

ETSI EN 302 609 V2.1.1 (2016-12)



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

Reference

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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 a mandate from the European Commission issued prepared under Council Directive 98/34/EC~~the Commission's standardisation request C(2015) 5376 final [i.8] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulations-

The] 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.6] 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.6] are, compliance with the normative clauses of the present document given in ~~annex~~table A.

The Euroloop transmission system operates in accordance with ERC Recommendation 70-03, annex 4.

These specifications are complementary-1 confers, within the limits of the scope of the present document, a presumption of conformity with the system and interoperability requirements for these devices established under Commission Decision 2004/447/EC [i.7]-corresponding essential requirements of that Directive, and associated EFTA regulations.

National transposition dates

Date of adoption of this EN:	12 December 2016
Date of latest announcement of this EN (doa):	31 March 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 September 2017
Date of withdrawal of any conflicting National Standard (dow):	30 September 2018

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 [i.2].~~

The Euroloop communication system is defined by the specifications [1] and [2] of the UNISIG consortia ~~[i.3].~~

1 Scope

The present document covers the technical requirements for radio transmitters and receivers used in the Euroloop transmission system. The system is ~~only~~ used in railway systems.

~~The present document applies to the following two equipment units as is shown in figure 1:~~

- 1) The On-Board Equipment (OBE) receiving the Euroloop signal and the OBE comprises a receiver fitted with a dedicated antenna.
- 2) The Track-Side Equipment (Euroloop) transmitting the Euroloop signal that is always installed in an inner or outer foot of a rail.

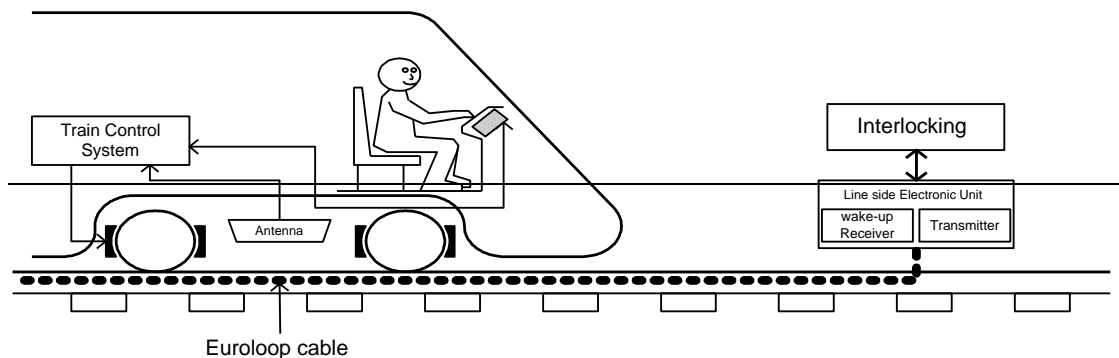


Figure 1: Euroloop situation on railway track

~~The Euroloop comprises DSSS BPSK modulated transmitter fitted with a dedicated antenna. It is always switched on but is only transmitting in the presence of a train.~~

~~The Euroloop transmission system operates in frequency bands listed in table 1 in accordance with the EC Decision 2013/752/EU [i.2], and ERC Recommendation 70-03 [i.3], annex 4.~~

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

Table 1: Radiocommunications service frequency bands

	Radio communications frequencies
OBE receive frequency band	Radiocommunications service frequency bands 11,1 - 16,0 MHz
OBE receive centre transmit frequency band	13,54727,09 - 27,10 MHz
Euroloop receiver centre-frequency band	27,09509 - 27,10 MHz
Euroloop transmit centre-frequency band	13,54711,1 - 16,0 MHz
Euroloop transmit modulation	BPSK, DSSS chip rate 4,516 MHz

~~The present document is intended contains requirements to cover the provisions of Directive 1999/5/EC [i.6] (R&TTE Directive) article 3.2, which states demonstrate that "...radio equipment shall be so constructed that it both effectively uses the and supports the efficient use of radio spectrum allocated to terrestrial/space radio communications and orbital resources so as in order to avoid harmful interference".~~

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

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 <http://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] ERTMS/ETCS: "FFFIS for Euroloop", SUBSET-044, Issue 2.4.0, 29th February 2012.
- [2] ERTMS/ETCS: "Test Specification for Euroloop", SUBSET-103, Issue 1.1.0, 29th February 2012.

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.

~~For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.~~

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] ETSI TR 100 028 (2001) (all parts) 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. (OJ L153, 22.5.2014, p62).~~
- [i.2] 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.3] CEPT/ERC/Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".
- [i.4] ETSI TR 100 028-1 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1".
- [i.5] ETSI TR 100 028-2 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".
- ~~[i.6] ERTMS/ETCS – CLASS 1, SUBSET-044 FFFIS for Euroloop.~~

2.2 Informative references

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

- [i.1] ~~ETSI TR 102 273 (2001) (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.2] ~~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.3] ~~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.4] ~~ETSI EN 302 608300 330-1 (V1.47.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio Equipment for Eurobalise railway systems; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Part 1: Technical characteristics and test methods".~~
- [i.7] ~~Directive 98/34/EC 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.~~
- 1 ~~CENELEC EN 50121-2 (2015-03): "Railway applications - Electromagnetic compatibility - Part 2: Emission of the whole railway system to the outside world" / Applies in conjunction with EN 50121-1 (2000-09)".~~
- [i.8] ~~Directive 1999/5/EC of] 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 Parliament and of the Council of 9 March 1999 on Telecommunications Standards Institute as regards radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).~~
- [i.7] ~~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 in support of Directive 2014/53/EU of the European Parliament and of the Council.~~

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

eurobalise: 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.

euroloop: wayside transmission unit that uses the magnetic transmission technology

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

magnetic transmission technology: method that uses magnetic coupling in the air gap between a transmitter and a receiver

NOTE: In the Euroloop transmission system context, it considers systems using the ~~13,547~~band 11,1 - 16,0 MHz for Uplink (track to train) transmission.

rf carrier: fixed radio frequency prior to modulation

uplink: transmission link from the Euroloop to the OBE

3.2 Symbols

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

f	Frequency
f_H	Highest frequency of the power envelope
f_L	Lowest frequency of the power envelope
Ω	ohm
Ω	Ohm
R	Distance
R_c	Chip rate
λ	wavelength

3.3 Abbreviations

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

BPSK	Binary Phase Shift Keying
<u>CW</u>	<u>Continous Wave</u>
dB	deciBel (<u>logarithmic scale</u>)
DSSS	Direct Sequence Spread Spectrum
<u>ERC</u>	<u>European Radiocommunications Committee</u>
<u>LOOMO</u>	<u>LOOp MOdem</u>
OBE	On-Board Equipment
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RMS	Root Mean Square
SRD	Short Range Device
<u>TX</u>	<u>Transmitter</u>
<u>UNISIG</u>	<u>UNion Industry of SIGnalling</u>
VSWR	Voltage Standing Wave Ratio

4 Technical requirements specifications

4.1 OBE unwanted emissions Environmental profile

4.1.1 Definition

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 at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 Transmitter conformance requirements

4.2.1 OBE TX field strength and Transmitter mask

4.2.1.1 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.

NOTE: Eurobalise-~~OBU~~OBE tele-powering is used for wake-up of the Euroloop. ~~The~~

4.2.1.2 Limits

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

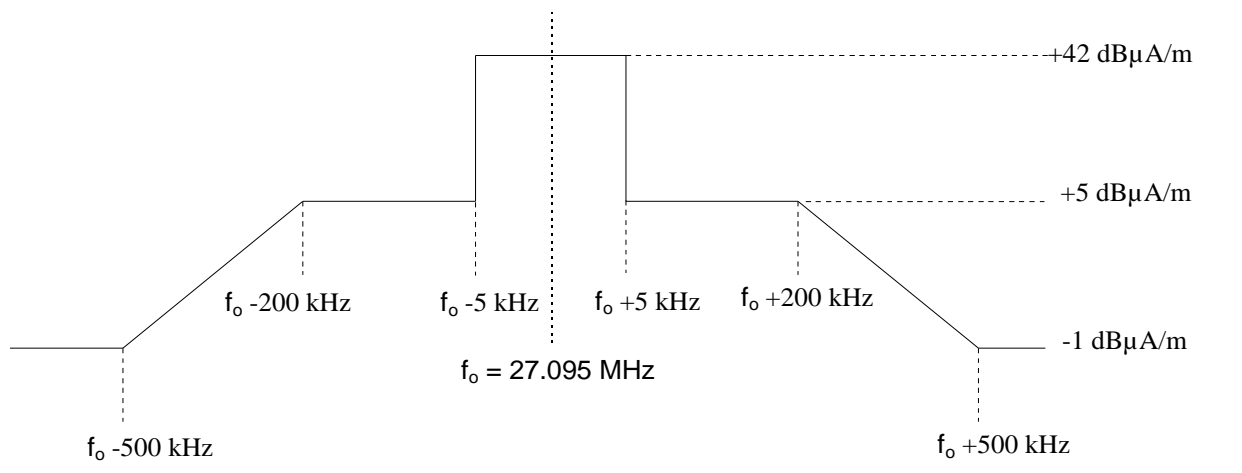


Figure 1: OBE transmitter mask

4.2.1.3 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 5.3.

4.2.2 OBE unwanted emissions

4.2.2.1 Applicability

This test only applies to the OBE. Unwanted emissions consist of out-of-band and spurious emissions outside the frequency range $27,095 \text{ MHz} \pm 500 \text{ kHz}$ as defined in clause 4.2.1.2.

~~NOTE: Eurobalise OBE transmitter mask is defined in EN 302 608 [i.4].~~

4.1.2 Test procedure

~~This test OBE tele-powering is performed using a radiated measurement used for wake-up of the Euroloop.~~

4.2.2.2 Limits

The limits in table 2 (expressed in dB μ A/m at a distance of 10 m for frequencies below 30 MHz and expressed in dB μ V/m at a ~~conducted measurement~~ distance of 10 m for frequencies ~~from equal or greater than 30 MHz to 1 000 MHz~~ (see clause 7.1)) shall not be exceeded.

4.1 Table 2: OBE unwanted emissions limits

Frequency: (f)	Limit
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	44 dB μ A/m at 9 kHz decreasing with logarithm of frequency to 19 dB μ A/m at 150 kHz
$150 \text{ kHz} \leq f < 30 \text{ MHz}$	54 dB μ A/m at 150 kHz decreasing with logarithm of frequency to 4 dB μ A/m at 30 MHz
$30 \text{ MHz} \leq f \leq 1 \text{ GHz}$	79 dB μ V/m at 30 MHz decreasing with logarithm of frequency to 54 dB μ V/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.	

4.2.2.3 Limit Conformance

~~The spurious components between 9 kHz and 10 MHz shall not exceed a generated H field at a distance of 10 m of 5,5 dB μ A/m at 9 kHz descending 3 dB/oct. and 22 dB μ A/m between 10 MHz and 30 MHz measured in 10 kHz bandwidth.~~

~~The spurious components above 30 MHz shall not exceed the conducted power of 2 nW into 50 Ω resistive load.~~

4.2 Euroloop field strength

4.2.1 Definition

~~This test only applies to the~~ 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 5.3.

4.2.3 Euroloop transmitter- field strength

4.2.2 Test procedure 3.1 Applicability

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

This only applies to the Euroloop transmitter.

4.2.3 Limit 2 Limits

The transmitted magnetic field strength shall not exceed $-7 \text{ dB}\mu\text{A/m}$ at 10 m distance within the frequency range of 11,1 MHz to 16,0 MHz measured in a bandwidth of 10 kHz spatially averaged over any 200 m length of the loop.

4.2.3.3 Conformance

The conformance test suite for the Euroloop transmitter field strength shall be as defined in clause 6.1.4 of the present document.

4.2.4 Euroloop transmitter mask

4.3.2.4.1 Definition Applicability

This test only applies to Euroloop transmitters.

4-the Euroloop transmitter consisting of out-of-band and spurious emissions outside the frequency range 11,1 MHz to 16,0 MHz as defined in clause 4.2.3.2 Test procedure.

~~This test is performed using conducted measurement (see clause 7.2).~~

4.3.3.2.4.2 Limit

The measured spectrum (field strength) shall not exceed the relative frequency mask values of figure 2.

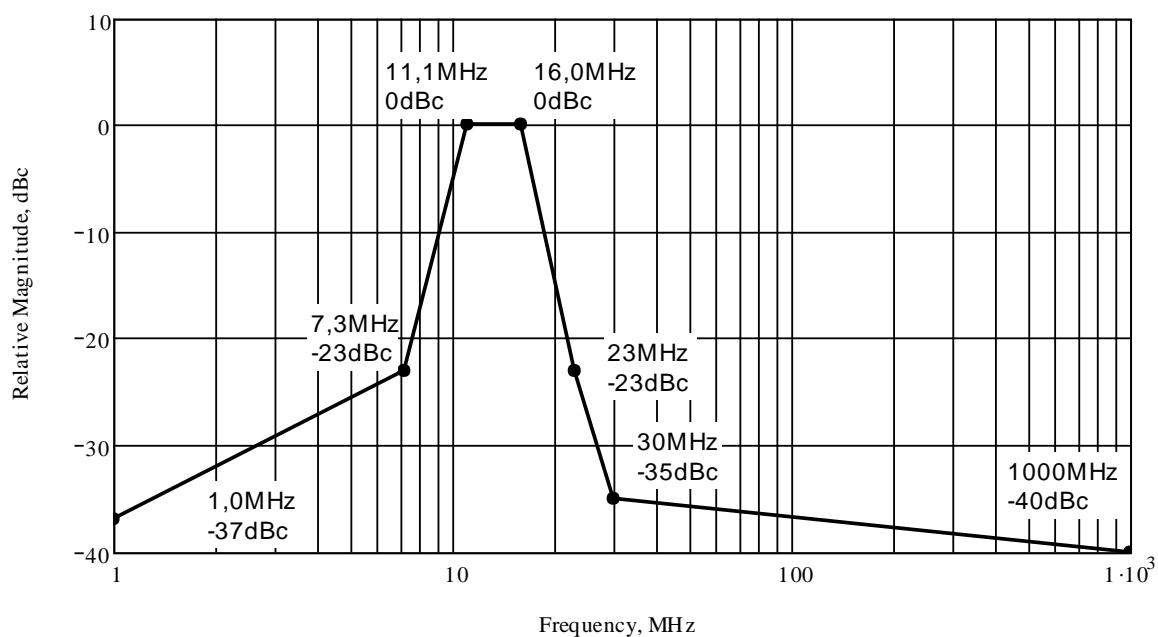


Figure 2: Euroloop transmitter spectrum and spurious mask

The limit at 1 MHz shall also apply for frequencies below 1 MHz.

4.4 Maximum allowable measurement uncertainty

See clause 4.2.4.3 Conformance

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

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 specified in [1, ~~table~~], clause 7.5.2.1.2 "Sensitivity".

4.3.1.3 Conformance

See clause 6.2.1.

4.3.2 OBE Receiver co-channel rejection

4.3.2.1 Applicability

This only applies to the OBE receiver.

4.3.2.2 Limits

The OBE receiver co-channel rejection limits are specified in [1-
5—Test], clause 7.5.2.4 "Co-Channel Rejection".

4.3.2.3 Conformance

See clause 6.2.2.

4.3.3 OBE Receiver blocking

4.3.3.1 Applicability

This only applies to the OBE receiver.

4.3.3.2 Limits

The OBE receiver blocking limits are specified in [1], clause 7.5.2.5 "Blocking".

4.3.3.3 Conformance

See clause 6.2.3.

4.3.4 OBE Receiver radio-frequency intermodulation

4.3.4.1 Applicability

This only applies to the OBE receiver.

4.3.4.2 Limits

The OBE receiver radio-frequency intermodulation limits are specified in [1], clause 7.5.2.3 "Inter-modulation Immunity".

4.3.4.3 Conformance

See clause 6.2.4.

4.3.5 Euroloop Receiver sensitivity

4.3.5.1 Applicability

This only applies to the Euroloop receiver.

4.3.5.2 Limits

The Euroloop receiver sensitivity limits are specified in [1], clause 7.3.3 "Interface 'A_{L4}' – Activation Signal".

4.3.5.3 Conformance

See clause 6.2.5.

5 Testing for compliance with technical requirements

5.1 Environmental conditions for testing

5-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

Testing shall be made under normal test conditions.

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

The test conditions and procedures shall be as specified in clauses ~~5.2.5.2.2~~ to ~~5.6.5.2.4~~.

5.2.2 Test power source

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

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

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 ~~clauses~~ ~~clause~~ 5.3.2. 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 $< \pm 1$ % 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 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 %.

The test conditions are only for the test equipment and not for the installed Euroloop system.

5.2.3.2 Normal test power source

5.2.3.2.1 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.~~

5.2.3.2.2 Other power sources

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

5.4 ~~Requirements for the Euroloop test modulation~~

~~The applied DSSS code during tests shall be the Euroloop test code #15 specified in SUBSET 044 [2].~~

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

5.52.4 Choice of equipment for test suites

5.52.4.1 Choice of model

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 tests shall be performed as radiated - and conducted test using the appropriate measurement procedures.

The 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.

5.6.2.4.2 Measuring receiver

The term "measuring receiver" refers to a spectrum analyser. The bandwidth and detector type of the measuring receiver are given in table 23 and table 4 unless otherwise specified.

Table 3: Measuring receiver for OBE signals

Frequency: (f)	Detector type	Spectrum analyzer bandwidth
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	Quasi Peak	300 Hz
$150 \text{ kHz} \leq f < 29,090 \text{ MHz}$	Quasi Peak	10 kHz
$29,090 \text{ MHz} \leq f < 29,100 \text{ MHz}$	Quasi Peak	300 Hz
$29,100 \text{ MHz} \leq f < 30 \text{ MHz}$	Quasi Peak	10 kHz
$30 \text{ MHz} \leq f \leq 1 \text{ GHz}$	Quasi Peak	100 kHz

Table 4: Measuring receiver for Euroloop transmitter signals

Frequency: (f)	Detector type	Spectrum analyser bandwidth
$9 \text{ kHz} \leq f < 150 \text{ kHz}$	RMS	300 Hz
$150 \text{ kHz} \leq f < 30 \text{ MHz}$	RMS	10 kHz
$30 \text{ MHz} \leq f \leq 1 \text{ 000 MHz}$	RMS	100 kHz

6 Measurement uncertainty

5.3 Interpretation of the measurement 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 recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 3-5.

Table 3: Absolute measurement uncertainties: maximum values

Parameter	Uncertainty
Radiated field strength	$\pm 6 \text{ dB}$
Conducted RF power	$\pm 1,25 \text{ dB}$
Temperature	$\pm 1 \text{ }^\circ\text{C}$
Humidity	$\pm 10 \%$

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028 [1] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which

provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian-). Principles for the calculation of measurement uncertainty are contained in ETSI TR 100 028-1 [i.4], in particular in annex D of the ETSI TR 100 028-2 [i.5].

Table 4 Table 5 is based on such expansion factors.

The particular expansion factor used for the evaluation of the Table 5: Maximum measurement uncertainty shall be stated.

Parameter	Uncertainty
Radiated field strength	± 6 dB
Conducted RF power	$\pm 1,25$ dB
Temperature	± 1 °C
Humidity	± 10 %

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

6 ~~7~~ Performance Test procedures Suites

6.1 Conformance methods of measurement for essential radio test suite transmitters

76.1.1 OBE unwanted emissions Tx field strength and Transmitter Mask

~~For~~ See clause 5.2 for the test conditions, see clause 5.1.

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

The OBE transmitter Tx field strength within the frequency range $27,095 \text{ MHz} \pm 500 \text{ kHz}$ shall be determined and recorded. The OBE Tele-powering signal (it is a CW signal) is measured as follows.

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 5.2.4.2. The H-field strength should be measured over the frequency range ~~1 MHz to~~ $1\,000\text{-}27,095 \text{ MHz} \pm 500 \text{ kHz}$ at 10 m distance for the three polarizations of the loop antenna (x-/y-/z-axis). The maximum filed strength of the three polarizations shall be recorded in the test report for the frequency range $27,095 \text{ MHz} \pm 500 \text{ kHz}$. Those values shall be below the limits in clause 4.2.1.2.

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

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

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

- Resolution bandwidth: In accordance with table 2 in clause 5.6.
- Video bandwidth: Not less than the resolution bandwidth.
- Detector mode: Quasi Peak.

The OBE unwanted emissions are measured:

- Step 1 For frequencies below 30 MHz the H field strength shall be measured at 10 m distance by using Quasi Peak detector and the resolution bandwidth as given in table 2 of clause 5.6. The results are 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 F of [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 below 30 MHz.~~

Step 2 — ~~For frequencies above 30 MHz the dedicated antenna shall be replaced by a non-reactive non-radiating resistive 50 Ω termination. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector shall not be greater than 1,5: 1 over the frequency range of the measurement. The conducted power into the termination shall be measured.~~

7.2 Euroloop transmitter conducted measurements

6.1.2 OBE Unwanted Emission

See clause ~~5.1~~ 5.2 for the test conditions.

The ~~measurements~~ measuring receiver shall ~~cover~~ be tuned over the frequency range 9 kHz to 1 000 GHz, excluding the frequency range 27,095 MHz ± 500 kHz on which the transmitter is intended to operate.

~~The measurements of the conducted transmitter spectrum shall be carried out in a test lab.~~

~~The Euroloop transmitter spectrum shall be measured and recorded. The Euroloop transmitter shall be activated according to the specification of the manufacturer. During spectrum measurements the Euroloop transmitter shall be terminated by a non-reactive, non-radiating resistive 50 Ω power termination instead of the dedicated leaky feeder cable. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector shall not be greater than 1,5: 1 over the frequency range of the measurement.~~

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

~~Resolution bandwidth: In accordance with table 2 in clause 4.2.2.2. 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, if the measurements are in the far field.~~

The OBE unwanted emissions are measured as follows.

~~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 H-field strength is measured over the frequency range 9 kHz to 30 MHz at 10 m distance for the three polarizations of the loop antenna (x-/y-/z-axis). The maximum field strength of the three polarization shall be recorded in the test report for the frequency range 9 kHz to 30 MHz. 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. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex F of [i.6.~~
- ~~—Video bandwidth: Not less than the resolution bandwidth.~~
- ~~—Detector mode: RMS.~~

~~7], and these calculations shall be stated in the test report.~~

6.1.3 Euroloop field strength measurements

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

Euroloop field strength measurements shall be carried out at appropriate installation sites in railway environment. At least at one side of the track enough space to carry out measurements at 10 m distance is required.

For safety reasons all field measurements shall be made at railway tracks without any railway traffic during the measurements. As no train is present the Euroloop shall be activated according to the specification of the manufacturer.

The measurement range along the Euroloop shall cover the whole length of the Euroloop leaky feeder cable in the track, however, this shall not exceed the length of 1 km.

The field strength spectrum shall be measured over the frequency range 10,8 MHz to 16,3 MHz, step size 30 kHz.

Any measured values shall be at least 6 dB above noise level of the measuring equipment. The measurement results will also include the signals of other services.

The measurement system shall be configured as follows unless otherwise stated:

- Antenna location: 10 m orthogonal distance from Euroloop and 1 m above ground.
- Resolution bandwidth: 10 kHz.
- Video bandwidth: Not less than the resolution bandwidth.
- Detector mode: RMS.
- Averaging: 5 times- (average over 5 sweeps).

Step 1 The magnetic field strength spectrum shall be measured and recorded every 5 m along the Euroloop in x- (along Euroloop), y- (horizontal orthogonal to Euroloop), and z-direction (vertical to Euroloop).

Step 2 Utilize the measurement results according to annex ~~D~~B. The limit shall not be exceeded over any 200 m length of the loop.

6.1.4 Euroloop transmitter conducted measurements

The measurements shall cover the frequency range 9 kHz to 1 000 MHz.

The measurements of the conducted transmitter spectrum shall be carried out in a test lab.

The Euroloop transmitter spectrum shall be measured and recorded. The Euroloop transmitter shall be activated according to the specification of the manufacturer. During spectrum measurements the Euroloop transmitter shall be terminated by a non-reactive, non radiating resistive 50 Ω power termination instead of the dedicated leaky feeder cable. The Voltage Standing Wave Ratio (VSWR) at the 50 Ω connector shall not be greater than 1,5: 1 over the frequency range of the measurement.

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

- Resolution bandwidth: In accordance with table 4 in clause 5.2.4.2.
- Video bandwidth: Not less than the resolution bandwidth.
- Detector mode: RMS.

6.2 Conformance Methods of Measurement for Receiver

6.2.1 OBE receiver sensitivity

The conformance test suite for the OBE receiver sensitivity is defined in [2], clause 6.3 "Dynamic Range of the Receiver".

6.2.2 OBE Receiver co-channel rejection

The conformance test suite for the OBE receiver co-channel rejection is defined in [2], clause 6.6 "Co-Channel Rejection for Narrowband Signal" and clause 6.7 "Co-Channel Rejection of other Euroloop Signal".

6.2.3 OBE Receiver blocking

The conformance test suite for the receiver blocking is defined in [2], clause 6.8 "Blocking".

6.2.4 OBE Receiver radio-frequency intermodulation

The conformance test suite for the receiver radio-frequency intermodulation is defined in [2], clause 6.5 "Inter-modulation Immunity".

6.2.5 Euroloop receiver sensitivity

The conformance test suite for the Euroloop receiver sensitivity is defined in [2], clause 5.8 "Activation and Deactivation of LOOMO by Activation Signal".

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 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.

Table A.1: HS Requirements and conformance Test specifications Table (HS-RTT)

Harmonized Standard EN 302 609						
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
4	OBE unwanted emissions	4.1	G	Applies to OBE only	E	7.1
2	Euroloop magnetic radiated field strength	4.2	G	Applies to Euroloop only	E	7.3
3	Euroloop transmitter mask	4.3	G	Applies to Euroloop only	E	7.2

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: Relationship between the present document and the essential requirements of Directive 2014/53/EU

Harmonised Standard ETSI EN 302 609				
The following requirements are relevant to the presumption of conformity under the article 3.2 of Directive 2014/53/EU [i.1]				
Requirement			Requirement Conditionality	
No	Description	Reference: Clause No	U/C	Condition
1	OBE Transmitter mask	4.2.1	C	Applies to OBE only
2	OBE unwanted emissions	4.2.2	C	Applies to OBE only
3	Euroloop transmitter field strength	4.2.3	C	Applies to Euroloop only
4	Euroloop transmitter mask	4.2.4	C	Applies to Euroloop only
5	OBE Receiver sensitivity	4.3.1	C	Applies to OBE only
6	OBE Receiver co-channel rejection	4.3.2	C	Applies to OBE only
7	OBE Receiver blocking	4.3.3	C	Applies to OBE only
8	OBE Receiver radio-frequency intermodulation	4.3.4	C	Applies to OBE only
9	Euroloop Receiver sensitivity	4.3.5	C	Applies to Euroloop only

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

Condition Explains the conditions when the requirement shall or shall 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.

~~Annex B (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 C (normative): Radiated measurement~~

~~Improvement of radiated methods of measurement and evaluation of the corresponding measurement uncertainties are also described in TR 102 273 [i.1].~~

~~Annex D~~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): Field strength measurements along the Euroloop

The measured field strength spectrum contains the signals of other services also. To extract the representative maximum the ideal envelope of the Euroloop spectrum is fitted to the measured values:

- Step 1 Calculate the magnitude of magnetic field strength for every measurement location and all frequencies using the components of the x-, y- and z-direction:

$$|H| = \sqrt{|H_x|^2 + |H_y|^2 + |H_z|^2} \quad |H| = \sqrt{|H_x|^2 + |H_y|^2 + |H_z|^2} \quad (\text{DB.1})$$

- Step 2 Determine the maximum field strength for every measurement location by fitting the ideal field strength spectrum envelope $S(f)$ to the measured field strength spectrum $M(f)$.

$$S(f) = A \cdot \frac{\sin\left(\frac{\pi \cdot (f - f_0)}{R_C}\right)}{\frac{\pi \cdot (f - f_0)}{R_C}}$$

f_0 : carrier frequency 13,547 MHz

R_C : chip rate 4,516 MHz

A: normalizing Factor $\mu\text{A/m}$

$$S(f) = A \cdot \frac{\sin\left(\frac{\pi \cdot (f - f_0)}{R_C}\right)}{\frac{\pi \cdot (f - f_0)}{R_C}}$$

Determine A so that the following condition is met:

$$\left| \sum_f [20 \cdot \log M(f) - 20 \cdot \log S(f)] \right| = \min \left| \sum_f [20 \cdot \log M(f) - 20 \cdot \log S(f)] \right| = \min \quad (\text{DB.2})$$

The resulting maximum field strength at the measurement location is A.

- Step 3 Calculate the arithmetic mean of maximum magnetic field strength values (in $\mu\text{A/m}$) determined in step 2 above over any sub-range of consecutive measurement locations covering a range of 200 m each.

If the length of the Euroloop leaky feeder cable is shorter than 200 m then the mean magnetic field strength is calculated over the actual length.

- Step 4 The limit shall not be exceeded by the mean magnetic field strength of any of the 200 m long sub-ranges of an Euroloop.

Annex EC (informative): E-fields in the near field at low frequencies Change History

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:

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

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 .

$$Z_m = Z_0 \frac{d}{\lambda} \text{ if } d < \frac{\lambda}{2\pi} \text{ (near field)} \quad (\text{E.2})$$

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

Equation (E.1) gives:

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

Equation (D.2) and (D.3) into (D.4) gives:

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

where f_c is the carrier frequency in MHz.

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

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

For $2\pi d/\lambda < 1$ if $f_c < 4,78$ MHz then equation (E.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 (E.6).

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

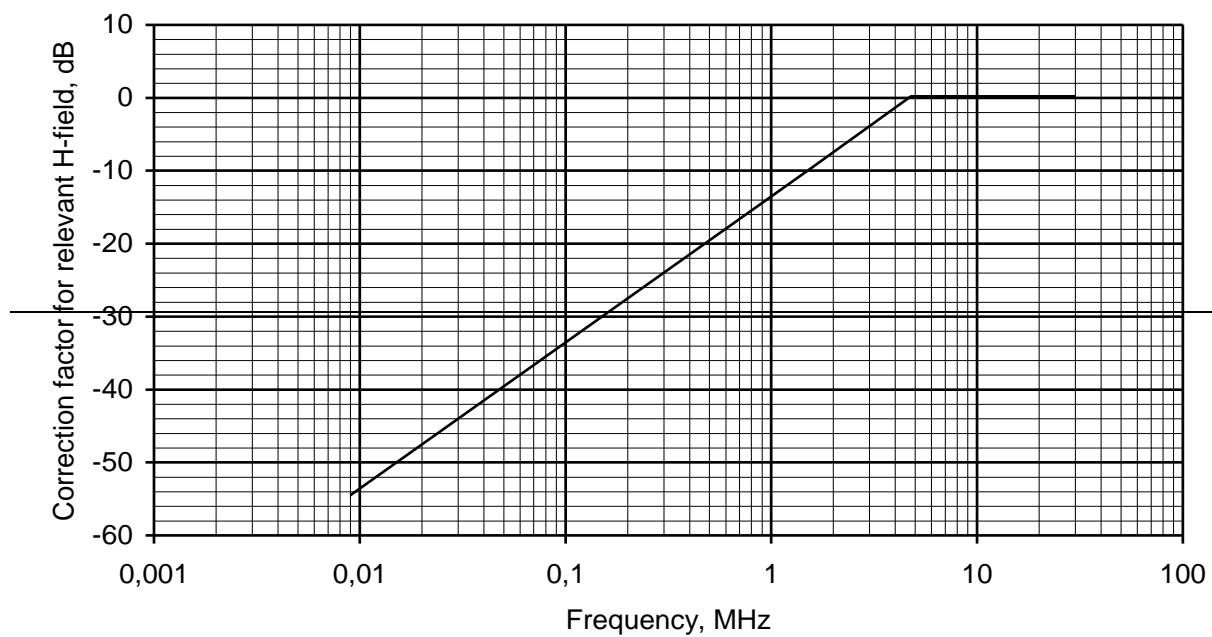


Figure E.1: Conversion factor C30 versus frequency

Annex F (normative): H-field measurements and limits at 3 m and 30 m

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 result in conversions of the H field limits for 3 m or 30 m as specified in clauses F.1 and F.2.

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.

F.1 Limits for measurements at 30 m distance

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

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

where:

- H_{10m} is the H field limit in $\text{dB}\mu\text{A}/\text{m}$ at 10 m distance according to the present document; and
- C_{30} is a conversion factor in dB which is determined from figure F.1.

Conversion factor, C_{30} , for limits at 30 m distance, dB

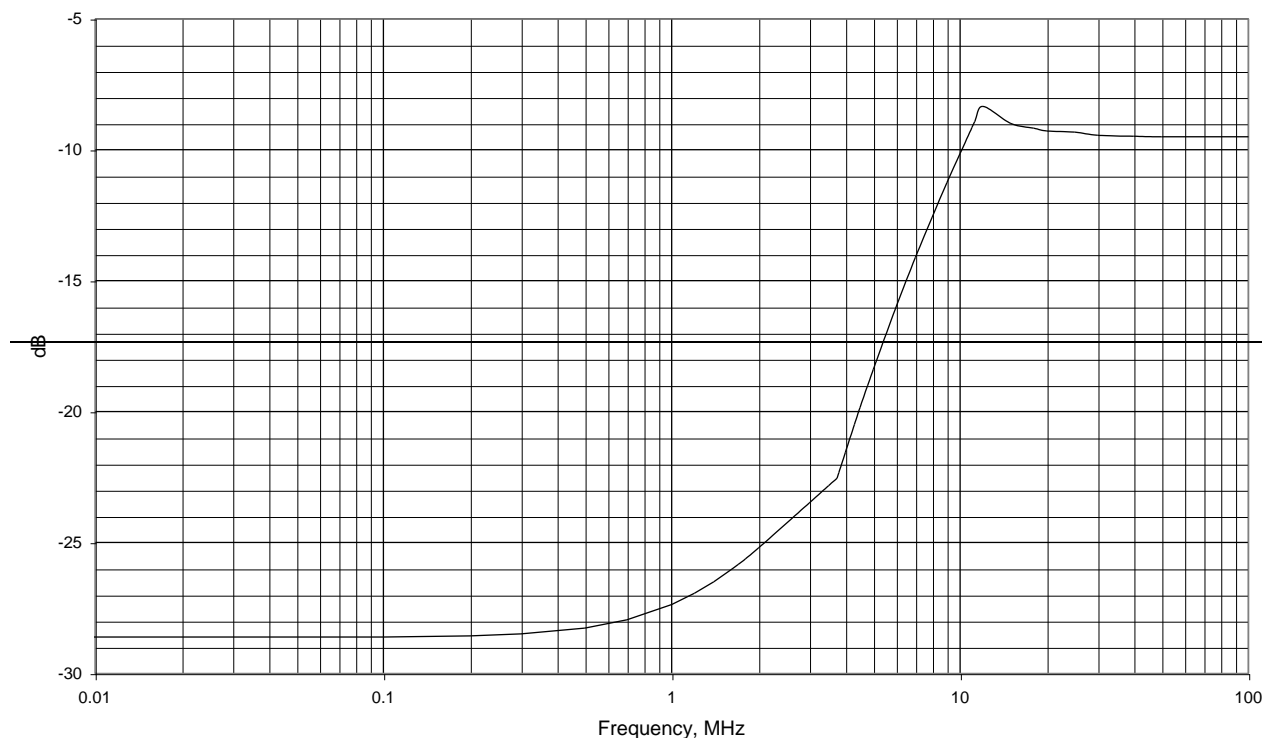


Figure F.1: Conversion factor C_{30} versus frequency

F.2 Limits for measurements at 3 m distance

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

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

where:

— H_{10m} is the H field limit in dB μ A/m at 10 m distance according to the present document; and

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

Correction factor, C_3 , for limits at 3 m distance, dB

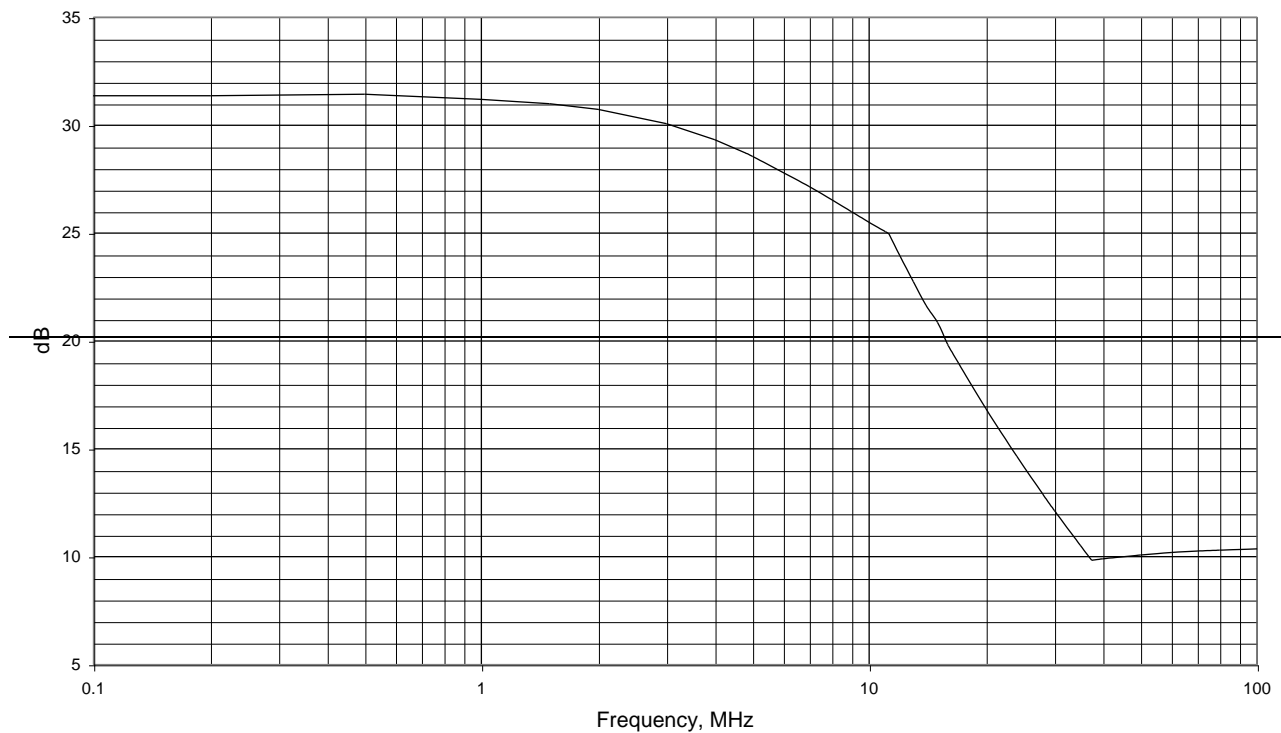


Figure F.2: Conversion factor C_3 versus frequency

Annex G (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).~~

~~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).~~

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

~~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).~~

~~Ketterling, H.P.: "Verification of the performance of fully and semi-anechoic chambers for radiation measurements and susceptibility/immunity testing", 1991, Leatherhead/Surrey.~~

~~CENELEC EN 50121 (all parts): "Railway Applications – Electromagnetic Compatibility".~~

Table to cover paragraph 2 of Article 5 of the EU Standardization Request:

Date	Version	Information about changes
<u>November 2008</u>	<u>1.1.1</u>	<u>Last publication as HS under R&TTE</u>
<u>October 2016</u>	<u>2.1.1</u>	<u>Revision for compliance with Directive 2014/53/EU</u> <u>Receiver parameters added</u> <u>Reference to railway specific standards (UNISIG Subset) added</u>

History

Document history		
V1.1.1	December 2007	Public Enquiry PE 20080425: 2007-12-26 to 2008-04-25
V1.1.1	August 2008	Vote V 20081028: 2008-08-29 to 2008-10-28
V1.1.1	November 2008	Publication
<u>V2.1.0</u>	<u>February 2016</u>	<u>EN Approval Procedure AP 20160522: 2016-02-22 to 2016-05-23</u>
<u>V2.1.1</u>	<u>October 2016</u>	<u>Vote V 20161211: 2016-10-12 to 2016-12-12</u>
<u>V2.1.1</u>	<u>December 2016</u>	<u>Publication</u>