BRITISH STANDARD

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

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

ICS 33.100.20; 43.040.10

BSI
British Standards

National foreword

This British Standard is the UK implementation of ISO 11452-10:2009.

The UK participation in its preparation was entrusted to Technical Committee AUE/16, Electrical and electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

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

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

Partie 10: Immunité aux perturbations conduites dans la bande des audiofréquences étendues

Reference number
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Foreword

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ISO 11452-10 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

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*

— *Part 8: Immunity to magnetic fields*

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

— *Part 11: Radiated immunity test method using a reverberation chamber*

The following parts are under preparation:

— *Part 9: Portable transmitters*

Introduction

Immunity measurements of complete road vehicles can generally only be carried out 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.

ISO 11452-1 specifies general test conditions, definitions, practical use and basic principles of the test procedure.

INTERNATIONAL STANDARD **ISO 11452-10:2009(E)**

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

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

1 Scope

This part of ISO 11452 specifies a conducted voltage test method and procedure 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 method is applied to each individual device under test (DUT) lead and is applicable to all power and output leads, as well as low frequency analogue leads. The method is particularly useful in evaluating DUTs with acoustic or visible display functions.

The disturbances considered in this part of ISO 11452 are limited to continuous narrowband electric voltage waveforms.

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 applicable frequency range of the test method is 15 Hz to 250 kHz.

The user of this part of ISO 11452 shall specify the test severity level or levels over the frequency bands. Typical test levels are given for information purposes in Annex A.

Standard test conditions are given in ISO 11452-1 for the following:

— test temperature;

— supply voltage;

— dwell time;

— test signal quality.

Unless otherwise specified, the tolerance on all parameters is ± 10 %.

5 Test location

For the frequency range of this test, there are no special grounding or shielding requirements.

6 Test apparatus

6.1 General

The primary functional requirement is that the apparatus provide a source impedance of less than 0,5 Ω from 15 Hz to 50 kHz and less than or equal to 2 Ω from 50 kHz to 250 kHz at the signal source (i.e. at the output of the isolation transformer) over the test frequency range. Annex B details a procedure for verifying the source impedance of the test apparatus. The frequency range of the apparatus used for the test shall meet the test plan frequency range requirements.

NOTE 1 The upper frequency limit for the apparatus in 6.2.1, 6.2.2 and 6.2.3 can be reduced in accordance with the user's frequency range requirements.

NOTE 2 It is recognized that other types of apparatus can produce equivalent signals, e.g. a power oscillator can replace the oscillator and amplifier, a power operational amplifier can replace the amplifier and power supply, etc.

The test apparatus consists of the following:

— an audio oscillator or signal generator,

— an extended range audio amplifier,

— an isolation transformer,

— a voltage measuring instrument,

— a current measuring instrument,

— a power supply, and

— a capacitor.

6.2 Apparatus

6.2.1 Audio oscillator, 15 Hz to 250 kHz frequency range.

6.2.2 Audio power amplifier, 15 Hz to 250 kHz frequency range; 50 W output power minimum with output impedance equal to or less than 2,0 Ω (capable of delivering 50 W into a 0,5 Ω resistive load connected across the specified isolation transformer secondary).

The amplifier shall be capable of operating open circuit without damage.

6.2.3 Isolation transformer, 15 Hz to 250 kHz frequency range; 4:1 impedance ratio; secondary as connected shall be capable of handling the total lead (supply plus test signal) current flow without saturating the core.

NOTE It has been verified that at least one commercially available 30 Hz to 250 kHz transformer satisfies the extended frequency requirements of this part of ISO 11452.

6.2.4 Voltage measuring instrument, i.e. oscilloscope, a.c. voltmeter, or other suitable high impedance meter.

6.2.5 Current measuring instrument, i.e. negligible series impedance inducing probe with appropriate magnitude capability.

NOTE A clip-on Hall effect probe is suitable.

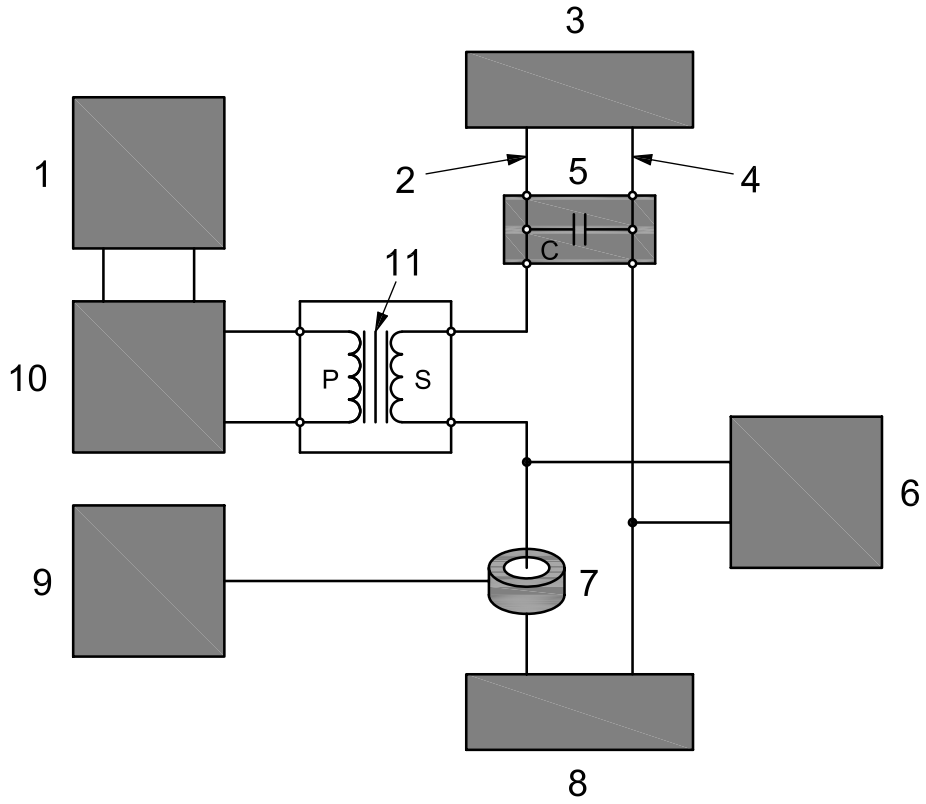
6.2.6 The **power supply** defined in ISO 11452-1 shall be used for this test method.

6.2.7 A 100 µF **capacitor** may be used (for lines other than power lines) to shunt the source end of the isolation transformer to ground if difficulty is encountered in obtaining sufficient test voltage.

Verification shall be made that desired signals are not excessively disturbed by the inclusion of the 100 µF capacitor.

7 Test set-up

The test set-up is shown in Figure 1. A d.c. power amplifier that satisfies the source impedance requirement of this part of ISO 11452 and can supply the power required by the DUT may be substituted for the power amplifier and isolation transformer for power supply lead testing.



Key

1 audio oscillator
2 test wire
3 connection to power supply or sensor or load
4 ground wire
5 capacitor (see 6.2.7)
6 voltage measuring instrument
7 current probe
8 device under test (DUT)
9 current measuring instrument
10 power amplifier
11 isolation transformer

Figure 1 — Test set-up for measuring conducted immunity, 15 Hz to 250 kHz

8 Test method

8.1 General

For the frequency range of this test, the impedances seen by the signal, load and power supply leads are generally known and can be treated as lumped constants. In this test, a wide range audio voltage source is coupled through a transformer in differential mode to each specified pin of the DUT. The signal source impedance must be low in comparison to the impedance of the circuit being tested. Experience has shown that a signal source impedance as defined in Clause 6 is adequate for the test. The DUT should be connected such that it will operate in its normal manner. Actual loads and sources should be used where appropriate or may be simulated.

Filters incorporated into DUTs may experience excessive and potentially damaging current flow. To prevent this type of over stress in the DUT, a current probe is included in the test set-up.

The impedance characteristics of the DUT line being tested may cause distortion to the test signal. This complicates the use of an a.c. voltmeter. A method of addressing this phenomenon is included in the test procedures.

8.2 Test plan

Prior to performing the tests, a test plan shall be generated which shall include:

— test set-up;

— frequency range;

— test frequencies or step sizes;

— DUT leads to be tested;

— DUT mode of operation;

— DUT acceptance criteria;

— test severity levels;

— DUT monitoring conditions;

— test report content.

8.3 Test procedure

8.3.1 Power supply voltage

The system power supply voltage shall be set as specified in the test plan and shall be measured at the DUT to account for voltage drop in the isolation transformer secondary winding.

NOTE The voltage drop across the transformer secondary can become significant at higher currents.

8.3.2 Audio oscillator

The audio oscillator shall be tuned through the required frequency range as specified in the test plan.

8.3.3 Test signal injection

The injected signal level shall be progressively increased toward the level specified in the test plan.

Alternatively, the test signal may be held at a specified test level and, if an effect on the DUT is detected, the test voltage reduced to determine the threshold.

The lead current shall be simultaneously monitored to ensure that the injected test current does not exceed a root mean square current, I_{rms}, of 1 A.

8.3.4 DUT monitoring

The DUT shall be monitored for malfunction, degradation of performance or deviation of parameters beyond tolerances indicated in the apparatus specification or the test plan.

8.3.5 Test signal amplitude

Where the impedance of the DUT lead causes significant distortion of the test signal, a suggested method of measuring the amplitude of the test signal is to connect a 4 Ω non-inductive load in place of the DUT lead. This will allow an accurate reading to be taken in the substitute configuration.

Do not change the signal generator or amplifier controls when:

— substituting the DUT lead in place of the 4 Ω resistor when setting the level;

— substituting the 4 Ω resistor in place of the DUT lead when determining the threshold level.

8.3.6 Test signal frequency and threshold level

The effects resulting from the injection of electromagnetic energy, the frequency and the threshold level shall be recorded.

8.4 Test report

As required in the test plan, a test report shall be submitted detailing information regarding the test apparatus, test set-up, systems tested, frequencies, power levels, system interactions and any other relevant information regarding the test.

Annex A
(informative)

Function performance status classification (FPSC)

A.1 General

This annex gives examples of test severity levels which should be used in line with the principle of function performance status classification (FPSC) described in ISO 11452-1.

A.2 Classification of test severity level

The suggested test severity levels are given in Table A.1.

Table A.1 — Example of test severity levels for conducted immunity test

Test severity levels Volt peak to peak	**Category 1**	**Category 2**	**Category 3**
L_{4i}	3,0	3,0	3,0
L_{3i}	3,0	3,0	3,0
L_{2i}	0,50	1,0	3,0
L_{1i}	0,15	0,50	1,0 [a, b]

[a] The user may elect to reduce the frequency range to 30 Hz to 50 Hz for conducted noise simulation.

[b] L_{1i} and L_{2i} may best represent cross coupling conducted noise simulation.

Annex B
(informative)

Verification procedure for source impedance

The following procedure can be used to verify the signal source impedance at the isolation transformer secondary terminals.

a) Set a voltage level at the primary terminals and measure the open circuit secondary voltage, V_{oc}.

b) Connect a known non-inductive load, R_L, of 0,5 Ω value across the secondary and measure the closed-circuit secondary voltage, V_{cc}. The resistance value shall be known to at least two significant figures.

c) The impedance, Z, expressed in Ω, shall be calculated according to Equation (B.1):

$$Z = \frac{R_L(V_{oc} - V_{cc})}{V_{cc}} \quad \text{(B.1)}$$

d) Repeat the previous procedure at one frequency per decade from 15 Hz and 250 kHz (including 15 Hz and 250 kHz).

e) The measured impedance should be less than or equal to 0,5 Ω from 15 Hz to 50 kHz and less than or equal to 2 Ω from 50 kHz to 250 kHz.

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