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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Integrated circuits – Measurement of electromagnetic immunity – Part 1: General conditions and definitions

Circuits intégrés – Mesure de l'immunité électromagnétique – Partie 1: Conditions générales et définitions

IEC 62132-1:2015-10(en-fr)

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FOREWORD

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International Standard IEC 62132-1 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 2006 and 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 1 GHz has been deleted from the title;
b) frequency step above 1 GHz has been added in Table 2 in 7.4.1;
c) IC performance classes in 8.3 have been modified;
d) Table A.1 was divided into two tables, and references to IEC 62132-8 and IEC 62132-9 have been added in the new Table A.2 in Annex A.

The text of this standard is based on the following documents:

FDIS	Report on voting
47A/974/FDIS	47A/977/RVD

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

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

A list of all parts in the IEC 62132 series, published under the general title *Integrated circuits – Measurement of electromagnetic immunity*, 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 publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

INTRODUCTION

The IEC 62132 series is published in several parts, under the general title *Integrated circuits – Measurement of electromagnetic immunity*:

- Part 1: General conditions and definitions
- Part 2: Measurement of radiated immunity – TEM cell and wideband TEM cell method
- Part 3: Bulk current injection (BCI) method
- Part 4: Direct RF power injection method
- Part 5: Workbench Faraday cage method
- Part 8: Measurement of radiated immunity – IC stripline method
- Part 9: Measurement of radiated immunity – Surface scan method

INTEGRATED CIRCUITS – MEASUREMENT OF ELECTROMAGNETIC IMMUNITY –

Part 1: General conditions and definitions

1 Scope

This part of IEC 62132 provides general information and definitions about measurement of electromagnetic immunity of integrated circuits (ICs) to conducted and radiated disturbances. It also defines general test conditions, test equipment and setup, as well as the test procedures and content of the test reports for all parts of the IEC 62132 series. Test method comparison tables are included in Annex A to assist in selecting the appropriate measurement method(s).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62132-2, *Integrated circuits – Measurement of electromagnetic immunity – Part 2: Measurement of radiated immunity –TEM cell and wideband TEM cell method*

IEC 62132-3, *Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz – Part 3: Bulk current injection (BCI) method*

IEC 62132-4, *Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz – Part 4: Direct RF power injection method*

IEC 62132-5, *Integrated circuits – Measurement of electromagnetic immunity, 150 kHz to 1 GHz – Part 5: Workbench Faraday cage method*

IEC 62132-8, *Integrated circuits – Measurement of electromagnetic immunity – Part 8: Measurement of radiated immunity –IC Stripline method*

IEC TS 62132-9, *Integrated circuits – Measurement of electromagnetic immunity – Part 9: Measurement of radiated immunity – Surface scan method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
amplitude modulation
AM
process by which the amplitude of a periodic carrier wave is varied according to a specified law

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

[SOURCE: IEC 60050-314:2001, 314-08-01, modified – The abbreviation AM has been added as a second preferred term, the existing note has been removed and a new Note 1 has been added.]

3.2
artificial network
AN
network presenting a reference load impedance (simulated) to the DUT (e.g. extended power or communication lines) across which the RF disturbance voltage can be measured and which isolates the apparatus from the power supply or loads in a given frequency range

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

3.3
associated equipment
transducers (e.g. probes, networks and antennas) connected to a measuring receiver or test generator; also transducers which are used in the signal or disturbance transmission path between a DUT and measuring equipment or a (test) signal generator

3.4
auxiliary equipment
AE
equipment not under test that is nevertheless indispensable for setting up all the functions and assessing the correct performance (operation) of the equipment under test (EUT) during its exposure to the disturbance

3.5
bias tee
coupling device that allows the signal superposition of an RF signal to a DC signal to an output port without affecting the RF path

3.6
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 second preferred term "asymmetrical voltage" has been removed and a new admittted term, "asymmetrical disturbance voltage" has been added.]

3.7
common mode current
vector sum of the currents flowing through two or more conductors at a specified cross-section of a plane intersected by these conductors

3.8
continuous wave
CW
waves, whose successive oscillations are identical under steady state conditions

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

3.9
coupling network
electrical circuit for transferring energy from one circuit to another with well-defined impedances

3.10
decoupling network
electrical circuit for preventing test signals applied to the DUT from affecting other devices, equipment or systems that are not under test

3.11
device under test
DUT
device, equipment or system being evaluated

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

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

3.12
die shrink
reduction of the die size by using an advanced fabrication process including a finer lithography node and reduced masks

Note 1 to entry: The amount of die shrink of a mask used to produce an IC is expressed as a percentage or as dimensions relative to the original artwork layout.

3.13
differential mode current
in a two-conductor cable, or 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/AMD2:1998, 161-04-38]

3.14
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.]

3.15
directional coupler
transmission coupling device for separately (ideally) sampling (through known coupling loss for measuring purposes) either the forward (incident) or backward (reflected) waves in a transmission line

3.16
electrically small PCB
printed circuit board with length and width shorter than $\lambda/2$, e.g. 100 mm to 150 mm at 1 GHz

3.17
electromagnetic compatibility
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

[SOURCE: IEC 60050-161:1990, 161-01-07]

3.18
forward power
amount of power that is sent from the RF source towards the (assumed matched) RF load without considering the RF power that is being reflected backwards by the RF load

3.19
ground plane
reference ground plane
flat conductive surface whose potential is used as a common reference

[SOURCE: IEC 60050-161:1990/AMD5:2015, 161-04-36, modified – The first preferred term "ground plane" has been added, the abbreviation RGP has been removed, the definition has been shortened and Notes 1 and 2 have been deleted.]

3.20
immunity
<to a disturbance> ability of a device, equipment or system to perform without degradation in the presence of an electromagnetic disturbance

[SOURCE: IEC 60050-161:1990, 161-01-20]

3.21
injection network
coupling network to inject RF signals into a cable

3.22
peak power
maximum power level occurring on an AM RF signal measured over the time interval of the (lowest LF) signal used for the amplitude modulation

Note 1 to entry: In the case of two-tone RF signals (to represent AM), the beat frequency should be considered for the time interval.

3.23
reference port
specific port of the test setup to which the disturbance signal is applied

3.24
reflected power
power that is reflected backward by the RF load due to an impedance mismatch of the RF load to the characteristic impedance of the transmission-line

3.25
radio frequency ambient
RF ambient
electromagnetic environment
totality of electromagnetic phenomena existing at a given location

[SOURCE: IEC 60050-161:1990/AMD1:1997, 161-01-01, modified – The preferred term has been changed into an admitted term, two new preferred terms have been added and the Note has been removed.]

3.26
RF power meter
measurement system to quantify the RF signal power as a function of time

3.27
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 removed.]

3.28
test generator
generator (RF-generator, modulation source, attenuators, broadband power amplifiers and filters) capable of generating the required test signal

4 Test conditions

4.1 General

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

4.2 Ambient conditions

4.2.1 Ambient temperature

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

NOTE The RF immunity of some ICs is dependent on the ambient temperature.

4.2.2 RF ambient

The RF ambient noise level shall be at least 6 dB (typical) below the lowest level(s) of intended immunity measurement, which shall be confirmed before the measurements. The DUT shall be installed in the test setup with disenabled power supply. RF ambient shall be described in the test report.

4.2.3 RF-immunity of the test setup

Before the test, all equipment used in the test setup, excluding the DUT, shall be checked to ensure that it is sufficiently immune to the disturbance signal so as not to influence the test results.

4.2.4 Other ambient conditions

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

NOTE Even illumination would influence the test results when a semiconductor device is exposed in an open ceramic IC package.

4.3 Test generator

Depending on applications and the desired test, various test signals (disturbance signals) can be used:

– non-modulated RF signal (continuous wave);
– amplitude-modulated RF signal, e.g. according to IEC 61000-4-6 and IEC 61000-4-3;
– pulse-modulated RF signals , e.g. according to IEC 61000-4-3.

4.4 Frequency range

The recommended frequency range is 150 kHz to 1 GHz, and may be extended if the specific procedure is applicable. The range of interest may be smaller depending on the application's requirement. The applicable frequency range is described in each part of IEC 62132.

5 Test equipment

5.1 General

The equipment described in this Clause 5 is common to all test methods described in all parts of IEC 62132. The unique parts of the test equipment are described in the individual test procedures in each specific part.

5.2 Shielding

The shielding requirement depends upon the specific test method, the ambient noise level and the sensitivity of other equipment used in the test setup. In general, the ambient RF noise level should be at least 6 dB smaller than the applied disturbance signal so that a sufficient margin is present. A shielded room may be required to provide sufficient attenuation to protect operators, equipment and telecommunication services. Some measurement setups are designed so that intrinsic shielding is built in. Specific measurement procedures are described in each part of IEC 62132.

5.3 Test generator and power amplifier

The test generator shall supply the test signal as described in 4.3. The RF power amplifier shall meet the requirements of the test procedures in other parts of IEC 62132. The amplitude behaviour shall be linear and the distortions shall be less than –20 dBc (spurious signals are 20 dB below the RF carrier level) of the signal amplitude.

5.4 Other components

It shall be checked that cables, connectors and terminators included in the measurement path meet the required characteristics over the intended frequency range.

It shall be checked that cables, connectors and terminators that are not in the measurement path between the reference point and the input of the measuring instrument that may, however, affect the measurement result, meet the required characteristics over the intended frequency range.

6 Test setup

6.1 General

The test setup shall comply with the specific test procedure described in the respective part of IEC 62132. All the relevant test parameters shall be recorded to ensure the reproducibility of test results.

6.2 Test circuit board

The choice of test boards used for RF immunity testing depends on the measurement method specified in IEC 62132. A general recommendation for the test board is given in Annex B. The description of the test board shall be included in the test report. Test boards shall follow the good layout practice described in other parts of IEC 62132.

As the interaction between the EM environment and the IC in immunity test is similar to the interaction in the RF emission test, a similar test board can be used. The difference between these boards is that output signals are monitored in immunity tests to find whether the IC is affected by the RF disturbance.

6.3 Pin selection scheme

Pins that are considered to be subject to RF immunity testing are those connected to external devices through cables, e.g.:

– actuator/sensor cables;
– supply cables;
– communication cables, e.g. for use with controller area network (CAN), RS 422/485, unshielded twisted pairs (UTP) with ethernet, low voltage differential signalling (LVDS).

Pins that are connected by traces to active or passive devices on the application board are not considered to be subject to RF immunity testing (see IEC 62132-3 and IEC 62132-4), e.g.:

– memory interfaces;
– crystal oscillator;
– chip select;
– biasing or current reference inputs with analogue part.

6.4 IC pin loading/termination

The pins of the DUT shall be loaded or terminated according to the default values given in Table 1, including the parameters specified by the manufacturer. Pins that do not fall into any of the categories listed in Table 1 shall be loaded as functionally required. Pin loading conditions at the test shall be included in the test report.

Table 1 – IC pin loading default values

IC pin type	Pin loading
Analogue	
– Supply	According to the device specification
– Input	10 kΩ to ground (V_{ss}) unless the IC is internally terminated
– Output signal	10 kΩ to ground (V_{ss}) unless the IC is internally terminated
– Output power	Nominal loading as stated by the manufacturer
Digital	
– Supply	According to device specification
– Input	Ground (V_{ss}) or 10 kΩ to supply (V_{dd}) if the input cannot be grounded, unless the IC is internally terminated
– Output	47 pF to ground (V_{ss})
Control	
– Input	Ground (V_{ss}) or 10 kΩ to supply (V_{dd}) if the input cannot be grounded, unless the IC is internally terminated
– Output	According to the device specification
– Bi-directional	47 pF to ground (V_{ss})
– Analogue	According to the device specification

6.5 Power supply requirements

The DUT shall be powered by the source immune from the applied test signal. If a battery is used, it shall meet the IC requirements and provide the stable voltage level to maintain a consistent operating environment. All power supply lines to the DUT shall be adequately filtered according to the IC manufacturer's recommendation.

6.6 IC specific considerations

6.6.1 IC supply voltage

The supply voltage(s) shall be as specified by the IC manufacturer with a tolerance of ±5 %.