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INTERNATIONAL STANDARD

Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics –
Part 1: General

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AUDIO AND AUDIOVISUAL EQUIPMENT – DIGITAL AUDIO PARTS – BASIC MEASUREMENT METHODS OF AUDIO CHARACTERISTICS –

Part 1: General

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International Standard IEC 61606-1 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2003. It constitutes a technical revision.

The significant technical changes with respect to the first edition are the following:

- changed the period of preconditioning;
- add A weighting filter in measuring instruments;
- correct the wrong reference number;
- some inappropriate descriptions have been improved.

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

FDIS	Report on voting
100/1547/FDIS	100/1581/RVD

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

A list of all parts of the IEC 61606 series, under the general title *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics*, can be found on the IEC website.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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

AUDIO AND AUDIOVISUAL EQUIPMENT – DIGITAL AUDIO PARTS – BASIC MEASUREMENT METHODS OF AUDIO CHARACTERISTICS –

Part 1: General

1 Scope

This part of IEC 61606 is applicable to the basic methods of measurement of the audio characteristics of the digital audio part of audio and audiovisual equipment for all of consumer use, professional use and personal computer.

The common measuring conditions and methods, described in this standard, are used for the measurement of the performance characteristics of equipment having an audio bandwidth equal to approximately one-half of the sampling frequency of a system, where the audio information is processed in the form of digital data. CD players, DAT recorders, digital amplifiers, digital sound broadcast receivers and television broadcast receivers with digital sound are examples.

This standard describes test methods for equipment which has digital input with analogue output and analogue input with digital output. Future revisions of this standard will cover digital-in/digital-out and analogue-in/analogue-out tests.

This standard does not apply to a lossy compression signal and also does not apply to power amplifiers.

NOTE 1 A digital audio system having an analogue input and an analogue output with digital signal processing may have different characteristics from those of a pure analogue audio system due to sampling of the audio signal and performance of incorporated A/D and D/A converters. Measurement methods described in IEC 60268-3 may not give correct results when applied to a digital system.

NOTE 2 The methods described are mostly based on sampling frequencies of 32 kHz and higher.

NOTE 3 For tests of those systems of digital-in – digital-out, and analogue-in – analogue-out tests, refer to AES17.

NOTE 4 This standard is planned to harmonize with the first edition of IEC 61606 (1997)[1], AES17 and EIAJ CP-2i50.

2 Normative references

The following referenced documents are indispensable for the application 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 60107-5, *Recommended methods of measurement on receivers for television broadcast transmissions – Part 5: Electrical measurements on multichannel sound television receivers using the NICAM two-channel digital sound system*

1 IEC 61606:1997, *Audio and audiovisual equipment – Digital audio parts – Basic methods of measurement of audio characteristics* (this publication has been replaced by the IEC 61606 series)

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

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

IEC 60958 (all parts), *Digital audio interface*

IEC 61606-2, *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 1: Consumer use*

IEC 61606-3, *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 3: Professional use*

IEC 61606-4, *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 4: Personal computer*

IEC 61079-4, *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band – Part 4: Electrical measurements on sound/data decoder units for the digital subcarrier NTSC system*

IEC 61079-5, *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band – Part 5: Electrical measurements on decoder units for MAC/packet systems*

IEC 61672-1, *Electroacoustics – Sound level meters – Part 1: Specifications*

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

ITU-R BS 468-4, *Measurement of audio-frequency noise voltage level in sound broadcasting*

AES17, *AES standard method for digital audio engineering – Measurement of digital audio equipment*

3 Terms, definitions, explanations and rated values

3.1 Terms and definitions

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

3.1.1
aliasing components
output frequency components below the folding frequency made from the input signal above the folding frequency

3.1.2
analogue full-scale amplitude
nominal signal level at the analogue input of an EUT corresponding to the digital full-scale level

3.1.3
coding format
series of data bit stream with control information in accordance with the standard for which the EUT is designed, such as IEC 60958, IEC 61883-6 or some kind of AV interface

NOTE A coding word is arranged as a 2’s complimentary binary form in this standard.

3.1.4
digital audio signal
series of digital signals expressed by sampled data

NOTE This data is constructed with LPCM (Linear Pulse Code Modulation) data.

3.1.5
digital interface for measurement
type of input or output digital interface which is used for measurement, such as IEC 60958, IEC 61883-6 or some kind of AV interface

NOTE Details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use).

3.1.6
digital signal generator
all types of digital generators, which including digital sine signal generators or package media or RF signal generators

3.1.7
digital zero
signal that has a value consisting of all zeroes for all samples

3.1.8
equipment under test
EUT
equipment to be measured using the methods described in this standard

3.1.9
folding frequency
one half the sampling frequency of the digital system

NOTE Signals applied to the input with frequency components higher than this frequency are subject to aliasing.

3.1.10
full-scale level
FS
signal level of a sine wave whose positive peak value reaches the positive digital full scale, leaving the negative maximum code unused

EXAMPLE The largest positive value is 7FFFH and the largest negative value is 8001H in 16 bit data.

3.1.11
in-band frequency range
frequency range from 4 Hz to upper band-edge frequency (see 3.1.19).

3.1.12
jitter
deviation of the timing of the transitions of a clock signal from their ideal or nominal times

3.1.13
normal load impedance
impedance which is connected to output terminals of EUT

NOTE The concrete value is defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use).

3.1.14
normal measuring level
signal level equal to –20 dB_{FS}

3.1.15
normal source impedance
impedance which is connected to input terminals of EUT

NOTE The concrete value is defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) IEC 61606-4 (PC use).

3.1.16
out-of-band frequencies
frequency range from folding frequency to 500 kHz.

NOTE Signals applied to the input in this frequency range are subject to aliasing.

3.1.17
sampling frequency
$\boldsymbol{f_s}$
number of samples of a signal taken per unit time

3.1.18
signal level
$\mathbf{dB_{FS}}$
result obtained from the following equation:

$$\text{signal level } (\text{dB}_{FS}) = 20 \log_{10} (A/B)$$

where A is the r.m.s. value of the signal whose level is to be determined, and B is the r.m.s. value of a sine wave which corresponds to full-scale level in digital data or to analogue full-scale level in analogue signals

3.1.19
upper band-edge frequency
frequency calculated by the equation:

$$f_s \times 0{,}46$$

NOTE If f_s is higher than 44,1 kHz, the manufacturer may define the upper band-edge frequency between 20 kHz and f_s × 0,46. In this case, the upper band-edge frequency should be stated in the system description by the manufacturer.

3.1.20
word length
number of bits of a data element

NOTE The least significant bit of the data element should not be ignored.

3.2 Explanation of term "jitter"

The performance of conversion processes are potentially affected by jitter present on the synchronization input, the digital audio inputs, or both. For example, if the sampling clock for the analogue-to-digital converter inside the EUT is derived from or locked to either the synchronization input or a digital audio input, jitter present on that input can degrade conversion accuracy.

There are various types of jitter susceptibility to be considered such as analogue-to-digital jitter susceptibility, digital-to-analogue susceptibility, and digital-to-digital susceptibility. See AES17 for detailed discussion on the subject.

3.3 Rated values

For a full explanation of these terms, see IEC 60268-2. The following are rated conditions for digital audio equipment and should be specified by the manufacturer:

- rated supply voltage;
- rated supply frequency;
- rated pre-emphasis and de-emphasis characteristics;
- rated digital input word length;
- rated sampling frequencies.

4 Measuring conditions

4.1 Environmental conditions

Air pressure	96 kPa ± 10 kPa
Ambient temperature	15 °C to 35 °C
Relative humidity	60 % ± 15 %

4.2 Power supply

4.2.1 Supply voltage

The rated power supply voltage, as specified in IEC 60038, shall be used. The tolerance of the supply voltage should be ±1 % or less. A tolerance of up to ±10 % may be allowed if the results of the measurements are not noticeably affected.

4.2.2 Frequency(ies)

The power supply frequency(ies) specified by the manufacturer shall be used. The tolerance of the frequency should be ±2 % or less. A d.c. power supply may be used if specified.

4.2.3 High-frequency and harmonic components (or ripples) in the power supply output

High-frequency components in the power supply output should be less than the level which affects the result of measurement.

4.3 Test signal frequencies

The frequency of the test signal shall be selected from the actual values in Table 1. In catalogues and other documents, where precision is not required or implied in the description, it is permitted to use the normal figures shown in Table 1. Unless otherwise specified, the reference frequency for measurements shall be 997 Hz, which may be stated in non-critical contexts, as 1 kHz.

Table 1 – Actual frequencies used in the measurement

Nominal Hz	Actual frequency Hz						
	f_s = 32 kHz	f_s = 44,1 kHz	f_s = 48 kHz	f_s = 88,2 kHz	f_s = 96 kHz	f_s = 176,4 kHz	f_s = 192 kHz
4	4	4	4	4	4	4	4
8	7	7	7	7	7	7	7
16	17	17	17	17	17	17	17
32	31	31	31	31	31	31	31
63	61	61	61	61	61	61	61
125	127	127	127	127	127	127	127
250	251	251	251	251	251	251	251
500	499	499	499	499	499	499	499
1 000	997	997	997	997	997	997	997
2 000	1 999	1 999	1 999	1 999	1 999	1 999	1 999
4 000	3 997	3 997	3 997	3 997	3 997	3 997	3 997
8 000	7 993	7 993	7 993	7 993	7 993	7 993	7 993
10 000	10 007	10 007	10 007	10 007	10 007	10 007	10 007
12 000	12 503	-	-	-	-	-	-
14 000	13 999	-	-	-	-	-	-
14 500	14 501	-	-	-	-	-	-
16 000	-	16 001	16 001	16 001	16 001	16 001	16 001
18 000	-	17 997	17 997	-	-	-	-
20 000	-	19 997	19 997	19 997	19 997	19 997	19 997
22 000	-	-	22 001	-	-	-	-
30 000	-	-	-	30 011	30 011	-	-
35 000	-	-	-	34 981	34 981	-	-
40 000	-	-	-	40 009	40 009	40 009	40 009
44 000	-	-	-	-	43 997	-	-
50 000	-	-	-	-	-	49 999	49 999
70 000	-	-	-	-	-	70 001	70 001
80 000	-	-	-	-	-	79 999	79 999
88 000	-	-	-	-	-	-	88 001

If a sweep signal is used in the measurement, the sweep frequency range is from 16 Hz to $1/2 \times f_s$.

4.4 Standard setting

4.4.1 Standard input conditions for the EUT

4.4.1.1 Analogue input

Connect the EUT with the source equipment which has normal source impedance.

4.4.1.2 Digital input

Connect the EUT to the digital interface, for which the EUT is designed.

4.4.1.3 RF input

See IEC 60107-5, IEC 61079-4 and IEC 61079-5.

4.4.2 Standard output conditions for the EUT

4.4.2.1 Analogue output

Analogue output terminals which are connected to subsequent equipment shall be terminated with the normal load impedance.

4.4.2.2 Digital output

Digital audio output terminals shall be terminated in a manner appropriate to the output interface format.

4.4.3 Standard setting of controls

The following settings apply.

a) Each channel of the EUT is set to the standard input and output conditions.

b) Setting of level controls

   For analogue-in/digital-out devices:
   When a sinusoidal input signal of 997 Hz and the normal measurement level is applied to the input terminals of the EUT, adjust the level control so as to obtain the normal measurement level across the digital output. If the EUT has no digital output terminal and it only records the data to recording media, adjust the level control so as to record the normal measurement level into the recording media.

   For digital-in/analogue-out devices:
   When a sinusoidal signal of 997 Hz and the normal measurement level is applied to the digital input terminal of the EUT, adjust the level control so as to obtain an analogue output signal at the normal measurement level across the analogue output terminals with a normal load impedance.

   The level control shall be set to the maximum position if the output level cannot come to the normal measurement level.

c) If the EUT is equipped with a balance control, it shall be set to the centre position.

d) Setting of the pre-emphasis and de-emphasis:
   If pre-emphasis and/or de-emphasis are optional then they shall be turned off, if possible. If results with pre-emphasis or de-emphasis are required for the measurement, these shall be stated separately and the emphasis characteristics used shall be stated with the results.

e) Setting of other controls:
   The tone controls, inter-channel balance controls and others shall be set to the positions specified by the manufacturer, so that the EUT has a flat frequency response. The loudness control and the filters shall be turned off, if possible. If this is not possible, this shall be stated with the results. The condition of any other controls that can affect the audio signal shall be stated with the result.

4.5 Preconditioning

The equipment shall be connected under normal operating conditions for the manufacturer-specified preconditioning period prior to any measurements being performed. This condition is intended to allow the equipment to stabilize. If no preconditioning period is specified by the manufacturer, a one hour period shall be assumed. Should operational requirements preclude preconditioning, the manufacturer shall state so.

Should power to the equipment be interrupted during the measurement, sufficient time shall be allowed for restabilization to be realized.

4.6 Measuring instruments

4.6.1 General

All of analogue measuring instruments are applicable up to a 20 bit system because the lowest signal level of a 24 bit system such as quantization noise is lower than thermal noise which is caused by input impedance of analogue measuring instruments.

Definitions given in this standard are elementary functions of measuring instruments.

Then these definitions can be applied not only to a discrete measuring instrument but also to a combined measuring instrument.

If input impedance of instruments which are ready to use don't conform to the definition of this clause, a register may be used to connect across the input terminals to get the right value.

4.6.2 Signal generator

4.6.2.1 Single sine wave generator

4.6.2.1.1 Analogue signal generator

Output impedance: normal source impedance

Frequency error: less than ±2 %

Output signal level: up to 3 dB over the analogue full-scale amplitude

Distortion: distortion of the signal generator shall be less than a level which does not affect the performance of EUT

4.6.2.1.2 Digital sine signal generator

The digital signal generator shall be able to supply coding format of digital audio signal. A signal is calculated from ideal sine wave form.

Output interface format: digital interface for measurement

Frequency error: error is less than $1/f_s$

Output signal level: from zero level to full-scale level

Error accuracy: better than 1/2 LSB

4.6.2.2 Signal generator for inter-modulation measurement

A generator for inter-modulation measurement shall generate the two-tone signal, composed of 60 Hz (or 70 Hz) and 7 kHz mixed at a ratio of 4:1.

In the case of digital signal generator, the peak level of the signal is the same as the peak level of full-scale level.

In the case of analogue signal generator, the peak level of the signal is the same as analogue full scale amplitude.

It is desirable that the test signal for CCIF inter-modulation test (11 kHz + 12 kHz) is also available from the generator.

4.6.2.3 Signal generator for group delay measurement

4.6.2.3.1 Analogue signal

The analogue signal generator for group delay measurement shall generate a test signal with the waveform of Figure 1.

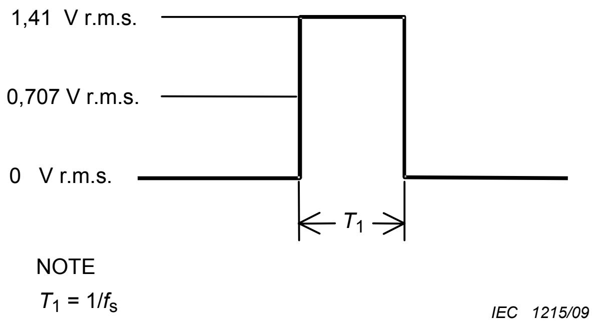

Figure 1 – Analogue test signal waveform

Output impedance: normal source impedance.

Normally, the repetition rate of the signal is 4 Hz. But if an input signal level does not satisfy the level at which an analogue group delay meter can work correctly, a repetition rate as given in Table 2 may be used.

4.6.2.3.2 Digital signal

The digital signal generator for group delay measurement for digital interface, packaged media and digital broadcast, shall generate a test signal with the waveform of Figure 2.

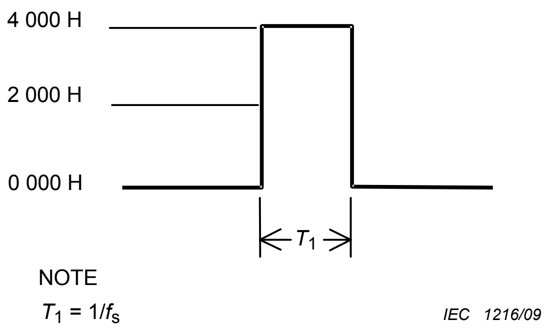

Figure 2 – Digital test signal waveform

Normally, the repetition rate of the signal is 4 Hz. But if an input signal level does not satisfy the level at which a digital group delay meter can work correctly, a repetition rate as given in Table 2 may be used.

This digital group delay meter should synchronously have analogue output, having the same waveform as the digital data waveform.

4.6.2.4 Packaged media for testing

A digital packaged medium may be used when it generates signals which are consistent with the digital sine signal generator, the signal generator for inter-modulation measurement or the signal generator for group delay measurement.

4.6.2.5 RF signal generator

An RF signal generator may be used when a modulated output data is consistent with the digital sine signal generator, the signal generator for inter-modulation measurement or the signal generator for group delay measurement.

4.6.3 Filter

4.6.3.1 Low pass filter (analogue)

Input impedance: normal load impedance

Output impedance: normal source impedance

Transmission distortion: no effect shall be observed to the measured values

4.6.3.2 Band pass characteristics

Pass band 4 Hz to upper band-edge frequency

Ripple: less than ±0,3 dB

Stop band 0,55 f_s and above

Attenuation: more than 60 dB

If upper band-edge frequency is not 0,46 f_s, then the stop band is upper band-edge frequency + $f_s \times 1/10$ and above

4.6.3.3 Out-of-band filter (analogue)

Input impedance: normal load impedance

Output impedance: normal source impedance

Transmission distortion: no effect shall be observed to the measured value.

Band pass characteristics

Pass band:
- Frequency range: Upper band-edge frequency + ($1/10 \times f_s$) to 500 kHz
- Ripple: less than ± 0,3 dB

Lower stop frequency
- Frequency range: below the upper band-edge frequency
- Attenuation: more than 60 dB

Upper stop frequency
- Frequency range: above 500 kHz
- Attenuation: more than 18 dB/octave

4.6.3.4 Narrow band-pass filter (analogue and digital)

4.6.3.4.1 Input/output characteristics

For analogue signal

a) Input impedance: normal load impedance
b) Output impedance: normal source impedance

For digital signal

Applicable to digital interface for measurement.

4.6.3.4.2 Transmission distortion

No effect shall be observed to the measured values.

4.6.3.4.3 Transmission characteristics

Pass band: ripple: less than ±0,3 dB at measuring frequency.

Stop band: attenuation: more than –60 dB at half and twice the measuring frequencies.

4.6.3.4.4 Centre frequency of the filter

The centre frequencies of the narrow band pass filter shall comply with Table 1.

4.6.3.5 Weighting filter

Two types of weighting filter may be used.

One is the weighting filter which shall comply with ITU-R BS 468-4.

Another weighing filter used shall have A-weighing characteristics with tolerances less than 1 dB as specified for sound level measurements in IEC 61672-1.

The selection of the filter shall be defined in the corresponding methods.

4.6.4 Level meter

4.6.4.1 Digital level meter

A digital level meter shows the r.m.s. level as dB_{FS}.

Frequency range: in-band frequency range

NOTE All of the frequency range may be used if the calculation data is not affected.

Measuring range: FS to 1 LSB

Error: less than 1 % of reading or 1/2 LSB. The larger value is applied.

Input interface format: Applicable to digital interface for measurement.

Details: The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use), as appropriate.

4.6.4.2 Analogue in-band level meter

The analogue in-band level meter indicates the r.m.s. value of a sinusoidal signal.

Frequency range: from 4 Hz to upper band-edge frequency

Input impedance: in the case of measuring EUT output directly: Normal load impedance, other cases: 100 kΩ or more

Measuring range: +30 dB to –115 dB (0 dB = 1 V r.m.s.)

Error: less than 2 % of a full-scale value in the frequency range

NOTE If the analogue in-band level meter has not sufficient sensitivity, a voltage amplifier may be added before the analogue in-band level meter.

4.6.4.3 Analogue out-of-band level meter

The analogue out-of-band level meter indicates the r.m.s. value of a sinusoidal signal.

Frequency range: from upper band-edge frequency to 500 kHz

Input impedance: normal load impedance

Error: error is less than 2 % of a full-scale value in the frequency range

Measuring range: 0 dB to –100 dB (0 dB = 1 V r.m.s.)

4.6.5 Distortion meter

4.6.5.1 Analogue distortion meter

A distortion meter shall be capable of measuring the harmonics and noise after removing the fundamental frequency component. The measured data shall be indicated in % which is a r.m.s. value ratio of harmonics and noise to total signals.

Input impedance: normal load impedance

Error: less than ± 3 % of full scale value of the measuring range

NOTE If the analogue distortion meter has not sufficient sensitivity, a voltage amplifier may be added before the analogue in-band level meter.

4.6.5.2 Digital distortion meter

4.6.5.2.1 General

Calculate a ratio of the total signal output to the noise and distortion component. They are calculated as an r.m.s. value. The result is shown in %.

4.6.5.2.2 Specifications

Input interface format: applicable to digital interface for measurement.

Frequency range: signal components are calculated from 4 Hz to the upper band-edge frequency

Measuring signal level: 2 bits below FS to 1 LSB.

Error: less than 3 % of the reading or 1 LSB. The larger value is applied.

4.6.5.2.3 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use), as appropriate.

4.6.6 Frequency meter

The tolerance of frequency is less than 1 %.

4.6.7 Group delay meter

4.6.7.1 General

If input data is an analogue signal, it is converted to digital data whose accuracy should be better than 16 bits.

4.6.7.2 Calculation of delay time

The delay time of 997 Hz is calculated by the phase delay $\Phi_R°$ which is calculated at 997 Hz by Fourier transformation. This delay time τ_R is calculated by the following equation.

$$\tau_R = (-\Phi_R°/360) \times (1/997)$$

The delay time of the measurement frequency is calculated by the phase delay $\Phi_R°$ which is calculated at measurement frequency by Fourier transformation. This delay time τ_C is calculated by the following equation.

$$\tau_C = (-\Phi_C°/360) \times (1/f)$$

Digital group delay τ is calculated by the following equation.

$$\tau = \tau_C - \tau_R$$

4.6.7.3 Specifications

Input impedance: If the input signal is analogue, the input impedance shall be normal load impedance of the EUT.

Input interface format: If the input signal is digital, confirm to the interface format of the EUT.

Accuracy: The processing error shall be less than 0,1 μs for a magnitude of the impulse response signal of larger than 1/8 of FS.

4.6.7.4 Repetition rate

Normally, the amount of data is more than the amount of f_s. But if an input signal level does not satisfy to calculate phase delay, the data in Table 2 may be used.

Table 2 – Impulse conditions and measuring range

Condition of data			Normal case sufficient data	Small data case
Impulse conditions		Impulse width	$4T$ ($T = 1/f_s$)	$1T$ ($T = 1/f_s$)
		Number of calculation data	8 192	1 024
Sampling frequency	44,1 kHz 48 kHz	Frequency range for measurement	5,4 Hz to 100 Hz	100 Hz to upper band-edge frequency
		Impulse repetition rate	4 Hz	40 Hz
	88,2 kHz 96 kHz	Frequency range for measurement	11 Hz to 200 Hz	200 Hz to upper band-edge frequency
		Impulse repetition rate	8 Hz	80 Hz
	176,4 kHz 196 kHz	Frequency range for measurement	21 Hz to 400 Hz	400 Hz to upper band-edge frequency
		Impulse repetition rate	16 Hz	160 Hz

4.6.8 Analogue spectrum analyzer

The spectrum analyzer shall be capable of analyzing frequency spectra of an analogue signal up to a minimum of 50 kHz with sufficient frequency accuracy and dynamic range. The spectrum analyzer shall be capable of measuring the group delay of the output signal from the EUT by measuring the response waveform of the group delay measurement signal.

Input impedance: higher than 10 times the normal load impedance.

4.6.9 Digital waveform monitor

The digital waveform monitor shall display the actual transmitting digital audio data. The display may be either in real time or display of stored data in memory.

The time axis is in the X-direction and the amplitude of the audio data shall be displayed in the Y-direction. The minimum time regulation is $1/f_S$, and maximum full-scale signal level shall be the full-scale level. This digital waveform monitor should have a capability of displaying analogue signal too.

Input interface format: confirm to the interface format of the EUT.

4.6.10 Voltage amplifier

Input impedance: normal load impedance

Frequency response: from 4 Hz to the upper band-edge frequency

Gain: 60 dB ± 0,1 dB

Maximum output level: more than 2 V r.m.s.

Distortion and noise: sufficiently smaller than the EUT

NOTE A voltage amplifier can be used if the distortion meter does not have enough dynamic range for the measurement. If the analogue in-band level meter does not have sufficient measuring range, this voltage amplifier can be used.

4.6.11 Standard digital player

The digital media player shall be capable of reproducing a stored digital audio signal in the packaged media and transferring the signal to the digital interface without making any changes to the signal.

a) Input data: measuring signal recorded to a recording medium by the EUT.

b) Output signal: the recorded signal is reproduced according to the recorded format and transferred to other equipment by the digital interface for measurement.

c) Error: Output digital data shall not have any error from recording medium.

5 Methods of measurement (digital-in/analogue-out)

5.1 General

This clause describes the concept of measurement. Concrete procedures are described in IEC 61606-2 for consumer use or IEC 61606-3 for professional use or IEC 61606-4 for PC use.

The methods of measurement described in the following sub-clauses apply to the equipment where the input signal is a digital audio signal and the output signal is an analogue signal. If the EUT provides two or more channels, all channels should be measured in the same way.

5.2 Input/output characteristics

5.2.1 Maximum output amplitude

5.2.1.1 Basic concept of measurement

This test measures the maximum output amplitude across the load without saturation of output active devices. Input signal is a full-scale level 997 Hz signal. If the EUT has a level control, maximum output level may contain 1 % distortion.

If the EUT has no level control, maximum output amplitude is a level when a full-scale level signal is applied.

5.2.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.2.2 Gain difference between channels and tracking error

5.2.2.1 Basic concept of measurement

If the EUT is 2-channel equipment, this test measures the gain difference between the L channel gain and R channel gain. If the EUT is multi-channel equipment, this test measures the gain difference between the maximum gain channel and the minimum gain channel.

The input signal is normal measuring level and 997 Hz.

The gain difference is the value which is measured at the maximum position of the gain control.

The tracking error is the gain difference between channels when a level control is adjusted from the maximum level to the rated level.

5.2.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.3 Frequency characteristics

5.3.1 Frequency response

5.3.1.1 Basic concept of measurement

This test measures the frequency response of an audio channel in the EUT. The input signal level is the normal measuring level –20 dB_{FS}. The reference frequency is 997 Hz. Frequency response at the testing frequency is the gain difference between the reference frequency and the testing frequency.

5.3.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.3.2 Group delay (phase linearity)

5.3.2.1 Basic concept of measurement

This test measures the delay time difference between the component of 997 Hz signal and the measuring frequency signal.

The digital impulse signal is applied from the signal generator for group delay measurement.

The analogue output signal from EUT is converted to digital signal in the group delay meter.

First, calculate the phase delay value at 997 Hz data and the measuring frequency by the group delay meter.

Second, each delay time is calculated from these phase delay values.

Finally, the group delay of the measuring frequency is calculated by the difference of these two delay times.

If phase linearity at the measured frequency is needed, calculate the phase from the group delay time at the measured frequency.

5.3.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

5.4 Noise characteristics

5.4.1 Signal-to-noise ratio (idle channel noise)

5.4.1.1 Basic concept of measurement

This test measures the ratio between the r.m.s. value of full-scale level output at 997 Hz and of noise output with digital zero input. In this case, analogue signal processing circuit in equipment with a D/A converter is not active because of an input signal of digital zero, as defined in 3.1.7. Then this signal-to-noise ratio is different from ordinary analogue equipment whose circuit is active even with no input signal.

5.4.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.4.2 Dynamic range

5.4.2.1 Basic concept of measurement

This test measures the noise level when the signal processing circuitry of the EUT is active. The input signal is –60 dB_{FS} to avoid generating non-linear distortion. Distortion and noise are measured by a distortion meter and calculated as *A* dB. A weighting filter is used before the distortion meter because this test measures mainly noise signals. The dynamic range is given by (*A* + 60) dB.

5.4.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.4.3 Out-of-band noise ratio

5.4.3.1 Basic concept of measurement

This test measures a noise ratio, which is calculated between the full-scale level signal of 997 Hz and the noise level in the out of band frequency range.

5.4.3.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

5.4.4 Channel separation

5.4.4.1 Basic concept of measurement

This test measures the output level of interference signals which are caused from another channel signal.

If the EUT is multi-channel equipment, tests shall be done for all inputs and the worst value is defined as the channel separation. In this case, the interference signal is converted by a D/A converter and then this measurement method indicates a leakage of the interference signal. The measured signals are the fundamental component of the interference signal and do not include harmonics.

5.4.4.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.5 Distortion characteristics

5.5.1 Level non-linearity

5.5.1.1 Basic concept of measurement

This test measures the deviation from the linearly proportion between the output signal and the input signal. The frequency of test signal is 997 Hz.

The measured signal shall be the fundamental component and it does not include noise or distortion.

5.5.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.5.2 Distortion and noise

5.5.2.1 Basic concept of measurement

This test measures the distortion and noise expressed in % which is obtained as the ratio of noise and distortion r.m.s. voltage to the total output r.m.s. voltage at the specified frequency. The frequency range of the noise and distortion is within the in-band frequency range.

5.5.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

5.5.3 Intermodulation

5.5.3.1 Basic concept of measurement

This test measures intermodulation arising from large signal non-linearity effects as described in IEC 60268-3.

5.5.3.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6 Methods of measurement (analogue-in/digital-out)

6.1 General

This clause describes the concept of measurement. Specific procedures are described in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use).

6.2 Input/output characteristics

6.2.1 Analogue to digital level calibration

6.2.1.1 Basic concept of measurement

This test measures the correlation between the analogue input signal level and digital output signal level.

The analogue full-scale amplitude is calculated by this clause. The logical analogue input level corresponding to the digital full-scale output level is the analogue full-scale amplitude.

This level is estimated by a digital output signal of –20 dB_{FS}.

6.2.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.2.2 Maximum allowable input amplitude

6.2.2.1 Basic concept of measurement

This test measures the allowable input analogue signal amplitude to the EUT. The level control of the EUT may set at any position. This level shows the saturation level of input device. The saturation means the point of 1 % distortion.

6.2.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

6.2.3 Gain difference between channel and tracking error

6.2.3.1 Basic concept of measurement

If the EUT is 2-channel equipment, this test measures a gain difference between the L channel gain and R channel gain. If the EUT is multi-channel equipment, this test measures the gain difference between the maximum gain channel and the minimum gain channel. This test is done to input the normal measuring level and if output signal will be clipped, decrease the input signal level, and if output signal will be small to measure exact value, increase the input signal level.

The gain difference is the value which is measured at the maximum position of the gain control.

The tracking error is the gain difference between channels when a level control is adjusted from the maximum level to the rated level.

6.2.3.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

6.3 Frequency characteristics

6.3.1 Frequency response

6.3.1.1 Basic concept of measurement

This test measures the frequency response of an audio channel in the EUT. The input signal level is the normal measuring level − 20 dB_{FS}. The reference frequency is 997 Hz. The frequency response at a testing frequency is the gain difference from the reference frequency to the testing frequency.

6.3.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

6.3.2 Group delay

6.3.2.1 Basic concept of measurement

This test measures the delay time deference between the component of 997 Hz signal and the measuring frequency signal.

The analogue impulse signal is applied from the signal generator for group delay measurement.

The first, calculate the phase delay value at 997 Hz data and the measuring frequency by the group delay meter.

Second, both of these phase delay data are calculated to the delay time.

Finally, the group delay of the measuring frequency is calculated by the difference of these two delay times.

If phase linearity at the measured frequency is needed, calculate the phase from the group delay time at the measured frequency.

6.3.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.4 Noise characteristics

6.4.1 Signal-to-noise ratio (idle channel noise)

6.4.1.1 Basic concept of measurement

This test measures the unwanted output noise components across the output terminals when an analogue input signal is terminated with normal source impedance. The ratio is with reference to the full-scale output level. A weighting filter is used in the measurement of the noise component to compensate for the noise signals relative to human listening ability. The meaning of this method is different from the a digital-to-analogue system. In analogue-to-digital system, noise signals are often generated from an A/D converter and the audio signal processing circuit may be active. Then noise will be supplied to the output terminal. The measurement of signal-to-noise ratio in this case is very much similar to the measurement of analogue equipment.

6.4.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PV use) as appropriate.

6.4.2 Dynamic range

6.4.2.1 Basic concept of measurement

This test measures the noise level when signal processing circuitry of the EUT is active. The input signal is –60 dB_{FS} to avoid generating non-linear distortion. Distortion and noise are measured by a distortion meter and are calculated as *A* dB. A weighting filter is used before the distortion meter because this test mainly measures noise signals. The dynamic range is given by (*A* + 60) dB.

6.4.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

6.4.3 Folded noise

6.4.3.1 Basic concept of measurement

This test measures unwanted noise signals within the in-band frequency when an input signal which is higher than $f_s/2$ is applied to the analogue input of the EUT. The input signal level is the analogue full-scale amplitude.

6.4.3.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.4.4 Cross-talk

6.4.4.1 Basic concept of measurement

This test measures the level of unwanted signals which is leaked from unrelated channels. The measured signal is the fundamental component of the interference signal at the selected output terminal when an interference signal at full-scale level is added to an un-selected input terminal. This is different from digital to analogue equipment, where there will be leakage from un-selected input terminal to A/D converter. This test measures analogue circuitry performance.

6.4.4.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.4.5 Channel separation

6.4.5.1 Basic concept of measurement

This test measures the output level of interference signals which are related to another channel signal. If the EUT is multi-channel equipment, tests are done for all inputs and channel separation is defined as the worst value. This measurement indicates leakage of the interference signal. The measured signal is the fundamental component of the interference signal and do not include harmonics.

6.4.5.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.5 Distortion characteristics

6.5.1 Level non-linearity

6.5.1.1 Basic concept of measurement

This test measures the deviation from the linearly proportion between the output signal and input signal. The measured signal is the fundamental component.

It does not include noise or distortion. The frequency of input signal is 997 Hz.

6.5.1.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

6.5.2 Distortion and noise

6.5.2.1 Basic concept of measurement

This test measures the distortion and noise expressed in % which is obtained as the ratio of noise and

distortion r.m.s. voltage to the total output r.m.s. voltage at the specified frequency. The frequency range of noise and distortion is within the in-band frequency range.

6.5.2.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) or IEC 61606-4 (PC use) as appropriate.

6.5.3 Intermodulation

6.5.3.1 Basic concept of measurement

This test measures intermodulation arising from large signal non-linearity effects as described in IEC 60268-3.

6.5.3.2 Details

The details are defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use) as appropriate.

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