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INTERNATIONAL STANDARD

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Integrated circuits - Measurement of electromagnetic immunity - Part 8: Measurement of radiated immunity - IC stripline method

Circuits intégrés - Mesure de l'immunité électromagnétique - Partie 8: Mesure de l'immunité rayonnée - Méthode de la ligne TEM à plaques pour circuit intégré

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Integrated circuits - Measurement of electromagnetic immunity - Part 8: Measurement of radiated immunity - IC stripline method

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IEC 62132-8 has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices. It is an International Standard.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) frequency range of 150 kHz to 3 GHz was deleted from the scope;
b) extension of upper usable frequency to 6 GHz or higher as long as the defined requirements are fulfilled.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
47A/1205/FDIS	47A/1209/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This part of IEC 62132 is to be read in conjunction with IEC 62132-1.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all the parts in the IEC 62132 series, published under the general title *Integrated circuits - Measurement of electromagnetic immunity*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This part of IEC 62132 specifies a method for measuring the immunity of an integrated circuit (IC) to radio frequency (RF) radiated electromagnetic disturbances using an IC stripline.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60050-131, *International Electrotechnical Vocabulary (IEV) - Part 131: Circuit theory*

IEC 60050-161, *International Electrotechnical Vocabulary (IEV) - Part 161: Electromagnetic compatibility*

IEC 62132-1, *Integrated circuits - Measurement of electromagnetic immunity - Part 1: General conditions and definitions*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 62132-1, IEC 60050-131 and IEC 60050-161, and the following, apply.

3.1

transverse electromagnetic mode
TEM mode
waveguide mode in which the components of the electric and magnetic fields in the propagation direction are much less than the primary field components across any transverse cross-section

3.2

TEM waveguide
open or closed transmission line system, in which a wave is propagating in the transverse electromagnetic mode to produce a specified field for testing purposes

3.3

IC stripline
TEM waveguide consisting of an active conductor placed on a defined spacing over an enlarged ground plane, connected to a port structure on each end and an optional shielded enclosure

Note 1 to entry: This arrangement guides a wave propagation in the transverse electromagnetic mode to produce a specific field for testing purposes between the active conductor and the enlarged ground plane. The ground plane of the standard EMC test board, according to IEC 62132-1, is used. An optional shielding enclosure may be used to shield the IC stripline. In contrast to the open version without a shielding enclosure, the shied leads to a closed version of the IC stripline. For further information, see Annex A.

3.4

characteristic impedance
magnitude of the ratio of the voltage between the active conductor and the corresponding ground plane to the current on either conductor for any constant phase wave-front

Note 1 to entry: The characteristic impedance is independent of the voltage/current magnitudes and depends only on the cross sectional geometry of the transmission line. TEM waveguides are typically designed to have a 50 Ω characteristic impedance. For further information and equation to stripline arrangements, see Annex A.

3.5
primary field component
electric field component aligned with the intended test polarization

Note 1 to entry: For example, in IC stripline, the active conductor is parallel to the horizontal floor, and the primary mode electric field vector is vertical at the transverse centre of the IC stripline.

4 General

An IC to be evaluated for EMC performance is referred to as a device under test (DUT). The DUT should be mounted on an EMC test board according to IEC 62132-1. The EMC test board is provided with the appropriate measurement or monitoring points at which the DUT response parameters can be measured. It controls the geometry and orientation of the DUT relative to the active conductor and eliminates in the case of a closed version of the IC stripline any connecting leads within the housing (these are on the non-DUT side of the board, which is outside the housing).

For the IC stripline, one of the 50 Ω ports is terminated with a 50 Ω load. The other 50 Ω port is connected to the output of an RF disturbance generator. The injected RF disturbance signal exposes the DUT to an electromagnetic field determined by the injected power, the typical impedance and the distance between the ground plane of the EMC test board and the active conductor of the IC stripline. The relation is given in Annex A.

Rotating the EMC test board in the four possible orientations in the aperture to accept EMC test board of the IC stripline will affect the sensitivity of the DUT. Dependent upon the DUT, the response parameters of the DUT may vary (e.g. a change of current consumption, deterioration in function performance, waveform jitter). The intent of this test method is to provide a quantitative measure of the RF immunity of DUTs for comparison or other purposes.

For further information, see Annex A.

5 Test conditions

5.1 General

The test conditions shall meet the requirements as described in IEC 62132-1. In addition, the following test conditions shall apply.

5.2 Supply voltage

The supply voltage shall be as specified by the IC manufacturer. If the users of this procedure agree to other values, they shall be documented in the test report.

5.3 Frequency range

The effective frequency range of this radiated immunity procedure is 150 kHz to 6 GHz in combination with the voltage standing wave ratio (VSWR) characteristic ≤ 1,25 for $f \leq 3$ GHz and ≤ 1,4 for $f > 3$ GHz. The upper frequency can be extended if the IC stripline does not exhibit significant higher order modes over the frequency range being measured.

NOTE 1 The given VSWR value of 1,4 is based on evolving technical solutions for IC striplines. For accuracy reasons, the VSWR value is targeted as low as possible (e.g. 1,3).

NOTE 2 Higher-order modes can affect the VSWR of the IC Striplines by interfering with the TEM mode and perturb the desired field distribution.

6 Test equipment

6.1 General

The test equipment shall meet the requirements described in IEC 62132-1. In addition, the following test equipment requirements shall apply.

6.2 Cables

Double shielded or semi-rigid coaxial cable, of 50 Ω characteristic impedance, can be required to interface with the IC stripline.

6.3 Shielding

Testing in a shielded room is only necessary for the open IC stripline version. The closed version of the IC stripline is shielded by its housing.

6.4 RF disturbance generator

An RF disturbance generator with sufficient power handling capabilities shall be used. The RF disturbance generator can comprise of an RF signal generator with a modulation function, an RF power amplifier and an optional attenuator. The VSWR at the output of the RF disturbance generator shall be less than 1,5 over the frequency range being measured.

6.5 IC stripline

The IC stripline (open or closed version) used for this test procedure shall be fitted with an aperture to mate with the EMC test board.

For further information as to field strength determination, IC stripline designs and the limitation of geometrical dimensions of closed version, see Annex A, Annex B and Annex C.

6.6 50 Ω termination

A 50 Ω termination with a VSWR ≤ 1,1 for $f \leq 3$ GHz and a VSWR ≤ 1,2 for $f > 3$ GHz up to the maximum used frequency and sufficient power handling capabilities over the frequency range of measurement is recommended for the IC stripline 50 Ω port not connected to the RF disturbance generator.

6.7 DUT monitor

The performance of the DUT shall be monitored for indications of performance degradation. The monitoring equipment shall not be adversely affected by the injected RF disturbance signal.

7 Test setup

7.1 General

A test setup shall meet the requirements described in IEC 62132-1. In addition, the following test setup requirements shall apply.

7.2 Test configuration

See Figure 1 for IC stripline test configurations. One of the IC stripline 50 Ω ports is terminated with a 50 Ω load. The other IC stripline 50 Ω port is connected to the output port of the RF disturbance generator.

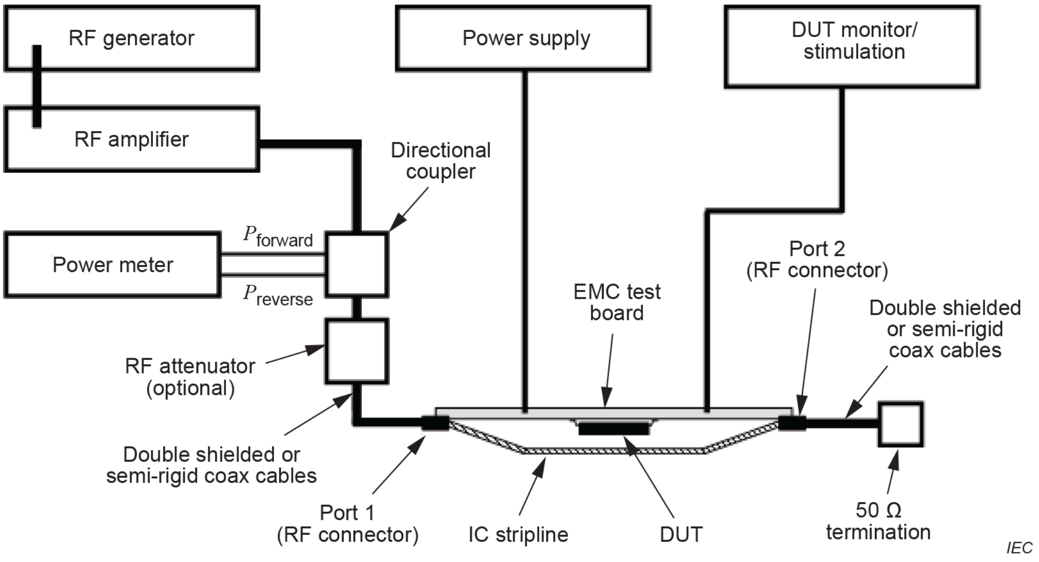

Figure 1 – IC stripline test setup

For further information and cross-section view of the IC stripline, see Annex B.

7.3 EMC test board (PCB)

The EMC test board shall be designed in accordance with the requirements in IEC 62132-1 with the DUT positioned at the centre of the test board.

8 Test procedure

8.1 General

Test procedure shall be in accordance with IEC 62132-1, except as modified herein. These default test conditions are intended to assure a consistent test environment. The following steps shall be performed:

a) operational check (see 8.2);

b) immunity measurement (see 8.3).

If the users of this procedure agree to other conditions, they shall be documented in the test report.

8.2 Operational check

Power up the DUT and complete an operational check to verify proper function of the device (i.e. run DUT test code) in the ambient test condition. During the operational check, the RF disturbance generator and any monitoring equipment shall be powered; however, the output of the RF disturbance generator shall be disabled. The performance of the DUT shall not be degraded by ambient conditions.

8.3 Immunity measurement

8.3.1 General

With the EMC test board powered on and the DUT operated in the intended test mode, measure the immunity to the injected RF disturbance signal over the desired frequency range.

8.3.2 RF disturbance signal

The RF disturbance signal may be one or more of the signals specified in IEC 62132-1 as described below:

- CW (continuous wave, no modulation);
- amplitude modulated by a 1 kHz sinusoidal wave with 80 % depth;
- pulse modulated with 50 % duty cycle and 1 kHz pulse repetition rate.

8.3.3 Test frequency steps and ranges

The RF immunity of the DUT is generally evaluated in the frequency range from 150 kHz to 6 GHz or higher as long as the IC stripline does not exhibit significant higher order modes over the frequency range being measured. The frequency steps shall be in accordance with IEC 62132-1.

8.3.4 Test levels and dwell time

The applied test level shall be increased in steps until a malfunction is observed or the maximum signal generator setting (test level) is reached. The step size and test level shall be documented in the test report.

The dwell time shall be in accordance with IEC 62132-1.

8.3.5 DUT monitoring

The performance of the DUT shall be monitored for indications of performance degradation using suitable test equipment. The monitoring equipment shall not be adversely affected by the injected RF disturbance signal.

8.3.6 Detailed procedure

8.3.6.1 Field strength determination

At each frequency to be tested, the RF disturbance generator setting to achieve the desired electric field level or levels shall be determined as described in Annex A.

8.3.6.2 Immunity measurement

The test flow, including major steps, is described below. One of two strategies can be employed in performing this measurement as follows:

a) The output of the RF disturbance generator shall be set at a low value (e.g. 20 dB below a desired upper limit) and slowly increased (e.g. in steps of 1 dB or 2 dB) up to the desired limit while monitoring the DUT for performance degradation. Any performance degradation at or below the desired limit shall be recorded.

b) The output of the RF disturbance generator shall be set at the desired performance limit while monitoring the DUT for performance degradation. Any performance degradation at the desired limit should be recorded. The output of the RF disturbance generator shall then be reduced until normal function returns. This level shall be recorded.

NOTE The DUT can respond differently to each of the above methods. In such a case, a method in which the interference signal is ramped up as well as down can be required. Additionally, in some cases, it can be necessary to reset or restart the DUT to come back to proper operation.

The RF immunity measurement shall be performed for at least two orientations (0°, 90°). If the users of this document consider it necessary, the other orientations 180° and 270° can also be tested. The first measurement is made with the EMC test board mounted in an arbitrary orientation in the IC stripline aperture. The second measurement is made with the EMC test board rotated 90° from the orientation in the first measurement. For each of the third and fourth measurements, the EMC test board is rotated again to ensure immunity is measured in all four possible orientations. The results and their tested orientations shall be documented in the test report.

9 Test report

The test report shall be in accordance with the requirements of IEC 62132-1.

10 RF immunity acceptance level

The RF immunity acceptance level of a DUT, if any, is to be agreed upon between the manufacturer and the user of the DUT and can be defined also differently for special frequency bands.