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Navigation radars used on inland waterways; Harmonised Standard for access to radio spectrum; Part 1: Magnetron Radars

Reference
DEN/ERM-TGMAR-540

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Contents

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Foreword

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.1] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.2].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in Table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

The present document is part 1 of a multi-part deliverable covering navigation radars used on inland waterways, as identified below:

Part 1: "Magnetron Radars";

Part 2: "Solid State Radars".

National transposition dates	
Date of adoption of this EN:	15 June 2026
Date of latest announcement of this EN (doa):	30 September 2026
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 March 2027
Date of withdrawal of any conflicting National Standard (dow):	31 March 2028

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**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 technical characteristics and methods of measurements for magnetron-based inland waterways navigational radars having the following characteristics:

- Transmitter peak power not exceeding 10 kW.
- Operating on a pulse modulated single, non-tuneable carrier frequency in the range specified in Table 1.
- At the transmitter output, a 4 port RF-circulator or equivalent is used.
- The antenna is passive, rotating and waveguide based.
- The radar display is an integral part of the equipment.

Table 1: Radio navigation service frequencies

	Radio navigation service frequencies
Transmit	9 300 MHz to 9 500 MHz
Receive	9 300 MHz to 9 500 MHz

NOTE: The relationship between the present document and the essential requirements of article 3.2 of Directive 2014/53/EU [i.2] is given in Annex A.

2 References

2.1 Normative 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 in the ETSI docbox.

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

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

[i.1] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.2] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.3] ITU Radio Regulations (2024).

[i.4] Recommendation ITU-R M.1177-4 (04/2011): "Techniques for measurement of unwanted emissions of radar systems".

[i.5] ETSI EG 203 336 (V1.2.1) (05-2020): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.6] ETSI EN 303 676 (V1.1.1) (07-2021): "Navigation radar used on inland waterways; operational, functional and technical requirements".

[i.7] Recommendation ITU-R SM.1541-7 (09/2024): "Unwanted emissions in the Out of Band domain".

[i.8] ERC Recommendation 74-01 (05/2022): "Unwanted emissions in the spurious domain".

[i.9] ECC Recommendation (02)05 (03/2012): "Unwanted emissions".

[i.10] IEC 60945:2002/COR1:2008 including corrigendum 1 (04/2008): "Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results".

[i.11] IEC 60153-2: 2016: "Hollow metallic waveguides. Part 2: Relevant specifications for ordinary rectangular waveguides".

[i.12] Recommendation ITU-R SM.332-4 (07/1978): "Selectivity of receivers".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

active state: state producing the authorized emission

idle/stand-by state: state where the transmitter is available for traffic but is not in the active state

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 1: This definition is taken from ITU Radio Regulation [i.3].

NOTE 2: For the radars covered by the present document the necessary bandwidth B_N is considered to be B_{-20} (20 dB bandwidth) as defined in Recommendation ITU-R SM.1541-7 [i.7].

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

NOTE 2: This definition is taken from ITU Radio Regulations [i.3], chapter I, 1.153.

NOTE 3: For primary radars $\beta/2$ equals 0,5 %.

Peak Envelope Power (PEP): 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 Regulations [i.3], chapter I, 1.157.

product configuration: hardware variant of the same typology of system under test (e.g. different power outputs, magnetrons)

pulse length: 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)

radial resolution capability: shortest distance between two targets on the same bearing that can be discriminated

NOTE: This is defined in ETSI EN 303 676 [i.6], clause 5.2.2.5.

3.2 Symbols

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

B_{-20}	-20 dB bandwidth (in MHz)
B_{-40}	-40 dB bandwidth (in MHz)
B_{IF}	Intermediate frequency bandwidth
B_m	Measurement bandwidth
B_{ref}	Reference bandwidth
dB	decibel
dBm	Power ratio expressed in decibels (dB) with reference to one milli watt
dBpp	Power ratio expressed in decibels (dB) with reference to peak power
f_{image}	Image frequency
f_{rx}	Nominal frequency of the receiver
fo	Operating frequency (in MHz) of the magnetron
G_s	Gain of the measurement system (dB)
k	Boltzmann's constant ($1{,}38 \times 10^{-23}$ J/K)
P_t	Pulse power of transmission
t	Time
tp	Pulse length
tr	Pulse rise time

3.3 Abbreviations

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

ANSI	American National Standards Institute
dBi	Gain in decibels relative to an isotropic antenna
DC	Direct Current
ECC	Electronic Communication Committee
EFTA	European Free Trade Association
EN	European Norm
ERC	Electronic Radiocommunication Committee
EUT	Equipment Under Test
FM	Frequency Modulation
FTC	Fast Time Constant
GHz	GigaHertz
IEC	International Electrotechnical Committee
IF	Intermediate Frequency
IMD	Intermodulation Distortion
ITU-R	International Telecommunication Union - Radiocommunication Sector
kHz	kiloHertz
kW	kiloWatt
LO	Local Oscillator

MBR	Measurement Bandwidth Ratio
MHz	MegaHertz
NA	not applicable
OoB	Out of Band
PEP	Peak Envelope Power
RBW	Resolution BandWidth
RF	Radio Frequency
RML	Receiver Maximal input Level
RWB	Referenced BandWidth
STC	Sensitive Time Control
SWT	SWeep Time
VBW	Video BandWidth
VRM	Variable Range Marker
VSWR	Voltage Standing Wave Ratio

4 Technical requirements specifications

4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use, but as a minimum, shall be that specified in the test conditions contained in the present document. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

4.2 Conformance requirements

4.2.1 Transmitter Requirements

4.2.1.1 Occupied Bandwidth

4.2.1.1.1 Definition

Occupied bandwidth is the 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 β/2 of the total mean power of a given emission as defined in ITU Radio Regulations [i.3], chapter I, 1.153.

4.2.1.1.2 Limits

The occupied bandwidth with β/2 = 0,5 % shall be maintained wholly within the frequency range specified in Table 1.

NOTE: The value of β/2 = 0,5 % is taken from ITU Radio Regulations [i.3], chapter I, 1.153.

4.2.1.1.3 Conformance

The conformance tests are specified in clause 5.5.1.1.

4.2.1.2 Transmitter Peak Power

4.2.1.2.1 Definition

The transmitter peak power of a pulse radar is the peak value of the transmitter pulse power during the transmission pulse.

4.2.1.2.2 Limits

The transmitter peak power shall not exceed 10 kW.

4.2.1.2.3 Conformance

The conformance tests are specified in clause 5.5.1.2.

4.2.1.3 Measured Bandwidth (B_{-20})

4.2.1.3.1 Definition

The measured -20 dB bandwidth (B_{-20}) is the measured bandwidth of the emission 20 dB below the measured peak power.

4.2.1.3.2 Limits

The measured -20 dB bandwidth (B_{-20}) of the signal shall be contained completely within the frequency range specified in Table 1.

4.2.1.3.3 Conformance

The conformance tests are specified in clause 5.5.1.3.

4.2.1.4 Out of Band Emissions

4.2.1.4.1 Definition

Out of Band (OoB) emissions refer to emissions in the region between calculated -40 dB bandwidth (B_{-40}) and the spurious region (see definition of spurious region in clause 4.2.1.5.1).

NOTE 1: The calculated B_{-40} is defined in Annex I.

NOTE 2: More information can be found in Recommendation ITU-R SM.1541-7 [i.7], Annex 8 (OoB domain emission limits for primary radar systems), clause 3.

4.2.1.4.2 Limits

Out of Band (OoB) emissions shall not exceed the limits specified in Table 2 below.

NOTE: These limits are specified in Table 1 of Annex 2 of ECC Recommendation (02)05 [i.9].

The Out of Band mask rolls off at 30 dB/decade from the calculated B_{-40} to the level specified for spurious emissions (see Figure 1 below).

Table 2: Limits for unwanted emissions in the OoB domain

Offset Frequency x B_{-40}	Limit dB_{pp}	Slope dB/decade
0 to 0,5	0	0
0,5	-40	-∞
0,5 to 2,3	-40 to -60	-30