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AMENDMENT 1
2002-06

Amendment 1

Maritime navigation and radiocommunication equipment and systems – Radar –

Part 1: Shipborne radar – Performance requirements – Methods of testing and required test results

Amendement 1

Matériels et systèmes de navigation et de radiocommunication maritimes – Radar –

Partie 1: Radars de navire – Exigences de fonctionnement – Méthodes d'essai et résultats d'essai exigés

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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FOREWORD

This amendment has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

The text of this amendment is based on the following documents:

FDIS	Report on voting
80/341/FDIS	80/346/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2003. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

CONTENTS

Annex D, replace by new title:

Annex D (normative) Unwanted emissions of radar systems – Methods of measurement and required results

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Annex D – Measurement methods for spurious emissions

Replace the existing annex D by the following new annex D:

Annex D
(normative)

Unwanted emissions of radar systems – Methods of measurement and required results

D.1 Introduction

ITU-R has now developed a new recommendation for out-of-band (OOB) emission limits (D.6.d)). This recommendation is associated with the following recommendations:

a) OOB emissions falling into an adjacent allocated band (D.6.f));

b) boundary between OOB and spurious emissions (D.6.e));

c) spurious emissions – SM.329 (D.6.c)).

Spurious emission limits for radar systems have been incorporated into section II of appendix 3 of the Radio Regulations, in terms of level, but not in terms of frequency range. There is no intention at present of a similar treatment for either the OOB or adjacent allocated band limits.

It has been agreed that within the ITU WRC – 2003 Agenda item 1.8.1, the boundary between OOB and spurious emissions will be defined for all radio services and incorporated into Appendix 3 of the Radio Regulations. As this will not occur until after the date of 1 January 2003 (the date at which the new spurious limits apply for new radar installations), there is a need for this standard to define the boundary conditions based upon the text contained in the ITU-R Recommendation SM.1539 (D.6.e)).

The purpose of this annex is to define how the requirements of Appendix 3 of the Radio Regulations and these new ITU Recommendations concerned with unwanted emissions are to be implemented with regard to marine radars. This includes the requirements, method of measurement, the results to be obtained and the interpretation of the measurement results.

D.2 Requirements

The requirements are defined in Appendix 3 of the Radio Regulations and the recommendations listed above in D.1.

The boundary between the OOB and spurious domains and the OOB mask are defined in the OOB recommendation – Annex 8 in the following manner –

a) (Boundary and mask) – “the mask rolls off at 20 dB per decade from the 40 dB bandwidth to the spurious level specified in Appendix 3 of the Radio Regulations. The B_{-40} dB bandwidth can be offset from the frequency of maximum emission level, but the necessary bandwidth (1.152 of the Radio Regulations) should be contained completely within the allocated band”.

b) (Exclusions) – “the OOB limits are not applicable inside exclusive Radiodetermination and or Earth Exploration Satellite (EES) and Space research service bands, but do apply at the band edges.”

These requirements are illustrated in Figures D.1 and D.2.

The OOB masks shown in Figures D.1 and D.2 are calculated using the transmitted pulse width and rise time.

The necessary bandwidth and the –40 dB bandwidth are generally centred about the operating frequency but may be offset to take account of spectrum asymmetry.

The OOB mask commences at a level of –40 dB and falls off at the rate of –20 dB per decade until it meets the spurious emission limit at the OOB boundary.

When the calculated –40 dB bandwidth falls within the allocated band the OOB mask commences at the edge of the allocated band.

When the –40 dB bandwidth falls outside the allocated band the OOB mask commences at that point in the adjacent band.

The OOB mask can be offset further into the adjacent band to allow for spectrum asymmetries, but the necessary bandwidth associated with this mask shall be contained completely within the allocated band.

The OOB mask emission limits only apply outside the adjacent bands i.e. below 2,7 GHz and above 3,3 GHz in the case of radars operating in the 2,9 GHz to 3,1 GHz band, and below 8,5 GHz and above 9,8 GHz in the case of radars operating in the 9,3 GHz to 9,5 GHz band.

Emissions in the spurious domain (Figures D.1 and D.2) shall be at least 43 + 10 log PEP or 60 dB, whichever is the least stringent, below the carrier power, as measured in the far field of the radar. For most current marine radars the limit will be 60 dB and this means that the spurious domain starts at $5 \times B_{-40}$ from the operating frequency of the radar.

D.3 Methods of measurement

The basic methods of measurement for unwanted emissions are contained in ITU-R Recommendation M.1177 (D.6.a)). This describes two methods, referred to as the “direct” and “indirect” methods. Either method is admissible.

Measurements are to be made for all frequencies in the measurement frequency bands specified in the table D.1 below.

Table D.1 – Measurement frequency ranges

Allocated band	Measurement band	
	Lower limit	Upper limit
2,9 GHz – 3,1 GHz	2 GHz	5th harmonic
9,3 GHz – 9,5 GHz	0,7 of the waveguide cut-off	26 GHz

D.4 Guidelines for the use and interpretation of ITU-R Recommendation M.1177

The recommendation provides some specific techniques for the measurement of the unwanted emissions of radar systems, that in principle can be used for any type of radar system. In practice, the recommendation makes no attempt to provide detailed test methods for each type of system.

This standard provides the additional detail required for the minimum test requirements for the measurement of marine radars as a basis for certification, that the particular marine radar system under test, meets the requirements of the Radio Regulations and ITU-R Recommendations as appropriate.

D.4.1 Selection of pulse widths

The ITU-R Recommendation on OOB (D.6.d)) applies to complex and simple radars with user-selectable pulse waveforms. For a particular radar, the pulse length and rise time for a number of representative pulses (including the shortest and longest pulses) shall be measured and the corresponding

B_{-40} bandwidths calculated. The widest calculated B_{-40} bandwidth shall then be used to create the OOB mask to be applied to that radar. Emission measurements only need to be carried out for the pulse length setting producing the widest calculated B_{-40} bandwidth.

D.4.2 Measurement in azimuth and elevation – antennas

For marine radars that are essentially surface search radars, there is no requirement to make measurements in the vertical plane.

For measurements in the azimuth plane, the antenna may be either rotating or the measurement system may be aligned to the antenna bore sight and measurements in azimuth taken at appropriate antenna angles where the directions of unwanted emissions are known. Both techniques are admissible and the particular choice shall be made by agreement between the manufacturer and the test authority.

In both cases the maximum value of the emission occurring in the azimuth plane shall be recorded over the frequency range defined in table D.1.

Provided that all of the antennas to be used with the equipment under test are of the same type, then only the smallest (i.e. that with the largest azimuth beamwidth) need to be used to verify compliance with the unwanted emission requirements.

D.5 Results required

D.5.1 Necessary bandwidth

The necessary bandwidth as calculated from the measured pulse width and rise time shall be within the allocated frequency band.

D.5.2 B_{-40} bandwidth

The B_{-40} bandwidth shall be calculated using the methods defined in D.4.1 and in Annex 8 of reference D.6.d). This bandwidth together with the declared frequency of the pulse transmission are used to determine which of the masks illustrated in Figure D.1 or Figure D.2 shall be used for the purposes of conformity.

D.5.3 Emission spectrum

The emission spectrum shall be below the calculated mask, as determined by D.5.2 above, in both the OOB and spurious domains, for all appropriate frequencies over the ranges specified in table D.1. As previously indicated in D.2, the OOB emission masks limits do not apply within the allocated band or the adjacent RD/ESS bands.

The spurious emission limit applies in the spurious domain, regardless of frequency band.

Systems shall be compliant if the OOB mask of Figure D.2 is offset further into the adjacent band to allow for spectrum asymmetries, provided that the necessary bandwidth associated with this mask is completely contained within the allocated band.

D.6 References

a) ITU-R Recommendation M.1177: Techniques for measurement of unwanted emissions for radar systems

b) ITU-R Recommendation M.1313: Technical characteristics of maritime radionavigation radars

c) ITU-R Recommendation SM.329: Spurious emissions

d) ITU-R Recommendation SM.1541: Unwanted emissions in the out-of-band domain

e) ITU-R Recommendation SM.1539: Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329

f) ITU-R Recommendation SM.1540: Unwanted emissions in the out-of-band domain falling into adjacent allocated bands.

g) ITU-R – Radio Regulations – Appendix 3:Spurious emissions

NOTE The latest version of the ITU-R Recommendation shall be used.

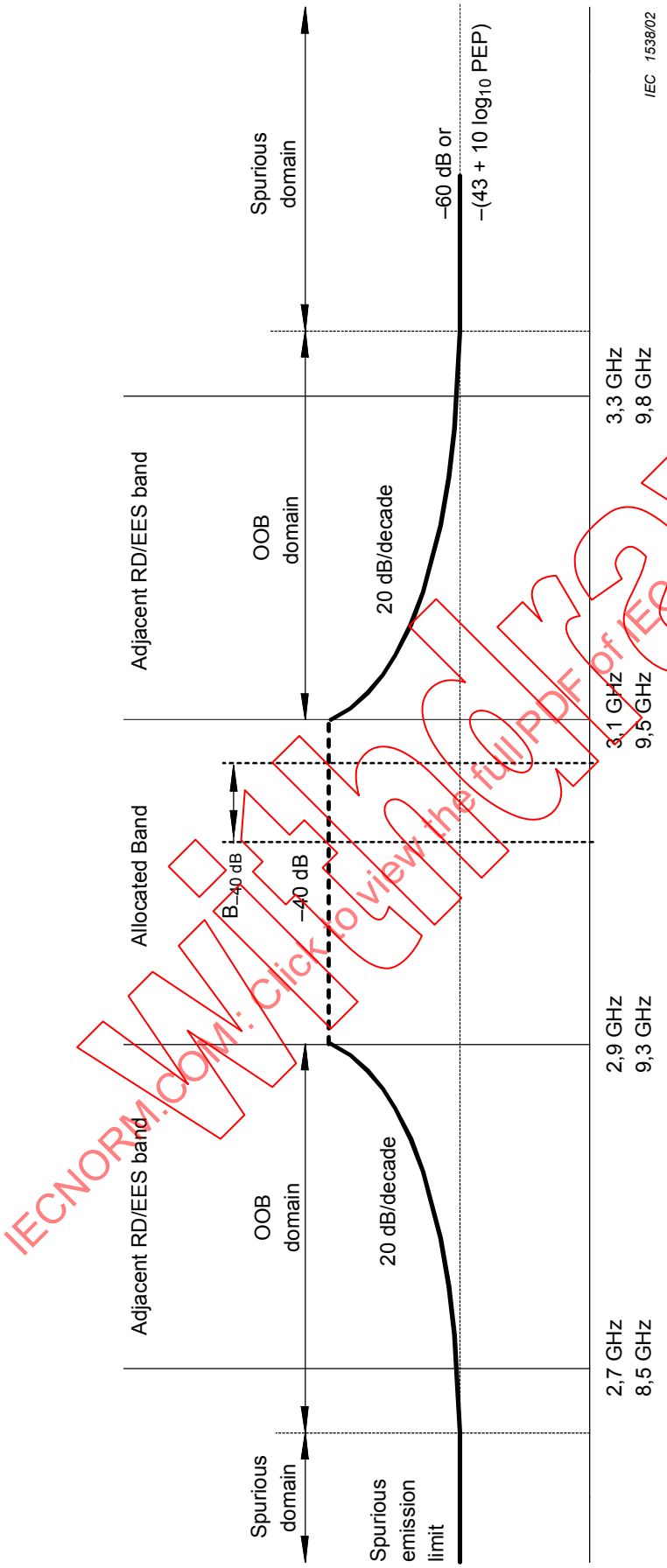

Figure D.1 – B_{-40} falls within the allocated band

NOTE RD/EES – Radiodetermination / Earth Exploration Satellite.

NOTE OOB emission mask limits do not apply within the allocated or adjacent RD/EES bands.

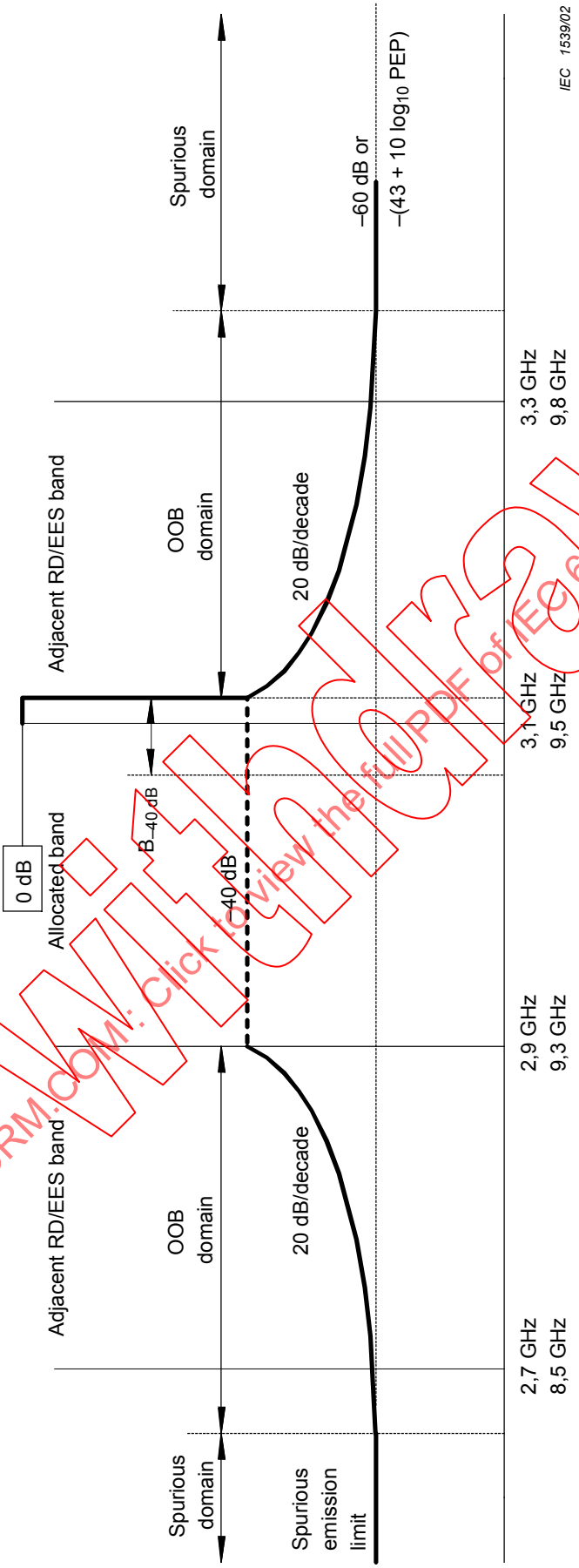

Figure D.2. – B_{-40} falls outside the allocated band

NOTE RD/EES – Radiodetermination / Earth Exploration Satellite.

NOTE OOB emission mask limits do not apply within the allocated or adjacent RD/EES bands.