IEC 60118-13

Edition 5.0 2019-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Electroacoustics – Hearing aids – Part 13: Requirements and methods of measurement for electromagnetic immunity to mobile digital wireless devices

Électroacoustique – Appareils de correction auditive– Partie 13: Exigences et méthodes de mesure de l'immunité électromagnétique aux appareils numériques mobiles sans fil

IEC 60118-13:2019-10(en-fr)

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ELECTROACOUSTICS – HEARING AIDS –

Part 13: Requirements and methods of measurement for electromagnetic immunity to mobile digital wireless devices

FOREWORD

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International Standard IEC 60118-13 has been prepared by IEC technical committee 29: Electroacoustics.

This fifth edition cancels and replaces the fourth edition published in 2016 and constitutes a technical revision.

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

a) it introduces a new measurement method and set of EMC requirements for hearing aids immunity to mobile digital wireless devices;
b) generic EMC requirements for hearing aids are no longer included – should be covered by other standards as appropriate.

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

FDIS	Report on voting
29/1024/FDIS	29/1031/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 in the IEC 60118 series, published under the general title *Electroacoustics – Hearing aids*, can be found on the IEC website.

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- withdrawn,
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INTRODUCTION

This part of IEC 60118 specifies methods of measurement and requirements for hearing aid immunity to digital wireless devices. Most hearing aids contain digital signal processors and some can contain wireless transceivers.

Experience in connection with the use of hearing aids in recent times has identified digital wireless devices, such as wireless telephones and GSM mobile phones, as potential sources of disturbance for hearing aids. Interference in hearing aids depends on the emitted power from the digital wireless device as well as the immunity of the hearing aid. The performance criteria in this document will not totally ensure hearing aid users' interference- and noise-free use of wireless telephones, but will establish useable conditions in most situations.

In practice, a hearing aid user, when using a wireless telephone, will seek, if possible, to find a position on the ear, which gives minimum or no interference in the hearing aid. Various test methods have been considered for determining the immunity of hearing aids. When a digital wireless device is used close to a hearing aid, there is an RF near-field illumination of the hearing aid. However, validation investigations in preparing this document have shown that it is possible to establish a correlation between the measured far-field immunity level and the immunity level experienced by an actual hearing aid used in conjunction with a digital wireless device. The use of a far-field test has shown high reproducibility and is considered sufficient to verify and express the immunity of hearing aids. Near-field illumination of the hearing aid (i.e. by generating an RF field using a dipole antenna) could however provide valuable information during the design and development of hearing aids.

It is recognized that the new wireless products introduced have to coexist with existing spectra, potential networks and other wireless products (medical as well as non-medical). This revision does not address the issue of coexistence, and the user of this document shall consult applicable entities for guidance.

In this fifth edition of IEC 60118-13, the field strengths and hearing aid positioning during measurements have been updated for consistency with IEEE C63.19 [1][1] and ANSI C63.19 [2]. The field strength levels used since the first edition of IEC 60118-13 was published in 1997 have demonstrated, through measurements of more than 1 000 hearing aid models (ref. European Hearing Instrument Manufacturers Association – EHIMA), to be sufficiently high to ensure well-functioning hearing aids in everyday use, with only a small expectation of a few complaints regarding interference from digital wireless devices.

Hearing aids where the outputs are non-acoustic, for example bone conduction hearing aids, are not directly included in this document, but this document can be used if precise descriptions of measurement setups for these types of hearing aids are given by the manufacturer.

[1] Numbers in square brackets refer to the Bibliography

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ELECTROACOUSTICS – HEARING AIDS –

Part 13: Requirements and methods of measurement for electromagnetic immunity to mobile digital wireless devices

1 Scope

This part of IEC 60118 covers the relevant EMC phenomena for hearing aids. Hearing aid immunity to high frequency fields originating from digital wireless devices such as mobile phones was identified as one of the most relevant EMC phenomena impacting hearing aids.

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 60118-0:2015, *Electroacoustics – Hearing aids – Part 0: Measurement of the performance characteristics of hearing aids*

IEC 60318-5, *Electroacoustics – Simulators of human head and ear – Part 5: 2 cm^3 coupler for the measurement of hearing aids and earphones coupled to the ear by means of ear inserts*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-20, *Electromagnetic compatibility (EMC) – Part 4-20: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
hearing aid
wearable instrument intended to aid a person with impaired hearing, usually consisting of a microphone, amplifier, signal processor and earphone, powered by a low-voltage battery, and possibly also containing an induction pick-up coil and which is fitted using audiometric and prescriptive methods

Note 1 to entry: Hearing aids can be placed on the body (BW), behind the ear (BTE), in the ear (ITE) or in the canal (ITC).

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3.2
bystander compatibility
immunity of a hearing aid that ensures it is usable in environments where digital wireless devices are in operation in the proximity of the hearing aid wearer

3.3
user compatibility
immunity of a hearing aid that ensures that it is usable when the wearer is using a digital wireless device at the wearer's own aided ear

3.4
gain
G
difference between the acoustic or the magnetic equivalent input level ($L_{p,\text{in}}$) and the respective acoustic output level ($L_{p,\text{out}}$)

Note 1 to entry: The gain is determined at an acoustic input sound pressure level (SPL) of 55 dB or (for induction pick-up coils) at a magnetic field strength level re 1 A/m of −35 dB which is the magnetic equivalent of 55 dB (SPL).

Note 2 to entry: $G = L_{p,\text{out}} - L_{p,\text{in}}$.

Note 3 to entry: If not stated otherwise in this document, gain is determined at a frequency of 1 kHz.

3.5
output related interference level
$ORIL$
sound pressure level at the output of the hearing aid during exposure to a 1 kHz 80 % amplitude modulated RF signal with time weighting FAST

Note 1 to entry: $ORIL = L_{p,\text{ out}}$ at 1 kHz, 80 % AM RF.

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

3.6
input related interference level
$IRIL$
$ORIL$ with gain (G) subtracted:

$$IRIL = ORIL - G$$

Note 1 to entry: $IRIL$ is used to characterize the immunity of a hearing aid.

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

3.7
input related ambient noise
$IRAN$
equivalent acoustic input sound pressure level that would lead to the acoustic noise output produced by a hearing aid:

$$IRAN = ORIL_{\text{RF off}} - G$$

and

$ORIL_{\text{RF off}} = L_{p,\text{ out}}$, RF switched off

Note 1 to entry: $IRAN$ is determined in the same way as $IRIL$ but with the RF signal switched off.

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

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3.8
GSM
global system for mobile communication

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

3.9
TEM cell
closed measuring device in which a voltage difference creates a TEM-mode electromagnetic field

3.10
GTEM cell
TEM cell that has been altered to extend the usable frequency range

3.11
radio frequency
RF
frequency of electromagnetic radiation within the range of 30 kHz to 30 GHz

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

3.12
microphone mode
hearing aid omnidirectional setting active

3.13
induction pick-up coil mode
hearing aid induction pick-up coil active

3.14
directional mode
hearing aid directional setting active

4 Operation and function of the hearing aid

Hearing aids basically consist of a microphone, an amplifier, an optional induction pick-up coil and a small earphone (receiver). For behind the ear (BTE) hearing aids, the sound is often fed to the ear canal by means of an individually made ear mould (ear insert), or with the receiver in the auditory canal (RITE). In the ear (ITE) and in the canal (ITC) hearing aids, have the active circuitry located in the ear.

The power source normally used is a small battery. On some hearing aids, the user can perform some adjustments of the controls of the hearing aid.

5 Requirements for electromagnetic immunity

5.1 General

Clause 5 specifies the electromagnetic immunity requirements for hearing aids to wireless digital devices. IEC 61000-4-3 describes testing and measurement techniques for general radiated immunity which shall be applied. For the purpose of the radiated RF electromagnetic field immunity requirements, two hearing aid user compatibility classes are defined (see 3.2 and 3.3) which are related to the hearing aid user's situation.

A "bystander compatible" hearing aid will ensure that the hearing aid is usable in environments where digital wireless devices are in operation in the proximity of the hearing aid wearer.

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A "user compatible" hearing aid will ensure that the hearing aid is usable when the hearing aid wearer is using a mobile digital wireless device at the wearer's own aided ear.

5.2 Compliance criteria

To demonstrate compatibility, the following criteria shall be met when applying the immunity test levels defined in Table 1 and following the measurement procedure specified in Clause 6:

- the hearing aid operation mode shall not change; and
- the IRIL shall not exceed 55 dB SPL.

Table 1 specifies the field strengths of RF test signals to establish immunity for bystander compatible and user compatible hearing aids. "Bystander compatibility" criteria shall be fulfilled as a minimum requirement, whereas "user compatibility" is optional.

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Table 1 – Field strengths of RF test signals to be used to establish immunity for bystander compatible and user compatible hearing aids

	Bystander compatibility ***IRIL*** **≤ 55 dB SPL for field strengths,** ***E*** V/m					**User compatibility** ***IRIL*** **≤ 55 dB SPL for field strengths,** ***E*** V/m					
Frequency range in GHz	0,08 to 0,65	0,65 to 0,96	0,96 to 1,4	1,4 to 2,7	2,7 to 6,0	0,08 to 0,65	0,65 to 0,96	0,96 to 1,4	1,4 to 2,0	2,0 to 2,7	2,7 to 6,0
Microphone mode	Not relevant	10	Not relevant	10	Not relevant	Not relevant	60	Not relevant	40	30	Not relevant
Induction pick-up coil mode [a]	Not relevant	10	Not relevant	10	Not relevant	Not relevant	60	Not relevant	40	30	Not relevant
Directional mode [a]	Not relevant	10	Not relevant	10	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant

[a] If provided.

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6 Test procedures for immunity to radiated RF electromagnetic fields

6.1 General

Clause 6 describes the equipment and measurement methods for the radiated RF electromagnetic field immunity test. Annex A provides background information for the development of the procedures.

6.2 Test setup

An example of a suitable test arrangement is given in Figure 1.

Hearing aids whose outputs are non-acoustic, for example, bone conduction hearing aids, will require use of an appropriate load and coupling device. Precise descriptions of measurement setups for these types of hearing aids shall be given by the manufacturer.

Proposed testing, validation and measurement techniques, when using a GTEM cell, is to be found in IEC 61000-4-20.

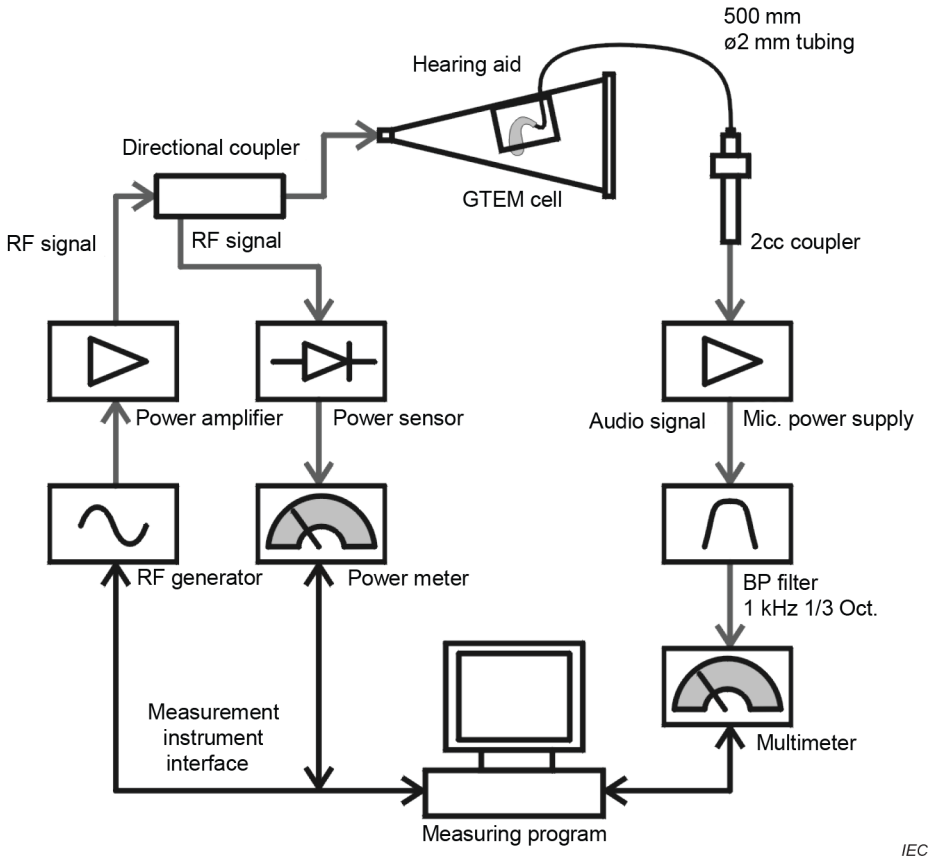

Figure 1 – Example of a test arrangement for hearing aid immunity measurements using a GTEM cell

6.3 Hearing aid test setting

The hearing aid gain control shall be adjusted to the reference test setting (RTS), and the other controls shall be set to the basic settings as described in 6.4.3 in IEC 60118-0:2015 ("adaptive features disabled").

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6.4 Determination of gain

For the determination of gain, the same acoustic coupler and tubing as used for the *ORIL* measurement shall be used. Measurement setup for determination of gain shall be in accordance with IEC 60118-0:2015. The gain of a hearing aid in microphone mode is determined by applying a sinusoidal 1 kHz signal with a sound pressure level ($L_{p,\text{in}}$) to be swept from 30 dB SPL to 80 dB SPL at the microphone reference point of the hearing aid.

From the input-output response curve, take the acoustic sound pressure level of the output ($L_{p,\text{out}}$) at 55 dB input level.

For the gain of a hearing aid in directional mode, use the gain obtained in microphone mode.

The gain of a hearing aid in induction pick-up coil mode is determined by applying a sinusoidal 1 kHz signal with a magnetic field strength level re 1 A/m ($L_{H,\text{in}}$) in dB to be swept from −60 dB to −10 dB at the induction pick-up coil reference point of the hearing aid, measuring the acoustic sound pressure level ($L_{p,\text{out}}$) at its output.

From this input-output response curve, take the acoustic sound pressure level ($L_{p,\text{out}}$) input level re 1 A/m at −35 dB (which is equivalent to the acoustic sound pressure level of 55 dB); see examples in Figure 2.

Calculate gain and inductive pick-up coil gain by:

G (dB) = $L_{p,\text{out}}$ (dB) – 55 (dB)

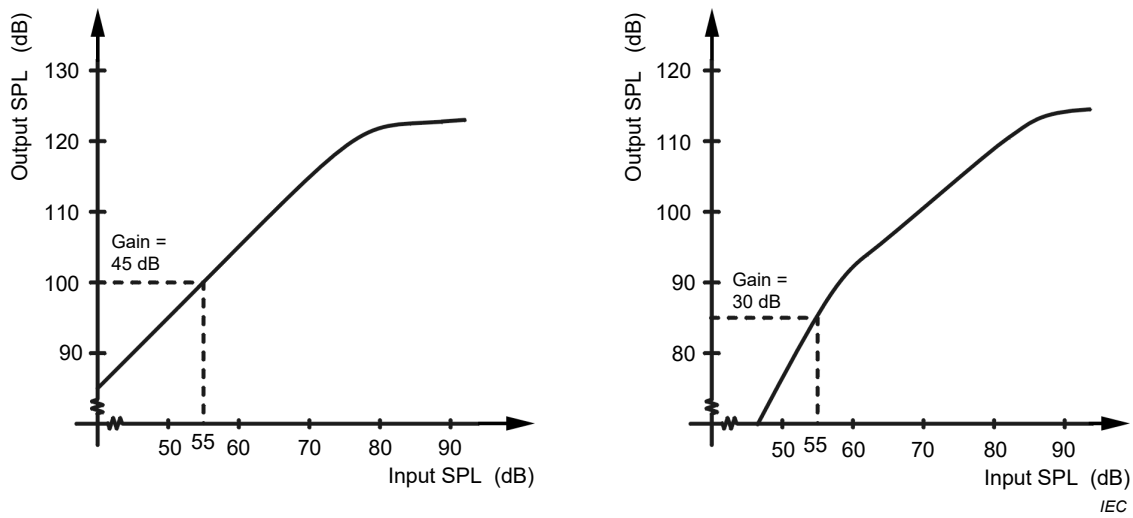

Figure 2 – Examples of input-output response curves at 1 kHz and the determination of gain at an input SPL of 55 dB

6.5 Measurement of the input related ambient noise (*IRAN*)

Perform an *ORIL* measurement with RF signal switched off to get $ORIL_{\text{RF off}}$.

Determine *IRAN* by subtracting gain (G) from $ORIL_{\text{RF off}}$: $IRAN = ORIL_{\text{RF off}} - G$.

Measurements shall be taken to verify that ambient noise is at least 15 dB below the IRIL limit of 55 dB SPL.

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6.6 Hearing aid output coupling during immunity test

The hearing aid shall be placed in the RF field.

No objects, other than the hearing aid, which could distort the RF-field, shall be present in the test volume. In order to remove the metallic coupler as specified in IEC 60318-5 from the test volume, the normal tubing between the hearing aid and the coupler shall be replaced by tubing of 2 mm bore and with a length typically between 50 mm and 1 000 mm.

For in the ear hearing aids, the outlet from the receiver shall be coupled to the tubing by a suitable adapter. This adapter and the length of the tubing are not critical, as the hearing aid gain is determined in each individual test configuration.

6.7 Position of the hearing aid during immunity test

The hearing aid shall be placed in six measurement orientations, consisting of three orientations related by 180˚ rotations about a bounding cube ortho-axis, and their three opposite-side orientations established by 180˚ rotations about the E-field vector from each of the three original orientations.

The six positions are defined as X0, X180, Y0, Y180, Z0, Z180. The position can be defined with the following three starting positions X0, Y0, Z0, shown in Figure 3.

Position X180 is attained from the starting position X0 with a rotation 180˚ about the E-field vector. Position Y180 is attained by starting from the Y0 position and then making a 180˚ rotation about the E-field vector. Position Z180 is attained by starting from the Z0 position and then making a 180˚ rotation about the E-field vector.

For custom hearing aids, the X0 position is intended to reproduce the normal position of the device in the ear, with the RF field addressing the side of the head. X180 is attained by starting at the X0 position and then making a 180˚ rotation about the E-field vector. Y180 is attained by starting at the Y0 position and then making a 180˚ rotation about the E-field vector. Z180 is attained by starting at the Z0 position and then making a 180˚ rotation about the E-field vector.

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