

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



Electroacoustics – Audiometric equipment –  
Part 3: Test signals of short duration

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Électroacoustique – Appareils audiométriques –  
Partie 3: Signaux d'essai de courte durée

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IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

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Part 3: Test signals of short duration

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**ELECTROACOUSTICS – AUDIOMETRIC EQUIPMENT –****Part 3: Test signals of short duration**

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International Standard IEC 60645-3 has been prepared by IEC technical committee 29: Electroacoustics.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

- a) new figures of reference signals;
- b) changes in definitions.

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

|              |                  |
|--------------|------------------|
| FDIS         | Report on voting |
| 29/1066/FDIS | 29/1070/RVD      |

Full information on the voting for the approval of this document 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 of IEC 60645 series, under the general title *Electroacoustics – Audiometric equipment*, can be found on the IEC website.

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

- reconfirmed;
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## INTRODUCTION

Developments in the field of hearing measurements for diagnostic, hearing conservation and rehabilitation purposes have resulted in the availability of a wide range of audiometric equipment. In addition, it is possible to consider audiometric equipment in terms of a set of functional units that can be specified independently. By specifying these functional units, it is then possible to specify the performance of other audiometric equipment that uses these units. The IEC 60645 series consists of a number of parts. IEC 60645-3 covers the requirements for reference and other test signals of short duration.

Examples of test methods, where such signals are commonly used, are the recording of auditory evoked potentials and evoked otoacoustic emissions. Reference signals are described in order to provide a basis for calibration and as a recommendation for use when there is no specific reason to have an alternative signal. Measurement methods for short duration acoustic and vibratory test signals are described.

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# ELECTROACOUSTICS – AUDIOMETRIC EQUIPMENT –

## Part 3: Test signals of short duration

### 1 Scope

This part of IEC 60645 specifies a means of describing the physical characteristics, in terms of electrical waveforms, of audiometric reference and test signals of short duration and methods for their measurement.

The object of this document is to ensure that audiometric stimuli of short duration are specified and measured in the same way and that the calibration of equipment using such signals is carried out using defined methods.

This document does not describe the method of use of short-duration test signals.

### 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 60318-1, *Electroacoustics – Simulators of human head and ear – Part 1: Ear simulator for the measurement of supra-aural and circumaural earphones*

IEC 60318-3, *Electroacoustics – Simulators of human head and ear – Part 3: Acoustic coupler for the calibration of supra-aural earphones used in audiometry*

IEC 60318-4, *Electroacoustics – Simulators of human head and ear – Part 4: Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts*

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

IEC 60318-6, *Electroacoustics – Simulators of human head and ear – Part 6: Mechanical coupler for the measurement on bone vibrators*

IEC 61260-1, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

ISO 389-6, *Acoustics – Reference zero for the calibration of audiometric equipment – Part 6: Reference threshold of hearing for test signals of short duration*



### 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

##### **short-duration signal**

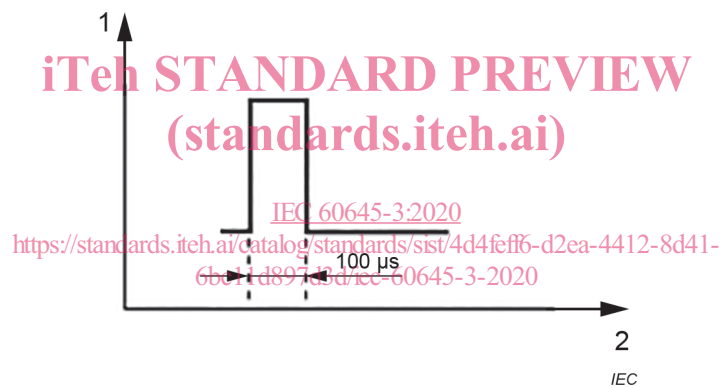
signal having a duration of less than 200 ms

#### 3.2

##### **click**

transient acoustic or vibratory signal whose frequency spectrum covers a broad frequency range, produced by applying a single rectangular electrical pulse to the terminals of the transducer

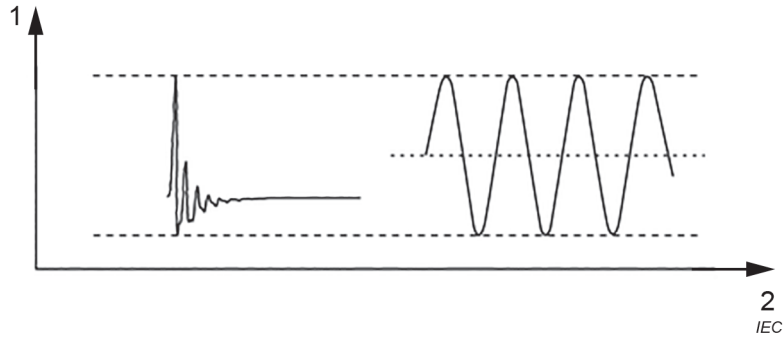
Note 1 to entry: See Figure 1 and Figure 2.



#### Key

- 1 level
- 2 time

**Figure 1 – Basic specification of an electrical reference click**



**Key**

- 1 level
- 2 time

NOTE The left part of the figure shows an example of the acoustic click signal generated by an electrical rectangular pulse applied to a transducer (100  $\mu$ s electrical pulse fed to a TDH-39 earphone with MX-41/AR cushion and measured on an IEC 60318-1 ear simulator) and the right part presents the long duration sinusoidal signal.

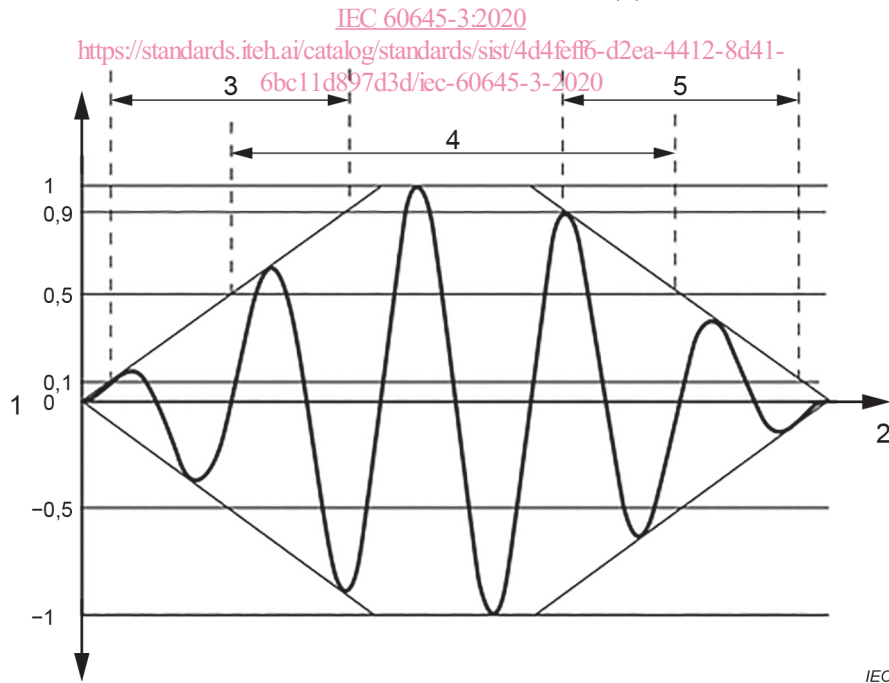
**Figure 2 – Illustration of the method of measurement of peak-to-peak equivalent signal levels**

**3.3 tone-burst**

gated sinusoidal signal having a duration of less than 200 ms

Note 1 to entry: Figure 3 shows a reference tone-burst (see 4.3)

Note 2 to entry: A tone-burst is sometimes called a "brief tone" or a "tone pip".



**Key**

- 1 level
- 2 time
- 3 rise time
- 4 duration
- 5 fall time

**Figure 3 – Temporal characteristics of an electrical reference tone-burst**

**3.4****instantaneous frequency**

frequency  $f$  which, for a signal  $s(t)$  with a waveform

$$s(t) = A(t) \sin(\phi(t)),$$

is defined at time  $t$  as

$$f(t) = \frac{1}{2\pi} \frac{d\phi(t)}{dt}$$

with the amplitude modulation  $A(t)$  slowly varying compared to the frequency

$$\frac{dA(t)}{dt} \ll A(t) f(t)$$

**3.5****chirp**

short-duration signal in which the instantaneous frequency between two specified values varies monotonically for the duration of the signal

**3.6****upward chirp**

chirp which presents the low frequency components in the chirp before the high frequency components

**3.7****broadband chirp**

chirp that has a specified electrical amplitude spectrum covering at least 5 octaves of the normal audible frequency range,

Note 1 to entry: See Figure 5.

**3.8****octave-band chirp**

chirp with an electrical amplitude spectrum corresponding to the amplitude-frequency characteristic of an IEC 61260-1 octave-band filter with a specified center frequency

**3.9****condensation signal**

short-duration signal, the initial wave of which causes an over-pressure relative to ambient pressure, or an over-force relative to the static force at the plane of the output port of the transducer

**3.10****rarefaction signal**

short-duration signal, the initial wave of which causes an under-pressure relative to ambient pressure, or an under-force relative to the static force at the plane of the output port of the transducer

**3.11****alternating polarity signal**

series of short-duration signals, consisting of rarefaction and condensation signals in alternating order

**3.12****initial wave of a click stimulus signal**

first half wave of the stimulus signal, the amplitude of which is larger than 0,5 times the amplitude of the next half wave with opposite polarity

**3.13****duration of initial wave of a click stimulus signal**

time interval between the two zero crossings of the initial stimulus signal wave

**3.14****duration of a tone-burst**

time interval between the half maximum amplitude points on the rising and falling portions of the envelope of the electrical tone-burst signal

Note 1 to entry: See Figure 3, key 4.

**3.15****rise and fall times of a tone-burst**

time intervals between the 10 % and 90 % amplitude points of the rising portion and the 90 % and 10 % amplitude points on the falling portion of the envelope of the electrical tone-burst signal

Note 1 to entry: See Figure 3, key 3 and key 5.

**3.16****peak-to-peak equivalent signal level**

root-mean-square (RMS) value of a long duration sinusoidal signal which, when compared under the same test conditions with a short-duration output signal from the transducer under test, has the same peak-to-peak value (i.e. amplitude difference between the maximum and minimum values) as the short-duration signal

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Note 1 to entry: See Figure 2.

Note 2 to entry: For clicks and broadband chirps, the long duration sinusoidal signal should have a frequency of 1 000 Hz, and for tone-bursts its frequency should equal the fundamental frequency of the tone-burst. For octave-band chirps, its frequency should equal the centre frequency of the band.

Note 3 to entry: The term "peak-to-peak equivalent signal level" is also referred to as "peak equivalent signal level".

Note 4 to entry: The recommended abbreviations for "peak-to-peak equivalent sound pressure level" and "vibratory force level" are peSPL and peVFL.

**3.17****RMS signal level**

RMS value of a short-duration signal continuously presented with a given presentation rate, measured as equivalent continuous sound pressure level or vibratory force level without any frequency weighting

Note 1 to entry: If short-duration signals are presented with a given presentation rate, their behavioral threshold can be described by an RMS signal level, which has, for a given transducer, a given ear simulator, and a given presentation rate a fixed ratio to the peak-to-peak equivalent signal level of the short-duration signal, see [1].

Note 2 to entry: If a sound level meter is to be used to measure the RMS signal level, the IEC 61672-1 Z frequency weighting should be applied to realize these conditions.

**4 Reference signals****4.1 General**

The following reference signals are described for the purposes of standardization.