BRITISH STANDARD

BS EN
50121-4:2006
*Incorporating corrigendum May 2008*

# Railway applications — Electromagnetic compatibility —

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

ICS 33.100.01; 29.280; 45.020



BSI
British Standards

# National foreword

This British Standard is the UK implementation of EN 50121-4:2006, incorporating corrigendum May 2008. It supersedes BS EN 50121-4:2000 which is withdrawn.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CENELEC corrigendum May 2008 is indicated in the text by [AC1] 〈AC1〉.

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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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2006



ISBN 978 0 580 63368 3

**Amendments/corrigenda issued since publication**

| Date | Comments |
|---|---|
| 31 October 2008 | Implementation of CENELEC corrigendum May 2008 |
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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 50121-4

July 2006

ICS 29.020; 29.280; 45.020

Supersedes EN 50121-4:2000
Incorporating corrigendum May 2008

English version

# Railway applications - Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus

Applications ferroviaires - Compatibilité électromagnétique Partie 4: Emission et immunité des appareils de signalisation et de télécommunication

Bahnanwendungen - Elektromagnetische Verträglichkeit Teil 4: Störaussendungen und Störfestigkeit von Signal- und Telekommunikationseinrichtungen

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Ref. No. EN 50121-4:2006 E

## Foreword

This European Standard was prepared by Technical Committee TC 9X: Electrical and electronic applications for railways. The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50121-4 on 2006-07-01.

This European Standard supersedes EN 50121-4:2000.

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

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

The following dates were fixed:

| | | |
|---|---|---|
| latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2007-07-01 |
| latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2009-07-01 |

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EC Directive [AC1] 2004/108/EC [AC1]. See Annex ZZ.

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## 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 in the railway locations.

Test requirements are specified for each port considered.

Safety considerations are not covered by this standard.

In special 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 which is installed in the railway environment. Signalling and telecommunication apparatus mounted in vehicles is covered by EN 50121-3-2.

This standard specifies limits for emission and immunity and provides performance criteria for signalling and telecommunications (S&T) apparatus which may interfere with other apparatus in the railway environment, or increase the total emissions for the railway environment beyond the limits defined in the appropriate standard and so risk causing Electro-Magnetic Interference (EMI) to apparatus outside the railway system.

Apparatus which complies with the emission levels of EN 61000-6-4 will meet the emission requirements of this standard provided that emissions from any d.c. power port are within the emissions limits specified for a.c. power ports. The immunity levels of EN 61000-6-2 will also be adequate except for the special case of apparatus as defined in note 1 of Table 1. This standard provides the immunity requirements for such apparatus.

The immunity levels given for the apparatus will in most cases allow the apparatus to perform as intended in the railway environment (see note). 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.

If a port is intended to transmit or receive for the purpose of radio communication (intentional radiators. e.g. transponder systems), then the emission and immunity limits in this standard at the communication frequency do not apply.

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 requirements and test methods also apply to telecommunications and signalling data and power lines connected to the equipment under test (EUT).

The frequency range considered is from d.c. 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 or EN 61000-3-3, the requirements of those standards apply.

Testing methods are given in the basic standards listed in Clause 2, Normative references.

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

NOTE 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 referenced documents are indispensable for the application of this document. 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 | Railway applications – Electromagnetic compatibility<br>Part 1: General |
| EN 50121-3-2 | Railway applications – Electromagnetic compatibility<br>Part 3-2: Rolling stock – Apparatus |
| EN 61000-3-2 | Electromagnetic compatibility (EMC) –<br>Part 3-2: Limits – Limits for harmonic current emissions (equipment input current up to and including 16 A per phase) (IEC 61000-3-2) |
| EN 61000-3-3 | Electromagnetic compatibility (EMC) –<br>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) |
| EN 61000-4-1 | Electromagnetic compatibility (EMC) –<br>Part 4-1: Testing and measurement techniques – Overview of IEC 61000-4 series (IEC 61000-4-1) |
| EN 61000-4-2 | Electromagnetic compatibility (EMC) –<br>Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test (IEC 61000-4-2) |
| EN 61000-4-3 | Electromagnetic compatibility (EMC) –<br>Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3) |
| EN 61000-4-4 | Electromagnetic compatibility (EMC) –<br>Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test (IEC 61000-4-4) |
| EN 61000-4-5 | Electromagnetic compatibility (EMC) –<br>Part 4-5: Testing and measurement techniques – Surge immunity test (IEC 61000-4-5) |
| EN 61000-4-6 | Electromagnetic compatibility (EMC) –<br>Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields (IEC 61000-4-6) |
| EN 61000-4-8 | Electromagnetic compatibility (EMC) –<br>Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test (IEC 61000-4-8) |
| EN 61000-4-9 | Electromagnetic compatibility (EMC) –<br>Part 4-9: Testing and measurement techniques – Pulse magnetic field immunity test (IEC 61000-4-9) |
| EN 61000-6-2 | Electromagnetic compatibility (EMC) –<br>Part 6-2: Generic standards – Immunity for industrial environments (IEC 61000-6-2) |

EN 61000-6-4 Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments (IEC 61000-6-4, mod.)

## 3 Definitions

For the purpose of this Part 4 of the European Standard, the following definitions apply.

**3.1**
**port**
particular interface of the specified apparatus with the external environment e.g. a.c. power port, d.c. power port, I/O (input/output) port, earth port

**3.2**
**enclosure port**
physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

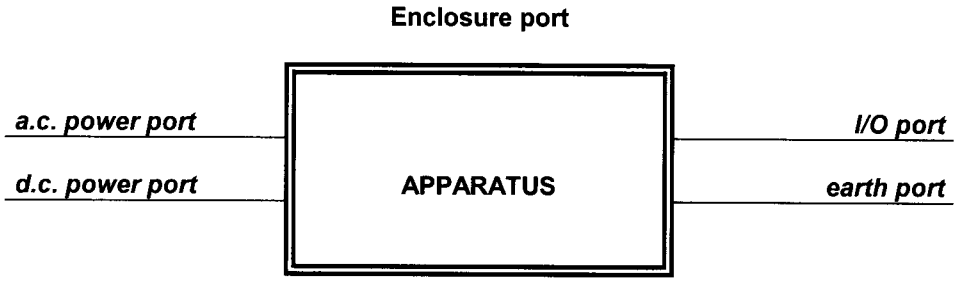


**Figure 1 – Main categories of ports**

## 4 Description of location

The railway environment is characterised as described in EN 50121-1. Special consideration is given in this standard to apparatus intended to be installed within 3 m of the centreline of the nearest track and as defined in note 1 of Table 1.

NOTE Tests covering compatibility with specific items of signalling equipment may be required.

## 5 Emission limits for apparatus

The maximum emissions permitted by EN 61000-6-4 shall be complied with. The conducted emission limits shall apply to both a.c. and d.c. power ports. A measurement distance of 10 m may be used with the limits increased by 10 dB for the radiated emission of the enclosure port. 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.

If the field-strength measurement at 10 m or 30 m cannot be made because of high ambient noise levels, or for other reasons, measurements may be made at a closer distance, for example 3 m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance. Care should be taken in the measurement of large EUTs at 3 m at frequencies near 30 MHz, due to the near field effects.

## 6 Immunity

### 6.1 Performance criteria

It is impossible to define precise criteria for the evaluation of the apparatus within the scope of this document, but performance criteria are as specified in EN 50121-1, unless otherwise stated.

### 6.2 Test requirements

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

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 1 to 5. If the apparatus has a large number of similar 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.

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 1 – Immunity – Enclosure port**

| | Environmental phenomena | Test specification | | Basic Standard | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| 1.1 | **Radio-frequency electromagnetic field. Amplitude modulated** | 80 MHz ... 1 000 MHz<br>10 V/m (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-3 | EN 61000-4-3 | The test level specified is the r.m.s. value of the unmodulated carrier | **A** |
| 1.2 | **Radio-frequency electromagnetic field, from digital mobile telephones** | 800 MHz ... 1 000 MHz<br>20 V/m (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-3 | EN 61000-4-3 | See note 1 | **A** |
| | | 1 400 MHz...2 100 MHz<br>10 V/m (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | | | | |
| | | 2 100 MHz...2 500 MHz<br>5 V/m (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | | | | |
| 1.3 | **Power - frequency magnetic field** | 16,7 Hz<br>50 Hz<br>0 Hz<br>100 A/m (r.m.s)<br>300 A/m | <br><br>d.c<br>a.c. systems<br>d.c. systems | EN 61000-4-8 | EN 61000-4-8 | See note 1 & 2<br>All frequencies have to be tested | **A** |
| 1.4 | **Electrostatic discharge** | ± 6 kV<br>± 8 kV | Contact discharge<br>Air discharge | EN 61000-4-2 | EN 61000-4-2 | See note 3 | **B** |
| 1.5 | **Pulsed magnetic field** | 300 A/m | | EN 61000-4-9 | EN 61000-4-9 | See note 1 | **B** |

NOTE 1 The tests given apply to apparatus inside 3 m – zone and vital equipment such as interlocking or command and control which are mounted in areas where a high risk of interference from mobile radio telephones has been identified. For other apparatus within the railway environment, requirements of EN 61000-6-2 apply.

NOTE 2 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).

NOTE 3 Only applicable to equipment accessible to members of the public and operational staff (not maintenance).

## Table 2 – Immunity – I/O port

| | Environmental phenomena | Test specification | | Basic Standard | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| 2.1 | **Radio-frequency common mode** | 0,15 MHz ... 80 MHz<br>10 V (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-6 | EN 61000-4-6 | See note 1, 2 & 5<br>The test level specified is the r.m.s. value of the unmodulated carrier | **A** |
| 2.2 | **Fast transients** | ± 2 kV<br>5/50 ns<br>5 kHz | Peak<br>$T_r$ / $T_h$<br>Repetition frequency | EN 61000-4-4 | EN 61000-4-4 | See note 1<br>Capacitive clamp used | **A** |
| 2.3 | **Surges** | 1,2 / 50 µs<br>± 2 kV<br>± 1 kV | Open circuit test voltage, line to earth<br>Open circuit test voltage, line to line | EN 61000-4-5 | EN 61000-4-5 | See notes 1, 3 & 4 | **B** |

NOTE 1 This test applies to I/O Port connected to cable inside 3 m - boundary or connected to cable longer than 30 m within 10 m boundary.
I/O ports connected to cable other than above shall comply with the requirements of EN 61000-6-2 except that Note 2 of Table 3 of EN 61000-6-2 is not applicable.

NOTE 2 Applicable only to ports interfacing with cables whose total length according to the manufacturer's specification may exceed 3 m.

NOTE 3 This test is intended to replicate the phenomenon known as direct coupling; hence an output impedance of 42 Ω (40 Ω and 2 Ω generator) and a coupling capacitance of 0,5 µF is recommended.

NOTE 4 For telecommunication ports and other ports intended for connection to highly balanced pairs, a line to line test is not required.

NOTE 5 The test level can also be defined as the equivalent current into a 150 Ω load.

## Table 3 – Immunity – D.C. power ports

| | Environmental phenomena | Test specification | | Basic Standard | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| 3.1 | **Radio-frequency common mode** | 0,15 MHz ... 80 MHz<br>10 V (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-6 | EN 61000-4-6 | See note 2<br>The test level specified is the r.m.s. value of the unmodulated carrier | **A** |
| 3.2 | **Fast transients** | ± 2 kV<br>5/50 ns<br>5 kHz | Peak<br>$T_r$ / $T_h$<br>Repetition frequency | EN 61000-4-4 | EN 61000-4-4 | | **A** |
| 3.3 | **Surges** | 1,2 / 50 µs<br>± 2 kV<br>± 1 kV | Open circuit test voltage, line to earth<br>Open circuit test voltage, line to line | EN 61000-4-5 | EN 61000-4-5 | See note 1 | **B** |

NOTE 1 This test is intended to replicate the phenomena known as direct coupling. 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. When the power supply is not isolated from earth, an output impedance of 12 Ω (10 Ω and 2 Ω generator) and a coupling capacitance of 9 µF are recommended. These requirements are for cable-length above 30 m.

NOTE 2 The test level can also be defined as the equivalent current into a 150 Ω load.

## Table 4 – Immunity – A.C. power ports

| | Environmental phenomena | Test specification | | Basic Standard | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| 4.1 | **Radio-frequency common mode** | 0.15 MHz ... 80 MHz<br>10 V (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-6 | EN 61000-4-6 | See note 2<br>The test level specified is the r.m.s. value of the unmodulated carrier | **A** |
| 4.2 | **Fast transients** | ± 2 kV<br>5/50 ns<br>5 kHz | Peak<br>$T_r$ / $T_h$<br>Repetition frequency | EN 61000-4-4 | EN 61000-4-4 | | **A** |
| 4.3 | **Surges** | 1,2 / 50 µs<br>± 2 kV<br>± 1 kV | Open circuit test voltage, line to earth<br>Open circuit test voltage, line to line | EN 61000-4-5 | EN 61000-4-5 | See note 1 | **B** |
| NOTE 1 This test is intended to replicate the phenomena known as direct coupling; hence an output impedance of 12 Ω (10 Ω and 2 Ω generator) and a coupling capacitance of 9 µF is recommended.<br>NOTE 2 The test level can also be defined as the equivalent current into a 150 Ω load. | | | | | | | |

## Table 5 – Immunity – Earth port

| | Environmental phenomena | Test specification | | Basic Standard | Test set-up | Remarks | Performance criteria |
|---|---|---|---|---|---|---|---|
| 5.1 | **Radio-frequency common mode** | 0,15 MHz ... 80 MHz<br>10 V (r.m.s)<br>80 % AM, 1 kHz | Unmodulated carrier | EN 61000-4-6 | EN 61000-4-6 | See note 1 & 2<br>The test level specified is the r.m.s. value of the unmodulated carrier | **A** |
| 5.2 | **Fast transients** | ± 1 kV<br>5/50 ns<br>5 kHz | Peak<br>$T_r$ / $T_h$<br>Rep. frequency | EN 61000-4-4 | EN 61000-4-4 | See note 1 | **A** |
| NOTE 1 Test may not be practicable with cable length less than 3 m.<br>NOTE 2 The test level can also be defined as the equivalent current into a 150 Ω load. | | | | | | | |

## ⟨AC1⟩ Annex ZZ
(informative)

## Coverage of Essential Requirements of EC Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Annex I, Article 1(b) of the EC Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned.

WARNING: Other requirements and other EC Directives may be applicable to the products falling within the scope of this standard. ⟨AC1⟩

**BS EN 50121-4:2006**

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