IEC/TR 61000-1-6

Edition 1.0   2012-07

TECHNICAL
REPORT

colour
inside

**Electromagnetic compatibility (EMC) –
Part 1-6: General – Guide to the assessment of measurement uncertainty**

IEC/TR 61000-1-6:2012(E)

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BASIC EMC PUBLICATION

Electromagnetic compatibility (EMC) –
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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-6: General –
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FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 61000-1-6, which is a technical report, has been prepared by the IEC technical committee 77: Electromagnetic compatibility in corporation with CISPR (International Special Committee on Radio Interference).

It forms Part 1-6 of IEC 61000. It has the status of a basic EMC publication in accordance with IEC Guide 107, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
77/397/DTR	77/409/RVC

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

A list of all the parts of the IEC 61000 series, published under the general title *Electromagnetic compatibility* (*EMC*) can be found on the IEC website.

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

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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

The contents of the corrigendum of October 2014 have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 61000 is published in separate parts, according to the following structure:

Part 1: General

General considerations (introduction, fundamental principles)

Definitions, terminology

Part 2: Environment

Description of the environment

Classification of the environment

Compatibility levels

Part 3: Limits

Emission limits

Immunity limits (in so far as they do not fall under the responsibility of the product committees)

Part 4: Testing and measurement techniques

Measurement techniques

Testing techniques

Part 5: Installation and mitigation guidelines

Installation guidelines

Mitigation methods and devices

Part 6: Generic standards

Part 9: Miscellaneous

Each part is further subdivided into several parts, published either as international standards or as technical specifications or technical reports, some of which have already been published as sections. Others will be published with the part number followed by a dash and a second number identifying the subdivision (example: IEC 61000-6-1).

ELECTROMAGNETIC COMPATIBILITY (EMC) –

Part 1-6: General –
Guide to the assessment of measurement uncertainty

1 Scope

This part of IEC 61000 provides methods and background information for the assessment of measurement uncertainty. It gives guidance to cover general measurement uncertainty considerations within the IEC 61000 series.

The objectives of this Technical Report are to give advice to technical committees, product committees and conformity assessment bodies on the development of measurement uncertainty budgets; to allow the comparison of these budgets between laboratories that have similar influence quantities; and to align the treatment of measurement uncertainty across the EMC committees of the IEC.

Any contributing factor to measurement uncertainty that is mentioned within this Technical Report shall be treated as an example: the technical committee responsible for the preparation of a basic immunity standard is responsible for identifying the factors that contribute to the measurement uncertainty of their basic test method.

It gives a description for

– a method for the assessment of measurement uncertainty (MU),
– mathematical formulas for probability density functions,
– analytical assessment of statistical evaluations,
– correction of measured data,
– documentation.

This Technical Report is not intended to summarize all measurement uncertainty influence quantities nor is it intended to define how measurement uncertainty is to be taken into account in determining compliance with an EMC requirement.

NOTE Some of the examples given in this report are taken from IEC publications other than the IEC 61000 series that have already implemented the evaluation procedure presented here. These examples are used to illustrate the principles.

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 60050-161, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electro-magnetic compatibility*

CISPR 16-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus*

CISPR 16-4-2, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*, corrected 1st edition, 2008

3 Terms, definitions, symbols and abbreviations

3.1   Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161, as well as the following apply.

NOTE   Several of the most relevant terms and definitions from IEC 60050-161 are included among the terms and definitions below.

3.1.1
combined standard uncertainty
standard measurement uncertainty that is obtained using the individual standard measurement uncertainties associated with the input quantities in a measurement model

[SOURCE: ISO/IEC Guide 99:2007, definition 2.31, modified – Admitted term became the preferred (and only) term.]

3.1.2
confidence level
probability, generally expressed as a percentage, that the true value of a statistically estimated quantity falls within a pre-established interval about the estimated value

[SOURCE: IEC 60050-393:2003, 393-18-31]

3.1.3
coverage factor
numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

[SOURCE: ISO/IEC Guide 98-3:2008, definition 2.3.6, modified – NOTE was deleted.]

3.1.4
coverage interval
interval containing the set of quantity values of a measurand with a stated probability, based on the information available

[SOURCE: ISO/IEC Guide 99:2007, definition 2.36, modified – True quantity values was changed to quantity values.]

3.1.5
coverage probability
probability that the set of quantity values of a measurand is contained within a specified coverage interval

[SOURCE: ISO/IEC Guide 99:2007, definition 2.37, modified – True quantity values was changed to quantity values.]

3.1.6
distribution function
function giving, for every value ξ, the probability that the random variable X be less than or equal to ξ:

$$G(\xi) = \mathrm{Pr}(X \leq \xi)$$

[SOURCE: ISO/IEC Guide 98-3, Supplement 1:2008, definition 3.2]

3.1.7
error
measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 99:2007, definition 2.16, modified – Second admitted term became the preferred (and only) term.]

3.1.8
expanded uncertainty
quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

[SOURCE: ISO/IEC Guide 98-3:2008, definition 2.3.5, modified – Notes 1 to 3 were deleted.]

iTeh STANDARD PREVIEW

3.1.9
electromagnetic compatibility (standards.iteh.ai)
EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

IEC TR 61000-1-6:2012
https://standards.iteh.ai/catalog/standards/sist/190356ba-dc10-412d-b4a6-

[SOURCE: IEC 60050-161:1990, 161-01-07] iec-tr-61000-1-6-2012

3.1.10
emission
phenomenon by which electromagnetic energy emanates from a source

[SOURCE: IEC 60050-161:1990, 161-01-08, modified – The addition "electromagnetic" in the term was deleted.]

3.1.11
emission level
emission level of a disturbing source
level of a given electromagnetic disturbance emitted from a particular device, equipment or system

[SOURCE: IEC 60050-161:1990, 161-03-11]

3.1.12
emission limit
emission limit from a disturbing source
specified maximum emission level of a source of electromagnetic disturbance

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

3.1.13
immunity
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]

3.1.14
immunity limit
specified minimum immunity level

[SOURCE: IEC 60050-161:1990, 161-03-15]

3.1.15
immunity test level
level of a test signal used to simulate an electromagnetic disturbance when performing an immunity test

[SOURCE: IEC 60050-161:1990, 161-04-41]

3.1.16
indication
quantity value provided by a measuring instrument or a measuring system

[SOURCE: ISO/IEC Guide 99:2007, definition 4.1, modified – Notes 1 and 2 were deleted.]

3.1.17
influence quantity
quantity that is not the measurand but that affects the result of the measurement

[SOURCE: IEC 60050-394:2007, 394-40-27, modified – Note was deleted.]

3.1.18
instrumentation uncertainty
IU
measurement instrumentation uncertainty
MIU
parameter, associated with the disturbance quantity generated during an emission measurement or applied during an immunity test that characterizes the dispersion of the values that could reasonably be attributed to the measurand, induced by all relevant influence quantities that are related to the measurement instrumentation and the test facility

Note 1 to entry: This term is intended to be applicable to both emission measurements and immunity tests. The CISPR 16 series of documents also employs the term 'measurement instrumentation uncertainty' (MIU).

Note 2 to entry: Based on IEC 60359:2001, definition 3.1.4.

3.1.19
intrinsic uncertainty of the measurand
minimum uncertainty that can be assigned in the description of a measured quantity

Note 1 to entry: In theory, the intrinsic uncertainty of the measurand would be obtained if the measurand was measured using a measurement system having a negligible measurement instrumentation uncertainty.

Note 2 to entry: No quantity can be measured with continually lower uncertainty, inasmuch as any given quantity is defined or identified at a given level of detail. If one tries to measure a given quantity at an uncertainty lower than its own intrinsic uncertainty one is compelled to redefine it with higher detail, so that one is actually measuring another quantity. See also ISO/IEC Guide 98-3:2008, D.1.1.

Note 3 to entry: The result of a measurement carried out with the intrinsic uncertainty of the measurand may be called the best measurement of the quantity in question.

[SOURCE: IEC 60359:2001, definition 3.1.11, modified – An additional explanation has been added, i.e. Note 1 to entry.]

3.1.20
level
level of a time varying quantity
value of a quantity, such as a power or a field quantity, measured and/or evaluated in a specified manner during a specified time interval

[SOURCE: IEC 60050-161:1990, 161-03-01, modified – The NOTE was deleted.]

3.1.21
limits of error of a measuring instrument
extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system

[SOURCE: ISO/IEC Guide 99:2007, definition 4.26, modified – The term has been clarified and Notes 1 and 2 have been deleted.]

3.1.22
measurand
particular quantity subject to measurement

[SOURCE: IEC 60050-311:2001, 311-01-03]

3.1.23
measurement accuracy
accuracy of measurement
DEPRECATED: precision of measurement
closeness of agreement between a measured quantity value and the true quantity value of a measurand

Note 1 to entry: 'accuracy' is a qualitative concept.

[SOURCE: IEC 60050-311:2001, 311-06-08, modified – The term has been changed and replaced by two terms, Note 1 has been deleted and Note 2 replaced by an explanation.]

3.1.24
measurement precision
closeness of agreement between indications or measured quantity values obtained by replicate measurements on the same or similar objects under specified conditions

[SOURCE: ISO/IEC Guide 99:2007, definition 2.15, modified – Notes 1 to 4 have been deleted.]

3.1.25
measurement result
set of quantity values being attributed to a measurand together with any other available relevant information

[SOURCE: IEC 60050-311:2001, 311-01-01, modified – The term has been clarified and the definition extended. Notes 1 to 5 have been deleted.]

3.1.26
measuring system
complete set of measuring instruments and other equipment assembled to carry out specified measurements

[SOURCE: IEC 60050-311:2001, 311-03-06]

3.1.27
measurement trueness
closeness of agreement between the average of an infinite number of replicate measured quantity values and the reference quantity value

[SOURCE: ISO/IEC Guide 99:2007, definition 2.14, modified – Only preferred term is given and Notes 1 to 3 have been deleted.]

3.1.28
measurement uncertainty
MU
non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

[SOURCE: ISO/IEC Guide 99:2007, definition 2.26, modified – Only preferred term is given and Notes 1 to 4 have been deleted.]

3.1.29
probability density function
PDF
derivative, when it exists, of the distribution function

$$g(\xi) = \frac{\mathrm{d}G(\xi)}{\mathrm{d}\xi}$$

Note 1 to entry: $g(\xi)\mathrm{d}\xi$ is the 'probability element'; $g(\xi)\mathrm{d}\xi = \Pr(\xi < X < \xi + \mathrm{d}\xi)$

[SOURCE: ISO/IEC Guide 98-3:2008, definition 3.3, modified – Equation has been changed.]

3.1.30
random error
difference between a measurement and the mean that would result from an infinitely large number of measurements of the same measurand carried out under repeatability conditions

[SOURCE: IEC 60050-394:2007, 394-40-33, modified – Definition was changed and Notes 1 and 2 have been deleted.]

3.1.31
repeatability
repeatability of results of measurements
closeness of agreement between the results of successive measurements of the same measurand, carried out under the same conditions of measurement, i.e.:

• by the same measurement procedure,

• by the same observer,

• with the same measuring instruments, used under the same conditions,

• in the same laboratory,

• at relatively short intervals of time

[SOURCE: IEC 60050-311:2001, 311-06-06, modified – Note has been deleted.]

3.1.32
reproducibility of measurements
closeness of agreement between the results of measurements of the same value of a quantity, when the individual measurements are made under different conditions of measurement:

- principle of measurement,

- method of measurement,

- observer,

- measuring instruments,

- reference standards,

- laboratory,

- under conditions of use of the instruments, different from those customarily used,

- after intervals of time relatively long compared with the duration of a single measurement.

Note 1 to entry: The term 'reproducibility' also applies to the instance where only certain of the above conditions are taken into account, provided that these are stated.

[SOURCE: IEC 60050-311:2001, 311-06-07, modified – Note 1 has been deleted and Note 2 has been renumbered Note 1 to entry.]

3.1.33
sensitivity coefficient
relationship between a change in an output estimate, y, for a corresponding change in an input estimate, x_i.

3.1.34
standard deviation of a single measurement in a series of measurements
parameter characterising the dispersion of the result obtained in a series of n measurements of the same measurand

$$s(q_j) = \sqrt{\frac{1}{(n-1)} \sum_{j=1}^{n}(q_j - \overline{q})^2}$$

where $\overline{q}$ is the mean value of n measurements

[SOURCE: ISO/IEC Guide 98-3:2008, definition B.2.17, modified – Term, definition and equation have been modified and Notes 1 to 4 have been deleted.]

3.1.35
standard deviation of the arithmetic mean of a series of measurements
parameter characterising the dispersion of the arithmetic mean of a series of independent measurements of the same value of a measured quantity, given by the formula:

$$s(\overline{q}) = \sqrt{\frac{1}{n \cdot (n-1)} \sum_{j=1}^{n}(q_j - \overline{q})^2}$$

Note 1 to entry: $s(\overline{q})$ is the standard uncertainty for type A evaluation (see 5.3), if $\overline{q}$ is used as the estimate.

3.1.36
standard uncertainty
measurement uncertainty expressed as a standard deviation

[SOURCE: ISO/IEC Guide 99:2007, definition 2.30, modified – Admitted term became the preferred (and only) term.]