INTERNATIONAL STANDARD

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

Part 4: Bulk current injection (BCI)

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

Partie 4: Méthodes d'injection de courant (BCI)

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 11452-4 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This third edition cancels and replaces the second edition (ISO 11452-4:2001), 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 shielded enclosure*

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

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

— *Part 5: Stripline*

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

The radiating loop method is to form the subject of a future part 8.

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 4:
Bulk current injection (BCI)

1 Scope

This part of ISO 11452 specifies bulk current injection (BCI) test methods for determining the immunity of electronic components of passenger cars and commercial vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The electromagnetic disturbances considered in this part of ISO 11452 are limited to continuous narrowband electromagnetic fields. See ISO 11452-1 for general test conditions.

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

The frequency range of the BCI test method is a direct function of the current probe characteristic. More than one type of current probe may be required.

For testing automotive electronic systems, the applicable frequency range of the BCI test method is 1 MHz to 400 MHz.

The user shall specify the test severity level(s) over the frequency range. Suggested test levels are included in Annex E.

Standard test conditions shall be according to ISO 11452-1 for the following:

— test temperature;

— supply voltage;

— modulation;

— dwell time;

— frequency step sizes;

— definition of test severity levels;

— test signal quality.

5 Test location

The tests shall be performed in a shielded enclosure.

6 Test apparatus and instrumentation

6.1 General

Bulk current injection (BCI) is a method of carrying out immunity tests by inducing disturbance signals directly into the wiring harness by means of a current injection probe. The injection probe is a current transformer through which the wiring harnesses of the device under test (DUT) are passed. Immunity tests are carried out by varying the test severity level and frequency of the induced disturbance.

6.2 Measuring equipment

6.2.1 Current injection probe or set of probes, capable of operating over the entire test frequency range, required to couple the test equipment to the DUT. The probe(s) shall be capable of withstanding a continuous input power over the test frequency range regardless of the system loading.

6.2.2 Current measurement probe or set of probes, capable of operating over the entire test frequency range.

6.2.3 Artificial network(s) (AN): see 7.2 and Annex C.

6.2.4 RF generator, with internal (or external) modulation capabilities.

6.2.5 Power amplifier

6.2.6 Powermeter (or equivalent measuring instrument), for measuring forward power and reflected power.

6.2.7 Current measuring equipment

6.3 Stimulation and monitoring of DUT

The DUT shall be operated as required in the test plan by actuators that have a minimum effect on the electromagnetic characteristics, e.g. plastic blocks on the push-buttons, pneumatic actuators with plastic tubes.

Connections to equipment monitoring electromagnetic interference reactions of the DUT may be accomplished by using fibre-optics, or high-resistance leads. Other types of lead may be used but require extreme care to minimize interactions. The orientation, length and location of such leads shall be carefully documented to ensure repeatability of test results.

Any electrical connection of monitoring equipment to the DUT may cause malfunctions of the DUT. Extreme care shall be taken to avoid such an effect.

7 Test set-up

7.1 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 1 500 mm, or the length of the entire underneath of the equipment plus 200 mm, whichever is the larger.

The height of the ground plane (test bench) shall be (900 ± 100) mm above the floor.

The ground plane shall be bonded to the shielded enclosure such that the d.c. resistance shall not exceed 2,5 mΩ. In addition, the bond straps shall be placed at a distance no greater than 0,3 m apart.

7.2 Power supply and AN

Each DUT power supply lead shall be connected to the power supply through an AN.

Power supply is assumed to be negative ground. If the DUT utilizes a positive ground then the test set-ups shown in the figures need to be adapted accordingly. Power shall be applied to the DUT via a 5 µH/50 Ω AN (see Annex C for the schematic). The number of ANs required depends on the intended DUT installation in the vehicle.

— For a remotely grounded DUT (vehicle power return line longer than 200 mm), two ANs are required: one for the positive supply line and one for the power return line (see Annex D).

— For a locally grounded DUT (vehicle power return line 200 mm or shorter): one AN is required for the positive supply (see Annex D).

The AN(s) shall be mounted directly on the ground plane. The case or cases of the AN(s) shall be bonded to the ground plane.

The power supply return shall be connected to the ground plane — between the power supply and the AN(s).

The measuring port of each AN shall be terminated with a 50 Ω load.

7.3 Location of DUT

The DUT shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon_r \leqslant 1{,}4$), at (50 ± 5) mm above the ground plane.

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

The face of the DUT shall be located at least 100 mm from the edge of the ground plane.

There should be a distance at least 500 mm between the DUT and any metal part such as the walls of the shielded enclosure, with the exception of the ground plane on which the DUT is placed.

7.4 Location of test harness

The total length of the test harness between the DUT and the load simulator (or the RF boundary) shall be (1 000 ± 100) mm, unless otherwise specified in the test plan.

The wiring type is defined by the actual system application and requirement.

The test harness should be straight over its whole length and of fixed (position and number of wires) composition. It should pass through the current injection and current measurement probes. The length of the wires in the simulator should be short by comparison with the length of the harness. The wires within the simulator should be anchored.

The test harness shall be placed on a non-conductive, low relative permittivity (dielectric-constant) material ($\varepsilon_r \leqslant 1{,}4$), at (50 ± 5) mm above the ground plane.

7.5 Location of load simulator

Preferably, the load simulator shall be placed directly on the ground plane. If the load simulator has a metallic case, this case shall be bonded to the ground plane.

Alternatively, the load simulator may be located adjacent to the ground plane (with the case of the load simulator bonded to the ground plane) or outside of the test chamber, provided the test harness from the DUT passes through an RF boundary bonded to the ground plane.

When the load simulator is located on the ground plane, the d.c. power supply lines of the load simulator shall be connected through the AN(s).

7.6 Location of current probe(s)

7.6.1 Substitution method

The injection probe shall be placed at the following distances, d, from the connector of the DUT:

— d = (150 ± 10) mm;

— d = (450 ± 10) mm;

— d = (750 ± 10) mm.

If a current measurement probe is used during the test it shall be placed at (50 ± 10) mm from the connector of the DUT.

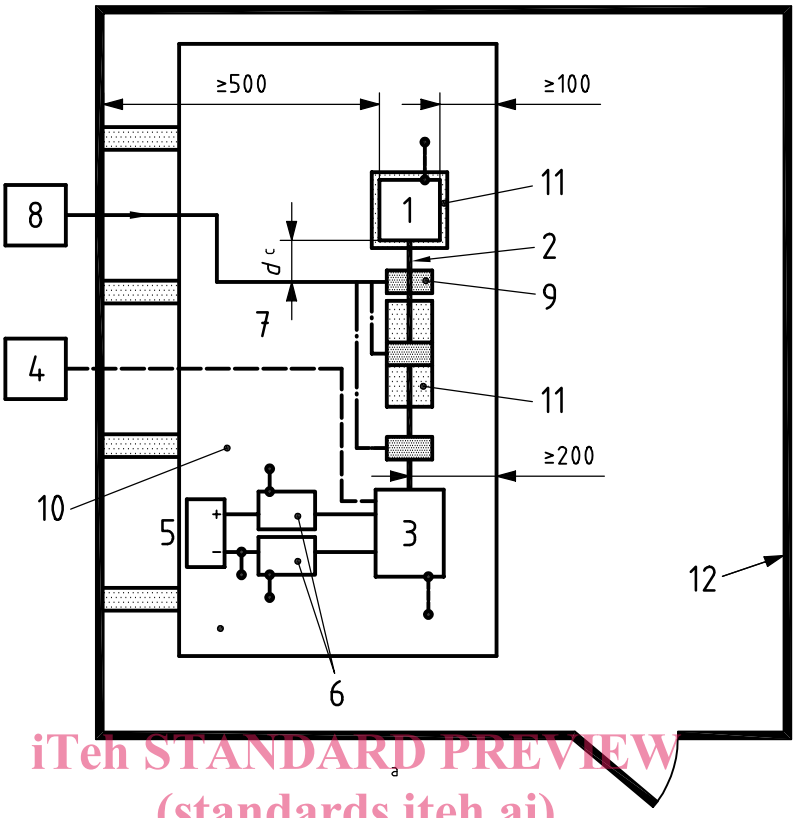
7.6.2 Closed-loop method with power limitation

The injection probe shall be placed at (900 ± 10) mm from the connector of the DUT.

The current measurement probe shall be placed at (50 ± 10) mm from the connector of the DUT.

Examples of test configurations are shown in Figure 1 for the substitution method (8.3.1) and Figure 2 for the closed-loop method with power limitation (8.3.2).

Dimensions in millimetres



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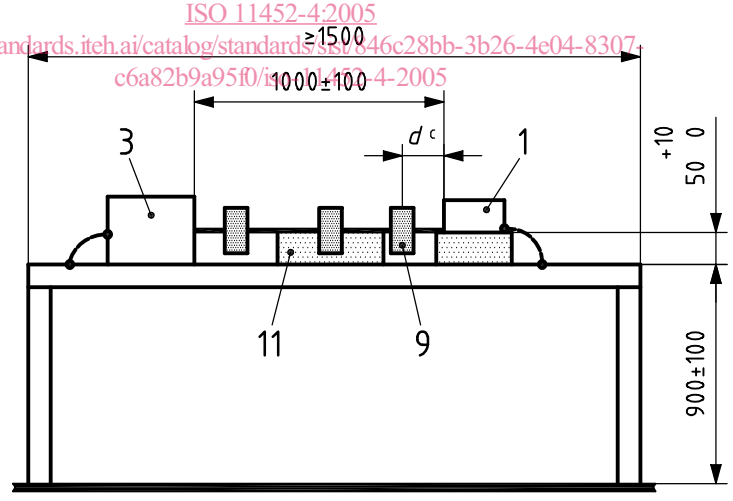


b

Key

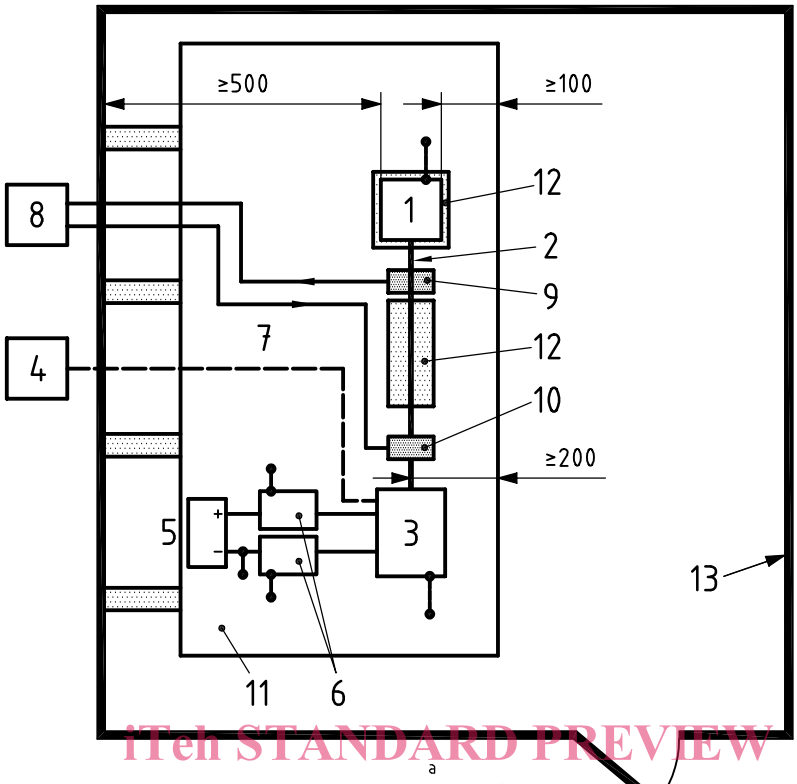
1 DUT (grounded if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 stimulation and monitoring system
5 power supply
6 artificial network (AN)
7 optical fibres
8 high-frequency equipment
9 injection probe
10 ground plane (bonded to shielded enclosure)
11 low relative permittivity support ($\varepsilon_r \leqslant 1{,}4$)
12 Shielded enclosure

NOTE The current measurement probe, optional-for this test, is not represented. See 8.3.1.3.

[a] Upper view. [b] Side view. [c] See 7.6.1.

Figure 1 — BCI test set-up — Substitution method

Dimensions in millimetres



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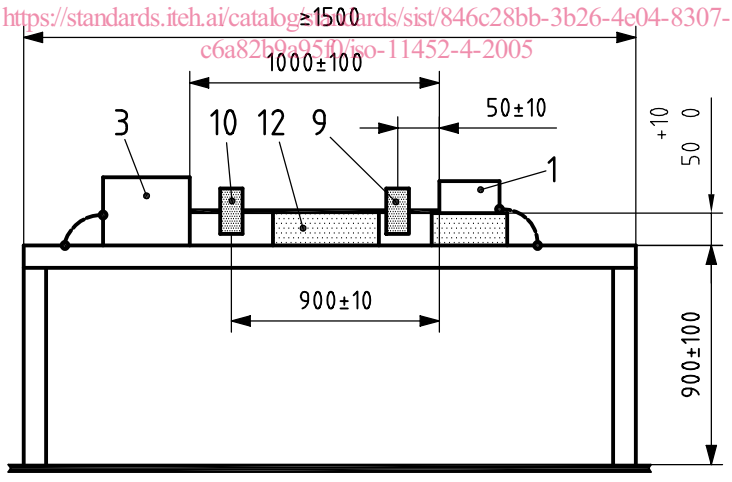

b

Key

1 DUT (grounded if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 stimulation and monitoring system
5 power supply
6 artificial network (AN)
7 optical fibres
8 high-frequency equipment
9 current measurement probe
10 injection probe
11 ground plane (bonded to shielded enclosure)
12 low relative permittivity support ($\varepsilon_r \leqslant 1{,}4$)
13 Shielded enclosure

a Upper view.
b Side view.

Figure 2 — BCI configuration — Closed-loop method with power limitation