

INTERNATIONAL STANDARD



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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INTEGRATED CIRCUITS –
MEASUREMENT OF ELECTROMAGNETIC EMISSIONS,
~~150 kHz to 1 GHz~~ –****Part 1: General conditions and definitions**

FOREWORD

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International Standard IEC 61967-1 has been prepared by subcommittee 47A: Integrated circuits, of IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

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

- a) the frequency range of 150 kHz to 1 GHz has been deleted from the title;
- b) the frequency step above 1 GHz has been added to Table 1, Table 2 and to 5.4;
- c) Table A.1 has been divided into two tables, and IEC 61967-8 has been added to Table A.2 of Annex A;
- d) the general test board description has been moved to Annex D.

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

FDIS	Report on voting
47A/1062/FDIS	47A/1066/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.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://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- withdrawn,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, ~~150 kHz to 1 GHz~~ –

Part 1: General conditions and definitions

1 Scope

This part of IEC 61967 provides general information and definitions on the measurement of conducted and radiated electromagnetic disturbances from integrated circuits. It also provides a description of measurement conditions, test equipment and set-up as well as the test procedures and content of the test reports. Test method comparison tables are included in Annex A to assist in selecting the appropriate measurement method(s).

The object of this document is to describe general conditions in order to establish a uniform testing environment and to obtain a quantitative measure of RF disturbances from integrated circuits (IC). Critical parameters that are expected to influence the test results are described. Deviations from this document are noted explicitly in the individual test report. The measurement results can be used for comparison or other purposes.

Measurement of the voltage and current of conducted RF emissions or radiated RF disturbances, coming from an integrated circuit under controlled conditions, yields information about the potential for RF disturbances in an application of the integrated circuit.

The applicable frequency range is described in each part of IEC 61967.

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(161), International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility~~

~~CISPR 16-1-1:1999, Specification for radio disturbance and immunity measuring apparatus and Methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus~~

~~CISPR 25:1995, Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles~~

~~ANSI C63.2:1996, American Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications~~

3 Terms and definitions

For the purposes of this document, the following terms and definitions, ~~taken mostly from IEC 60050(161)~~, apply.

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

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

3.1

artificial network

AN

~~agreed reference load impedance (simulated), presented to the EUT by networks~~ network presenting a reference load impedance (simulated) to the DUT (e.g. extended power or communication lines) across which the RF disturbance voltage is measured and which isolates the apparatus from the power supply or loads in ~~that~~ a given frequency range

Note 1 to entry: This note applies to the French language only.

~~[IEV 161-04-05, modified]~~

3.2

associated equipment

transducers (e.g. probes, networks and antennae) connected to a measuring receiver or test generator, also transducers ~~(for example, probes, networks, and antennas) which are~~ used in the signal or disturbance transmission path between ~~an EUT~~ a DUT and measuring equipment or a (test-) signal generator

3.3

auto-sweep

~~fastest calibrated sweep which a spectrum analyser will automatically select based on start frequency, stop frequency, resolution bandwidth and video bandwidth~~

3.3

broadband disturbance

broadband emission

~~emission~~ electromagnetic disturbance which has a bandwidth greater than that of a particular measuring apparatus, receiver or susceptible device

Note 1 to entry: For some purposes, particular spectral components of a broadband disturbance may be considered as narrowband disturbances.

Note 2 to entry: Emission that has a bandwidth greater than that of a particular measuring apparatus or receiver.

[SOURCE: IEC 60050-161:1990, 161-06-11, modified – Note 2 to entry and the second preferred term "broadband emission" have been added.]

3.4

common mode voltage

asymmetrical disturbance voltage

mean of the phasor voltages appearing between each conductor and a specified reference, usually earth or frame

[SOURCE: IEC 60050-161:1990, 161-04-09, modified – The word "disturbance" has been added to the admitted term.]

3.5 common mode current

~~in a cable having more than one conductor, including shields and screens, if any, the magnitude of the sum of the phasors representing the currents in each conductor [IEV 161-04-39]~~

vector sum of the currents flowing through two or more conductors at a specified cross-section of a mathematical plane intersected by these conductors

3.6 conducted emission

transient and/or other disturbance observed on the external terminals of a device during its normal operation

3.7 continuous disturbance

~~RF disturbance with a duration of more than 200 ms at the IF-output of a measuring receiver, which causes a deflection on the meter of a measuring receiver in quasi-peak detection mode which does not decrease immediately~~

electromagnetic disturbance the effects of which on a particular device or equipment cannot be resolved into a succession of distinct effects

Note 1 to entry: RF disturbance with a duration of more than 200 ms at the IF-output of a measuring receiver that causes a deflection on the meter of a measuring receiver in quasi-peak detection mode that does not decrease immediately.

[SOURCE: IEC 60050-161:1990, 161-02-11, modified – Note 1 to entry has been added.]

3.8 DUT device under test

device, equipment or system being evaluated

Note 1 to entry: As used in this document, DUT refers to a semiconductor device being tested.

Note 2 to entry: This note applies to the French language only.

3.9 die shrink

~~amount of shrink of the mask used to produce the integrated circuit (IC) expressed as a percentage or dimensions relative to the original artwork layout (drawn size)~~

reduction of die size by using an advanced fabrication process including finer lithography node and masks

3.10 differential mode current

in a two-conductor cable, or for two particular conductors in a multi-conductor cable, half the magnitude of the difference of the phasors representing the currents in each conductor

[SOURCE: IEC 60050-161:1990, 161-04-38]

3.11 differential mode voltage

voltage between any two of a specified set of active conductors

[SOURCE: IEC 60050-161:1990, 161-04-08, modified – The second preferred term "symmetrical voltage" has been removed.]

3.12**discontinuous disturbance**

electromagnetic disturbance, the effects of which on a particular device or equipment can be resolved into a succession of distinct effects

Note 1 to entry: It is recognised that this definition does not characterise the disturbance independently of the effect that it produces. As a practical matter, any measure of a disturbance should be relatable to its effect on a susceptible device.

Note 2 to entry: For counted clicks, disturbance with a duration of less than 200 ms at the IF-output of a measuring receiver, which causes a transient deflection on the meter of a measuring receiver in quasi-peak detection mode.

[SOURCE: IEC 60050-161:1990, 161-02-28, modified – Note 2 to entry has been added.]

3.13**electrically small PCB**

printed circuit board, ~~whose dimension is smaller~~ with length and width shorter than $\lambda/2$, for example 100 mm to 150 mm at 1 GHz

3.14**EMC****electromagnetic compatibility**

ability of an ~~equipment~~ apparatus or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

~~[IEV 161-01-07]~~

3.15**electromagnetic emission**

phenomenon by which electromagnetic energy emanates from a source

3.16**electromagnetic radiation
radiated emission**

- 1) phenomenon by which energy in the form of electromagnetic waves emanates from a source into space
- 2) energy transferred through space in the form of electromagnetic waves

[SOURCE: IEC 60050-161:1990, 161-01-10, modified – The second preferred term "radiated emission" has been added and the Note to entry has been omitted.]

3.17**emission limit**

<from a disturbing source> specified maximum emission level of a source of electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-03-12]

3.18**ground reference plane**

flat conductive surface whose potential is used as a common reference

[SOURCE: IEC 60050-161:2014, 161-04-36, modified – The term "reference-ground plane" has been changed to "ground reference plane", the definition has been condensed and the notes to entry, omitted.]

3.19

lead frame

supporting structure for the silicon die that interfaces the external pins to the die

3.20

measuring receiver

receiver for the measurement of disturbances with different detectors

Note 1 to entry: The bandwidth of the receiver should be as specified in CISPR 16-1-1.

~~**3.22**~~

~~**multi-chip module**~~

~~**MCM**~~

~~integrated circuit whose elements are formed on or within two or more semiconductor chips that are mounted in a single package~~

~~**3.23**~~

~~**multi-IC sets**~~

~~set of ICs that functions as a unit; in a higher level of integration the set could be a single IC~~

3.21

narrowband emission

~~emission which has a bandwidth less than that of a particular measuring apparatus or receiver~~

electromagnetic disturbance, or spectral component thereof, which has a bandwidth less than or equal to that of a particular measuring apparatus, receiver or susceptible device

Note 1 to entry: Emission with bandwidth less than that of a particular measuring apparatus or receiver.

[SOURCE: IEC 60050-161:1990, 161-06-13, modified – The term "narrowband disturbance" has been changed to "narrowband emission" and Note 1 to entry has been added.]

3.22

peak detector

detector, the output voltage of which is the peak value of the applied signal

[SOURCE: IEC 60050-161:1990, 161-04-24]

3.23

preamp noise floor

inherent thermal noise generated by the first stage amplifier that limits the signal resolution of the measurement system

3.24

receiver terminal voltage

antenna voltage

~~external voltage measured in dB(μV) at the input of a radio interference measuring instrument conforming to the requirements of CISPR 16-1 or ANSI C63.2~~

voltage generated by a source of radio disturbance and measured in dB (μV) by a radio disturbance measuring instrument conforming to the requirements of CISPR 16

Note 1 to entry: External voltage measured in dB (μV) at the input of a radio interference measuring instrument conforming to the requirements of CISPR 16-1-1.

[SOURCE: CISPR 25:2008, ~~3.1~~ 3.8, modified – Note 1 to entry has been added.]

3.25**reference point**

specific port or point on the test set-up where the measurement of the sampled parameter is made

3.26**repetition rate**

number of surges, spikes, or pulses per unit of time

3.27**radio frequency ambient****RF ambient**

electromagnetic environment

totality of electromagnetic phenomena existing at a given location

[SOURCE: IEC 60050-161:1990, 161-01-01, modified – The preferred terms "radio frequency ambient" and "RF ambient" have been added and Note 1 to entry has been removed.]

3.28**shielded enclosure**

mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and external environment

[SOURCE: IEC 60050-161:1990, 161-04-37, modified – The second preferred term "screened room" has been omitted.]

3.29**significant IC change**

+ changes that may influence the electromagnetic emissions of an IC

Note 1 to entry: Examples include changes to a new device, new manufacturer or process line, die shrink, new package type, significant manufacturing process, internal/external clock, I/O drive capability, etc.

3.30**system gain**

gain (or attenuation) of the measurement path between the reference point and the input of the RF measuring instrument

3.31**test plan**

document provided by the test requester to define the tests to be carried out, the object of the testing, the DUT operating status, the conditions for the test and performance objectives

Note 1 to entry: The test plan completely guides the implementation of the test, by reference to the standard test procedure, or by detailing revisions or additions for the specific DUT.

3.35**work bench Faraday cage****WBFC**

Under consideration.

4 Test conditions

4.1 General

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

4.2 Ambient conditions

4.2.1 General

The following ambient conditions shall be met.

4.2.2 Ambient temperature

The ambient temperature during the test shall be $23\text{ °C} \pm 5\text{ °C}$ for repeatability. IC emissions may vary with temperature.

4.2.3 Ambient RF field strength

The ambient RF noise level shall be at least 6 dB below the lowest emission level(s) to be measured. This shall be verified before measurements of the IC are made. The DUT shall be installed in the test set-up, as used for testing. The DUT shall not be activated (for example, the power supply voltage shall be disconnected). A scan shall be made to measure the residual noise. A description of the ambient RF noise level shall be part of the test report.

4.2.4 Other ambient conditions

All other ambient conditions that ~~may~~ can affect the result shall be stated in the individual test report.

4.2.5 IC stability over time

The functional behaviour of the IC shall be stable over time so that two measurements, separated by an interval of time, shall yield the same results within the expected variation of the measurement technique.

5 Test equipment

5.1 General

The equipment described in Clause 5 is common to all test procedures described in this document. Specific equipment shall be itemized in the individual test procedures.

5.2 Shielding

The necessary shielding depends upon the specific test method and the ambient noise level. A shielded room may be required to provide a controlled ambient noise level for emission measurements. A non-shielded set-up ~~may~~ can be used if ambient noise levels are at least 6 dB below the lowest level to be measured.

5.3 RF measuring instrument

5.3.1 General

Either measuring receivers or spectrum analysers ~~may~~ can be used (see Tables 1 and 2 for default settings). The measuring receiver, if used, shall meet the bandwidth requirements as stated in CISPR 16-1-1.