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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 for access to radio spectrum

Reference
REN/ERM-TGMAR-604

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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
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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.2] 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:	6 January 2021
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Date of withdrawal of any conflicting National Standard (dow):	31 October 2022

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 below-deck equipment for maritime mobile broadband radiocommunication systems (MBR) radio equipment utilizing integral electronically phase steered antennae applicable for communications between vessels and between vessels and platforms engaged in coordinated off-shore activities and intended to operate at the frequencies shown in table 1, operating with linear polarization or Left Hand Circular Polarization (LHCP)

Table 1: MBR operating frequencies

Operation	MBR operating frequencies
Transmission	5 862 MHz, 5 890 MHz
Reception	5 862 MHz, 5 890 MHz

NOTE: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU 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 at https://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.

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

[1] Recommendation ITU-T O.150 (05-1996) plus corrigendum 1 (05/2002): "General requirements for instrumentation for performance measurements on digital transmission equipment".

[2] 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] 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.3] ECC Recommendation (17)03 (2017): "Guidance for the harmonised use and coordination of Maritime Broadband Radio (MBR) systems on board ships and off-shore platforms operating within the frequency bands 5852-5872 MHz and 5880-5900 MHz".

[i.4] 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.5] ERC Recommendation 74-01 (2019): "Unwanted emissions in the spurious domain".

[i.6] ITU Radio Regulations (2020).

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

out-of-band domain: frequency range, immediately outside the necessary bandwidth but excluding the spurious domain

switching range: maximum frequency band within which an equipment can operate

3.2 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
dBW	Level (dB) relative to 1 W
f	frequency
N	Number of transmitted bits
ppm	parts per million (10^{-6})
s	second
V	Volt

3.3 Abbreviations

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

ac	alternating current
ATPC	Adaptive Transmitter Power Control
BER	Bit Error Rate
CRC	Cyclic Redundancy Check
EIRP	Equivalent Isotropically Radiated Power
EUT	Equipment Under Test
FER	Frame Error Rate
LHCP	Left Hand Circular Polarization
MBR	Maritime Broadband Radiolink
NA	Not Applicable
OOB	Out Of Band
PTT	Push To Talk

RBW	Reference BandWidth
RF	Radio Frequency
sr	switching range
TDMA	Time Division Multiple Access
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 General and operational requirements

4.2.0 General

Compliance with clauses 4.2.1, clause 4.2.2 and clause 4.2.3 shall be established by simple inspection of the equipment and its technical documentation.

4.2.1 Construction

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

4.2.2 Controls and indicators

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

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 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.

4.2.3 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.

4.3 Transmitter Requirements

4.3.1 Operating Frequency error

4.3.1.1 Definition

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

4.3.1.2 Method of measurement

The measurement setup shall be as in Figure 1.

The MBR transmitter shall be configured to transmit on the highest frequency available in the equipment, at a normal RF output power level using test signal 1.

The receiving test antenna shall be connected to a frequency counter.

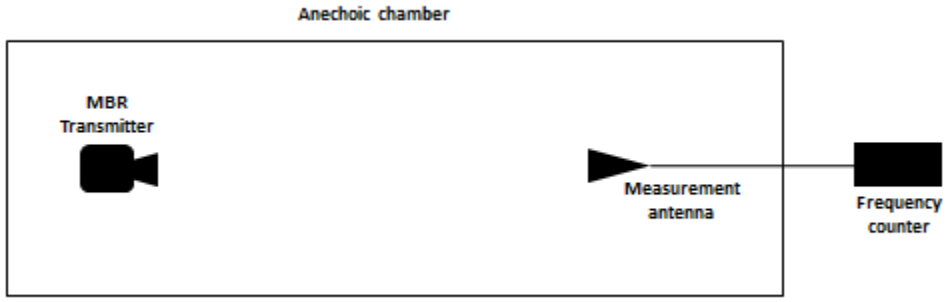

Figure 1: Measurement set up for operating frequency error

The transmitter frequency shall be measured and noted.

4.3.1.3 Limits

The measured frequency error shall not exceed 2 ppm.

4.3.2 Transmitter EIRP

4.3.2.1 Definition

The transmitter EIRP is the maximum radiated power of the equipment with its associated antenna.

4.3.2.2 Method of measurement

The measurement setup shall be as in Figure 2.

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 a spectrum analyser.

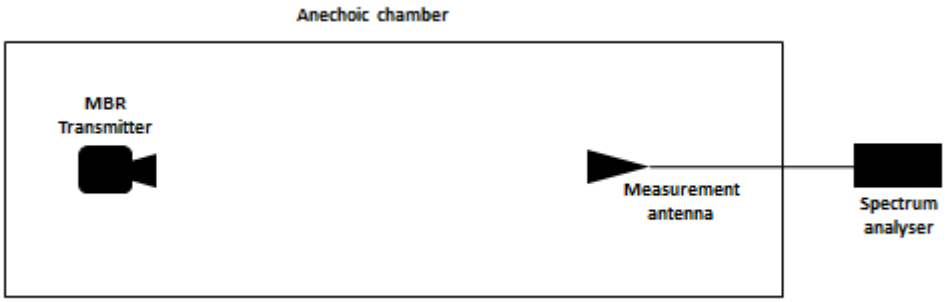

Figure 2: Measurement setup for transmitter EIRP

Max Hold (peak detector) 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 [2] shall be used.

4.3.2.3 Limits

The EIRP shall not exceed 25 dBW (55 dBm) with left hand circular polarized radiation and 22 dBW (52 dBm) with linear polarized radiation.

NOTE: These values are specified in Annex 1 of ECC Recommendation (17)03 [i.3].

4.3.3 Adaptive Transmitter Power Control

4.3.3.1 Definition

Adaptive power control is an automatic mechanism to regulate the transmitter output power.

4.3.3.2 Method of measurement

The measurement setup shall be as in Figure 3.

For the measurement, two MBR equipments (MBR A and MBR B) shall be used to establish a normal MBR communication link using test signal 2.

The equipment under test (MBR A) shall be operated at a power level that produces a signal level of at least 50 dB above the sensitivity level (see clause 4.4.1) at MBR B with the Adaptive Transmitter Power Control (ATPC) inactive.

The receiving test antenna shall be connected to a spectrum analyser.

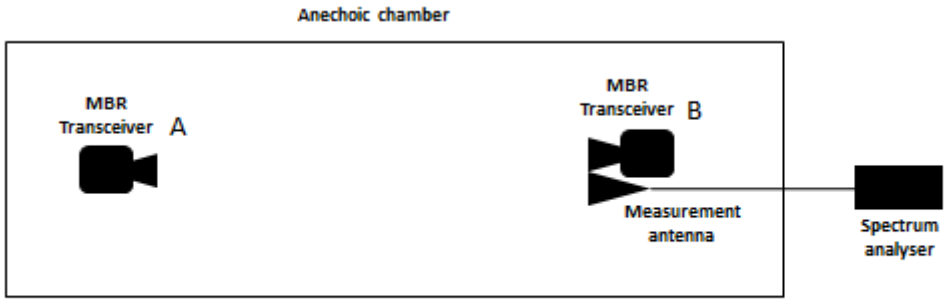

Figure 3: Measurement setup for adaptive transmitter power control

Max Hold (peak detector) shall be selected and the output power of the equipment under test (MBR A) shall be measured.

The ATPC in the equipment (MBR A) under test shall then be activated and the change of the output power shall be measured.

4.3.3.3 Limits

The output power of the EUT shall be reduced by the ATPC by at least 25 dB.

NOTE: The value is specified in Annex 1 of ECC Recommendation (17)03 [i.3].

4.3.4 Transmitter spectrum mask

4.3.4.1 Definition

A spectrum mask is a set of limit lines applied to a plot of a transmitter spectrum. The transmitter spectrum mask defines emission limits in the out-of-band domain.

4.3.4.2 Method of measurement

The measurement setup shall be as in Figure 4.

The MBR transmitter shall be configured to operate at a maximum EIRP using test signal 2.

The receiving test antenna shall be connected to a spectrum analyser.

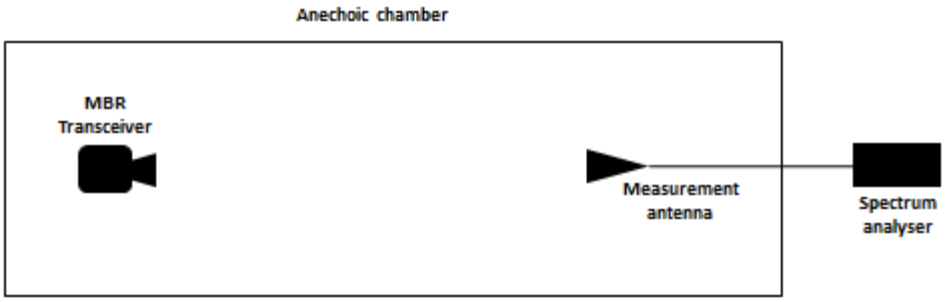

Figure 4: Measurement setup for transmitter spectrum mask

Max Hold (peak detector) 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.

4.3.4.3 Limits

The emissions shall not exceed the transmitter spectrum mask in figure 5 or an absolute level of -30 dBm/MHz, whichever is greater.

NOTE: The spectrum mask is specified in ECC Recommendation (17)03 [i.3].

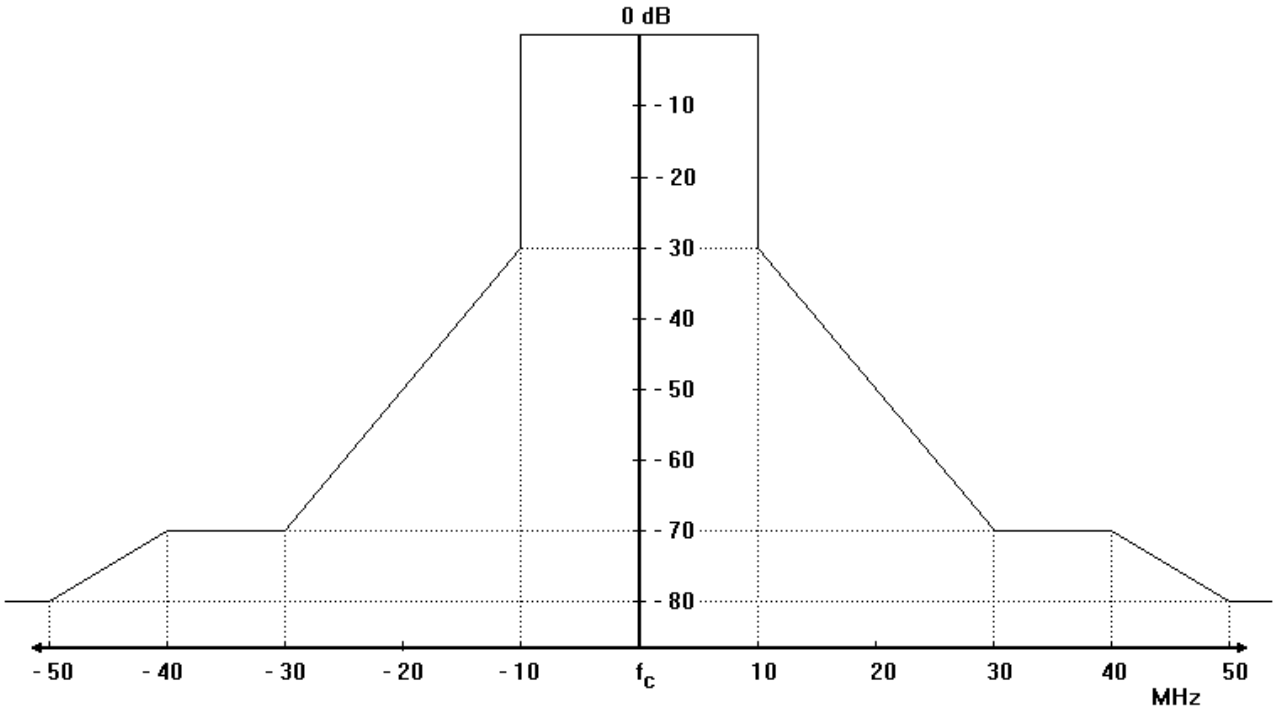

Figure 5: Transmitter power spectrum mask

4.3.5 Transmitter spurious emissions

4.3.5.1 Definition

Spurious emissions are 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.

4.3.5.2 Method of measurement

The measurement setup shall be as in Figure 6.

The MBR transmitter shall be configured to operate at a maximum EIRP using test signal 1.

If the dynamic range of the spectrum analyzer does not have sensitivity for measuring spurious emissions with test signal 1 present, a notch filter shall be used.

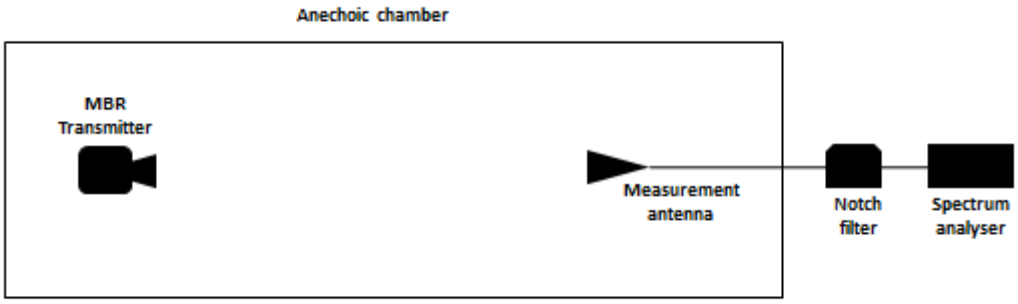

Figure 6: Measurement setup for transmitter spurious emissions

Max Hold (peak detector) shall be selected.

The value of the power shall be measured over a 30 s period and noted.

The measurement shall be made over the frequency range from 30 MHz to 26 GHz excluding the channel on which the transmitter is operating and the out of band domain (±50 MHz). The reference bandwidths shall be in accordance with Table 2.

4.3.5.3 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 limits and measurement bandwidth

Frequency range	Emission Limits	RBW
30 MHz ≤ f ≤ 1 GHz	-40 dBm	100 kHz
1 GHz < f ≤ 26 GHz	-30 dBm	1 MHz

NOTE: The limit for frequencies below 1 GHz is stricter than the one specified in Table 6 of ERC Recommendation 74-01 [i.5].

4.4 Receiver Requirements

4.4.1 Maximum usable sensitivity

4.4.1.1 Definition

The maximum usable sensitivity (data or messages) is the minimum level of signal at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the test signal 2 (see clause 5.2.2.2), which will, without interference, produce after demodulation a data signal with a specified bit error ratio or a specified successful message ratio.

4.4.1.2 Method of measurement

The measurement setup shall be as in Figure 7.

The MBR transmitter shall be configured to operate with test signal 2 and connected to the transmitter antenna via a precision attenuator.

The transmitter signal level shall be reduced in 1 dB steps until the received BER exceeds 10^{-5}.

The measurement test antenna shall be connected to a spectrum analyser.

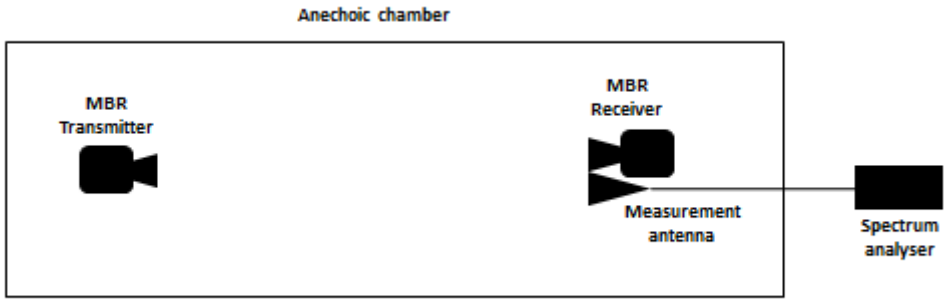

Figure 7: Measurement setup for maximum usable sensitivity

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

The sensitivity level shall be measured and noted.

4.4.1.3 Limits

The maximum usable sensitivity shall be better than -83 dBm.

4.4.2 Error behaviour at high input levels (dynamic range)

4.4.2.1 Definition

The error behaviour at high input levels 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.

4.4.2.2 Method of measurement

The measurement setup shall be as in Figure 8.

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

The measurement test antenna shall be connected to a spectrum analyser.

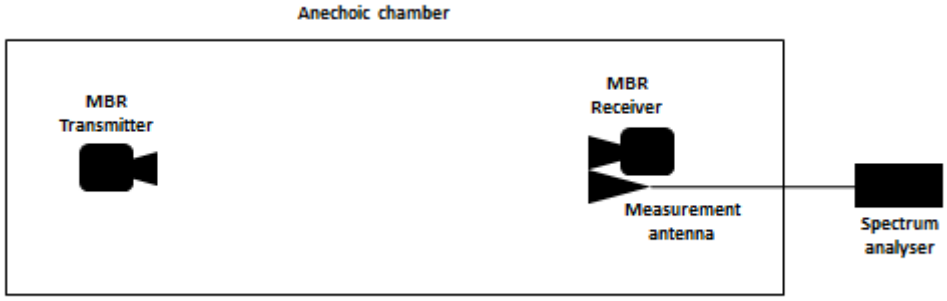

Figure 8: Measurement setup for error behaviour at high input levels (dynamic range)

The BER shall be measured and noted.

4.4.2.3 Limits

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

4.4.3 Co-channel rejection

4.4.3.1 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.

4.4.3.2 Method of measurement

The measurement setup shall be as in Figure 9.

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.

The measurement test antenna shall be connected to a spectrum analyser.

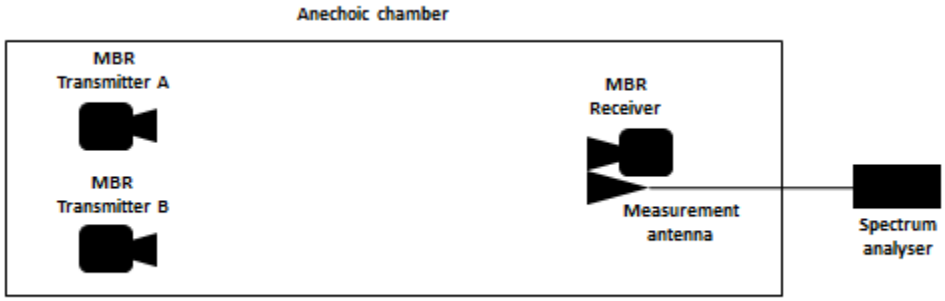

Figure 9: Measurement setup for co-channel rejection

The two transmitters shall be fed to calibrated antennas of equal gain, each within the 3 dB beamwidth of the antenna of the receiver under test.

Both transmitters shall operate at the nominal frequency of the receiver under test.

Initially, MBR transmitter B (unwanted signal) shall establish a link with the receiver under test and is then 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 as measured in clause 4.4.1.

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 signal levels of MBR transmitter A and B shall be measured and noted.

The co-channel rejection ratio 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).

4.4.3.3 Limits

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

4.4.4 Adjacent channel selectivity

4.4.4.1 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.

4.4.4.2 Method of measurement

The measurement setup shall be as in Figure 10.

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

The measurement test antenna shall be connected to a spectrum analyser.

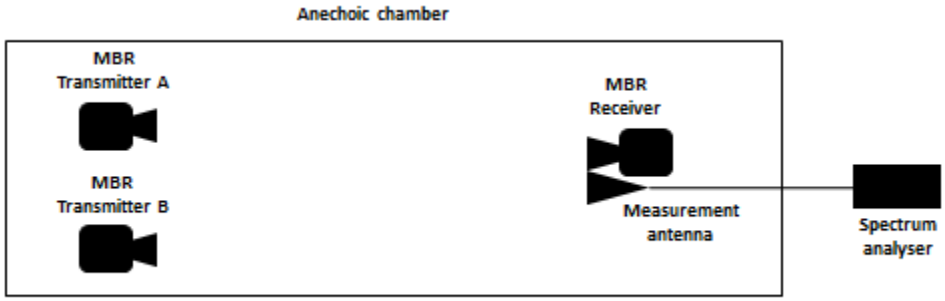

Figure 10: Measurement setup for adjacent channel selectivity

The two transmitters shall be fed to calibrated antennas of equal gain, each within the 3dB beamwidth of the antenna of the receiver under test.

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 ratio, in dB, between the level of the unwanted (transmitter B) and the level of the wanted signal (transmitter A).

The signal levels of MBR transmitter A and B shall be measured and noted.

4.4.4.3 Limits

The adjacent channel selectivity shall be greater than 40 dB.

4.4.5 Blocking

4.4.5.1 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.

4.4.5.2 Method of measurement

The measurement setup shall be as in Figure 11.

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

The measurement test antenna shall be connected to a spectrum analyser.

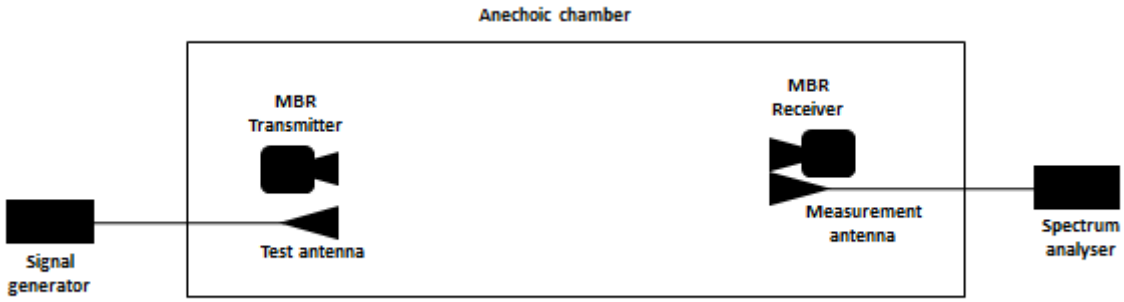

Figure 11: Measurement setup for blocking

The unwanted signal shall be an unmodulated signal at the frequencies ±500 MHz and ±1 GHz from the nominal frequency of the MBR link, where Fc is the nominal frequency of the receiver.

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 signal levels of MBR transmitter A and B shall be measured and noted.

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).

4.4.5.3 Limits

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

4.4.6 Receiver and Transmitter standby spurious emissions

4.4.6.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is switched on, but the transmitter is not activated.

Transmitter stand-by mode emissions refer to emissions radiated during periods where the equipment is available for traffic, but is not transmitting.

4.4.6.2 Method of measurement

The measurement setup shall be as in Figure 12.

The MBR equipment shall be switched on, but the transmitter shall not be activated.

The receiving test antenna shall be connected to a spectrum analyser and Max Hold (peak detector) shall be selected.

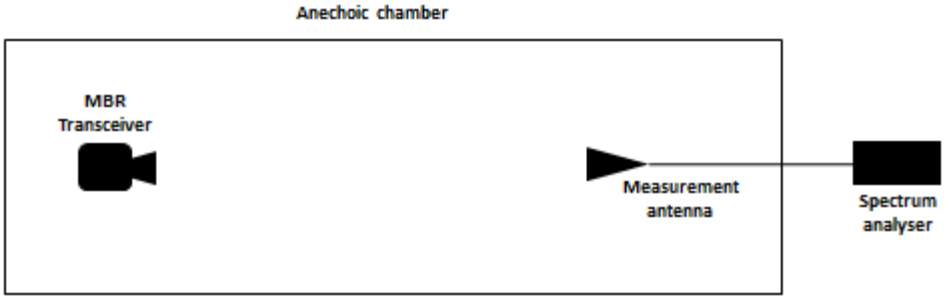

Figure 12: Measurement setup for receiver spurious emissions

The antennas of the MBR transceiver and the measurement antenna shall be at the same height.

The measurement antenna and the spectrum analyser shall be calibrated to read absolute values.

The emissions shall be measured and noted.

The measurement shall be made over the frequency range from 30 MHz to 26 GHz. The reference bandwidths shall be in accordance with Table 3.

4.4.6.3 Limits

The spurious emissions of the receiver shall be as specified in Table 3.

Table 3: Receiver spurious emission limits and measurement bandwidth

Frequency range	Emission Limits	RBW
30 MHz ≤ f ≤ 1 GHz	-57 dBm	100 kHz
1 GHz < f ≤ 26 GHz	-47 dBm	1 MHz
NOTE: -57 dBm and -47 dBm are defined in Table 2 of ERC Recommendation 74-01 [i.5].		

4.4.7 Receiver spurious response rejection

4.4.7.1 Definition

The receiver spurious response rejection is a measure of the capability of the receiver to receive a wanted signal without exceeding a given degradation due to the presence of an unwanted signal at any frequency at which a response is obtained. The frequencies of the adjacent channels are excluded.

4.4.7.2 Method of measurement

To determine the frequencies at which spurious responses can occur the following calculations shall be made:

a) calculation of the "limited frequency range":

- the limited frequency range is defined as the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the sum of the intermediate frequencies (f_{I1},...f_{In}) and a half the switching range (sr) of the receiver;
- hence, the frequency f_l of the limited frequency range is:

$$f_{LO} - \sum_{j=1}^{j=n} f_{Ij} - \frac{sr}{2} \leq f_l \leq f_{LO} + \sum_{j=1}^{j=n} f_{Ij} + \frac{sr}{2}$$

b) calculation of frequencies outside the limited frequency range:

- a calculation of the frequencies at which spurious responses can occur outside the range determined in a) is made for the remainder of the frequency range of interest, as appropriate;
- the frequencies outside the limited frequency range are equal to the harmonics of the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the first intermediate frequency (f_{I1}) of the receiver;
- hence, the frequencies of these spurious responses are:

$$nf_{LO} \pm f_{I1}$$

- where n is an integer greater than or equal to 2;

the measurement of the first image response of the receiver shall initially be made to verify the calculation of spurious response frequencies.

For the calculations a) and b) above, the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{LO}) applied to the 1st mixer of the receiver, the intermediate frequencies (f_{I1}, f_{I2}, etc.), and the switching range (sr) of the receiver.

The measurement setup shall be as in Figure 13.

The receiving test antenna shall be connected to a spectrum analyser.

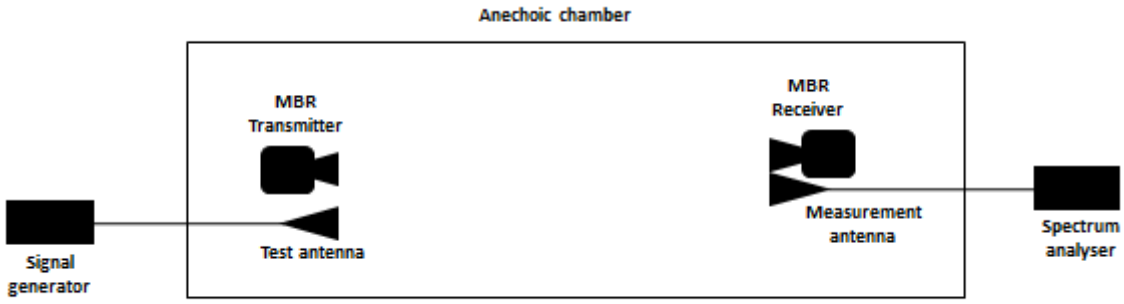

Figure 13: Measurement setup for receiver spurious response rejection

The measurement procedure shall be as follows:

I) the wanted signal, provided by signal generator A (an MBR transmitter), shall be at the nominal frequency of the receiver and shall have the test signal 2;

the unwanted signal, provided by signal generator B, shall be unmodulated.

II) initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance);

the level of the wanted signal from generator A shall be adjusted to the level of +3 dB above the sensitivity level of the receiver;

the bit error ratio of the receiver after demodulation shall be noted;

signal generator B shall then be switched on, and the level of the unwanted signal adjusted until BER is less than 10^{-5}.

III) the frequency of the unwanted signal generator shall be varied in increments of 10 MHz over the limited frequency range (see clause 4.4.7.2, calculation a)) and over the frequencies in accordance with the calculations outside of this frequency range (see clause 4.4.7.2, calculation b)).

The signal levels of MBR transmitter B and the BER shall be measured and noted.

4.4.7.3 Limit

At any frequency where a response is identified, the level of generator B shall be +33 dB above the sensitivity level of the receiver and the BER shall be better that 10^{-5}.

4.4.8 Receiver radio-frequency intermodulation

4.4.8.1 Definition

Receiver radio-frequency intermodulation response rejection is a measure of the capability of the receiver to receive a wanted signal, without exceeding a given degradation due to the presence of at least two unwanted signals at two different frequencies with a specific frequency relationship to the wanted signal frequency.

4.4.8.2 Method of Measurement

The measurement setup shall be as in Figure 14.

For the measurement, three MBR transmitters shall be used (transmitter A, transmitter B and transmitter C). Transmitter A and B shall be adjusted to produce test signal 2. Transmitter C shall be adjusted to produce test signal 1.

The measurement test antenna shall be connected to a spectrum analyser.

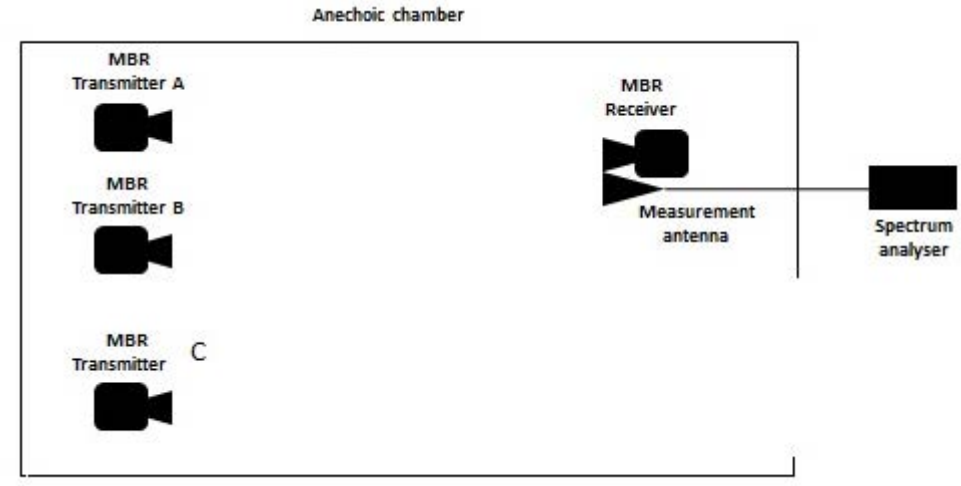

Figure 14: Measurement setup for intermodulation rejection

The three transmitters shall be fed to calibrated antennas of equal gain, each within the 3 dB beamwidth of the antenna of the MBR receiver under test.

MBR transmitter A (wanted signal) shall operate on one of the operating frequencies of the EUT and MBR transmitter B (unwanted signal) shall operate on the other MBR operating frequency. MBR transmitter C shall operate on the frequency 5 876 MHz.

Initially, MBR transmitter B and MBR transmitter C (unwanted signals) 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 MBR receiver.

The MBR transmitter B and MBR transmitter C shall then be switched on and the level of the two unwanted signals shall be maintained equal and be adjusted until BER more than 10^{-5} is appearing in MBR receiver.

The receiver radio-frequency intermodulation response rejection shall be expressed as the ratio, in dB, between the level of the unwanted signals (MBR transmitter B and MBR transmitter C) and the level of the wanted signal (transmitter A).

The signal levels of MBR transmitter A and of MBR transmitter B and MBR transmitter C shall be measured and noted.

4.4.8.3 Limit

The receiver radio-frequency intermodulation response rejection shall be greater than 30 dB.

5 Testing for compliance with technical requirements

5.1 General conditions of measurements

5.1.1 General

Tests shall be carried out on the frequencies available in the equipment.

NOTE: According to Annex 1 of ECC Recommendation (17)03 [i.3], MBR systems can operate only at 5 862 MHz and 5 890 MHz.

5.1.2 Test site and general arrangements for measurements

The test site (anechoic chamber) shall be as described in clause 5.2.1.2 of ETSI TS 103 052 [2].

The antennas of the MBR Transmitter and MBR receiver shall be at the same height.

The measurement antenna shall be placed as close as possible to the MBR Receiver antenna and shall be adjusted to the same height as the antenna for the MBR Transmitter and MBR Receiver.

The measurement antenna is adjusted in the direction of the MBR Transmitter Antenna.

The measurement antenna and spectrum analyzer shall be calibrated to read absolute values.

5.1.3 Test signals

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

5.1.4 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.

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.

5.1.5 Impedance

In the present document the term "50 Ω" is used for a 50 Ω non-reactive impedance. Non-reactive impedance is taken to mean a VSWR of 1,2 or better over the frequency range of interest.

5.1.6 Tests of equipment with a notch filter

A notch filter may be required to obtain the required dynamic range for measurement of the transmitter. If a notch filter is used, it shall be centred on the transmitter carrier frequency and attenuating this signal by at least 30 dB.

If a notch filter is used, its characteristics shall be declared in the test report, and the measured results shall be corrected for the loss in the notch filter.

5.1.7 Facilities for access

5.1.7.1 Coupling arrangements

Equipment to be connected to the Equipment Under Test (EUT) shall not affect the radiated field.

5.1.8 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 described in clause 5.2.2.2.

5.2 Environmental conditions for testing

5.2.1 General Requirements

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

Where 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.

5.2.2 Test conditions

5.2.2.1 General

All the tests shall be performed in normal test conditions.

5.2.2.2 Test signals

Test signal 1 shall be an unmodulated carrier.

Test signal 2 shall be an MBR message consisting of a pseudo-random bit sequence of at least 8 192 payload bits according to clause 5 of Recommendation ITU-T O.150 [1]. The bit modulation rate over the air shall be 10 Mb/s. The message shall contain a header targeting the targeted receiver identity.

5.2.2.3 Normal test conditions

5.2.2.3.1 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: not exceeding 75 %.

5.2.2.3.2 Normal power source

5.2.2.3.2.1 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.

5.2.2.3.2.2 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 (e.g. 12 V or 24 V).

5.2.2.3.2.3 Other power sources

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

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.2] 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	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Operating frequency error	3.2	4.3.1	U	
2	Transmitter EIRP	3.2	4.3.2	U	
3	Adaptive Transmitter Power Control	3.2	4.3.3	U	
4	Transmitter spectrum mask	3.2	4.3.4	U	
5	Transmitter spurious emissions	3.2	4.3.5	U	
6	Maximum usable sensitivity	3.2	4.4.1	U	
7	Error behaviour at high input levels (dynamic range)	3.2	4.4.2	U	
8	Co-channel rejection	3.2	4.4.3	U	
9	Adjacent channel selectivity	3.2	4.4.4	U	
10	Blocking	3.2	4.4.5	U	
11	Receiver and Transmitter standby spurious emissions	3.2	4.4.6	U	
12	Receiver spurious response rejection	3.2	4.4.7	U	
13	Receiver radio-frequency intermodulation	3.2	4.4.8	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.

Essential requirements of Directive

Identification of article(s) defining the requirement in the Directive.

Clause(s) of the present document

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): Maximum measurement uncertainty

The measurements described in the present document are based on the following assumptions:

- the measured value related to the corresponding limit is used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter is included in the test report.

Table B.1 shows the recommended values for the maximum measurement uncertainty figures.

Table B.1: Maximum measurement uncertainty

Parameter	Uncertainty
Radio Frequency	±1 x 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 C (informative): Checklist

This annex provides a traceability of the technical parameters for article 3.2 of Directive 2014/53/EU [i.1] defined in ETSI EG 203 336 [i.4] with the technical requirements for conformance defined in clause 4 of the present document.

If a technical parameter for article 3.2 of Directive 2014/53/EU [i.1] defined in ETSI EG 203 336 [i.4] has not been included in the present document, an explanation is provided.

An explanation is also provided whenever a technical parameter defined in ETSI EG 203 336 [i.4] is covered by an alternative technical requirement.

Table C.1: Checklist

Technical Parameters defined in ETSI EG 203 336 [i.4]	Clauses of the present document	Comments
Transmitter Parameters		
Transmit power (and possible accuracy)	4.3.2 4.3.3	
Spectrum mask	4.3.4	
Transmitter Frequency stability	4.3.1	
Transmitter Intermodulation attenuation	NA	This test is only needed when there are two or more transmitters co-sited or sharing the same antenna. Offshore coordinated operations where MBR is involved concerns 2 units so there is never a need for more than one link. Therefore there is no justification for this measurement.
Unwanted emissions (OOB and spurious domains)	4.3.4 4.3.5 4.4.6	
Transmitter Time domain characteristics (e.g. e.g. the duty cycle, turn-on and turn-off, frequency hopping cycle, dynamic changes of modulation scheme and others)	4.3.4	This equipment has only two states: • Off • Active (TDMA) There is no PTT keying, it is also fixed frequency and not frequency agile. Transmitter time domain characteristics are contained in the transmitter spectrum mask
Transmitter Transients	4.3.4	This equipment has only two states: • Off • Active (TDMA) There is no PTT keying, it is also fixed frequency and not frequency agile. Transmitter transients are contained in the transmitter spectrum mask
Receiver Parameters		
Receiver sensitivity	4.4.1	
Receiver co-channel rejection	4.4.3	
Adjacent signal/channel Selectivity	4.4.4	
Spurious response Rejection	4.4.7	
Receiver blocking	4.4.5	
Receiver radio-frequency intermodulation	4.4.8	
Receiver dynamic range	4.4.2	
Reciprocal mixing	NA	This technical requirement is covered by the blocking requirement defined in clause 4.4.5 and the selectivity requirement defined in clause 4.4.4.

Technical Parameters defined in ETSI EG 203 336 [i.4]	Clauses of the present document	Comments
Desensitization	NA	As desensitization is a receiver effect addressed by other parameters, its inclusion as a separate parameter is not required.
Receiver unwanted emissions in the spurious domain	4.4.6	

Annex D (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 E (informative): Change history

Version	Information about changes
1.1.1	First publication
1.2.1	Implemented modifications: - some requirements not relevant to article 3.2 of the RED have been removed - clarifications on the emission mask as per LS from the ECC (Doc. FM(18)190 - Annex 45) - general editorial corrections and clarifications - some test methods have been improved - an informative Annex (checklist against the technical Requirements for conformance defined in ETSI EG 203 336) has been added

History

Document history		
V1.1.1	November 2017	Publication
V1.2.0	October 2020	EN Approval Procedure AP 20210106: 2020-10-08 to 2021-01-06
V1.2.1	January 2021	Publication