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2003-10

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

Part 1: General

FOREWORD

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

IEC 61606-2 and this standard cancel and replace IEC 61606 (1997). This first edition of IEC 61606-1 constitutes a technical revision.

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

FDIS	Report on voting
100/694/FDIS	100/715/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.

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

IEC 61606 consists of the following parts under the general title *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics:*

Part 1: General

Part 2: Consumer use

Part 3: Professional use[1]

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

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- withdrawn;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

A bilingual edition may be issued at a later date.

1 Under consideration.

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

Part 1: General

1 Scope

This part of IEC 61606 deals with the basic methods of measurement of the audio characteristics of the digital audio part of audio and audiovisual equipment for both consumer and professional use.

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. Methods specified in this standard are not applicable to systems incorporating bit-rate reduced digital audio signals that have data loss.

This standard describes tests 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 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 test, refer to AES 17.

NOTE 4 This standard is planned to provide the industry with a harmonized set of methods of measurements for digital audio equipment as described in the first edition of IEC 61606 (1997), AES 17 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*

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

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

ISO 266, *Acoustics – Preferred frequencies*

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

AES 17, *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

digital audio signal
series of digital signals expressed by sampled data

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

3.1.2

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.

3.1.3

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)[2]

3.1.4

word length
the number of bits of a data element

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

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[2] Under consideration.

3.1.5

sampling frequency
f_S
the number of samples of a signal taken per unit time

3.1.6

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 $7FFF_H$ and the largest negative value is 8001_H in 16 bit data.

3.1.7

signal level
dB_{FS}
the result obtained from the following equation:

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

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

3.1.8

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

3.1.9

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

3.1.10

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

3.1.11

normal source impedance
impedance which is connected to input terminals of EUT The concrete value is defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use). For example, IEC 61938 is applied in IEC 61606-2

3.1.12

normal load impedance
impedance which is connected to output terminals of EUT. The concrete value is defined in IEC 61606-2 (consumer use) or IEC 61606-3 (professional use). For example, IEC 61938 is applied in IEC 61606-2

3.1.13

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.

3.1.14

in-band frequency range
frequency range from 4 Hz to upper band-edge frequency (see 3.1.15)

3.1.15

upper band-edge frequency
f_S × 0,46

NOTE If *fs* 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.

3.1.16

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

aliasing components
frequency components produced below the folding frequency due to sampling of input signals above the folding frequency

3.1.18

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

3.1.19

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

3.1.20

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

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 AES 17 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 % or –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 this table. 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 K	997	997	997	997	997	997	997
2 K	1 999	1 999	1 999	1 999	1 999	1 999	1 999

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 K	3997	3 997	3 997	3 997	3 997	3 997	3 997
8 K	7 993	7 993	7 993	7 993	7 993	7 993	7 993
10 K	10 007	10 007	10 007	10 007	10 007	10 007	10 007
12 K	12 503	-	-	-	-	-	-
14 K	13 999	-	-	-	-	-	-
14,5 K	14 501	-	-	-	-	-	-
16 K	-	16 001	16 001	16 001	16 001	16 001	16 001
18 K	-	17 997	17 997	-	-	-	-
20 K	-	19 997	19 997	19 997	19 997	19 997	19 997
22 K	-	-	22 001	-	-	-	-
30 K	-	-	-	30 011	30 011	-	-
35 K	-	-	-	34 981	34 981	-	-
40 K	-	-	-	40 009	40 009	40 009	40 009
44K	-	-	-	-	43 997	-	-
50 K	-	-	-	-	-	49 999	49 999
70 K	-	-	-	-	-	70 001	70 001
80 K	-	-	-	-	-	79 999	79 999
88 K	-	-	-	-	-	-	88 001

If a sweep signal is used in the measurement, the sweep frequency range is from 16 Hz to 1/2 x *fs*.

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 input terminals, and output terminals

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

b) Setting of level controls

   For analogue input signal: adjust the level control so as to obtain the normal measurement level signal across the digital output when a sinusoidal input signal of 997 Hz and the normal measurement level is applied to the input terminals of the EUT. The level control shall be set to the maximum position if these settings cannot be obtained.

   For digital input signal: adjust the level control so as to obtain an analogue output signal at the normal measurement level across the analogue output terminals terminated with a normal load impedance when a sinusoidal signal of 997 Hz and the normal measurement level is applied to the digital input terminal of the EUT.

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 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 5 min 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 Signal generator

4.6.1.1 Single sine wave generator

4.6.1.1.1 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

4.6.1.1.2 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

4.6.1.2 Signal generator for inter-modulation measurement

A generator for inter-modulation measurement shall generate the rated maximum full-scale level signal representing a two-tone signal, composed of 60 Hz (or 70 Hz) and 7 kHz mixed at a ratio of 4:1. It is desirable that the test signal for CCIF inter-modulation test (11 kHz + 12 kHz) is also available from the generator.

4.6.1.3 Signal generator for group delay measurement

4.6.1.3.1 Analogue signal

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

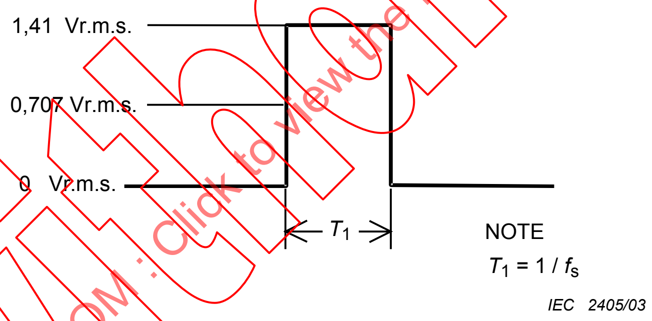

Figure 1 – Analogue test signal waveform

Output impedance: normal source impedance

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

4.6.1.3.2 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.

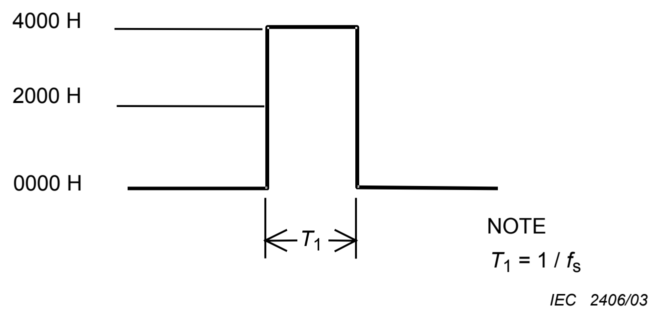

Figure 2 – Digital test signal waveform

Normally, the repetition rate of the signal is 4 Hz. But if an input signal level does not satisfy a digital group delay meter, 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.

4.6.1.4 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.

4.6.1.5 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.

4.6.2 Filter

4.6.2.1 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

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 × 1/10 and above

4.6.2.2 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.

Pass band	(Upper band-edge frequency + 1/10 × f_s) to 500 kHz
	Ripple: less than ±0,3 dB
Lower stop band	Frequency below the upper band-edge frequency
	Attenuation: more than 60 dB
Upper stop band above 500 kHz	Attenuation of more than 18 dB/octave

4.6.2.3 Narrow band-pass filter (analogue and digital)

4.6.2.3.1 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.

4.6.2.3.2 Transmission distortion

No effect shall be observed to the measured values.

4.6.2.3.3 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.

4.6.2.3.4 Centre frequency of the filter

The centre frequencies of the narrow band pass filter shall comply with Table 1. The data are the same as for the 1/3 octave filters specified in ISO 266.

4.6.2.4 Weighting filter

The weighting filters shall comply with ITU-R BS 468-4.

4.6.3 Level meter

4.6.3.1 Digital level meter

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

Frequency range: in-band frequency range

Measuring range: FS to 1 LSB

Error is less than 1 % of reading or 1/2 LSB

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

4.6.3.1.1 Input interface format

Applicable to digital interface for measurement.

4.6.3.1.2 Details

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

4.6.3.2 Analogue in-band level meter

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

Input impedance	Normal load impedance
Measuring range	+30 dB to –115 dB (0 dB = 1 Vr.m.s.)
Error	Error is less than 2 % of a full-scale value of the measuring range from 4 Hz to upper band-edge frequency

If the analogue in-band level meter cannot cover the measuring range, a voltage amplifier may be added before the analogue in-band level meter.

4.6.3.3 Analogue out-of-band level meter

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

Input impedance	Normal load impedance
Error	Error is less than 2 % of a full-scale value of the measuring range from upper band-edge frequency to 500 kHz
Measuring range	0 dB to –100 dB (0 dB = 1 Vr.m.s.)

If an analogue out-of-band level meter does not have sufficient measuring range, it can nevertheless be used if it does not affect the result of measurement.

4.6.4 Distortion meter

4.6.4.1 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.

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

Input impedance: normal load impedance.

4.6.4.2 Digital distortion meter

Calculate a ratio of the total signal output to the noise and distortion component. The result is shown in %. The total signal output is calculated from 4 Hz to the upper band-edge frequency. It is calculated as an r.m.s. value. The noise and distortion component is calculated from 4 Hz to the upper band edge frequency as an r.m.s. value without an input signal.

4.6.4.2.1 Input interface format

Applicable to digital interface for measurement.

4.6.4.2.2 Measuring range

2 bits below FS to 1 LSB.

4.6.4.2.3 Accuracy

Error is less than 3 % of the reading or 1 LSB.

4.6.4.2.4 Details

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

4.6.5 Frequency meter

The tolerance of frequency is less than 1 %.

4.6.6 Group delay meter

4.6.6.1 Digital group delay meter

Data is calculated relative to the phase ϕ_R° of the 997 Hz signal by Fourier transformation and indication is made of the delay time τ_R. This is calculated by the following equation.

$$\tau_R = -\phi_R/360 \times 1/997$$

Data is calculated relative to the phase of the requested frequency ϕ_C° by Fourier transformation and indication is made by the delay time τ_C. This is calculated by the following equation.

$$\tau_C = -\phi_C/360 \times 1/f$$

Digital group delay τ is calculated by the following equation.

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

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

Table 2 – Impulse conditions and measuring range

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

4.6.6.1.1 Input interface format

Applicable to the digital interface for measurement.

4.6.6.1.2 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 f_s.

4.6.6.2 Analogue group delay meter

The input signal is converted to digital data whose accuracy should be better than 16 bits. Data is calculated relative to the phase of the 997 Hz signal ϕ_R by a Fourier transformation and indication is made of the delay time τ_R. This delay time is calculated by the following equation:

$$\tau_R = -\phi_R°/360 \times 1/997$$

The data is calculated by carrying out a Fourier transform at the requested frequency, and the delay time τ_C is calculated from the phase $\phi_C°$ by the following equation:

$$\tau_C = -\phi_C°/360 \times 1/f$$

Group delay τ is calculated by the following equation:

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

Input impedance = Normal load impedance.

4.6.6.2.1 Accuracy

The processing error shall be less than 0,1 µs for a magnitude of the impulse response signal greater than 1/8 of the full-scale level.

4.6.7 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.

4.6.8 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: applicable to digital interface for measurement

4.6.9 Voltage amplifier

The voltage amplifier shall have characteristics of:

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 Vr.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.

4.6.10 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 correction shall be made according to the recorded format so that no error is generated in the standard recording media.

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

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.

The methods of measurement described in the following subclauses 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.

5.1 Input/output characteristics

5.1.1 Maximum output amplitude

5.1.1.1 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 level is a level when a full-scale level signal is applied.

5.1.1.2 Details

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

5.1.2 Gain difference between channels and tracking error

5.1.2.1 Basic concept of measurement

This test measures the gain difference between the L channel gain and R channel gain, if the EUT is 2 channel equipment. If the EUT is multi-channel, this test measures the gain difference between the maximum gain channel and the minimum gain channel. This test is done with an input signal of 997 Hz at normal measuring level. The gain difference is the data when a gain control is set at the maximum position. The tracking error is the gain difference between channels when a dual level control is incorporated in the equipment and is adjusted.

5.1.2.2 Details

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

5.2 Frequency characteristics

5.2.1 Frequency response

5.2.1.1 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.

5.2.1.2 Details

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

5.2.2 Group delay (phase linearity)

5.2.2.1 Basic concept of measurement

This test measures the delay time difference between the 997 Hz signal and the measuring frequency. First, the phase delay value which is a component of the 997 Hz signal and the measuring frequency signal is calculated by applying the impulse signal to the EUT. This signal is applied from a signal generator for group delay measurement. Second, delay times are calculated from these phase delay values. Then the group delay of the measuring frequency is calculated as the difference time from the 997 Hz delay time. If phase linearity at the measured frequency is needed, calculate the phase from the group delay time at the measured frequency.

5.2.2.2 Details

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

5.3 Noise characteristics

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

5.3.1.1 Basic concept of measurement

This test measures the ratio of the full-scale level 997 Hz signal-to-noise without input signals. Analogue signal processing circuit in equipment with a D/A converter is not active with an input signal of digital zero, as defined in 3.1.9. The signal-to-noise ratio in such a case is different from ordinary analogue equipment whose signal processing circuit is active even with no input signal.