BS EN 50121-4:2016

BSI Standards Publication

Railway applications — Electromagnetic compatibility

Part 4: Emission and immunity of the signalling and telecommunications apparatus

bsi.

National foreword

This British Standard is the UK implementation of EN 50121-4:2016. It supersedes BS EN 50121-4:2015 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

This document (EN 50121-4:2016) has been prepared by CLC/TC 9X: “Electrical and electronic applications for railways”.

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-07-24
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2019-10-24

This document supersedes EN 50121-4:2015.

EN 50121-4:2016 includes the following significant technical changes with respect to EN 50121-4:2006:

— clarification of scope (Clause 1);

— set dated normative references (Clause 2);

— new definition (Clause 3);

— emission requirement extended in the frequency range 1 GHz to 6 GHz following EN 61000-6-4;

— immunity requirement extended in the frequency range 5,1 GHz to 6 GHz;

EN 50121-4:2016 includes the following significant technical changes with respect to EN 50121-4:2015

— revision of Annex ZZ.

This European Standard is to be read in conjunction with EN 50121-1.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

This standard forms Part 4 of the European Standard series EN 50121, published under the general title “Railway applications - Electromagnetic compatibility”. The series consists of:

— Part 1: *General;*

— Part 2: *Emission of the whole railway system to the outside world;*

— Part 3-1: *Rolling stock – Train and complete vehicle;*

— Part 3-2: *Rolling stock – Apparatus;*

— Part 4: *Emission and immunity of the signalling and telecommunications apparatus;*

— Part 5: *Emission and immunity of fixed power supply installations and apparatus.*

Introduction

This European Standard has been prepared in the form of a Product Standard.

It defines the immunity and emission test requirements for apparatus defined in the scope in relation to the electromagnetic disturbances likely to be experienced in the railway. In particular, the test requirements represent the essential electromagnetic immunity requirements and have been selected to ensure an adequate level of immunity for apparatus installed on the railway locations.

Test requirements are specified for each port considered.

Safety considerations are not covered by this standard.

In specific situations, where the level of disturbances may exceed the levels considered in this standard, e.g. at a special location or where a hand-held transmitter is used in very close proximity to an apparatus, special mitigation measures may have to be employed.

1 Scope

This European Standard applies to signalling and telecommunication apparatus that is installed inside the railway environment. Signalling and telecommunication apparatus mounted in vehicles is covered by EN 50121-3-2:2016, signalling and telecommunication apparatus installed inside the substation and connected to substation equipment is covered by EN 50121-5:2016.

This European Standard specifies limits for emission and immunity and provides performance criteria for signalling and telecommunications (S&T) apparatus (including power supply systems belonging to S&T) which may interfere with other apparatus inside the railway environment, or increase the total emissions for the railway environment and so risk causing Electro-Magnetic Interference (EMI) to apparatus outside the railway system.

The requirements specified in this standard apply for:

— vital equipment such as interlocking or command and control;

— apparatus inside the 3 m zone;

— ports of apparatus inside the 10 m zone with connection inside the 3 m zone;

— ports of apparatus inside the 10 m zone with cable length > 30 m.

Other apparatus not covered by at least one of these given cases should be in compliance with EN 61000-6-2.

If a port is intended to transmit or receive for the purpose of radio communication (intentional radiators, e.g. transponder systems), then the radiated emission requirement in this standard are not intended to be applicable to the intentional transmission from a radio-transmitter as defined by the ITU.

Immunity limits do not apply in the exclusion bands as defined in the corresponding EMC related standard for radio equipment.

The standard does not specify basic personal safety requirements for apparatus such as protection against electric shock, unsafe operation, insulation co-ordination and related dielectric tests. The requirements were developed for and are applicable to this set of apparatus when operating under normal conditions. Fault conditions of the apparatus have not been taken into account.

The frequency range considered is from DC to 400 GHz. No measurements need to be performed at frequencies where no requirement is specified.

For products in the scope of EN 61000-3-2, EN 61000-3-3, EN 61000-3-11 or EN 61000-3-12 the requirements of those standards also apply.

These specific provisions are to be used in conjunction with the general provisions in EN 50121-1:2016.

The immunity and emission levels do not of themselves guarantee that the integration of apparatus will necessarily be satisfactory. The standard cannot cover all the possible configurations of the apparatus, but the test levels are sufficient to achieve satisfactory EMC in the majority of cases.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50121-1:2017, *Railway applications — Electromagnetic compatibility — Part 1: General*

EN 55016-2-1:2014, *Specification for radio disturbance and immunity measuring apparatus and methods — Part 2-1: Methods of measurement of disturbances and immunity — Conducted disturbance measurements (CISPR 16-2-1:2014)*

EN 61000-4-2:2009, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test (IEC 61000-4-2:2008)*

EN 61000-4-3:2006, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3:2006)*

EN 61000-4-4:2012, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test (IEC 61000-4-4:2012)*

EN 61000-4-5:2014, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test (IEC 61000-4-5:2014)*

EN 61000-4-6:2014, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6:2013)*

EN 61000-4-8:2010, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test (IEC 61000-4-8:2009)*

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

EN 61000-6-4:2007[1], *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments (IEC 61000-6-4:2006)*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
port
particular interface of the specified apparatus with the external environment

EXAMPLE AC power port, DC power port, I/O (input/output) port, earth port.

[SOURCE: IEC 60050-821: CDV2015, 821-11-36]

3.1.2
enclosure port
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

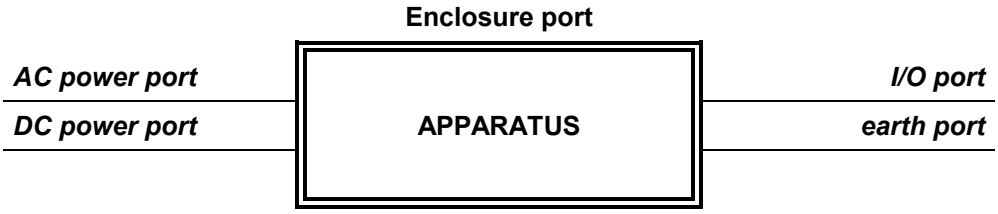

Figure 1 — Main categories of ports

[1] As impacted by EN 61000-6-4:2007/A1:2011

3.1.3
3 m zone
area along the railway line within a distance of 3 m from the centreline of the nearest track at both sides of the track

3.1.4
10 m zone
area along the railway line within a distance of 10 m from the centreline of the nearest track at both sides of the track

3.2 Abbreviations

AC	Alternating current
AM	Amplitude modulation
DC	Direct current
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
I/O	Input / Output
ITU	International Telegraph Union
S&T	Signalling and telecommunication

4 Description of location

The railway environment is characterized as described in EN 50121-1:2017.

5 Emission limits for apparatus

Apparatus which complies with the emission levels of EN 61000-6-4 is deemed to meet the emission requirements of this standard provided that emissions from any DC power port are within the emission limits specified for AC power ports.

The emission limits defined in Table 1 shall be complied with. The conducted emission limits shall apply to both AC and DC power ports. Where the apparatus is intended to be used in an environment other than the railway environment, then the emission limits given in the appropriate standards shall apply.

Table 1 — Emission — AC or DC power ports (input and output)

	Port	Test specification		Basic Standard	Test set-up	Applicability note	Remarks
1.1	**AC or DC power ports**	150 kHz to 500 kHz	79 dBµV quasi-peak 66 dBµV average	EN 55016–2-1	EN 55016–2-1	See [a]	
		500 kHz to 30 MHz	73 dBµV quasi-peak 60 dBµV average				

[a] Impulse noise (clicks) which occur less than five times per minute is not considered. For clicks appearing more often than 30 times per minute the limits apply. For clicks appearing between 5 and 30 times per minute, a relaxation of the limits is allowed of 20 log 30/N dB (where N is the number of clicks per minute). Criteria for separated clicks may be found in CISPR 14-1.

6 Immunity

6.1 Performance criteria

The variety and diversity of the apparatus within the scope of this document makes it difficult to define precise criteria for the evaluation of the immunity test results. Three general levels of performance are therefore used, as defined in EN 50121-1:2017.

6.2 Immunity requirements

The immunity requirements for apparatus covered by this standard are given on a port by port basis.

Test requirements are specified for each port considered.

Tests shall be conducted in a well-defined and reproducible manner. The tests shall be carried out as single tests in sequence. The sequence of testing is optional. The description of the test, the test generator, the test methods and the test set-up are given in the Basic Standards referred to in Tables 2 to 6.

If the apparatus has a large number of similar ports or ports with many similar connections, then a sufficient number shall be selected to simulate actual operating conditions and to ensure that all the different types of termination are covered (e.g. 20 % of the ports or at least four ports).

The immunity levels given for the apparatus will in most cases allow the apparatus to perform as intended inside the railway environment. The immunity level establishes a common reference for evaluating the performance of the apparatus when subject to interference resulting from direct exposure of the apparatus and associated cables to a radio frequency field, or by coupling of the interference from a remote source.

The contents of the Basic Standards are not repeated here; however, additional information needed for the practical application of the tests is given where appropriate.

Voltages induced by traction currents are not treated here. They have to be covered by the functional specification.

Table 2 — Immunity – Enclosure ports

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
2.1	**Radio-frequency electromagnetic field. Amplitude modulated**	80 MHz to 800 MHz 10 V/m (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–3	EN 61000–4–3		The test level specified is the rms value of the unmodulated carrier	**A**
2.2	**Radio-frequency electromagnetic field**	800 MHz to 1 000 MHz 20 V/m (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–3	EN 61000–4–3		The test level specified is the rms value of the unmodulated carrier These tests are intended to simulate disturbances from digital communication devices	**A**
		1 400 MHz to 2 000 MHz 10 V/m (rms) 80 % AM, 1 kHz	Unmodulated carrier					
		2 000 MHz to 2 700 MHz 5 V/m (rms) 80 % AM, 1 kHz	Unmodulated carrier					
		5 100 MHz to 6 000 MHz 3 V/m (rms) 80 % AM, 1 kHz	Unmodulated carrier					

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
2.3	**Power - frequency magnetic field**	16,7 Hz 100 A/m 50 Hz 100 A/m 0 Hz 300 A/m		EN 61000–4–8	EN 61000–4–8	See [a]	All frequencies have to be tested Testing time is ≥ 10s	**A**
2.4	**Electrostatic discharge**	±6 kV ±8 kV	Contact discharge Air discharge	EN 61000–4–2	EN 61000–4–2	See [b]		**B**

[a] Test only applies to apparatus containing devices sensitive to magnetic fields e.g. Hall elements, electro-dynamic microphones etc. Unshielded CRT displays can exhibit interference effects above 1 A/m (rms). Equipment mounted directly on the running rails is not covered as higher field strength may occur.

[b] Only applicable to equipment accessible to members of the public and operational staff (not maintenance staff) otherwise levels specified in EN 61000–6–2 apply.

Table 3 — Immunity – I/O ports

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
3.1	**Radio-frequency common mode**	0,15 MHz to 80 MHz 10 V (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–6	EN 61000–4–6	See [a] [b] [e]	The test level specified is the rms value of the unmodulated carrier	**A**
3.2	**Fast transients**	±2 kV 5/50 ns 5 kHz	Peak T_r / T_h Repetition frequency	EN 61000–4–4	EN 61000–4–4	See [e]	Capacitive clamp used	**A**
3.3	**Surges**	1,2 / 50 µs ±2 kV ±1 kV	Open circuit test voltage, line to earth Open circuit test voltage, line to line	EN 61000–4–5	EN 61000–4–5	See [c] [d] [e]	All severity levels below the given severity level have to be tested with 5 pulses for each severity level and a test sequence not alternating but starting with one polarity followed by the other polarity	**B**

[a] Applicable only to ports interfacing with cables whose total length according to the manufacturer's specification may exceed 3 m.

[b] The test level can also be defined as the equivalent current into a 150 Ω load.

[c] An output impedance of 42 Ω (40 Ω and 2 Ω generator) and a coupling capacitance of 0,5 µF is specified.

[d] For telecommunication ports and other ports intended for connection to highly balanced pairs, a line to line test is not required.

[e] Ports directly connected to power ports or to the (public) low voltage network are classified as power ports also.

Table 4 — Immunity – DC power ports

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
4.1	**Radio-frequency common mode**	0,15 MHz to 80 MHz 10 V (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–6	EN 61000–4–6	See [a]	The test level specified is the rms value of the unmodulated carrier	**A**
4.2	**Fast transients**	±2 kV 5/50 ns 5 kHz	Peak T_r / T_h Repetition frequency	EN 61000–4–4	EN 61000–4–4			**A**
4.3	**Surges**	1,2 / 50 µs ±2 kV ±1 kV	Open circuit test voltage, line to earth Open circuit test voltage, line to line	EN 61000–4–5	EN 61000–4–5	See [b]	All severity levels below the given severity level have to be tested with 5 pulses for each severity level and a test sequence not alternating but starting with one polarity followed by the other polarity	**B**

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

[b] When the power supply is isolated from earth, an output impedance of 42 Ω (40 Ω and 2 Ω generator) and a coupling capacitance of 0,5 µF are recommended.

Table 5 — Immunity – AC power ports

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
5.1	**Radio-frequency common mode**	0,15 MHz to 80 MHz 10 V (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–6	EN 61000–4–6	See [a]	The test level specified is the rms value of the unmodulated carrier	**A**
5.2	**Fast transients**	±2 kV 5/50 ns 5 kHz	Peak T_r / T_h Repetition frequency	EN 61000–4–4	EN 61000–4–4			**A**
5.3	**Surges**	1,2 / 50 µs ±2 kV ±1 kV	 Open circuit test voltage, line to earth Open circuit test voltage, line to line	EN 61000–4–5	EN 61000–4–5		All severity levels below the given severity level have to be tested with 5 pulses for each severity level and a test sequence not alternating but starting with one polarity followed by the other polarity	**B**

[a] The test level can also be defined as the equivalent current into a 150 Ω load.

Table 6 — Immunity – Earth ports

	Environmental phenomena	Test specification		Basic Standard	Test set-up	Applicability note	Remarks	Performance criteria
6.1	**Radio-frequency common mode**	0,15 MHz to 80 MHz 10 V (rms) 80 % AM, 1 kHz	Unmodulated carrier	EN 61000–4–6	EN 61000–4–6		The test level specified is the rms value of the unmodulated carrier	**A**
6.2	**Fast transients**	±1 kV 5/50 ns 5 kHz	Peak T_r / T_h Repetition frequency	EN 61000–4–4	EN 61000–4–4			**A**

Annex ZZ
(informative)

Relationship between this European Standard and the essential requirements of Directive 2014/30/EU [2014 OJ L96] aimed to be covered

This European Standard has been prepared under a Commission's standardization request as regards harmonized standards in support of Directive 2014/30/EU relating to electromagnetic compatibility, to provide one voluntary means of conforming to essential requirements of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Table ZZ.1 — Correspondence between this European standard and Annex I of Directive 2014/30/EU [2014 OJ L96]

Essential requirements of Directive 2014/30/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
Electromagnetic disturbances (emissions), Article 6 and Annex I(1)(a)	Clause 5, Emission limits for apparatus	
Electromagnetic immunity to electromagnetic disturbances (immunity), Article 6 and Annex I(1)(b)	Clause 6, Immunity	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

Bibliography

EN 50121-3-2:2016, *Railway applications — Electromagnetic compatibility — Part 3-2: Rolling stock — Apparatus*

EN 61000-3-2:2006, *Electromagnetic compatibility (EMC) — Part 3-2: Limits — Limits for harmonic current emissions (equipment input current <= 16 A per phase)(IEC 61000-3-2:2005)*

EN 61000-3-3:2013, *Electromagnetic compatibility (EMC) — Part 3-3: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current <= 16 A per phase and not subject to conditional connection (IEC 61000-3-3:2013)*

EN 61000-3-11:2000, *Electromagnetic compatibility (EMC) — Part 3-11: Limits — Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems — Equipment with rated current <= 75 A and subject to conditional connection (IEC 61000-3-11:2000)*

EN 61000-3-12:2011, *Electromagnetic compatibility (EMC) — Part 3-12: Limits — Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and <= 75 A per phase (IEC 61000-3-12:2011)*

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