DRAFT INTERNATIONAL STANDARD

ISO/DIS 7637-3

ISO/TC **22**/SC **3**

Secretariat: **DIN**

Voting begins on:
2014-07-28

Voting terminates on:
2014-10-28

Road vehicles — Electrical disturbances from conduction and coupling —

Part 3:
Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

Véhicules routiers — Perturbations électriques par conduction et par couplage —

Partie 3: Transmission des perturbations électriques par couplage capacitif ou inductif le long des lignes autres que les lignes d'alimentation

ICS: 43.040.10

Reference number
ISO/DIS 7637-3:2014(E)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 7637-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electric and electronic equipment*.

This third edition cancels and replaces the second edition (2007), of which has been technically revised.

ISO 7637 consists of the following parts, under the general title *Road vehicles — Electrical disturbances from conduction and coupling*:

— *Part 1: Definitions and general considerations*

— *Part 2: Electrical transient conduction along supply lines only*

— *Part 3: Vehicles with nominal 12 or 24 V supply voltage - Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines*

Annex A forms an integral part of this part of ISO 7637.

Annexes B and C are informative.

Introduction

Experience collected over a long period of immunity testing of instruments, devices and equipment (DUTs) shows that a test simulating transient pulses coupling phenomena is needed for a sufficient coverage of the wide range of electric and electromagnetic interferences. The knowledge of these facts is common among EMC experts, and many companies have developed such coupling tests.

The fast transient pulse test uses bursts composed of a number of fast transient pulses, which are coupled into lines (I/O lines in particular) of electronic equipment. The fast rise time, the repetition rate and the low energy of the fast transient bursts are significant to the test.

The slow transient pulse test applies a number of single pulses, as used for conducted transient pulse test, to the DUT.

During system development, the final application wiring harness is typically not available and the vehicle electrical noises are not known. Therefore the test shall be performed with a standardized setup, represented by the capacitive and inductive coupling described in this standard.

Road vehicles — Electrical disturbances from conduction and coupling — Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

1 Scope

This part of ISO 7637 defines bench test methods to evaluate the immunity of devices under test (DUTs) to transient pulses coupled to lines other than supply lines. The test pulses simulate both fast and slow transient disturbances caused by the switching of inductive loads and relay contact bounce.

Three test methods are described in this part of ISO 7637:

— the capacitive coupling clamp (CCC) method;

— the direct capacitive coupling (DCC) method; and

— the inductive coupling clamp (ICC) method.

This part of ISO 7637 applies to road vehicles fitted with nominal 12 V or 24 V electrical systems.

For transient pulses immunity, Annex B provides recommended test severity levels in line with the functional performance status classification (FPSC) principle described in ISO 7637-1.

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.

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

ISO 7637-2, *Road vehicles — Electrical disturbances from conduction and coupling — Part 2: Electrical transient conduction along supply lines only*

ISO 11452-4, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 4: Harness excitation methods*

3 Terms and definitions

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

4 Test methods

4.1 General

This clause describes bench test methods for testing the immunity of electrical system components or devices under test (DUTs) against coupled transient pulses. These tests shall be performed in the laboratory.

The defined transient pulses represent the characteristics of most of the known transient pulses which may occur in the vehicle.

Some transient pulses tests may be omitted if a device, depending on its function or its configuration, is not subjected to comparable transient pulses in the vehicle. It is part of the vehicle manufacturer's responsibility to define the transient pulses tests needed for specific components.

A test plan shall be written to define

— the test methods to be used;

— the transient pulses tests to be applied;

— the transient pulses levels;

— the number of transient pulses to be applied;

— the DUT operating modes;

— the wiring harness (test versus production);

— the leads to be included in the capacitive coupling clamp, if used;

— the leads to be tested using the direct coupling capacitor method, if used;

— the capacitance values to be used, if the direct coupling capacitor method is used for specific communication lines;

— the leads to be included in the inductive coupling clamp, if used; and

— the type of inductive coupling clamp, if the inductive coupling method is used.

Suggested values for the evaluation of immunity of DUTs can be chosen from Tables B.1, B.2.

The transient pulses test severity levels should be mutually agreed upon between the vehicle manufacturer and the supplier prior to the test.

The applicability of the three different test methods is indicated in Table 1.

It is sufficient to select one test method for slow transient pulses and one test method for fast transient pulses.

Table 1 — Test method applicability

Transient pulses type	CCC method	DCC method	ICC method
Slow transient pulses 2a of 5.3.3	Not applicable	Applicable	Applicable
Fast transient pulses 3a and 3b of 5.3.2	Applicable	Applicable	Not applicable

4.2 Standard test conditions

The ambient temperature during the test shall be (23 ± 5) °C.

Unless otherwise defined in this part of ISO 7637, the tolerance on time, resistance and capacitance is ± 10 %.

Unless otherwise defined in this part of ISO 7637, the tolerance on voltage is $\binom{+10}{0}$ %.

The supply voltage shall be as shown in Table 2 unless other values are agreed upon by the users of this part of ISO 7637 and shall be documented in the test plan and in the test report.

Table 2 — Test voltages

Nominal system voltage V	Test voltage V
12	13 ± 1
24	26 ± 2

4.3 Ground plane

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

The minimum width of the ground plane shall be 1 000 mm.

The minimum length of the ground plane shall be 2 000 mm, or underneath the entire equipment plus 200 mm, whichever is larger.

4.4 General test set-up conditions

The DUT is arranged and connected according to its requirements. The DUT should be connected to the original operating devices (loads, sensors, etc.) using the test setup described in 4.5.4, 4.6.4 and 4.7.4 unless otherwise agreed between the vehicle manufacturer and the supplier.

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

The 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, unless the DUT case is connected to the chassis and has its own ground connection.

The DUT shall be connected to the grounding system according to the manufacturer's installation specification; no additional grounding connections are allowed.

All harnesses 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.

Where possible, all loads, sensors, etc. are connected to the ground plane using the shortest possible lead length.

NOTE 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 room (with the exception of the ground plane underneath the test set-up), should be more than 0,5 m.

4.5 CCC method

4.5.1 General

The CCC method is suitable for coupling the fast transient pulses, particularly for DUTs with a moderate or large number of leads to be tested. It will not couple the slow transient pulses.

4.5.2 Generator verification

The transient pulse parameters (of Figures 8 and 9) shall be verified prior to the test according to ISO 7637-2. Verification shall be performed with the 50 Ω load condition only.

4.5.3 Transient pulses level adjustment

The transient pulses generator shall be connected through a 50 Ω coaxial cable to the CCC terminated in a 50 Ω resistor. The coaxial cable shall not be longer than 1 m.

The transient pulse level is adjusted with a 50 Ω oscilloscope connected through a 50 Ω coaxial cable to a 50 Ω attenuator which is mounted to the coupling clamp as shown in Figure 1. There shall be no lines routed through the coupling clamp during adjustment. Examples of test severity levels are listed in Annex B.

NOTE The open circuit voltage of the transient pulses generator is approximately twice the value of the specific test voltage, due to 50 Ω loading of the attenuator and the oscilloscope.

Key

1 transient pulses generator
2 50 Ω coaxial cable (≤ 1 m)
3 CCC
4 50 Ω attenuator
5 oscilloscope (50 Ω input)

Figure 1 — Set-up for transient pulses level adjustment — CCC method

4.5.4 DUT test

The test method using the CCC is shown in Figure 2. The coupling circuit consists of a CCC through which lines of the DUT are installed as agreed between the vehicle manufacturer and the supplier and documented in the test plan. The coupling length is 1 m.

The DUT 12 / 24 V supply lines (ground and supply) should not be included in the CCC. Any other ground or supply line delivered by the DUT to an auxiliary equipment (sensors, actuators) shall be included in the CCC. If the auxiliary equipment is locally grounded, this local ground connection shall be excluded from the CCC. Any exception about ground or supply lines included in the CCC shall be stated in the test plan.

The lines which are included in the CCC shall be limited to the maximum number of lines which can be placed flat in a single layer in the CCC (typically 10 to 20 lines); this may require multiple tests to be performed in order to test all the DUT lines.

The hinged lid of the CCC shall be placed as flat as possible to ensure contact with the test harness which should be positioned as flat as possible.

Twisted and shielded wire configurations shall be maintained inside the CCC.

The test conditions for a DUT with multiple connectors (single test on all the branches or test on individual branch) or for a harness with more than 10 to 20 lines shall be specified in the test plan.

The distance between the DUT and the CCC, and between peripheral devices and the CCC, shall be greater or equal than 300 mm. The portions of the lines being tested which are outside the CCC shall be placed at a distance of (50 ± 5) mm above the ground plane and oriented 90° ± 15° to the longitudinal CCC axis.

The DUT shall be placed on a (50 ± 5) mm height insulating support.

The case of the DUT shall not be grounded to the ground plane unless it is intended to simulate the actual vehicle configuration.

The lines which are not under CCC test are routed outside the coupling clamp. They should be placed on a (50 ± 5) mm height insulating support and shall be placed at a minimum distance of 100 mm to the coupling clamp.

The DUT shall be placed on the same end of the CCC as the transient pulses generator.

The test shall be performed with a total harness length of 1700 mm (+300 mm / -0 mm).