

**Sub-part 1: "X-band sensors using pulsed signals and transmitting power up to 100 kW".**

NOTE: SMR systems using FM-CW signals may be covered by future sub-parts of this multi-part deliverable.

<b>Proposed National transposition dates</b>	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

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## Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the R&TTE Directive [i.1]. The modular structure is shown in EG 201 399 [i.10].

The current version includes necessary changes due to updates in reference documents Recommendation ITU-R SM.1541-4 [i.8], ECC/Recommendation (02)05 [i.4] and ERC/Recommendation 74-01 [i.5] (essentially changes of Out-of-Band emission mask).

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# 1 Scope

The present document applies to X-band radar sensors intended for the surveillance of airport surface movement traffic with the following characteristics:

- Utilizing modulated or unmodulated pulses.
- Transmitter Peak Envelope Power up to 100 kW.
- The transceiver-antenna connection is using a hollow metallic rectangular waveguide.
- The antenna is rotating, waveguide- based and passive.
- At the transceiver output an RF-circulator is used.

The present document covers only the essential requirements of article 3.2 of the R&TTE Directive [i.1].

NOTE 1: Since transceiver and antenna are hollow metallic rectangular waveguide based the frequency range for measurements that needs to be addressed covers 6,56 GHz to 26 GHz The lower limit of this frequency range is obtained as cut-off frequency of the combination of WR112/R84 taper section and a WR90/R100 Waveguide IEC 60153-2 [i.3]. The upper limit corresponds to the upper limit stated in ERC/Recommendation 74-01 [i.5].

NOTE 2: Since at the transceiver output an RF circulator is used, it is assumed that the transceiver characteristics remain independent from the antenna.

NOTE 3: According Article 5 of the ITU Radio Regulations [i.6] the band 9 000 MHz to 9 200 MHz is allocated to the Aeronautical Radionavigation Service on a primary basis and the band 9 300 MHz to 9 500 MHz is allocated to the Aeronautical Radionavigation Service on a secondary basis.

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# 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 reference 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.

Not applicable.

## 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] Merrill I. Skolnik: "Radar Handbook", 2nd Edition, McGraw Hill publications.

- [i.3] IEC 60153-2 (Edition 2.0, 1974): "Hollow metallic waveguides. Part 2: Relevant specifications for ordinary rectangular waveguides".
- [i.4] ECC/Recommendation (02)05 (2012): "Unwanted emissions".
- [i.5] ERC/Recommendation 74-01 (2011): "Unwanted emissions in the spurious domain".
- [i.6] ITU Radio Regulations (2012).
- [i.7] Recommendation ITU-R M.1177-4 (2011): "Techniques for measurement of unwanted emissions of radar systems".
- [i.8] Recommendation ITU-R SM.1541-4 (2011): "Unwanted emissions in the out-of-band domain".
- [i.9] Directive 98/34/EC of the European Parliament and of the Council laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on information society services.
- [i.10] ETSI EG 201 399: "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of Harmonized Standards for application under the R&TTE Directive".
- [i.11] 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.

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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:

**necessary bandwidth:** width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions for a given class of emission

NOTE: This definition is taken from ITU Radio Regulation No. 1.152 [i.6].

**occupied bandwidth:** width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage  $\beta/2$  of the total mean power of a given emission

NOTE 1: This definition is taken from ITU Radio Regulation No. 1.153 [i.6].

NOTE 2: Unless otherwise specified in an Recommendation ITU-R for the appropriate class of emission, the value of  $\beta/2$  should be taken as 0,5 %.

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

NOTE: This definition is taken from ITU Radio Regulation No. 1.157 [i.6].

**pulse duration:** time between the 50 % amplitude (voltage) points

**pulse rise time:** time taken for the leading edge of the pulse to increase from 10 % to 90 % of the maximum amplitude (voltage)

### 3.2 Symbols

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

$B_{-40}$	-40 dB bandwidth
$B_C$	Chirp bandwidth
$B_N$	Necessary bandwidth



$B_{res}$	3 dB resolution bandwidth of transceiver
$dBpp$	dB with respect to peak power
$D_{no\ spur}$	Detectability Factor (function of PD & Pfa)
$k$	Boltzmann's constant
$MDS$	Minimum Detectable Signal
$NF_{sys}$	Noise Figure of the system
$PD$	Probability of detection
$PEP$	Peak Envelope Power
$Pfa$	Probability of false detection
$P_t$	Pulse power of transmission
$t$	Time
$t_p$	Pulse duration
$t_r$	Pulse rise time
$T_0$	Temperature in Kelvin
$T_C$	Chirp length in sec.
$\lambda$	Wavelength

### 3.3 Abbreviations

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

AC	Alternating Current
FM	Frequency Modulated
FM-CW	Frequency Modulated Continuous Wave
IEC	International Electrotechnical Commission
ITU-R	International Telecommunication Union - Radiocommunication
LNA	Low Noise Amplifier
MDS	Minimum Detectable Signal
OoB	Out-of-Band
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
SMR	Surface Movement Radar

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## 4 Technical requirements

### 4.1 Environmental profile

Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile which, as a minimum, shall be that specified in the test conditions contained in the present document.

As technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions as specified in the present document to give confidence of compliance for the affected technical requirements (which shall also be within the boundary limits of the declared operational environmental profile).

### 4.2 Conformance requirements

#### 4.2.1 Operating frequency

##### 4.2.1.1 Definition

The transmitter of a pulsed radar produces microwave pulses, which cause a broad frequency spectrum, depending on the pulse duration.

The operating frequency is to be understood as the frequency of the microwave emission during the transmitting pulse and is represented by the spectral line of highest amplitude.

NOTE: It is only practicable to indicate an operating frequency for radars with unmodulated pulses. In this case a limit for the frequency tolerance is specified. For radars with modulated pulses such a limit is not applicable. In any case the occupied bandwidth is completely contained in the allocated frequency band(s).

#### 4.2.1.2 Limits

The limit for the frequency tolerance for SMR applying unmodulated pulses is  $\pm 30$  MHz.

For all radar types covered by the present documents the occupied bandwidth of the signal shall be contained completely within the frequency ranges 9 000 MHz to 9 200 MHz or 9 300 MHz to 9 500 MHz in all operating modes.

#### 4.2.1.3 Conformance

Conformance tests as defined in clause 5.3.1 shall be carried out.

### 4.2.2 Transmitter power

#### 4.2.2.1 Definition

The transmitter power shall be referenced with respect to the output port of the radar transmitter.

The transmitter power of a pulse radar is understood as the peak value of the transmitter pulse power during the transmission pulse (PEP).

If the transmitter power varies over the azimuth, the highest PEP over at least one rotation period has to be used.

#### 4.2.2.2 Limits

The transmitter power shall be as specified by the manufacturer with an accuracy of at least  $\pm 1$  dB. The peak power value shall not exceed 100 kW (50 dBW).

#### 4.2.2.3 Conformance

Conformance tests as defined in clause 5.3.2 shall be carried out.

### 4.2.3 Out-of-band emissions

#### 4.2.3.1 Definition

An important parameter of the Out-of-Band (OoB) emissions mask of the radar is the -40 dB bandwidth. Annex 8 of Recommendation ITU-R SM.1541-4 [i.8] specifies the -40 dB bandwidth specified for various types of waveforms (e.g. pulsed radar signals). With the following assumptions which apply to most airport surface movement radars these specifications can be further simplified:

- the radar is operating in the bands 9 000 MHz to 9 200 MHz or 9 300 MHz to 9 500 MHz;
- the pulse power is below 100 kW;
- the pulse rise time  $t_r$  is greater than  $0,0094 \cdot t$ , where  $t$  is the pulse duration.

With the aforementioned assumptions the -40 dB bandwidth ( $B_{-40}$ ) for primary non-FM pulse radars can be determined as follows:

$$B_{-40} = \frac{7,6}{\sqrt{t \times t_r}}$$