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Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 1: General principles and terminology

Véhicules routiers — Méthodes d'essai d'un équipement soumis à des perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite —
Partie 1: Principes généraux et terminologie

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword

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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).

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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 fourth edition cancels and replaces the third edition (ISO 11452-1:2005) which has been technically revised. It also incorporates the Amendment ISO 11452-1:2005/Amd 1:2008.

ISO 11452 consists of the following parts, under the general title *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*:

— *Part 1: General principles and terminology*

— *Part 2: Absorber-lined shielded enclosure*

— *Part 3: Transverse electromagnetic mode (TEM) cell*

— *Part 4: Harness excitation methods*

— *Part 5: Stripline*

— *Part 7: Direct radio frequency (RF) power injection*

— *Part 8: Immunity to magnetic fields*

— *Part 9: Portable transmitters*

— *Part 10: Immunity to conducted disturbances in the extended audio frequency range*

— *Part 11: Reverberation chamber*

Introduction

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.

Electrical and radio-frequency disturbances occur during normal operation of many items of motor vehicle equipment. They are generated over a wide frequency range with various electrical characteristics and can be distributed to on-board electronic devices and systems by conduction, radiation, or both. Narrowband signals generated from sources on or off the vehicle can also be coupled into the electrical or electronic system, affecting the normal performance of electronic devices. Such sources of narrowband electromagnetic disturbances include mobile radios and broadcast transmitters.

The characteristics of the immunity of components to radiated disturbances have to be established. The ISO 11452 series provides various test methods for the evaluation of component immunity characteristics. Not all test methods need be used for a given device under test (DUT). For example, stripline and transverse electromagnetic (TEM) cell test methods provide very similar exposure to the DUT. Only those tests necessary for replicating the use and mounting location of the DUT need to be included in the test plan. This will help to ensure a technically and economically optimized design for potentially susceptible components and systems.

The ISO 11452 series is not intended as a product specification and cannot function as one (see A.1). Therefore, no specific values for the test severity level are given.

Annex A of this part of ISO 11452 specifies a general method for functional performance status classification (FPSC), Annex B specifies Artificial Networks (AN), Artificial Mains Networks (AMN), and Asymmetric Artificial Networks (AAN), Annex C explains the principle of constant peak test level while Annex D describes an example for the design of a load simulator. Typical severity levels are included in an annex of each of the other parts of ISO 11452.

Protection from potential disturbances has to be considered as a part of total vehicle validation as described in ISO 11451, which covers vehicle test methods. Component test method described in the ISO 11452 series is to be performed prior to vehicle test. Due to the vehicle's shape, harness, and component location diversities, conformity to parts of ISO 11452 does not guarantee conformity to parts of ISO 11451. Nevertheless, the ISO 11452 series component tests are essential for giving a sufficient level of confidence before integration on vehicle(s).

Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 1: General principles and terminology

1 Scope

This part of ISO 11452 specifies general conditions, defines terms, gives practical guidelines, and establishes the basic principles of the component tests used in the other parts of ISO 11452 for determining the immunity of electronic components of passenger cars and commercial vehicles to electrical disturbances from narrowband radiated electromagnetic energy, regardless of the vehicle propulsion system (e.g. spark-ignition engine, diesel engine, electric motor).

The electromagnetic disturbances considered are limited to continuous narrowband electromagnetic fields. A wide frequency range (d.c. and 15 Hz to 18 GHz) is allowed for the immunity testing of the components in this and in the other parts of ISO 11452.

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.

CISPR 16-1-2; *Specification for radio disturbance and immunity measuring apparatus and methods — Part 1-2: Radio disturbance and immunity measuring apparatus — Ancillary equipment — Conducted disturbances; Edition 1.2*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
absorber-lined shielded enclosure
shielded enclosure/screened room with radio-frequency-absorbing material on its internal ceiling and walls

Note 1 to entry: The common practice is for the room to have a metallic floor, but absorbing material may also be used on the floor.

3.2
amplitude modulation
AM
process by which the amplitude of a carrier wave is varied following a specified law, resulting in an AM signal

3.3
artificial mains network
AMN
network that provides a defined impedance to the EUT at radio frequencies, couples the disturbance voltage to the measuring receiver, and decouples the test circuit from the supply mains

Note 1 to entry: There are two basic types of AMN, the V-network (V-AMN) which couples the unsymmetrical voltages, and the delta-network which couples the symmetric and the asymmetric voltages separately. The terms line impedance stabilization network (LISN) and V-AMN are used.

Note 2 to entry: Network inserted in the power mains of the vehicle in charging mode and provides, in a given frequency range, a specified load impedance and which isolates the vehicle from the power mains in that frequency range.

3.4
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 (low voltage and/or high voltage) 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.

3.5
asymmetric artificial network
AAN
network used to measure (or inject) asymmetric (common mode) voltages on unshielded symmetric signal (e.g. telecommunication) lines while rejecting the symmetric (differential mode) signal

Note 1 to entry: This network is inserted in the communication/signal lines of the vehicle in charging mode to provide a specific load impedance and/or a decoupling (e.g. between communication/signal lines and power mains).

3.6
bonded
grounded connection providing the lowest possible impedance (resistance and inductance) connection between two metallic parts with a d.c. resistance which shall not exceed 2,5 mΩ

Note 1 to entry: A low current (≤100 mA) 4-wire milliohm metre is recommended for this measurement.

3.7
broadband artificial network
BAN
device used in power, signal, and control lines that presents a controlled impedance to the DUT over a specified frequency range while allowing the DUT to be interfaced to its support system

3.8
bulk current
total amount of common mode current in a harness

3.9
compression point
input signal level at which the measurement system becomes non-linear, when the output value will deviate from the value given by an ideal linear system

3.10
coupling
means or device for transferring power between systems

[SOURCE: IEC 60050-726, modified]

3.11
current injection probe
device for injecting current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits

3.12
current (measuring) probe
device for measuring the current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits

[SOURCE: IEC 60050-161]

3.13
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" also applies to temporary or permanent failure.

[SOURCE: IEC 60050-161]

3.14
dual directional coupler
four-port device consisting of two transmission lines coupled together in such a manner that a single travelling wave in any one transmission line will induce a single travelling wave in the other, the direction of propagation of the latter wave being dependent upon that of the former

[SOURCE: IEC 60050-726, modified]

3.15
electromagnetic compatibility
EMC
ability of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment

[SOURCE: IEC 60050-161]

3.16
electromagnetic disturbance
any electromagnetic phenomenon which can degrade the performance of a device, equipment, or system, or adversely affect living or inert matter

EXAMPLE An electromagnetic disturbance can be an electromagnetic noise, an unwanted signal, or a change in the propagation medium itself.

[SOURCE: IEC 60050-161]

3.17
electromagnetic interference
EMI
degradation of the performance of equipment, transmission channel, or system caused by electromagnetic disturbance

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

[SOURCE: IEC 60050-161]

3.18
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 60050-161]

3.19
susceptibility
⟨electromagnetic⟩ inability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance

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

[SOURCE: IEC 60050-161]

3.20
forward power
power supplied by the output of an amplifier or generator

3.21
function performance status
expected performance objectives for the function of the device under test subjected to the test conditions, agreed between the customer and the supplier which is specified in the test plan

3.22
ground (reference) plane
flat conductive surface whose potential is used as a common reference

[SOURCE: IEC 60050-161]

3.23
immunity (to a disturbance)
ability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161]

3.24
immunity level
maximum level of a given electromagnetic disturbance incident on a particular device, equipment, or system for which it remains capable of operating at a required degree of performance

[SOURCE: IEC 60050-161]

3.25
load simulator
physical device including real and/or simulated peripheral loads which are necessary to ensure DUT nominal and/or representative operation mode

3.26
narrowband emission
emission which has a bandwidth less than that of a particular measuring apparatus or receiver

[SOURCE: IEC 60050-161]

3.27
net power
forward power minus reflected power

3.28
polarization
property of sinusoidal electromagnetic wave or field vector defined at a fixed point in space by the direction of the electric field strength vector or of any specified field vector, when this direction varies with time

Note 1 to entry: The property may be characterized by the locus described by the extremity of the considered field vector.

[SOURCE: IEC 60050-726, modified]

3.29
portable transmitter
hand-held radio frequency communication device

Note 1 to entry: A portable transmitter could be a commercial device (e.g. cellular phone) or a simulated one.

3.30
pulse modulation
PM
process by which the amplitude of a carrier wave is varied following a specified law, resulting in a PM signal

3.31
reflected power
power reflected by the load due to impedance mismatch between RF source and the load

3.32
reverberation chamber
high quality factor shielded room (cavity) whose boundary conditions are changed via one or several stepped rotating tuners

Note 1 to entry: This results in a statistically uniform electromagnetic field.

3.33
shielded enclosure screened room
mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and external environment

[SOURCE: IEC 60050-161]

3.34
stripline
terminated transmission line consisting of two parallel plates between which a wave is propagated in the transverse electromagnetic mode to produce a specified field for testing purposes

3.35
transverse electromagnetic cell
TEM cell
enclosed system, often a rectangular coaxial line, in which a wave is propagated in the transverse electromagnetic mode to produce a specified field for testing purposes

[SOURCE: IEC 60050-161]

3.36
transverse electromagnetic mode
TEM mode
mode in which the longitudinal components of both the electric and magnetic field strength vectors are everywhere zero

[SOURCE: IEC 60050-726, modified]

3.37
tubular wave coupler
TWC
device to couple RF power to a harness or a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits

[SOURCE: IEC 60050-161]

3.38
voltage standing wave ratio
VSWR
ratio, along a transmission line, of a maximum to an adjacent minimum magnitude of a particular field component of a standing wave

Note 1 to entry: VSWR is expressed by the following formula:

$$\mathrm{VSWR} = \frac{(1+r)}{(1-r)}$$

where r is the absolute value of the coefficient of reflection.

[SOURCE: IEC 60050-726]

4 General aim and practical use

The test methods, procedures, test instrumentation, and levels specified in the ISO 11452 series are intended to facilitate component specification for electrical disturbances by narrowband radiated electromagnetic energy. A basis is provided for mutual agreement between vehicle manufacturers and component suppliers intended to assist rather than restrict.

Certain devices are particularly susceptible to some characteristics of electromagnetic disturbance, such as frequency, severity level, type of coupling, or modulation.

Electronic devices are sometimes more susceptible to modulated, as opposed to unmodulated, radio-frequency (RF) signals. The reason is that high-frequency disturbances can be demodulated by semiconductors. In the case of unmodulated signals, this leads to a continuous shift of, for example, a voltage; in the case of amplitude-modulated signals, the resulting low-frequency fluctuations can be interpreted as intentional signals (e.g. speed information) and therefore disturb the function of the DUT more severely.

A single standard test might not reveal all the needed information about the DUT. It is thus necessary for users of ISO 11452 to anticipate the appropriate test conditions, select applicable parts of ISO 11452, and define function performance objectives. The main characteristics of each test method in ISO 11452-2 to ISO 11452-11 are presented in Table 1.

Table 1 — Main characteristics of test methods in ISO 11452

Part of ISO 11452 and subject	Applicable frequency range	Coupling to	Test severity parameter and unit	Provisions
ISO 11452-2 Absorber-lined shielded enclosure	80 MHz to 18 GHz	DUT and wiring harness	Electric field (V/m)	Absorber lined shielded enclosure required
ISO 11452-3 TEM cell	10 kHz to 200 MHz	DUT and wiring harness or DUT	Electric field (V/m)	DUT and/or wiring harness size limitation

Table 1 *(continued)*

Part of ISO 11452 and subject	Applicable frequency range	Coupling to	Test severity parameter and unit	Provisions
ISO 11452-4 Harness excitation methods	1 MHz to 3 GHz	Wiring harness	Current (mA) Power (W)	Shielded enclosure required
ISO 11452-5 Stripline	10 kHz to 400 MHz	Wiring harness and/or DUT	Electric field (V/m)	Shielded enclosure recommended: DUT size limitation
ISO 11452-7 Direct RF power injection	250 kHz to 400 MHz	Wiring harness	Power (W)	Influence of isolator on DUT sensor signals
ISO 11452-8 Immunity to magnetic fields	d.c. and 15 Hz to 150 kHz	DUT	Magnetic field (A/m)	
ISO 11452-9 Portable transmitters	26 MHz to 5,85 GHz	DUT and wiring harness	Power (W)	Absorber lined shielded enclosure recommended
ISO 11452-10 Immunity to conducted disturbances in the extended audio frequency range	15 Hz to 250 kHz	Wiring harness	Volt (peak to peak)	
ISO 11452-11 Reverberation chamber	LUF (lowest usable frequency) to 18 GHz	DUT and wiring harness	Electric field (V/m)	Shielded enclosure required

5 General test conditions

5.1 General

Unless otherwise specified, the following test conditions are common to all parts of ISO 11452:

— test temperature;

— supply voltage;

— modulation;

— dwell time;

— frequency step sizes;

— definition of test severity level;

— test signal quality.

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

— ±10 % for durations and distances;

— ±10 % for resistances and impedances;

and the following magnitude accuracy:

— ±1 dB for power meter including power sensor;

— ±3 dB for field probe.