AES standard method for
digital audio engineering —
Measurement of
digital audio equipment

Published by
Audio Engineering Society, Inc.
Copyright © 2015 by the Audio Engineering Society

Abstract

This standard provides methods for specifying and verifying the performance of medium-to-high performance
digital audio equipment. It comprises an exhaustive list of measurements applicable to digital audio equipment.
This edition substantially revises and updates AES17-1998.

An AES standard implies a consensus of those directly and materially affected by its scope and provisions and
is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an AES
standard does not in any respect preclude anyone, whether or not he or she has approved the document, from
manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the
standard. Prior to approval, all parties were provided opportunities to comment or object to any provision.
Attention is drawn to the possibility that some of the elements of this AES standard or information document
may be the subject of patent rights. AES shall not be held responsible for identifying any or all such patents.
Approval does not assume any liability to any patent owner, nor does it assume any obligation whatever to
parties adopting the standards document. This document is subject to periodic review and users are cautioned to
obtain the latest edition. Recipients of this document are invited to submit, with their comments, notification of
any relevant patent rights of which they are aware and to provide supporting documentation.

Audio Engineering Society Inc. 551 Fifth Avenue, New York, NY 10176, US.
www.aes.org/standards standards@aes.org
Contents

0 Introduction ....................................................................................................................................... 4
1 Scope ................................................................................................................................................. 4
2 Normative references ...................................................................................................................... 4
3 Terms and definitions ...................................................................................................................... 5
4 Measurement conditions ................................................................................................................. 7
  4.1 Environmental .............................................................................................................................. 7
  4.2 Power supply ............................................................................................................................... 7
  4.3 Bandwidth .................................................................................................................................... 7
  4.4 EUT settings ................................................................................................................................ 7
  4.5 EUT preconditioning .................................................................................................................... 8
5 Measurement equipment ................................................................................................................. 8
  5.1 Signal generator ........................................................................................................................... 8
  5.2 Signal analyzer ............................................................................................................................ 8
  5.3 Scope of measurements ............................................................................................................. 11
  5.4 Standard frequencies ................................................................................................................. 11
  5.5 Documentation of results .......................................................................................................... 12
6 Measurement methods .................................................................................................................. 13
  6.1 Overview .................................................................................................................................... 13
  6.2 Linear characteristics .................................................................................................................. 13
  6.3 Non-linear characteristics .......................................................................................................... 16
  6.4 Noise .......................................................................................................................................... 19
  6.5 Interference and crosstalk .......................................................................................................... 20
  6.6 Digitization artifacts .................................................................................................................... 23
  6.7 Digital interface characteristics .................................................................................................. 25
  6.8 Audio measurements requiring advanced equipment ................................................................ 27
Annex A (informative): Advanced measurement methods for production testing .................... 29
  A.1 Characterization vs production testing ...................................................................................... 29
  A.2 Overview of FFT-based analysis methods ................................................................................ 29
  A.3 Synchronous multitone analysis ............................................................................................... 30
  A.4 Exponential sine sweep (chirp) analysis .................................................................................... 33
Annex B (informative): Frequency-domain and window-width filters ......................................... 36
  B.1 Overview .................................................................................................................................... 36
  B.2 Windowing .................................................................................................................................. 36
  B.3 Method of operation of frequency-domain and window-width filters ........................................ 36
  B.4 Bandwidth of window-width filters ........................................................................................... 37
  B.5 The noise problem ..................................................................................................................... 37
Annex C (informative): Informative references .............................................................................. 39
Foreword

[This foreword is not a part of AES standard method for digital audio engineering — Measurement of digital audio equipment, AES17-1998]

This document has been prepared by the SC-02-01 Working Group on Digital Audio Measurement Techniques of the SC-02 Subcommittee on Digital Audio of the Audio Engineering Society Standards Committee. It is a revision of AES17-1991. With the permission of AESSC, it also had been independently released by ANSI Accredited Standards Committee S4 as ANSI S4.51-1991.

Discussions on the revision project, AES17-R, began in the autumn of 1995. Proposals for revision have been discussed at five subsequent open working group meetings and over the working group reflector, SC_02_01@aessc.aes.org. The call for comment on its draft was published 1997-10-09 on http://www.aes.org/standards and was distributed with the Journal of the Audio Engineering Society, vol. 45, no. 11.

The following individuals contributed to the preparation of the 1991 edition of this document: Robert Adams, Richard Cabot, Louis Fielder, David Haynes, and Tomlinson Holman. The revision was prepared by R. Cabot based on the working group discussions.

Richard Cabot, Chairman
Working Group SC-02-01 on Digital Audio Measurement Techniques
1998-03

Foreword to 2015 revision

[This foreword is not part of AES17-2015, AES standard method for digital audio engineering - Measurement of digital audio equipment.]

This document substantially revises and updates AES17-1998, AES standard method for digital audio equipment - Measurement of digital audio equipment. It includes measurements using more up-to-date measurement tools, and includes annexes describing advanced measurement methods for production testing, and frequency-domain and window-width filters.


Tom Kite, Chairman
Working group SC-02-01 on Digital Audio Measurement Techniques
2015-07

Note on normative language

In AES standards documents, sentences containing the word “shall” are requirements for compliance with the document. Sentences containing the verb “should” are strong suggestions (recommendations). Sentences giving permission use the verb “may”. Sentences expressing a possibility use the verb “can”.

AES standard method for
digital audio engineering -
Measurement of
digital audio equipment

0 Introduction
This standard provides methods for specifying and verifying the performance of medium- to high-performance
digital audio equipment.

Many tests are very similar to those used for testing analogue equipment. However, because of the unique
requirements of digital audio equipment and the effects of its imperfections, additional tests are needed.

The characteristics of voice-grade digital audio EUTs are sufficiently different from those of high-performance
equipment that some of the test levels and frequencies specified in this document may need to be revised for
these applications. Low bit-rate coders are an example of EUTs that require additional test techniques. The
nature of such coders dictates that the test methods be based on psychoacoustic models which can predict
subjective performance. However, the techniques described here should still be informative for such systems.

Another caveat concerns digital EUTs which purposely modify the time-domain characteristics of the audio
signal, such as pitch shifters and reverberators. Many of the tests in this standard assume that the frequency
spectrum of the output signal is substantially the same as that of the input signal. Also, high-level interfering
signals (as would be encountered with reverberators) have not been considered.

1 Scope
This standard specifies basic measurement methods of medium- to high-performance digital audio equipment.

It includes definitions, and measuring conditions and methods applicable to professional equipment.

This standard does not consider:
− measurement of low-quality audio devices,
− measurement of low-bit-rate audio devices (‘sub-band’ or ‘perceptual’ coding devices),
− measurement of devices which significantly modify time or frequency characteristics of the signal, such as
  pitch shifters or reverberators,
− measurement of signals from analogue input to analogue output, beyond the most general,
− EMC and safety related testing.

2 Normative references
The following documents, in whole or in part, are normatively referenced in this document and are
indispensable for its application. For dated references, only the edition cited applies. For undated references, the
latest edition of the referenced document (including any amendments) applies.

ITU-R BS.468-4, Measurement of audio-frequency noise voltage in sound broadcasting. International
Telecommunication Union, Geneva, Switzerland.

IEC 61260-1, Electroacoustics - Octave-band and fractional-octave-band filters. International Electrotechnical
Commission, Geneva, Switzerland.