ETSI EN 302 608 V2.1.1 (2017-11)

~~Electromagnetic compatibility and Radio spectrum Matters (ERM);~~

Short Range Devices (SRD);
Radio equipment for Eurobalise railway systems;
~~Harmonized EN~~Harmonised Standard covering the essential requirements
of article 3.2 of ~~the R&TTE~~ Directive 2014/53/EU

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Contents

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Foreword

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

~~The present document has been produced by ETSI in response to mandate M/364 from the European Commission issued under Council Directive 98/34/EC [i.1] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations.~~

~~The~~The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.8] 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 ~~intended to become a Harmonized Standard, the reference of which will be published~~cited in the Official Journal of the European ~~Communities referencing the Directive 1999/5/EC [i.2] of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity ("the R&TTE~~Union under that Directive~~").~~

~~Technical specifications relevant to Directive 1999/5/EC [i.2] are~~, compliance with the normative clauses of the present document given in ~~annex~~table A.

~~These specifications are complementary with the system and interoperability requirements for these devices established under Commission Decision 2004/447/EC [i.3].~~

~~In addition, relevant parts of EN 50121 [i.4] are applicable for~~1 confers, within the ~~electromagnetic compatibility of railway applications (part 3-2 for~~ limits of the ~~OBE and part 4 for~~ scope of the ~~Eurobalise equipment).~~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:	27 November 2017
Date of latest announcement of this EN (doa):	28 February 2018
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2018
Date of withdrawal of any conflicting National Standard (dow):	31 August 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).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document is part of a set of standards developed by ETSI and is designed to fit in a modular structure to cover all radio and telecommunications terminal equipment within the scope of the ~~R&TTE~~ Directive~~. The modular structure is shown in EG 201 399~~ 2014/53/EU [~~i.5~~i.1].

The Eurobalise transmission system is defined by the specifications [1] and [2] of the UNISIG consortium ~~[i.6] and [i.7].~~.

1 Scope

The present document ~~covers the~~specifies technical ~~requirements~~characteristics and methods of measurements for radio transmitters and receivers used in the Eurobalise transmission system. The system is ~~only~~ used in railway ~~systems~~environment for the communication between tracks and trains.

It applies to the following equipment units:

a) ~~a)~~ the On-Board Equipment (OBE) Tele-powering the Eurobalise; and

b) ~~b)~~ the Eurobalise that is always installed in between the rails.

The OBE comprises a transmitter (normally un-modulated) and a receiver fitted with an integral or dedicated antenna.

The Eurobalise FSK-modulated transmitter is Tele-powered by the OBE and has an integral antenna.

The Eurobalise transmission system operates in frequency bands listed in table 1 in accordance with the EC Decision 2013/752/EU [i.5] and ERC Recommendation 70-03 ~~[i.8~~[i.2], annex 4.

These radio equipment types are capable of operating at the following frequencies as given in ~~table 1~~table 1.

Table 1: Radio communications frequencies

	Radio communications frequencies Note
OBE ~~transmit centre~~receive frequency band	~~27,095 MHz~~2,5 MHz to 6 MHz (4,234 MHz centre frequency)
Eurobalise transmit ~~centre~~ frequency band	4,234~~-~~ MHz ± 1 MHz

~~The present document is intended to cover the provisions of Directive 1999/5/EC [i.2] (R&TTE Directive) article 3.2, which states that "… radio equipment shall be so constructed that it effectively uses the spectrum allocated to terrestrial/space radio communications and orbital resources so as to avoid harmful interference".~~

~~NOTE: A list of such ENs is included on the web site http://www.newapproach.org.~~

NOTE: EC decision for SRDs [i.5] and ERC Recommendation 70-03 [i.2] are providing the usage conditions for Eurobalise transmissions in frequency range 984 - 7 484 kHz (4,234 MHz centre frequency). The 27 MHz band is only used in the OBE for telepowering the Eurobalise, which is not in the scope of the present document.

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 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] UNISIG SUBSET-036-3.1.0: "FFFIS for Eurobalise", December 2015.

NOTE: Available at http://www.era.europa.eu/Document-Register/Documents/SUBSET-036%20v310.pdf.

[2] UNISIG SUBSET-085-3.0.0: "Test Specification for Eurobalise FFFIS", February 2012.

NOTE: Available at http://www.era.europa.eu/Document-Register/Documents/Set-2-Index043-SUBSET-085%20v300.pdf.

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.

~~2.1 Normative references~~

The following referenced documents are ~~indispensable~~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] ~~. For dated references, only the edition cited applies. For non-specific references, the latest edition~~ CEPT/ERC/Recommendation 70-03: "Relating to the use of ~~the referenced document (including any amendments) applies.~~Short Range Devices (SRD)".

[i.3] ETSI TR 100 028 (V1.4.1) (12-2001) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.4~~[1]~~] ETSI TR 102 273 (V1.2.1) (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties".

[i.5] EC Decision 2013/752/EU: "Commission Implementing DECISION of 11 December 2013 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC".

[i.6~~[2]~~ ~~CISPR 16 (2006), (parts 1-1, 1-4 and 1-5): "Specification for radio disturbance and immunity measuring apparatus and methods; Part 1: Radio disturbance and immunity measuring apparatus".~~

~~[3] ETSI TR 100 028 (V1.4.1) (all parts): "~~] ETSI EN 300 330 (V2.1.1): "Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

[i.7] CENELEC EN 50121-2:2015: "Railway applications - Electromagnetic compatibility ~~and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".~~

~~[4] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated~~ Part 2: Emission ~~Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".~~

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the userof the whole railway system to the outside world". Applies in conjunction with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.EN 50121-1 (09-2000).

[i.8] 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 98/34/EC2014/53/EU of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

[i.2] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[i.3] Commission Decision 2004/447/EC of 29 April 2004 modifying Annex A to Decision 2002/731/EC of 30 May 2002 and establishing the main characteristics of Class A system (ERTMS) of the control-command and signalling subsystem of the trans-European conventional rail system referred to in Directive 2001/16/EC of the European Parliament and of the Council.

[i.4] CENELEC EN 50121 (all parts): "Railway Applications - Electromagnetic Compatibility".

[i.9] ETSI EG 201 399 (V2.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); A guide to the production of candidate Harmonized Standards for application under the R&TTE Directive".

[i.6] UNISIG SUBSET-085: "116-1.1.0: "Eurobalise On-board Equipment, Susceptibility Test Specification for Eurobalise FFFIS".", June 2016.

[i.7] UNISIG SUBSET-036: "FFFIS for Eurobalise".

NOTE: The UNISIG Consortium was composed of the following European Companies working in the Railway Signalling area: Alstom, Ansaldo Signal, Bombardier, Invesys Rail, Siemens, and Thales.

[i.8] CEPT/ERC/Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

NOTE: Available at http://www.era.europa.eu/Document-Register/Pages/Set-3-Eurobalise-On-board-equipment-susceptibility-test-specification.aspx.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

dedicated antenna: removable antenna supplied and tested with the radio equipment, designed as an indispensable part of the equipment

down-link: optional binary ASK- modulated transmission link from the OBE to trackside units

duty cycle: defined as the ratio, expressed as a percentage, of the maximum transmitter "on" time monitored over one hour, relative to a one hour period

eurobaliseEurobalise: wayside transmission unit that uses the magnetic transponder technology

NOTE: Its main function is to transmit and/or receive signals through the air gap. The Eurobalise is a single device mounted on the track, which communicates with a train passing over it.

integral antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

intersystem interference: interference from sources not under the control of the operator or manufacturer of the equipment

intrasystem interference: interference from source that are part of the system and are under the control of the manufacturer or the operator of the equipment

magnetic transponder technology: method that uses magnetic coupling in the air gap between a transmitter and a receiver for conveying data and energy

NOTE: In the Eurobalise transmission system context, it considers systems using the 27,095 MHz for Tele--powering and 4,234 MHz for Up-link transmission.

On-Board Equipment (OBE): part of the inductive communication system installed on the train

NOTE: The OBE consists of antenna unit(s) (for magnetic transponder technology)the communication between the train and the Balise transmission functionEurobalise.

NOTE: It functionally matches the air-gap interface and is installed on a train.

RF carrier: fixed radio frequency prior to modulation

Teletele-powering: signal transmitted by the OBE, which activates the Eurobalise upon passage

NOTE: The signal is normally an un-modulated RF carrier (CW). However, it may optionally be binary ASK-modulated for the transmission of down-link data.

up-link: transmission link from the Eurobalise to the OBE

3.2 Symbols

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

f	Frequency
S	Power Density
λ	Wavelength

3.3 Abbreviations

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

AC	Alternating Current
ASK	Amplitude Shift Keying
CW	Continuous Wave
EUT	Equipment Under Test
FSK	Frequency Shift Keying
HS	HarmonizedHarmonised Standard
OATS	Open Area Test Site
OBE	On-Board Equipment
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
SRD	Short Range Device
VSWR	Voltage Standing Wave Ratio

4 Technical Requirements SpecificationSpecifications

4.1 TechnicalEnvironmental 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. 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.

4.2 Transmitter Conformance Requirements

4.12.1 OBE TX Field Strength and Transmitter Mask

4.2.1.1.1 Definition Applicability

This test only applies to the OBE.

The radiated H-field mask is defined in the direction of maximum field strength under specified conditions of measurement.

4.2.1.1.2 Test ProcedureLimits

~~This test is performed using a radiated measurement (see clause 7.1).~~

~~4.1.1.3 Limit~~

The limits of figure 1 (expressed in dBµA/m at a distance of 10 m) shall not be exceeded.

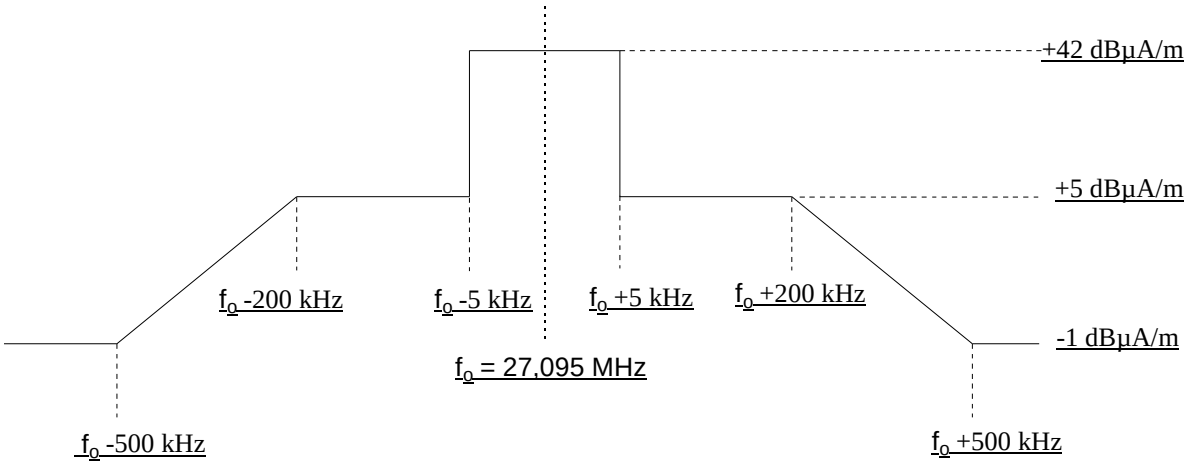


Figure 1: OBE transmitter mask

4.12.1.3 Conformance

The conformance test suite for OBE transmitter mask shall be as defined in clause 6.1.1 of the present document.

4.2.1.4 Maximum Allowable Measurement Uncertainty

~~See table 5 in clause 6.~~

The maximum allowable measurement uncertainty shall be as given in table 6 in clause 5.3.

4.12.2 OBE Unwanted EmissionsEmission

4.12.2.1 DefinitionApplicability

This test only applies to the OBE. Unwanted emissions consist of out-of-band and spurious emissions outside the frequency range 27,095 MHz ± 500 kHz as defined in clause 4.2.1.1.3.

4.1.2.2 Test Procedure

This test is performed using a radiated measurement (see clause 7.2). Limits

4.1.2.3 Limit

The limits in table 2 (expressed in dBµA/m at a distance of 10 m for frequencies below 30 MHz and expressed in dBµV/m at a distance of 10 m for frequencies equal or greater than 30 MHz) shall not be exceeded.

Table 2: OBE unwanted emissions limits

Frequency: (f)	Limit
9 kHz ≤ f < 150 kHz	44 dBµA/m at 9 kHz decreasing with logarithm of frequency to 19 dBµA/m at 150 kHz
150 kHz ≤ f < 30 MHz	54 dBµA/m at 150 kHz decreasing with logarithm of frequency to 4 dBµA/m at 30 MHz
30 MHz ≤ f ≤ 1 GHz	79 dBµV/m at 30 MHz decreasing with logarithm of frequency to 54 dBµV/m at 1 GHz
NOTE: The values are based on the assumption that the system operates in a rail environment installed below a rail vehicle. The values are extracted from the EMC limits for rail equipment given in figure 1 (150 kHz to 1 GHz) and figure C.1 (below 150 kHz) of CENELEC EN 50121-2:2015 [i.7]. The most stringent EMC limits (Category C) decreased by 6 dB have been chosen for the limits in clause 4.2.2.2 table 2.	

4.12.2.3 Conformance

The conformance test suite for OBE unwanted emission shall be as defined in clause 6.1.2 of the present document.

4.2.2.4 Maximum Allowable Measurement Uncertainty

See table 5 in clause 6.

The maximum allowable measurement uncertainty shall be as given in table 6 in clause 5.3.

4.12.3 Eurobalise TX Field Strength and Transmitter Mask

4.12.3.1 DefinitionApplicability

This test only applies to Eurobalises.

The radiated H-field uplink mask is defined in the direction of maximum field strength under specified conditions of measurement.

4.12.3.2 Test ProcedureLimits

This test is performed using a radiated measurement (see clause 7.3).

~~4.1.3.3 Limit~~

The limits of figure 2 (expressed in dBµA/m at a distance of 10 m) shall not be exceeded.

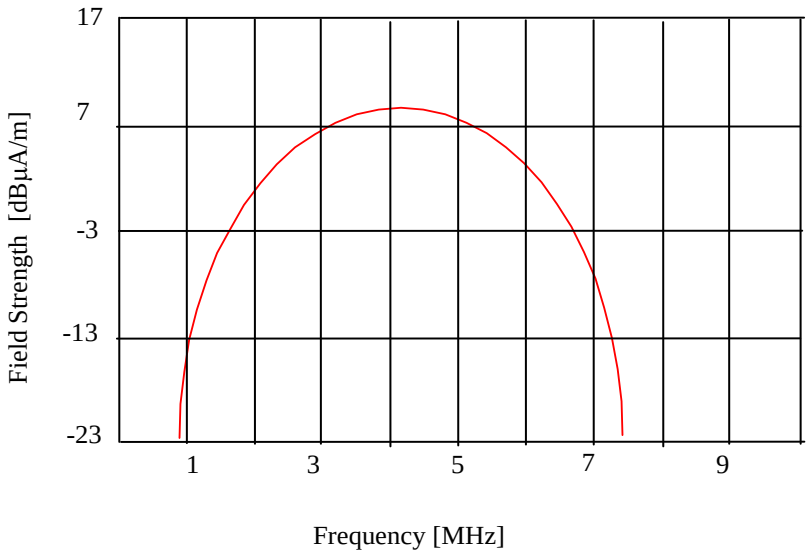


Figure 2: Eurobalise transmitter mask

The defined in-band frequency range is limited to the frequency range 4,234 MHz ± 1 MHz. The maximum value in the graph of figure 2 is 9 dBµA/m.

NOTE: ERC Recommendation 70-03 ~~[i.8~~[i.2], annex 4 recommends a maximum duty cycle of 1-% for the Eurobalise transmitter. This duty cycle ~~can not~~cannot be exceeded during normal operation ~~due to the fact~~it is not foreseen that ~~the~~a train ~~never~~ stops above the Eurobalise, ~~i.e. the train only stops after the Eurobalise has been passed.~~ In principle, it is impossible to exceed the defined duty cycle with a moving ~~trains~~train due to the given safety distance between trains versus Eurobalise operating range.

~~The provider shall declare the maximum duty cycle to not exceed 1 %.~~

~~4.1~~4.2.3.3 Conformance

The conformance test suite for Eurobalise transmitter mask shall be as defined in clause 6.1.3 of the present document.

4.2.3.4 Maximum Allowable Measurement Uncertainty

~~See table 5 in clause 6.~~

The maximum allowable measurement uncertainty shall be as given in table 6 in clause 5.3.

4.~~1~~2.4 Eurobalise Unwanted ~~Emissions~~Emission

4.~~1~~2.4.1 ~~Definition~~Applicability

This test only applies to ~~Eurobalises.~~track site Eurobalise equipment. Unwanted emissions consist of out-of-band and spurious emissions outside the frequency range 27,095 MHz ± 500 kHz as defined in clause 4.2.1~~.1.3~~, and outside the frequency range 4,234 MHz- ± 1 MHz as defined in clause 4.~~1.3~~2.3.

~~4.1.4.2 Test Procedure~~

~~This test is performed using a radiated measurement (see clause 7.4).~~.2 Limits

~~4.1.4.3 Limit~~

The limits in table 3 (expressed in dBµA/m at a distance of 10 m for frequencies below 30 MHz and expressed in dBµV/m at a distance of 10 m for frequencies equal or greater than 30 MHz) shall not be exceeded.

Table 3: Eurobalise unwanted emissions limits

Frequency: (f)	Limit
9 kHz- ≤ f < 150 kHz	44 dBµA/m at 9 kHz decreasing with logarithm of frequency to 19 dBµA/m at 150 kHz
150 kHz- ≤ f < 30 MHz	54 dBµA/m at 150 kHz decreasing with logarithm of frequency to 4 dBµA/m at 30 MHz
30 MHz- ≤ f ~~≤~~ ≤ 1 GHz	79 dBµV/m at 30 MHz decreasing with logarithm of frequency to 54 dBµV/m at 1 GHz
NOTE: The values are based on the assumption that the system operates in a rail environment installed below a rail vehicle. The values are extracted from the EMC limits for rail equipment given in figure 1 (150 kHz to 1 GHz) and figure C.1 (below 150 kHz) of CENELEC EN 50121-2:2015 [i.7]. The most stringent EMC limits (Category C) decreased by 6 dB have been chosen for the limits in clause 4.2.4.2 table 3.	

4.2.4.3 Conformance

The conformance test suite for Eurobalise unwanted emission shall be as defined in clause 6.1.4 of the present document.

4.2.4.4 Maximum Allowable Measurement Uncertainty

The maximum allowable measurement uncertainty shall be as given in table 6 in clause 5.3.

~~See table 5 in clause 6.~~

~~5~~4.3 Receiver Conformance Requirements

4.3.1 OBE Receiver Sensitivity

4.3.1.1 Applicability

This only applies to the OBE receiver.

4.3.1.2 Limits

The OBE receiver sensitivity limits are defined in UNISIG SUBSET-036-3.1.0 [1], clause 6.2.2.1 "Up-link Balise Detection".

4.3.1.3 Conformance

The conformance test suite for OBE receiver sensitivity shall be as defined in clause 6.2.1 of the present document.

4.3.2 OBE Receiver Blocking

4.3.2.1 Applicability

This only applies to the OBE receiver.

4.3.2.2 Limits

The normal operation of the OBE receiver shall not be blocked or disturbed by simultaneous reception of CW signals at out-band frequencies as given in table 4.

The OBE receiver blocking limits for CW shall be as given in table 4.

Table 4: Field Strength Limits for CW

Frequency [MHz]	Field Strength, RMS [dBµA/m]
1,0	100
2,5	83
6,0	74

4.3.2.3 Conformance

The conformance test suite for OBE receiver blocking shall be as defined in clause 6.2.2 of the present document.

5 Testing for Compliance with Technical Requirements

5.1 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.

Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements.

5.2 General Conditions for Testing

5.2.1 Test Conditions

~~5.1 General~~

Testing shall be made under normal test conditions.

NOTE: The Eurobalise system components (OBE as well as the Eurobalise) are built for interoperability and the UNISIG ~~specifications~~specification [2] apply over the full operating temperature range (including the spectrum masks).

~~The test conditions and procedures shall be as specified in clauses 5.2 and 5.3.~~

~~5~~5.2.2 Test Power Source

The OBE equipment shall be tested using the appropriate test power source.

The test power source used shall be stated in the test report.

The Eurobalise is purely Tele-powered during the test.

During the tests, the power source of the equipment shall be replaced by an external test power source capable of producing normal test voltages as specified in clause 5.~~3.~~2.4. The internal impedance of the external test power source shall be low enough for its effect on the test results to be negligible. For the purpose of the tests, the voltage of the external test power source shall be measured at the input terminals of the equipment. For radiated measurements any external power leads should be so arranged so as not to affect the measurements.

During tests, the test power source voltages shall be within a tolerance of < ±1 % relative to the voltage at the beginning of each test. The value of this tolerance can be critical for certain measurements. Using a smaller tolerance will provide a better uncertainty value for these measurements.

5.2.3 ~~Normal~~Nominal Test Conditions

5.2.3.1 Normal Temperature and Humidity

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

- Temperature +15 °C to +35 °C;
- Relative humidity 20 % to 75 %.

5.2.3.2 Normal Test Power Source

~~5.3.2.1~~ , Mains Voltage

The normal test voltage for equipment to be connected to the mains shall be the nominal 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 was designed.

~~The frequency of the test power source corresponding to the AC mains shall be between 49 Hz and 51 Hz.~~

~~5.3.2.2~~ 5.2.3.3 Normal Test Power Source, Other Power Sources

For operation from other power sources, the normal test voltage shall be that declared by the equipment ~~provider~~manufacturer and agreed by the test laboratory. Such values shall be stated in the test report.

5.2.4 Requirements for ~~the~~ Test Modulation

The OBE is un-modulated (CW) during testing. ~~If the OBE has implemented the optional down-link modulation (binary ASK), then testing shall occur with a modulated OBE as well.~~ The Eurobalise is Tele-powered and the specified FSK modulation applies. The information content shall be representative of normal use.

The manufacturer shall provide the means to operate the transmitter during the tests.

5.2.5 Choice of Equipment ~~for Test Suites~~

The tests shall be carried out on one or more production models or equivalent preliminary models, as appropriate. If testing is performed on (a) preliminary model(s), then the corresponding production models shall be identical to the tested models in all respects relevant for the purposes of the present document.

If equipment has several optional features that are considered to affect directly the RF parameters, then tests need only be performed on the equipment configured with the considered worst case combination of features as declared by the manufacturer.

The test shall be performed as a radiated test using the radiated measurement procedures.

The ~~provider~~manufacturer shall provide one or more samples of the equipment, as appropriate for testing. Additionally, technical documentation and operating manuals, sufficient to make the test, shall be supplied.

5.2.6 Measuring Receiver

The term "measuring receiver" refers to a spectrum analyser. The bandwidth and detector type of the measuring receiver are given in ~~table 4~~table 5.

Table 5: Measuring receiver

Frequency: (f)	Detector type	Spectrum ~~analyzer~~analyser bandwidth
9 kHz- ≤ f < 150 kHz	Quasi Peak	300 Hz
150 kHz- ≤ f < ~~30~~27,090 MHz	Quasi Peak	10 kHz
27,090 kHz ≤ f < 27,100 MHz	Quasi Peak	300 Hz
27,100 kHz ≤ f < 30 MHz	Quasi Peak	10 kHz
30 MHz- ≤ f ≤ 1 GHz	Quasi Peak	100 kHz

~~6~~ 5.3 Interpretation of the Measurement ~~Uncertainty~~Results

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

- the measured value related to the corresponding limit shall be 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 shall be separately included in the test report;
- the value of the measurement uncertainty should be, for each measurement, equal to or ~~lower~~less than the figures in ~~table 5~~table 6.

Table 6: Absolute measurement uncertainties: maximum values

Parameter	Uncertainty
Radiated field strength	±6 dB
Temperature	±1 °C
Humidity	±10 %

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with ETSI TR 100 028 [~~3~~i.3], 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~~).~~)).

~~Table 5~~Table 6 is based on such expansion factors.

The particular expansion factor used for the evaluation of the measurement uncertainty shall be stated.

ETSI TR 102 273 [~~1~~i.4] provides further information concerning the usage of test sites.

~~7 Test Procedures for Essential Radio~~6 Performance Test Suites

~~7~~6.1 Conformance Methods of Measurement for Transmitter

6.1.1 OBE TX Field Strength and Transmitter Mask

~~See clause 5.1 for the~~ The test conditions~~.~~

~~The measurements of the transmitter radiated H-field~~ shall be ~~made on one of the test sites specified~~as given in ~~annex B.~~ clause 5.2.

Any measured values shall be at least 6 dB above the ambient noise level.

The OBE transmitter ~~spectrum~~field strength within the frequency range 27,095 MHz ± 500 kHz shall be determined and recorded. The OBE Tele-powering signal (it is a CW signal) is measured as follows.

~~Step 1 The H-field strength should be measured at 10 m distance by using quasi peak detector and a 10 kHz resolution bandwidth. The result shall be recorded in the test report as the total field strength.~~

~~Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex D, and these calculations shall be stated in the test report.~~ The H-field is measured with a shielded loop antenna connected to a measurement receiver. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.6.

The ~~spectrum analyser or equivalent shall~~H-field strength should be ~~configured as follows unless otherwise stated:~~

- ~~Resolution bandwidth:~~ measured over~~10 kHz.~~
- ~~Video bandwidth:~~ ~~Not less than~~ the ~~resolution bandwidth.~~
- ~~Detector mode:~~ ~~Quasi-peak.~~

~~For equipment where the optional OBE down-link modulation is implemented (binary ASK modulation), the following measurement shall be conducted:~~

- ~~Step 2~~ frequency range 27,095 MHz ± 500 kHz at 10 m distance for the three polarizations of the loop antenna (x-/y-/z-axis). The ~~spectrum~~maximum field strength of the ~~transmitter is measured also with modulation in the same way as described in step 1 above. The result~~three polarizations shall be recorded in the test report. Those values shall be below the limits in clause 4.2.1.2.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. ~~7~~In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex I of ETSI EN 300 330 [i.6], and these calculations shall be stated in the test report. The H-field is measured with a shielded loop antenna connected to a measurement receiver.

6.1.2 OBE Unwanted ~~Emissions~~Emission

~~See clause 5.1 for the~~ The test conditions shall be as given in clause 5.2.

The measuring receiver shall be tuned over the frequency range 9 kHz to 1 GHz, excluding the frequency range 27,095 MHz ± 500 kHz on which the transmitter is intended to operate.

At each frequency at which a relevant spurious signal is detected, the OBE under test and the test antenna shall be rotated until maximum field strength is indicated on the measuring receiver. This level shall be noted.

For measuring equipment calibrated in dBµV/m, the reading should be reduced by 51,5 dB to be converted to dBµA/m, or vice-versa.

The OBE unwanted emissions are measured as follows.

~~Step 1 The H-field strength is measured at 10 m distance by using quasi peak detector and the resolution bandwidth as given in table 4 of clause 5.6. The results shall be recorded in the test report as the total field strength.~~

~~Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex D, and these calculations shall be stated in the test report.~~ The H-field is measured with a shielded loop antenna connected to a measurement receiver below 30 MHz. In the frequency range from 30 MHz to 300 MHz a dipole or bi-conical antenna shall be used. Above 300 MHz a log-periodic antenna shall be used. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.6~~.~~:

The ~~spectrum analyser shall be configured as follows unless otherwise stated:~~

- ~~Resolution bandwidth: 300 Hz, 10 kHz or 100 kHz in accordance with table 4 in clause 5.6.~~
- ~~Video bandwidth: Not less than~~H-field strength is measured over the ~~resolution bandwidth.~~
- ~~Detector mode: Quasi-peak.~~

~~For equipment where~~frequency range 9 kHz to 30 MHz, excluding the ~~optional OBE down-link modulation is implemented (binary ASK modulation), the following measurement shall be conducted:~~

- ~~Step 2 The spectrum~~band 27,095 MHz ± 500 kHz, at 10 m distance for the three polarizations of the ~~transmitter is measured also with modulation in the same way as described in step 1 above. The result~~loop antenna (x-/y-/z-axis). The maximum field strength of the three polarization shall be recorded in the test report. Those values shall be below the limits in clause 4.2.2.2.
- The H-field strength is measured over the frequency range 30 MHz to 1 GHz at 10 m distance for the two polarizations of the antennas (vertical and horizontal). The maximum field strength of the two polarizations shall be recorded in the test report for the frequency range 30 MHz to 1 GHz. Those values shall be below the limits in clause 4.2.2.2.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. ~~7~~In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex I of ETSI EN 300 330 [i.6] and these calculations shall be stated in the test report.

6.1.3 Eurobalise Tx Field Strength and Transmitter Mask

~~See clause 5.1 for the~~ The test conditions~~.~~

~~The measurements of the transmitter radiated H-field~~ shall be ~~made on one of the test sites specified~~as given in ~~annex B.~~ clause 5.2.

Any measured values shall be at least 6 dB above the ambient noise level.

The H-field is measured with a shielded loop antenna connected to a measurement receiver. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.6.

The Eurobalise transmitter ~~spectrum~~field strength centred at 4,234 MHz shall be measured down to a field strength value of -23 dBµA/m at a distance of 10 m and be recorded. During the measurement, the Eurobalise will be Tele-powered. However, a two-step approach as defined below is also allowed~~.~~:

1) Measure and record the maximum value(s) of the transmitter spectrum at a distance of 10 m.
2) Perform another relative measurement at a shorter distance in order to verify the overall shape of the spectrum.

The H-field strength is measured at 10 m distance (or using the two-step approach above) ~~by using quasi-peak detector and a 10 kHz resolution bandwidth.~~for the three polarizations of the loop antenna (x-/y-/z-axis). The ~~result is~~maximum field strength of the three polarizations shall be recorded in the test report ~~as the total field strength~~. Those values shall be below the limits in clause 4.2.3.2.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex ~~D,~~I of ETSI EN 300 330 [i.6] and these calculations shall be stated in the test report. ~~The H-field is measured with a shielded loop antenna connected to a measurement receiver. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.6.~~

~~The spectrum analyser or equivalent shall be configured as follows unless otherwise stated:~~

- ~~Resolution bandwidth: 10 kHz.~~
- ~~Video bandwidth: Not less than the resolution bandwidth.~~
- ~~Detector mode: Quasi-peak.~~

~~7~~6.1.4 Eurobalise Unwanted ~~Emissions~~Emission

~~See clause 5.1 for the~~ The test conditions shall be as given in clause 5.2.

The measuring receiver shall be tuned over the frequency range 9- kHz to 1- GHz, except for the in-band frequency ~~ranges as defined in clauses 7.~~bands 27,095 MHz ± 500 kHz and 4,234 MHz ± 1 ~~and 7.3~~ MHz.

The H-field is measured with a shielded loop antenna connected to a measurement receiver below 30 MHz. In the frequency range from 30 MHz to 300 MHz a dipole or bi-conical antenna shall be used. Above 300 MHz a log-periodic antenna shall be used. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.6.

At each frequency at which a relevant spurious signal is detected, the Eurobalise under test and the test antenna shall be rotated until maximum field strength is indicated on the measuring receiver. This level shall be noted.

For measuring equipment calibrated in ~~dBµV~~ dBµV/m, the reading should be reduced by 51,5- dB to be converted to ~~dBµA~~ dBµA/m, or vice-versa.

The Eurobalise unwanted emissions are measured as follows~~.~~:

- ~~Step 1 –~~ The H-field strength is measured at 10- m distance ~~by using quasi peak detector~~ over the frequency range 9 kHz to 30 MHz, excluding the bands 27,095 MHz ± 500 kHz and ~~the resolution bandwidth as given in table 4~~4,234 MHz ± 1 MHz for the three polarizations of ~~clause 5.6.~~the loop antenna (x-/y-/z-axis). The ~~results are~~maximum field strength of the three polarizations shall be recorded in the test report ~~as the total field strength~~. Those values shall be below the limits in clause 4.2.4.2.

- The H-field strength is measured over the frequency range 30 MHz to 1 GHz at 10 m distance for the two polarizations of the antennas (vertical and horizontal). The maximum field strength of the two polarizations shall be recorded in the test report for the frequency range 30 MHz to 1 GHz. Those values shall be below the limits in clause 4.2.4.2.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. ~~Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report.~~ In this case, the measured value at actual test distance shall be extrapolated to 10- m according to annex ~~D,~~I of ETSI EN 300 330 [i.6], and these calculations shall be stated in the test report. ~~The H-field is measured with a shielded loop antenna connected to a measurement~~

6.2 Conformance Methods of Measurement for Receiver

6.2.1 OBE Receiver Sensitivity

The test conditions shall be as given in clause 5.2.

The conformance test suite for the OBE receiver ~~below 30 MHz. In the frequency range from 30 MHz to 300 MHz a dipole antenna shall be~~sensitivity is defined in UNISIG SUBSET-085-3.0.0 [2], clause 5.2.5 "Transmission Tests".

6.2.2 OBE Receiver Blocking

The test conditions shall be as given in clause 5.2.

The Eurobalise system shall initially operate without interference according to its specified sensitivity (operated as intended).

The fulfilment of the Eurobalise performance criterion in all possible operational modes shall be tested in the presence of the inference signals according to table 4.

For each test frequency the "reaction" of the device shall be recorded and checked against the performance criterion.

The manufacturer shall declare the performance criteria used~~. Above 300 MHz a log-periodic antenna shall be used. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.6~~ to determine the performance of the receiving parts inside the EUT system.

~~The spectrum analyser shall be configured as follows unless otherwise stated:~~

~~Resolution bandwidth:~~ A possible example of a detailed test procedure is given in UNISIG SUBSET-116-1.1.0 [i.9], clause 5.4.3.

- ~~300 Hz~~, ~~10 kHz or 100 kHz in accordance with table 4 in clause 5.6.~~
- ~~Video bandwidth: Not less than the resolution bandwidth.~~
- ~~Detector mode: Quasi-peak.~~

Annex A (~~normative):~~ ~~HS Requirements and conformance Test specifications Table (HS-RTT)~~

~~The HS Requirements and conformance Test specifications Table (HS-RTT) in table A.1 serves a number of purposes, as follows:~~

~~it provides a statement of all the requirements in words and by cross reference to (a) specific clause(s) in~~ informative): Relationship between the present document ~~or to (a) specific clause(s) in (a) specific referenced document(s);~~and the essential requirements of Directive 2014/53/EU

- ~~it provides a statement of all the test procedures corresponding to those requirements by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);~~
- ~~it qualifies each requirement to be either:~~
  - ~~Unconditional: meaning that the requirement applies in all circumstances, or~~
  - ~~Conditional: meaning that the requirement is dependant on the manufacturer having chosen to support optional functionality defined within the schedule.~~
- ~~in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;~~
- ~~it qualifies each test procedure to be either:~~
  - ~~Essential: meaning that it is included with the Essential Radio Test Suite and therefore the requirement shall be demonstrated to be met in accordance with the referenced procedures;~~
  - ~~Other: meaning that the test procedure is illustrative but other means of demonstrating compliance with the requirement are permitted.~~

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.8] 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: ~~HS Requirements~~Relationship between the present document and ~~conformance Test specifications Table (HS-RTT)~~ the essential requirements of Directive 2014/53/EU

~~Harmonized Standard EN 302 608~~ ~~The following technical requirements and test specifications are relevant to the presumption of conformity under the article 3.2 of the R&TTE Directive~~						
~~Requirement~~			~~Requirement Conditionality~~		~~Test specification~~	
~~No~~	~~Description~~	~~Reference: clause No~~	~~U/C~~	~~Condition~~	~~E/O~~	~~Reference: clause No~~
~~1~~	~~OBE transmitter mask~~	~~4.1.1~~	~~C~~	~~Applies only to OBE~~	~~E~~	~~7.1~~
~~2~~	~~OBE unwanted emissions~~	~~4.1.2~~	~~C~~	~~Applies only to OBE~~	~~E~~	~~7.2~~
~~3~~	~~Eurobalise transmitter mask~~	~~4.1.3~~	~~C~~	~~Applies only to Eurobalise~~	~~E~~	~~7.3~~
~~4~~	~~Eurobalise unwanted emissions~~	~~4.1.4~~	~~C~~	~~Applies only to Eurobalise~~	~~E~~	~~7.4~~
~~5~~	~~Duty cycle~~	~~4.1.3~~	~~C~~	~~Applies only to Eurobalise~~	~~X~~	

Harmonised Standard ETSI EN 302 608				
Requirement			Requirement Conditionality	
No	Description	Reference: clause No	U/C	Condition
1	OBE transmitter mask	4.2.1	C	Applies only to OBE
2	OBE unwanted emissions	4.2.2	C	Applies only to OBE
3	Eurobalise transmitter mask	4.2.3	C	Applies only to Eurobalise
4	Eurobalise unwanted emissions	4.2.4	C	Applies only to Eurobalise
5	Duty cycle	4.2.3	C	Applies only to Eurobalise
6	OBE receiver sensitivity	4.3.1	C	Applies only to OBE
7	OBE receiver blocking	4.3.2	C	Applies only to OBE

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement ~~or its test specification~~.

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 ~~to be~~ unconditionally applicable (U) or is conditional upon the ~~manufacturers~~manufacturer's claimed functionality of the equipment (C).

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

~~**Test Specification:**~~

~~**E/O** Indicates whether the test specification forms part of the Essential Radio Test Suite (E) or whether it is one of the Other Test Suite (O).~~

~~NOTE: All tests whether "E" or "O" are relevant to the requirements. Rows designated "E" collectively make up the Essential Radio Test Suite; those designated "O" make up the Other Test Suite; for those designated "X" there is no test specified corresponding to the requirement. The completion of all tests classified "E" as specified with satisfactory outcomes is a necessary condition for a presumption of conformity. Compliance with requirements associated with tests classified "O" or "X" is a necessary condition for presumption of conformity, although conformance with the requirement may be claimed by an equivalent test or by manufacturer's assertion supported by appropriate entries in the technical construction file.~~

~~**Clause Number** Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.~~

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 (normative): Radiated Measurement

B.1 Test sites and General Arrangements for Measurements Involving the use of Radiated Fields

B.1.1 General

This annex introduces three most commonly available test sites, an anechoic chamber, an anechoic chamber with a ground plane and an Open Area Test Site (OATS), which may be used for radiated tests. These test sites are generally referred to as free field test sites. Both absolute and relative measurements can be performed in these sites. Where absolute measurements are to be carried out, the chamber should be verified. A detailed verification procedure is described in TR 102 273 [1].

NOTE: To ensure reproducibility and tractability of radiated measurements only these test sites should be used in measurements in accordance with the present document.

B.1.2 Anechoic Chamber

An anechoic chamber is an enclosure, usually shielded, whose internal walls, floor and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The chamber usually contains an antenna support at one end and a turntable at the other. A typical anechoic chamber is shown in figure B.1.

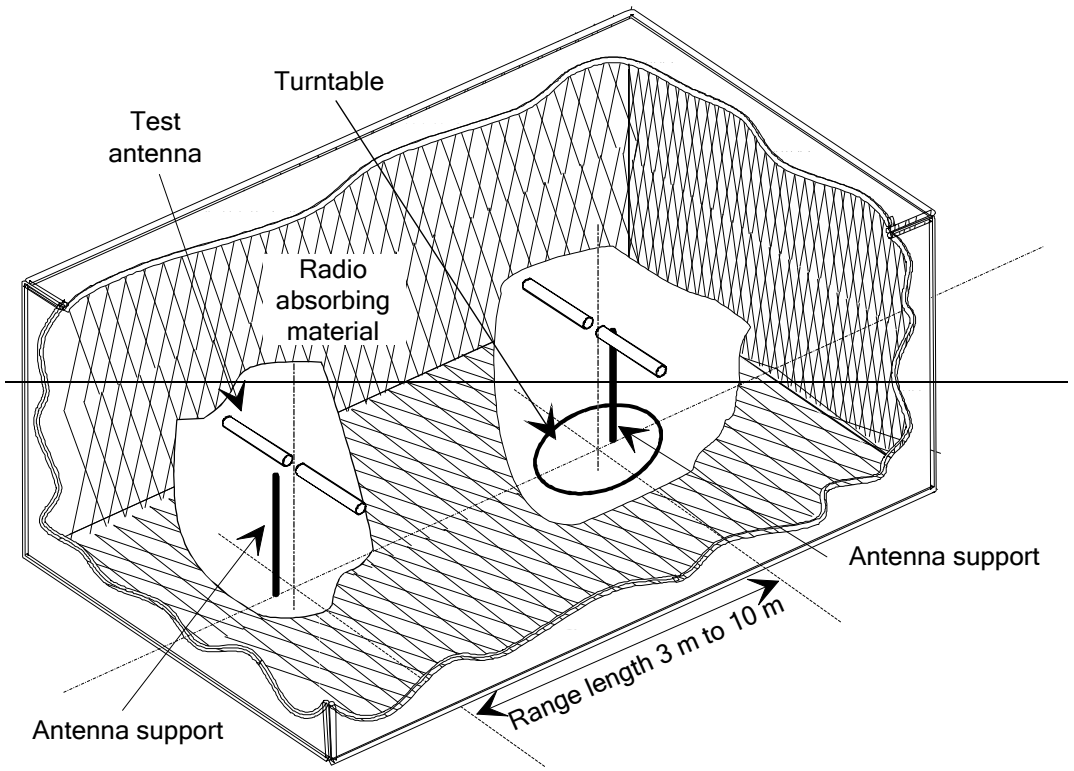


Figure B.1: A typical anechoic chamber

The chamber shielding and radio absorbing material work together to provide a controlled environment for testing purposes. This type of test chamber attempts to simulate free space conditions.

The shielding provides a test space, with reduced levels of interference from ambient signals and other outside effects, whilst the radio absorbing material minimizes unwanted reflections from the walls and ceiling which can influence the measurements. In practice it is relatively easy for shielding to provide high levels (80 dB to 140 dB) of ambient interference rejection, normally making ambient interference negligible.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (EUT) at a suitable height (e.g. 1 m) above the ground plane. The chamber shall be large enough to allow the measuring distance of at least 3 m or 2 $(d_1 + d_2)^2/\lambda$ (m), whichever is greater (see clause B.2.4). The distance used in actual measurements shall be recorded with the test results.

The anechoic chamber generally has several advantages over other test facilities. There is minimal ambient interference, minimal floor, ceiling and wall reflections and it is independent of the weather. It does however have some disadvantages which include limited measuring distance and limited lower frequency usage due to the size of the pyramidal absorbers. To improve low frequency performance, a combination structure of ferrite tiles and urethane foam absorbers is commonly used.

All types of emission, sensitivity and immunity testing can be carried out within an anechoic chamber without limitation.

B.1.3 Anechoic Chamber with a Conductive Ground Plane

An anechoic chamber with a conductive ground plane is an enclosure, usually shielded, whose internal walls and ceiling are covered with radio absorbing material, normally of the pyramidal urethane foam type. The floor, which is metallic, is not covered and forms the ground plane. The chamber usually contains an antenna mast at one end and a turntable at the other. A typical anechoic chamber with a conductive ground plane is shown in figure B.2.

This type of test chamber attempts to simulate an ideal Open Area Test Site whose primary characteristic is a perfectly conducting ground plane of infinite extent.

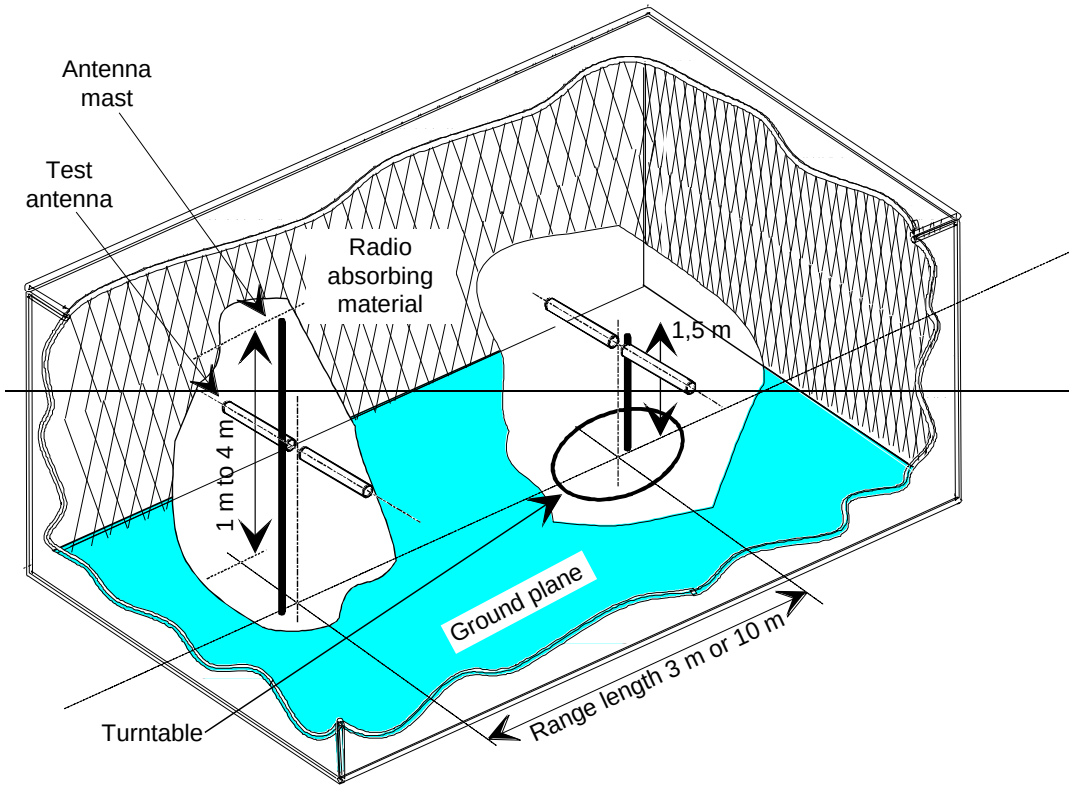


Figure B.2: A typical Anechoic Chamber with a conductive ground plane

In this facility the ground plane creates the wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals from both the direct and reflected transmission paths. This creates a unique received signal level for each height of the transmitting antenna (or EUT) and the receiving antenna above the ground plane.

The antenna mast provides a variable height facility (from 1 m to 4 m) so that the position of the test antenna can be optimized for maximum coupled signal between antennas or between an EUT and the test antenna.

A turntable is capable of rotation through 360° in the horizontal plane and it is used to support the test sample (EUT) at a specified height, usually 1,5 m above the ground plane. The chamber shall be large enough to allow the measuring distance of at least 3 m or 2 $(d_1 + d_2)^2/\lambda$ (m), whichever is greater (see clause B.2.4). The distance used in actual measurements shall be recorded with the test results.

Emission testing involves firstly "peaking" the field strength from the EUT by raising and lowering the receiving antenna on the mast (to obtain the maximum constructive interference of the direct and reflected signals from the EUT) and then rotating the turntable for a "peak" in the azimuth plane. At this height of the test antenna on the mast, the amplitude of the received signal is noted. Secondly the EUT is replaced by a substitution antenna (positioned at the EUT's phase or volume centre) which is connected to a signal generator. The signal is again "peaked" and the signal generator output adjusted until the level, noted in stage one, is again measured on the receiving device.

B.1.4 Open Area Test Site (OATS)

An Open Area Test Site comprises a turntable at one end and an antenna mast of variable height at the other end above a ground plane, which in the ideal case, is perfectly conducting and of infinite extent. In practice, whilst good conductivity can be achieved, the ground plane size has to be limited. A typical OATS is shown in figure B.3.

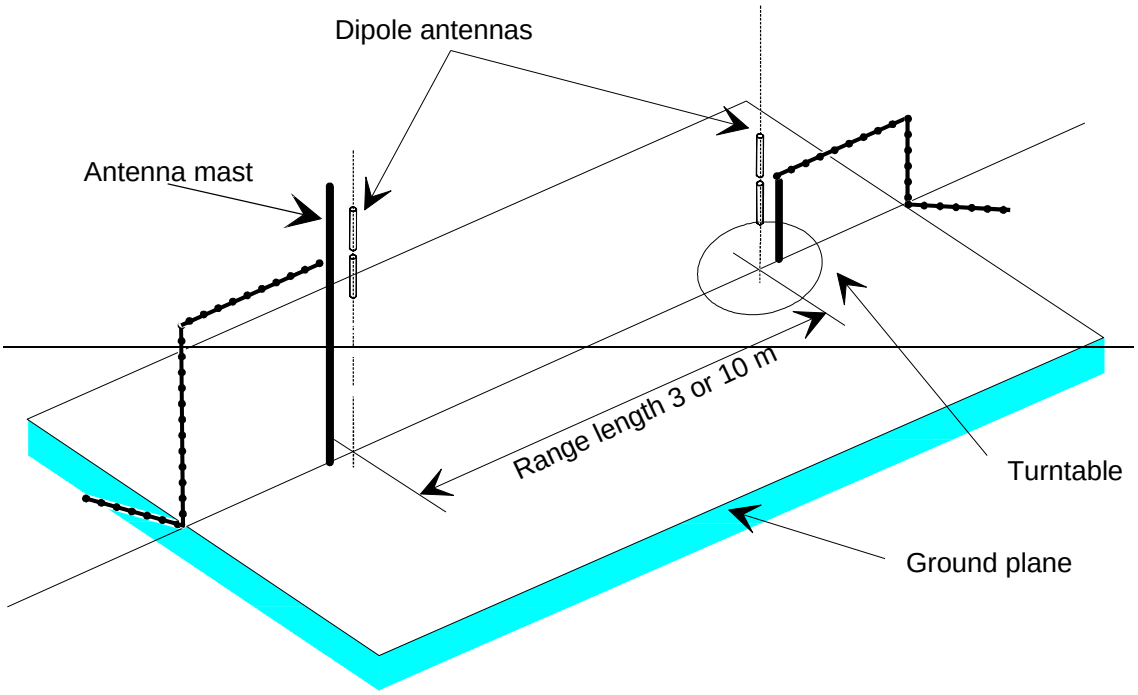


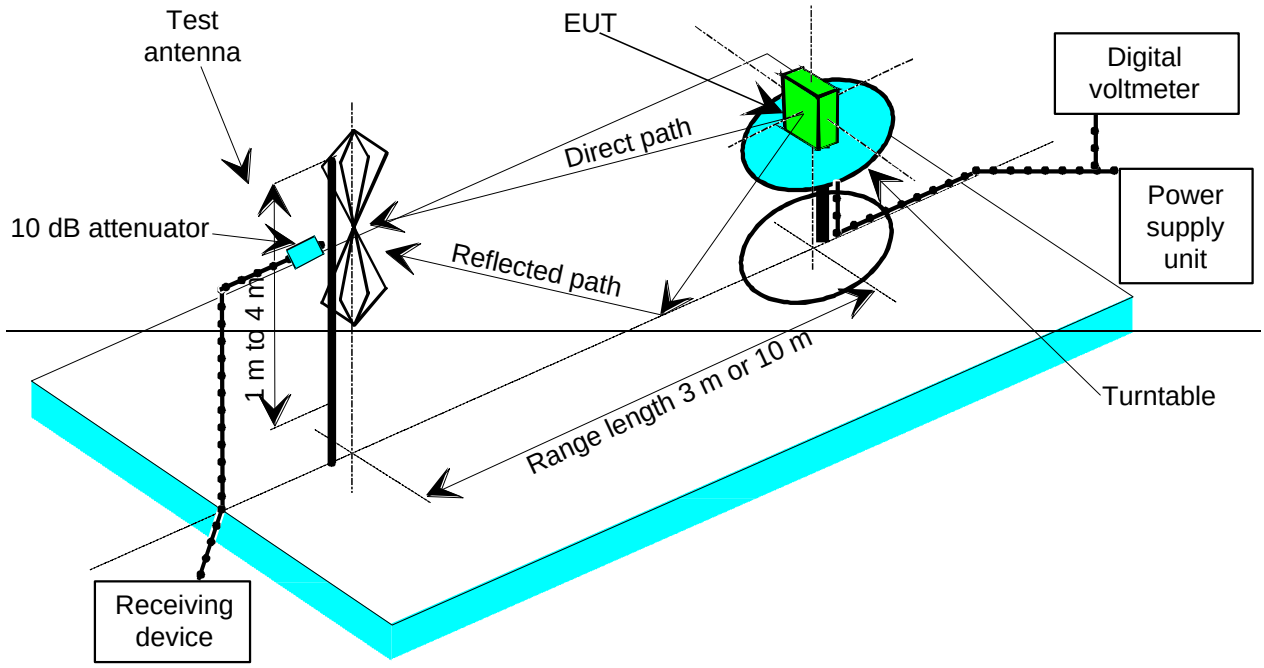
Figure B.3: A typical Open Area Test Site

The ground plane creates a wanted reflection path, such that the signal received by the receiving antenna is the sum of the signals received from the direct and reflected transmission paths. The phasing of these two signals creates a unique received level for each height of the transmitting antenna (or EUT) and the receiving antenna above the ground plane.

Site qualification concerning antenna positions, turntable, measurement distance and other arrangements are same as for anechoic chamber with a ground plane. In radiated measurements an OATS is also used by the same way as anechoic chamber with a ground plane.

~~For measurements below 30 MHz tests may be made according to CISPR 16 [2]. The measurements are made with an inductive shielded loop test antenna, which reads the magnetic field (H-field) only. These measurements are valid for both the far-field and the near-field situations. In this case the OATS shall not have a ground plane using a magnetic conductive material. Therefore, such measurements are normally made without a ground plane.~~

~~Typical measuring arrangement common for ground plane test sites is presented in figure B.4.~~



~~Figure B.4: Measuring arrangement on ground plane test site (OATS set-up for unwanted emission testing)~~

~~B.1.5 Test Antenna~~

~~A test antenna is always used in radiated test methods. In emission tests the test antenna is used to detect the field from the EUT in one stage of the measurement and from the substitution antenna in the other stage.~~

~~The test antenna should be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization which, on ground plane sites (i.e. anechoic chambers with ground planes and Open Area Test Sites), should additionally allow the height of its centre above the ground to be varied over the specified range (usually 1 m to 4 m).~~

~~In the frequency range 9 kHz to 30 MHz, inductive shielded loop antennas according to CISPR 16 [2] are generally recommended. This test antenna method supports measurements in both the far-field and near-field.~~

~~In the frequency band 30 MHz to 1 GHz, dipole antennas (constructed in accordance with ANSI C63.5 [4] are generally recommended. For frequencies of 80 MHz and above, the dipoles should have their arm lengths set for resonance at the frequency of test. Below 80 MHz, shortened arm lengths are recommended. For spurious emission testing, however, a combination of bicones and log periodic dipole array antennas (commonly termed "log periodics") could be used to cover the entire 30 MHz to 1 GHz band.~~

~~B.2 Guidance on the Use of Radiation Test Sites~~

~~B.2.1 General~~

~~This clause details procedures, test equipment arrangements and verification that should be carried out before any of the radiated tests are undertaken. These schemes are common to all types of test sites described in annex B.~~

B.2.2 Verification of the Test Site

No test should be carried out on a test site which does not possess a valid certificate of verification. The verification procedures for the different types of test sites described in annex B (i.e. anechoic chamber, anechoic chamber with a ground plane and Open Area Test Site) are given in TR 102 273 [1].

B.2.3 Preparation of the EUT

The provider should supply information about the EUT covering the operating frequency, polarization, supply voltage(s) and the reference face.

Where necessary, a mounting bracket of minimal size should be available for mounting the EUT on the turntable. This bracket should be made from low conductivity, low relative dielectric constant (i.e. less than 1,5) material(s) such as expanded polystyrene, balsa wood, etc.

B.2.4 Range Length

B.2.4.1 Far-field Length Above 30 MHz

The range length for all these types of test facility should be adequate to allow for testing in the far-field of the EUT, i.e. it should be equal to or exceed:

$$\frac{2(d_1 + d_2)^2}{\lambda}$$

where:

- d_1 is the largest dimension of the EUT (m);
- d_2 is the largest dimension of the test antenna (m);
- λ is the test frequency wavelength (m).

It should be noted in the test report when either of these conditions is not met so that the additional measurement uncertainty can be incorporated into the results.

NOTE 1: For the fully anechoic chamber, no part of the volume of the EUT should, at any angle of rotation of the turntable, fall outside the "quiet zone" of the chamber at the nominal frequency of the test.

NOTE 2: The "quiet zone" is a volume within the anechoic chamber (without a ground plane) in which a specified performance has either been proven by test, or is guaranteed by the designer/manufacture. The specified performance is usually the reflectivity of the absorbing panels or a directly related parameter (e.g. signal uniformity in amplitude and phase). It should be noted however that the defining levels of the quiet zone tend to vary.

NOTE 3: For the anechoic chamber with a ground plane, a full height scanning capability, i.e. 1 m to 4 m, should be available for which no part of the test antenna should come within 1 m of the absorbing panels. For both types of Anechoic Chamber, the reflectivity of the absorbing panels should not be worse than -5 dB.

NOTE 4: For both the anechoic chamber with a ground plane and the Open Area Test Site, no part of any antenna should come within 0,25 m of the ground plane at any time throughout the tests. Where any of these conditions cannot be met, measurements should not be carried out.

B.2.4.2 Near-field and Far-field Length Below 30 MHz

Inductive systems below 30 MHz can be measured both in the near-field and far-field regions at an open test site by means of a shielded loop antenna according to CISPR 16 [2].

The minimum measurement distance, d is determined by:

$$d \geq 3D$$

where D is the maximum dimension in metre of the inductive loop.

B.2.5 Site Preparation

The cables for both ends of the test site should be routed horizontally away from the testing area for a minimum of 2 m (unless, in the case both types of anechoic chamber, a back wall is reached) and then allowed to drop vertically and out through either the ground plane or screen (as appropriate) to the test equipment. Precautions should be taken to minimize pick up on these leads (e.g. dressing with ferrite beads, or other loading). The cables, their routing and dressing should be identical to the verification set-up.

NOTE: For ground reflection test sites (i.e. anechoic chambers with ground planes and Open Area Test Sites) which incorporate a cable drum with the antenna mast, the 2 m requirement may be impossible to comply with. In this case the cable routing is described in the test report.

Calibration data for all items of test equipment should be available and valid. For test, substitution and measuring antennas, the data should include gain relative to an isotropic radiator (or antenna factor) for the frequency of test. Also, the VSWR of the substitution and measuring antennas should be known.

The calibration data on all cables and attenuators should include insertion loss and VSWR throughout the entire frequency range of the tests. All VSWR and insertion loss figures should be recorded in the log book results sheet for the specific test.

Where correction factors/tables are required, these should be immediately available.

For all items of test equipment, the maximum errors they exhibit should be known along with the distribution of the error e.g.:

- Cable loss: ±0,5 dB with a rectangular distribution;
- Measuring receiver: 1,0 dB (standard deviation) signal level accuracy with a Gaussian error distribution.

At the start of measurements, system checks should be made on the items of test equipment used on the test site.

B.3 Coupling of Signals

B.3.1 General

The presence of leads in the radiated field may cause a disturbance of that field and lead to additional measurement uncertainty. These disturbances can be minimized by using suitable coupling methods, offering signal isolation and minimum field disturbance (e.g. optical and acoustic coupling).

B.3.2 Data Signals

Isolation can be provided by the use of optical, ultrasonic or infrared means. Field disturbance can be minimized by using a suitable fibre optic connection. Ultra sonic or infrared radiated connections require suitable measures for the minimization of ambient noise.

~~B.4 Standard Test Position~~

~~The standard position in all test sites for equipment shall be on a non conducting support, height 1,5 m, capable of rotating about a vertical axis through the equipment. The standard position of the equipment shall be placed in the position closest to normal use as declared by the provider.~~

Annex C (informative): E-fields in the Near Field at Low Frequencies

E-field at low frequencies is often in the near field and it is in reality only possible to measure the H-field component with the shielded loop antenna; in this case there is also a relation between the E-field and the H-field by the wave impedance Z. In the near field the wave impedance is highly dependent on the type of radiating antenna (loop or open end wire) and the wavelength. If the power density at a certain distance is the same for an H-field and an E-field generated signal, the following calculation can be made:

In the direction of maximum power in the near field, the power density S is:

$$S = \frac{E^2}{Z_e} = H_e^2 Z_e = H_m^2 Z_m \quad \text{(C.1)}$$

where:

- S = power density.
- E = electrical field generated by an E-field antenna at distance d.
- H_e = magnetic field generated by an E-field antenna at distance d.
- H_m = magnetic field generated by an H-field antenna at distance d.
- Z_e = wave impedance of a field generated by an E-field antenna at distance d.
- Z_m = wave impedance of a field generated by an H-field antenna at distance d.

$$Z_m = Z_o 2\pi \frac{d}{\lambda} \; if \; d < \frac{\lambda}{2\pi} \text{ (near field)} \quad \text{(C.2)}$$

$$Z_e = Z_0 \frac{\lambda}{2\pi d} \; if \; d < \frac{\lambda}{2\pi} \text{ (near field)} \quad \text{(C.3)}$$

Equation (C.1) gives:

$$H_e = H_m \sqrt{\frac{Z_m}{Z_e}} \; (A/m) \quad \text{(C.4)}$$

Equation (C.2) and (C.3) into (C.4) give:

$$H_e = H_m \frac{2\pi d}{\lambda} = H_m \frac{2\pi d \, f_c}{300} \quad \text{(C.5)}$$

where fc is the carrier frequency in MHz.

For $2\pi d/\lambda = 1$, d = 10 and f_c = 4,78 MHz, and using equation (C.5), this gives:

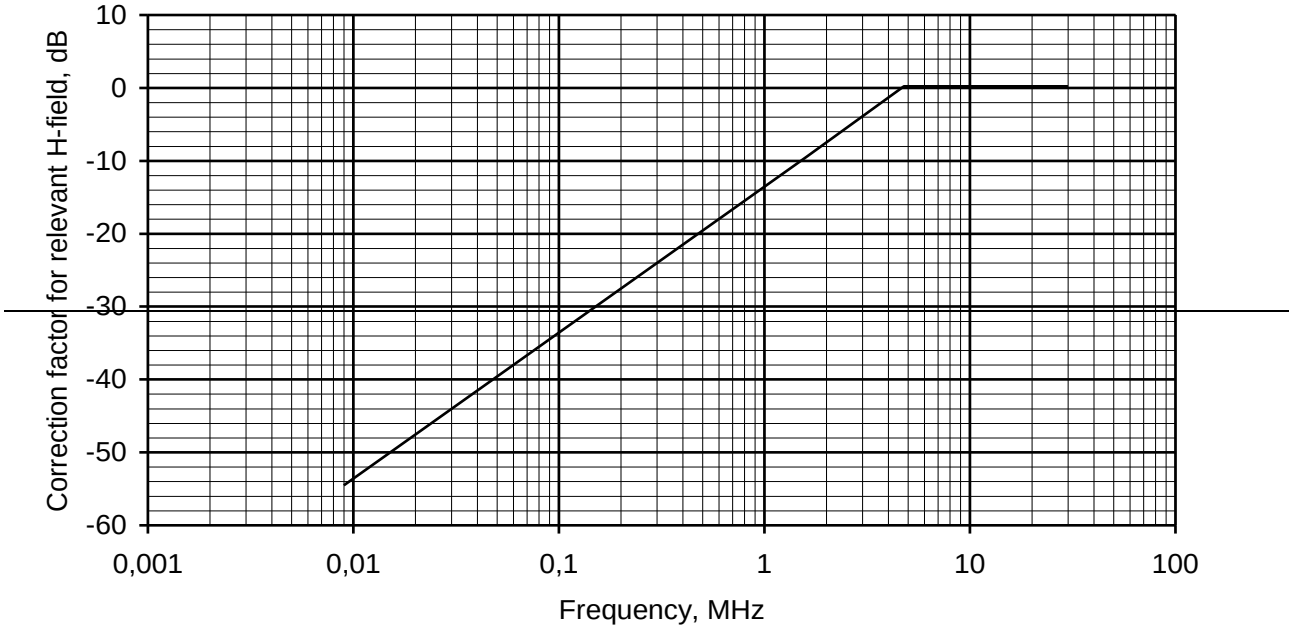
$$H_e = H_m \frac{f_c}{4{,}78} \; (f \text{ in MHz}) \quad \text{(C.6)}$$

For $2\pi d/\lambda < 1$ if f_c < 4,78 MHz then equation (5) is valid, (i.e. near field).

For $2\pi d/\lambda \geq 1$ if f_c > 4,78 MHz then $H_e = H_m$, (i.e. far field).

The method allows an electric generated E-field to be measured as a magnetic generated H-field by adding a correction factor derived from (C.6).

~~For a graphical representation of the correction factor, see figure C.1.~~



~~Figure C.1: Correction factor~~

Annex D (normative): H-field Measurements and Limits at 3 m and 30 m

D.1 General

The present document allows field measurements to be made at other distances than 10 m. In this case, the appropriate H-field limit, H_x, for provider requested measurement distance, d_x, shall be determined by the provider. Both the requested measurement distance and the appropriate limit shall be stated in the Test Report.

The conversion of the H-field limits at 10 m to a new measurements distance is not trivial as the near-field to far-field boundary is changing with both frequency and distance. Different combinations of near/far-field and maximum radiated field strength in either the coaxial or coplanar direction of the loop antenna the conversions of the H-field limits of the present document to 3 m are 30 m (see clauses D.2 and D.3).

The conversion methods of this annex are only applicable if the maximum dimension of the loop coil is small in relation to the measurement distance.

D.2 Limits for Measurements at 30 m Distance

The H-field limit at 30 m, H_{30m}, is determined by the following equation:

$$H_{30m} = H_{10m} + C_{30} \quad \text{(D.1)}$$

where:

H_{10m} is the H-field limit in dBµA/m at 10m distance according to the present document; and

C_{30} is a conversion factor in dB which is determined from figure D.1.

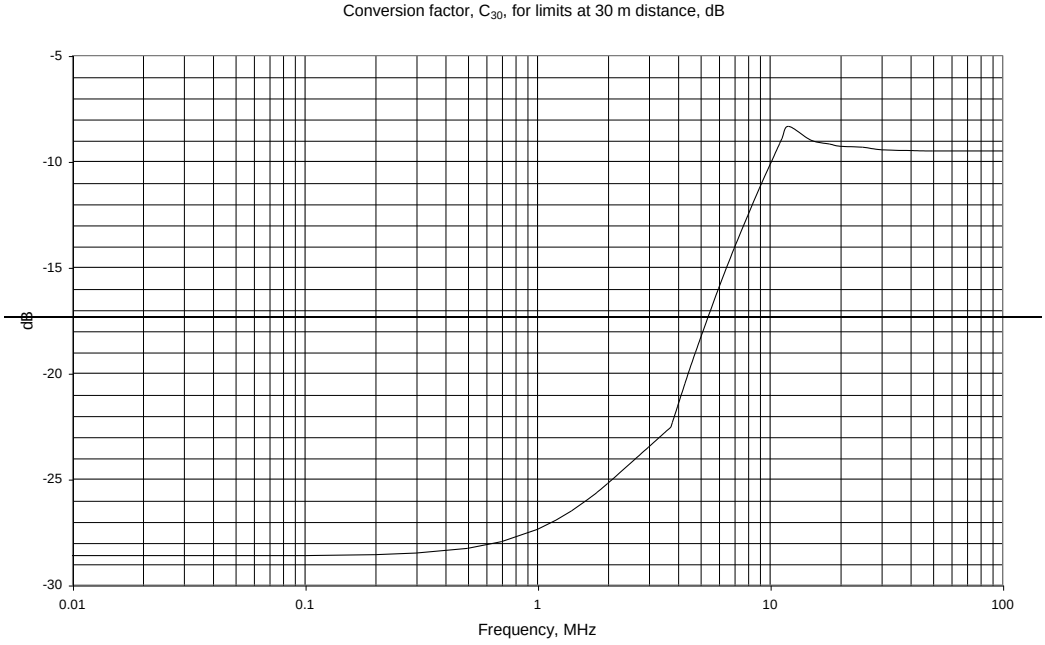


Figure D.1: Conversion factor C_{30} versus frequency

D.3 Limits for Measurements at 3 m Distance

The H-field limit in dBµA/m at 3 m, H_{3m}, is determined by the following equation:

$$H_{3m} = H_{10m} + C_3 \quad \text{(D.2)}$$

where:

H_{10m} is the H-field limit in dBµA/m at 10 m distance according to the present document; and

C_3 is a conversion factor in dB determined from figure D.2.

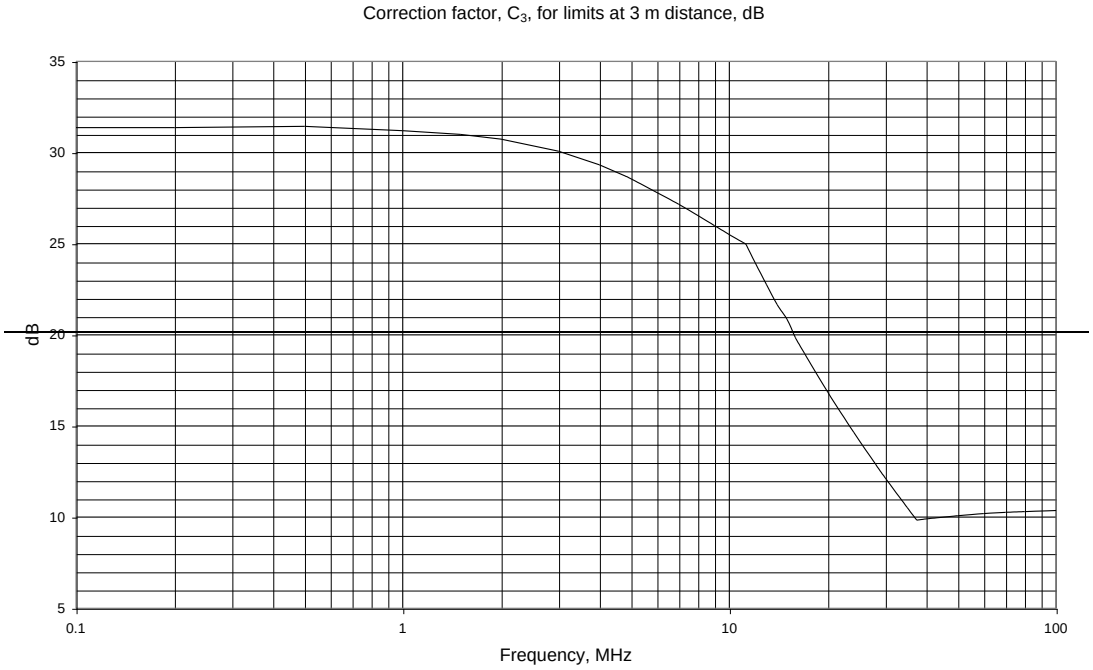


Figure D.2: Conversion factor C_3 versus frequency

~~Annex E (informative):~~
~~The EN title in the official languages~~

~~The enlargement of the European Union (EU) resulted in a requirement from the EU for a larger number of languages for the translation of the titles of Harmonized Standards and mandated ENs that are to be listed in the Official Journal to support the implementation of this legislation.~~

~~For this reason the title translation concerning the present document can be consulted via the e-approval application.~~

~~Annex F (informative): Bibliography~~

- ~~Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive).~~
- ~~Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (LV Directive).~~
- ~~Ketterling, H-P: "Verification of the performance of fully and semi-anechoic chambers for radiation measurements and susceptibility/immunity testing", 1991, Leatherhead/Surrey.~~
- ~~Mandate M/364: Standardization mandate to CEN, CENELEC and ETSI in the field of ICT: Harmonized standards for specific short range devices used for Euroloop and Eurobalise applications giving presumption of conformity with the R&TTE Directive (1999/5/EC).~~
- ~~Commission Decision 2002/731/EC of 30 May 2002 concerning the technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Council Directive 96/48/EC (Text with EEA relevance).~~

Annex B (informative): Change history

Version	Information about changes
V1.1.1	Latest published version of ETSI EN 302 608 under R&TTE
V2.1.1	• Update of ETSI EN 302 608 in accordance with the Radio Equipment directive • New requirement on receiver parameters for Eurobalise and OBE added Updated references to the relevant UNISIG standards

History

Document history		
~~V1.1.1~~	~~December 2007~~	~~Public Enquiry PE 20080425: 2007-12-26 to 2008-04-25~~
~~V1.1.1~~	~~September 2008~~	~~Vote V 20081104: 2008-09-05 to 2008-11-04~~
V1.1.1	November 2008	Publication
V2.1.0	December 2016	EN Approval Procedure AP 20170315: 2016-12-15 to 2017-03-15
V2.1.1	September 2017	Vote V 20171126: 2017-09-27 to 2017-11-27
V2.1.1	November 2017	Publication