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Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC/IEEE 62209-1528 edition 1.1 contains the first edition (2020-10) [documents 106/514/FDIS and 106/520/RVD] and its amendment 1 (2026-09) [documents 106/738/FDIS and 106/747/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC/IEEE 62209-1528 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure, in cooperation with the International Committee on Electromagnetic Safety of the IEEE Standards Association, under the IEC/IEEE Dual Logo Agreement.

This first edition of IEC/IEEE 62209-1528 cancels and replaces IEC 62209-1:2016, IEC 62209-2:2010, IEC 62209-2:2010/AMD1:2019 and IEEE Std 1528-2013. This edition constitutes a technical revision.

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

a) extension of the frequency range down to 4 MHz and up to 10 GHz;
b) testing of devices with proximity sensors;
c) application specific phantoms;
d) device holder specifications;
e) fast SAR testing procedures;
f) test reduction procedures;
g) LTE assessment procedure;
h) revision of validation clause, including validation antennas;
i) revision of SAR assessment procedure;
j) time-average SAR measurement procedure;
k) uncertainty analysis;

This publication is published as an IEC/IEEE Dual Logo standard.

This publication contains attached files in the form of the Fast SAR Wizard described in 7.9.2.2 as well as CAD files for the SAM phantom. These files are available at:

http://www.iec.ch/dyn/www/f?p=103:227:0::::FSP_ORG_ID,FSP_LANG_ID:1303,25.

These files are intended to be used as a complement and do not form an integral part of the publication.

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

FDIS	Report on voting
106/514/FDIS	106/520/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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this document and its amendment 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, or

– revised.

INTRODUCTION

The objective of this document is to provide procedures for measuring the human exposure from devices intended to be used at a position near the human head or body. It was developed to provide procedures to evaluate electromagnetic field (EMF) exposures due to radio frequency (RF) transmitting devices used next to the ear, in front of the face, mounted on the body, operating in conjunction with other RF-transmitting and non-transmitting devices or accessories (e.g. belt-clips), or embedded in garments. The types of devices dealt with include but are not limited to mobile telephones, cordless telephones, cordless microphones, and radio transmitters in personal computers. The applicable frequency range is from 4 MHz to 10 GHz. The document defines:

– measurement system requirements (Clause 6),

– SAR measurement protocols (Clause 7),

– SAR measurement uncertainty evaluation (Clause 8), and

– reporting requirements (Clause 9).

At the time this document was developed, two computational and measurement joint IEC/IEEE projects dealing with millimetre-wave power density assessment were under development, covering the frequency range from 6 GHz to 300 GHz. Hence there is an overlap of frequency between this document, which deals with SAR, and the other joint IEC/IEEE projects dealing with power density from 6 GHz to 10 GHz. The IEC/IEEE joint working group was aware of this fact and believed that it would give the flexibility of using whatever metrics suitable for the considered case of compliance assessment.

1 Scope

This document specifies protocols and test procedures for the reproducible and repeatable measurement of the conservative exposure peak spatial average SAR (psSAR) induced inside a simplified model of the head and the body by radio-frequency (RF) transmitting devices, with a defined measurement uncertainty. These protocols and procedures apply to a significant majority of the population, including children, during the use of hand-held and body-worn wireless communication devices. These devices include single or multiple transmitters or antennas, and are operated with their radiating structure(s) at distances up to 200 mm from a human head or body. This document is employed to evaluate SAR compliance of different types of wireless communication devices used next to the ear, in front of the face, mounted on the body, operating in conjunction with other RF-transmitting, non-transmitting devices or accessories (e.g. belt-clips), or embedded in garments. The applicable frequency range is from 4 MHz to 10 GHz. Devices operating in the applicable frequency range can be tested using the phantoms and other requirements defined in this document.

The device categories covered include, but are not limited to, mobile telephones, cordless microphones, and radio transmitters in personal, desktop and laptop computers, for multi-band operations using single or multiple antennas, including push-to-talk devices. This document can also be applied for wireless power transfer devices operating above 4 MHz.

This document does not apply to implanted medical devices.

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 62209-3:2019, *Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 3: Vector measurement-based systems (Frequency range of 600 MHz to 6 GHz.*

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

3 Terms and definitions

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

ISO, IEC, and IEEE 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
- IEEE Dictionary Online: available at http://dictionary.ieee.org

3.1
accessory
optional component or attachment that can be used in conjunction with the device under test (DUT)

EXAMPLE 1 Accessories for holding, affixing, or otherwise carrying, wearing or attaching the device, as well as providing a specific use condition on the body of the user (e.g. a belt-clip, wrist-strap or any other body strap, or lanyard for wearing the device using a necklace).

EXAMPLE 2 Electronic accessories for performing specialized tasks or which provide additional features (e.g. GPS modules, outboard printers, MP3 players, cameras or viewing devices).

EXAMPLE 3 Electronic accessories providing audio or video input or output (e.g. headsets, microphones, cameras).

EXAMPLE 4 Accessories providing enhanced RF capability to the device (e.g. original, replacement, or auxiliary antennas).

EXAMPLE 5 Batteries and related DC power components.

EXAMPLE 6 Combinations of accessories, where two or more of the above are combined within one component.

3.2
axial isotropy
maximum deviation of the SAR measured when rotating the probe around its major axis while it is exposed to a wave impinging from a direction coinciding with its major axis

3.3
basic restriction
human exposure limits for compliance with time-varying electric, magnetic, and electromagnetic fields measured inside the body that are based on established adverse health effects

Note 1 to entry: Within the scope of this document, the physical quantity used as a basic restriction is the specific absorption rate (SAR).

3.4
body-worn device
device containing one or more wireless transmitters or transceivers which is positioned in close proximity to a person’s torso or limbs (excluding the head) by means of a carrying accessory to support intended use operations

Note 1 to entry: This document uses the term body-worn synonymously for the term body-mounted, which was employed in earlier versions.

3.5
body-supported device
device containing one or more wireless transmitters or transceivers, with intended use that includes transmitting with any portion of the device being held directly against a user’s body

3.6
boundary effect
change in the sensitivity of an electric-field probe when the probe tip is located close (less than one probe-tip diameter) to media boundaries

Note 1 to entry: This effect is caused by distortion of the scattered field at the probe tip due to the nearby phantom dielectric surface. This effect can be compensated if the probe orientation with respect to the phantom surface is known.

3.7
cable
wire that is necessary for the device functionality in the intended operational configuration

3.8
channel
RF channel
specific sub-division of the transmit frequency range according to the operating parameters of a particular wireless technology