

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Sound system equipment –
Part 23: TVs and monitors – Loudspeaker systems**

**Équipements pour systèmes électroacoustiques –
Partie 23: Téléviseurs et moniteurs – Systèmes de haut-parleurs**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Sound system equipment –
Part 23: TVs and monitors – Loudspeaker systems**

**Équipements pour systèmes électroacoustiques –
Partie 23: Téléviseurs et moniteurs – Systèmes de haut-parleurs**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.160.01; 33.160.50

ISBN 978-2-8322-6548-2

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms, definitions and abbreviated terms	10
3.2 Abbreviated terms.....	11
4 Type description	12
5 Physical characteristics	12
5.1 Dimensions.....	12
5.2 Mass.....	12
6 Conditions	12
6.1 Normal measuring conditions.....	12
6.2 Rated conditions.....	13
6.3 Rated frequency range.....	13
6.4 Climatic conditions.....	13
7 Test signals.....	13
7.1 General.....	13
7.2 Sinusoidal chirp signal	13
7.3 Steady-state single-tone signal.....	13
7.4 Steady-state two-tone signal.....	14
7.5 Sparse multi-tone complex.....	14
7.6 Broadband noise signal.....	14
7.7 Narrow-band noise signal	14
7.8 Hann-burst signal.....	14
7.9 Impulsive signal	14
8 Acoustical environment.....	14
8.1 General.....	14
8.2 Free-field conditions	14
8.3 Simulated free-field conditions	14
8.4 In-situ environment	15
8.5 Listening room	15
9 Measurement equipment	15
10 Positioning of the EUT	15
10.1 Reference plane and normal vector.....	15
10.2 Reference point	15
10.3 Reference axis.....	16
10.4 Orientation vector	16
10.5 Horizontal and Vertical Trajectories	18
11 Measuring distance between EUT and microphone.....	18
11.1 Far-field conditions	18
11.2 Near-field conditions.....	18
12 Mounting of the EUT.....	19
12.1 General.....	19
12.2 Mounting methods	19
12.2.1 Stand-type.....	19

12.2.2	Wall mount-type.....	19
12.3	Mounting for free-field conditions	20
12.3.1	General	20
12.3.2	EUT rotating condition	20
12.3.3	Microphone rotating condition	20
13	Rated ambient conditions	20
13.1	Temperature ranges.....	20
13.1.1	Performance limited temperature range	20
13.1.2	Damage limited temperature range	21
13.2	Humidity ranges	21
13.2.1	Relative humidity range	21
13.2.2	Damage limited humidity range.....	21
14	Evaluation point and distance	21
14.1	Evaluation point	21
14.2	Evaluation distance.....	21
15	Free-field measurements	22
15.1	General.....	22
15.2	On-axis SPL FR	22
15.2.1	Definition	22
15.2.2	Measurement methods	22
15.2.3	Reporting.....	22
15.3	Spatial transfer function	23
15.3.1	Definition	23
15.3.2	Measurement method	23
15.3.3	Reporting.....	24
15.4	Sound power response	24
15.4.1	Definition	24
15.4.2	Measurement methods	25
15.4.3	Reporting.....	25
15.5	Directional characteristics	26
15.5.1	General	26
15.5.2	Measurement methods	27
15.5.3	Post-processing.....	27
15.5.4	Reporting.....	30
16	In-situ testing.....	30
16.1	General.....	30
16.2	In-situ transfer function	31
16.2.1	Definition	31
16.2.2	Measurement method	32
16.2.3	Reporting.....	33
16.3	Room transfer function.....	33
16.3.1	Definition	33
16.3.2	Measurement method	33
16.4	Reflected sound SPL response	34
16.4.1	Definition	34
16.4.2	Measurement method	34
16.4.3	Reporting.....	35
16.5	In-situ SPL FR	35

16.5.1	Definition	35
16.5.2	Measurement methods	35
16.5.3	Reporting.....	36
17	Mean SPL in an acoustical zone	37
17.1	General.....	37
17.2	Definition	37
17.3	Measurement.....	38
17.4	Numerical prediction	38
17.5	Reporting.....	38
18	FR characteristics.....	38
18.1	General.....	38
18.2	Mean value of SPL in a rated frequency range	39
18.2.1	Definition and unit.....	39
18.2.2	Setup.....	39
18.2.3	Procedure.....	39
18.2.4	Analysis.....	39
18.2.5	Reporting.....	40
18.3	Effective frequency range (EFR)	40
18.3.1	Definition and unit.....	40
18.3.2	Setup.....	40
18.3.3	Procedure.....	40
18.3.4	Analysis.....	41
18.3.5	Reporting.....	41
18.4	Spectral balance (SB).....	42
18.4.1	Definition and unit.....	42
18.4.2	Setup.....	42
18.4.3	Procedure.....	42
18.4.4	Analysis.....	42
18.4.5	Reporting.....	43
18.5	Regression line deviation (RLD).....	43
18.5.1	Definition and unit.....	43
18.5.2	Setup.....	43
18.5.3	Procedure.....	43
18.5.4	Analysis.....	44
18.5.5	Reporting.....	44
18.6	Narrow band variation (NBV)	45
18.6.1	Definition and unit.....	45
18.6.2	Setup.....	45
18.6.3	Procedure.....	45
18.6.4	Analysis.....	45
18.6.5	Reporting.....	46
19	Large-signal characteristics	46
19.1	Modelling at high amplitudes.....	46
19.2	Noise spectrum.....	47
19.2.1	Definition and measurement	47
19.2.2	Reporting.....	47
19.3	Short-term amplitude compression.....	47
19.3.1	Definition and unit.....	47
19.3.2	Setup.....	47

19.3.3	Procedure.....	47
19.3.4	Analysis.....	48
19.3.5	Reporting.....	48
19.4	Multi-tone distortion	48
19.4.1	Multi-tone distortion spectrum.....	48
19.4.2	Absolute multi-tone distortion	50
19.4.3	Relative multi-tone distortion	51
19.4.4	Total multi-tone distortion ratio	52
19.5	Harmonic distortion in sound pressure output	53
19.5.1	Definition and unit.....	53
19.5.2	Setup.....	54
19.5.3	Procedure and analysis	54
19.5.4	Reporting.....	55
19.6	Equivalent input total harmonic distortion.....	56
19.6.1	Definition and unit.....	56
19.6.2	Setup.....	57
19.6.3	Procedure.....	57
19.6.4	Analysis.....	57
19.6.5	Reporting.....	58
19.7	Impulsive distortion.....	59
19.7.1	Definition and unit.....	59
19.7.2	Setup.....	59
19.7.3	Procedure.....	59
19.7.4	Analysis.....	59
19.7.5	Reporting.....	60
19.8	Rated maximum input value	60
19.8.1	Definition and unit.....	60
19.8.2	Setup.....	60
19.8.3	Procedure.....	61
19.8.4	Analysis.....	62
19.8.5	Reporting.....	62
19.9	Rated maximum SPL	62
19.9.1	Definition and unit.....	62
19.9.2	Setup.....	62
19.9.3	Procedure.....	62
19.9.4	Reporting.....	63
Bibliography.....		64
Figure 1 –Test signal scope		12
Figure 2 –Recommended position and orientation of the EUT		16
Figure 3 – Measuring the horizontal directivity in spherical coordinates by rotating the EUT (e.g., OLED TV) in upright position.....		17
Figure 4 – Measuring the vertical directivity in spherical coordinates by rotating the tilted EUT (e.g. OLED TV).....		17
Figure 5 – Example for stand-type		19
Figure 6 – Example for wall mount-type		20
Figure 7 – Evaluation point and distance (centre)		21
Figure 8 – SPL distribution of the direct sound represented in colour in 3D		24

Figure 9 – Measurement locations at vertical and horizontal trajectories at distance r_d	26
Figure 10 – Measurement locations at listening window	28
Figure 11 – Measurement locations at equivalent sound power.....	29
Figure 12 – Example for reporting the directional characteristics measured at distance r_d	30
Figure 13 – Modelling the sound reproduction under in-situ conditions.....	32
Figure 14 – Example of time-frequency analysis (spectrogram) applied to reflected sound impulse response $h_{REFL}(t,r)$ measured at a distance $r = 1,5$ m from the EUT in an office room.....	33
Figure 15 – SPL FR of the in-situ condition.	36
Figure 16 – Mean value of SPL at rated frequency range	40
Figure 17 – Effective Frequency Range at Frequency Response.....	41
Figure 18 – Regression line deviation at rated frequency range	44
Figure 19 – Loudspeaker model considering the dominant signal distortion at high amplitudes	46
Figure 20 – SPL spectrum of the reproduced multi-tone stimulus (MDS) at full FFT resolution comprising the fundamental components at the excited tones and the distortion components at other frequencies	49
Figure 21 – SPL of the fundamental, multi-tone distortion and noise floor integrated into frequency bands at the excitation frequencies of the multi-tone stimulus	51
Figure 22 – Relative multi-tone distortion $L_{RMD}(f_i)$ and relative noise floor $L_{RNF}(f_i)$ in decibel versus excitation frequencies f_i	52
Figure 23 – Total harmonic distortion (THD) referred to the fundamental component measured at three distances on the reference axis	55
Figure 24 – SPL FR of the fundamental component, total harmonic components ($L_{TH}(f,r_e)$), and the noise floor $L_{NFTH}(f,r_e)$	56
Figure 25 – Signal flow chart illustrating the generation of the equivalent input distortion by inverse filtering the sound pressure signal measured at three different points in an in-situ environment (office).....	57
Figure 26 – Equivalent input total harmonic distortion (EITHD) in percent versus excitation frequency measured at three distances on the reference axis in an in-situ environment.....	58
Table 1 – Recommended coordinates of the trajectories at distance r_D	18
Table 2 – Evaluation distance reference standard	22
Table 3 – Weights for polar angle θ at 10° Increments	29
Table 4 – Worked example for mean value of SPL	40
Table 5 – Worked example for effective frequency range	41
Table 6 – Worked example for spectral balance	43
Table 7 – Worked example for RLD.....	44
Table 8 – Worked example for NBV	46
Table 9 – Worked example for rated maximum input value.....	62
Table 10 – A Worked example for Rated maximum SPL.....	63

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SOUND SYSTEM EQUIPMENT –

Part 23: TVs and monitors – Loudspeaker systems

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60268-23 has been prepared by technical area 20: Analogue and digital audio, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

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

Draft	Report on voting
100/3774/CDV	100/3831/RVC

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

The language used for the development of this International Standard is English.

A list of all parts in the IEC 60268 series, published under the general title *Sound system equipment*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document 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,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

documents a preview generated by EVS

INTRODUCTION

IEC TC 100 has already standardized loudspeaker measurement methods. However, the locations of the loudspeakers of TVs and monitors vary (e.g. front, bottom, back, side), and TVs and monitors are used on stands or wall-mounted, and methods used for their installation continue to evolve. Since the sound characteristics change according to the installation type and position of the loudspeaker, it is necessary to develop new measurement methods for loudspeakers of TVs and monitors. This document provides measurement methods for the audio system of TVs and monitors that take into account the listening environment.

This document is a preview generated by EVS

SOUND SYSTEM EQUIPMENT –

Part 23: TVs and monitors – Loudspeaker systems

1 Scope

This part of IEC 60268 specifies acoustical measurement methods that apply to TV sets, monitors with built-in loudspeakers, and other audio devices having similar acoustical properties (e.g. flat-panel loudspeakers). The acoustical measurements are performed under free-field conditions and in-situ.

This document does not assess the perception and cognitive evaluation of the reproduced sound, nor the impact of perceived sound quality.

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 60268-2:1987, *Sound system equipment – Part 2: Explanation of general terms and calculation methods*

IEC 60268-21:2018, *Sound system equipment – Part 21 Acoustical (output-based) measurements*

IEC 61094-4, *Measurement microphones – Part 4: Specifications for working standard microphones*

IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications*

ISO 3744, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Engineering methods for an essentially free field over a reflecting plane*

ISO 3745, *Acoustics – Determination of sound power levels and sound energy levels of noise sources using sound pressure – Precision methods for anechoic rooms and hemi-anechoic rooms.*

ISO 80000-2, *Quantities and units – Part 2: Mathematics*

ANSI/CTA 2034-A:2015, *Standard Method of Measurement for In-Home Loudspeakers*

3 Terms, definitions and abbreviated terms

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses: