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Železniške naprave - Združljivost voznih sredstev in sistemov za detekcijo vlaka - 2. del: Združljivost s tirnimi tokokrogi

Railway applications - Compatibility between rolling stock and train detection systems - Part 2: Compatibility with track circuits

Bahnanwendungen - Kompatibilität zwischen Fahrzeugen und Gleisfreimeldesystemen - Teil 2: Kompatibilität mit Gleisstromkreisen

Applications ferroviaires - Compatibilité entre le matériel roulant et les systèmes de détection des trains - Partie 2 - Compatibilité avec les circuits de voie

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English Version

Railway applications - Compatibility between rolling stock and train detection systems - Part 2: Compatibility with track circuits

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This Technical Specification was approved by CENELEC on 2020-06-15.

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

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European foreword

This document (CLC/TS 50238-2:2020) 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 50238-2:2015 and its corrigendum of July 2016.

CLC/TS 50238-2:2020 includes the following significant technical changes with respect to CLC/TS 50238-2:2015:

The interference current limits for RST have been updated in the normative Annex A.

This Technical Specification is Part 2 of the EN 50238 series published under the title *Railway applications — Compatibility between rolling stock and train detection systems*. The series consists of:

— Part 1: General:

— Part 2: Compatibility with track circuits [this document];

— Part 3: Compatibility with axle counters.

Introduction

This Technical Specification defines the interference limits and evaluation criteria for electromagnetic compatibility between rolling stock and track circuits.

The limits have been defined on the basis of national specifications described in NTRs.

This Part 2 of the series defines:

— a set of interference current limits for rolling stock based on defined track circuits,

— measurement and evaluation methods to verify rolling stock interference current emissions and demonstrate compatibility with the track circuits;

— traceability of compatibility requirements (types of track circuit and associated limits).

1 Scope

This document defines, for the purpose of ensuring compatibility between rolling stock and track circuits, the limits for interference current emissions from rolling stock. The measurement and evaluation methods for verifying conformity of rolling stock to these limits are presented in a dedicated annex.

The interference limits are only applicable to rolling stock that is intended to run on lines exclusively equipped with preferred track circuits listed in this document. The rolling stock test methodology (infrastructure conditions, test configurations, operational conditions, etc.) presented in this document is applicable to establish compatibility with any track circuits.

This document gives guidance on the derivation of interference current limits specified for rolling stock and defines measurement methods and evaluation criteria in a dedicated annex.

This document defines:

a) a set of interference current limits for RST (Rolling Stock) applicable for each of the following types of traction system:

   1) DC (750 V, 1,5 kV and 3 kV);

   2) 16,7 Hz AC;

   3) 50 Hz AC;

b) methodology for the demonstration of compatibility between rolling stock and track circuits;

c) measurement method to verify interference current limits and evaluation criteria.

NOTE 1 The basic parameters of track circuits associated with the interference current limits for RST are not in the scope of this document.

NOTE 2 Any phenomena linked to traction power supply and associated protection (over voltage, short-circuit current, under- and over-voltage if regenerative brakes are used) is part of the track circuit design and outside the scope of 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 50126 (all parts), *Railway applications — The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)*

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

EN 50129, *Railway applications — Communication, signalling and processing systems — Safety related electronic systems for signalling*

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

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

EN 50388, *Railway Applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability*

CLC/TR 50507, *Railway applications - Interference limits of existing track circuits used on European railways*

UIC 550, *Power supply installations for passenger stock*

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 CLC/TS 50238-3 and the following apply.

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

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

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

3.1.1
coupled vehicles
part of the influencing unit which can be considered as an individual source of interference, different to the traction subsystem

Note 1 to entry: See Figure 1 for examples.

Note 2 to entry: Since one influencing unit can consist of multiple sources of influence, it is normally ensured that the resulting interference current emitted by the influencing unit into the power supply network does not exceed the interference current limits for RST value.

3.1.2
influencing unit
rolling stock influencing the train detection system

Note 1 to entry: One influencing unit comprises all coupled/connected vehicles, e.g. complete train with single or multiple traction, single vehicle, multiple connected/coupled vehicles and wagons, e.g. one complete passenger train, consisting of one or more TUs and up to 16 coaches.

Note 2 to entry: The influencing unit can consist of several “traction units“ (TU). Each TU is fed from one pantograph. One TU can be:

— one locomotive;

— one electric multiple unit, with one or several propulsion systems or traction power units (motor cars);

— one set of passenger coaches is considered as a separate TU if it contributes to the total current of the IU

Note 3 to entry: The number of TUs that form one IU depends on the type of rolling stock and its application. Therefore, the definition of such numbers is out of the scope of this Technical Specification. The following figure shows some examples for various types and compositions of traction units, forming one influencing unit in each case:

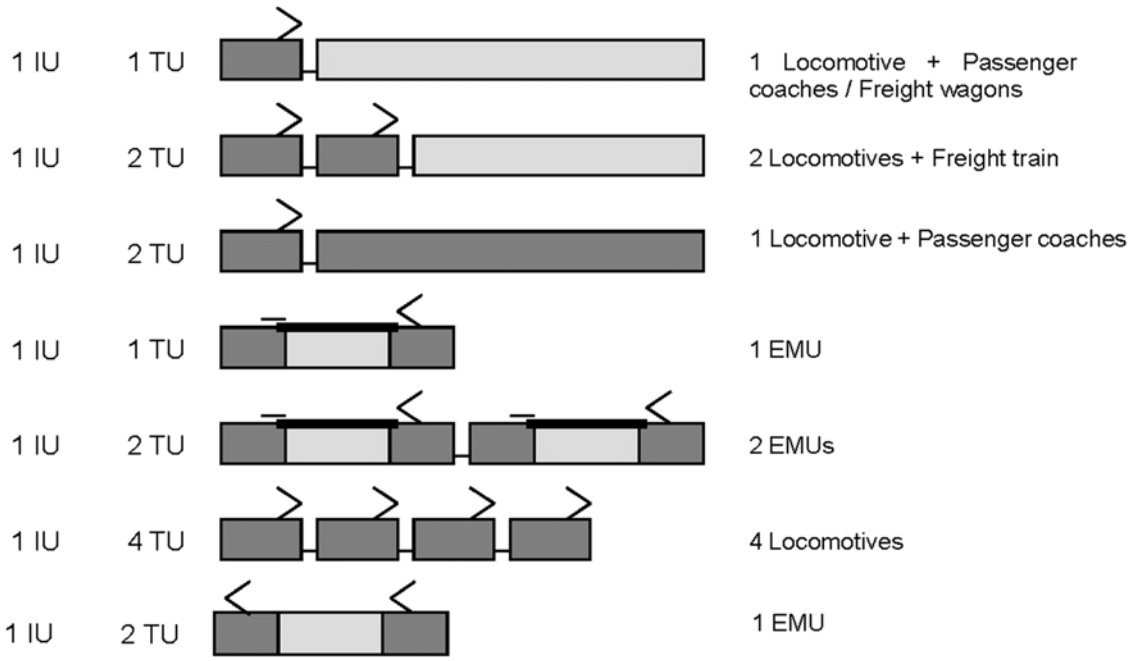


Figure 1 — Examples of IUs

3.1.3
integration time
window size over which the root mean square (RMS) of the output of the bandpass filter is calculated

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

3.1.4
interference source
equivalent to traction unit which is fed from its own power supply interface point (pantograph or shoe gear)

3.1.5
propulsion system
electrical/mechanical system that produces mechanical force to push the train forward

3.1.6
sources
interference sources which can generate harmonics independently

3.1.7
train detection system
system which comprises of equipment to detect the presence of a train

3.1.8
traction power unit
unit on the train housing, the converter/inverter equipment and its associated control to drive the propulsion system

Note 1 to entry: It is also known as the motor car.

3.1.9
traction subsystem
subset of the Traction Unit which produces traction force or electric brake force

3.1.10
train under test
influencing unit used for the test measurements

3.1.11
traction unit
locomotive, motor coach or train-unit

[SOURCE: IEC 60050-811:2017, 811-02-04]

3.1.12
transmitter breakthrough
background interference which can be present at the track circuit receiver from rolling stock on adjacent tracks or substation harmonics due to shared cross bonds and/or electrical imbalance of the track circuit

3.2 Abbreviations

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

AC Alternating Current
AT Autotransformer
ATP Automatic Train Protection system
A/D Analogue to Digital
DC Direct Current
EC European Commission
EMU Electrical Multiple Unit
FFT Fast Fourier Transforms
FSK Frequency Shift Keying
HVI High Voltage Impulse
IU Influencing Unit
PWM Pulse Width Modulation
RMS Root Mean Square
RSF Right Side Failure
RST Rolling stock
TC Track Circuit
TDS Train Detection System
TU Traction Unit
WSF Wrong Side Failure

4 General aspects of interference current limits for RST

4.1 Derivation of interference current limits for RST

The interference limits are defined for a set of preferred types of existing track circuits that are also defined by Railway Infrastructure companies for use on future new signalling projects.

In principle, the preferred types of track circuits from CLC/TR 50507 have been considered in defining the interference current limits for RST. Where new upgrades of track circuits are available, their improved susceptibility limits have been taken into account in this Technical Specification.

Annex A defines the interference current limits for compatibility with track circuits. The interference current limits for RST are defined up to and including the highest frequency range occupied by existing track circuits.

The limits I_0 are defined under worst case credible failure conditions of the track circuit such as unbalance or broken bonds or rails as defined by national authorities.

The transfer function between the interference current limit I_0 and the susceptibility of the track circuit can be different for different infrastructure conditions. In the worst case, if the transfer function ratio is one, the total interference current limit is defined by the susceptibility of the track circuit, taking into account any contribution from the power supply.

4.2 Application of Interference current limits to RST design

The interference current limits for RST apply to one influencing unit.

By definition, the interference current limits for RST are based on the maximum steady-state interference signal to which the track circuit may be exposed.

The rolling stock interference current limits incorporate the established margins for the relevant track circuits which take into account the interference current generated by other vehicles on adjacent or the same tracks. Specific traction supply harmonics circulated through the impedance of the influencing unit are dealt with as part of the evaluation methods presented in Annex B.

In the case of testing of single traction units on the operational railway the interference current limits for RST will have to be applied to the influencing unit by using applicable summation rules, as explained in Annex B.

The interference current limits for RST are defined at absolute frequencies and therefore not dependent on mains frequency variations. The measured RST interference current is dependent on the mains frequency variations.

A vehicle is required to conform only to the interference current limits for RST for the traction system(s) (DC, 16,7 Hz, 50 Hz) on which it is intended to operate.

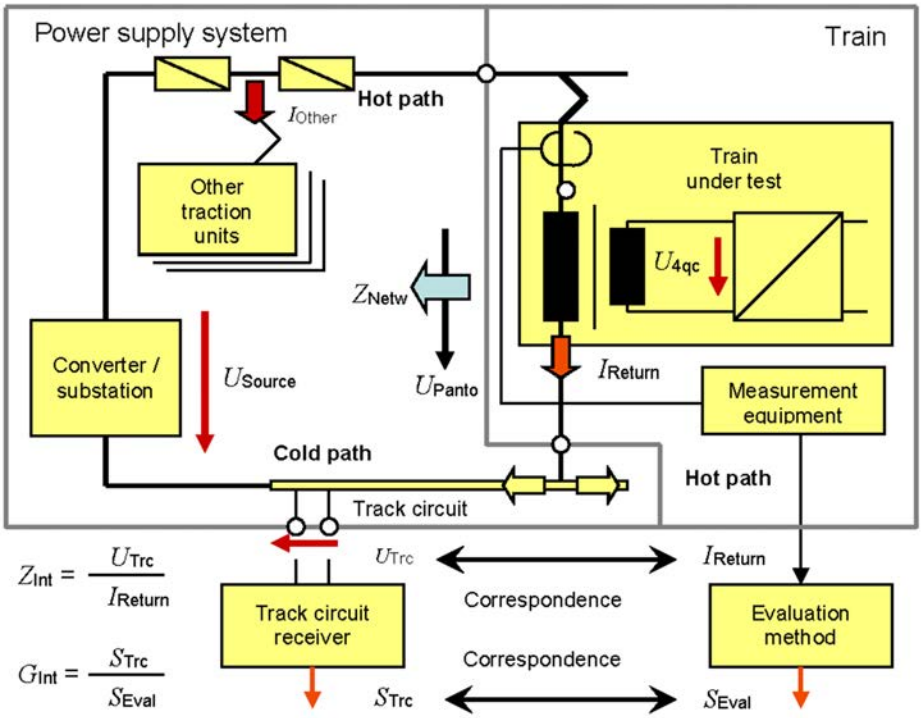
4.3 System definition

4.3.1 Structure

The overall system to be considered is shown in Figure 2 [1)]. It consists of four main parts that are defined in the following subclauses.

Example characterization of parts of the system based on a recent measurement campaign in different railway networks can be found in Annex C.

1) If the configuration is applied to DC, normally DC transducers are placed in the ‘Hot path'.



Key

	Return current path between the traction unit and the energy source via rails
G_{In}	Ratio of signal at the track circuit receiver and measured interference signal
Hot path	Path between the energy source and the traction unit for drawing current
I_{Other}	Current measured in the pantograph of other trains
I_{Return}	Current measured in the pantograph of the train under test
S_{Eval}	Interference signal processed using established evaluation criteria
S_{Trc}	Actual interference signal at the track circuit receiver produced by the train under test while over the TC
U_{Panto}	Voltage measured at the pantograph of the train
U_{Source}	Voltage measured at the substation(s) or converter(s). Some railway systems have multiple side feeding arrangements
U_{Trc}	Voltage measured at the track circuit receiver while occupied by the train
U_{4qc}	Voltage developed at the four quadrant converter of the train
Z_{Int}	Railway impedance as seen by the train; it defines the transfer function (coupling factor) between interference signal produced by RST and the track circuit
Z_{Netw}	Railway line impedance as seen by the train

Figure 2 — System configuration considered for interference

4.3.2 Train under test

In the context of this Technical Specification, the ‘train under test’ is the source of interference for which the respective interference current limits apply. It can be a part of or the whole influencing unit. By operation of its traction and auxiliary converters and other interaction it produces interference currents which are conducted into the infrastructure.

A train may contain one or several traction units (not necessarily all of the same type) plus auxiliaries (in both traction units and individual wagons).