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Short Range Devices (SRD);
Radio equipment for Euroloop railway systems;
Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

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Contents

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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.6] 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 covers the technical requirements for radio transmitters and receivers used in the Euroloop transmission system. The system is used in railway systems.

The present document applies to the following equipment:

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.

The Eurobalise transmission system operates 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 centre frequency	13,547 MHz
Euroloop receiver centre frequency	27,095 MHz
Euroloop transmit centre frequency	13,547 MHz
Euroloop transmit modulation	BPSK, DSSS chip rate 4,516 MHz

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 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.

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

3 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

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 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
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

dB	deciBel
DSSS	Direct Sequence Spread Spectrum
ERC	European Radiocommunications Committee
LOOMO	LOOpMOdem
OBE	On-Board Equipment
RF	Radio Frequency
RMS	Root Mean Square
SRD	Short Range Device
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 declared by the supplier. 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 Transmitter mask

Eurobalise-OBE tele-powering is used for wake-up of the Euroloop.

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.

4.2.1.2 Limits

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

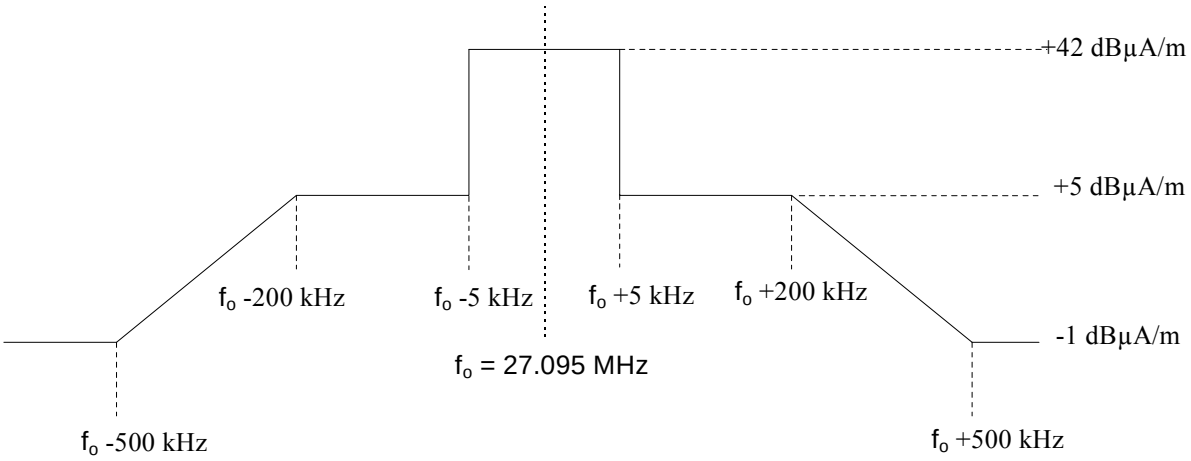

Figure 1: OBE transmitter mask

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 3 in clause 5.2.4.2.

4.2.2 OBE unwanted emissions

Eurobalise-OBE tele-powering is used for wake-up of the Euroloop.

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

4.2.2.3 Conformance

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

4.2.2.4 Maximum Allowable Measurement Uncertainty

See table 3 in clause 5.2.4.2.

4.2.3 Euroloop transmitter field strength

4.2.3.1 Applicability

This only applies to the Euroloop 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.

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

4.2.4.1 Applicability

This only applies to the Euroloop transmitter.

4.2.4.2 Limit

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

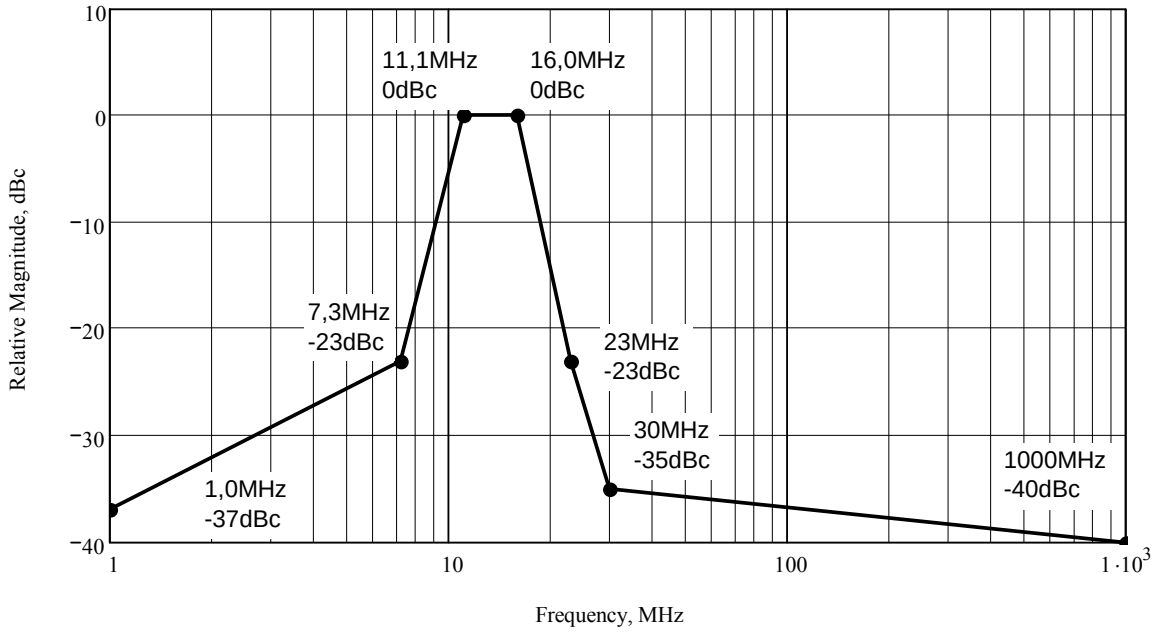

Figure 2: Euroloop transmitter spectrum and spurious mask

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

4.2.4.3 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], 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], 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".

4.3.2.3 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

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 [2] specification apply over the full operating temperature range (including the spectrum masks).

The test conditions and procedures shall be as specified in clauses 5.2.2 to 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 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 < ±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 provider and agreed by the test laboratory. Such values shall be stated in the test report.

5.2.4 Choice of equipment for test suites

5.2.4.1 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.

5.2.4.2 Measuring receiver

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

Table 3: Measuring receiver

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

Table 4: Measuring receiver for Euroloop 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 Interpretation of the measurement results

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

- the measured value related to the corresponding limit will be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;
- the recorded value of the measurement uncertainty shall be, for each measurement, equal to or lower than the figures in table 3.

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterising 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 5 is based on such expansion factors.

Table 5: Maximum measurement uncertainty

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

6 Performance Test Suites

6.1 Conformance methods of measurement for transmitters

6.1.1 OBE Transmitter Mask

See clause 5.2 for the test conditions.

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

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

- The H-field strength should be measured at 10 m distance by using quasi peak detector and a 10 kHz resolution bandwidth (except for the band 27,090 MHz to 27,100 MHz where 300 Hz applies). The result shall be recorded in the test report as the total field strength.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex D, and these calculations shall be stated in the test report. The H-field is measured with a shielded loop antenna connected to a measurement receiver. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.4.2.

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

- Resolution bandwidth: 300 Hz, or 10 kHz in accordance with table 3 in clause 5.2.4.2.
- Video bandwidth: Not less than the resolution bandwidth.
- Detector mode: Quasi-peak.

6.1.2 OBE Unwanted Emission

See clause 5.2 for the test conditions.

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

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

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

The OBE unwanted emissions are measured as follows.

- The H-field strength is measured at 10 m distance by using quasi peak detector and the resolution bandwidth as given in table 3 of clause 5.2.4.2. The results shall be recorded in the test report as the total field strength.

Where a measurement distance of 10 m is not practical, e.g. due to physical size of the equipment including the antenna or with use of special field cancelling antenna, then other distances may be used. When another distance is used, the distance used and the field strength value measured shall be stated in the test report. In this case, the measured value at actual test distance shall be extrapolated to 10 m according to annex D, and these calculations shall be stated in the test report. The H-field is measured with a shielded loop antenna connected to a measurement receiver below 30 MHz. In the frequency range from 30 MHz to 300 MHz a dipole or bi-conical antenna shall be used. Above 300 MHz a log-periodic antenna shall be used. The measuring bandwidth and detector type of the measurement receiver shall be in accordance with clause 5.2.4.2.

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

- Resolution bandwidth: 300 Hz, 10 kHz, or 100 kHz in accordance with table 3 in clause 5.2.4.2.

- Video bandwidth: Not less than the resolution bandwidth.
- Detector mode: Quasi-peak.

6.1.3 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.

6.1.4 Euroloop field strength measurements

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.

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.

6.2 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): 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.6] 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.

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

Condition Explains the conditions when the requirement shall or shall not be 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 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:

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

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:

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

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 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.

History

Document history		
V1.1.1	November 2008	Publication
V2.1.0	February 2016	EN Approval Procedure AP 20160522: 2016-02-22 to 2016-05-23