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Part 3: Amplifiers

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SOUND SYSTEM EQUIPMENT –**Part 3: Amplifiers****FOREWORD**

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International Standard IEC 60268-3 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This fifth edition cancels and replaces the fourth edition published in 2013. This edition constitutes a technical revision.

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

- a) rated condition of digital input is newly specified;
- b) tolerance of rated power supply is changed;
- c) maximum effective output power is appended to output characteristics list;
- d) "Terms, definitions and rated values" clause is complemented.

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

CDV	Report on voting
100/2960/CDV	100/3069/RVC

Full information on the voting for the approval of this 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 60268 series, published under the general title *Sound system equipment*, can be found on the IEC website.

This part of IEC 60268 shall be used in conjunction with IEC 60268-1:1985 and IEC 60268-2:1987.

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

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SOUND SYSTEM EQUIPMENT –

Part 3: Amplifiers

1 Scope

This part of IEC 60268 applies to analogue amplifiers, and the analogue parts of analogue/digital amplifiers, which form part of a sound system for professional or household applications. It specifies the characteristics that should be included in specifications of amplifiers and the corresponding methods of measurement.

NOTE The methods of measurement for digital amplifiers and similar equipment are given in IEC 61606 [1]¹.

In general, the specified methods of measurement are those which are seen to be most directly related to the characteristics. This does not exclude the use of other methods that give equivalent results.

In general, the methods are based on the simplest measuring equipment which can provide useful results. This does not exclude the use of more complex equipment that can give higher accuracy and/or allow automatic measurement and recording of results.

Rated conditions and standard measuring conditions are specified in order to allow measurements to be reliably repeated.

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 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60268-1:1985, *Sound system equipment – Part 1: General*

IEC 60268-1:1985/AMD1:1988

IEC 60268-1:1985/AMD2:1988

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

Amendment 1:1991

IEC 60417:2002, *Graphical symbols for use on equipment – 12-month subscription to regularly updated online database comprising all graphical symbols published in IEC 60417*

IEC 60958:2016 (all parts), *Series, Digital audio interface*

¹ Numbers in square brackets refer to the Bibliography.

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*

IEC 61000-4-13:2002/AMD1:2009

IEC 61000-4-13:2002/AMD2:2015

IEC 61000-4-17:1999, *Electromagnetic Compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*

IEC 61000-4-17:1999/AMD1:2001

IEC 61000-4-17:1999/AMD2:2008

IEC 61000-4-29:2000, *Electromagnetic Compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on d.c. input power ports immunity tests*

IEC 61606-1:2009, *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 1: General*

IEC 61883-6:2014, *Consumer audio/video equipment – Digital interface – Part 6: Audio and music data transmission protocol*

IEC 61938:2013, *Multimedia systems – Guide to the recommended characteristics of analogue interfaces to achieve interoperability*

3 Terms, definitions and rated values

3.1 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>

3.1.1

class A

class of operation in which the current in each active device supplying the load current is greater than zero throughout each cycle of the signal for all values of load current up to, and including, the value determined by the rated output power or voltage and the rated load impedance

3.1.2

class B

class of operation in which the current in each active device supplying the load current is equal to zero for exactly one-half of each cycle of load current

Note 1 to entry: In common usage, the term Class B is extended to the case where current flows for slightly more than one half-cycle.

Note 2 to entry: Classes G and H are modifications of class B with improved efficiency.

3.1.3

class AB

class of operation in which the current in at least one of the active devices supplying the load current is zero for some part of each cycle of load current for some range of values of load current not exceeding the value defined by the rated output power or voltage and the rated load impedance

Note 1 to entry: At sufficiently low signal levels, a Class AB amplifier usually operates in Class A.

3.1.4 class D

class of operation in which all active power devices are switched between fully on and fully off at a rate faster than the highest frequency of interest, and where the wanted signal is encoded in the switching pattern

Note 1 to entry: Other classes of operation have been commercialized but no formal definitions of such classes have been submitted for standardization.

3.2 Rated values

A full explanation of the term "rated" is given in IEC 60268-2.

The rated conditions for amplifiers are:

- rated power supply voltage;
- rated source impedance;
- rated source e.m.f.;
- rated load impedance;
- rated total harmonic distortion, or rated (distortion-limited) output voltage or power;
- rated mechanical and climatic conditions.

NOTE 1 Total harmonic distortion and (distortion-limited) output voltage or power are interdependent. Both cannot be taken as rated conditions simultaneously because normally a given sample amplifier produces less than rated total harmonic distortion at rated output voltage or power.

NOTE 2 If the power supply frequency is critical, it is also a rated condition.

To obtain the correct conditions for measurements, the values for the above-mentioned rated conditions shall be taken from the manufacturer's specification. These values themselves are not subject to measurement but they constitute the basis for measuring the other characteristics.

Methods of measurement for these other characteristics are given in this document and the manufacturer is either required or permitted to state 'rated values' for these characteristics in the specification of the equipment. These include

- rated voltage gain;
- rated distortion limited output voltage or power (when not adopted as a rated condition);
- rated signal-to-noise ratio;
- rated equivalent noise source e.m.f.

4 Conditions

4.1 Rated conditions and standard measuring conditions

4.1.1 Overview

For convenience in specifying how amplifiers shall be set up for measurement, sets of conditions are specified in this document, under the titles of "Rated conditions" and "Standard measuring conditions".

4.1.2 Rated conditions

4.1.2.1 Analogue input

An amplifier, considered as a four-terminal network with regard to a specified pair of input terminals and a specified pair of output terminals, shall be understood to be working under rated conditions when the following conditions are fulfilled:

- a) the amplifier is connected to its rated power supply;
- b) the source e.m.f. is connected in series with the rated source impedance to the input terminals;

NOTE 1 Multi-channel amplifiers can be specified with any number of channels driven, or all channels. See Annex B. The input signal can be applied simultaneously to all inputs of similar channels.

- c) the output terminals are terminated with the rated load impedance;

NOTE 2 For the measurement of Class D amplifiers, the low pass filter can be connected between the analyser and the rated load impedance. The low pass filter (analogue) is given in IEC 61606-1 (see Figure 3).

- d) the terminals which are not used during the measurement are terminated, if necessary, as specified by the manufacturer;
- e) the source e.m.f. is a sinusoidal voltage equal to the rated source e.m.f. at an appropriate frequency. Unless there is a special reason to the contrary, this frequency shall be the standard reference frequency of 1 000 Hz according to IEC 60268-1.

Such a reason could be that the standard reference frequency is outside or near the limit of the effective frequency range of the amplifier;

- f) the volume control, if any, is set to such a position that the rated distortion-limited output voltage appears at the output terminals;
- g) the tone controls, if any, are set to a specified position to give the specified frequency response, generally the flat frequency response;
- h) the balance control(s), if any, is (are) set to the mechanical central position;
- i) the rated mechanical and climatic conditions according to IEC 60268-1 are complied with.

Figure 1 shows block diagrams of amplifiers with some rated conditions stated.

Amplifiers for which the rated distortion-limited output power exceeds the rated temperature-limited output power are likely to be subject to overheating when operated under rated conditions for an extended period of time. For these amplifiers, rated conditions shall be maintained for no longer than can be tolerated by the amplifier.

4.1.2.2 Digital input

The amplifier and measuring instrument is connected as shown in Figure 2. The input signal is a digital audio signal and the output signal is an analogue signal. All the digital specifications are described in IEC 61606-1. The digital interface can be according to IEC 60958 or IEC 61883-6, or other interfaces having the same specification as in 3.1 of IEC 61606-1. The source e.m.f. for digital input is the signal level of the digital sine signal generator specified in 4.6.2 of IEC 61606-1:2009:

- a) the amplifier is connected to its rated power supply;
- b) input signal is adjusted to:
 - frequency: 997 Hz;
 - signal level: full-scale level.

NOTE 1 Multi-channel amplifiers can be specified with any number of channels driven, or all channels. See Annex B. The input signal can be applied simultaneously to all inputs of similar channels.

NOTE 2 The standard reference frequency of 997 Hz is according to 4.3 of IEC 61606-1:2009.

- c) the output terminals are terminated with the rated load impedance;

NOTE 3 For the measurement of Class D amplifiers, the low pass filter can be connected between the analyser and the rated load impedance. The low pass filter (analogue) is given in IEC 61606-1 (see Figure 2).

- d) the terminals that are not used during the measurement are terminated, if necessary, as specified by the manufacturer;
- e) the volume control, if any, is set to such a position that the rated distortion-limited output voltage appears at the output terminals;
- f) the tone controls, if any, are set to a specified position to give the specified frequency response, generally the flat frequency response;
- g) the balance control(s), if any, is (are) set to the mechanical central position;
- h) the rated mechanical and climatic conditions according to IEC 60268-1 are complied with.

Amplifiers for which the rated distortion-limited output power exceeds the rated temperature-limited output power are likely to be subject to overheating when operated under rated conditions for an extended period of time. For these amplifiers, rated conditions shall be maintained for no longer than can be tolerated by the amplifier.

4.1.3 Standard measuring conditions

These are obtained by bringing the amplifier under rated conditions (see 4.1.2) and then reducing the source e.m.f. to a level of –10 dB referred to the rated source e.m.f.

4.2 Other conditions

If supplementary data of the amplifier are presented, applying to other than the rated or standard measuring conditions, for example at different frequencies or at different settings of controls, then the conditions shall be fully defined in the presentation. These conditions shall, if possible, be chosen according to the recommendations made in the relevant clauses of this document.

The procedures for supplementary measurements may be derived from the measurement procedures given for the standard conditions. If special precautions are necessary to ensure accuracy, these shall be indicated together with the measurement procedure involved.

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5 Classes of operation

Amplifier classes are classified according to the operation of an amplifying stage. These classes are defined as Class A, Class B, Class AB and Class D; detailed definitions are given in 3.1.

6 Interchangeable parts

For type measurements, interchangeable parts shall have characteristics as close as is reasonably practicable to the mean characteristics specified for these parts.

For measurements on a particular sample, the interchangeable parts supplied with that amplifier shall be used.

7 Automatic controls

The amplifier may contain automatic control circuits such as limiters, compressors, expanders and electronic fader circuits. These circuits make certain characteristics of the amplifier dependent either on a signal passing through the amplifier itself or on an external control signal. When measuring the characteristics of such an amplifier, the automatic control circuits shall be disabled, except when measuring their characteristics.

8 Power supply

Measurements shall be made with the amplifier connected to rated power supply. Care shall be taken to maintain the power supply voltage at the rated value during the measurement. The tolerance of the supply voltages should be $\pm 1\%$ or less. A tolerance of up to $\pm 10\%$ may be allowed if the results of the measurements are not noticeably affected.

Additional measurements may be made at the upper and lower limits claimed as tolerable for the power supply voltage, the power supply frequency and the a.c. power supply harmonics or the d.c. power supply ripple.

WARNING – The power supply voltage tolerances specified by the manufacturer shall not be exceeded.

9 Position of the volume controls

If a characteristic is measured at only one position of the volume control, the control shall be at the position corresponding to rated conditions (see 4.1.2), unless a maximum or minimum position of the control is inherent in the characteristic to be measured.

If the characteristic is to be measured for several settings of the volume control, then the position for rated conditions shall be included, other preferred settings being maximum, and -3 dB , -6 dB , -10 dB , -20 dB and -40 dB with respect to the setting for rated conditions.

Volume controls belonging to channels not being measured shall, if possible, be put in the minimum position, unless otherwise stated.

10 Pre-conditioning for measurements

Before beginning measurements on an amplifier, it shall be operated under approximately standard measuring conditions for a period of 1 h, or as specified by the manufacturer.

Before operating the amplifier the manufacturer's instructions concerning initial operation should be studied.

The amplifier is then brought under standard measuring conditions (see 4.1.3). Due to internal heating, the output voltage may subsequently vary with time. Unless excessive, this effect is ignored during the pre-conditioning period. When the pre-conditioning period is over, the amplifier shall be brought under rated conditions or standard measuring conditions, as required.

11 Series of measurements

If a series of measurements is made, the amplifier should preferably be maintained under standard measuring conditions in the periods between measurements.

If the amplifier has to be put out of operation for an extended period between measurements, then pre-conditioning according to Clause 10 shall be repeated before each set of measurements, unless this can be shown to be unnecessary.