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Road vehicles — Electrical disturbances from conduction and coupling —

Part 1: Definitions and general considerations

Véhicules routiers — Perturbations électriques par conduction et par couplage —

Partie 1: Définitions et généralités

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 General aim and practical use of ISO 7637 ..... **4**
5 General test conditions **5**
5.1 General 5
5.2 Test temperature 5
5.3 Supply voltage 6
Annex A (normative) **Function performance status classification (FPSC)** **7**
Bibliography **10**

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

This third edition cancels and replaces the second edition (ISO 7637-1:2002), which has been technically revised. It also incorporates the Amendment ISO 7637-1:2002/Amd 1: 2008.

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

The following parts are under preparation:

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

— *Part 5: Enhanced definitions and verification methods for harmonization of pulse generators according to ISO 7637–2* [Technical Report]

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

Introduction

Electrical and radio-frequency disturbances occur during normal operation of many items of motor vehicle equipment. They are generated over a wide frequency range and can be distributed to on-board electronic devices and systems by conduction, coupling or radiation.

In recent years, an increasing number of electronic devices for controlling, monitoring and displaying a variety of functions have been introduced into vehicle designs. It is necessary to consider the electrical and electromagnetic environment in which these devices operate and, in particular, the disturbances generated in the vehicle electrical system itself. Such disturbances can cause degradation (temporary malfunction or even permanent damage) of the electronic equipment. Moreover, "worst-case" situations are usually those resulting from disturbances generated inside the vehicle by, for example, ignition systems, generator and alternator systems, electric motors and actuators.

Annex A specifies a general method for function performance status classification (FPSC). Typical severity levels are included in an annex of each of the other parts of ISO 7637.

While narrowband signals generated on or outside the vehicle (by broadcasting and radio-transmitters) can also affect the performance of electronic devices, and recognizing that protection from such potential disturbances has to be considered as part of total system certification, these matters are nevertheless outside the scope of ISO 7637 and are not covered by it.

ISO 11451 and ISO 11452 specify test methods for immunity to radiated disturbances for vehicles and for components, respectively. ISO 10605 specifies test methods for immunity to electrostatic discharge (ESD) for vehicle and for components.

Road vehicles — Electrical disturbances from conduction and coupling —

Part 1: Definitions and general considerations

1 Scope

This part of ISO 7637 defines the basic terms relating to electrical disturbances from conduction and coupling used in the other parts of ISO 7637. It also gives general information on the whole ISO 7637 series.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050–151, *International Electrotechnical Vocabulary — Part 151: Electrical and magnetic devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050–151 and the following apply.

3.1
artificial network
AN
network inserted in the supply lead or signal/load lead of apparatus to be tested which provides, in a given frequency range, a specified load impedance for the measurement of disturbance voltages and which can isolate the apparatus from the supply or signal sources/loads in that frequency range

Note 1 to entry: Network inserted in the d.c. power lines of the DUT which provides, in a given frequency range, a specified load impedance and which isolates the DUT from the d.c. power supply in that frequency range.

3.2
burst
transient comprised of a complex series of transient voltage variations

Note 1 to entry: For bursts, in addition to the parameters given in the definitions; 3.2.1, 3.2.2 and 3.2.3 are also relevant. For an illustration of a burst transient waveform, see ISO 7637–2.

3.2.1
burst cycle time
time between the start of the first *pulse* (3.13) of two consecutive *bursts* (3.2)

3.2.2
burst duration
time during which a complex series of transient voltage variations occurs during a single *burst* (3.2)

3.2.3
time between bursts
time between the end of one *burst* (3.2) and the start of the next one

3.3
coupling
means or device for transferring power between systems

Note 1 to entry: For coupling, in addition to the parameters given in the definitions; 3.3.1 and 3.3.2 are also relevant.

[SOURCE: IEC 60050–726–14–01, modified]

3.3.1
coupling clamp
device of defined dimensions and electromagnetic characteristics designed for common-mode *coupling* (3.3) of the disturbance transient to the circuit under test without any galvanic connection to it

3.3.1.1
capacitive coupling clamp
CCC
special fixture that facilitates capacitive *coupling* (3.3) of fast transient *test pulses* (3.15) into signal lines under test without any galvanic connection to the terminals of the circuits, or any other part of the DUT

3.3.1.2
inductive coupling clamp
ICC
bulk current injection (BCI) type probe to provide the means of *coupling* (3.3) slow transient *test pulses* (3.15) into signal lines under test without any galvanic connection to the terminals of the circuits, or any other part of the DUT

3.3.2
coupling network
electrical circuit for the purpose of transferring energy from one circuit to another

3.3.3
direct capacitive coupling
DCC
method using discrete, non-polarized capacitor to couple fast and slow transient test pluses into the DUT's signal lines under test

3.4
degradation
⟨of performance⟩ undesired departure in the operational performance of any device, equipment or system from its intended performance

Note 1 to entry: The term "degradation" can apply to temporary or permanent failure.

[SOURCE: IEC 60050-161-01-19]

3.5
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable *electromagnetic disturbances* (3.6) to anything in that environment

[SOURCE: IEC 60050-161-01-07]

3.6
electromagnetic disturbance
any electromagnetic phenomenon which can degrade the performance of a device, equipment or system, or adversely affect living or inert matter

Note 1 to entry: An electromagnetic disturbance may be an electromagnetic noise, an unwanted signal or a change in the propagation medium itself.

[SOURCE: IEC 60050-161-01-05]

3.7
electromagnetic interference
EMI
degradation (3.4) of the performance of equipment, transmission channel or system caused by an *electromagnetic disturbance* (3.6)

Note 1 to entry: The English words “interference” and “disturbance” are often used indiscriminately.

[SOURCE: IEC 60050-161-01-06, modified]

3.8
electromagnetic radiation
phenomenon by which energy in the form of electromagnetic waves emanates from a source into space; energy transferred through space in the form of electromagnetic waves

Note 1 to entry: By extension, the term “electromagnetic radiation” sometimes also covers induction phenomena.

[SOURCE: IEC 60050-731-01-01, modified]

3.9
susceptibility
⟨electromagnetic⟩ inability of a device, equipment or system to perform without *degradation* (3.4) in the presence of an *electromagnetic disturbance* (3.6)

Note 1 to entry: Susceptibility is a lack of immunity.

[SOURCE: IEC 60050-161-01-21]

3.10
ground (reference) plane
flat conductive surface whose potential is used as a common reference

[SOURCE: IEC 60050-161]

3.11
immunity (to a disturbance)
ability of a device, equipment or system to perform without *degradation* (3.4) in the presence of an *electromagnetic disturbance* (3.6)

[SOURCE: IEC 60050-161-01-20]

3.12
peak amplitude
highest absolute value of the amplitude of a *transient* (3.17)

3.13
pulse
comparatively smooth *transient* (3.17) with defined shape and time characteristics

Note 1 to entry: For pulses, the definitions given in 3.13.1, 3.13.2, 3.13.3, and 3.13.4 relative to pulse characteristics are also relevant.

3.13.1
pulse duration
time from the instant the absolute value of the *pulse* (3.13) rises above 10 % of the absolute value of the *peak amplitude* (3.12) to the instant it falls below 10 % of this

3.13.2
pulse fall time
time taken for the absolute value of the *pulse* (3.13) to decrease from 90 % to 10 % of the absolute value of the *peak amplitude* (3.12)

3.13.3
pulse repetition time
time between the start of two repetitive *pulses* (3.13) within the *burst* (3.2)

3.13.4
pulse rise time
time taken for the absolute value of the *pulse* (3.13) to increase from 10 % to 90 % of the absolute value of the *peak amplitude* (3.12)

3.14
shielded enclosure
mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and external environment

[SOURCE: IEC 60050-161-04-37]

3.15
test pulse
⟨test method⟩ representative *pulse* (3.13) applied to the device under test

Note 1 to entry: See the respective parts of ISO 7637 for the applicable test pulse.

3.16
test pulse severity
specification of severity level of essential *test pulse* (3.15) parameters

3.17
transient
phenomenon or quantity which varies between two consecutive steady states during a time interval which is short compared to the time scale of interest

Note 1 to entry: "Transient" is a general term and can be used to describe a single pulse or a *burst* (3.2) (a complex series of transient voltage variations).

4 General aim and practical use of ISO 7637

ISO 7637 is concerned with the problem of electrical transient disturbances in road vehicles and also in trailers. It deals with the emission of transients, transient transmission through electrical wiring and the potential susceptibility of electronic components to electrical transients.

The test methods and procedures, and test instrumentation and limits, given in the various parts of ISO 7637 are intended to facilitate component specification for electrical disturbance by conduction and coupling. A basis is thus provided for mutual agreement between vehicle manufacturers and component suppliers, intended to assist rather than restrict.

Immunity measurements of complete vehicles are generally able to be carried out only by the vehicle manufacturer, owing to, for example, the desire to preserve the secrecy of prototypes or a large number of different vehicle models. Therefore, for research, development, and quality control, a laboratory measuring method is used by the vehicle manufacturer and equipment suppliers to test electronic components.

These tests, specified in the different parts of ISO 7637, are called "bench tests". The bench test methods, some of which require the use of an artificial network, will provide comparable results between laboratories. They also give a basis for the development of devices and systems and may be used during the production phase.

Protection from potential disturbances has to be considered as a part of total vehicle validation. It is important to know the correlation between laboratory tests and vehicle.

A bench test method for the evaluation of the immunity of a device against supply or data-line transients may be performed by means of a test pulse generator; this may not cover all types of transients that

can occur in a vehicle. Therefore, the test pulses described in the different parts of ISO 7637 are characteristic of typical pulses.

Certain devices are particularly susceptible to some characteristics of electrical disturbances, such as pulse repetition rate, pulse width, and time relation to other signals. A standard test, therefore, cannot apply in all cases and it is necessary for the designer of potentially susceptible equipment to anticipate the appropriate test conditions through an in-depth knowledge of the design and function of the particular equipment.

A device shall be subjected only to those tests in the relevant part of ISO 7637 which apply to that device. Only the tests necessary to replicate the use and mounting location of the device under test need be included in the test plan. This will help ensure a technically and economically optimized design for potentially susceptible components and systems.

The main characteristics of each test method in ISO 7637-2 to ISO 7637-3 are presented in Table 1.

Table 1 — Main characteristics of test methods in ISO 7637

Part of ISO 7637 Subject	Applicability	Coupling to	Test severity parameter and unit	Provisions
ISO 7637-2 Electrical transient conduction along supply lines only	Transient emission Transient immunity	12 V and 24 V power lines	Pulse characteristics Voltage (V) for emission Voltage (V), time (s) for immunity	
ISO 7637-3 Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines	Transient immunity	Signal/control lines	Pulse characteristics Voltage (V), time (s) for immunity	Defines the applicable test methods among various methods (CCC, DCC, ICC) depending on slow or fast transients

The user should specify the test severity level for the various transients. The concept of FPSC is detailed in Annex A.

5 General test conditions

5.1 General

Unless otherwise specified, the following test conditions are common to all parts of ISO 7637:

— test temperature;

— supply voltage.

Unless otherwise specified, the variables used shall have the following tolerances:

— ±10 % for durations and distances;

— ±10 % for resistances and impedances.

5.2 Test temperature

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

5.3 Supply voltage

The supply voltage during the test shall be (13 ± 1) V for 12 V electrical systems and (26 ± 2) V for 24 V electrical systems.

Annex A
(normative)

Function performance status classification (FPSC)

A.1 General

This Annex provides a general method for defining the acceptable performance of electrical/electronic functions of automotive electrical systems during and after the components immunity test for electrical disturbances from conduction and coupling. This method is based on the following considerations:

a) DUT can include one or several functions (e.g. an electronic unit can manage front wiping, courtesy lighting and low beam lighting);

b) function can have one or several operating modes (e.g. low beam ON, low beam OFF, courtesy lighting ON, courtesy lighting OFF);

c) operating mode can have several statuses (I, II, III, IV) (e.g. in low beam ON operating mode, the status II can be associated to low beam OFF during disturbance application with automatic recovery of low beam after disturbance suppression).

The functional performance status classification is applicable to each function.

A.2 FPSC approach

The approach is based on the following principles:

a) functional performance status classification is applicable to each individual function; hence, a DUT is likely to include several functions (e.g. an electronic unit can manage front wiping, courtesy lighting and low beam lighting);

b) function can be a simple on-off operation or it can be complex, like data communication on a data bus.

It has to be emphasized that components or systems shall only be tested under the conditions, as described in ISO 7637, which represent the simulated automotive electromagnetic environments to which the devices would actually be subjected. This will help to ensure a technically and economically optimized design for potentially susceptible components and systems.

It should also be noted that this Annex is not intended to be a product specification and cannot function as one. It should be used in conjunction with a specific test procedure in ISO 7637. Therefore, no specific values for the test signal severity level are included in this Annex since they should be determined by the vehicle manufacturers and component suppliers. Nevertheless, using the concepts described in this Annex and by careful application and agreement between manufacturer and supplier, this Annex can be used to describe the functional status requirements for a specific device. This can then, in fact, be a statement of how a particular device can be expected to perform under the influence of the specified test signals.

A.3 Essential elements of FPSC

There are two elements, listed below, required to describe an FPSC.

A.3.1 Function performance status

This element defines the expected performance objectives for the function of the DUT subjected to the test conditions. The four function performance statuses of the function (expected behaviour of the function observed during test) are listed below.

NOTE 1 This element is applicable to every single individual function of a DUT and describes the operational status of the defined function during and after a test.

NOTE 2 The minimum functional status is given in each test. An additional test requirement can be agreed between supplier and vehicle manufacturer.

a) **Status I:** The function performs as designed during and after the test.

b) **Status II:** The function does not perform as designed during the test, but returns automatically to normal operation after the test.

c) **Status III:** The function does not perform as designed during the test and does not return to normal operation without a simple driver/passenger intervention, such as turning off/on the DUT, or cycling the ignition switch after the disturbance is removed.

d) **Status IV:** The function does not perform as designed during and after the test and cannot be returned to proper operation without more extensive intervention, such as disconnecting and reconnecting the battery or power feed. The function shall not have sustained any permanent damage as a result of the testing.

A.3.2 Test severity level

This element defines the specification of test severity level of essential signal parameters. The test severity level is the stress level applied to the device under test for any given test method. The test severity levels should be determined by the vehicle manufacturer and supplier depending on the required operational characteristics of the function.

A.4 FPSC approach example

A.4.1 General example of FPSC application

The following illustration demonstrates the relationship between the test signal severity levels and their corresponding function performance status classification.

Comments listed in Figure A.1 can be interpreted as follows:

a) function should be nominal event No. 1 (Status I) up to severity level L_1;

b) unexpected event No. 2 is allowed above test severity level L_1;

c) unexpected event No. 3 is allowed above test severity level L_2;

d) unexpected event No. 4 is allowed above test severity level L_3.

Users may group functions into categories to allow the use of different test levels.

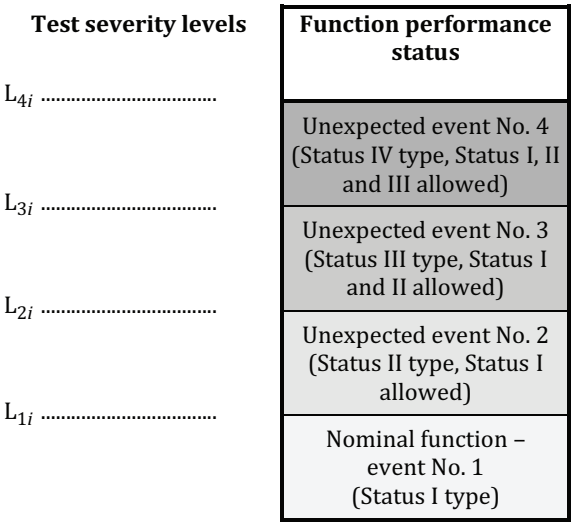

Figure A.1 — Function performance status classification

A.4.2 Classification of test severity levels

Examples of test severity levels are given in each part of ISO 7637.

Bibliography

[1] ISO 11451 (all parts), *Road vehicles — Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy*

[2] ISO 11452 (all parts), *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*

[3] ISO 10605, *Road vehicles — Test methods for electrical disturbances from electrostatic discharge*

[4] IEC 60050–161, *International Electrotechnical Vocabulary — Chapter 161: Electromagnetic compatibility*

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