SLOVENSKI STANDARD
SIST-TS CLC/TS 50238-3:2022

01-marec-2022

Nadomešča:
SIST-TS CLC/TS 50238-3:2020

Železniške naprave - Združljivost voznih sredstev in sistemov za detekcijo vlaka - 3. del: Združljivost s števci osi

Railway applications - Compatibility between rolling stock and train detection systems - Part 3: Compatibility with axle counters

Bahnanwendungen - Kompatibilität zwischen Fahrzeugen und Gleisfreimeldesystemen - Teil 3: Kompatibilität mit Achszähler

Applications ferroviaires - Compatibilité entre le matériel roulant et les systèmes de détection des trains - Partie 3: Compatibilité avec les compteurs d'essieux

Ta slovenski standard je istoveten z: CLC/TS 50238-3:2022

ICS:

03.220.30	Železniški transport	Transport by rail
45.060.01	Železniška vozila na splošno	Railway rolling stock in general

SIST-TS CLC/TS 50238-3:2022 **en**

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CLC/TS 50238-3

January 2022

ICS 29.280; 45.060.10

Supersedes CLC/TS 50238-3:2019

English Version

Railway applications - Compatibility between rolling stock and train detection systems - Part 3: Compatibility with axle counters

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This Technical Specification was approved by CENELEC on 2021-12-21.

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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. CLC/TS 50238-3:2022 E

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European foreword

This document (CLC/TS 50238-3:2022) has been prepared by CLC/SC 9XA “Communication, signalling and processing systems”, of Technical Committee CLC/TC 9X “Electrical and electronic applications for railways”.

This document supersedes CLC/TS 50238-3:2019.

CLC/TS 50238-3:2022 includes the following significant technical changes with respect to CLC/TS 50238-3:2019:

— any normative references to the ERA document ERA/ERTMS/033281 have been removed;

— amended and new limits in Annex A.

This document is Part 3 in the following series:

— EN 50238-1, *Railway applications – Compatibility between rolling stock and train detection systems – Part 1: General*;

— CLC/TS 50238-2, *Railway applications – Compatibility between rolling stock and train detection systems – Part 2: Compatibility with track circuits*;

— CLC/TS 50238-3, *Railway applications – Compatibility between rolling stock and train detection systems – Part 3: Compatibility with axle counters*.

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Introduction

This document defines the interference limits and evaluation criteria for electromagnetic compatibility between rolling stock and axle counter detectors.

The limits have been defined on the basis of a test specification defined in EN 50617-2[1] (laboratory tests).

This document defines:

— a set of interference limits for magnetic fields resulting from both rail current and equipment on board the vehicles;

— evaluation criteria to verify rolling stock emissions and demonstrate compatibility with the interference limits for magnetic fields;

— traceability of requirements (type of axle counter detectors considered for the limits).

In the relevant frequency range of the axle counter detectors, the magnetic field is dominant and only this type of field is considered. Experience has shown that the effects of electric fields are insignificant and therefore not considered.

1 Scope

For the purpose of demonstrating compatibility between rolling stock and axle counters, this document defines the interference limits for axle counter detectors and evaluation methods to verify rolling stock emissions.

Wheel sensors and crossing loops are not covered by this document.

For wheel sensors and wheel detectors in other applications than axle counters but utilizing 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.

This document gives recommended individual limits to be applied to establish compatibility between RST and all selected types of axle counter detectors, including several covered by national standards.

The list of selected types of axle counter detectors and their limits for compatibility are drawn on the basis of established performance criteria.

To ensure adequate operational availability, it is essential that the rolling stock complies with the defined limits; otherwise, the established availability of the valid output function of axle counter detectors could be compromised. The influences from metal parts or inductively coupled resonant circuits on the vehicle, eddy current brakes or magnetic brakes, are not covered by this 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 50238-1, *Railway applications - Compatibility between rolling stock and train detection systems - Part 1: General*

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

EN 50617-2:2015 [1], *Railway Applications – Technical parameters of train detection systems for the interoperability of the trans-European railway system – Part 2: Axle counters*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50238-1 and the following apply.

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

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
axle counter detector
detector consisting of the axle counter sensor and of the detection circuit, which includes in general filters and rectifiers

[SOURCE: EN 50617-2:2015[1], 3.1.2]

[1] As impacted by the corrigendum EN 50617-2:2015/AC:2016.

3.1.2
axle counter sensor
sensor head mounted in the track

[SOURCE: EN 50617-2:2015[1], 3.1.3]

3.1.3
axle counter system
whole system including the axle counter detector with its sensor and the evaluation unit

[SOURCE: EN 50617-2:2015[1], 3.1.4]

3.1.4
integration time
window size over which the root mean square (RMS) of the output of the band-pass filter is calculated

[SOURCE: EN 50617-2:2015[1], 3.1.12, modified – The beginning of the sentence “parameter for evaluation defined as the” has been removed]

3.2 Abbreviations

For the purposes of this document, the terms and definitions and abbreviations given in EN 50238-1 and the following apply.

AM	Amplitude Modulation
CW	Continuous Wave
DSL	Digital Subscriber Line
FSK	Frequency Shift Key
ISDN	Integrated Services Digital Network
RMS	root mean square
RST	Rolling Stock
T_{int}	Integration Time

4 General aspects

4.1 Interference mechanism

4.1.1 General

Axle counter detectors can be influenced in different ways, e.g. by magnetic fields or metallic parts in the vicinity of wheels and bogies and thus close to the sensors. The influence of magnetic fields on the immunity of the individual axle counter detector is dominant. In addition, the duration and/or repetition rate of interference and the magnetic field strength are also relevant.

4.1.2 Axle counter detector

The compatibility limits in this document are based on the immunity of axle counter detectors and are specified only for the axle counter detector – comprising the sensor on the rail and the detection circuits in the trackside equipment as shown in Figure 1.

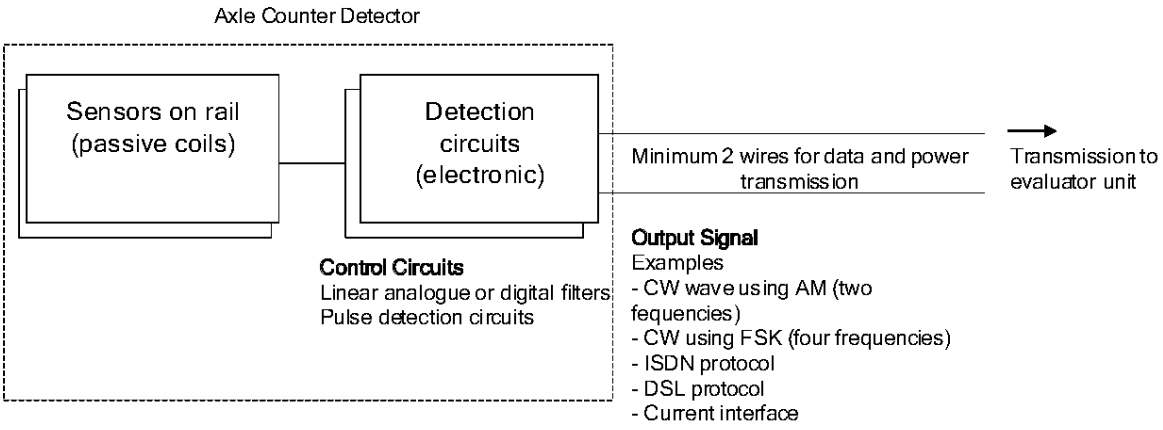

Figure 1 — Axle counter detector, schematic diagram

Axle counter detectors use various additional filter techniques and algorithms that reject interference pulses in order to maximize reliability while maintaining safety.

EXAMPLES

— Nonlinear pulse duration filters which reject wheel pulses of a duration less than the minimum wheel pulse from a vehicle;

— rejection of wheel pulses in one channel if the axle counter is already in an occupied status.

4.1.3 Susceptibility of the detector on the rail

The precise area of susceptibility is product specific. The position of the measurement antenna has been chosen to take into account the sensors listed in A.1.

The immunity (susceptibility limit) is defined as the magnetic field that can generate interference pulses or corrupt the wheel pulses of one or more channels of the axle counter detector.

The magnetic coupling between the transmission and reception units of the axle counter sensor depends among other things on the rail type. Large rail profiles like UIC 60 profiles, which provide higher attenuation of the receiver voltage, are therefore more critical with respect to the susceptibility.

4.1.4 Sources of interference fields

The following commonly known sources of interference are considered for immunity:

— magnetic fields generated by electrical equipment on the vehicle and coupled to the axle counter sensor through the air gap;

— rail currents, which include both currents circulated inside the vehicle and currents between the vehicle and infrastructure in the susceptibility range of operation of the axle counter sensor (hence referred to as rail current fields).

The interference fields from the two above defined sources are superimposed on the axle counter sensor whereby the vector of rail current fields has a predictable direction and the vector of magnetic fields has an unpredictable direction, because it is dependent on the source on the vehicle and on the type of rail.

4.2 Availability margin

Axle counter systems are assumed to fail right side if excessive interference leads to a malfunction because of additional control measures being implemented at a system level. A safety margin is therefore not required, but a margin is required to meet the performance requirements with regard to reliability of counting.

If the interference limit of the axle counter detector is exceeded and a resulting spurious wheel pulse is generated, this may or may not lead to a failure of the axle counter system.

A margin of 9 dB is included in the values in A.1, which accounts for the following factors:

— 6 dB signal to noise ratio to meet the probability requirements for miscount within the established equipment operating tolerances;

— 3 dB accounting for:

  — uncertainty of measuring chain;

  — positioning of the measurement antenna;

  — overlapping effects (analyzing methods);

  — other environmental effects affecting interference (rain, temperature, etc.).

4.3 Specific axle counter parameters

The interference susceptibility of axle counter detectors depends, among other things, on the amplitude and the duration, for which the interference magnetic field is present. For continuous interference, the limits are lower than for short duration (transient) interference.

5 Compatibility requirements

5.1 General

Individual axle counter limits for rolling stock for demonstrating compatibility with existing types of axle counter detectors are defined in Annex A or in NTRs where these exist.

Axle counter detector susceptibility shall be established in accordance with the immunity specification defined in EN 50617-2[1].

The corresponding measurement method and evaluation procedures for RST shall follow EN 50592.

5.2 Short duration interference limits

In case the limits specified in Table A.1 are exceeded and the minimum time interval between two successive exceedances is bigger than the integration time defined, further evaluation for short duration interference shall be conducted for reduced integration times. For the axle counter detectors addressed in this document, the emission limits and maximum time durations of exceedances for short-term interferences are listed in Table A.2.

The approach provided in EN 50592 can be used for evaluation of all kind of interference (e.g. also for repetitive traction noise) as long as the criteria at the filter output are fulfilled.

5.3 Mitigating arguments when limits are exceeded

Mitigating techniques may be used to achieve compatibility case for the vehicle in cases where exceedances from the emission limits in Table A.1 are recorded. The compatibility case shall follow the requirements in EN 50238-1. From practical experience, a compatibility case is not credible if rolling stock emissions are 25 dB above the limits stated in Table A.1 under any condition.