IEC 62479

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Assesment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

Évaluation de la conformité des appareils électriques et électroniques de faible puissance aux restrictions de base concernant l'exposition des personnes aux champs électromagnétiques (10 MHz à 300 GHz)

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ASSESMENT OF THE COMPLIANCE OF LOW-POWER ELECTRONIC AND ELECTRICAL EQUIPMENT WITH THE BASIC RESTRICTIONS RELATED TO HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS (10 MHz to 300 GHz)

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International Standard IEC 62479 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure.

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

FDIS	Report on voting
106/198/FDIS	106/205/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.

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- withdrawn,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.

ASSESMENT OF THE COMPLIANCE OF LOW-POWER ELECTRONIC AND ELECTRICAL EQUIPMENT WITH THE BASIC RESTRICTIONS RELATED TO HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS (10 MHz to 300 GHz)

1 Scope

This International Standard provides simple conformity assessment methods for low-power electronic and electrical equipment to an exposure limit relevant to electromagnetic fields (EMF). If such equipment cannot be shown to comply with the applicable EMF exposure requirements using the methods included in this standard for EMF assessment, then other standards, including IEC 62311 or other (EMF) product standards, may be used for conformity assessment.

2 Normative references

The following referenced documents are indispensable for the application 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 62311, *Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz)*

3 Terms and definitions

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

3.1
available antenna power
the maximum power, averaged over a time interval equal to the averaging time, supplied to the antenna feed line that can be theoretically delivered by a source having an impedance of positive real part to a directly connected load when the impedance of the load is widely varied

NOTE 1 The available antenna power is obtained when the resistance of the load is equal to that of the source and its reactance is equal in magnitude but of opposite sign. However, other scenarios are possible e.g. if the PA monitors the current rather than the actual power, a changing antenna impedance (when DUT is operated close to the body) might actually cause a higher output power than the matched load. Then, a push-pull analysis with varied realistic loads (according to antenna impedance in the vicinity of the body) should be performed.

NOTE 2 In some cases, conditions such as overheating or overvoltage prevent the available antenna power from being obtained.

NOTE 3 Time average shall be taken during continuous or maximum duty cycle transmission at maximum power to the extent possible for a given technology.

NOTE 4 Adapted from IEC 60050-702:1992 [11][1)], 702-07-10.

NOTE 5 Antenna feed line is defined by IEC 60050-712:1992 [12], 712-06-01.

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1) Figures in square brackets refer to the Bibliography.

3.2
average total radiated power
the time average of the total radiated power over a time interval equal to the averaging time. This time average is taken during continuous or maximum duty cycle transmission at maximum power to the extent possible for a given technology

NOTE If the user is in the reactive near field of the antenna, the presence of the user may result in a change in the total radiated power due to a change in the antenna impedance. In this case, the average total radiated power must be the maximum possible power in the presence of the user.

3.3
averaging time
t_{avg}
the appropriate time over which exposure is averaged for purposes of determining compliance with exposure limits

3.4
basic restriction
restriction(s) on exposure to time-varying electric, magnetic, and electromagnetic fields that are based directly on established health effects

NOTE Depending upon the frequency of the field, the physical quantities used to specify these restrictions are current density, specific absorption rate (SAR), and power density.

3.5
conformity assessment
demonstration that specified requirements relating to a product, process, system, person or body are fulfilled

NOTE The subject field of conformity assessment includes activities such as testing, inspection and certification, as well as the accreditation of conformity assessment bodies.

[ISO 17000:2004 [14], definition 2.1, modified]

3.6
information technology equipment
ITE
any equipment which has a primary function of either (or a combination of) entry, storage, display, retrieval, transmission, processing, switching, or control, of data and of telecommunication messages and which may be equipped with one or more terminal ports typically operated for information transfer

EXAMPLE Types of ITE include data processing equipment, office machines, electronic business equipment and telecommunication equipment.

3.7
low-power equipment
equipment where the available antenna power and/or the average total radiated power is less than or equal to the low-power exclusion level

3.8
low-power exclusion level
P_{max}
specified condition on device output power, which may also depend on other variables such as frequency and distance of radiating source from persons, such that the exposure level produced by the source will not exceed a specific basic restriction. If the device output power is less than P_{max}, then the device is deemed to comply with the basic restrictions

3.9
multimedia equipment
MME
equipment that has the function of information technology equipment (ITE), audio, video or broadcast-receiving equipment, interaction and/or communication with the user of the product or combinations of these functions

[CISPR 32____[2)] [9], definition 3.1.17]

3.10
peak radiated power
the maximum instantaneous radiated power

3.11
power density
the power passing through an element of surface normal to the direction of propagation of energy of an electromagnetic wave divided by the area of the element

[IEC 60050-705:1995 [13], 705-02-03, power flux density]

NOTE Power density is expressed in watts per square meter.

3.12
pulse repetition frequency
PRF
the number of pulses transmitted per unit time

3.13
specific absorption
SA
energy absorbed by (dissipated in) an incremental mass contained in a volume element of biological tissue when exposure to a radio frequency electromagnetic field occurs

NOTE Specific absorption is expressed in joules per kilogram.

3.14
specific absorption rate
SAR
power absorbed by (dissipated in) an incremental mass contained in a volume element of biological tissue when exposure to a radio frequency electromagnetic field occurs

NOTE SAR is expressed in watts per kilogram.

3.15
total radiated power
the total power emitted by the equipment in the form of electromagnetic fields in the absence of any nearby objects (e.g. a human body)

NOTE For transmitters that use antennas, the total radiated power is independent of antenna gain.

3.16
unintentional radiator
non-intentional radiator
electrical or electronic equipment that radiates radio frequency (RF) energy, even though the emission is not a deliberate or necessary part of its function

EXAMPLE Examples of unintentional radiators include all types of ITE without antenna and/or wireless radio transmission function.

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2) In preparation.

4 Conformity assessment methods

4.1 General considerations

Compliance of electromagnetic emissions from electronic and electrical equipment with the basic restrictions usually is determined by measurements and, in some cases, calculation of the exposure level. If the electrical power used by or radiated by the equipment is sufficiently low, the electromagnetic fields emitted will be incapable of producing exposures that exceed the basic restrictions. This standard provides simple EMF assessment procedures for this low power equipment.

Any relevant compliance assessment procedure which is consistent with the state of the art, reproducible and gives valid results can be used.

For transmitters intended for use with more than one antenna configuration option, the combination of transmitter and antenna(s) which generates the highest available antenna power and/or average total radiated power shall be assessed.

Four routes, as illustrated in Figure 1 and described as follows, can be used to demonstrate compliance with this standard:

A Typical usage, installation and the physical characteristics of equipment make it inherently compliant with the applicable EMF exposure levels such as those listed in the bibliography. This low-power equipment includes unintentional (or non-intentional) radiators, for example incandescent light bulbs and audio/visual (A/V) equipment, information technology equipment (ITE) and multimedia equipment (MME) that does not contain radio transmitters.

NOTE Equipment is described as A/V equipment, ITE or MME if its main use is playback/recording of music, voice or images, or processing of digital information.

B The input power level to electrical or electronic components that are capable of radiating electromagnetic energy in the relevant frequency range is so low that the available antenna power and/or the average total radiated power cannot exceed the low-power exclusion level defined in 4.2.

C The available antenna power and/or the average total radiated power are limited by product standards for transmitters to levels below the low-power exclusion level defined in 4.2.

D Measurements or calculations show that the available antenna power and/or the average total radiated power are below the low-power exclusion level defined in 4.2.

If none of these routes can be used, then the equipment is deemed to be out of the scope of this standard and EMF assessment for conformity assessment purposes shall be made according to other standards, such as IEC 62311 or other EMF product standards.

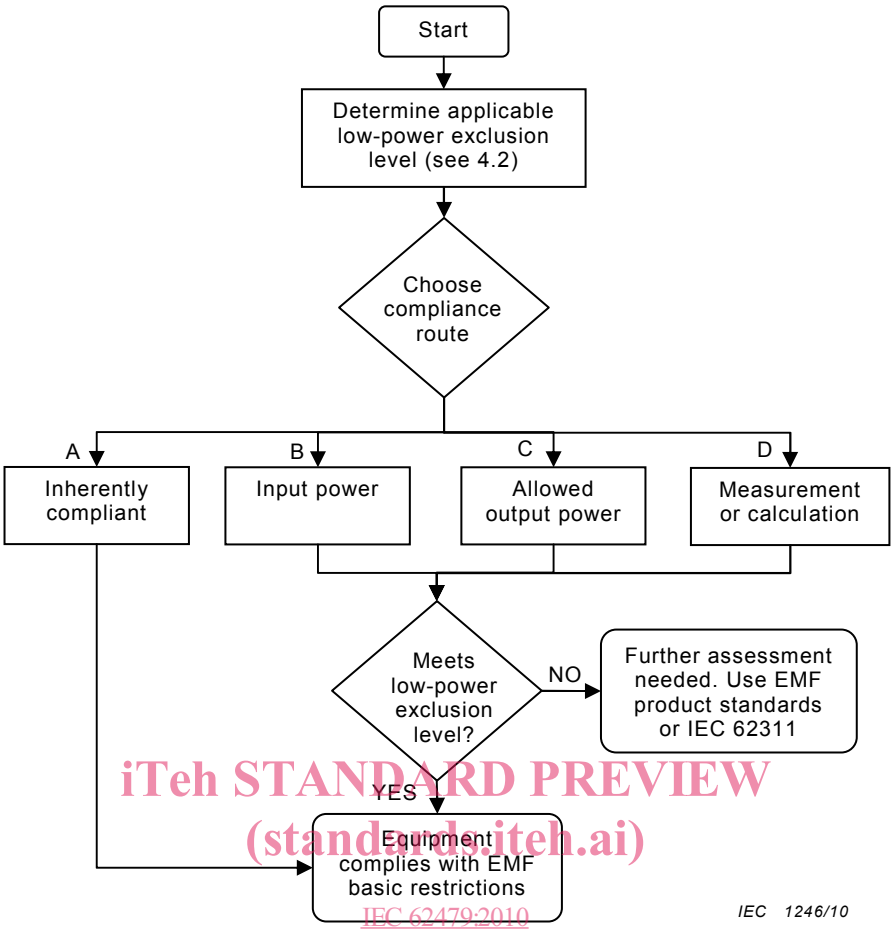

Figure 1 – Routes to show compliance with low-power exclusion level

4.2 Low-power exclusion level (P_{max})

Low-power electronic and electrical equipment is deemed to comply with the provisions of this standard if it can be demonstrated using routes B, C or D that the available antenna power and/or the average total radiated power is less than or equal to the applicable low-power exclusion level P_{max}.

Annex A contains example values for P_{max} derived from existing exposure limits listed in the bibliography, such as the ICNIRP guidelines [1], IEEE Std C95.1-1999 [2], and IEEE Std C95.1-2005 [3].

For wireless devices operated close to a person's body with available antenna powers and/or average total radiated powers higher than the P_{max} values given in Annex A, the alternative P_{max} values (called P_{max}'), described in Annex B can also be used.

NOTE In order to be able to use the alternative P_{max} values (P_{max}'), the device under assessment shall fit within the scope of applicability of P_{max}' as defined in Annex B. If P_{max}' as defined in Annex B is not applicable to a particular product, then the example values P_{max} for the corresponding exposure limits described in Annex A should be used.

For low power equipment using pulsed signals, other limits may apply in addition to those considered in Annex A and Annex B. Both ICNIRP guidelines [1] and IEEE standards [2], [3] have specific restrictions on exposures to pulsed fields, and the requirements of those standards with respect to exposure to pulses shall be met. Annex C discusses this topic further.

4.3 Exposure to multiple transmitting sources

If an equipment under test (EUT) is equipped with multiple intentional radiators, the overall conformity assessment might require more than just the assessment of conformity of each one of the radiators separately. The effect of multiple intentional radiators should be considered in the conformity assessment process.

Technical Report IEC 62630 [8] provides generic guidance on how to assess the EMFs generated by multiple intentional radiators.

5 EMF assessment report

5.1 General considerations

The means and rationale for determining compliance with the low-power exclusion level shall be recorded, as shall all information needed for performing repeatable assessments, tests, calculations, or measurements yielding results within the required calibration and uncertainty limits.

Further guidelines on the assessment report can be found in 5.10 of ISO/IEC 17025:2005. Annex D is a sample of what is contained in ISO/IEC 17025 as it might pertain to EMF assessment reports.

5.2 Equipment-related information

Relevant information concerning the settings of controls and the intended usage of the equipment shall be recorded. In addition, the following should be included in the assessment report:

- description of the equipment including type designation, serial number, etc.;
- any instructions needed for a user to properly operate the equipment such that exposures will be compliant with the basic restrictions;
- provisions for ensuring that the equipment cannot be modified to change its power so that it could exceed the low-power exclusion level.

6 Use of measurement uncertainty in the evaluation of compliance to limits

The equipment is deemed to fulfil the requirements of this standard if the assessment results are less than or equal to the limit and if the estimated uncertainty of the assessment results is less than the maximum measurement uncertainty specified for the assessment method(s) that are applied. This means that for each assessment route shown in Figure 1, separate uncertainty estimations must be performed as applicable for the route used. The uncertainty of the assessment method shall be determined by calculating the expanded uncertainty using a confidence interval of 95 % (coverage factor k = 1,96).

NOTE 1 The uncertainty of EMF assessment methods is generally given in %. If the uncertainty is stated in non-linear units, e.g. dB, then this value should be converted into percentage (%) first.

NOTE 2 Guidance about uncertainty estimation can be found in ISO/IEC Guide 98-3:2008, *Guide to the expression of uncertainty in measurement*, often referred to as the GUM [10].

Generally, a relative uncertainty (expanded) of 30 % is used for a number of EMF assessment methods. Therefore this level of relative uncertainty is used as a default maximum in this generic standard. The uncertainty values specified for each EMF assessment method are the maximum allowed uncertainties. If the uncertainty value is not specified, then a default value of 30 % shall be used.

If the relative uncertainty is less than 30 %, then the measured value L_{m} shall be compared directly with the applicable limit L_{lim} for evaluation of compliance.

If the computed uncertainty is larger than 30 %, then the computed uncertainty shall be included in the evaluation of compliance with the limit as follows (i.e. by adding this computed value to the measured or computed result).

Equation (1) shall be used to determine whether the measured value L_m complies with a "reduced" limit if the actual measurement uncertainty of the applicable assessment method is 30 % or more. If the computed assessment uncertainty is larger than the specified maximum allowed uncertainty value for any particular method and if it is also larger than the maximum default uncertainty value of 30 %, then a penalty value shall be added to the assessment result before comparison with the limit.

Conversely, one can also reduce the applicable limit L_{lim} with the same penalty value, and compare the actual measured L_m value with the reduced limit. The right-hand side of Equation (1) shows how the limit L_{lim} is reduced in case the computed uncertainty is larger then 30 %.

$$L_m \leq \left(\frac{1}{0{,}7 + \frac{U(L_m)}{L_m}} \right) L_{lim} \tag{1}$$

where

L_m is the measured value;

L_{lim} is the exposure limit;

$U(L_m)$ is the absolute value of the expanded uncertainty.

EXAMPLE Suppose the relative uncertainty of a certain EMF assessment method is 55 %. Then

$$\frac{U(L_m)}{L_m} = 0{,}55$$

Using Equation (1), the acceptance criterion for the measured value is then:

$$L_m \leq \left(\frac{1}{0{,}7 + \frac{U(L_m)}{L_m}} \right) L_{lim} = \left(\frac{1}{0{,}7 + 0{,}55} \right) L_{lim} = \frac{1}{1{,}25} L_{lim} = 0{,}8\ L_{lim}$$

The uncertainty penalty (the amount of reduction of the limit) is then:

$$U_{pen} = L_{lim} - 0{,}8 L_{lim} = 0{,}2\ L_{lim}$$