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Harmonized European Standard (Telecommunications series)

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
Navigation radar for use on non-SOLAS vessels;
Harmonized EN covering the essential requirements
of article 3.2 of the R&TTE Directive**

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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
Association à but non lucratif enregistrée à la
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Foreword

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

The present document is a harmonized EN covering essential requirements under article 3.2 of the R&TTE directive for navigation radar for use on non-SOLAS vessels.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under Council Directive 98/34/EC [i.2] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.

The present document is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Directive 1999/5/EC [i.1] 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 ("the R&TTE Directive").

Technical specifications relevant to Directive 1999/5/EC [i.1] are given in annex A.

National transposition dates	
Date of adoption of this EN:	13 June 2008
Date of latest announcement of this EN (doa):	30 September 2008
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2009
Date of withdrawal of any conflicting National Standard (dow):	31 March 2010

1 Scope

The present document applies to non-SOLAS radar equipment.

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.

This radar equipment operates in the frequency range 2 900 MHz to 3 100 MHz or 9 300 MHz to 9 500 MHz allocated to the radio navigation service as defined in article 5 of the Radio Regulations [6].

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
 - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
 - for informative references.

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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 indispensable for the application of this document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] CENELEC EN 60945 (Edition 4 - 2002): "Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results".
- [2] ITU-R Recommendation M.1177-3 (2003): "Techniques for measurement of unwanted emissions of radar systems".
- [3] ANSI C63.5 (1988): "American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electromagnetic Interference (EMI) Control".
- [4] ETSI TR 100 028 (V1.3.1 - all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

- [5] ETSI TR 102 273 (2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".
- [6] ITU Radio Regulations.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

- [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 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.3] ITU-R Recommendation SM.1541-1: "Unwanted emissions in the out-of-band domain".

3 Symbols and abbreviations

3.1 Symbols

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

B_{-40}	-40 dB bandwidth
P_m	Transmission mean power
P_t	Transmission pulse power
t	Time
t_p	Transmission pulse duration
t_r	Pulse rise time

3.2 Abbreviations

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

EBL	Electronic Bearing Line
EUT	Equipment Under Test
FTC	Fast Time Constant
HS	Harmonized Standard
LNA	Low Noise Amplifier
OATS	Open Area Test Site
OOB	Out Of Band
PEP	Peak Envelope Power
PRT	Pulse Repetition Time
RF	Radio Frequency
RJ	Rotary Joint
SOLAS	Safety Of Life At Sea
STC	Sensitivity Time Control
VRM	Variable Range Marker
VSWR	Voltage Standing Wave Ratio

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 Radiated emissions

4.2.1.1 Definition

Radiated electromagnetic emissions are to be understood as any signals radiated by the completely assembled and operated radar equipment, other than the operating frequency, with its spectra, which can potentially disturb other equipment on the ship, such as radio receivers or rate of turn indicators.

4.2.1.2 Limits

In the frequency range 150 kHz to 2 GHz, the measured radio frequency field strength at a distance of 3 m caused by the EUT shall not exceed the limits shown in table 1.

Table 1: Radiated electromagnetic emission

Frequency range	Measuring Bandwidth	Limits
150 kHz to 300 kHz	9 kHz	10 mV/m to 316 μ V/m (80 dB μ V/m to 52 dB μ V/m)
300 kHz to 30 MHz	9 kHz	316 μ V/m to 50 μ V/m (52 dB μ V/m to 34 dB μ V/m)
30 MHz to 156 MHz and 165 MHz to 2 GHz	120 kHz	500 μ V/m (54 dB μ V/m)
156 MHz to 165 MHz	9 kHz	16 μ V/m (24 dB μ V/m) quasi peak or 32 μ V / m (30 dB μ V/m) peak

4.2.1.3 Conformance

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

4.2.2 Operating frequency

4.2.2.1 Definition

The transmitter produces short microwave pulses, which causes a broad frequency spectrum, depending on the pulse duration and the pulse repetition frequency. The operating frequency is to be understood as the frequency of the microwave during the transmitting pulse and is represented by the spectral line of highest amplitude.

4.2.2.2 Limits

In all switchable distance ranges and pulse durations the operation frequency of the radar equipment shall have values in the range of 2 900 MHz to 3 100 MHz or 9 300 MHz to 9 500 MHz.

4.2.2.3 Conformance

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

4.2.3 Transmitter pulse power

4.2.3.1 Definition

Transmitter pulse power P_t is to be understood as the mean value of the microwave power during the transmission pulse at the antenna side of the Rotary Joint (RJ). For the arithmetic mean value of the transmitting power, integrated over the PRT, the abbreviation P_m will be used.

4.2.3.2 Limits

The transmitter pulse power P_t shall be as specified by the manufacturer +0 dB to -3 dB.

4.2.3.3 Conformance

Conformance tests as defined in clause 5.3.3 shall be carried out.

4.2.4 Out of band emissions

4.2.4.1 Definition

ITU-R Recommendation SM.1541-1 [i.3] gives guidance to calculate the -40 dB bandwidth and to specify the OOB mask for primary radars in per cent of the -40 dB bandwidth (see figure 1).

The -40 dB bandwidth (B_{-40}) for primary radars shall be determined with the following established formula by using the lesser of:

$$B_{-40} = \frac{K}{\sqrt{t} \times t_r} \text{ or } \frac{64}{t}$$

where the coefficient K is 6,2 for radars with output power greater than 100 kW and 7,6 for lower-power radars and radars operating in the radio navigation service in the 2 900 MHz to 3 100 MHz and 9 300 MHz to 9 500 MHz band. The latter expression applies if the rise time t_r is less than about 0,0094 t when K is 6,2 or about 0,014 t when K is 7,6.

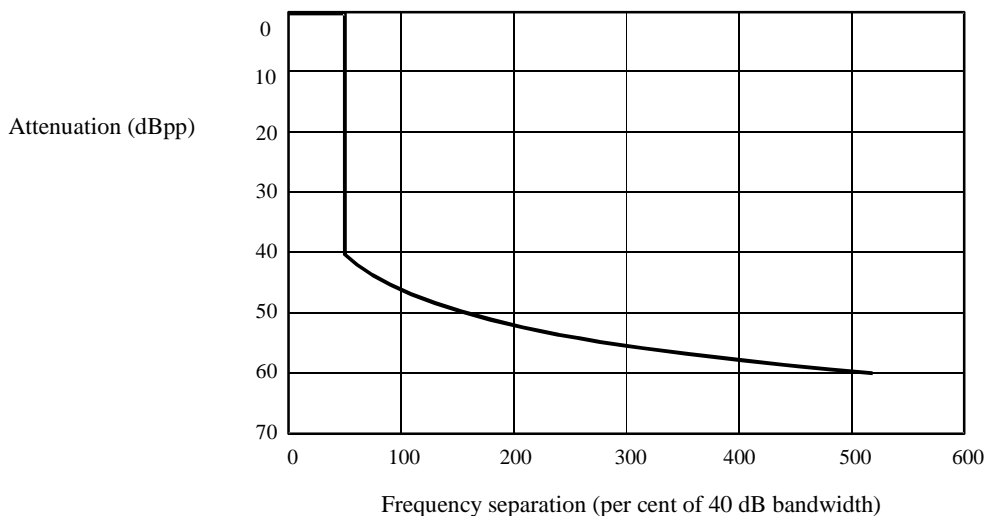


Figure 1: OOB mask for primary radars

For ideal rectangular pulses, the spectrum falls off at 20 dB per decade leading to a B_{-40} of $6,4/t$ and a 40 dB bandwidth ten times as large, i.e. $64/t$. To discourage the use of pulses with abrupt rise and fall times, no margin is allowed. The spectra of trapezoidal pulses fall off firstly at 20 dB per decade and then ultimately at 40 dB per decade. If the radio or rise time to pulse duration exceeds 0,008 the 40 dB points will fall on the 40 dB per decade slope, in which case the bandwidth B_{-40} would be:

$$B_{-40} = \frac{5,7}{\sqrt{t \times t_r}}$$

e.g. a radar with a fixed 10 ns rise time would result in bandwidth values as shown in table 2.

Table 2: Examples of -40 dB bandwidth of a primary radar at different pulse durations (rise time = 10 ns)

Pulse duration	- 40 dB bandwidth B_{-40}
Short pulse (t = 50 ns)	$B_{-40} = 255$ MHz
Medium Pulse (t = 200 ns)	$B_{-40} = 127$ MHz
Long Pulse (t = 500 ns)	$B_{-40} = 81$ MHz

4.2.4.2 Limits

The maximum radiated Out Of Band-emission power level shall not exceed the limits given in figure C.3.

4.2.4.3 Conformance

Conformance tests as defined in clause 5.3.4 shall be carried out.

4.2.5 Radiated spurious emissions

4.2.5.1 Definition

Spurious emissions are defined as the entity of all emissions in the frequency range of 70 % of the cut-off frequency of the waveguide to 26 GHz, but outside the OOB-boundaries.

They include:

- harmonic emissions (whole multiples of the operating frequency);
- parasitic emissions (independent, accidentally);
- intermodulation (between oscillator- and operation frequency or between oscillator and harmonics);
- emissions caused by frequency conversions.

4.2.5.2 Limits

All radiated spurious emission levels shall be $43+10 \log$ PEP or 60 dB below the PEP level of the radiated operating frequency (see figure C.3) whichever is less stringent.

4.2.5.3 Conformance

Conformance tests as defined in clause 5.3.5 shall be carried out.

5 Testing for compliance with technical requirements

5.1 Test conditions, power supply and ambient temperatures

5.1.1 Standard operating mode of the radar equipment

Unless otherwise stated the radar equipment shall be set to the standard operating mode which is understood to be as follows:

Operation state:	on (antenna turns);
Antenna height:	7 m;
RANGE:	shortest;
TUNE setting:	optimal;
GAIN setting:	optimal;
STC setting:	zero;
FTC setting:	off;
Range rings:	visible;
VRM:	visible;
EBL:	visible;
Brilliance of all attributes:	optimal (well readable).

5.1.2 Normal test conditions

5.1.2.1 Normal temperature and humidity

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

- temperature: +15 °C to +35 °C; or within the manufacturers stated operating range and stated in the report;
- relative humidity: 20 % to 75 %.

When the relative humidity is lower than 20 %, it shall be stated in the test report.

5.1.2.2 Normal test power supply

5.1.2.2.1 AC test power supply

The test voltage for equipment to be connected to an AC supply shall be the nominal mains voltage declared by the manufacturer -10 % to +10 %. For the purpose of the present document, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment is indicated as having been designed. The frequency of the test voltage shall be 50 Hz \pm 1 Hz.