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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Integrated circuits – Measurement of electromagnetic emissions –
Part 8: Measurement of radiated emissions – IC stripline method

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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61967-8:2011. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61967-8 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 2011. 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:

Draft	Report on voting
47A/1152/FDIS	47A/1153/RVD

Full information on the voting for its approval 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 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 parts of the IEC 61967 series, under the general title *Integrated circuits – Measurement of electromagnetic emissions* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTEGRATED CIRCUITS – MEASUREMENT OF ELECTROMAGNETIC EMISSIONS –

Part 8: Measurement of radiated emissions – IC stripline method

1 Scope

~~The measurement procedure of~~ This part of IEC 61967 defines a method for measuring the electromagnetic radiated emission from an integrated circuit (IC) using an IC stripline ~~in the frequency range of 150 kHz up to 3 GHz~~. The IC being evaluated is mounted on an EMC test board (PCB) between the active conductor and the ground plane of the IC stripline arrangement.

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) – Chapter 161: Electromagnetic compatibility*

IEC 61967-1, *Integrated circuits – Measurement of electromagnetic emissions~~, 150 kHz to 1 GHz~~ – Part 1: General conditions and definitions*

~~*IEC 61967-2: Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 2: Measurement of radiated emissions – TEM cell and wideband TEM cell method*~~

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61967-1, IEC 60050-131 and IEC 60050-161, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

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~~ either 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. As enlarged ground plane the ground plane of the standard EMC test board according to IEC 61967-1 should be used. An optional shielding enclosure may be used for fixing the IC stripline configuration and for shielding purposes. This leads to a closed version of the IC stripline in opposite to the open version without shielding enclosure. For further information, see Annex A.

3.4
two-port TEM waveguide
TEM waveguide with input/output measurement ports at both ends

3.5
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.

3.6
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

This test method is based on the TEM wave guide measurement principle according to IEC 61000-4-20. A stripline set-up is used to measure the RF emission of ICs. The RF voltage at the stripline port is related to the electromagnetic radiation potential of the IC and will be measured using a spectrum analyzer or measuring receiver. The intent of this test method is to provide a quantitative measure of the RF emissions from ICs for comparison or other evaluation.

5 Test conditions

5.1 General

The test conditions shall meet the requirements as described in IEC 61967-1. In addition, the following test conditions described in 5.2 and 5.3 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 for the IC stripline is 150 kHz to 6 GHz in combination with the VSWR characteristic ≤ 1,25 for f ≤ 3 GHz and ≤ 1,4 for f > 3 GHz. ~~The range is limited by its Voltage Standing Wave Ratio (VSWR) characteristics (≤ 1,25).~~ The upper frequency can be extended if the IC stripline does not exhibit significant higher order modes over the frequency range being measured.

NOTE 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).

6 Test equipment

6.1 General

The test equipment shall meet the requirements as described in IEC 61967-1. In addition, the test equipment requirements described in 6.2 to 6.5 shall apply.

6.2 RF measuring instrument

A spectrum analyzer or EMI receiver shall be used. The resolution bandwidth shall be 9 kHz for EMI receivers or 10 kHz for spectrum analyzers in the frequency range from 150 kHz to 30 MHz and respectively 120 kHz or 100 kHz above 30 MHz according to IEC 61967-1. Measurements shall be made with a peak detector and presented in units of dBµV [for 50 Ω system: (dBm readings) + 107 = dBµV]. For spectrum analyzers, the frequency band of interest shall be swept in calibrated or coupled mode (auto sweep).

6.3 Preamplifier

Optionally, a 20 dB to 30 dB gain, low noise preamplifier ~~might~~ can be used. If used, the preamplifier shall be connected directly to the measurement port of the IC stripline using the appropriate 50 Ω coaxial adapter.

6.4 IC stripline

Two-port TEM waveguide, consisting of an active conductor placed on a defined spacing over an enlarged ground plane, connected to a port structure on ~~each~~ either end and an optional shielded enclosure. The spacing between active conductor and ground plane of the IC stripline has a default value of 6,7 mm. Other spacing can be used but ~~has to~~ shall be noted in the test report.

NOTE A conversion factor allows comparisons between IC stripline arrangements with different spacing between active conductor and ground plane (see Annex A).

This IC stripline arrangement guides wave propagation in the transverse electromagnetic mode to produce a specific field for testing purposes between the active conductor and the enlarged ground plane ~~which is preferably~~. As enlarged ground plane, the ground plane of the standard EMC test board according to IEC 61967-1 should be used. The EMC test board controls the geometry and orientation of the operating IC relative to the IC stripline and eliminates any connecting leads within the IC stripline (these are on the backside of the board, which is opposite to the IC stripline). An optional shielding enclosure may be used for fixing the IC stripline configuration and for shielding purposes. This leads to a closed version of the IC stripline as opposed to the open version without shielding enclosure.

For further information, see Annex A.

6.5 50 Ω termination

A 50 Ω termination with a VSWR less than 1,1 ~~over the frequency range of measurement is recommended~~ for $f \leq 3$ GHz and ≤ 1,2 for $f > 3$ GHz up to the maximum used frequency shall be used for the IC stripline 50 Ω port not connected to the RF measuring instrument.

~~6.6 System gain~~

~~The gain (or attenuation) of the measuring equipment, without the IC stripline, shall be known with an accuracy ±0,5 dB. The gain of the RF measurement system shall remain within a 6 dB envelope for the frequency range of interest.~~

7 Test set-up

7.1 General

The test set-up shall meet the requirements as described in IEC 61967-1. In addition, the following test set-up requirements shall apply.

7.2 Test configuration

See Figure 1 for IC stripline test configuration. One of the 50 Ω ports is terminated with a 50 Ω load. The remaining 50 Ω port is connected to the spectrum analyzer through the optional preamplifier.

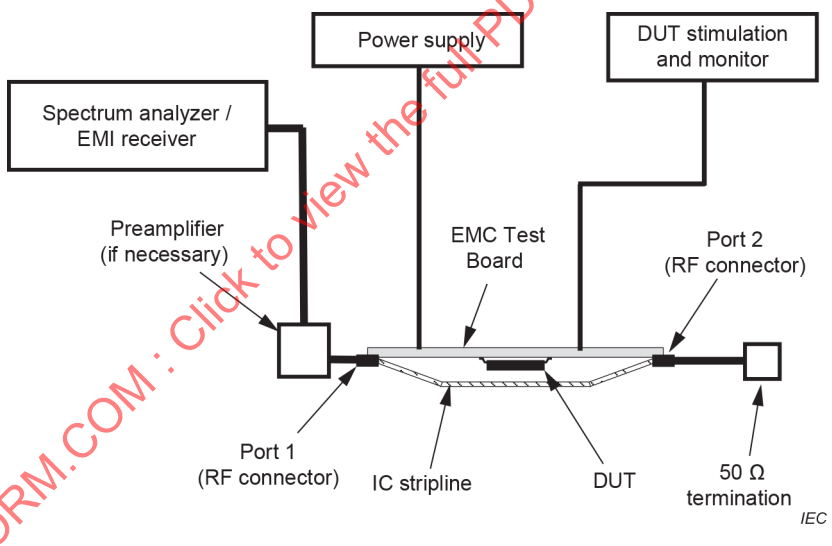


Figure 1 – IC stripline test set-up

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

7.3 EMC test board (PCB)

The DUT shall be mounted on a PCB according to IEC 61967-1 and in this document. In cases where IEC 61967-1 and this document are in conflict, the requirements of this document shall apply.

The EMC test board is provided with the appropriate measurement or monitoring points to ensure the correct DUT operation. It controls the geometry and orientation of the DUT relative to the active conductor and eliminates in case of a closed version of the IC stripline, any connecting leads within the housing (these are on the backside of the board, which is outside the housing).

8 Test procedure

8.1 General

These default test conditions are intended to assure a consistent test environment. If the users of this procedure agree to other conditions, they shall be documented in the test report.

8.2 Ambient conditions

The definitions for ambient temperature and general condition of IEC 61967-1 are valid.

The ambient RF noise level shall be verified to be at least 6 dB below the lowest emission level(s) to be measured. The DUT shall be installed in the test set-up, as used for testing. The DUT shall not be activated (e.g. power supply voltage disabled). A scan shall be made to measure the ambient noise. A description of the ambient conditions shall be a part of the test report.

If the measured noise floor is excessive, e.g. due to external ambient noises or the noise floor of the measurement system itself, shielded enclosure should be used. The noise floor measurement system can be improved by using a lower noise preamplifier.

8.3 Operational check

Energize the DUT and complete an operational check to assure proper function of the device (i.e. Run IC test code).

8.4 Verification of IC stripline RF characteristic

For verification of the IC stripline RF characteristic, the VSWR value of the empty IC stripline with 50 Ω load termination at the second port shall be measured and documented in the test report. The value shall be ~~lower than 1,25~~ in accordance with 5.3.

~~Optionally it is recommended to check the DUT-loaded IC stripline. In this case, the IC stripline resonances shall be verified with unpowered DUT in accordance to IEC 61000-4-20.~~

In addition, it is recommended to check also the DUT loaded IC stripline. Before testing, the IC stripline resonances should be determined in accordance with IEC 61000-4-20 with the test set-up including DUT installed and powered off.

~~$$A_{tloss} = \left| 10 \times \lg \left(\frac{P_{refl}}{P_{fwd}} + \frac{P_{output}}{P_{fwd}} \right) \right| \leq 1\ dB$$~~

$$A_{\text{tloss}} = \left| 10 \times \log_{10} \left(\frac{P_{\text{output}}}{P_{\text{fwd}} - P_{\text{refl}}} \right) \right| \leq 1 \text{ dB} \quad (1)$$

where

A_{tloss} is the transmission loss of loaded IC stripline [dB];

P_{refl} is the reflected power at input port [W];

P_{fwd} is the forward power at input port [W];

P_{output} is the measured power at output port [W].

Measurements carried out at frequencies where the VSWR and transmission losses A_{tloss} exceed the maximum tolerated values shall be ignored.

8.5 Test technique

With the EMC test board energized and the DUT being operated in the intended test mode, measure the RF emissions over the desired frequency band.

When using a spectrum analyzer, enable the "Max Hold" function and allow the analyzer to perform a minimum of three sweeps while the IC code loop executes. The sweep time shall be greater than the IC code loop execution time.

NOTE The "Max Hold" setting on a spectrum analyzer maintains the maximum level of each trace data point and updates each point if a new maximum level is detected in successive sweeps.

When using a receiver, the dwell time for each test frequency shall be greater than or equal to two times the IC code loop execution time and record the maximum level detected.

Four separate emissions measurements are performed resulting in four sets of data. The first measurement is made with the EMC test board mounted in an arbitrary orientation in the test setup. The second measurement is made with the EMC test board rotated 90 degrees from the orientation in the first measurement. For each of the third and fourth measurements, the EMC test board is rotated again to ensure emissions are measured from all four possible orientations. The four sets of data shall be documented in the test report.

9 Test report

9.1 General

The test report shall be in accordance with the requirements of IEC 61967-1. In addition, the following test report requirements shall apply.

9.2 Measurement conditions

All measurement conditions shall be documented in the test report.

10 IC Emissions reference levels

IC emissions acceptance levels, if any, are to be agreed upon between the manufacturers and the users of ICs and may be selected using the reference level scheme in Annex B. These reference levels apply to measurements over the frequency range of 150 kHz to ~~3 GHz~~ the maximum used measurement frequency in units of dBµV.

Annex A
(normative)

IC stripline description

A.1 General

The IC stripline offers a broadband method of measuring either immunity of a DUT to fields generated within the IC stripline or radiated emission from a DUT placed within the IC stripline. It eliminates the use of conventional antennas with their inherent measurement limitations of bandwidth, non-linear phase, directivity and polarization. The IC stripline is a special kind of transmission line that propagates a TEM wave. This wave is characterized by transverse orthogonal electric (E) and magnetic (H) fields, which are perpendicular to the direction of propagation along the length of the IC stripline or transmission line. This field simulates a planar field generated in free space with impedance of 377 Ω. The TEM mode has no low frequency cut-off. This allows the IC stripline to be used at frequencies as low as desired. The TEM mode also has linear phase and constant amplitude response as a function of frequency. This makes it possible to use the IC stripline to generate or detect a field intensity in a defined way. The upper useful frequency for an IC stripline is limited by distortion of the test signal caused by resonances and multi-moding that occur within the IC stripline. These effects are a function of the physical size and shape of the IC stripline.

The IC stripline is of a size and shape, with impedance matching at the input and output feed points of the IC stripline that limits the VSWR to ~~less than 1,25 up to its rated frequency~~ the values given in 5.3. In principle there are two versions of IC stripline possible – open and closed version. The open version uses the common stripline configuration (Figure A.1). At the closed version a shielding case is added (Figure A.2). The active conductor of the IC stripline is tapered at each end to adapt to conventional 50 Ω coaxial connectors. The requested EMC test board can be based on a TEM cell board according to IEC 61967-1. The first resonance is demonstrated by a high VSWR over a narrow frequency range. An IC stripline verified for field generation to a maximum frequency will also be suitable for emission measurements to this frequency.

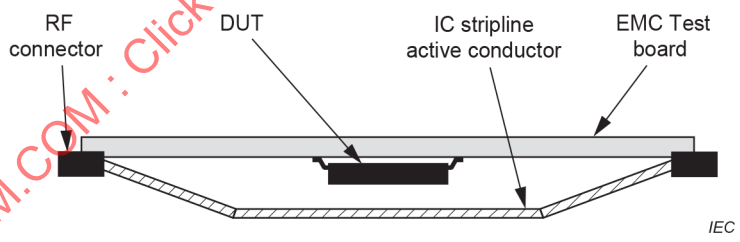


Figure A.1 – Cross-section view of an example of an unshielded IC stripline

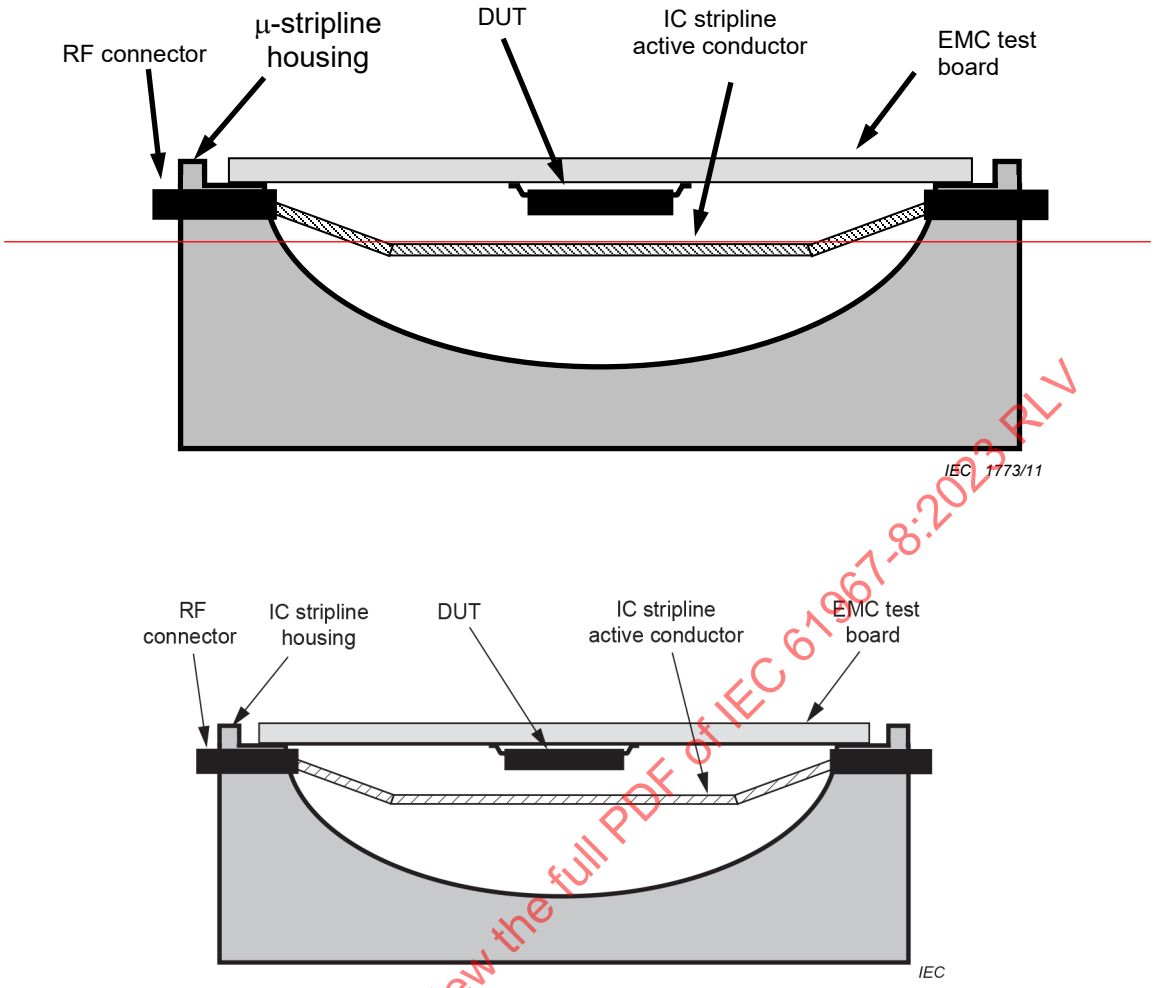


Figure A.2 – Cross-section view of an example of an IC stripline with housing

The maximum usable DUT size is limited by the IC stripline dimensions. The ratio of DUT package height to IC stripline height is recommended to one third but shall not exceed one half according to IEC 61000-4-20. In x-y dimension, the package shall not exceed the width of active conductor by more than 10 %.

NOTE D field simulations have shown that an uniform field (not more than +0 dB and not less than -3 dB) is present outside the active conductor width geometrical boundary up to a package size which exceeds the width of the active conductor by 10 % at a half of active conductor height [1][1].

The limitation values for the 6,7 mm IC stripline for example are given in Table A.1 and Table A.2. The active conductor width for the closed version is dependent on the distance between active conductor and housing. The complete setup ~~has to~~ shall fulfill the ~~requirements~~ definitions of 8.4.

Table A.1 – Maximum DUT dimensions for 6,7 mm IC stripline open version

	Active conductor 6,7 mm IC stripline open version	**DUT**
z dimension (height)	6,7 mm	≤ 3,35 mm
x-y dimension (width)	33 mm	≤ 36,3 mm

[1] Numbers in square brackets refer to the Bibliography.

Table A.2 – Maximum DUT dimensions for 6,7 mm IC stripline closed version

	Active conductor 6,7 mm IC stripline closed version	DUT
z dimension (height)	6,7 mm	≤ 3,35 mm
x-y dimension (width)	24 mm	≤ 26,4 mm

~~NOTE The 24 mm width of the closed version stripline is related to the stripline height and shielding design with shape and distance to achieve the stripline characteristic defined in 8.4.~~

A.2 Characteristic impedance of stripline arrangements

The nominal, characteristic impedance of an open version of IC stripline can be calculated as follows [1], if $1 < w/h \leq 10$:

$$Z = \frac{120 \times \pi}{\frac{w}{h} + 2{,}42 - 0{,}44 \times \frac{h}{w} + \left[1 - \frac{h}{w}\right]^6} \quad \text{(A.1)}$$

where

Z is the characteristic impedance [Ω], typical 50 Ω;

w is the width [m] of active conductor;

h is the height [m] between the active conductor and ground plane.

For the closed version of the IC stripline, the influence of housing ~~has to~~ shall be taken into account. This correction depends on the housing geometry. For spherical housing surface, an analytical formula for the characteristic impedance cannot be provided, empirical investigations are necessary. The characteristic impedance of those stripline arrangements ~~have to~~ shall be verified by measurement.

A.3 Conversion for different active conductor heights

A conversion factor (X) to correlate measuring results of IC striplines with different heights to the default IC stripline height of 6,7 mm can be calculated by:

~~$$X = 20 \times \lg\left(\frac{h_1}{h_2}\right)$$~~

$$X = 20 \times \log_{10}\left(\frac{h_1}{h_2}\right) \quad \text{(A.2)}$$

where

X is the conversion factor [dB] to IC stripline 6,7 mm height type results;

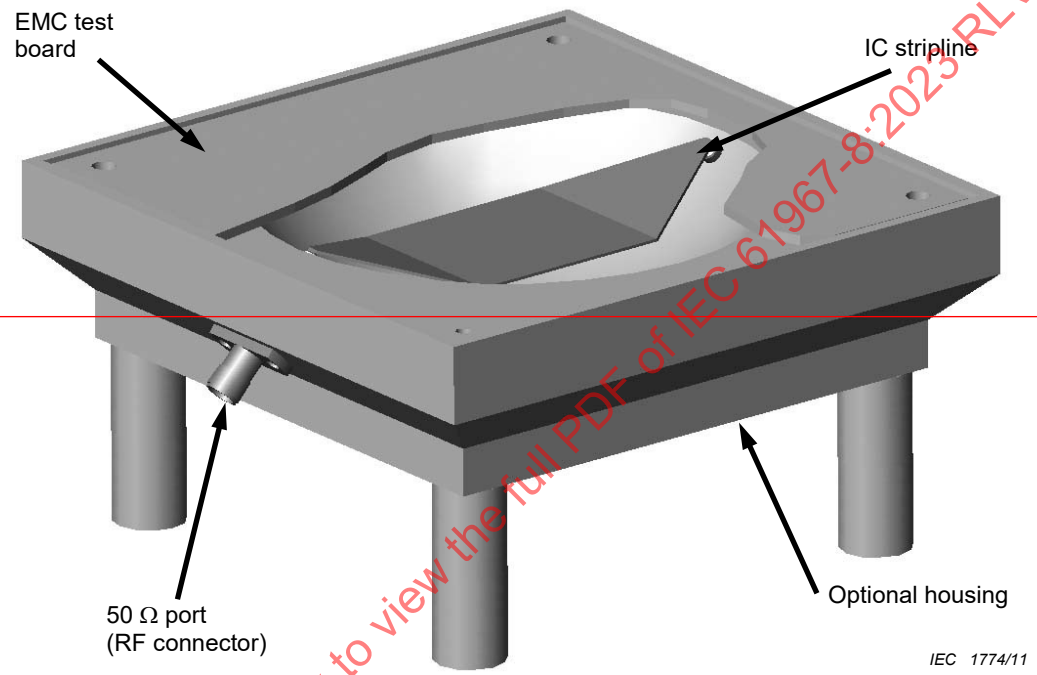
h_1 is the active conductor height of specific type;

h_2 is the active conductor height of 6,7 mm type.

For example the conversion factor for an IC stripline with h_1 = 8 mm is X = 1,54 dB. That means 1,54 dB ~~has to~~ shall be added to the measured voltage in dBµV at the measurement port of the 8 mm height IC stripline.

A.4 Example for IC stripline arrangement

An example for IC stripline with housing is given in Figure A.3. The housing x-y dimensions are defined by the used EMC test board (IEC 61967-1: 100 mm × 100 mm). The housing in z direction ~~shall~~ should be as far as possible from the active conductor but avoid resonances and multi-moding in the frequency range of interest.



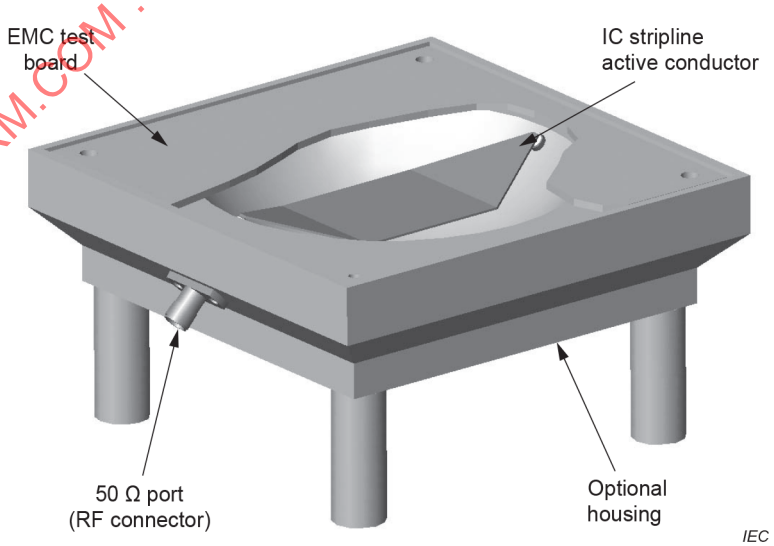


Figure A.3 – Example of IC stripline with housing

Annex B
(informative)

Specification of emission levels

B.1 Scope

This Annex B provides a method of specifying the emission level profiles of integrated circuits.

B.2 General

This Annex B is not meant to be a product specification. However, using the concept described in this document and by careful application and agreement between manufacturer and user, it is possible to develop a description of the RF emissions behavior for a specific integrated circuit in one of three (x-y-z) field orientations.

B.3 Specification of emission levels

The diagram in Figure B.1 represents a scheme that facilitates classification of emission levels for ICs. In order to be able to use the classification as defined in IEC 61967-2 [3] values are to be calculated using

~~$$A = B + 20 \times \lg\left(\frac{h_{IC\ Stripline}}{h_{\mu TEM}}\right)$$~~

$$A = B + 20 \times \log_{10}\left(\frac{h_{\text{ICstripline}}}{h_{\text{TEM}}}\right) \quad \text{(B.1)}$$

where

A is the converted result for comparison with reference levels;

B is the measurement result of spectrum analyzer or EMI receiver;

~~$h_{\mu TEM}$~~ h_{TEM} is the septum height ~~μ~~TEM cell of 45 mm (default);

$h_{\text{IC stripline}}$ is the active conductor height of 6,7 mm (default).

B.4 Presentation of results

The typical description of the maximum emission level consists of two letters and one number always following the same sequence. If one of the three slopes is not needed, the corresponding letter or number will be omitted.

~~The first character shall be a capital letter indicating the position of the horizontal line with zero dB/decade slope. The second character shall be a number indicating the position of the -20 dB/decade slope. The third character shall be a small letter indicating the position of the -40 dB/decade slope.~~

The capital letter is first and represents the position of the horizontal line with zero dB per decade slope. Second is the number, which defines the position of the -20 dB per decade slope. The third and small letter defines the position of the -40 dB per decade slope.

Such defined maximum emission levels with the described notation offer a standardized way to communicate maximum emission levels unambiguously.

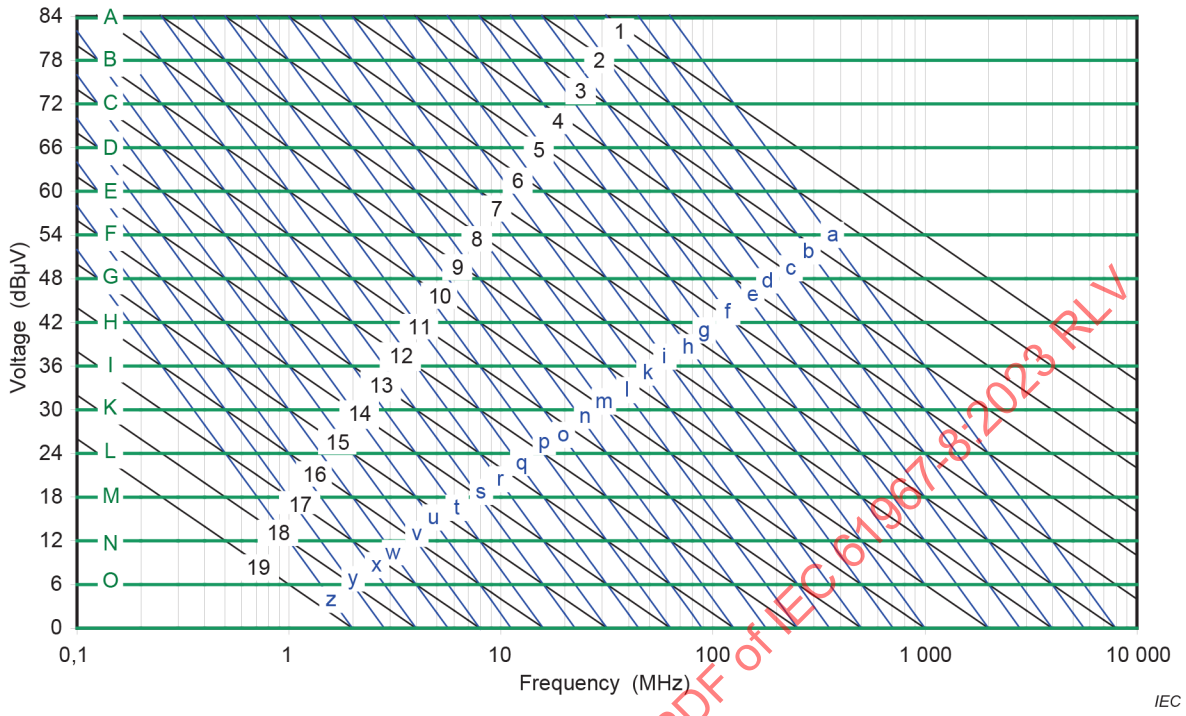


Figure B.1 – Emission characterization levels

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[1] Körber, Klotz, Müller, Müllerwiebus, Trebeck: IC- Stripline for Susceptibility and Emission Testing of ICs, EMC COMPO ~~2007~~2009

~~[2] Körber, Mueller, Trebeck, *IC- Streifenleitung – Neues Messverfahren zur Bewertung der EMV- Eigenschaften von Halbleitern*, EMV Düsseldorf 2008~~

[2] M. V. Schneider, "Microstrip Lines for Microwave Integrated Circuits" The Bell System Technical Journal, vol. 48, pp. 1421–1444, May 1969

[3] IEC 61967-2, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 2: Measurement of radiated emissions – TEM cell and wideband TEM cell method*

~~[4] Körber, Klotz, Müller, Müllerwiebus, Trebeck, *IC- Stripline for Susceptibility and Emission Testing of ICs*, EMC COMPO 2009~~

IEC 61967-8

Edition 2.0 2023-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Integrated circuits – Measurement of electromagnetic emissions – Part 8: Measurement of radiated emissions – IC stripline method

Circuits intégrés – Mesure des émissions électromagnétiques – Partie 8: Mesure des émissions rayonnées – Méthode de la ligne TEM à plaques (stripline) pour circuit intégré

IEC 61967-8:2023-05(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTEGRATED CIRCUITS – MEASUREMENT OF ELECTROMAGNETIC EMISSIONS –

Part 8: Measurement of radiated emissions – IC stripline method

FOREWORD

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IEC 61967-8 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 2011. 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:

Draft	Report on voting
47A/1152/FDIS	47A/1153/RVD

Full information on the voting for its approval 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 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 parts of the IEC 61967 series, under the general title *Integrated circuits – Measurement of electromagnetic emissions* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
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- amended.

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INTEGRATED CIRCUITS – MEASUREMENT OF ELECTROMAGNETIC EMISSIONS –

Part 8: Measurement of radiated emissions – IC stripline method

1 Scope

This part of IEC 61967 defines a method for measuring the electromagnetic radiated emission from an integrated circuit (IC) using an IC stripline. The IC being evaluated is mounted on an EMC test board (PCB) between the active conductor and the ground plane of the IC stripline arrangement.

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) – Chapter 161: Electromagnetic compatibility*

IEC 61967-1, *Integrated circuits – Measurement of electromagnetic emissions – Part 1: General conditions and definitions*

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61967-1, IEC 60050-131 and IEC 60050-161, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

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 either 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. As enlarged ground plane the ground plane of the standard EMC test board according to IEC 61967-1 should be used. An optional shielding enclosure may be used for fixing the IC stripline configuration and for shielding purposes. This leads to a closed version of the IC stripline in opposite to the open version without shielding enclosure. For further information, see Annex A.

3.4
two-port TEM waveguide
TEM waveguide with input/output measurement ports at both ends

3.5
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.

3.6
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

This test method is based on the TEM wave guide measurement principle according to IEC 61000-4-20. A stripline set-up is used to measure the RF emission of ICs. The RF voltage at the stripline port is related to the electromagnetic radiation potential of the IC and will be measured using a spectrum analyzer or measuring receiver. The intent of this test method is to provide a quantitative measure of the RF emissions from ICs for comparison or other evaluation.

5 Test conditions

5.1 General

The test conditions shall meet the requirements as described in IEC 61967-1. In addition, the following test conditions described in 5.2 and 5.3 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 for the IC stripline is 150 kHz to 6 GHz in combination with the VSWR characteristic ≤ 1,25 for f ≤ 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 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).

6 Test equipment

6.1 General

The test equipment shall meet the requirements as described in IEC 61967-1. In addition, the test equipment requirements described in 6.2 to 6.5 shall apply.

6.2 RF measuring instrument

A spectrum analyzer or EMI receiver shall be used. The resolution bandwidth shall be 9 kHz for EMI receivers or 10 kHz for spectrum analyzers in the frequency range from 150 kHz to 30 MHz and respectively 120 kHz or 100 kHz above 30 MHz according to IEC 61967-1. Measurements shall be made with a peak detector and presented in units of dBµV [for 50 Ω system: (dBm readings) + 107 = dBµV]. For spectrum analyzers, the frequency band of interest shall be swept in calibrated or coupled mode (auto sweep).

6.3 Preamplifier

Optionally, a 20 dB to 30 dB gain, low noise preamplifier can be used. If used, the preamplifier shall be connected directly to the measurement port of the IC stripline using the appropriate 50 Ω coaxial adapter.

6.4 IC stripline

Two-port TEM waveguide, consisting of an active conductor placed on a defined spacing over an enlarged ground plane, connected to a port structure on either end and an optional shielded enclosure. The spacing between active conductor and ground plane of the IC stripline has a default value of 6,7 mm. Other spacing can be used but shall be noted in the test report.

NOTE A conversion factor allows comparisons between IC stripline arrangements with different spacing between active conductor and ground plane (see Annex A).

This IC stripline arrangement guides wave propagation in the transverse electromagnetic mode to produce a specific field for testing purposes between the active conductor and the enlarged ground plane. As enlarged ground plane, the ground plane of the standard EMC test board according to IEC 61967-1 should be used. The EMC test board controls the geometry and orientation of the operating IC relative to the IC stripline and eliminates any connecting leads within the IC stripline (these are on the backside of the board, which is opposite to the IC stripline). An optional shielding enclosure may be used for fixing the IC stripline configuration and for shielding purposes. This leads to a closed version of the IC stripline as opposed to the open version without shielding enclosure.

For further information, see Annex A.

6.5 50 Ω termination

A 50 Ω termination with a VSWR less than 1,1 for $f \leq 3$ GHz and ≤ 1,2 for $f > 3$ GHz up to the maximum used frequency shall be used for the IC stripline 50 Ω port not connected to the RF measuring instrument.

7 Test set-up

7.1 General

The test set-up shall meet the requirements as described in IEC 61967-1. In addition, the following test set-up requirements shall apply.

7.2 Test configuration

See Figure 1 for IC stripline test configuration. One of the 50 Ω ports is terminated with a 50 Ω load. The remaining 50 Ω port is connected to the spectrum analyzer through the optional preamplifier.

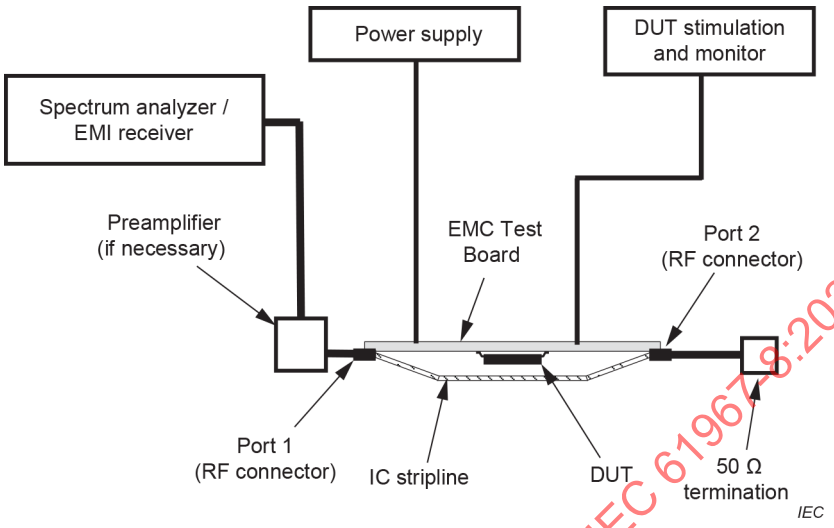

Figure 1 – IC stripline test set-up

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

7.3 EMC test board (PCB)

The DUT shall be mounted on a PCB according to IEC 61967-1 and in this document. In cases where IEC 61967-1 and this document are in conflict, the requirements of this document shall apply.

The EMC test board is provided with the appropriate measurement or monitoring points to ensure the correct DUT operation. It controls the geometry and orientation of the DUT relative to the active conductor and eliminates in case of a closed version of the IC stripline, any connecting leads within the housing (these are on the backside of the board, which is outside the housing).

8 Test procedure

8.1 General

These default test conditions are intended to assure a consistent test environment. If the users of this procedure agree to other conditions, they shall be documented in the test report.

8.2 Ambient conditions

The definitions for ambient temperature and general condition of IEC 61967-1 are valid.

The ambient RF noise level shall be verified to be at least 6 dB below the lowest emission level(s) to be measured. The DUT shall be installed in the test set-up, as used for testing. The DUT shall not be activated (e.g. power supply voltage disabled). A scan shall be made to measure the ambient noise. A description of the ambient conditions shall be a part of the test report.

If the measured noise floor is excessive, e.g. due to external ambient noises or the noise floor of the measurement system itself, shielded enclosure should be used. The noise floor measurement system can be improved by using a lower noise preamplifier.

8.3 Operational check

Energize the DUT and complete an operational check to assure proper function of the device (i.e. Run IC test code).

8.4 Verification of IC stripline RF characteristic

For verification of the IC stripline RF characteristic, the VSWR value of the empty IC stripline with 50 Ω load termination at the second port shall be measured and documented in the test report. The value shall be in accordance with 5.3.

In addition, it is recommended to check also the DUT loaded IC stripline. Before testing, the IC stripline resonances should be determined in accordance with IEC 61000-4-20 with the test set-up including DUT installed and powered off.

$$A_{\text{tloss}} = \left| 10 \times \log_{10} \left(\frac{P_{\text{output}}}{P_{\text{fwd}} - P_{\text{refl}}} \right) \right| \leq 1 \text{ dB} \quad (1)$$

where

A_{tloss} is the transmission loss of loaded IC stripline [dB];

P_{refl} is the reflected power at input port [W];

P_{fwd} is the forward power at input port [W];

P_{output} is the measured power at output port [W].

Measurements carried out at frequencies where the VSWR and transmission losses A_{tloss} exceed the maximum tolerated values shall be ignored.

8.5 Test technique

With the EMC test board energized and the DUT being operated in the intended test mode, measure the RF emissions over the desired frequency band.

When using a spectrum analyzer, enable the "Max Hold" function and allow the analyzer to perform a minimum of three sweeps while the IC code loop executes. The sweep time shall be greater than the IC code loop execution time.

NOTE The "Max Hold" setting on a spectrum analyzer maintains the maximum level of each trace data point and updates each point if a new maximum level is detected in successive sweeps.

When using a receiver, the dwell time for each test frequency shall be greater than or equal to two times the IC code loop execution time and record the maximum level detected.

Four separate emissions measurements are performed resulting in four sets of data. The first measurement is made with the EMC test board mounted in an arbitrary orientation in the test setup. The second measurement is made with the EMC test board rotated 90 degrees from the orientation in the first measurement. For each of the third and fourth measurements, the EMC test board is rotated again to ensure emissions are measured from all four possible orientations. The four sets of data shall be documented in the test report.

9 Test report

9.1 General

The test report shall be in accordance with the requirements of IEC 61967-1. In addition, the following test report requirements shall apply.

9.2 Measurement conditions

All measurement conditions shall be documented in the test report.

10 IC Emissions reference levels

IC emissions acceptance levels, if any, are to be agreed upon between the manufacturers and the users of ICs and may be selected using the reference level scheme in Annex B. These reference levels apply to measurements over the frequency range of 150 kHz to the maximum used measurement frequency in units of dBµV.

Annex A
(normative)

IC stripline description

A.1 General

The IC stripline offers a broadband method of measuring either immunity of a DUT to fields generated within the IC stripline or radiated emission from a DUT placed within the IC stripline. It eliminates the use of conventional antennas with their inherent measurement limitations of bandwidth, non-linear phase, directivity and polarization. The IC stripline is a special kind of transmission line that propagates a TEM wave. This wave is characterized by transverse orthogonal electric (E) and magnetic (H) fields, which are perpendicular to the direction of propagation along the length of the IC stripline or transmission line. This field simulates a planar field generated in free space with impedance of 377 Ω. The TEM mode has no low frequency cut-off. This allows the IC stripline to be used at frequencies as low as desired. The TEM mode also has linear phase and constant amplitude response as a function of frequency. This makes it possible to use the IC stripline to generate or detect a field intensity in a defined way. The upper useful frequency for an IC stripline is limited by distortion of the test signal caused by resonances and multi-moding that occur within the IC stripline. These effects are a function of the physical size and shape of the IC stripline.

The IC stripline is of a size and shape, with impedance matching at the input and output feed points of the IC stripline that limits the VSWR to the values given in 5.3. In principle there are two versions of IC stripline possible – open and closed version. The open version uses the common stripline configuration (Figure A.1). At the closed version a shielding case is added (Figure A.2). The active conductor of the IC stripline is tapered at each end to adapt to conventional 50 Ω coaxial connectors. The requested EMC test board can be based on a TEM cell board according to IEC 61967-1. The first resonance is demonstrated by a high VSWR over a narrow frequency range. An IC stripline verified for field generation to a maximum frequency will also be suitable for emission measurements to this frequency.

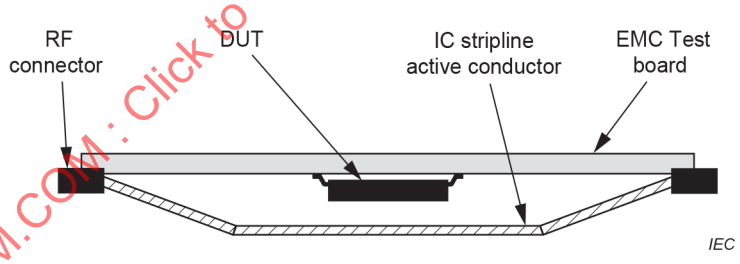

Figure A.1 – Cross-section view of an example of an unshielded IC stripline

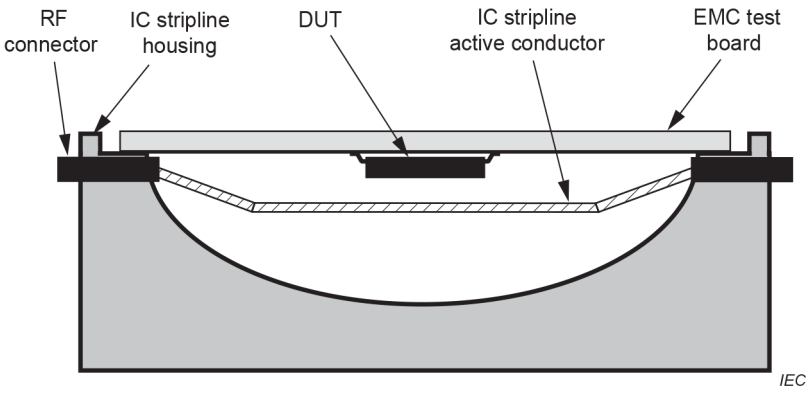

Figure A.2 – Cross-section view of an example of an IC stripline with housing

The maximum usable DUT size is limited by the IC stripline dimensions. The ratio of DUT package height to IC stripline height is recommended to one third but shall not exceed one half according to IEC 61000-4-20. In x-y dimension, the package shall not exceed the width of active conductor by more than 10 %.

NOTE D field simulations have shown that an uniform field (not more than +0 dB and not less than -3 dB) is present outside the active conductor width geometrical boundary up to a package size which exceeds the width of the active conductor by 10 % at a half of active conductor height [1][1].

The limitation values for the 6,7 mm IC stripline for example are given in Table A.1 and Table A.2. The active conductor width for the closed version is dependent on the distance between active conductor and housing. The complete setup shall fulfill the definitions of 8.4.

Table A.1 – Maximum DUT dimensions for 6,7 mm IC stripline open version

	Active conductor 6,7 mm IC stripline open version	**DUT**
z dimension (height)	6,7 mm	≤ 3,35 mm
x-y dimension (width)	33 mm	≤ 36,3 mm

Table A.2 – Maximum DUT dimensions for 6,7 mm IC stripline closed version

	Active conductor 6,7 mm IC stripline closed version	**DUT**
z dimension (height)	6,7 mm	≤ 3,35 mm
x-y dimension (width)	24 mm	≤ 26,4 mm

A.2 Characteristic impedance of stripline arrangements

The nominal, characteristic impedance of an open version of IC stripline can be calculated as follows [1], if $1 < w/h \leq 10$:

$$Z = \frac{120 \times \pi}{\frac{w}{h} + 2{,}42 - 0{,}44 \times \frac{h}{w} + \left[1 - \frac{h}{w}\right]^6} \quad \text{(A.1)}$$

where

Z is the characteristic impedance [Ω], typical 50 Ω;

w is the width [m] of active conductor;

h is the height [m] between the active conductor and ground plane.

For the closed version of the IC stripline, the influence of housing shall be taken into account. This correction depends on the housing geometry. For spherical housing surface, an analytical formula for the characteristic impedance cannot be provided, empirical investigations are necessary. The characteristic impedance of those stripline arrangements shall be verified by measurement.

[1] Numbers in square brackets refer to the Bibliography.

A.3 Conversion for different active conductor heights

A conversion factor (X) to correlate measuring results of IC striplines with different heights to the default IC stripline height of 6,7 mm can be calculated by:

$$X = 20 \times \log_{10}\left(\frac{h_1}{h_2}\right) \quad \text{(A.2)}$$

where

X is the conversion factor [dB] to IC stripline 6,7 mm height type results;

h_1 is the active conductor height of specific type;

h_2 is the active conductor height of 6,7 mm type.

For example the conversion factor for an IC stripline with h_1 = 8 mm is X = 1,54 dB. That means 1,54 dB shall be added to the measured voltage in dBµV at the measurement port of the 8 mm height IC stripline.

A.4 Example for IC stripline arrangement

An example for IC stripline with housing is given in Figure A.3. The housing x-y dimensions are defined by the used EMC test board (IEC 61967-1: 100 mm × 100 mm). The housing in z direction should be as far as possible from the active conductor but avoid resonances and multi-moding in the frequency range of interest.

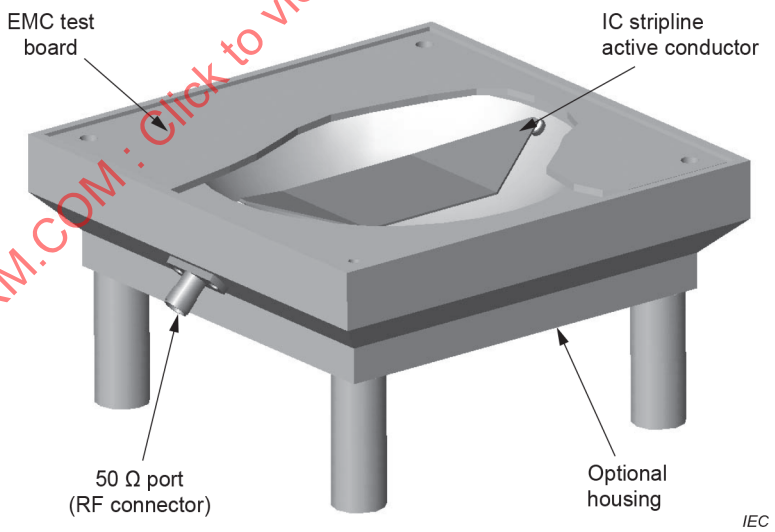

Figure A.3 – Example of IC stripline with housing

Annex B
(informative)

Specification of emission levels

B.1 Scope

This Annex B provides a method of specifying the emission level profiles of integrated circuits.

B.2 General

This Annex B is not meant to be a product specification. However, using the concept described in this document and by careful application and agreement between manufacturer and user, it is possible to develop a description of the RF emissions behavior for a specific integrated circuit in one of three (x-y-z) field orientations.

B.3 Specification of emission levels

The diagram in Figure B.1 represents a scheme that facilitates classification of emission levels for ICs. In order to be able to use the classification as defined in IEC 61967-2 [3] values are to be calculated using

$$A = B + 20 \times \log_{10}\left(\frac{h_{\text{ICstripline}}}{h_{\text{TEM}}}\right) \tag{B.1}$$

where

A is the converted result for comparison with reference levels;

B is the measurement result of spectrum analyzer or EMI receiver;

h_{TEM} is the septum height TEM cell of 45 mm (default);

$h_{\text{IC stripline}}$ is the active conductor height of 6,7 mm (default).

B.4 Presentation of results

The typical description of the maximum emission level consists of two letters and one number always following the same sequence. If one of the three slopes is not needed, the corresponding letter or number will be omitted.

The capital letter is first and represents the position of the horizontal line with zero dB per decade slope. Second is the number, which defines the position of the -20 dB per decade slope. The third and small letter defines the position of the -40 dB per decade slope.

Such defined maximum emission levels with the described notation offer a standardized way to communicate maximum emission levels unambiguously.

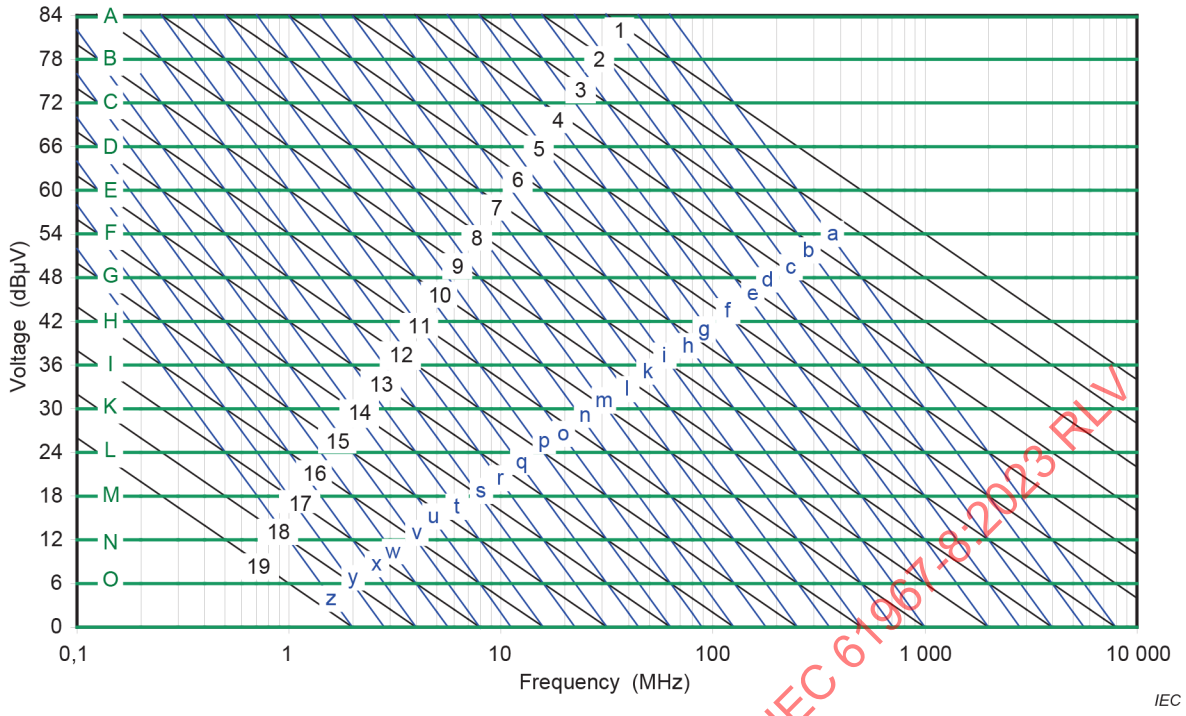

Figure B.1 – Emission characterization levels

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[1] Körber, Klotz, Müller, Müllerwiebus, Trebeck: IC- Stripline for Susceptibility and Emission Testing of ICs, EMC COMPO 2009

[2] M. V. Schneider, "Microstrip Lines for Microwave Integrated Circuits" The Bell System Technical Journal, vol. 48, pp. 1421–1444, May 1969

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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CIRCUITS INTÉGRÉS – MESURE DES ÉMISSIONS ÉLECTROMAGNÉTIQUES

Partie 8: Mesure des émissions rayonnées – Méthode de la ligne TEM à plaques (stripline) pour circuit intégré

AVANT-PROPOS

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L'IEC 61967-8 a été établie par le sous-comité 47A: Circuits intégrés, du comité d'études 47 de l'IEC: Dispositifs à semiconducteurs. Il s'agit d'une norme internationale.

Cette deuxième édition annule et remplace la première édition parue en 2011. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) la plage de fréquences de 150 kHz à 3 GHz a été retirée du domaine d'application;
b) la fréquence utile supérieure est étendue à 6 GHz ou plus dans la mesure où les exigences définies sont remplies.

Le texte de la présente Norme internationale est issu des documents suivants:

Projet	Rapport de vote
47A/1152/FDIS	47A/1153/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de la présente Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 61967, publiées sous le titre général *Circuits intégrés – Mesure des émissions électromagnétiques*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

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CIRCUITS INTÉGRÉS – MESURE DES ÉMISSIONS ÉLECTROMAGNÉTIQUES

Partie 8: Mesure des émissions rayonnées – Méthode de la ligne TEM à plaques (stripline) pour circuit intégré

1 Domaine d'application

La présente partie de l'IEC 61967 définit une méthode de mesure des émissions électromagnétiques rayonnées d'un circuit intégré (CI) à l'aide d'une ligne TEM à plaques (stripline) pour circuit intégré. Le CI à évaluer est monté sur une carte d'essai CEM (carte à circuit imprimé) entre le conducteur actif et le plan de masse du dispositif de la stripline pour CI.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-131, *Vocabulaire Électrotechnique International – Partie 131: Théorie des circuits*

IEC 60050-161, *Vocabulaire Électrotechnique International – Chapitre 161: Compatibilité électromagnétique*

IEC 61967-1, *Circuits intégrés – Mesure des émissions électromagnétiques – Partie 1: Conditions générales et définitions*

IEC 61000-4-20, *Compatibilité électromagnétique (CEM) – Partie 4-20: Techniques d'essai et de mesure – Essais d'émission et d'immunité dans les guides d'onde TEM*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 61967-1, de IEC 60050-131 et de l'IEC 60050-161, ainsi que les.suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
mode électromagnétique transverse
TEM
mode de guide d'ondes, dans lequel les composantes des champs électriques et magnétiques dans le sens de propagation sont très inférieures aux composantes de champ primaire à travers toute section transversale

Note 1 to entry: L'abréviation "TEM" est dérivée du terme anglais développé correspondant "Transverse electromagnetic mode"

3.2
guide d'ondes TEM
système de ligne de transmission ouverte ou fermée, dans lequel une onde se propage dans le mode électromagnétique transverse, afin de produire un champ spécifié pour les essais

3.3
ligne TEM à plaques pour circuit intégré
guide d'ondes TEM, comprenant un conducteur actif placé à une distance définie d'un plan de masse agrandi, connecté à une structure de port à chaque extrémité, et une enceinte blindée facultative

Note 1 to entry: Ce dispositif guide une propagation de l'onde dans le mode électromagnétique transverse pour produire un champ spécifique à des fins d'essais entre le conducteur actif et le plan de masse agrandi. Comme plan de masse agrandi, il convient d'utiliser le plan de masse de la carte d'essai CEM normalisée conformément à l'IEC 61967-1. Une enceinte blindée facultative peut être utilisée pour fixer la configuration de la stripline pour CI et à des fins de blindage. Il en résulte une version fermée de la stripline pour CI par opposition à la version ouverte sans enceinte blindée. Pour plus d'informations, voir l'Annexe A.

3.4
guide d'ondes TEM à deux ports
guide d'ondes TEM comportant des ports de mesure d'entrée/sortie aux deux extrémités

3.5
impédance caractéristique
amplitude du rapport de la tension entre le conducteur actif et le plan de masse correspondant sur le courant de chaque conducteur pour toute surface d'onde à phase constante

Note 1 to entry: L'impédance caractéristique ne dépend pas des amplitudes du rapport tension/courant, mais uniquement de la géométrie de la section transversale de la ligne de transmission. Les guides d'ondes TEM sont généralement conçus pour avoir une impédance caractéristique de 50 Ω. Pour plus d'informations et pour l'équation nécessaire à la conception de la stripline pour CI, voir l'Annexe A.

3.6
composante de champ primaire
composante de champ électrique alignée sur la polarisation d'essai prévue

Note 1 to entry: Par exemple, dans une stripline pour CI, le conducteur actif est parallèle au sol horizontal, et le vecteur de champ électrique de mode primaire est vertical au niveau du centre transversal de la stripline.

4 Généralités

Cette méthode d'essai repose sur le principe de mesure du guide d'ondes TEM conformément à l'IEC 61000-4-20. Un montage de stripline est utilisé pour mesurer l'émission RF des CI. La tension RF mesurée sur un port de la stripline est liée au potentiel de rayonnement électromagnétique du CI et sera mesurée au moyen d'un analyseur de spectre ou d'un récepteur de mesure. L'objectif de cette méthode d'essai est de fournir une mesure quantitative des émissions RF des CI en vue de comparaisons ou d'autres évaluations.

5 Conditions d'essai

5.1 Généralités

Les conditions d'essai doivent satisfaire aux exigences décrites dans l'IEC 61967-1. De plus, les conditions d'essai suivantes décrites au 5.2 et au 5.3 doivent s'appliquer.

5.2 Tension d'alimentation

La tension d'alimentation doit être celle spécifiée par le fabricant du CI. Si les utilisateurs de cette procédure conviennent d'autres valeurs, elles doivent figurer dans le rapport d'essai.

5.3 Plage de fréquences

La plage de fréquences efficace pour la stripline pour CI est comprise entre 150 kHz et 6 GHz en combinaison avec la caractéristique ROS ≤ 1,25 pour f ≤ 3 GHz et ≤ 1,4 pour f > 3 *GHz*. La fréquence supérieure peut être étendue si la stripline pour CI ne fait pas apparaître des modes d'ordre supérieur significatifs sur la plage de fréquences mesurée.

NOTE La caractéristique ROS donnée de 1,4 est fondée sur des solutions techniques évolutives pour les striplines pour CI. Pour des raisons d'exactitude, la valeur cible recherchée pour la valeur ROS est aussi faible que possible (par exemple. 1,3).

6 Appareillage d'essai

6.1 Généralités

L'appareillage d'essai doit satisfaire aux exigences décrites dans l'IEC 61967-1. De plus, les exigences décrites de 6.2 à 6.5 doivent s'appliquer à l'appareillage d'essai.

6.2 Appareil de mesure RF

Un analyseur de spectre ou un récepteur EMI doit être utilisé. La largeur de bande de résolution doit être de 9 kHz pour les récepteurs EMI ou de 10 kHz pour les analyseurs de spectre dans la plage de fréquences comprise entre 150 kHz et 30 MHz et respectivement de 120 kHz ou 100 kHz au-dessus de 30 MHz conformément à l'IEC 61967-1. Des mesures doivent être effectuées avec un détecteur de crête et présentées en unités de dBµV [pour système 50 Ω: (indications en dBm) + *107* = dBµV]. Pour les analyseurs de spectre, la bande de fréquences étudiée doit être balayée en mode étalonné ou couplé (balayage automatique).

6.3 Préamplificateur

De manière facultative, un préamplificateur à faible bruit présentant un gain de 20 dB à 30 dB peut être utilisé. S'il est utilisé, le préamplificateur doit être connecté directement au port de mesure de la stripline pour CI, à l'aide de l'adaptateur coaxial 50 Ω approprié.

6.4 Stripline pour CI

Guide d'ondes TEM, comprenant un conducteur actif placé à une distance définie d'un plan de masse agrandi, connecté à une structure de port à chaque extrémité, et une enceinte blindée facultative. L'espacement entre le conducteur actif et le plan de masse de la stripline pour CI a une valeur par défaut de 6,7 mm. Un autre espacement peut être utilisé mais il doit être noté dans le rapport d'essai.

NOTE Un facteur de conversion permet des comparaisons entre les dispositifs de stripline pour CI avec différents espacements entre le conducteur actif et le plan de masse (voir l'Annexe A).

Le dispositif de la stripline pour CI guide une propagation de l'onde dans le mode électromagnétique transverse pour produire un champ spécifique à des fins d'essais entre le conducteur actif et le plan de masse agrandi. Comme plan de masse agrandi, il convient d'utiliser le plan de masse de la carte d'essai CEM normalisée conformément à l'IEC 61967-1. La carte d'essai CEM contrôle la géométrie et l'orientation du circuit intégré en fonctionnement par rapport à la stripline pour CI, et élimine tous les conducteurs de connexion à l'intérieur de celle-ci (ils se situent sur la face arrière de la carte, qui est à l'opposé de la stripline pour CI). Une enceinte blindée facultative peut être utilisée pour fixer la configuration de la stripline pour CI et à des fins de blindage. Il en résulte une version fermée de la stripline pour CI par opposition à la version ouverte sans enceinte blindée.

Pour plus d'informations, voir l'Annexe A.