

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Sound system equipment –
Part 3: Amplifiers**

**Équipements pour systèmes électroacoustiques –
Partie 3: Amplificateurs**

<https://standards.iteh.ai/catalog/standards/sis/24907f4c-b844-4567-bbea-dedb31ef409f/iec-60268-3-2013>

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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**Sound system equipment –
Part 3: Amplifiers**

**Équipements pour systèmes électroacoustiques –
Partie 3: Amplificateurs**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XB**
CODE PRIX

ICS 33.160.10

ISBN 978-2-83220-735-2

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

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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 fourth edition cancels and replaces the third edition published in 2000. This edition constitutes a technical revision.

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

- rated condition of multi-channel amplifier is expanded;
- arrangement for the D-class amplifier is added;
- method of measurement for output power (distortion-limited) is expanded;
- Annex B is newly added.

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

FDIS	Report on voting
100/2010A/CDV	100/2066/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 publication 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.

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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 which 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 [4]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 which 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 which 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, 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.

IEC 60065:2001, *Audio, video and similar electronic apparatus – Safety requirements*
Amendment 1:2005
Amendment 2:2010

IEC 60268-1:1985, *Sound system equipment – Part 1: General*
Amendment 1:1988
Amendment 2:1988

IEC 60268-2:1987, *Sound system equipment – Part 2: Explanation of general terms and calculation methods*
Amendment 1:1991

IEC 60417, *Graphical symbols for use on equipment*. Available from: <http://www.graphical-symbols.info/equipment>

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*
Amendment 1:2009

¹ Numbers in square brackets refer to the Bibliography.

IEC 61000-4-17:1999, *Electromagnetic Compatibility (EMC) – Part 4-17: Testing and measurement techniques – Ripple on d.c. input power port immunity test*
Amendment 1:2001
Amendment 2:2008

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 61938:1996, *Audio, video and audiovisual systems – Interconnections and matching values – Preferred matching values of analogue signals*

3 Conditions

3.1 Rated conditions and standard measuring conditions

3.1.1 Overview

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

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 standard 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.

3.1.2 Rated conditions

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 2).

- 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.

3.1.3 Standard measuring conditions

These are obtained by bringing the amplifier under rated conditions (see 3.1.2) and then reducing the source e.m.f. to a level of –10 dB referred to the rated source e.m.f.

3.2 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 standard.

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.

4 Classes of operation

Class A: 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.

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

NOTE 2 Classes G and H are modifications of class B with improved efficiency.

Class AB: 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 3 At sufficiently low signal levels, a Class AB amplifier usually operates in Class A.

Class D: 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 4 Other classes of operation have been commercialized but no formal definitions of such classes have been submitted for standardization.

5 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.

6 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.

7 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. If the manufacturer claims power supply voltage tolerances exceeding $\pm 10\%$, then the characteristics to be specified shall also be stated for the upper and lower limits of these tolerances.

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.

8 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 3.1.2), 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.

9 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 3.1.3). 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.

10 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 9 shall be repeated before each set of measurements, unless this can be shown to be unnecessary.

11 Variable consumption apparatus

Sound system equipment shall be considered as variable consumption apparatus if it contains one or more power amplifiers operating in the Class AB, B, or D modes, in which the d.c. power supply for the output stages is either electronically regulated by means of series control elements or is not regulated.

NOTE 1 Variable consumption apparatus is defined in IEC 60065:1976² as 'apparatus in which the power consumption can vary more than 15 % due to changes in load impedances of the output circuit or in signal parameters', but no definition appears in the fifth (1985) or sixth (1998) editions.

NOTE 2 Where the d.c. supply is regulated by shunt control elements, the power consumption is usually, if not always, substantially constant. The apparatus, however, behaves in some respects as a variable consumption apparatus, and, in particular, the text of 14.7.4.1 still applies.

All the measurements contained in this standard may be performed on variable consumption apparatus, in most cases with no special problems. However, certain problems may occur in the measurement of hum and rated distortion-limited output power, and some additional measurements are valuable in assessing the performance of such apparatus (see the note of 14.6.3.1 and item c) of 14.14.3).

12 Marking

Principles for marking the terminals and controls are given in IEC 60268-1.

² IEC 60065:1976, *Safety requirements for mains operated electronic and related apparatus for household and similar general use*

Marking may concern

- personal safety and prevention of spread of fire, in the sense of IEC 60065;
- safety in case of faulty connections;
- indications relating to normal operation, according to IEC 60417.

Marking can neither prevent incorrect operation nor provide complete operating instructions. It therefore has to be considered in conjunction with adequate means for preventing dangerous or faulty operation, and with the directions for use included in the user's instructions. Care should be taken that marking is unambiguous and as clearly understandable as possible.

Terminals for the interconnection of equipment, which are inaccessible without the use of a tool when the equipment has been installed, shall be clearly and unambiguously identified with respect to the manufacturer's instructions for installation. It may be assumed that these instructions are to be read by adequately skilled personnel.

13 Operating environment

Measurements, especially those including temperature measurements, shall be carried out with the amplifier mounted in a situation similar to that in which it is to be used. Restrictions on mounting and special ventilation requirements shall be stated by the manufacturer and form part of the rated conditions (see 3.1.2). See also IEC 60065 or other appropriate IEC safety standard.

14 Characteristics to be specified, and their methods of measurement

14.1 Power supply characteristics

14.1.1 Characteristics to be specified

The following information shall (except where indicated as optional) be stated by the manufacturer in the locations indicated, for each pair of terminals to be connected to the power supply and for each position of the power supply voltage selector, if any:

- a) the type of power supply (d.c. or a.c.); on the equipment and in the specification;
- b) the rated power supply voltage (this is a rated condition, see 3.1.2); on the equipment and in the specification;
- c) the power supply frequency or range of frequencies (this may be a rated condition, see 3.1.2); on the equipment and in the specification;
- d) the power drawn, under rated conditions, expressed in watts; on the equipment and in the specification;
- e) for variable consumption apparatus (see Clause 11), the power drawn from the power supply may optionally be expressed as a function of output voltage or power from zero to the rated value, with specified load impedances, including the rated load impedance. This characteristic is particularly of value for equipment which may be operated from batteries. It may be presented as a graph.

If, in items d) or e) above, the apparent power drawn is significantly greater than the true power, the apparent power should be stated in addition.

14.1.2 Method of measurement

The amplifier is brought under rated conditions. The power drawn from the power supply is measured in watts by means of a wattmeter:

- a) with rated source e.m.f., see 14.5.3;
- b) with the source e.m.f. according to standard measuring conditions;

- c) for variable consumption apparatus, at various values of output voltage or power from zero to the rated value.

14.2 Tolerance of (long-term) power supply voltage variations

14.2.1 Characteristic to be specified

The tolerance of power supply voltage variation, such that, for any power supply voltage within the stated limits:

- a) the upper limit of working voltage is not exceeded for any condition of normal operation; this applies particularly to such components as semiconductor devices and electrolytic capacitors;
- b) the tolerances of the heater voltage of electronic tubes used in the amplifier are not exceeded;
- c) the maximum permissible temperature is not exceeded in any component when the amplifier works under standard measuring conditions – except as regards power supply voltage – for an extended period of time;
- d) neither output nor gain is subject to excessive variations;
- e) the signal-to-hum ratio is not reduced by more than 3 dB with respect to the rated value.

Amplifiers designed to take their power supply from the mains are generally not subject to power supply variations exceeding $\pm 10\%$. Such variations do not generally require a special design of amplifier.

Amplifiers designed to take their power supply from batteries or small converters may be subject to larger variations of power supply voltage, which may be due to changing load, the temperature of batteries or the gradual decrease of battery voltage during life or discharge.

The rated value shall be stated by the manufacturer in the specification. If the manufacturer states that the amplifier tolerates power supply voltage variations not exceeding $\pm 10\%$, then compliance with requirements a), b) and c) is considered to be within the scope of normal amplifier design. Compliance with requirements d) and e) shall be checked.

If the manufacturer states that the amplifier will tolerate power supply voltage variations exceeding $\pm 10\%$, the specification shall give details of any special means for compensating such variations and the proper working of these means shall be checked if possible. Compliance with requirements a) to e) shall be checked.

14.2.2 Methods of measurement

14.2.2.1 Temperature

The amplifier is brought under standard measuring conditions.

- a) If a rated temperature-limited output power is given, the source e.m.f. shall be adjusted so that this value of output power is obtained.
- b) The power supply voltage is adjusted to the upper limit stated by the manufacturer and the source e.m.f. readjusted, if necessary, to restore the output power to the value specified in item a).
- c) The amplifier shall be capable of working continuously under these conditions for at least 4 h without any component exceeding the maximum permissible temperature.

14.2.2.2 Variations of output and gain

The amplifier is brought under rated conditions, the total harmonic distortion being measured by the method given in 14.12.3.2.

- a) The source e.m.f. E_s and the output voltage U_2 are measured.