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Maritime Broadband Radiolink operating within the bands 5 852 MHz to 5 872 MHz and/or 5 880 MHz to 5 900 MHz for ships and off-shore installations engaged in coordinated activities; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

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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.4] 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.1].

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.

National transposition dates	
Date of adoption of this EN:	22 August 2017
Date of latest announcement of this EN (doa):	30 November 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 May 2018
Date of withdrawal of any conflicting National Standard (dow):	31 May 2019

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 maritime mobile broadband radiocommunication systems (MBR) radio equipment intended to operate in the 5,8 GHz band.

Table 1: Radiocommunications service frequency bands

	Radiocommunications service frequency bands
Transmit	5 852 MHz to 5 900 MHz
Receive	5 852 MHz to 5 900 MHz

The present document applies to systems utilizing integral electronically phase steered antennae applicable for communications between vessels and between vessels and platforms engaged in coordinated off-shore activities.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.1] under the conditions identified in annex A.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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

[1] Recommendation ITU-T E.161 (02-2001): "Arrangement of digits, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

[2] Recommendation ITU-T O.153 (10-1992): "Basic parameters for the measurement of error performance at bit rates below the primary rate".

[3] ISO 25862:2009: "Ships and marine technology -- Marine magnetic compasses, binnacles and azimuth reading devices".

[4] ETSI TS 103 052 (V1.1.1) (03-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

2.2 Informative 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.

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 not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] 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.2] ETSI TR 100 028-2 (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

[i.3] ETSI TR 100 028 (V1.4.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.4] 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.

3 Symbols and abbreviations

3.1 Symbols

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

C_F	Minimum number of frames
dB_c	Level (dB) below carrier
dBm	Level (dB) relative to 1 mW
N	Number of transmitted bits
ppm	parts per million (10^{-6})
Q	Q factor is a resonator parameter
V	Volt

3.2 Abbreviations

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

ac	alternating current
BER	Bit Error Rate
CRC	Cyclic Redundancy Check
dc	direct current
EC	European Commission
EFTA	European Free Trade Association
EIRP	Equivalent Isotropically Radiated Power
EN	European Norm
ERP	Effective Radiated Power
EU	European Union
EUT	Equipment Under Test
FER	Frame Error Rate
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union - Telecommunication standardization sector
LHCP	Left Hand Circular Polarization
MBR	Maritime Broadband Radiolink
RF	Radio Frequency
TR	Technical Report
TS	Technical Specification

4 General and operational requirements

4.0 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the manufacturer, 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 which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile.

4.1 Construction

The mechanical and electrical construction and finish of the equipment shall conform in all respects to good engineering practice, and the equipment shall be suitable for use on board ships.

All controls shall be of sufficient size to enable the usual control functions to be easily performed and the number of controls should be the minimum necessary for simple and satisfactory operation.

For the purpose of conformance testing, relevant technical documentation shall be supplied with the equipment.

The equipment shall be capable of operating on single frequency channels.

The MBR shall be equipped with an automatic mechanism for reducing the power level to the level necessary to achieve acceptable Bit Error Rate (BER).

It shall not be possible to transmit while any frequency synthesizer used within the transmitter is out of lock.

4.2 Controls and indicators

The equipment shall have a channel selector and shall indicate the channel at which the installation is set. The channel designator shall be legible irrespective of the external lighting conditions.

Where an input panel on the equipment for entering the digits 0 - 9 is provided, this shall conform to Recommendation ITU-T E.161 [1].

The equipment shall have the following additional controls and indicators:

- an on/off switch for the entire installation with a visual indication that the installation is in operation;
- a means for reducing the brightness of the equipment illumination to zero;
- a visual indication that the equipment is transmitting.

The equipment shall also meet the following requirements:

- the user shall not have access to any control which, if wrongly set, might impair the technical characteristics of the equipment.

4.3 Safety precautions

Measures shall be taken to protect the equipment against the effects of overcurrent or overvoltage.

Measures shall be taken to prevent damage to the equipment if the electrical power source produces transient voltage variations and to prevent any damage that might arise from an accidental reversal of polarity of the electrical power source.

Means shall be provided for earthing exposed metallic parts of the equipment.

All components and wiring in which the dc or ac voltage (other than radio-frequency voltage) produce, singly or in combination, peak voltages in excess of 50 V shall be protected against any accidental access and shall be automatically isolated from all electrical power sources if the protective covers are removed. Alternatively, the equipment shall be constructed in such a way as to prevent access to components operating at such voltages unless an appropriate tool is used such as a nut-spanner or screwdriver. Conspicuous warning labels shall be affixed both inside the equipment and on the protective covers.

The information in any volatile memory device shall be protected from interruptions in the power supply of up to 60 s duration.

4.4 Labeling

All controls, instruments, indicators and ports shall be clearly labelled.

Details of the power supply from which the equipment is intended to operate shall be clearly indicated on the equipment.

The transmitter may operate with high emitted radio power and the antenna shall be labelled with the minimum safe distance from the antenna.

The compass safe distance as defined in ISO 25862 [3] (Method B) shall be stated on the equipment or in the technical manual.

4.5 Frequencies

The equipment shall be capable of operating on the frequencies 5 862 MHz and/or 5 890 MHz.

4.6 Polarization

The equipment shall operate with vertical or left hand circular polarization (LHCP).

4.7 Antenna gain

The antenna gain shall be declared by the equipment manufacturer.

4.8 Self-monitoring

The MBR equipment shall be self-monitoring and should a malfunction be detected which could cause harmful interference, the MBR shall automatically cease its transmissions.

4.9 Adaptive transmitter power control

The MBR equipment shall have a transmitter power adaptive control where the output power of the transmitter is automatically reduced to the lowest necessary level.

The adaptive transmitter power control shall be able to reduce the MBR output power by at least 25 dB.

5 General conditions of measurements

5.1 Test site and general arrangements for measurements

Measurements of all equipment with integral antenna shall be done by radiated measurements.

Descriptions of the anechoic chamber and radiated measurement arrangements are included in ETSI TS 103 052 [4].

5.2 General

Tests shall be carried out on 5 862 MHz or on 5 890 MHz.

5.3 Test signals

Sources of test signals for application to the MBR receiver shall be a MBR transmitter with variable output power.

The levels of the test signals at the MBR receiver shall be expressed in terms of dBm.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

5.4 Bit error measurements

All BER measurements shall be conducted by field radiation with measurement of the BER in an indirect way. The indirect way is based on generating and receiving frames of limited length where any bit errors in the frame can be detected by means of a cyclic redundancy check (CRC). The fraction of erroneous frames out of the total number of frames, which is called the FER (frame error rate), allows to estimate the BER assuming that bit errors are equally distributed. Precautions shall be taken to prevent drops of error-free received frames caused by specific implementation of upper layers.

Assuming equally distributed and statistically independent occurrence of erroneous bits the following relations between FER, BER, and total number N of transmitted bits within a single frame apply:

$$FER=1-(1-BER)^{N},$$

$$BER=1-10^{\log(1-FER)/N}=1-(1-FER)^{1/N}$$

The minimum number C_F of frames together with the frame size shall be reported.

EXAMPLE 1: With BER = 10^{-6} and frame length N = 1 000, the equivalent FER is approximately 0,001.

The reasonable number C_F of frames to be transmitted is 10 000, i.e. 10 frames may be lost on average.

EXAMPLE 2: For a large value of FER, e.g. 0,9999 which may result in a BER = $2{,}0 \cdot 10^{-2}$ as used for test, a reasonable number C_F of frames to be transmitted is 100 000, i.e. 10 frames may be error-free on average. The very large number of frames to be transmitted is to be able to estimate the BER as a small variation in erroneous frames may change significantly the corresponding estimated BER.

5.5 Transceiver data interface

Equipment shall provide a digital connection such as Ethernet or other suitable interfaces for access to the equipment.

In the case where the equipment uses a proprietary interface, appropriate means and documentation allowing for the equipment to be tested are expected to be provided in view of the measurements.

Variation in the level of the input signals, within the specified limits for that interface, shall have no measurable influence on the characteristics of the signals on the radio path.

5.6 Impedance

In the present document the term "50 Ω" is used for a 50 Ω non-reactive impedance.

5.7 Tests of equipment with a notch filter

A notch filter may be required to obtain the required dynamic range for measurement of the transmitter.

The notch filter shall be centred on the transmitter carrier frequency and attenuating this signal by at least 30 dB.

The characteristics of the notch filter shall be declared in the test report, and the measured results shall be corrected for the loss in the notch filter.

5.8 Facilities for access

5.8.1 Coupling arrangements

Equipment to be connected to the Equipment Under Test (EUT) shall be connected by a method which does not affect the radiated field.

5.8.2 Arrangements for measurements with messages

For the measurement of the receiver on a test site, arrangements to couple the unit to be tested to the error observation device (or to an operator) shall be available.

5.9 Modes of operation of the transmitter

For the purpose of the measurements according to the present document, the transmitter has to be able to generate the necessary test signals, see clause 6.1.

The method of obtaining an unmodulated carrier or special types of modulation patterns may also, as appropriate, either be selected by the manufacturer or be agreed between the manufacturer and the test laboratory. It shall be described in test reports.

It may involve suitable temporary internal modifications of the EUT.

6 Test conditions

6.1 Normal test signals

Normal test signal 1 is an unmodulated carrier.

Normal test signal 2 is an MBR message consisting of a pseudo-random bit sequence of at least 8 192 payload bits according to Recommendation ITU-T O.153 [2]. The bit modulation rate over the air shall be 10 Mb/s. The message contains a header targeting the targeted receiver identity.

6.2 Normal test conditions

6.2.1 Normal temperature and humidity

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

- temperature: +15 °C to +35 °C;
- relative humidity: 20 % to 75 %.

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

6.2.2 Normal power source

6.2.2.1 Mains voltage and frequency

The normal test voltage shall be the nominal ac mains voltage. 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 ± 1 Hz.

6.2.2.2 Battery power source

Where the equipment is designed to operate from a battery, the normal test voltage shall be the nominal voltage of the battery (12 V, 24 V, etc.).

6.2.2.3 Other power sources

For operation from other power sources the normal test voltage shall be that declared by the equipment manufacturer.

6.3 Extreme test conditions

6.3.0 General requirements

Unless otherwise stated the extreme tests conditions means that the Equipment Under Test (EUT) shall be tested at the upper temperature and at the upper limit of the supply voltage applied simultaneously, and at the low temperature and the lower limit of the supply voltage applied simultaneously.

6.3.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with clause 6.3.3, at a lower temperature of -15 °C and an upper temperature of +55 °C.

6.3.2 Extreme values of test power source

6.3.2.1 Mains voltage and frequency

The extreme test voltages shall be the nominal ac mains voltage ±10 %. The frequency of the test voltage shall be 50 Hz ± 1 Hz.

6.3.2.2 Battery power source

Where the equipment is designed to operate from a battery, the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery (12 V, 24 V, etc.).

6.3.2.3 Other power sources

For operation from other power sources the extreme test voltages shall be declared by the equipment manufacturer.

6.3.3 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature stabilizing periods.

Before conducting tests at the upper temperature, the equipment consisting of a transmitter and associated receiver, shall be placed in the test chamber and left until thermal equilibrium is reached. The equipment shall then be switched on for half an hour in normal transmit mode in the high power transmit condition at the normal voltage, the equipment shall meet the requirement of the present document.

For tests at the lower temperature, the equipment shall be left in the test chamber until thermal equilibrium is reached and shall then be switched to the standby or receive position for one minute, after which the equipment shall meet the requirements of the present document.

For tests at extreme temperatures, the manufacturer shall provide a radiation transparent test cabinet.

7 Environmental tests

7.1 Introduction

The equipment shall be capable of continuous operation under the conditions of various sea states, vibration, humidity and change of temperatures likely to be experienced in a ship in which it is installed.

7.2 Procedure

Environmental tests shall be carried out before testing the same equipment to the other requirements of the present document. Unless otherwise stated, the equipment shall be connected to an electrical power source during the periods for which it is specified that electrical tests shall be carried out. These tests shall be performed using the normal test voltage.

7.3 Performance check

Performance check consists of transmitting and receiving the test signal 2 and measuring the BER. The signal level at the receiving antenna shall be above -80 dBm and the receiver BER shall be better than 10^{-5}.

7.4 Vibration test

7.4.1 Purpose

This test determines the ability of equipment to withstand vibration without resulting in mechanical weakness or degradation in performance.

7.4.2 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the vibration table by its normal means of support and in its normal attitude. The EUT may be resiliently suspended to compensate for weight not capable of being withstood by the vibration table. Provision may be made to reduce or nullify any adverse effect on EUT performance which could be caused by the presence of an electro-magnetic field due to the vibration unit.

The EUT shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 5 Hz and up to 13,2 Hz with an excursion of ±1 mm ± 10 % (7 m/s^2 maximum acceleration at 13,2 Hz);
- above 13,2 Hz and up to 100 Hz with a constant maximum acceleration of 7 m/s^2.

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the EUT.

A resonance search shall be carried out throughout the test. If any resonance of the EUT has $Q \geq 5$ measured relative to the base of the vibration table, the EUT shall be subjected to a further vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of two hours. If any resonance with $Q < 5$ occurs the further endurance test shall be carried out at one single observed frequency. If no resonance occurred, the further endurance test shall be carried out at a frequency of 30 Hz.

Performance check(s) shall be carried out at the end of each two hour endurance test period.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

After conducting the vibration tests, the equipment shall be inspected for any mechanical deterioration.

7.4.3 Requirement

The equipment shall meet the requirements of the performance check.

There shall be no harmful deterioration of the equipment visible.

7.5 Damp heat

7.5.1 Purpose

This test determines the ability of equipment to withstand conditions of high humidity.

7.5.2 Method of measurement

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be raised to +40 °C ± 2 °C, and the relative humidity raised to 93 % ± 3 % over a period of three hours ±0,5 hour. These conditions shall be maintained for a period of 10 to 16 hours. The temperature and relative humidity of the chamber shall be maintained as specified during the whole period. Any climatic control devices provided in the EUT may be switched on at the conclusion of this period. The EUT shall be switched on 30 minutes later, or after such period as agreed by the manufacturer, and shall be kept operational for at least two hours. At the end of the test period and with the EUT still in the chamber, the chamber shall be brought to room temperature in not less than one hour and the EUT shall be returned to normal environmental conditions or to those required at the start of the next test. The maximum rate of raising or reducing the temperature of the chamber in which the equipment is being tested shall be 1 °C/minute. Immediately after the test period, the EUT shall be subject to the performance check.

7.5.3 Requirement

The equipment shall meet the requirements of the performance check.

8 Transmitter

8.1 Frequency error

8.1.1 Definition

The frequency error is the difference between the measured carrier frequency and its nominal value.

8.1.2 Method of measurement

The MBR transmitter shall be configured to operate at a normal RF output power level using test signal 1.

The receiving test antenna shall be connected to spectrum analyser.

The settings of the spectrum analyser shall be adjusted to optimize the instruments frequency accuracy.

Max Hold shall be selected and the centre frequency adjusted to that of the EUT.

The peak value of the power envelope shall be measured and noted. The span shall be reduced and the marker moved in a positive frequency increment until the upper, (relative to the centre frequency), -10 dB_c point is reached. This value shall be noted as f_1.

The marker shall then be moved in a negative frequency increment until the lower, (relative to the centre frequency), -10 dB_c point is reached. This value shall be noted as f_2.

The centre frequency is calculated as $(f_1 + f_2) / 2$.

8.1.3 Limits

The calculated centre frequency for any given channel shall be maintained within the range ± 2 ppm of the nominal value.

8.2 Transmitter EIRP

8.2.1 Definition

The transmitter EIRP is the maximum radiated power of the equipment.

8.2.2 Method of measurement

The MBR transmitter shall be configured to operate at maximum RF output power level using test signal 1.

The receiving test antenna shall be connected to spectrum analyser.

Max Hold shall be selected and the centre frequency adjusted to that of the EUT.

The peak value of the power envelope shall be measured and noted.

For measuring the transmitter EIRP, the substitution method described in clause 4 of ETSI TS 103 052 [4] shall be used.

8.2.3 Limits

The mean EIRP shall not exceed 25 dBW with circular polarization and 22 dBW with linear polarization.

8.3 Transmitter spectrum mask

8.3.1 Definition

The nominal channel bandwidth is the widest band of frequencies, inclusive of guard bands, assigned to a single channel.

NOTE: The nominal channel bandwidth is evaluated at -30 dBc (see figure 1 below).

Out-of-band bandwidth is the bandwidth outside the nominal channel bandwidth but excluding spurious emissions.

8.3.2 Method of measurement

The MBR transmitter shall be configured to operate at a normal RF output power level using test signal 2. The receiving test antenna shall be connected to spectrum analyser.

Max Hold shall be selected and the centre frequency adjusted to that of the EUT.

The measurement shall be performed with a measuring bandwidth of 1 MHz.

The value of the power shall be measured and noted over the frequency range between -50 MHz and +50 MHz relative to the centre frequency.

8.3.3 Limits

The nominal channel bandwidth shall be less than 20 MHz.

The out-of-band emissions shall be within the transmitter spectrum mask in figure 1.

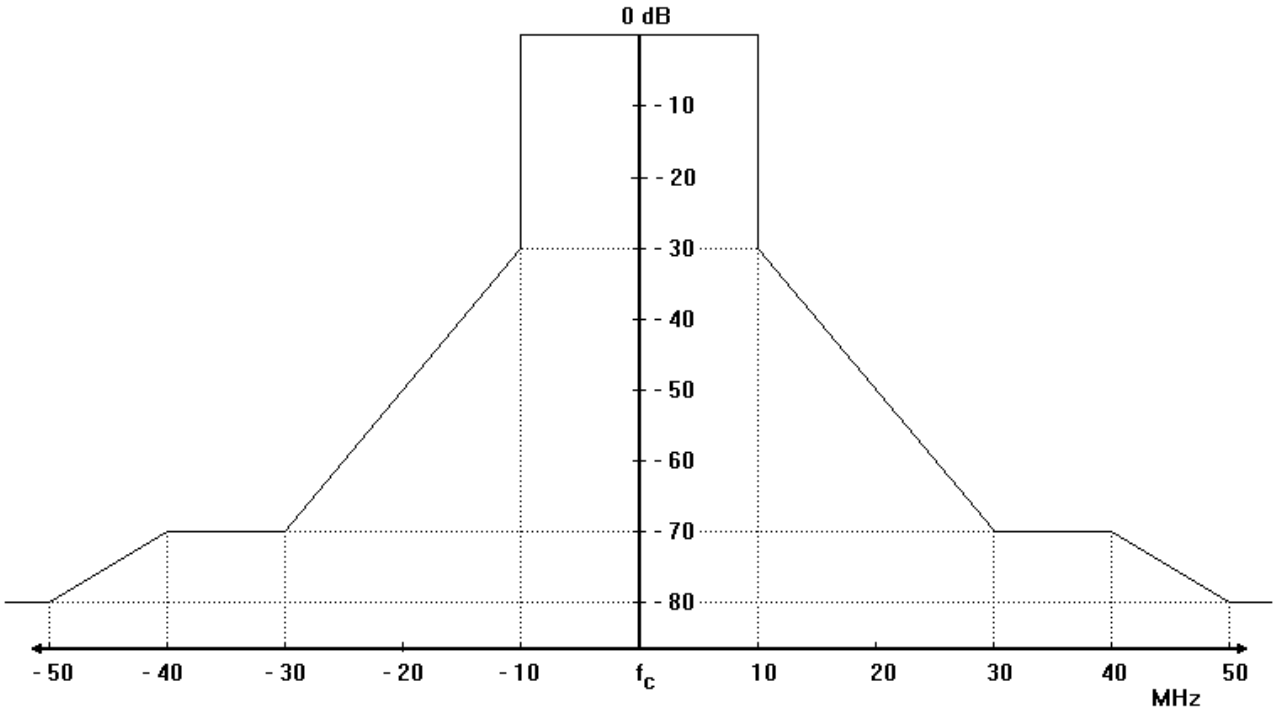

Figure 1: Transmitter power spectrum mask

8.4 Transmitter spurious emission

8.4.1 Definition

Spurious emission is emission on a frequency or frequencies outside the out-of-band domain and the level of which may be reduced without affecting the corresponding transmission of information.

8.4.2 Method of measurement

The MBR transmitter shall be configured to operate at a normal RF output power level using test signal 1.

The receiving test antenna shall be connected to spectrum analyser using the notch filter see clause 5.7.

Max Hold shall be selected.

The value of the power shall be measured.

The measurement shall be made over the frequency range from 30 MHz to 26,5 GHz excluding the channel on which the transmitter is operating and its adjacent channels (±50 MHz).

8.4.3 Limits

The level of any spurious emission on frequencies outside f_c ±50 MHz shall be in accordance with table 2.

Table 2: Transmitter spurious emissions

Frequency range	Maximum power	ERP measurement bandwidth
30 MHz to 1 GHz	-40 dBm	100 kHz
1 GHz to 26,5 GHz	-30 dBm	1 MHz

9 Receiver

9.1 Maximum usable sensitivity

9.1.1 Definition

The maximum usable sensitivity (data or messages, conducted) is the minimum level of signal at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal 2 (see clause 6.1), which will, without interference, produce after demodulation a data signal with a specified bit error ratio or a specified successful message ratio.

9.1.2 Method of measurement

The equipment (transmission and/or reception) under test shall be operated in its normal transmission mode.

The MBR transmitter shall be configured to operate with normal test signal 2.

The receiving test antenna shall be connected to spectrum analyser.

Max Hold shall be selected and the centre frequency adjusted to that of the EUT.

The transmitter signal level shall be reduced until the received BER is less than 10^{-5}.

The sensitivity of the receiver is the measured level plus the MBR receiver antenna gain.

9.1.3 Limits

The maximum usable sensitivity at the nominal channel bandwidth shall be lower than -83 dBm.

9.2 Error behaviour at high input levels

9.2.1 Definition

The error behaviour (performance) at high input levels (noise free operation) is defined by the bit error ratio (continuous bit stream) or by the number of messages lost or corrupted when the level of the wanted signal is significantly above the maximum usable sensitivity.

9.2.2 Method of measurement

The equipment (transmission and/or reception) under test shall be operated in its normal transmission mode.

The MBR transmitter shall be configured to operate with normal test signal 2 and the output power set to the level to produce -17 dBm at input of the MBR receiving antenna.

The receiving test antenna shall be connected to spectrum analyser.

Max Hold shall be selected and the centre frequency adjusted to that of the EUT.

9.2.3 Limits

The BER shall be less than 10^{-5}.

9.3 Co-channel rejection

9.3.1 Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

9.3.2 Method of measurement

The MBR equipment (transmission and reception) under test shall be operated in its normal operation mode.

For the measurement, two MBR transmitters shall be used (transmitter A and B). Both transmitters shall operate on the same frequency and shall be adjusted to produce test signal 2.

Each MBR transmitter shall be addressed and connected to an individual MBR receiver.

Both transmitters shall operate at the nominal frequency of the EUT.

Initially, MBR transmitter B (unwanted signal) shall be switched off.

The wanted signal shall be provided by MBR transmitter A and shall produce test signal 2 at a level +3 dB above the sensitivity level of the receiver.

The MBR transmitter B shall then be switched on and the level of the unwanted signal adjusted until BER is less than 10^{-5} is appearing in MBR link A.

The co-channel rejection ratio shall be expressed as the average ratio, in dB, between the level of the unwanted signal (transmitter B) and the level of the wanted signal (transmitter A).

9.3.3 Limits

The co-channel rejection at the nominal frequency of the EUT shall be better than -13 dB.

9.4 Adjacent channel selectivity

9.4.1 Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

9.4.2 Method of measurement

The equipment (transmission and/or reception) under test shall be operated in its normal transmission mode.

For the measurement, two MBR transmitters shall be used (transmitter A and B). Both transmitters shall be adjusted to produce test signal 2.

Each MBR transmitter shall be addressed and connected to an individual MBR receiver and shall operate at the nominal frequency of its belonging MBR receiver.

MBR transmitter A (wanted signal) shall operate on one of the MBR frequencies and MBR transmitter B (unwanted signal) shall operate on the other MBR frequency.

Initially, MBR transmitter B (unwanted signal) shall be switched off.

The wanted signal shall be provided by MBR transmitter A and shall produce test signal 2 at a level +3 dB above the sensitivity level of the receiver.

The MBR transmitter B shall then be switched on and the level of the unwanted signal adjusted until BER more than 10^{-5} is appearing in MBR link A.

The adjacent channel selectivity shall be expressed as the average ratio, in dB, between the level of the unwanted (transmitter B) and the level of the wanted signal (transmitter A).

9.4.3 Limits

The adjacent channel selectivity shall be greater than 40 dB.

9.5 Blocking or desensitization

9.5.1 Definition

Blocking is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies other than those of the spurious responses or the adjacent channels.

9.5.2 Method of measurement

The equipment (transmission and/or reception) under test shall be operated in its normal transmission mode.

The MBR transmitter shall be configured to operate with normal test signal 2 at the nominal frequency of the receiver.

The unwanted signal shall be unmodulated at a frequency between ±50 MHz and ±1 GHz from the nominal frequency of the MBR link. For practical reasons, frequencies approximately ±50 MHz, ±100 MHz, ±500 MHz and ±1 GHz shall be used.

Initially, the unwanted signal generator shall be switched off.

The wanted signal shall be provided by an MBR transmitter and shall produce test signal 2 at a level +3 dB above the sensitivity level of the receiver.

The unwanted signal generator shall then be switched on and the level of the unwanted signal adjusted until BER is less than 10^{-5} is appearing in MBR link.

The blocking level shall be expressed as the ratio, in dB, between the level of the unwanted signal (transmitter B) and the level of the wanted signal (transmitter A).

9.5.3 Limits

The blocking level for any of the above specified frequencies shall be greater than 55 dB.

9.6 Spurious emissions

9.6.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

9.6.2 Method of measurement

The MBR receiver shall be switched on.

Any radiation shall be measured with substitution method specified in clause 4 of ETSI TS 103 052 [4].

9.6.3 Limit

The spurious emissions of the receiver shall not exceed the limits given in table 3.

Table 3: Receiver spurious emission limits

Frequency range	Maximum power	ERP measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 26,5 GHz	-47 dBm	1 MHz

10 Testing for compliance with technical requirements

10.1 Environmental conditions for testing

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.

10.2 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- The measured value related to the corresponding limit will be used to decide whether equipment meets the requirements of the present document and the measurement shall be related to the tolerance and uncertainty as follows:

  $$d_{mv}^2 = d_{pt}^2 + d_{mu}^2$$

  Where d_{pt} is the permitted tolerance for the parameter under test; and

  d_{mu} is the measurement uncertainty applicable for that parameter;

  d_{mv} is the permitted error in the measured value;

- the measured value related to the corresponding limit will be used to decide whether equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or less than the figures in table 4.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028 [i.3] parts 1 and 2, in particular in annex D of the ETSI TR 100 028-2 [i.2].

Table 4 is based on such expansion factors.

Table 4: Maximum measurement uncertainties

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-7}$
Radiated RF power	±6 dB
Sensitivity at BER 10^{-5}	±6 dB
Two-signal measurement, valid up to 6 GHz (using radiated fields)	±6 dB
Radiated emission of the transmitter, valid up to 26,5 GHz	±6 dB
Radiated emission of receiver, valid up to 26,5 GHz	±6 dB
Temperature	±1 °C
Humidity	±5 %

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.4] 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.1].

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.

Table A.1: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 303 276				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	Transmitter frequency error	8.1	U	
2	Transmitter EIRP	8.2	U	
3	Transmitter spectrum mask	8.3	U	
4	Transmitter spurious emissions	8.4	U	
5	Receiver maximum usable sensitivity	9.1	U	
6	Receiver error behaviour at high input levels	9.2	U	
7	Receiver co-channel rejection	9.3	U	
8	Receiver adjacent channel selectivity	9.4	U	
9	Receiver blocking	9.5	U	
10	Receiver spurious emissions	9.6	U	

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is unconditionally applicable (U) or is conditional upon the manufacturer's claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement is or is not applicable for a requirement which is classified "conditional".

Presumption of conformity stays valid only as long as a reference to the present document is maintained in the list published in the Official Journal of the European Union. Users of the present document should consult frequently the latest list published in the Official Journal of the European Union.

Other Union legislation may be applicable to the product(s) falling within the scope of the present document.

Annex B (informative): Bibliography

- ETSI TR 103 109: "Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference document (SRdoc); Broadband communication links for ships and fixed installations engaged in off-shore activities operating in the 5 GHz to 8 GHz range SRdoc Broadband communication links for ships".

Annex C (informative): Change history

Version	Information about changes
1.1.1	First published version.

History

Document history			
V1.1.0	May 2017	EN Approval Procedure	AP 20170822: 2017-05-24 to 2017-08-22
V1.1.1	November 2017	Publication	