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

Part 7: Direct radio frequency (RF) power injection

Véhicules routiers — Méthodes d'essai d'un équipement soumis à des perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite —

Partie 7: Injection directe de puissance aux fréquences radioélectriques (RF)

Reference number
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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 11452-7 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 11452-7:1995), which has been technically revised.

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 chamber*

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

— *Part 4: Bulk current injection (BCI)*

— *Part 5: Stripline*

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

Introduction

Immunity measurements of complete road vehicles are generally able to be carried out only by the vehicle manufacturer, owing to, for example, high costs of absorber-lined shielded enclosures, the desire to preserve the secrecy of prototypes or a large number of different vehicle models.

For research, development and quality control, a laboratory measuring method can be used by both vehicle manufacturers and equipment suppliers to test electronic components.

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

Part 7:
Direct radio frequency (RF) power injection

1 Scope

This part of ISO 11452 specifies a direct RF power injection test for determining the immunity of electronic components of passenger cars and commercial vehicles to electrical disturbances from narrowband electromagnetic energy, regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The test method, which involves providing differential mode excitation to the DUT (device under test), is applicable to all DUT leads except RF Ground. Applicable over the frequency range 0,25 MHz to 500 MHz, the method can be used to predict the compatibility in the vehicle environment with respect to radiated and conducted RF energy, including conducted transient RF energy, and is especially useful as a means of isolating the susceptible circuits within a DUT and evaluating potential solutions.

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 11452-1, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11452-1 apply.

4 Test conditions

4.1 Standard test conditions

Standard test temperature, supply voltage, modulation, dwell time and frequency step size information shall be in accordance with ISO 11452-1.

4.2 Frequency range

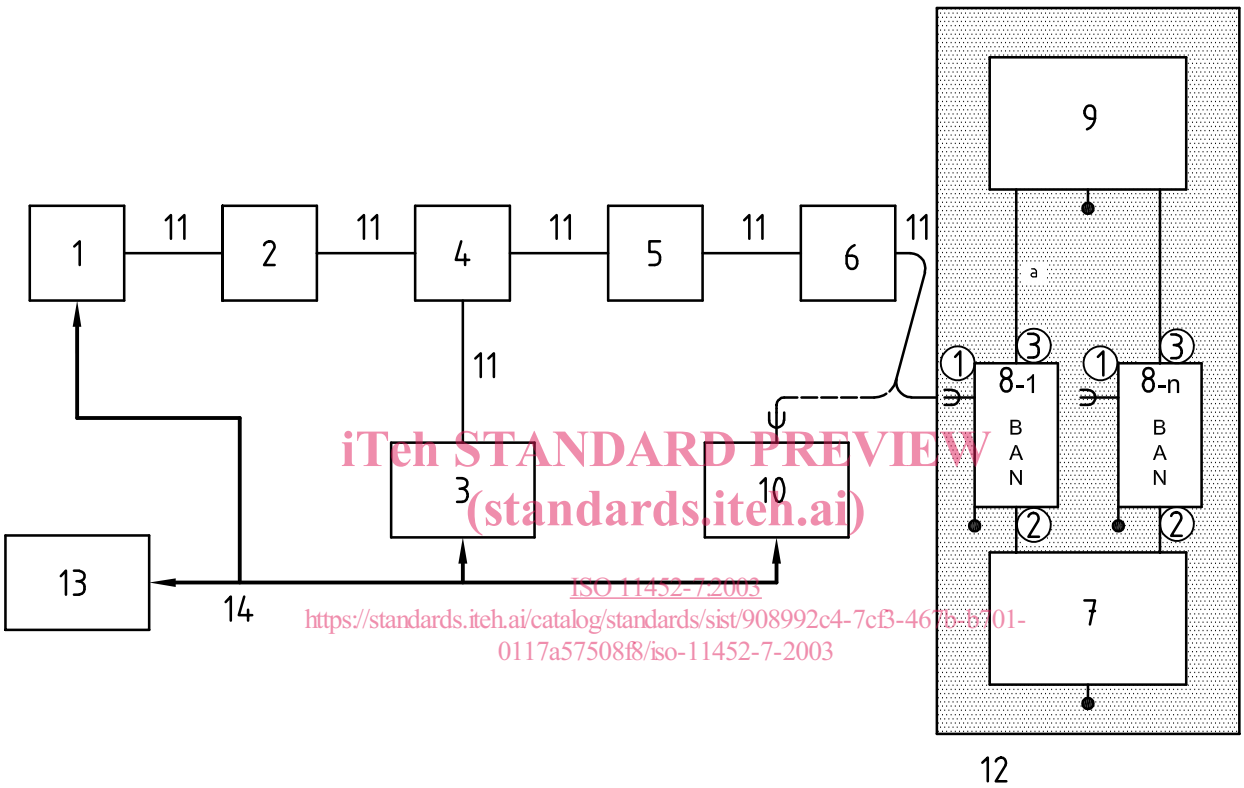
The upper limit of the test is limited by resonances and parasitic capacitances to Ground in the broadband artificial network (BAN) and leads from the BAN to the device under test (DUT). By using an appropriate BAN, a useful frequency range of 0,25 MHz to 500 MHz can be readily achieved.

See Annex A for information on BAN construction.

4.3 Test severity levels

The user should specify the test severity levels over the frequency range (see Annex B for suggested severity levels). These levels are expressed in terms of the equivalent root-mean-square value of the unmodulated wave.

The test severity level is measured at the output of the blocking capacitor (Item 6 in Figure 1). The RF sampling device is used to control the RF power during the test. Mismatch between the 50 Ω coaxial transmission line and the load consisting of the BAN and the DUT lead is disregarded.



Key

1 RF signal generator
2 RF amplifier(s) (10 W to 25 W, typical)
3 spectrum analyzer or RF power meter
4 RF sampling device (sampling “T” or directional coupler), 50 Ω, 25 W, rating, 30 dB isolation
5 attenuator (pad) 50 Ω, 10 dB, 10 W
6 d.c. blocking capacitor (impedance less than 5 Ω across entire frequency range)
7 peripherals
8 BAN, one in series with each lead except RF reference ground (see Figure A.1 for connector numbering 1 to 3)
9 DUT
10 RF power meter (for calibration)
11 coaxial transmission line (double shielded or equivalent)
12 ground plane
13 programmable controller and data acquisition equipment (optional)
14 instrumentation data bus

[a] Lead length from BAN to DUT shall be ⩽ 150 mm.

Figure 1 — Example of RF power injection test configuration

5 Test facility description and specification

5.1 Power injection system

Direct RF power injection is a technique whereby RF power is injected into the operating DUT, while eliminating variables related to wiring harness length and routing. The RF power is injected directly into the DUT at its connector pins.

This is a substitution test method. In preparation for performing a test, the power delivered through the d.c. blocking capacitor is measured on a calibrated power meter while the reference level at the RF sampling device ("sampling tee" or directional coupler) is recorded so that it can be used to establish the DUT exposure.

The DUT is connected in the test set-up to perform its designated functions with only the necessary connections made through broadband artificial networks (BANs). The BAN is a device that presents controlled impedance to isolate the DUT from sensors/loads over a specified frequency range while allowing the DUT to be interfaced to its sensors and loads.

In cases where the characteristics of the BAN significantly affects an input signal waveform (e.g. data bus signals), a special BAN with lower series impedance may be used. In such cases, document the characteristics of the distortion or characteristics of the special BAN, or both, in the test report.

5.2 Instrumentation

Figure 1 shows an example of a set-up of a direct RF power injection measurement system. The spectrum analyzer or power meter shall be capable of measuring levels provided by the sampling device with an uncertainty of $\pm$ 1 dB.

If necessary to meet national regulations or to preclude interference with other test activities, this test shall be performed in a shielded room.

A fuse device or a fixed attenuator (typically 10 dB) may be used to protect the spectrum analyzer input from a failure of the RF sampling device in a shortened mode. Any protective device shall be in place when the test reference level, specified in 6.2.1, is determined.

5.3 Test set-up

At the high frequencies within the range of this test, it is necessary to keep the leads between the DUT and the BANs as short as possible; they shall be spread out to minimize capacitive coupling between leads. The maximum length of the lead from the DUT to the BAN shall be 150 mm. Lengths of over 120 mm can begin to affect the test results at higher frequencies (i.e. $>$ 200 MHz) and therefore shall be avoided. When lengths of over 120 mm are used, these lengths and their positioning shall be documented in the test report. Care shall be taken to separate the DUT leads from the load and measuring instrument leads.

The RF power is delivered to the DUT through a 50 Ω, 10 dB attenuator, in order to minimize the effect of reflections at the injection point. A d.c. blocking capacitor is inserted at the injection point to prevent damage to the test equipment by the d.c. voltage on the device lead being tested.

The preferred construction of the BAN includes an RF connector, such as a BNC. This provides a controlled ground connection and a short exposed centre conductor. An alternate method of connection is the use of test clips and individual wires that may not exceed 50 mm length. The lengths of coaxial transmission line between the blocking capacitor and the BAN shall be a maximum of 250 mm.

NOTE Experience has shown that a separation of 25 mm between BANs provides sufficient isolation to allow construction a fixture with multiple BANs to efficiently test a DUT.