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Short Range Devices (SRD); Radio equipment for Euroloop communication systems; Harmonised Standard for access to radio spectrum

Reference

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the combined Public Enquiry and Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.7] 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.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

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

1 Scope

The present document specifies technical characteristics and methods of measurements for radio transmitters and receivers used in the Euroloop communications system. The system is used in railway systems.

The present document applies to the following equipment:

1) The On-Board Equipment (OBE) transmitting the tele-powering to wake-up the Trackside Equipment and receiving the Euroloop signal. The OBE comprises a receiver fitted with a dedicated antenna.

2) The Trackside Equipment receiving the tele-powering and transmitting the Euroloop signal. The antenna is a leaky feeder cable that is always installed in an inner or outer foot of a rail.

NOTE 1: For the purposes of the present document term "Euroloop" will be used as a descriptive term of the Euroloop communication system as defined by the specifications [1] and [2] of the UNISIG consortia.

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: Radio communications frequencies

	Radio communications frequencies
OBE receive frequency band	11,1 MHz -16,0 MHz
OBE transmit frequency band	27,09 MHz - 27,10 MHz
OBE transmit modulation	un-modulated RF carrier, continuous wave
Trackside Equipment receiver frequency band	27,09 MHz - 27,10 MHz
Trackside Equipment transmit frequency band	11,1 MHz -16,0 MHz
Trackside Equipment transmit modulation	BPSK, DSSS chip rate 4,516 MHz

NOTE 2: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.1] is given in annex A.

The present document contains requirements to demonstrate that radio equipment both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

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

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

[1] ERTMS/ETCS: "FFFIS for Euroloop", SUBSET-044, Issue 2.4.0, 29th February 2012.

NOTE: Available at https://www.era.europa.eu/content/set-specifications-2-etcs-b3-mr1-gsm-r-b1_en.

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

NOTE: Available at https://www.era.europa.eu/content/set-specifications-2-etcs-b3-mr1-gsm-r-b1_en.

[3] CISPR 16-1-4:2019: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

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

[i.1] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC, (OJ L153, 22.5.2014, p.62).

[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] 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)" (produced by CENELEC).

[i.7] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.8] ETSI TR 102 273-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".

[i.9] ETSI TR 102 273-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 3: Anechoic chamber with a ground plane".

[i.10] ETSI TR 102 273-4: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 4: Open area test site".

[i.11] ETSI EG 203 336 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

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

Eurobalise: trackside 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: trackside 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 (leaky feeder cable) 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 band 11,1 - 16,0 MHz for Uplink (track to train) transmission.

RF carrier: fixed radio frequency prior to modulation

tele-powering: signal transmitted by the OBE, which activates the Trackside Equipment

uplink: transmission link from the Trackside Equipment to the OBE

3.2 Symbols

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

f	Frequency
Ω	Ohm
R	Distance
R_C	Chip rate
λ	wavelength

3.3 Abbreviations

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

BER	Bit Error Ratio
BPSK	Binary Phase Shift Keying
CW	Continuous Wave
dB	deciBel

NOTE: Logarithmic scale.

DSSS	Direct Sequence Spread Spectrum
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunications Committee
EUT	Equipment Under Test
LOOMO	LOOp MOdem
MTIE	Maximum Time Interval Error
OATS	Open Area Test Site
OBE	On-Board Equipment

R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RMS	Root Mean Square
SRD	Short Range Device
TX	Transmitter
UNISIG	UNion Industry of SIGnalling
VSWR	Voltage Standing Wave Ratio

4 Technical requirements specifications

4.1 Environmental profile

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

4.2 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-OBE tele-powering is used for wake-up of the Trackside Equipment.

4.2.1.2 Limits

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

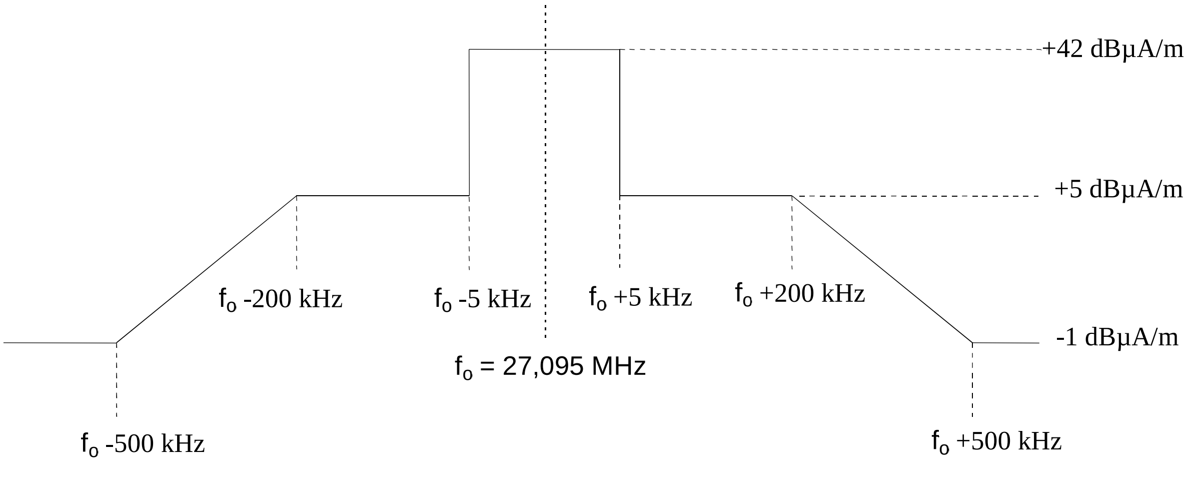

Figure 1: OBE transmitter mask

The maximum OBE TX field strength of +42 dBµA/m at 10 m distance is in accordance with the EC Decision for SRDs [i.2] and ERC Recommendation 70-03 [i.3], annex 4.

4.2.1.3 Conformance

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

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 MHz ± 500 kHz as defined in clause 4.2.1.2.

4.2.2.2 Limits

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 EN 50121-2:2015 [i.6]. The most stringent EMC limits (Category C) decreased by 6 dB have been chosen for the limits in this table.	

4.2.2.3 Conformance

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

4.2.3 Trackside Equipment transmitter field strength

4.2.3.1 Applicability

This only applies to the Trackside Equipment transmitter.

4.2.3.2 Limits

The transmitted magnetic field strength shall not exceed -7 dBµA/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.

The maximum Trackside Equipment transmitter field strength of -7 dBµA/m at 10 m distance is in accordance with the EC Decision for SRDs [i.2] and ERC Recommendation 70-03 [i.3], annex 4.

4.2.3.3 Conformance

The conformance test suite for the Trackside Equipment transmitter field strength shall be as defined in clause 6.1.3.

4.2.4 Trackside Equipment transmitter mask

4.2.4.1 Applicability

This test only applies to the Trackside Equipment 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.

4.2.4.2 Limit

The measured spectrum (field strength) shall not exceed the relative frequency mask values of figure 2 (from [1], clause 6.7.7 "Spectrum Mask").

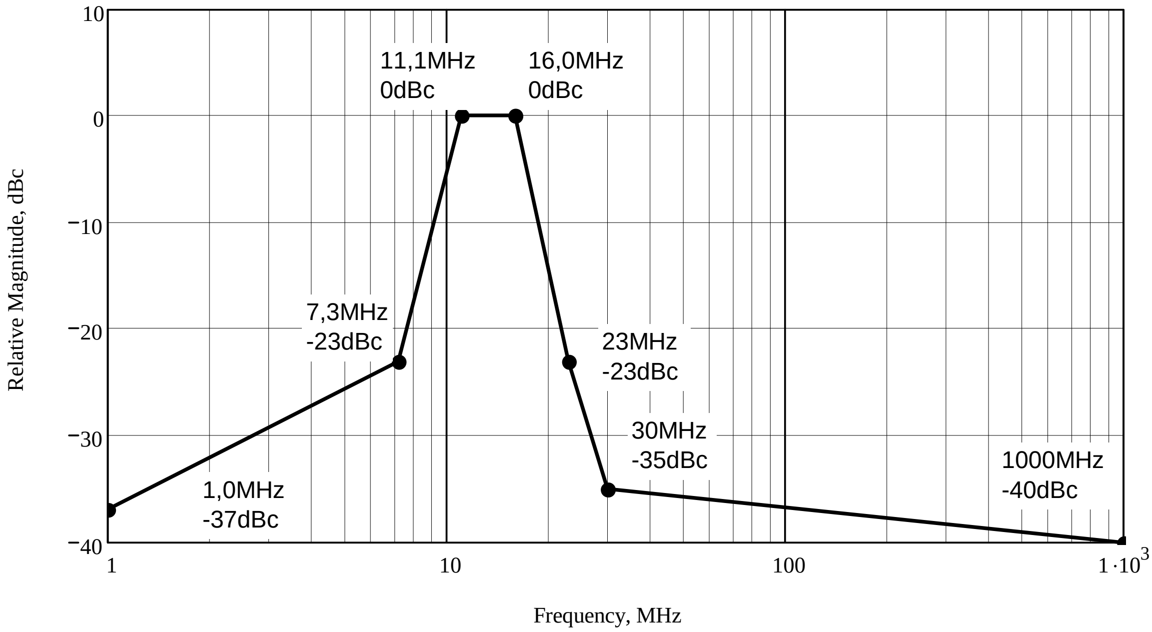

Figure 2: Trackside Equipment transmitter spectrum and spurious mask

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

4.2.4.3 Conformance

The conformance test suite for Trackside Equipment transmitter mask shall be as defined in clause 6.1.4.

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], clause 7.5.2.1.2 "Sensitivity".

4.3.1.3 Conformance

See clause 6.2.1.

4.3.2 OBE Receiver error behaviour at high wanted input signal level

4.3.2.1 Applicability

This only applies to the OBE receiver.

4.3.2.2 Limits

The OBE receiver upper limits for the dynamic range are specified in [1], clause 7.5.2.1.3 "Error Behaviour at High Wanted Input Signal Level".

4.3.2.3 Conformance

See clause 6.2.2.

4.3.3 OBE Receiver distortion immunity

4.3.3.1 Applicability

This only applies to the OBE receiver.

4.3.3.2 Limits

The OBE receiver distortion immunity limits are specified in [1], clause 7.5.2.2 "Distortion Immunity".

4.3.3.3 Conformance

See clause 6.2.3.

4.3.4 OBE Receiver inter-modulation immunity

4.3.4.1 Applicability

This only applies to the OBE receiver.

4.3.4.2 Limits

The OBE receiver sensitivity 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 OBE Receiver co-channel rejection

4.3.5.1 Applicability

This only applies to the OBE receiver.

4.3.5.2 Limits

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

4.3.5.3 Conformance

See clause 6.2.5.

4.3.6 OBE Receiver blocking

4.3.6.1 Applicability

This only applies to the OBE receiver.

4.3.6.2 Limits

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

4.3.6.3 Conformance

See clause 6.2.6.

4.3.7 OBE Receiver dynamic receiver performance

4.3.7.1 Applicability

This only applies to the OBE receiver.

4.3.7.2 Limits

The OBE receiver dynamic receiver performance limits are specified in [1], clause 7.5.2.6 "Dynamic Receiver Performance".

4.3.7.3 Conformance

See clause 6.2.7.

4.3.8 OBE Receiver multipath dynamic performance

4.3.8.1 Applicability

This only applies to the OBE receiver.

4.3.8.2 Limits

The OBE receiver multipath dynamic performance limits are specified in [1], clause 7.5.2.7 "Multipath Dynamic Performance".

4.3.8.3 Conformance

See clause 6.2.8.

4.3.9 OBE Receiver tolerable centre frequency error

4.3.9.1 Applicability

This only applies to the OBE receiver.

4.3.9.2 Limits

The OBE receiver tolerable centre frequency error limits are specified in [1], clause 7.5.2.8 "Tolerable Centre Frequency Error".

4.3.9.3 Conformance

See clause 6.2.9.

4.3.10 OBE Receiver tolerable chip rate error

4.3.10.1 Applicability

This only applies to the OBE receiver.

4.3.10.2 Limits

The OBE receiver sensitivity limits are specified in [1], clause 7.5.2.9 "Tolerable Chip Rate Error".

4.3.10.3 Conformance

See clause 6.2.10.

4.3.11 OBE Receiver tolerable MTIE of the chip rate

4.3.11.1 Applicability

This only applies to the OBE receiver.

4.3.11.2 Limits

The OBE receiver sensitivity limits are specified in [1], clause 7.5.2.10 "Tolerable MTIE of the Chip Rate".

4.3.11.3 Conformance

See clause 6.2.11.

4.3.12 Trackside Equipment Receiver sensitivity

4.3.12.1 Applicability

This only applies to the Trackside Equipment receiver.

4.3.12.2 Limits

The Trackside Equipment receiver sensitivity limits are specified in [1], clause 7.3.3 "Interface 'A_L4' - Activation Signal".

4.3.12.3 Conformance

See clause 6.2.12.

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 environmental profile defined by its intended use.

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 operational environmental profile defined by its intended use) 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, and also, where stated in the conformance clause 6, under extreme test conditions.

The test conditions and procedures shall be as specified in clauses 5.2.2 to 5.2.5.

5.2.2 Test power source

The OBE and Trackside 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 clause 5.2.3.2. 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 < ±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.

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 manufacturer and agreed by the test laboratory. Such values shall be stated in the test report.

5.2.4 Extreme test conditions

Some tests in the present document need to be repeated at extreme temperatures. Where that is the case, measurements shall be made over the extremes of the operating temperature range as defined in [1], clause 6.9.1 for the trackside equipment and in [1], clause 7.7.1 for the onboard equipment.

5.2.5 Choice of equipment for test suites

5.2.5.1 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.

5.2.5.2 Measuring receiver

The term "measuring receiver" refers to a spectrum analyser. The bandwidth and detector type of the measuring receiver are given in table 3 and table 4 unless otherwise specified.

Table 3: Measuring receiver for OBE signals

Frequency: (f)	Detector type	Spectrum analyser bandwidth
9 kHz ≤ f < 150 kHz	Quasi Peak	300 Hz
150 kHz ≤ f < 29,090 MHz	Quasi Peak	10 kHz
27,090 MHz ≤ f < 27,100 MHz	Quasi Peak	300 Hz
29,100 MHz ≤ f < 30 MHz	Quasi Peak	10 kHz
30 MHz ≤ f ≤ 1 GHz	Quasi Peak	100 kHz

Table 4: Measuring receiver for Trackside Equipment transmitter signals

Frequency: (f)	Detector type	Spectrum analyser bandwidth
9 kHz ≤ f < 150 kHz	RMS	300 Hz
150 kHz ≤ f < 30 MHz	RMS	10 kHz
30 MHz ≤ f ≤ 1 000 MHz	RMS	100 kHz

5.3 Void

6 Performance Test Suites

6.1 Conformance methods of measurement for transmitters

6.1.1 OBE Tx field strength and Transmitter Mask

The measurements of the transmitter radiated H-field shall be made on an open area test site as specified in clause C.1.3. 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 MHz ± 500 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 5.2.5.2. The H-field strength should be measured over the frequency range 27,095 MHz ± 500 kHz at 10 m distance for the three polarizations of the loop antenna (x-/y-/z-axis). The maximum field strength of the three polarizations shall be recorded in the test report for the frequency range 27,095 MHz ± 500 kHz. 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, 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.

6.1.2 OBE Unwanted Emission

For the measurements of the transmitter radiated H-field a test site from annex C shall be used.

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, 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 table 3 in clause 5.2.5.2. 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, 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.

6.1.3 Trackside Equipment field strength measurements

Trackside Equipment 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 Trackside Equipment shall be activated according to the specification of the manufacturer.

The measurement range along the Trackside Equipment 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 B. The limit shall not be exceeded over any 200 m length of the loop.

6.1.4 Trackside Equipment transmitter conducted measurements

The measurements shall be made under normal and extreme conditions.

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 Trackside Equipment transmitter spectrum shall be measured and recorded. The Trackside Equipment transmitter shall be activated according to the specification of the manufacturer. During spectrum measurements the Trackside Equipment 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 5.2.5.2.
- 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 error behaviour at high wanted input signal level

The conformance test suite for the OBE receiver error behaviour at high wanted input signal level is defined in [2], clause 6.3 "Dynamic Range of the Receiver".

The measurements shall be made under normal and extreme conditions.

6.2.3 OBE receiver distortion immunity

The conformance test suite for the OBE receiver distortion immunity is defined in [2], clause 6.4 "Doppler Immunity".

6.2.4 OBE receiver inter-modulation immunity

The conformance test suite for the OBE receiver inter-modulation immunity is defined in [2], clause 6.5 "Inter-modulation Immunity".

6.2.5 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".

6.2.6 OBE Receiver blocking

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

6.2.7 OBE receiver dynamic receiver performance

The conformance test suite for the OBE receiver dynamic receiver performance is defined in [2], clause 6.9 "Dynamic Receiver Performance".

6.2.8 OBE receiver multipath dynamic performance

The conformance test suite for the OBE receiver multipath dynamic performance is defined in [2], clause 6.10 "Multi path Dynamic Performance".

6.2.9 OBE receiver tolerable centre frequency error

The conformance test suite for the OBE receiver tolerable centre frequency error is defined in [2], clause 6.11 "Tolerable Centre Frequency combined with MTIE Error".

The measurements are made under normal and extreme conditions.

6.2.10 OBE Receiver tolerable chip rate error

The conformance test suite for the receiver tolerable chip rate error is defined in [2], clause 6.12 "Tolerable Chip Rate Error".

6.2.11 OBE Receiver tolerable MTIE of the chip rate

The conformance test suite for the receiver tolerable MTIE of the chip rate is defined in [2], clause 6.13 "Tolerable MTIE of the Chip Rate".

6.2.12 Trackside Equipment receiver sensitivity

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

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

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.7] 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 tables A.1 and A.2 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 for the OBE

Harmonised Standard ETSI EN 302 609					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	OBE TX field strength and Transmitter mask	3.2	4.2.1	U	
2	OBE unwanted emissions	3.2	4.2.2	U	
3	OBE Receiver sensitivity	3.2	4.3.1	U	
4	OBE Receiver error behaviour at high wanted input signal level	3.2	4.3.2	U	
5	OBE Receiver distortion immunity	3.2	4.3.3	U	
6	OBE Receiver inter-modulation immunity	3.2	4.3.4	U	
7	OBE Receiver co-channel rejection	3.2	4.3.5	U	
8	OBE Receiver blocking	3.2	4.3.6	U	
9	OBE Receiver dynamic receiver performance	3.2	4.3.7	U	
10	OBE Receiver multipath dynamic performance	3.2	4.3.8	U	
11	OBE Receiver tolerable centre frequency error	3.2	4.3.9	U	
12	OBE Receiver tolerable chip rate error	3.2	4.3.10	U	
13	OBE Receiver tolerable MTIE of the chip rate	3.2	4.3.11	U	

Table A.2: Relationship between the present document and the essential requirements of Directive 2014/53/EU for the Trackside Equipment

Harmonised Standard ETSI EN 302 609					
Requirement				Requirement Conditionality	
No	Description	Essential requirements of Directive	Clause(s) of the present document	U/C	Condition
1	Trackside Equipment transmitter field strength	3.2	4.2.3	U	
2	Trackside Equipment transmitter mask	3.2	4.2.4	U	
3	Trackside Equipment Receiver sensitivity	3.2	4.3.12	U	

Key to columns:

Requirement:

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

Description A textual reference to the requirement.

Essential requirements of Directive

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

Clause(s) of the present document

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

Requirement Conditionality:

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

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

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

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

Annex B (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 Trackside Equipment 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:

$$|H| = \sqrt{|H_x|^2 + |H_y|^2 + |H_z|^2} \tag{B.1}$$

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**	**µA/m**

Determine A so that the following condition is met:

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

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

Step 3 Calculate the arithmetic mean of maximum magnetic field strength values (in µA/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 Trackside Equipment 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 C (normative): Radiated measurements

C.1 Test sites and general arrangements for measurements involving the use of radiated fields

C.1.0 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 ETSI TR 102 273-2 [i.8], ETSI TR 102 273-3 [i.9] and ETSI TR 102 273-4 [i.10].

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

C.1.1 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 C.1.

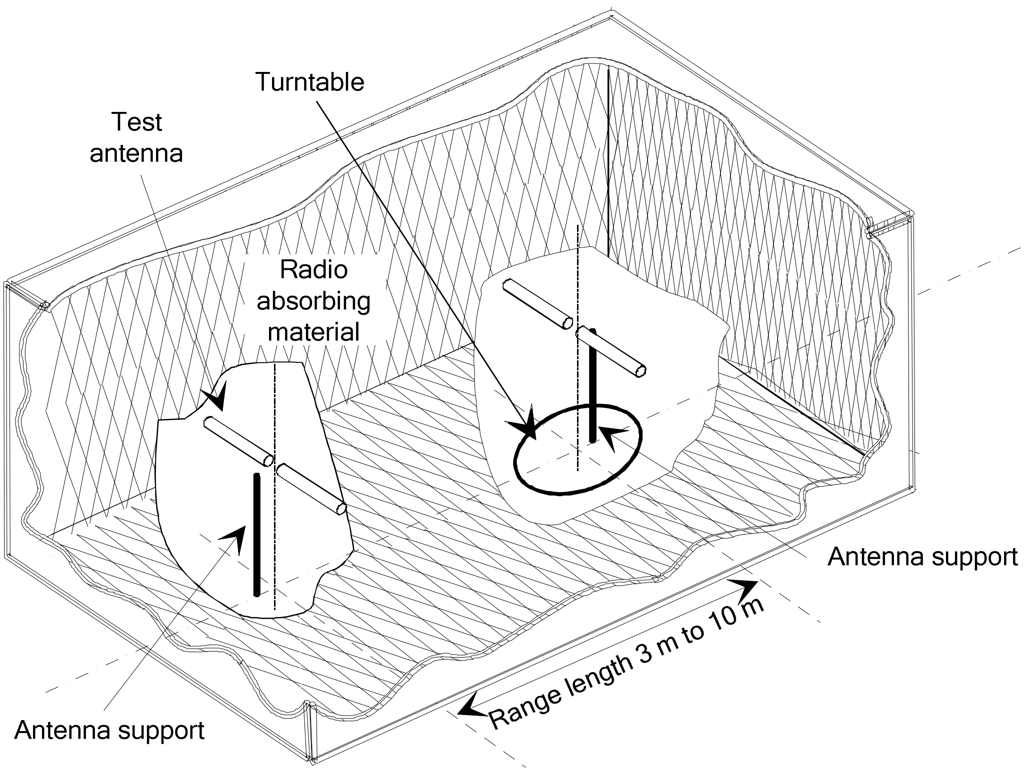

Figure C.1: A typical anechoic chamber

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, where:

d_1 is the largest dimension of the EUT/dipole after substitution (m);

d_2 is the largest dimension of the test antenna (m);

λ is the test frequency wavelength (m).

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.

C.1.2 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 C.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.

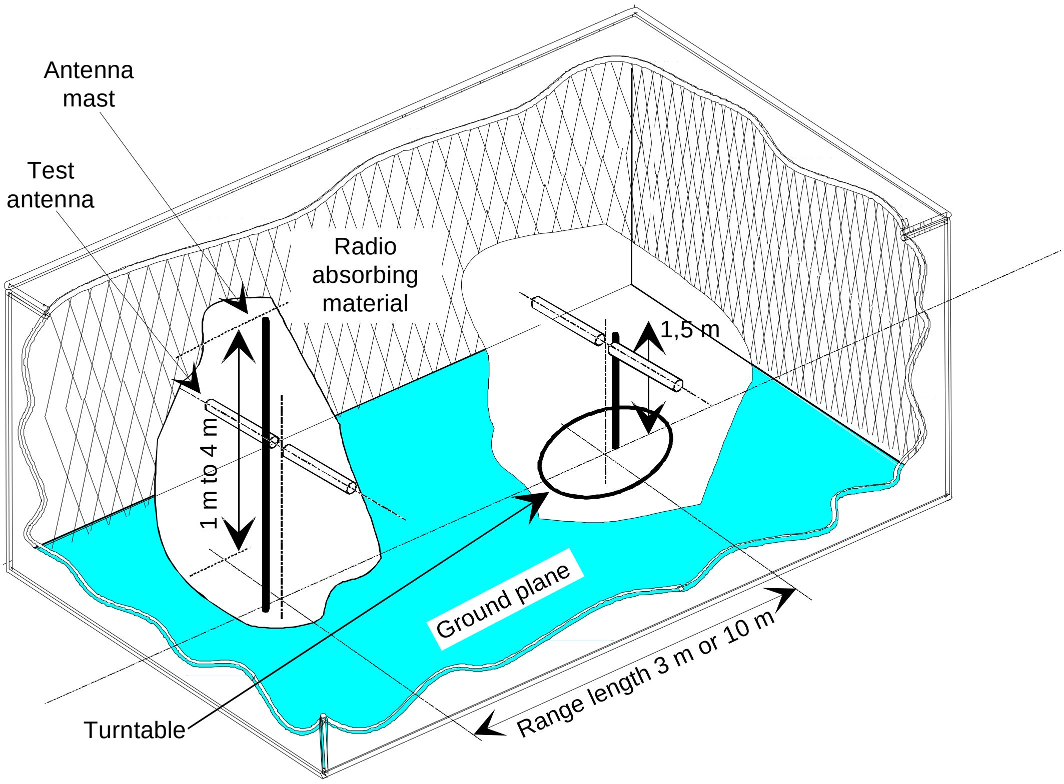

Figure C.2: A typical Anechoic Chamber with a conductive ground plane

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, where:

d_1 is the largest dimension of the EUT/dipole after substitution (m);

d_2 is the largest dimension of the test antenna (m);

λ is the test frequency wavelength (m).

The distance used in actual measurements shall be recorded with the test results.

Emission testing involves first "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.

Receiver sensitivity tests over a ground plane also involve "peaking" the field strength by raising and lowering the test antenna on the mast to obtain the maximum constructive interference of the direct and reflected signals, this time using a measuring antenna which has been positioned where the phase or volume centre of the EUT will be during testing. A transform factor is derived. The test antenna remains at the same height for stage two, during which the measuring antenna is replaced by the EUT. The amplitude of the transmitted signal is reduced to determine the field strength level at which a specified response is obtained from the EUT.

C.1.3 Open Area Test Site (OATS)

C.1.3.0 General

The OATS can be used for measurements in the range of 9 kHz to 1 000 MHz.

Measurements below 30 MHz shall be made according to clause C.1.3.1 and measurements above 30 MHz shall be made according to clause C.1.3.2.

An Open Area Test Site comprises a turntable at one end and an antenna mast of variable height at the other end. A typical OATS is shown in figure C.3.

In figure C.3, for measurements below 30 MHz the dipole antennas shall be replaced by loop antennas and as explained in clause C.1.3.1.

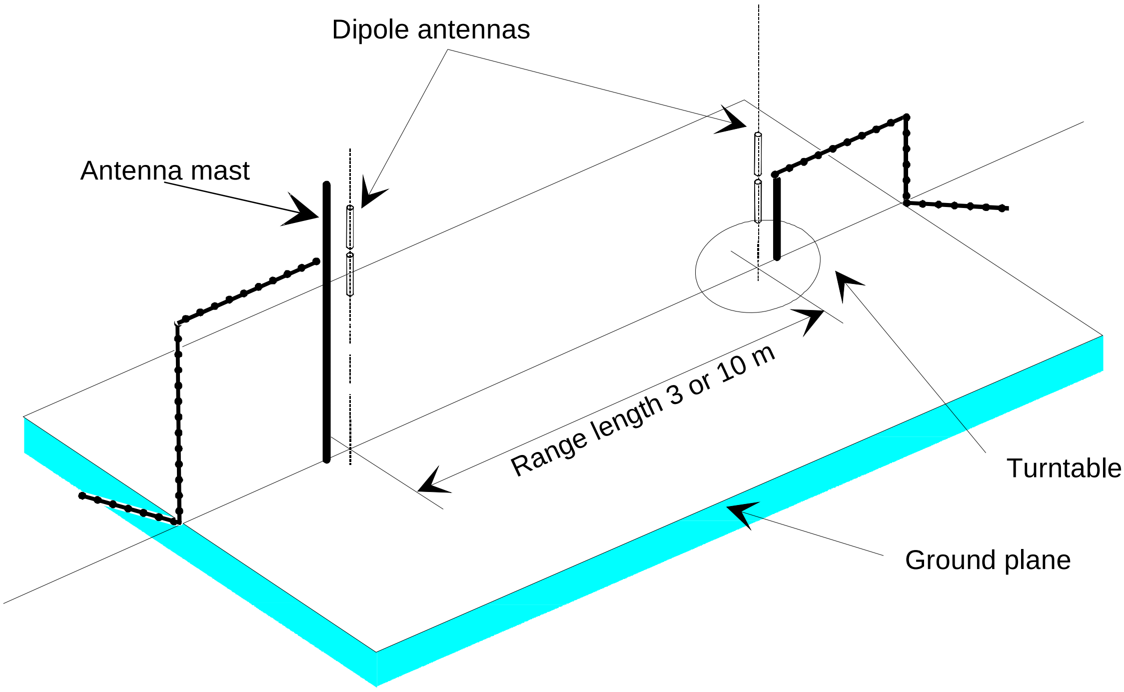

Figure C.3: A typical Open Area Test Site

C.1.3.1 Measurements below 30 MHz

For measurements below 30 MHz tests may be made according to CISPR 16-1-4 [3]. 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 with an electrical or magnetic conductive material.

Radiated emission test sites (OATS) below 30 MHz shall be free from metal objects, buried pipes, and any objects that can affect radiated measurements. An alternative test site that can demonstrate equivalence to a test site as described in the preceding paragraph shall be accepted for the purposes of the present document.

C.1.3.2 Measurements above 30 MHz

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 C.3.

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.

Typical measuring arrangement common for ground plane test sites for spurious emission testing is presented in figure C.4.

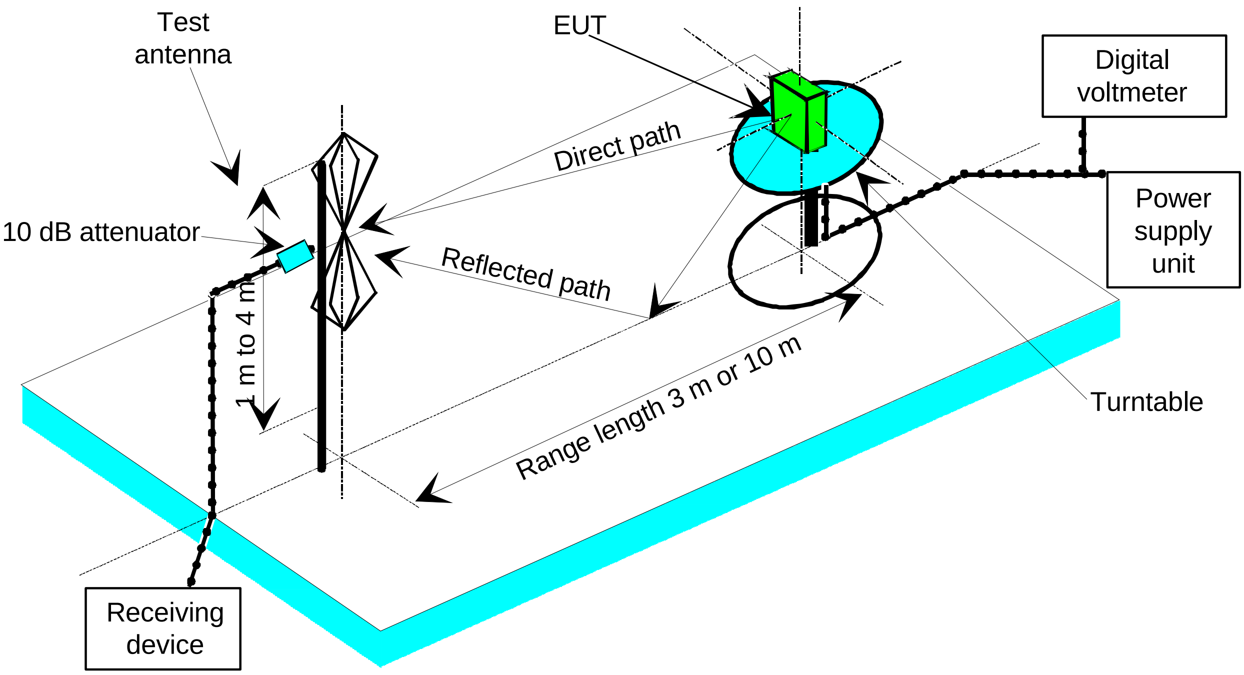

Figure C.4: Measuring arrangement on ground plane test site (OATS set-up for spurious emission testing)

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

D.0 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 a 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 are a discontinuous curves, see clauses D.1 and D.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.

D.1 Limits for measurements at 30 m distance

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

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

where:

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

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

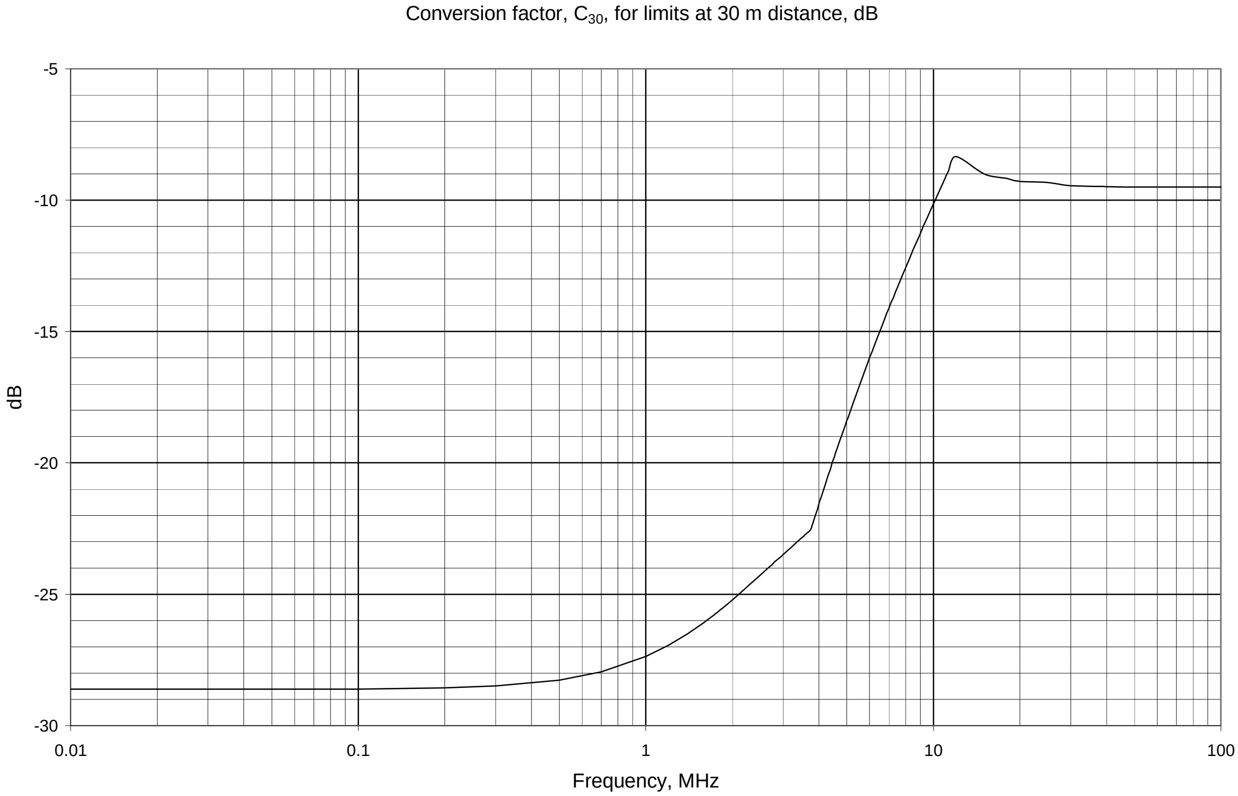

Figure D.1: Conversion factor C_{30} versus frequency

D.2 Limits for measurements at 3 m distance

The H-field limit in dBμA/m at 3 m, H_{3m}, is determined by the equation (D.2):

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

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.

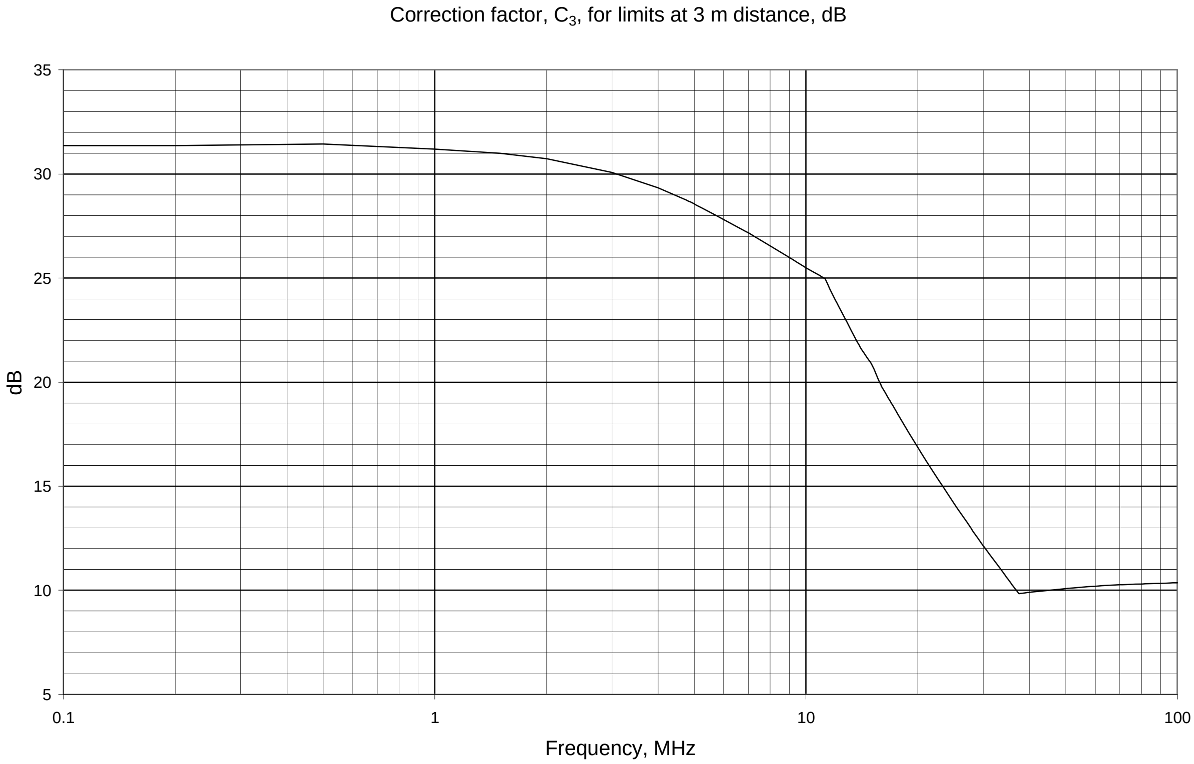

Figure D.2: Conversion factor C_3 versus frequency

Annex E (informative): Maximum measurement uncertainty

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

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

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

Table E.1: Maximum measurement uncertainty

Parameter	Uncertainty
RF frequency	$\pm 1 \times 10^{-7}$
Radiated field strength	±6 dB
RF power, conducted	±0,75 dB
Conducted spurious emissions of transmitters	±4 dB
Sensitivity	±3 dB
Two-signal measurements	±4 dB
Bit Error Ratio (BER) confidential level	99 %
Supply voltage	±5 %
Temperature	±1 °C
Humidity	±5 %

Annex F (informative): Selection of receiver parameters

F.1 OBE Receiver parameters as listed in ETSI EG 203 336 V1.1.1

F.1.1 Receiver sensitivity

The receiver sensitivity requirement is the ability to receive a wanted signal at low input signal levels while providing a pre-determined performance.

OBE receiver sensitivity is specified in clause 4.3.1. Sensitivity is tested at lowest field strength and performance is measured against a pre-determined Bit Error Ratio.

Trackside Equipment receiver sensitivity is specified in clause 4.3.12.2. The requirement is specified as a CW signal at the same frequency as the operating frequency.

F.1.2 Adjacent channel selectivity

The adjacent channel selectivity requirement measures the ability of the receiver to operate in the presence of an unwanted signal near the operating frequency.

The OBE is a spread spectrum digital receiver, that uses code division multiple access. Adjacent channel selectivity is not applicable for the OBE.

The Trackside Equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. Adjacent channel selectivity is not applicable for the trackside equipment receiver, it would only result in a unnecessary activation.

F.1.3 Blocking

The blocking requirement measures the ability of the receiver to operate in the presence of an unwanted signal outside the operating frequency.

For the OBE the requirement is specified as a CW signal and blocking is measured for multiple offsets of the unwanted CW signal from the operating frequency. Blocking is specified in clause 4.3.6. Blocking is measured for a minimum wanted signal level to provide a measure of receiver performance at the limit of range, and with a strong wanted signal level to provide a measure of receiver saturation. In addition, the measurements are repeated for all valid combinations of the spread spectrum signal.

The Trackside Equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. Blocking is not applicable for the trackside equipment receiver, it would only result in a unnecessary activation.

F.1.4 Co-channel rejection

The co-channel rejection requirement measures the receiver ability to reject an unwanted signal in the same operating channel as the operating frequency.

For the OBE co-channel rejection is specified in clause 4.3.5.

The Trackside Equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. Co-channel rejection is not applicable, it would only result in a unnecessary activation.

F.1.5 Spurious response rejection

The spurious response rejection requirement measures the ability of the receiver to operate in the presence of an unwanted signal at a frequency at which a spurious response is observed.

The defined functional principle of the OBE receiver has no potential for responding to single frequencies. Due to the code division multiple access principle signals that are not modulated with the correct golden code will produce no response after demodulation. Direct RF sampling applies.

The Trackside Equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. Spurious response rejection is not applicable, it would only result in a unnecessary activation.

F.1.6 Inter-modulation

Inter-modulation rejection is a measure of the ability of a receiver to operate in the presence of two or more unwanted signals the frequencies of which have a specific frequency relationship to the wanted signal.

For the OBE receiver inter-modulation immunity is specified in clause 6.2.4.

The Trackside Equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. Inter-modulation is not applicable, it would only result in a unnecessary activation.

F.1.7 Dynamic range

Dynamic range provides a measure of the range of signal levels over which the receiver is able to obtain the wanted criteria defined in [1]. Dynamic range is provided by a combination of the sensitivity requirement and the maximum input signal level requirement.

For the OBE receiver dynamic range is specified in clause 4.3.7.

The Trackside equipment receiver is a single bit digital activation signal, so dynamic range is not applicable, as no criteria for a dynamic range is defined in [1]. The requirement is activation above a defined threshold.

F.1.8 Reciprocal mixing

Reciprocal mixing results from the phase noise performance of the local oscillators within the radio receiver.

The OBE receiver principle does not use local oscillators. Direct RF Sampling applies, so tests against reciprocal mixing are not applicable.

The Trackside equipment receiver principle does not use local oscillators. Reciprocal mixing is not applicable.

F.1.9 Desensitization

Desensitization is a measure of the ability of the receiver to operate in the presence of a strong interfering signal.

According to the defined receiving principle max field strength of the defined bandwidth is limited to ≤ 76 dBuA/m for the OBE receiver.

The Trackside equipment receiver is used as single bit digital activation signal. Only the activation is performed by the receiver, then it remains active until a timeout occurs. The requirement is activation above a defined threshold. A strong interfering signal would result in a unnecessary activation.

F.1.10 Signal interference handling

Signal interference handling is not relevant to equipment covered by the present document.

F.2 Other receiver parameters

F.2.1 Receiver Multipath dynamic performance

The Euroloop signal received by the OBE is made up of replicas of the transmitted signal. These replicas have different amplitudes and delays as they reach the OBE along different propagation paths. This leads to constructive and destructive interference of the signal components at the OBE. Receiver multipath dynamic performance is specified in clause 4.3.8.

F.2.2 Receiver tolerable centre frequency

The centre frequency error of the OBE is defined as the difference between the nominal centre frequency f_c = 13,54750 MHz of the Euroloop signal and the corresponding actual centre frequency of the modulated Euroloop signal at the input of the OBE. Receiver tolerable centre frequency is specified in clause 4.3.9.

F.2.3 Receiver tolerable chip rate error

The chip rate error of the OBE is defined as the difference between the nominal chip rate R_c of the Euroloop signal and the corresponding actual chip rate R_{ac} of the modulated Euroloop signal at the input of the OBE. Receiver tolerable chip rate error is specified in clause 4.3.10.

F.2.4 Receiver tolerable MTIE

The tolerable MTIE of the chip rate is a requirement for the OBE to receive a wanted Euroloop signal with an MTIE without exceeding a given degradation. Receiver tolerable MTIE of the chip rate is specified in clause 4.3.11.

F.2.5 Receiver error behaviour at high wanted input signal

According to the defined receiving principle max field strength of the defined bandwidth is limited to ≤ 76 dBuA/m. Receiver error behaviour at high wanted input signal requirement is specified in clause 4.3.2.

F.2.6 Receiver distortion immunity

The Distortion Immunity is a requirement for the OBE to receive a wanted distorted Euroloop signal without exceeding a given degradation. Receiver distortion immunity is specified in clause 4.3.3.

Annex G (informative): Change History

Version	Information about changes
1.1.1	Last publication as HS under R&TTE
2.1.1	Revision for compliance with Directive 2014/53/EU Receiver parameters added Reference to railway specific standards (UNISIG Subset) added
2.2.0	Further receiver parameter added Extreme temperatures requirements explicitly added for selected test cases Test site requirements added Table 5 Maximum measurement uncertainty updated to table E.1

History

Document history		
V1.1.1	November 2008	Publication
V2.1.1	December 2016	Publication
V2.2.0	July 2020	EN Approval Procedure AP 20201020: 2020-07-22 to 2020-10-20