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INTERNATIONAL STANDARD

Multimedia systems – Guide to the recommended characteristics of analogue interfaces to achieve interoperability

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MULTIMEDIA SYSTEMS – GUIDE TO THE RECOMMENDED CHARACTERISTICS OF ANALOGUE INTERFACES TO ACHIEVE INTEROPERABILITY

FOREWORD

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International Standard IEC 61938 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This third edition cancels and replaces the second 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) electric tolerance is standardized;
b) recommended value of output source impedance is adjusted;
c) value of 6 Ω is additionally recommended to impedance-defined loudspeaker systems;
d) values in each table are chosen with respect to the state of the art and representative of best practice in industry.

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

CDV	Report on voting
100/2879/CDV	100/2996/RVC

Full information on the voting for the approval of this International 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.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The first edition of IEC 61938 was derived from IEC 60268-15, IEC 60574-4 and IEC 60933-1 and also from related proposals which had been submitted up until the date of this revision. IEC 60268-15 was the first standard to address 'interoperability' – the ability of equipment from different manufacturers to be assembled into a system with full compatibility at every 'interface'. The aim of the previous revision was to make the intention of this document easily comprehensible by using widely used terminology in the title and text of the document. The purpose of this revision is to expand the measurement frequency range in step with the progress of recent equipment.

The features of the revision are the following:

a) unification and arrangement of existing related standards, including effective proposals which have been submitted;

b) extension of the measurement frequency range.

NOTE The standard numbers mentioned above correspond to the revised numbers, if applicable.

MULTIMEDIA SYSTEMS – GUIDE TO THE RECOMMENDED CHARACTERISTICS OF ANALOGUE INTERFACES TO ACHIEVE INTEROPERABILITY

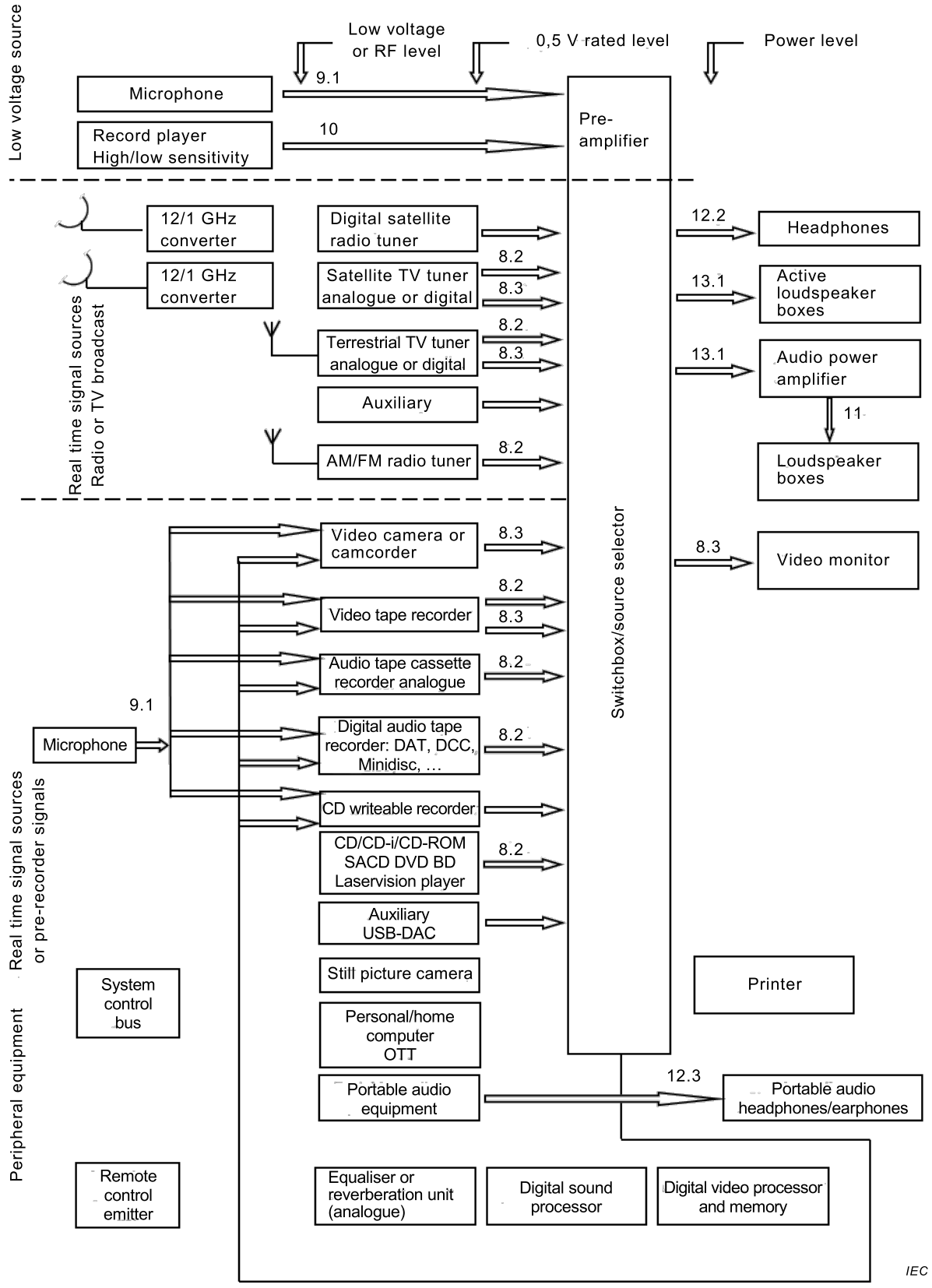
1 Scope

This document gives guidance on current practice for the characteristics of multimedia analogue interfaces to achieve interoperability between equipment from different manufacturers. It is not a performance standard.

Recommendations for interfaces for equipment used in vehicles, and for analogue video interfaces for broadcast and similar equipment, are not given.

Refer to IEC 60958 for the interconnection of digital signals.

Figure 1 shows in a diagram the possible interfaces of the audio and video sources and destinations.



NOTE The numbers indicated above the arrows refer to the appropriate clause or subclauses of this document.

Figure 1 – Audio and video sources and destinations

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 60038, *IEC standard voltages*

IEC 60094-2, *Magnetic tape recording and reproducing systems – Part 2: Calibration tapes*

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

IEC 60268-3, *Sound system equipment – Part 3: Amplifiers*

IEC 60268-5, *Sound system equipment – Part 5: Loudspeakers*

IEC 60268-7:2010, *Sound system equipment – Part 7: Headphones and earphones*

IEC 60268-11:1987, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60268-11:1987/AMD1:1989, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60268-11:1987/AMD2:1991, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60268-12, *Sound system equipment – Part 12: Application of connectors for broadcast and similar use*

IEC 60603-11:1992, *Connectors for frequencies below 3 MHz for use with printed boards – Part 11: Detail specification for concentric connectors (dimensions for free connectors and fixed connectors)*

IEC 60958:2016, *Digital audio interface – ALL PARTS*

ITU-R BT.1700:2005, *Characteristics of composite video signals for conventional analogue television systems*

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
luminance signal
electrical signal representing the luminance of the television picture elements

[SOURCE: IEC 60050-723:1997, 723-05-56, modified – Note has been deleted.]

3.2
chrominance signal
electrical signal that is associated with the luminance signal to convey colour information; in practice this signal is made up of two components

[SOURCE: IEC 60050-723:1997, 723-05-57]

3.3
Y" signal
VBS signal
combined signal consisting of

– a luminance signal;
– blanking and synchronizing signals.

Note 1 to entry: The Y" signal is the composite video signal (CVBS signal) without the C" signal.

3.4
colour signal
C" signal
chrominance signal with burst signal included, modulated on a subcarrier

3.5
composite video signal
CVS signal
combined signal consisting of

– a luminance signal;
– a colour signal.

3.6
composite video, blanking and synchronization signal
CVBS signal
combined signal consisting of

– a luminance signal;
– a colour signal;
– blanking and synchronizing signals.

3.7
blanking signal
signal used to control the suppression of the signal conveying picture information during certain parts of the scanning period, for example, during fly-back

[SOURCE: IEC 60050-723:1997, 723-05-37, modified – Example has been deleted.]

3.8
synchronizing signal
signal used to determine the timing for the scanning processes in transmission and reception

[SOURCE: IEC 60050-723:1997, 723-05-36]

3.9
interface
shared boundary between two pieces of equipment, defined by functional characteristics, common physical interconnection characteristics, signal characteristics and other characteristics, as appropriate

[SOURCE: ISO/IEC 2382-9:1995, definition 09.01.06, modified – Definition has been adapted.]

3.10
minimum output voltage
voltage measured across the rated load impedance of a piece of equipment, and related to a minimum input signal limited by signal-to-noise ratio

3.11
maximum output voltage
voltage measured across the rated load impedance of a piece of equipment and related to a maximum input signal limited by non-linearity

3.12
rated source impedance
internal impedance, stated by the manufacturer, of the source supplying the signal to the piece of equipment

Note 1 to entry: Unless otherwise specified, the rated source impedance is assumed to be a constant pure resistance.

Note 2 to entry: The manufacturer may also give the range of source impedances which he considers tolerable in practice.

Note 3 to entry: Multiple values, or a range of values, may be specified, providing the corresponding rated (distortion-limited) output voltages and/or powers are also stated.

3.13
input impedance
internal impedance measured between the input terminal and its corresponding return of the piece of equipment

3.14
rated source e.m.f.
e.m.f. specified by the manufacturer which, when connected to the input terminals in series with the rated source impedance, gives rated distortion-limited output voltage across the rated load impedance at an appropriate setting of the controls

3.15
minimum source e.m.f. for rated output voltage
e.m.f. that, when connected to the input terminals in series with the rated source impedance, gives rated output voltage across the rated load impedance with the volume control(s), if any, set for maximum gain and the tone control(s), if any, set as specified for rated conditions

3.16
rated load impedance
impedance, specified by the manufacturer, to which the output terminals are to be connected for measuring purposes

Note 1 to entry Unless otherwise specified by the manufacturer, the rated load impedance shall be assumed to be a constant pure resistance.

Note 2 to entry Multiple values, or a range of values, may be specified, provided the corresponding rated (distortion-limited) output voltages and/or powers are also stated.

3.17
output source impedance
internal impedance measured between the output terminal and its corresponding return under specified conditions

3.18
rated output voltage
voltage specified by the manufacturer, measured across the rated load-impedance of a piece of equipment

3.19
overload source e.m.f.
maximum source e.m.f. for which a piece of equipment, connected as for rated conditions and with an appropriate setting of the volume control, can deliver an output voltage 10 d B below the rated distortion limited output voltage without exceeding the rated total harmonic distortion

3.20
externally powered microphone
microphone containing internal active circuitry that obtains its operating power from an external device to which it is connected

3.21
powered input
point on a device at which an externally powered microphone may be connected

Note 1 to entry This is a terminal which serves as an input for signals from a microphone and also as an output for power to the microphone.

3.22
P12
designation of a specific phantom power supply system

3.23
P24
designation of a specific phantom power supply system

3.24
P48
designation of a specific phantom power supply system

4 General conditions

All voltages are RMS voltages, unless otherwise indicated.

Impedances of audio circuits are valid in the frequency range of 20 Hz to 20 kHz, unless otherwise indicated.

Electrical tolerance is ±5 %, unless otherwise indicated.

Tables containing tolerances indicate that the equipment should operate over the entire range of possible values, but may not meet all of its specifications at the given limits.

5 Power supply

5.1 Alternating current (AC) power supply voltages and frequencies

For AC power supply voltages and frequencies, refer to IEC 60038.

For special applications, for example ships and aircraft, other voltages and/or frequencies and the permissible tolerances are subject to agreement between manufacturers and users.

5.2 Direct current (DC) power supply voltages

DC power supply voltages and the permissible tolerances are given in Table 1. The equipment should operate over the range of voltages given, but may not necessarily meet all of its specifications at the given limits.

Table 1 – Direct current (DC) power supply voltages and tolerances

Type of power supply	Rated voltage/cell V	Operating voltage/cell V		
		Lower limit	Normal voltage	Upper limit
Primary batteries				
– Alkali-manganese, zinc chloride-zinc	1,5	1,0	1,5	1,65
– Lithium (organic electrolyte)	3,0	2,0	3,0	3,7
Secondary batteries:				
– Lead-acid, except vehicle batteries	2,0	1,8	2,0	2,2
– Lead-acid, vehicle batteries	2,0	1,8	2,4	2,6
– Nickel-cadmium	1,2	1,1	1,2	1,4

5.3 Power supply feed for microphones

Refer to 9.3, 9.4, and 9.5.

6 Interconnections

6.1 Connections

6.1.1 General

Signal cables shall have the appropriate electrical characteristics to permit the transfer of signals between the parts of a system without unacceptable impairment.

NOTE The degree of impairment which is unacceptable depends on the system specification and the need to comply with other International Standards, such as those concerning electromagnetic compatibility.

6.1.2 Characteristics of cables

6.1.2.1 General

The following characteristics of cables should be taken into account.

6.1.2.2 Resistance of the conductors

A resistance of less than one-hundredth of the load impedance is usually acceptable for loudspeaker connections. For other applications, values of one-tenth are acceptable.

Long cables may therefore require conductors of a larger cross-sectional area than those of short cables.

6.1.2.3 Insulation resistance

An insulation resistance of 50 MΩ is usually acceptable.

6.1.2.4 Magnetic and electromagnetic interference susceptibility of interconnections

The use of untwisted pairs or single conductors with separate return paths is a common source of magnetic and electromagnetic interference at both audio and radio frequencies, especially for loudspeaker wiring, and should be avoided. A description of the methods of avoiding such interference is given in Annex A.

6.1.2.5 Reactance of conductors

The acceptable values vary too widely to give more than general guidance. The cable should not appreciably affect the signal being carried. In the absence of particular requirements, the inductive reactance of the cable should not cause more than 1 dB change in response over the frequency range of interest. The capacitive reactance between the two conductors of a signal-carrying pair, or a coaxial cable, in parallel with the load impedance, should be greater than the rated load impedance, at the highest frequency of interest.

While it is not recommended to use cables in which single conductors carry different audio signals, the capacitive reactance between conductors in this case should exceed 1 000 times the load impedance at the highest frequency of interest.

6.1.2.6 Capacitance from conductor to screen

The acceptable value varies too widely to give more than general guidance. In the absence of particular requirements, the capacitive reactance of a coaxial cable, in parallel with the load impedance, should be greater than the rated load impedance. The capacitance between each conductor of a balanced pair and its screen should be equal within 7,5 %. A closer tolerance is desirable.

NOTE The 7,5 % tolerance, which can be achieved using normal cable manufacturing methods, ensures preservation of adequate common mode rejection in balanced circuits (see Whitlock, JAES, 1995-06). The electromagnetic interference rejection of such circuits is dependent on impedance balance.

6.1.2.7 Characteristic impedance

This is usually only important for high-frequency signals (such as digital signals in accordance with IEC 60958).

6.1.2.8 Continuity of screening

In some applications, the screen is connected to contacts of connectors at both ends of the cable. In other cases, the screen is connected at one end of the cable only. When the screen of a balanced cable is interrupted, for example to prevent the flow of circulating currents, such interruption should be at the receiving end of the signal path. The screen of a coaxial cable should not be interrupted. Connections between equipment should comply with the requirements of AES48.

The screening of signal cables and connectors shall not be used as a means for the preservation of safety earth continuity for the prevention of electric shock hazard.

6.1.2.9 Efficiency of screening

The use of screening is meant to reduce the unwanted effects of electromagnetic disturbances, such as:

a) in reducing crosstalk between conductors in the same cable;

b) in reducing emission of unwanted signals from the cable;

c) in maintaining immunity from external signals entering via the cable.

NOTE These characteristics are related, but good performance in one respect does not ensure good performance in another.

6.2 Connectors

For connectors used within the system, refer to the International Standards cited in Clause 2.

7 Marking and symbols for marking

7.1 Marking

Terminals and controls shall be adequately marked to give information regarding their function, characteristics and polarity.

The marking shall be such that it is possible to adjust the controls and to identify their positions with sufficient accuracy in connection with the information given in the user instructions.

7.2 Symbols for marking

Marking preferably should be composed of letter symbols, signs, numbers and colours, which are internationally intelligible. Refer to IEC 60027, IEC 60417, IEC 60617 and IEC 61293 for such symbols of marking.

Markings not included in the above-mentioned standards shall be clearly explained in the user instructions.

8 Electrical recommended values

8.1 General purpose output/input

In order to preserve the maximum flexibility of use and compatibility in the design of equipment, all inputs of destination equipment, and all outputs of source equipment for general applications shall have the same specifications. These are termed "general purpose input/output".

The manufacturer may choose to designate some or all of these input/outputs for particular purposes. For example, the general purpose input/output for audio signal would be designated for tuner, for tape recorder, or for auxiliary input, in order to simplify the operation, but the specification of all such inputs and outputs nevertheless shall be identical.

8.2 General purpose audio output/input

8.2.1 Audio-only interfaces for consumer equipment

Table 2 gives the values for audio-only interfaces.

Table 2 – General purpose values for audio-only interfaces

Output [a]		Input	
	Recommended values		Recommended values
Output source impedance	≤2,2 kΩ	Rated source impedance	2,2 kΩ
Rated load impedance	22 kΩ	Input impedance	≥22 kΩ
Rated output voltage	0,5 V [b]	Rated source e.m.f.	0,5 V [e]
Minimum output voltage	0,2 V [c]	Minimum source e.m.f. for rated output voltage	0,2 V
Maximum output voltage	2 V [d]	Overload source e.m.f.	≥2,8 V [f]
Specifications of values of impedance may be extended to cover the frequency range 2 Hz to 200 kHz, if			

required.

[a] The output voltages are measured with the rated load impedance connected.

[b] The value corresponds to:

a) an aerial input level of 40 dB (pW) for FM radio tuners, i.e. 0,86 mV across 75 Ω or 1,73 mV across 300 Ω. The modulation factor is 54 %;

– an aerial input e.m.f. of 1 mV for AM radio tuners. The modulation factor is 30 %;

– a vision carrier input level of 70 dB (μV) for TV sound tuners, having the sound to vision carrier ratio of the relevant television system (see ITU-R BT.1700). The modulation factor is 54 % for both AM and FM.

The modulation factor of the above signals is based on the average modulation factor of the relevant emissions, averaged over at least 15 s;

b) the output of a tape player or monitor, when reproducing a calibration tape in accordance with IEC 60094-2;

c) the output of a digital audio source (see footnote to table [g]), when reproducing a sinewave signal recorded at a level 12 dB below "full scale" (see footnote to table [d], item c) recorded digital signal;

d) a source level equal to the average level of the system in other cases.

[c] The value corresponds to:

a) a level of 8 dB below the recording level given in footnote to table [b], item b) above, in the case of a tape player or monitor;

b) the minimum source e.m.f. to the input of the system (8 dB below the rated source e.m.f.) in other cases.

The value as shown is not specified for tuners.

In the case of a digital audio source (see footnote to table [g]), it is not necessary to define a minimum output voltage since it is directly related to the rated output voltage.

[d] The value corresponds to:

a) the maximum r.f. input signal level and maximum modulation in the case of tuners. In some countries, FM emissions may exceed the rated maximum system deviation, while in others this is not permitted. AM emissions employing high-efficiency modulation techniques may produce at the receiver an audio output voltage corresponding to an apparent modulation of more than 100 %, up to approximately 150 %;

b) the maximum recording level in the case of a tape player or monitor;

c) the "full scale" level, which is the sinewave signal having positive and negative peak values represented by the digital values of 7FFFH and 8001H in a 16-bit system in the case of a digital audio source (see footnote to table [g]). In the compact disc specification, these values correspond to a maximum (RMS) analogue output voltage of 2 V ± 3 dB;

d) the input of the system when applying the overload source e.m.f. (12 dB above the rated source e.m.f.) in other cases.

[e] In the case of a tape recorder, the value which produces the same intensity of the magnetic field as that of the calibration tape in accordance with IEC 60094-2.

[f] For inputs intended only for the connection of analogue sources, the value is greater than or equal to 2,0 V. For inputs intended for the connection of analogue outputs of digital audio sources (see footnote to table [g]), the value is greater than or equal to 2,8 V.

[g] The digital audio source may be a compact disc (CD) player, a digital audio tape (DAT/DCC) recorder or player, a television receiver with digital sound reception facilities or a receiver for digital audio broadcast (see footnote table [h], below).

[h] For NICAM receivers, the relationship between the levels of alignment level tones transmitted by the broadcasting authorities and the maximum digital coding level, and between the levels of alignment level tones in mono and stereo modes, may vary in different countries. See:

a) EBU Techn. SPB 424 (3rd Ed.)

b) NICAM 728: Specification for two additional digital sound channels with system I television, IBA, BREMA and BBC, London 1988.

8.2.2 Interfaces for professional equipment and consumer equipment where audio and video signals are present on the same connector or cable

Table 3 gives the values for audio signals for professional interfaces. This table does not apply to interfaces for broadcasting equipment. See Table 14.

Table 3 – General purpose values for audio signals for professional interfaces

Output [a]		Input	
	Recommended values		**Recommended values**
Output source impedance	≤1 kΩ	Rated source impedance	1 kΩ
Rated load impedance	10 kΩ [g]	Input impedance	≥10 kΩ
Rated output voltage	0,5 V [b]	Rated source e.m.f.	0,5 V [e]
Minimum output voltage	0,2 V [c]	Minimum source e.m.f. for rated output voltage	0,2 V
Maximum output voltage	2 V [d]	Overload source e.m.f.	≥2,8 V [f]

[a] The output voltages are measured with the rated load impedance connected.

[b] The value corresponds to:

a) an aerial input level of 40 dB (pW) for FM radio tuners, i.e. 0,86 mV across 75 Ω or 1,73 mV across 300 Ω. The modulation factor is 54 %;

an aerial input e.m.f. of 1 mV for AM radio tuners. The modulation factor is 30 %;

a vision carrier input level of 70 dB (μV) for TV sound tuners, having the sound to vision carrier ratio of the relevant television system (see ITU-R BT.1700). The modulation factor is 54 % for both AM and FM.

The modulation factor of the above signals is based on the average modulation factor of the relevant emissions, averaged over at least 15 s;

b) the output of a tape player or monitor, when reproducing a calibration tape in accordance with IEC 60094-2;

c) the output of a digital audio source (see footnote to table [h]), when reproducing a sinewave signal recorded at a level 12 dB below "full scale" (see footnote to table [d], item c) recorded digital signal;

d) a source level equal to the average level of the system in other cases.

[c] The value corresponds to:

a) a level of 8 dB below the recording level given in footnote to table [b], item b) in the case of a tape player or monitor;

b) the minimum source e.m.f. to the input of the system (8 dB below the rated source e.m.f.) in other cases.

The value as shown is not specified for tuners.

In the case of a digital audio source (see footnote to table [h]), it is not necessary to define a minimum output voltage since it is directly related to the rated output voltage.

[d] The value corresponds to:

a) the maximum r.f. input signal level and maximum modulation in the case of tuners. In some countries, FM emissions may exceed the rated maximum system deviation, while in others this is not permitted. AM emissions employing high-efficiency modulation techniques may produce at the receiver an audio output voltage corresponding to an apparent modulation of more than 100 %, up to approximately 150 %;

b) the maximum recording level in the case of a tape player or monitor;

c) the "full scale" level, which is the sinewave signal having positive and negative peak values represented by the digital values of 7FFFH and 8001H in a 16 bit system in the case of a digital audio source (see footnote to table [h]). In the compact disc specification, these values correspond to a maximum (RMS) analogue output voltage of 2 V ± 3 dB;

d) the input of the system when applying the overload source e.m.f. (12 dB above the rated source e.m.f.) in other cases.

[e] In the case of a tape recorder, the value which produces the same intensity of the magnetic field as that of the calibration tape in accordance with IEC 60094-2.

[f] For inputs intended only for the connection of analogue sources, the value is greater than or equal to 2,0 V. For inputs intended for the connection of analogue outputs of digital audio sources (see footnote to table [h]), the value is greater than or equal to 2,8 V.

[g] The rated load impedance should be 1 kΩ for professional applications.

[h] The digital audio source may be a compact disc (CD) player, a digital audio tape (DAT/DCC) recorder or player, a television receiver with digital sound reception facilities or a receiver for digital audio broadcast (see footnote to table [i]).

[i] For NICAM receivers, the relationship between the levels of alignment level tones transmitted by the broadcasting authorities and the maximum digital coding level, and between the levels of alignment level

Output [a]	Input
tones in mono and stereo modes, can vary in different countries. See: a) EBU Techn. SPB 424 (3rd. Ed.) b) NICAM 728: Specification for two additional digital sound channels with system I television, IBA, BREMA and BBC, London 1988.	

8.3 General purpose video input/output

Values for general purpose video input/output are given in Table 4 and in accompanying notes.

Table 4 – General purpose recommended values for video signals

Input/output	Recommended values		
	NTSC	PAL	SECAM
Rated impedance [a]		75 Ω	
Composite video signal [b]	1 V_{p-p} ± 3 dB		
– Y" signal [b, e, f]	1 V_{p-p} ± 3 dB		
– C" signal [c, f]	0,286 V_{p-p} ± 3 dB	0,3 V_{p-p} ± 3 dB	Not applicable
Primary colour (RGB) signal [d]: difference between peak value and blanking level	0,7 V ± 0,1 V [d, f]		
Superimposed DC component	–	0 V to +2 V	

[a] The specified signal voltages should be measured under matched conditions.

[b] Difference between peak white level and synchronizing level. Synchronizing level should comply with ITU-R BT.1700. For the possible effects of non-standard synchronizing level, see IEC 60107-6.

[c] The values given in the table are the standard peak-to-peak amplitudes of the colour reference burst (for NTSC and PAL) and of the unmodulated dB chrominance carrier (for SECAM). The corresponding amplitude for PAL 100/0/100/0 colour bars is 885 mV, and for NTSC 100/7,5/100/7,5 colour bars the amplitude is 835 mV.

[d] For the analogue monochrome signals, the difference between any two primary colour signals and other parameters such as Y and vision colour signal shall not exceed 0,5 dB. The peak values of primary colour signals are those that give rise to a peak white luminance signal.

[e] The Y" signal consists of the composite signal according to ITU-R BT.1700 without the burst and chrominance signals or colour subcarrier.

[f] The permitted tolerances on the component signal levels should not be applied differentially. For example, a degraded picture quality is likely if the Y" signal level is at the minimum limit of tolerance and the C" signal at the maximum limit.

9 Interoperability of microphones and amplifiers

9.1 Microphones (excluding piezoelectric types)

Recommended values for microphones are given in Table 5.

Table 5 – Recommended values for microphones and amplifiers

Microphone	Amplifier	Recommended values		
Output	Input for microphones	Electrodynamic microphones	Electrostatic microphones	
			Professional use air- and electret-dielectric microphones	Consumer use electret microphones
Rated impedance	Rated source impedance	200 Ω	200 Ω	1 kΩ
Rated load impedance	–	1 kΩ	1 kΩ	5 kΩ
–	Input impedance [a]	≥1 kΩ	≥1 kΩ	>5 kΩ
Rated output voltage [b]	Rated source e.m.f.	0,2 mV	2 mV	2 mV
Maximum output voltage [c]	Overload source e.m.f. for broadcasting and sound reinforcement use [c]	0,2 V	5 V	not applicable
Maximum output voltage [d]	Overload source e.m.f. for household use [d]	20 mV	not applicable	200 mV

[a] Impedance values apply over the frequency range 40 Hz to 16 kHz. Input impedance values should be as high as possible and consistent with the desired performance. Inputs of several devices can be connected in parallel when one microphone feeds different devices simultaneously, which can result in degraded microphone performance if the resulting load impedance is too low.

[b] The values given relate to 0,2 Pa sound pressure (SPL = 80 dB (re 20 μPa) sound pressure level). The reference sensitivity values in this table are 1 mV/Pa for electrodynamic microphones and 10 mV/Pa for electrostatic microphones. Effective use of a microphone together with an amplifier depends on the minimum microphone output level being at least 5 dB higher than the inherent noise level of the amplifier, and the maximum microphone output level being no greater than the overload source e.m.f. of the amplifier. Attenuators or gain control circuits may be used in the microphone and the amplifier to achieve the desired dynamic range.

[c] Values given relate to 100 Pa sound pressure (SPL = 134 dB (re 20 μPa) sound pressure level) taking into account a possible microphone sensitivity up to 50 mV/Pa for air and electret-dielectric microphones and up to 2 mV/Pa for dynamic microphones. The requirement for overload source e.m.f. may be met by means of an adjustable attenuator built into the amplifier.

[d] Values given relate to 10 Pa sound pressure (SPL = 114 dB (re 20 μPa) sound pressure level) taking into account a possible 6 dB higher microphone sensitivity. For mains-operated household equipment, the values given for broadcasting and sound reinforcement can be required to avoid overload under extreme conditions.

9.2 Power supply feed for electret microphones fed over a signal conductor (“plug-in power”)

Power supply voltage U = 1,5 V to 5 V.

Feed resistor R = 1 kΩ to 10 kΩ.

Operating bias for unbalanced electret microphones is a positive DC voltage U fed through a resistor R to the signal conductor of the cable leading to the microphone. The signal is decoupled from the supply voltage using a series capacitor or other circuitry in the powering equipment. The negative pole of the supply voltage is connected to the signal return or screen. The precise values of U and R are not critical because current is limited by the characteristics of the field-effect transistor inside the electret microphone element.

NOTE This interface is described in JEITA CP-1203A:2007 with values of U = 2,5 V (+0,5 V, –1,0 V) and R > 1 kΩ.

Short-circuit current should be limited to 3 A.

The marking "PLUG IN POWER" should be visible adjacent to the powered input on the equipment.

Two-channel microphones using this interface are equipped with a three-conductor 3,5 mm concentric connector 60603-11-IEC-35P3, as shown in Figure 3. Single microphones using this interface are equipped with a two-conductor IEC 60603-11 connector, as shown in Figure 2.

Microphones using the IEC 60603-11 connector should be designed so that they are not damaged by being connected to equipment providing power on a separate conductor, such as that described in 9.3.

Single-channel powered inputs may also be wired as shown in Figure 3, with only one audio output used. This will permit most electret microphones designed to be fed by a separate conductor, as described in 9.3, also to function with such inputs.

9.3 Power supply feed for electret microphones fed by a separate conductor ("soundcard power" or "PC power")

Power supply voltage U = 2 V to 5,5 V.

Operating current I = 0,8 mA maximum

Input impedance = 4 kΩ minimum

This requirement applies when use is made of the IEC 60130-9 IEC 20/21 connector in accordance with IEC 60268-11:1987, Table III, as modified by Amendment 2:1991. The supply voltage is positive with respect to screen and return.

Desk-mounted, hand-held or head-worn electret microphones used in computer systems use 60603-11-IEC-35P3 (see IEC type designation in Clause 3 of IEC 60603-11:1992) 3,5 mm, 3-contact concentric connectors with U = 5 V and R = 2,2 kΩ, as shown in Figure 4 Such microphones should be designed so that they are not damaged by being connected with equipment designed for powering over the signal conductor as described in 9.2. U = 5 V is recommended for new designs, but microphones designed for this interface should function with U = 2 V to 5 V. Equipment should not be damaged by application of up to 10 V at the input connector.

Single-channel powered inputs may also be wired as shown in Figure 3, with only one audio output used. This will permit most electret microphones designed to be fed over a signal conductor, as described in 9.2, also to function with such inputs.

9.4 Phantom supply system

9.4.1 General

In the phantom supply system, both signal conductors have the same DC potential with respect to earth. This allows the use of microphone connections either for microphones which do not need a power supply (for example electrodynamic types), or for microphones having a circuit fed from a separate supply. In either case, it is essential that the amplifier to which the microphone is connected has a balanced floating input.

Equipment providing power to microphones using the phantom supply system may be a power supply, or powering circuitry incorporated in other equipment such as mixers and amplifiers. Typically a mixer or amplifier will include phantom powering on some or all of its inputs, which are referred to as "powered inputs."

9.4.2 Supply voltage polarity

The positive pole of the supply voltage shall be connected to the electrical centre of the signal conductors, the negative pole to the earth or return conductor, which may be the screen of the cable.

9.4.3 Circuit diagram

A typical circuit diagram for connection and power supply is given in Figure 5. The resistors R_1 and R_2 shall be within 10 % of their rated value, and shall be matched to within no more than 0,4 %. Closer matching may be required to achieve the desired immunity from electromagnetic interference. The microphone should draw current symmetrically from the two conductors of the phantom powering system. The difference between the current in the two conductors should be less than 0,8 %.

Table 6 gives the required values for voltage and current and typical values for R_1 and R_2. Instead of the resistors and/or transformers shown in the diagrams, other circuit components may be used, provided that the voltage and current requirements given in Table 6 are met, and that the balance of the circuit is not disturbed. A centre-tapped transformer fed via a series resistor may be used.

The use of values different from those of Table 6 may be preferred to fulfil the needs of special applications having wide dynamic range, or for power saving requirements. However, the connection of microphones designed for previously standardized phantom powering values may result in malfunction or even damage. Therefore, powered inputs using different values from those in Table 6 shall be adequately marked, and sufficient information in the specifications and operating manual shall be provided. A description of two alternate powering methods and recommendations for their use is given in Annex B.

9.4.4 Value of the supply voltage

Although 12 V and 24 V systems are still in use, P48 systems should be used for new developments.

9.4.5 Supply current

Microphones using the phantom supply system shall be designated to operate on one or more of the voltages shown in Table 6. When connected, a microphone shall consume no more than the maximum current listed. For best efficiency, microphones should be designed to consume no more than the rated current listed in Table 6, as this value results in the maximum amount of power being delivered to the microphone.

Equipment supplying power to microphones using the phantom supply system shall produce at least the rated current listed in Table 6, for each powered input to which a microphone can be connected. When microphones drawing the rated current are connected to all inputs of a device simultaneously, the voltage at any one input shall remain within the supply voltage limits when a microphone drawing the rated current is connected to or disconnected from any other input. When a microphone is connected or disconnected from a powering device, performance shall not be degraded for signals from other microphones powered by that device.

9.4.6 Marking

The supply voltage shall be marked on microphones and powering equipment using the designations from Table 6.

If a microphone is designed to operate on more than one supply voltage, this should be indicated by suitable marking, for example P48/12.

If a device supplying power using the phantom supply system is not capable of supplying the rated voltage and current to all powered inputs simultaneously, it shall be indicated by a suitable marking, for example "P48 maximum current xx mA."

Devices supplying power using values other than in Table 6 shall be marked with a suitable caution symbol and a designation as described in Annex B.

9.5 A-B supply system

9.5.1 General

In the A-B supply system, the supply current flows through the signal conductors a and b only (see Figure 6). Care should be taken to avoid incorrect operation by switching off the power supply before connecting microphones which do not need a DC power supply (for example dynamic types). If not built into the amplifier, suitable series capacitors shall be inserted in order to avoid DC magnetization of the input transformer.

9.5.2 Output impedance of the microphone

The output impedance of the microphone shall not exceed 200 Ω within the effective frequency range (40 Hz to 16 kHz).

9.5.3 Circuit diagram

The circuit diagram for connection and power supply is given in Figure 6. The resistors R_1 and R_2 shall be within 10 % of the rated value, but if the power supply is connected to earth (see 9.5.4), they shall be matched to within 1 %.

Table 7 gives the required values for voltage and current and typical values for R_1 and R_2.

Instead of the resistors shown in the diagrams, other components may be used, provided they have the equivalent DC resistance.

9.5.4 Connection of the power supply to earth

The positive pole A or the negative pole B may be connected to earth.

9.5.5 Marking

Microphones for A-B supply shall be marked with the letters AB.

9.6 Polarity of the audio frequency voltage

An inward movement of the microphone diaphragm (a positive instantaneous sound pressure) shall produce a positive instantaneous voltage on pin 2 (with respect to pin 3) of the connector wired according to IEC 60268-12, or on pin 1 (with respect to pin 3) of the connector wired according to IEC 60268-11.

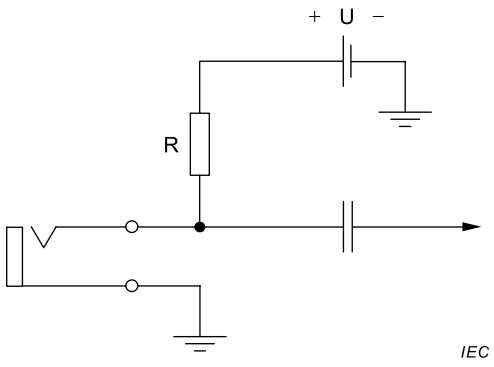


Figure 2 – Example of plug-in power system for a single microphone

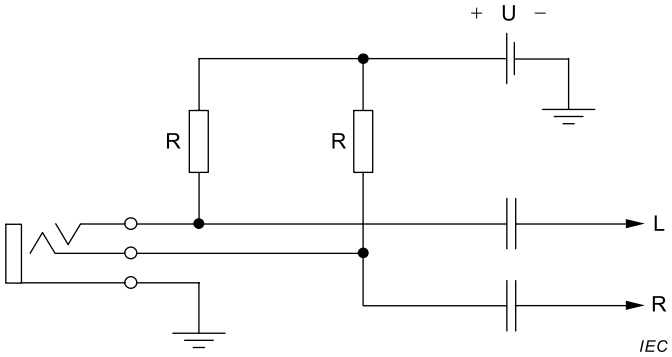


Figure 3 – Example of plug-in power system for a two-channel microphone

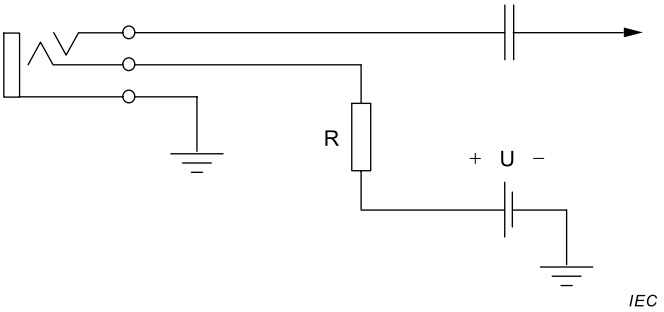


Figure 4 – Example of soundcard power system

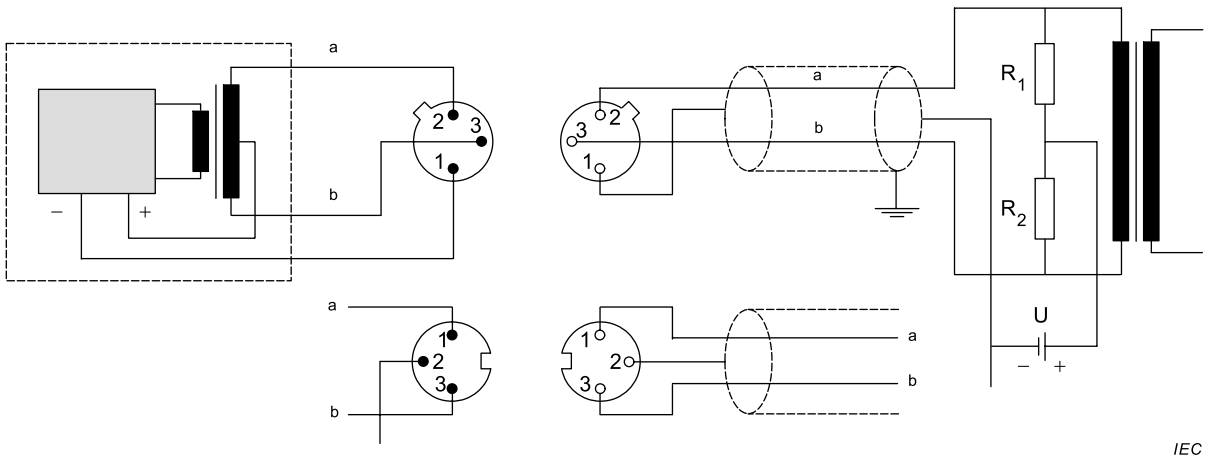


Figure 5 – Example of phantom power supply system

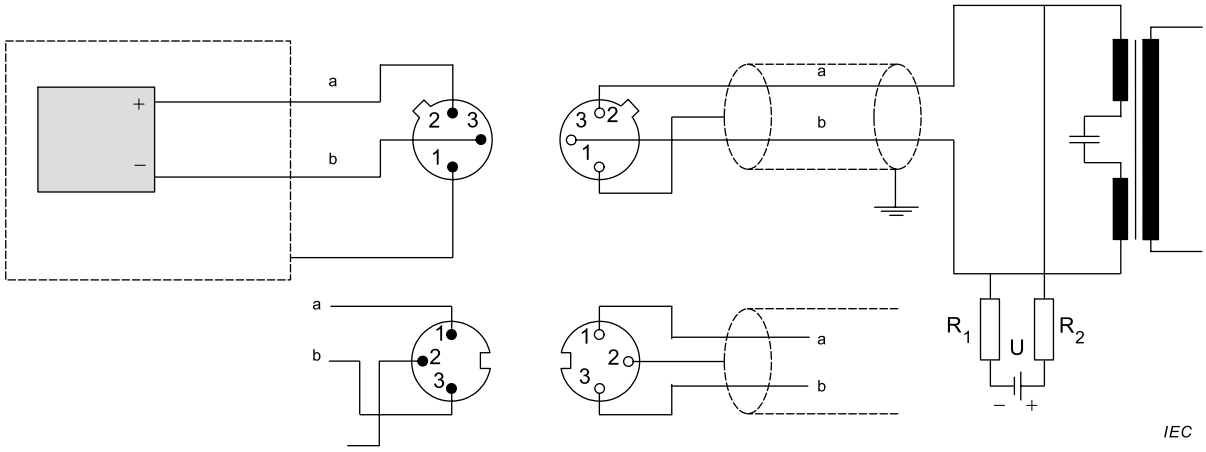


Figure 6 – Example of A-B power supply system

Table 6 – Required values for phantom supply systems

Designation	P12	P24	P48
Supply voltage U	12 V ± 1 V	24 V ± 4 V	48 V ± 4 V
Supply current I	Maximum 15 mA	Maximum 10 mA	Maximum 10 mA
Rated supply current	15 mA	10 mA	7 mA
R_1 and R_2 (typical values)	680 Ω	1,2 kΩ[a]	6,8 kΩ
[a] Equipment fitted with 1,2 kΩ resistors is not compatible with some types of microphone designed for 12 V operation. These microphones require resistors of at least 2,4 kΩ with a 24 V supply.			

Table 7 – Required values for A-B power supply systems

Supply voltage U	12 V ± 1 V
Supply current I	Maximum 15 mA
R_1 and R_2	180 Ω

10 Interoperability of record-playing units (pick-ups) and amplifiers

Recommended values for analogue record playing units and amplifiers are given in Table 8.

Table 8 – Recommended values for analogue record-playing units and amplifiers

Pick-up			Amplifier		
Output	Recommended values		Input for pick-up	Recommended values	
	Velocity sensitive			Velocity sensitive	
	High	Low		High	Low
Rated impedance	To be stated by the manufacturer		Rated source impedance	Series equivalent resistance: 2,2 kΩ The series equivalent inductance is also important	10 Ω

Rated load impedance	47 kΩ 420 pF [c]	100 Ω	Input impedance	47 kΩ in parallel with 220 pF	100 Ω
Rated output voltage [a]	5 mV	0,3 mV	Rated source e.m.f.	5 mV	0,3 mV
			Minimum source e.m.f. for rated output voltage	2,0 mV	0,12 mV
Maximum output voltage [b]	35 mV	2,8 mV	Overload source e.m.f.	≥35 mV	≥2,8 mV

[a] The values are related to a velocity of 7 cm/s and the lower sensitivity limits footnote to table [d] below.

[b] The values are related to a velocity of 17,5 cm/s and the upper sensitivity limits given in the remark above. The maximum output voltage values can be expected in the mid-frequency range between about 700 Hz and 3 000 Hz.

[c] This value is based on a parallel capacitance of 200 pF for the record-playing unit and its connecting cable, and 220 pF input capacitance of the amplifier.

[d] To determine the e.m.f. values given in the table, the following sensitivity ranges for pick-ups have been taken into account:

– high output: 0,7 mV/cm/s to 2 mV/cm/s;

– low output: 0,04 mV/cm/s to 0,16 mV/cm/s.

High output pick-ups are usually of the moving magnet type and low output pick-ups are usually of the moving coil type.

11 Interoperability of loudspeakers and amplifiers

11.1 Single unit loudspeakers

The following values of rated impedance for single unit loudspeakers should be: 4 Ω, 6 Ω, 8 Ω and 16 Ω.

11.2 Loudspeaker systems

11.2.1 Loudspeakers with built-in amplifier

A loudspeaker system with a built-in amplifier shall be considered as a power amplifier. The values given in the right-hand part of Table 12 apply.

11.2.2 Impedance-defined loudspeaker systems

Recommended values for impedance defined loudspeaker systems are given in Table 9.

Table 9 – Recommended values for impedance-defined loudspeaker systems

Amplifier	**Loudspeaker systems**	**Recommended values**			
Output for loudspeakers	**Input**				
Output source impedance	–	<1/10 the rated load impedance over the rated frequency range			
Rated load impedance	Rated impedance	4 Ω	6 Ω	8 Ω	16 Ω
Specifications of values of impedance may be extended to cover the frequency range 2 Hz to 200 kHz, if required.					

For electrostatic and piezoelectric loudspeakers, the rated impedance shall represent the impedance for correct interconnection, taking into consideration the capacitive character of the load presented to the amplifier.

11.2.3 Constant voltage loudspeaker systems

Recommended values for voltage defined loudspeaker systems are given in Table 10.

Table 10 – Recommended values for constant voltage loudspeaker systems

Amplifier	Loudspeaker systems	Recommended values				
Output for loudspeakers	Input					
Rated output voltage	–	25 V	35 V	50 V	70 V	100 V
–	Rated voltage	–	–	50 V	70 V	100 V
Output source impedance		<1/10 of the rated impedance over the rated frequency range				

The lower voltages in the table apply for the common practice of using a larger number of these loudspeakers at reduced power, each loudspeaker covering a smaller area.

NOTE The rated load impedance Z is calculated from the rated output power P of the amplifier and the line voltage V as given by $Z = V^2/P$.

The range of voltages may be extended to higher values for amplifiers designed for long distance distribution of power to a network of loudspeakers, for example, for line broadcasting in residential quarters from a central amplifying station.

11.3 Voltage (or power) interoperability of amplifiers and loudspeakers

11.3.1 Overview

In order to achieve optimum interoperability of amplifiers and loudspeakers, with regard to the intended conditions for use, the following characteristics are specified.

a) Short-term maximum output voltage and power of an amplifier: see IEC 60268-3.

b) Short-term maximum input voltage and power of a loudspeaker: see IEC 60268-5.

c) Long-term maximum output voltage and power of an amplifier: see IEC 60268-3.

d) Long-term maximum input voltage and power of a loudspeaker: see IEC 60268-5.

11.3.2 Interoperability requirements

The interoperability requirements depend on the condition of operation of the equipment as follows.

In the case of

a) low probability of incorrect operation leading to clipping of the amplifier (e.g. most hi-fi applications), and where the short-term and the long-term output voltages or powers of the amplifier differ by more than 3 dB:

   – the short-term input voltage or power of the loudspeaker shall be greater than or equal to the short-term output voltage or power of the amplifier;

   – the long-term input voltage of the loudspeaker shall be greater than or equal to one-half of the long-term output voltage of the amplifier;

   NOTE 1 This implies that the long-term input power of the loudspeaker is greater than one quarter of the long-term output power of the amplifier.

b) low probability of incorrect operation leading to clipping of the amplifier (e.g. most hi-fi applications), and where the short-term and the long-term output voltages or powers of the amplifier are not substantially different (less than 3 dB):

– the long-term input voltage of the loudspeaker shall be greater than or equal to one-half of the long-term output voltage of the amplifier;

NOTE 2 This implies that the long-term input power of the loudspeaker is greater than one quarter of the long-term output power of the amplifier.

c) significant probability of clipping in the amplifier, (e.g. sound reinforcement and household use) but acoustic feedback or other types of oscillation are not taken into account:

– the long-term input voltage or power of the loudspeaker shall be greater than or equal to the long-term output voltage or power of the amplifier.

11.4 Polarity of the sound pressure

A positive instantaneous voltage at pin 1 with respect to pin 2 of the connector, according to IEC 60268-11, shall produce an outward movement of the loudspeaker diaphragm (a positive instantaneous sound pressure).

12 Interoperability of headphones and amplifiers

12.1 General

Headphones in stationary applications are mostly used for only a few hours per week, and with programme material having a high dynamic range. In outside portable applications, mostly body-worn equipment is used, and it may be operated for several hours every day. The requirements for these two usage conditions differ so much that separate specifications are necessary, both for interoperability and with regard to hearing protection.

12.2 Interoperability of headphones with stationary amplifiers

This output is designed to produce, as far as possible, a constant sound pressure level in the headphones for a given setting of the volume control, irrespective of the impedance of the headphones over the range 8 Ω to 2 000 Ω. The recommended values are given in Table 11.

Electrostatic headphones equipped with matching units should also comply with the requirements of this subclause. Other types of electrostatic headphones are not covered by this document.

Table 11 – Recommended values for headphones and amplifiers in stationary applications

Amplifier		Headphones	
Output for headphones	**Recommended values**	**Input from amplifier**	**Recommended values**
Output source impedance [a]	120 Ω	Rated source impedance [a]	120 Ω
Rated load impedance	8 Ω to 2 000 Ω	Rated impedance	16 Ω, 32 Ω, 64 Ω, 200 Ω, 600 Ω [d]
Rated source e.m.f.	5 V maximum [b, c]	Rated input voltage (see IEC 60268-7)	5 V

Specifications of values of impedance may be extended to cover the frequency range 2 Hz to 200 kHz, if required.

[a] For most types of headphones, the source impedance has very little effect on the performance.

[b] For equipment having a low supply voltage, it may not be possible to produce 5 V. If the rated output voltage is less than 5 V, the ability to operate with high impedance headphones is restricted.

[c] The 5 V (RMS) represents a maximum signal voltage, on peaks of programme level. Signals at this voltage should not be clipped.

[d] The interface is also satisfactory for headphones with rated impedance between 8 Ω and 2 000 Ω.

12.3 Interoperability of portable audio headphones/earphones and portable audio equipment

12.3.1 General

Subclause 12.3 specifies recommended values for portable audio headphones/earphones and portable audio equipment.

12.3.2 Portable audio headphones/earphones

Headphones/earphones which are intended to be used with battery operated audio equipment and to be mainly used for listening to music outdoors. The actual design is mostly of supra-aural type, intra-concha type, supra-concha type or insert type, however, also other solutions are in use. The main feature of all these headphones is their small size. Relevant characteristics of headphones are described in IEC 60268-7.

12.3.3 Portable audio equipment

The following pieces of equipment are included:

– portable, mostly body-worn players that operate with low DC energy sources;

– small audio equipment used with earphones, used mainly for listening to music outdoors; and

– DC operated players with separate AC adapters.

NOTE The call function of mobile phones with music players is not included, however, the music player function is included.

12.3.4 Recommended values and input/output values for portable audio headphones/earphones and portable audio equipment

Portable audio pieces of equipment have a wide range of impedances. Long operating cycles require that any unnecessary power losses be avoided, e.g. by too high resistive source impedances. Very low source impedances lead to a constant signal voltage, but they also lead to a wider signal power variation than specified for stationary equipment. On the other hand, high resistive source impedances lead to a constant signal power, as specified for stationary equipment, but these source impedances lead to wider signal voltage.

To avoid dangerous sound levels it is important to evaluate the maximum sound pressure level, i.e. LA_{eqmax}, for every combination of portable audio headphones/earphones and portable audio equipment. Furthermore, it is preferable to let headphones be driven with a constant voltage when the maximum sound pressure level is defined in future.

In consideration of the above-mentioned issues, the recommended values are stated in Table 12.

Table 12 – Recommended values for portable audio headphones/earphones and portable audio equipment

Portable audio equipment		Portable audio headphones/earphones	
Output for headphones	**Values**	**Input from amplifier**	**Values**
Output source impedance	≤120 Ω [a]	Rated source impedance	≤120 Ω
Rated load impedance	16 Ω to 64 Ω	Rated impedance	16 Ω, 32 Ω, 64 Ω [d]
Rated source e.m.f.	Under consideration [b, c]	Rated input voltage	Under consideration [e]

Specifications of values of impedance may be extended to cover the frequency range 2 Hz to 200 kHz, if required.

[a] Portable audio equipment has a wide range of impedances. For output source impedances, a value of 2 Ω or less is recommended.

[b] The value to define safety limits is discussed in IEC TC 108 for the future edition of IEC 62368.

[c] The measurement procedure is given below:

The measurement signal shall be a simulated programme signal in accordance with IEC 60268-1. This simulated programme signal shall have a crest factor ranging between 1,8 and 2,2. The value shall be defined as unweighted true RMS voltage at the load resistance. As well as this value, the maximum output voltage V_{max} is defined as follows. All volume and tone controls of the players shall be adjusted to the maximum output voltage during tests. Player output shall be loaded with a resistive load of 16 Ω, 32 Ω and 64 Ω.

[d] The interface is also satisfactory for headphones with rated impedance between 16 Ω and 64 Ω.

[e] The value is same as the rated source e.m.f.

For reference purposes:

The maximum sound pressure level LA_{eqmax} can be calculated as follows:

$$LA_{eqmax} = 94 + 20\lg(V_{max}/V_{emf})$$

where

V_{max} is the maximum output voltage (see footnote to table [c]);

V_{emf} is the simulated programme signal characteristic voltage corrected by A-weighting characteristics and free-field response compensation (see IEC 60268-7:2010, 8.3.5).

13 Interoperability of amplifiers with other amplifiers

13.1 Pre-amplifiers and power amplifiers for general purpose and sound reinforcement

Recommended values for pre-amplifiers and power amplifiers are given in Table 13.

Table 13 – Recommended values for pre-amplifiers and power amplifiers

Pre-amplifier		Power amplifier [a]	
Output	**Recommended values**	**Input for pre-amplifier**	**Recommended values**
Output source impedance	≤1 kΩ	Rated source impedance	1 kΩ
Rated load impedance	10 kΩ [b]	Input impedance	≥10 kΩ
Rated output voltage [c]	1 V	–	–
–	–	Minimum source e.m.f. for rated output voltage	1 V
Rated distortion limited output voltage	≥3 V	–	–

Specifications of values of impedance may be extended to cover the frequency range 2 Hz to 200 kHz, if required.

[a] For power amplifiers which have no volume controls, the rated source e.m.f. is identical to the minimum source e.m.f. for rated output voltage and the overload source e.m.f. does not apply.

Power amplifiers, however, may be provided with a volume control. In this case, the overload source e.m.f. should be ≥8 V.

[b] The rated load impedance shall be 1 kΩ for pre-amplifiers for sound reinforcement. This permits up to 10 power amplifiers to be fed in parallel.

[c] Applying the relevant minimum source e.m.f. for rated output voltage to the input of the pre-amplifier, with the gain control at maximum.

13.2 Broadcast and similar line amplifiers

Recommended values for broadcast and similar line amplifiers are given in Table 14.

Table 14 – Recommended values for broadcast and similar line amplifiers

Input	Recommended values	Output	Recommended values
Rated source impedance	0 Ω to 300 Ω	Output source impedance	0 Ω to 50 Ω between 10 Hz and 22,4 kHz
Input impedance	≥10 kΩ between 10 Hz and 22,4 kHz	Rated load impedance	600 Ω in parallel with 22 nF
Rated source e.m.f.	1,95 V +8 dB (0,775 V)	Normal working output voltage	1,95 V +8 dB (0,775 V)
Overload source e.m.f.	3,88 V +14 dB (0,775 V)	–	–
Unbalance	≤−50 dB (22,4 Hz to 10 kHz)	–	–

Inputs and outputs should be free of sharp peaks or dips in impedance between 10 Hz and 100 kHz in order to avoid undue sensitivity to electromagnetic interference. Care should be taken that all inputs are protected from radio frequency interference caused by shield-current induced noise, using e.g. the recommendations of AES48.

Annex A
(informative)

Pairing and screening of conductors

Interconnections between equipment can create unwanted paths for magnetic and electromagnetic interference to enter conductive equipment enclosures causing degradation of performance, and unwanted paths for coupling of signals from one conductor to another. When it is necessary to reduce such interference, twisted pairs should be used for balanced signals, and for unbalanced signals carrying current of more than about 100 mA, such as loudspeaker wiring. Coaxial cable should be used for other unbalanced signals.

Twisted pairs and coaxial cables reduce the external fields generated by current flowing in the conductors, and by reciprocity reduce the sensitivity of these conductors to pick up such magnetic and electromagnetic fields.

The use of multi-pair cables, incorporating pairs twisted at different rates, is recommended for best immunity to crosstalk and interference.

Screening of paired conductors is of far less importance than twisting. When a paired conductor is provided with a screen, wire braid is preferred over metallic foil for reasons of ruggedness and balance, and to minimize the resistance of the screen.

Annex B
(informative)

Phantom power variants for specialized applications

The requirements for most microphone applications can be met using one of the interface variants described in this document. However, in some cases the amount of power provided to a microphone may be insufficient to permit the microphone to drive long cables without distortion. In other cases, equipment such as intercoms may be more efficiently made using lower current powered inputs. Standardized phantom power variants are listed in Table 6. Two variants have been defined as options to meet lower and higher requirements.

P12L is the designation for a specialized lower power interface intended for intercoms. Users of this variant should comply with the definitions of P12 and all other applicable parameters of this document, except that supply current I is 8 mA maximum, rated supply current is 4 mA, and typical values for R_1 and R_2 are 3,3 kΩ. Interfaces using this variant should use a connector having 4 or more contacts to avoid inadvertent connection with incompatible equipment.

SP48 is the designation for a specialized interface intended for microphones that require more power than is provided by the normal P48 interface, to produce extended dynamic range, particularly when driving long cables. Users of this variant should comply with the definitions of P48 and all other applicable parameters of this document, except that the supply current I and rated current are both 22 mA maximum, and typical values for R_1 and R_2 are 2,2 kΩ. Microphones using this variant should function when connected with P48 powering, but provide improved performance when connected with a powered input providing SP48 power. Technical data should include characteristics for P48 and SP48 operation.

Equipment with powered inputs using SP48 should also be switchable to provide P48 powering for use with microphones not rated for SP48. Most microphones designed for P48 will also function with SP48, but some models may malfunction or even be damaged. Suitable marking should be included near the powered input, such as "Use only with microphones rated for SP48" and the ISO 7000-0434B:2004, "Caution" symbol shown in Figure B.1.

ISO 7000-0434B-2004-01

Figure B.1 – Caution symbol

Suitable warnings should also be given in the manual, cautioning users of the equipment against use of SP48 with microphones not designed for the additional current.

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