



SLOVENSKI STANDARD
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Železniške naprave - Tehnični parametri sistemov za detekcijo vlaka, ki zagotavljajo interoperabilnost vseevropskega železniškega sistema - 2. del: Števci osi

Railway applications - Technical parameters of train detection systems for the interoperability of the trans-European railway system - Part 2: Axle counters

Bahnanwendungen - Technische Parameter von Gleisfreimeldesystemen - Teil 2: Achszähler

Applications ferroviaires - Paramètres techniques des systèmes de détection des trains - Partie 2: Compteurs d'essieux

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Bahnanwendungen - Technische Parameter von Gleisfreimeldesystemen für die Interoperabilität des transeuropäischen Eisenbahnsystems - Teil 2: Achszähler

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European foreword

This document (EN 50617-2:2024) has been prepared by CLC/SC 9XA “Communication, signalling and processing systems” of 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) 2025-09-23
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2027-09-23

This document supersedes EN 50617-2:2015 and all of its amendments and corrigenda (if any).

EN 50617-2:2024 includes the following significant technical changes with respect to EN 50617-2:2015:

- Annex D: new informative annex for intermodulation effects potentially affecting the compatibility limits for Rolling Stock

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

This document is Part 2 of the EN 50617 series, which consists of the following parts under the common title “*Railway Applications - Technical parameters of train detection systems*”:

- Part 1: Track circuits;
- Part 2: Axle counters.

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

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Introduction

The working group SC9XA WGA4-2 has developed the limits for electromagnetic compatibility between rolling stock and individual train detection systems, specifically track circuits and axle counter systems and correspondingly published two technical specifications CLC/TS 50238-2 and CLC/TS 50238-3. These limits and associated measurement methods are based on preferred existing systems (as defined in CLC/TS 50238-2 and CLC/TS 50238-3) which are well established and still put forward for signalling renewals by infrastructure managers.

To meet the requirements for compatibility between train detection systems and rolling stock in the future and to achieve interoperability and free movement within the European Union, ERA/ERTMS/033281 defines the relevant parameters for compatibility of rolling stock with track circuits and axle counter systems.

The train detection systems, track circuits and axle counters are an integral part of the CCS trackside subsystem in the context of the Rail Interoperability Directive. The relevant technical parameters are enumerated in the CCS and LOC&PAS TSI and ERA/ERTMS/033281. ERA/ERTMS/033281 specifies the relevant parameters for rolling stock for compatibility with the infrastructure. This document covers all relevant technical parameters of train detection systems (axle counter) in a manner that provides a presumption of conformity with interoperability requirements, but is not limited to interoperable lines. This document refers whenever needed to ERA/ERTMS/033281. Although the demand for FrM is driven by Interoperability requirements, it is independent from the drive to introduce systems like ERTMS level 3 or level 2.

This document is based on the current understanding of the railway experts represented at WGA4-2 that track circuits and axle counter systems will continue to be the essential two train detection systems for the foreseeable future.

The published specification EN 50592 can be used to ascertain conformity of rolling stock with the FrM presented in ERA/ERTMS/033281.

The published specification CLC/TS 50238-3 can be used to ascertain conformity of rolling stock with existing individual axle counter detectors.

In this document, the defined parameters are structured and allocated according to their basic references as follows:

— axle counter system parameters; [SIST EN 50617-2:2025](https://standards.iteh.ai/catalog/standards/sist/00fa748e-ff1e-4b68-8b33-bf8bf57e49fc/sist-en-50617-2-2025)

— train based parameters;

— track based parameters;

— environmental and other parameters.

Where possible, the parameters as defined are consistent with other European Standards.

Each parameter is defined by a short general description, the definition of the requirement, the relation to other standards and a procedure to show the fulfilment of the requirement as far as necessary. An overview of the safety relevance of each parameter is given – in the context of this document – in a separate table.

1 Scope

This document specifies parameters for the design and usage of axle counter systems.

For this, this document specifies the technical parameters of axle counter systems associated with the magnetic field limits for RST in the context of interoperability. In addition, test methods are defined for establishing the conformity and the performance of an axle counter detector.

This document is intended to be used to assess compliance of axle counter systems and other forms of wheel sensors used for train detection, in the context of the European Directive on the interoperability of the trans-European railway system and the associated technical specification for interoperability relating to the control-command and signalling track-side subsystems.

This document can also be used for axle counter systems installed on lines which are not declared as interoperable (including metro and tram lines).

For wheel sensors and wheel detectors in other applications than axle counters but using the same sensors on the rail and detection circuits, transient and continuous interference can be considered as equivalent to axle counter detectors or axle counter sensors.

Under interoperability, the frequency bands and rolling stock emission limits are currently defined in the axle counter FrM as specified in the ERA/ERTMS/033281 document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 16432-1:2017, *Railway applications - Ballastless track systems - Part 1: General requirements*

EN 50121-4:2016, *Railway applications - Electromagnetic compatibility - Part 4: Emission and immunity of the signalling and telecommunications apparatus*

EN 50124-2:2017, *Railway applications - Insulation coordination - Part 2: Overvoltages and related protection*

EN 50125-3:2003, *Railway applications - Environmental conditions for equipment - Part 3: Equipment for signalling and telecommunications*

EN 50126-1:2017, *Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 1: Generic RAMS Process*

EN 50126-2:2017, *Railway Applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part 2: Systems Approach to Safety*

EN 50128:2011, *Railway applications - Communication, signalling and processing systems - Software for railway control and protection systems*

EN 50129:2018, *Railway applications - Communication, signalling and processing systems - Safety related electronic systems for signalling*

EN 50592:2016, *Railway applications - Testing of rolling stock for electromagnetic compatibility with axle counters*

EN 60068-2-1:2007, *Environmental testing - Part 2-1: Tests - Test A: Cold (IEC 60068-2-1:2007)*

EN 60068-2-2:2007, *Environmental testing - Part 2-2: Tests - Test B: Dry heat (IEC 60068-2-2:2007)*

EN 60068-2-30:2005, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30:2005)*

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EN 60529:1991,¹ *Degrees of protection provided by enclosures (IP Code) (IEC 60529)*

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)*

ERA/ERTMS/033281, *Interfaces between control-command and signalling trackside and other subsystems*

3 Terms, definitions and abbreviations**3.1 Terms and definitions**

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1.1**antenna for generating magnetic fields****FGA**

square loop antenna to generate the magnetic fields for testing of the immunity

3.1.2**axle counter detector****ACD**

detector consisting of the axle counter sensor and of the detection circuit, which includes in general filters and rectifiers

3.1.3**axle counter sensor**

sensor head mounted in the track

3.1.4**axle counter system**

whole system including the axle counter detector with its sensor, and the evaluation unit

3.1.5**bandwidth**

difference between the upper and lower frequencies in a contiguous set of frequencies and is typically measured in Hz

3.1.6**equipment under test****EUT**

set of ACD connected to a rail

3.1.7**immunity level**

maximum level of interfering signal at which the correct operation of the equipment is granted to be in line with expectations

¹ As impacted by EN 60529:1991/A1:2000, EN 60529:1991/A2:2013, EN 60529:1991/AC:2016-12 and EN 60529:1991/A2:2013/AC:2019-02,

3.1.8**in-band**

in the working frequency range of an ACD

3.1.9**inflection point**

transition between the static (continuous wave) and dynamic immunity (short duration) behaviour of the ACD

3.1.10**integration time**

window size over which the root mean square (RMS) of the output of the band-pass filter is calculated

3.1.11**measurement antenna**

antenna mounted on the rail to capture magnetic field

Note 1 to entry: The measurement covers the axes X, Y and Z.

3.1.12**out-of-band**

outside of the working frequency range of an ACD

3.1.13**right-side failure****RSF**

failure in the signalling system that leaves the system in a safe condition

[SOURCE: IEC 60050-821:2017, 821-05-80, modified – “of an item of signalling equipment which cannot result in any hazard to the safety of railway traffic” has been replaced with “in the signalling system that leaves the system in a safe condition”.]

3.1.14**sinusoidal sway**

movement of a wheel of a running train in the y-direction, which influences the distance of the wheel flange in relation to the head of the rail

3.1.15**working frequency range**

frequency range or field where the sensors are operating

3.1.16**wrong side failure****WSF**

failure in the signalling system which leaves the system in a dangerous condition

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

| | |
|-------|---|
| ACD | axle counter detector |
| AM | amplitude modulation |
| CCS | control-command and signalling |
| DC | direct current |
| EMC | electromagnetic compatibility |
| ERTMS | European Rail Traffic Management System |

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| | |
|-------|---|
| ETCS | European Train Control System |
| EUT | equipment under test |
| FFFIS | form fit functional interface specification |
| FGA | field generating antenna |
| FrM | frequency management as defined in ERA/ERTMS/033281 |
| FSK | frequency shift key |
| HR | hazard rate |
| IM | infrastructure manager |
| IP | International Protection |
| IR | Infrared (electromagnetic radiation) |
| IPxx | ingress protection (rating) |
| LC | inductor/capacitor resonant circuit |
| MIZ | metallic influencing zone |
| MTBF | mean time between failure |
| MTTR | mean time to repair |
| PS | power supply |
| RMS | root mean square |
| RSF | right-side failure |
| RST | rolling stock |
| SIL | safety integrity level |
| TEU | trackside electronic unit |
| THR | tolerable hazard rate |
| TSI | technical specification for interoperability |
| UV | ultraviolet (electromagnetic radiation) |
| WSF | wrong side failure |

4 Description of train detection system

Train detection systems for route proving as a fully automatic train detection system are integrated into railway signalling and safety systems. The train detection is part of the route proving procedure contributing to a safe and reliable railway operation.

The train detection equipment provides information about whether track sections are clear of or occupied by rail vehicles.

Axle counter systems operate on the principle of difference calculation. The evaluation unit evaluates the signals received from each counting head associated with a section, compares the number of axles which have entered the train detection section with the number of axles which have left this section and generates a “track clear” or “track occupied” indication.

Figure 1 defines the system boundaries of a train detection system using axle counter systems:

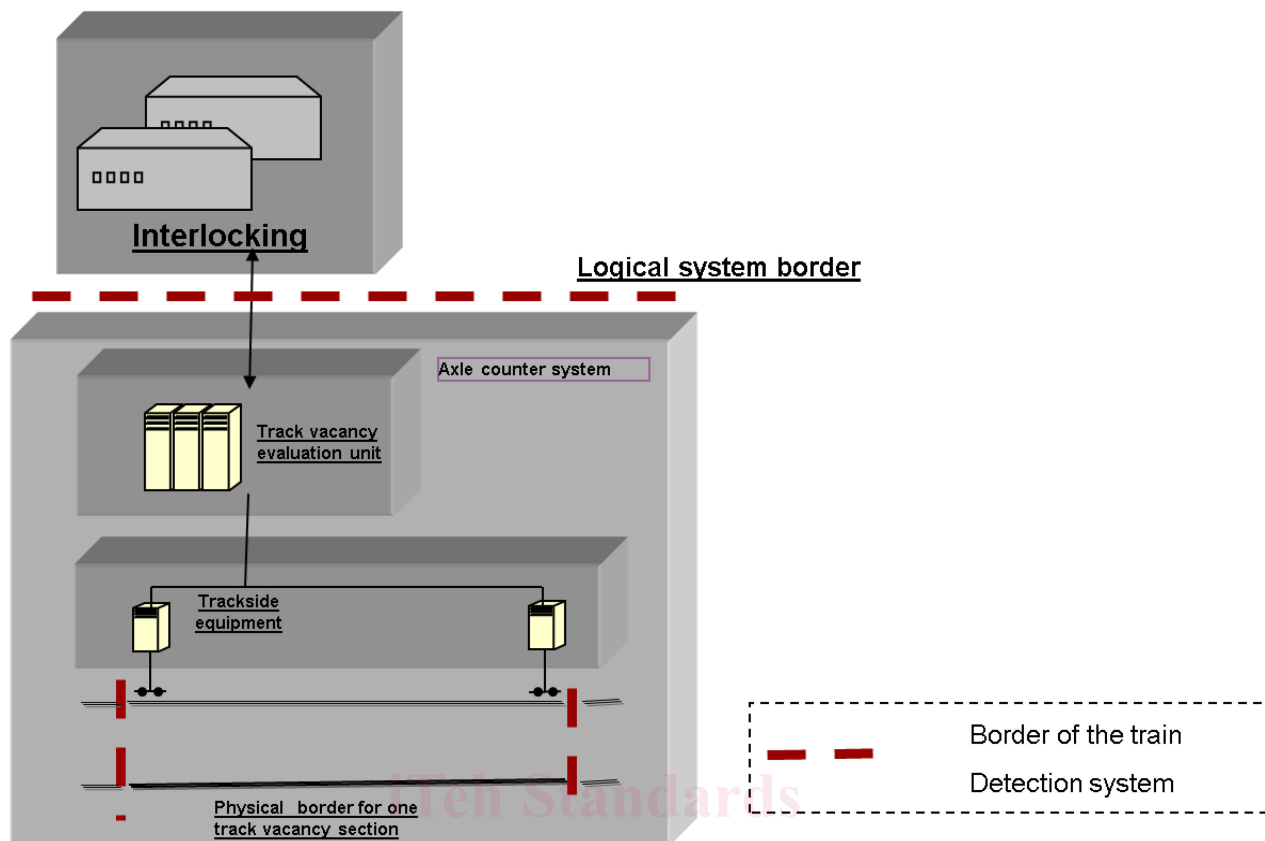


Figure 1 — System boundary of an axle counter system

5 Safety relevance per parameter

There are two degrees of safety relevance which may be assigned to the technical parameters of axle counter systems (see Table 1):

NOTE The issue safety relevance is defined in general in EN 50126-1:2017, EN 50126-2:2017 and EN 50129:2018 (see also 6.1.5). The information below is given only with respect to the parameters defined in this document. Table 1 gives an indication on the relationship between individual parameters and functional safety.

— Direct safety relevant parameters:

Failure to meet the direct safety relevant requirement can result directly in a wrong side failure.

— Indirect safety relevant parameters:

Failure to meet the indirect safety relevant requirement can cause a right-side failure but can also result in the occurrence of a second failure or human error which could subsequently lead to an accident, for example every not autocorrected fault count will lead to a reset of the section, which itself is a safety issue.

Indirect safety relevant parameters are generally availability related. A deviation can result in a reset being required. Human error can then lead to an accident.

The consequences of right-side failures and errors shall therefore be evaluated in the context of risk analysis and appropriately mitigated in the equipment and system design, and in the operational rules.

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Table 1 — Overview of safety relevance in the subclauses

| Subclause | Direct safety relevance (no indicates indirect safety relevance) |
|---|---|
| 6.1.2 Availability | no |
| 6.1.4 Maintainability | no |
| 6.1.5 Safety | yes |
| 6.2 Immunity against Magnetic fields – in-band and out-of-band | no |
| 6.1.6.2 Maximum time between train runs | no |
| 6.3 Immunity to traction and short circuit current in the rail | no |
| 6.4 Immunity to harmonics of traction current in the rail | no |
| 6.5 Sensor position integrity control (functional parameter) | yes |
| 6.6 Integration time | no |
| 6.7 Signalling power supply quality with respect to availability | no |
| 6.8 Requirements on the connection cables | no |
| 7.2 Vehicle, wheel and speed dependent parameters | yes |
| 7.3 Material properties of vehicle parts in the detection area (metal free space) | no |
| 7.4 Sinusoidal sway of train | yes |
| 7.5 Magnetic track brakes and eddy current brakes | no |
| 8.1 Material of sleepers | no |
| 8.2 Rail fittings/mounting area | no |
| 8.3 Slab track | no |
| Clause 9 Environmental and other parameters | no |
| C.4.5.3 Immunity to multiple transients | no |

6 Axle counter system parameters

6.1 RAMS

6.1.1 General

RAMS performance shall be defined for the axle counter system which may control one or more sections. It can be assumed that one section consists of an average of about 1,3 axle counter detectors.

6.1.2 Reliability

Reliability is defined in EN 50126-1:2017, EN 50126-2:2017. A single reliability figure cannot be harmonized because it is a combination of qualitative and quantitative aspects.

6.1.3 Availability

The following information and definitions are derived from EN 50126-1:2017, EN 50126-2:2017.

The availability is one of the most significant parameters of an axle counter system. It is dependent on the sufficient immunity margin (compatibility margin between susceptibility threshold and the radiated emission level