INTERNATIONAL STANDARD

ISO 11452-5

First edition
1995-12-01

Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods —

Part 5: Stripline

Véhicules routiers — Perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite — Méthodes d'essai d'un composant —

Partie 5: Ligne TEM à plaques

Reference number
ISO 11452-5:1995(E)

Contents

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

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.

International Standard ISO 11452-5 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 — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods*:

— *Part 1: General and definitions*

— *Part 2: Absorber-lined chamber*

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

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

— *Part 5: Stripline*

— *Part 6: Parallel plate antenna*

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

Annexes A and B of this part of ISO 11452 are for information only.

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Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods —

Part 5: Stripline

1 Scope

This part of ISO 11452 specifies tests for electromagnetic immunity of electronic components for passenger cars and commercial vehicles regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). To perform this test, the equipment harness is exposed to a disturbance field. This technique is limited to equipment harnesses which have a maximum diameter one-third the stripline height or less. The electromagnetic disturbances considered in this part of ISO 11452 are limited to continuous narrowband electromagnetic fields.

Immunity measurements of complete vehicles are generally only possible by the vehicle manufacturer because, for example, of the high costs of an absorber-lined room, preserving the secrecy of prototypes or the large number of different vehicle models. Therefore, for research, development and quality control, a laboratory measuring method is used by the manufacturer.

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

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 11452. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11452 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 11452-1:1995, *Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods — Part 1: General and definitions.*

3 Test conditions

3.1 Test temperature and supply voltage

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

The supply voltage during the test shall be (13,5 ± 0,5) V for 12 V electrical systems and (27 ± 1) V for 24 V electrical systems.

If other values are agreed by the users of this part of ISO 11452, the values shall be documented in the test report.

3.2 Frequency range

The applicable frequency range of the stripline is from 0,01 MHz to 200 MHz.

3.3 Modulation

The test determines the type and frequency of the modulation. If no values are agreed between the users of this part of ISO 11452, the following shall be used:

— no modulation (CW)

— 1 kHz sine-wave amplitude modulation (AM) of 80 %

3.4 Dwell time

At each frequency, the device under test shall be exposed to the test level for the minimum response time needed to control it. In all cases, this minimum time of exposure shall not be greater than 2 s.

3.5 Frequency step sizes

All tests in this part of ISO 11452 shall be conducted with frequency step sizes not greater than those shown in table 1.

Table 1 — Frequency step sizes

Frequency band MHz	Maximum frequency step size MHz
>0,01 to ≤0,1	0,01
>0,1 to ≤1	0,1
>1 to ≤10	1
>10 to ≤200	2

Alternatively, logarithmic frequency steps, with the same minimum number of frequency steps in each frequency band, may be used. The values, as agreed by the users of this part of ISO 11452, shall be documented in the test report.

If it appears that the susceptibility thresholds of the device under test are very near the chosen test level, these frequency step sizes should be reduced in the frequency range concerned to find the minimum susceptibility thresholds.

3.6 Test severity levels

The user should specify the test severity level(s) over the frequency range. Suggested test severity levels are included in annex B.

These test severity levels are expressed in terms of the equivalent root-mean-square value of the unmodulated wave.

4 Test instrument description and specifications

4.1 Stripline

A stripline ideally sets up a region of uniform electromagnetic field. The primary usage of this stripline is to expose at least 1,5 m of the wiring harness to RF fields (see figure 1).

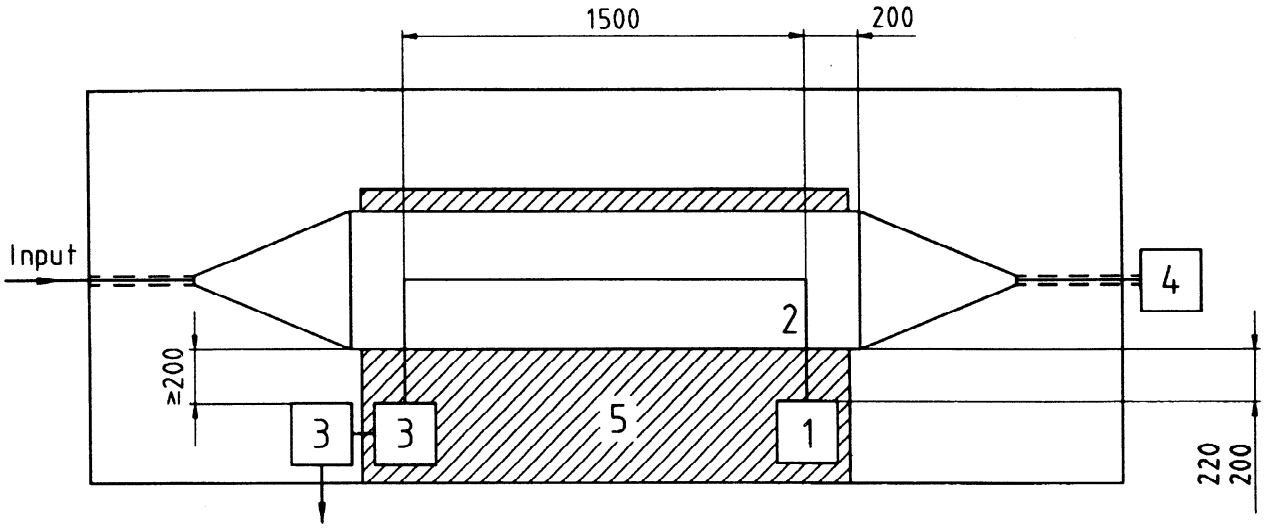
In practice, the fields generated will be uniform (± 2 dB) only below the TEM multi-mode frequency. The use of a straight length of cable or harness of 1,5 m within the stripline is required to integrate fields above the multi-mode frequencies along the length of the harness.

All wires in the wiring harness shall be terminated. When possible actual vehicles loads, sensors and actuators shall be used.

Since the wiring harness is typically oriented longitudinally along the length of the stripline, both the electric field and H-field are coupled into the wiring harness for this configuration (see figure 2). The main coupling mechanism is the differential mode since the wires in the harness are at different heights above the stripline ground plane. Common mode coupling also occurs due to capacitance (stray or through components) of the device under test to the ground plane. This coupling will provide information on the device under test behaviour representative of the vehicle environment.

The coupled fields will not correspond one-to-one to a plane wave radiated field intersecting the wiring harness. This is an acceptable compromise, since in an actual vehicle the fields at the device under test harness are typically not a plane wave, but are altered due to body panels causing slot antenna and cavity resonance effects. In some instances, the stripline field strength will need to be considerably higher than (e.g. twice) the plane wave field strength to obtain similar test results.

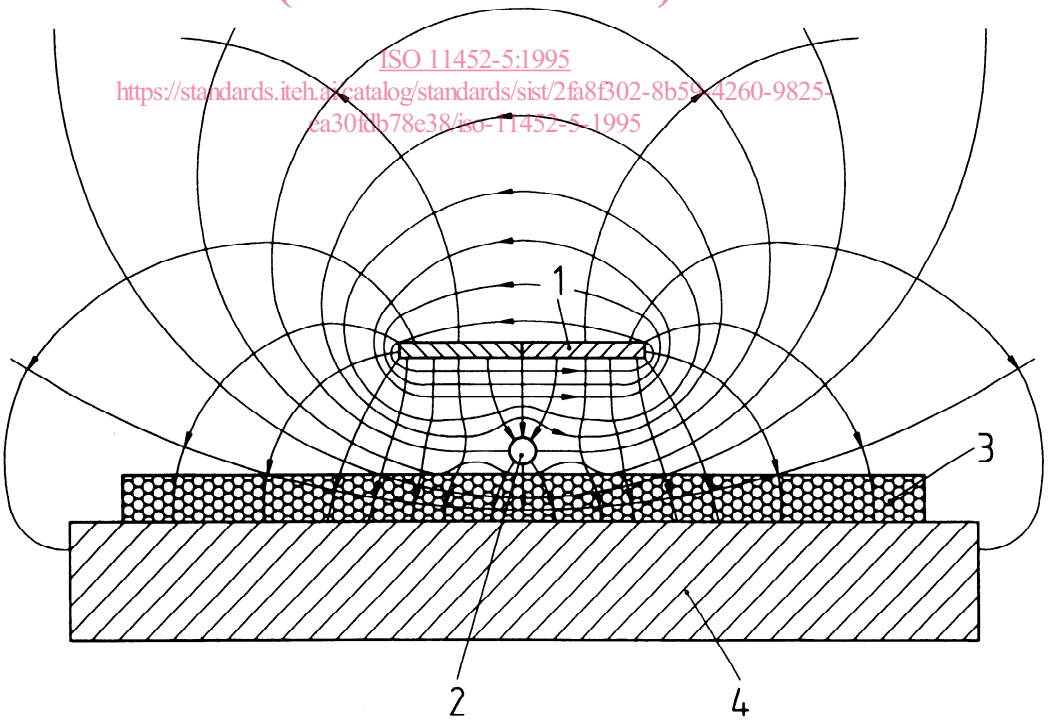
Dimensions in millimetres



Key

1 Device under test
2 Wiring harness
3 Peripheral
4 Terminating resistance
5 Insulating base (relative permittivity, $\varepsilon_r \leqslant 1{,}4$)

Figure 1 — Example of stripline test configuration



Key

1 Active conductor
2 Wiring harness
3 Insulating support (relative permittivity, $\varepsilon_r \leqslant 1{,}4$)
4 Ground table

Figure 2 — Electric field and H-field distribution in stripline

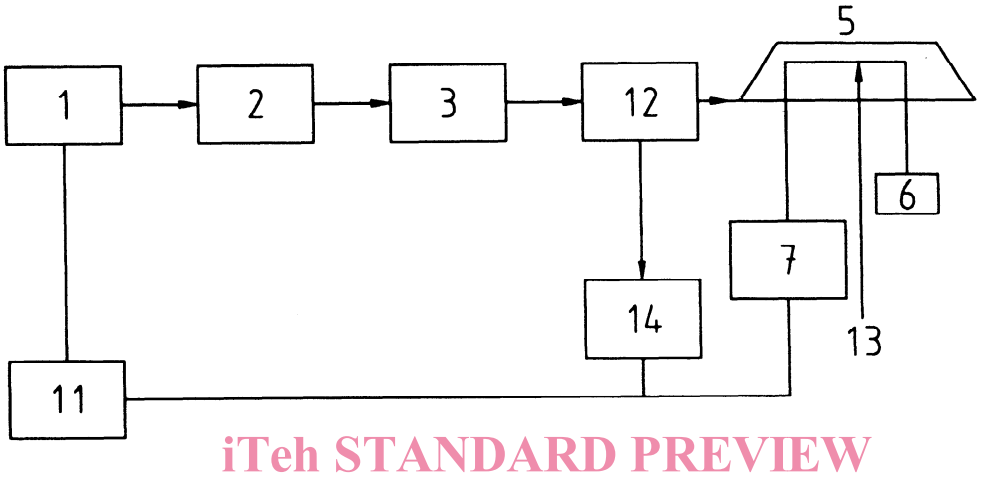
4.2 Instrumentation

The instrumentation shown in figure 3 b) may be limited by the frequency range of the directional coupler. As an alternative method for frequencies up to 10 MHz, the instrumentation in figure 3 a) may be used.

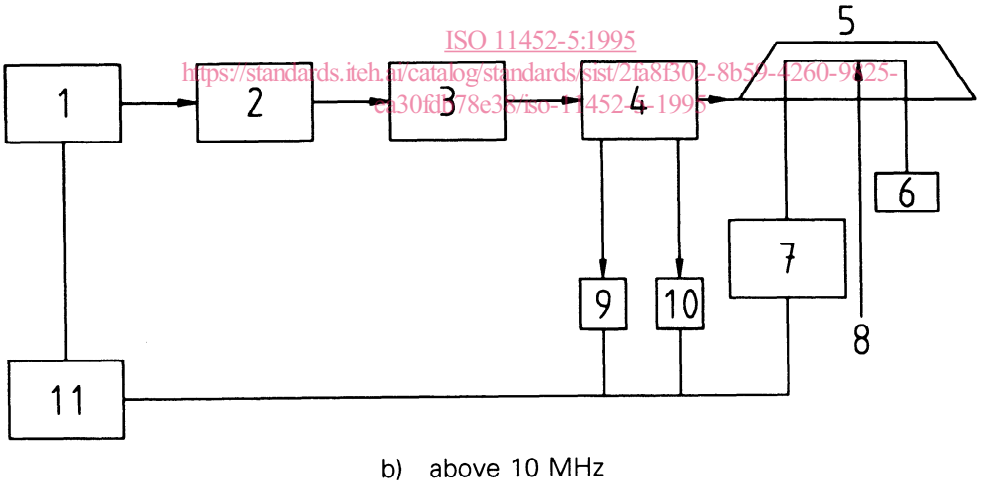
4.3 Test set-up

4.3.1 Test configuration

The test configuration shall be as shown in figure 1 and figure 3.



a) below 10 MHz



b) above 10 MHz

Key

1 Signal generator
2 RF amplifier
3 Low pass filter
4 Directional coupler
5 Stripline
6 Device under test
7 Test monitor
8 Wiring harness under test
9 Power meter F
10 Power meter R
11 Control computer
12 Voltage monitor tee
13 Cable under test
14 Voltmeter (DVM)

Figure 3 — Test set-up for stripline test

The device under test is installed next to the active conductor, with an edge parallel to it. The distance between the closest edges of the active conductor and the device under test shall be (200 $^{+20}_{0}$) mm. The distance from any peripheral device to the closest edge of the active conductor shall be at least 200 mm.

The device under test wiring harness shall be placed on a non-conductive fixture in the centre of the stripline, parallel to its major axis, supported at one-third of the height of the distance between the ground plane and active conductor. Note that the primary function of the fixture is to lock the positions of the harness and device under test to ensure the most repeatable results; it should be constructed with this in mind. The length of the longitudinal harness section under the active conductor shall be 1 500 mm (see figure 1). Deviations of the height above the ground table are only permitted near the device under test or the peripheral device(s).

Harness branchings to the device under test or to the peripheral devices are placed orthogonal to the longitudinal stripline axis and parallel to the ground plane.

All wires in the harness shall be terminated. If possible, the actual vehicle loads, sensors and actuators shall be used.

When a device under test with a metal housing and a periphery used for the measurement are to be both electrically connected directly to the vehicle mass (by screws, rivets, etc.), both shall be connected to the ground plane by a low impedance connection.

When the device under test or a periphery used for measurement are not electrically connected directly to the vehicle mass, both shall be placed on an insulating support. This insulating support shall have the same height as the insulating support on which the wiring harness is installed.

Energy radiated from the line into the enclosure will result in room resonance which can cause large errors. This effect can be reduced significantly by installing RF absorbing panels around the line. These panels absorb the energy radiated from the line (at frequencies above the multi-mode frequency) and therefore reduce the influence of any reflections from the walls of the shielded room.

4.3.2 Positioning of the device under test

Three test configurations are possible: exposure of the wiring harness is the most commonly used. Exclusive exposure of the device under test or exposure of both, harness and device under test together, requires special agreement between the users of this part of ISO 11452.

4.3.2.1 Exposure of wiring harness only

This test configuration permits the widest frequency range of testing. The RF fields induced in the harness couple into the device under test using the harness wiring as "antennas" for the received signal.

4.3.2.2 Exclusive exposure of device under test

When it is desired to determine device under test immunity directly, it may be placed under the stripline with the attached wiring harness exiting at 90° to the main axis of the stripline to minimize induction into the wiring harness.

Care shall be taken to ensure that the physical size of the device under test does not exceed one-third of the height under the stripline, as this might otherwise distort the test field.

4.3.2.3 Exposure of both device under test and its wiring harness

Both the device under test and its harness may be exposed simultaneously to the field of the stripline.

4.3.3 Supply and signal leads

The power supply and peripheral devices shall be installed outside the shielded test chamber, or shielded and filtered in the shielded test chamber, or — as in the case of exclusively linear peripherals (resistors, capacitors, coils, ferrites, mechanical switches, etc.) or radiation-resistant peripherals — unshielded and unfiltered in the shielded test chamber.

5 Test procedure

5.1 Test plan

Prior to performing the tests, a test plan shall be prepared, specifying the frequencies, power levels, modulation, dwell time, antennas and locations as well as the operation of the vehicle. Each device under test shall be verified under the most significant condition, i.e. at least in stand-by mode and in a mode where all the actuators can be excited.

5.2 Test methods

CAUTION — Hazardous voltages and fields may exist within the test area. Take care to ensure that the requirements for limiting the exposure of humans to RF energy are met.