PD ISO/TS 7637-4:2020

BSI Standards Publication

Road Vehicles — Electrical disturbance by conduction and coupling

Part 4: Electrical transient conduction along shielded high voltage supply lines only

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National foreword

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Part 4: Electrical transient conduction along shielded high voltage supply lines only

Vehicules routiers — Perturbations electriques par conduction et par couplage —

Partie 4: Conduction transitoire electrique seulement le long des lignes à haute tension blindées

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

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Road Vehicles — Electrical disturbance by conduction and coupling —

Part 4: Electrical transient conduction along shielded high voltage supply lines only

1 Scope

This document specifies test methods and procedures to ensure the compatibility to conducted electrical transients along shielded high voltage supply lines of equipment installed on passenger cars and commercial vehicles fitted with electrical systems with voltages higher than 60 V d.c. and lower than 1 500 V d.c. and a power supply isolated from the vehicle body. It describes bench tests for both, injection and measurement of transients. It is applicable to all types of electrical independent driven, road vehicles (e.g. battery electrical vehicle (BEV) or hybrid electrical vehicle (HEV), plugin hybrid electric vehicle (PHEV)).

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.

ISO 7637-1, *Road vehicles — Electrical disturbances from conduction and coupling — Part 1: Definitions and general considerations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7637-1 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/

4 Test methods

4.1 General

Various types of transients appear on the high voltage supply lines generated by the switching of various devices. Pulse A represents ringing caused by switching operations of high voltage semiconductors. Pulse B represents sinusoidal waves generated by harmonics from the grid and revolutions from, for example, electric propulsion motors.

Methods for measuring the transient emission on shielded high-voltage supply lines and test methods for the immunity of devices against transients are given in this document. These tests, called "bench tests", are performed in a laboratory.

The bench-test methods provide comparable and reproducible results between laboratories. They also give a test basis for the development of devices and systems and may be used during the production phase.

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A bench-test method for the evaluation of the immunity of a device against supply-line transients may be performed by a test pulse generator. This might not cover all types of transients which can occur in a vehicle. Therefore, all described test pulses are typical pulses.

In special cases, it may be necessary to apply additional test pulses. However, some test pulses may be omitted, if a device, depending on its function or its connection, is not influenced by comparable transients in the vehicle. It is part of the vehicle manufacturer's responsibility to define the test pulses required for a specific device.

There are two types of disturbances:

— Pulsed sinusoidal disturbances (Waveform A);

— Low frequency sinusoidal disturbances (Waveform B).

Pulsed sinusoidal disturbances on high voltage supply lines are caused by overshoots on square wave signals, e.g. produced by interaction of switching IGBTs in high voltage systems with parasitic capacities and inductivities of electrical engine systems, DC-DC-converters and any other kind of high voltage switching/commutation system. Pulsed sinusoidal disturbances on high voltage supply lines can be both common mode [line-to-ground (HV+ or/and HV- to ground)] and differential mode [line-to-line (HV+ to HV-)].

Test pulse A is used for testing high frequency oscillations, e.g. fast switching.

Test pulse B is used to test equipment against transient voltages.

The device under test (DUT) shall be operated under typical conditions which cause the maximum disturbance and sensitivity during the measurement. This is the worst-case mode for every test and frequency step. Conditions shall be agreed between the vehicle manufacturer and the supplier and shall be documented in the test plan.

4.2 Standard test conditions

Standard test conditions according to ISO 7637-1 shall be used for test temperature and supply voltage (low voltage).

The high supply voltage U_N can vary in a range from 60 V d.c. up to 1 500 V d.c. The used high voltage and its allowed tolerances of battery/generator in operation shall be agreed between vehicle manufacturer and supplier and shall be documented in the test plan.

4.3 Ground plane

The ground plane shall be made of 0,5 mm thick (minimum) copper, brass or galvanized steel.

Unless otherwise specified in the test plan, the minimum width of the ground plane shall be 1 000 mm, or underneath the entire setup width (excluding power supply and transient pulse generator) plus 200 mm, whichever is larger.

Unless otherwise specified in the test plan, the minimum length of the ground plane shall be 2 000 mm, or underneath the entire setup length (excluding power supply and transient pulse generator) plus 200 mm, whichever is larger.

4.4 General test setup conditions

The DUT is arranged and connected according to its requirements. The DUT should be connected to the original operating devices (loads, sensors, etc.) and the test setup described in 4.5.2, 4.6.2.1 and 4.6.3.1 shall be used, unless otherwise agreed between the vehicle manufacturer and the supplier.

If the actual DUT operating signal sources are not available, they may be simulated.

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Unless otherwise specified in the test plan, all loads, sensors, grounds (lines, metallic cases) are connected to the ground plane.

To minimize extraneous capacitive coupling to the DUT, it is advisable that the minimum distance between the DUT and all other conductive structures, such as walls of a shielded enclosure (with the exception of the ground plane underneath the test setup), should be more than 0,5 m.

4.5 Voltage transient emissions test along high voltage supply lines

4.5.1 General - Test methodology

A DUT which is considered as a potential source of conducted disturbances shall be tested according to the procedure described in this clause.

Transients shall be measured between HV+ and HV- (line-to-line) and between HV+ respectively HV- and ground (line-to-ground).

Care shall be taken to ensure that the surrounding electromagnetic environment does not interfere with the measurement set-up.

4.5.2 Test set-up for emission test

Voltage transients from the DUT, are measured using a high voltage artificial network (HV-AN) (see 5.1) to standardize the impedance loading on the DUT. The DUT is connected via the artificial network to the high voltage power supply (see 5.2) as given in Figure 1.

The length of the high voltage supply line shall be $(500\ ^{+200}_{0})$ mm, if not otherwise specified in the test plan. The used cable length shall be documented in the test report.

Ground connection of DUT shall be connected to ground plane. The default length is (200 ±50) mm, if not otherwise specified in the test plan. If the DUT has a metallic case, this case shall be bonded to the ground plane. The DC resistance of the ground connection shall not exceed 2,5 mΩ.

The DUT shall be placed on the ground plane as in the vehicle application. If no other requirements are specified the DUT and all wiring connections between artificial network and DUT shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon_r \leq 1{,}4$), at (50 ± 5) mm above the ground plane.

Supply voltage U_N and the disturbance voltage shall be measured close to the DUT terminals using a voltage probe and oscilloscope or waveform acquisition equipment at the power supply terminals (see Figure 1).

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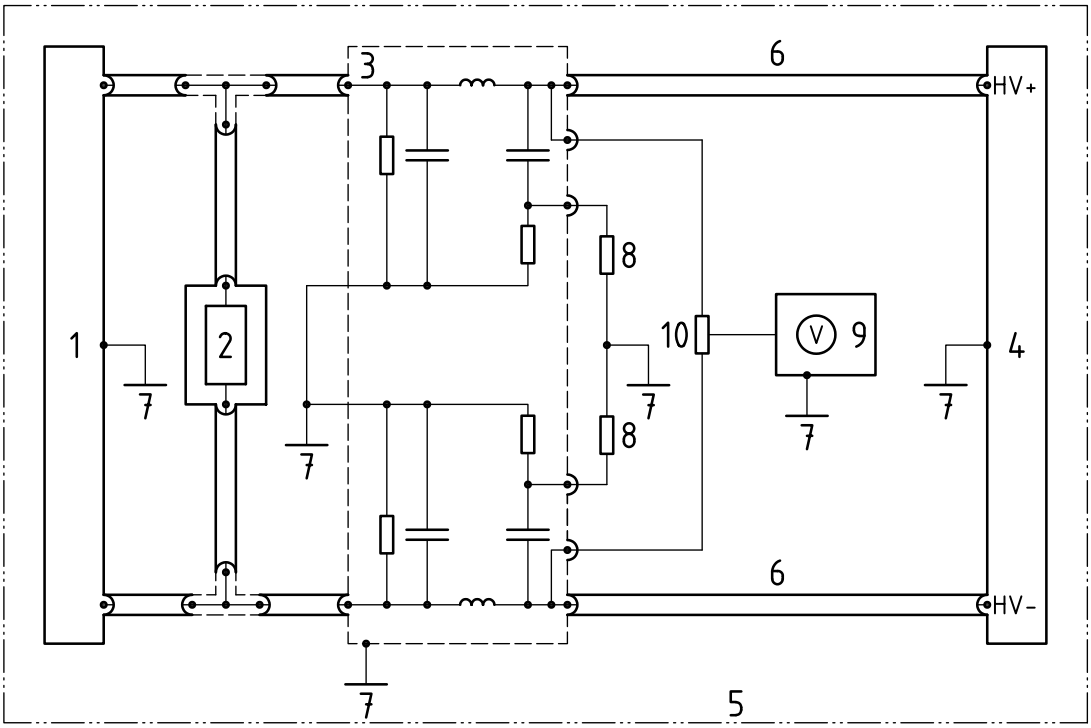

Key

1 high voltage power supply (optional: shielded and / or filtered)
2 load for high voltage battery (if necessary, see 5.4)
3 high voltage artificial network (HV-AN)
4 DUT
5 ground plane
6 high voltage supply line
7 ground connection
8 50 Ω termination
9 oscilloscope or waveform acquisition equipment
10 high voltage differential probe

Figure 1 — Transient emission test set-up to measure voltage ripple along high voltage supply lines

Figure 1 shows the test setup for the measurement between HV+ and HV-. For measurement between HV+ and ground or HV- and ground the other terminal of the voltage probe shall be connected to ground.

4.5.3 Test procedure for emission test

The various operating modes and the conditions of the DUT shall be considered for the measurements and specified in the test plan.

The measured transients shall be evaluated according to Annex B. The results shall be documented in the test report.

The voltage amplitude and transient parameters (rise time, fall time, transient duration) shall be recorded and documented in the test report.

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