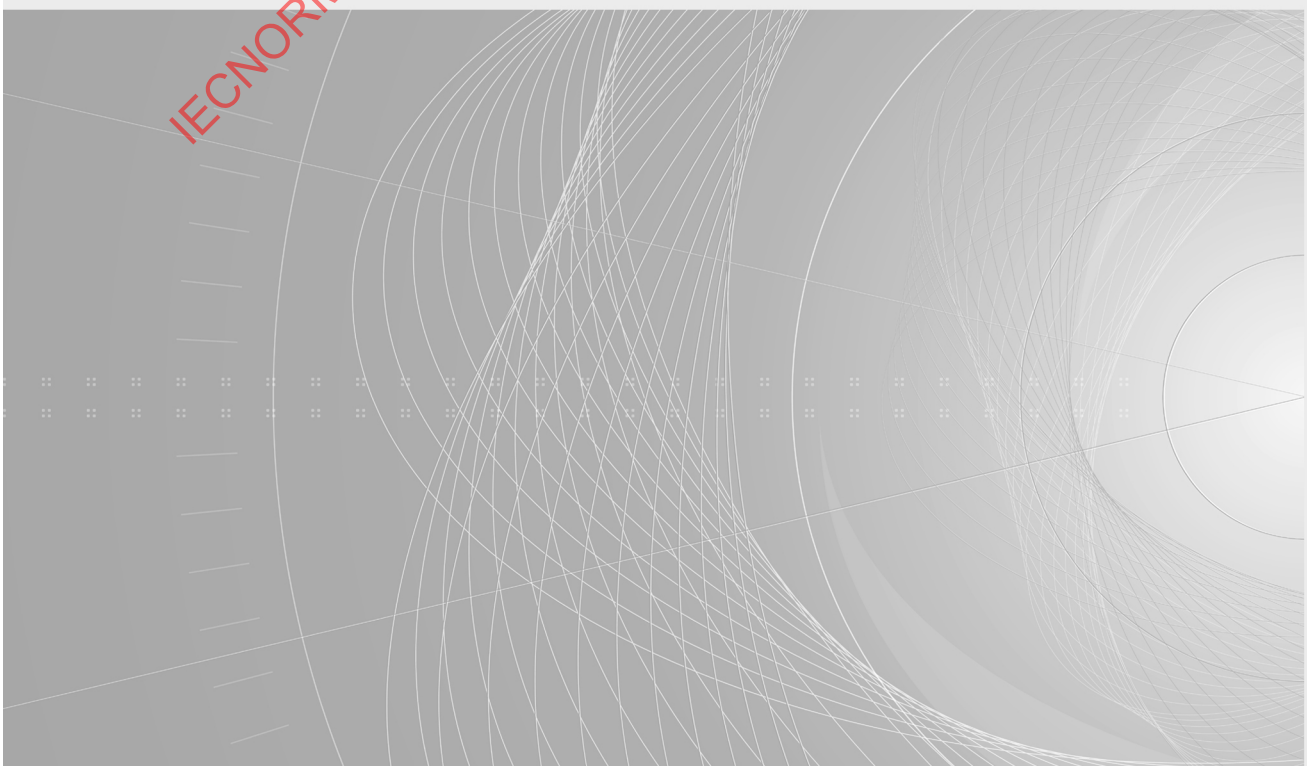
IEC 61606-2

Edition 2.0 2009-07

INTERNATIONAL STANDARD

Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 2: Consumer use



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Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 2: Consumer use

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE W

ICS 33.160.01

ISBN 978-2-88910-548-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2: Consumer use

FOREWORD

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International Standard IEC 61606-2 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
100/1548/FDIS	100/1582/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 part is to be used in conjunction with IEC 61606-1, General.

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- withdrawn,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 2: Consumer use

1 Scope

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

The common measuring conditions and methods are described in IEC 61606-1. This International Standard specify conditions and methods of measurement for consumer equipment are given in this standard.

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

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

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

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*

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

3 Terms, definitions, explanations and rated values

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61606-1 as well as the following apply.

3.1.1
analogue full-scale amplitude
nominal signal level of an EUT corresponding to the digital full-scale level

NOTE In order to accommodate the EUT in an audio system, it is recommended that the analogue full scale amplitude has the value defined in IEC 61938. In the case of general purpose audio for consumer equipment, the amplitude is 2 V r.m.s.

3.1.2
normal load impedance
value defined in IEC 61938, or in the case of general purpose audio for consumer equipment, 22 kΩ

3.1.3
normal measuring level
analogue signal level equal to –20 dB of analogue full-scale amplitude

3.1.4
normal source impedance
value defined in IEC 61938, or in the case of general purpose audio for consumer equipment, 2,2 kΩ

3.2 Explanation of terms “jitter”

See 3.2 of IEC 61606-1.

3.3 Digital interface for measurement

This standard can be applied to IEC 60958 or IEC 61883-6.

Other interfaces having the same specification as in 3.1 of IEC 61606-1 may also be used.

3.4 Rated values

For a full explanation of these terms, see IEC 60268-2. The following are rated conditions for digital audio equipment which 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 General

The measuring conditions applied in this part are the same as those given in IEC 61606-1, together with those given below.

4.2 Environmental conditions

As specified in 4.1 of IEC 61606-1.

4.3 Power supply

As specified in 4.2 of IEC 61606-1.

4.4 Test signal frequencies

As specified in 4.3 of IEC 61606-1.

4.5 Standard setting

As specified in 4.4 of IEC 61606-1.

4.6 Preconditioning

As specified in 4.5 of IEC 61606-1.

4.7 Measuring instruments

4.7.1 General

All specifications given in IEC 61606-1 are applicable, together with those given below.

4.7.2 Digital level meter

The r.m.s. signal level, V_{total} is calculated from the digital data within the in-band frequency range.

One method of calculation is as follows:

When the frequency components are calculated by the FFT method, the signal level is calculated as follows. All of the frequency components which are within the in-band frequency range are calculated using the following equation:

$$V_{total} = (V_{f1}^2 + V_{f2}^2 + V_{f3}^2 + \ldots V_{fn}^2)^{1/2}$$

The signal level S in dB_{FS} is calculated from the following equation:

$$S\ dB_{FS} = 20 \log_{10} (V_{total} / V_{full})$$

where V_{full} is the r.m.s. value of the full-scale amplitude of a 1 kHz signal.

The number of data points for the FFT calculation is greater than the value of f_s. The window used for the measurement shall be the minimum window having the following parameters:

$$W(t) = 1/L\ [a_0 + a_1 \cos(2\pi t/L) + a_2 \cos(4\pi t/L) + a_3 \cos(6\pi t/L)]$$

where

L is the number of data points,

$a_0 = 0{,}363\ 491\ 2$,

$a_1 = 0{,}489\ 268\ 2$,

$a_2 = 0{,}136\ 508\ 8$,

$a_3 = 0{,}010\ 731\ 8$,

and $t \leq L/2$.

NOTE If the signal level is calculated directly using digital data, it should be filtered to the in-band frequency range before the calculation.

4.7.3 Distortion meter

Calculate the ratio of the total signal output to the noise and distortion component.

NOTE One measurement method is as follows.

The r.m.s. signal level, V_{total} is calculated from the resultant in-band frequency components of the fast Fourier Transformation (FFT) of the processed input signal:

$$V_{total} = (V_{f1}^2 + V_{f2}^2 + V_{f3}^2 + \ldots V_{fn}^2)^{1/2}$$

V_N, is obtained by the FFT for frequency ranges from 4 Hz to f_L, which is 1/1,5 of the measuring frequency and f_H which is 1,5 times the measuring frequency to the upper limit frequency f_{MAX}, V_N is derived from the following equation:

$$V_N = ((V_{f1}^2 + V_{f2}^2 + V_{f3}^2 + \ldots V_{fL}^2) + (V_{fH}^2 + V_{fH+1}^2 + V_{fMAX}^2))^{1/2}$$

The total distortion D is obtained from the equation:

$$D = V_N / V_{total} \times 100 \quad \%$$

The conditions for the measurement are the same as those for the digital level meter.

4.7.4 Analogue weighting filter

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

4.7.5 Digital weighting filter

The characteristics of weighing filter shall comply with A-weighing characteristics with tolerances ±1 dB as specified for sound level measurements in IEC 61672-1.

4.7.6 Digital spectrum analyzer

A digital spectrum analyzer computes the Fast Fourier transform (FFT) of the input digital signal.

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

5.1 General

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. All the specifications described in IEC 61606-1 which correspond to this standard are applied to these subclauses.

These subclauses specify the details of measurement methods for consumer use equipment.

If the EUT provides two or more channels, all channels should be measured in the same way. The word length and sampling frequency shall be stated in the expression of the results of the measurement.

5.2 Input/output characteristics

5.2.1 Maximum output amplitude

5.2.1.1 Input signal

Frequency: 997 Hz

Signal level: full-scale level.

5.2.1.2 Procedures

Set the EUT to the standard setting specified in 4.5.

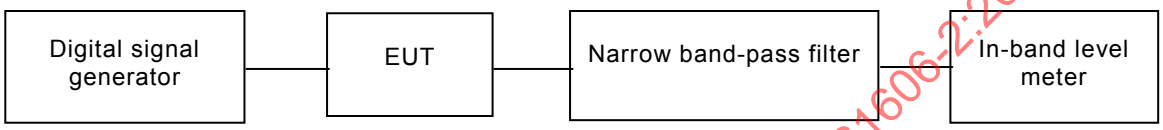
Apply the input signal to the EUT.

Adjust the level control and measure the maximum output voltage which does not show clipping and has total distortion of less than 1 %.

5.2.2 Gain difference between channels

5.2.2.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 1.



IEC 2407/03

Figure 1 – Connection diagram of equipment

5.2.2.2 Input signal

Frequency: 997 Hz.

Signal level: normal measuring level (–20 dB_{FS}).

5.2.2.3 Procedure

The following procedure applies.

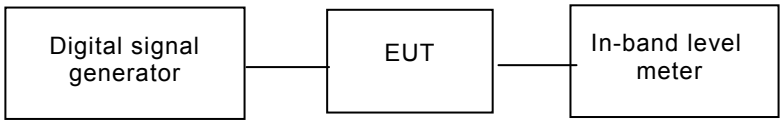
a) Set the EUT to the standard settings specified in 4.5.
b) Adjust the gain control (if any) to the maximum position. Apply the same input signal to all channels to be measured, either simultaneously or in turn.
c) Measure the output level of each channel.
d) The gain difference between the channels is expressed in dB.

5.3 Frequency characteristics

5.3.1 Frequency response

5.3.1.1 Block diagram of measuring devices

Connect the EUT and measuring instruments as shown in Figure 2.



IEC 2408/03

Figure 2 – Connection diagram of equipment

5.3.1.2 Input signal

The following characteristics apply.

a) Reference signal

Frequency: 997 Hz.

Signal level: normal measuring level (–20 dB_{FS}).

b) Test signal

Frequency: in the case of the discrete frequency method see IEC 61606-1, Table 1. In the case of the sweep frequency, the frequency range is from 16 Hz to 1/2 × f_s which is the same as the comment under the Table 1 of IEC 61606-1.

Signal level: normal measuring level (–20 dB_{FS}).

5.3.1.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply a reference signal to the EUT and measure the output signal with the analogue in-band level meter.
c) Repeat the same measurement as in b) for the test signals. Calculate the voltage ratio between measurement b) and c) in dB.
d) The results are presented in a table or graphically.

5.3.2 Group delay (phase linearity)

5.3.2.1 Block diagram of measuring devices

Connect the EUT and measuring instruments as in Figure 3.

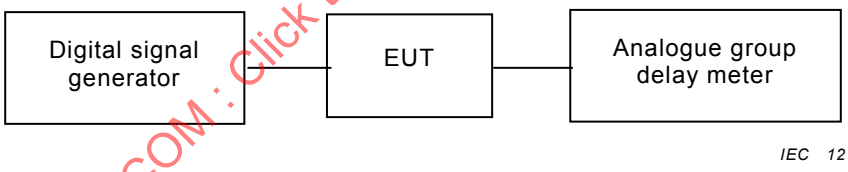


Figure 3 – Connection diagram of equipment

5.3.2.2 Input signal

The signal generator for group delay measurement (described in IEC 61606-1, 4.6.2.3.2) shall be used.

5.3.2.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the input signal to the EUT.
c) Analyze the output waveform from the EUT using FFT equipment to obtain the phase Φ_R (degree) of the 1 kHz signal and calculate the group delay τ_R from the following equation:

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

d) Repeat analyzing the testing frequency to obtain the phase Φ_C and the delay time τ_C from the following equation.

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

If the phase wraps in excess of 360°, the reading shall be adjusted before computing the above equation.

e) The group delay difference (τ_{RC}) and phase linearity (Φ_{RC}) at the measured frequency can be obtained from following equations.

$$\tau_{RC} = \tau_C - \tau_R$$

$$\Phi_{RC} = \tau_{RC} \times 360 \times f$$

5.4 Noise characteristics

5.4.1 Signal-to-noise ratio

5.4.1.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 4.

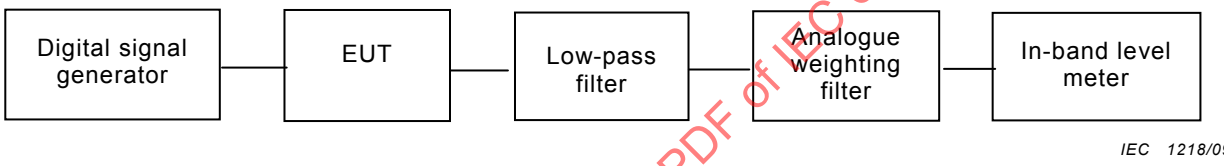


Figure 4 – Connection diagram of equipment

5.4.1.2 Input signal

The following characteristics apply.

Signal (A): Signal level = Full-scale level.

Frequency = 997 Hz.

Signal (B): Digital zero.

5.4.1.3 Procedure

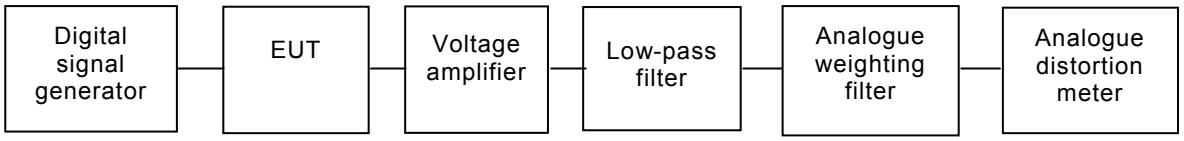
The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the signal (A) to the EUT and note the reading of the meter as A dB_{FS}.
c) Apply the signal (B) to the EUT and note the meter reading B dB_{FS}.
d) The signal-to-noise ratio SN in dB is obtained from the equation: $SN = (A - B)$.

5.4.2 Dynamic range

5.4.2.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 5.



NOTE If the analogue distortion meter has sufficient amplification for the measurement, the voltage amplifier may not be needed.

Figure 5 – Connection diagram of equipment

5.4.2.2 Input signal

Frequency: 997 Hz.

Signal level: –60 dB_{FS}.

5.4.2.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the input signal to the EUT.
c) Read the noise and distortion N (%), using the analogue distortion meter.
d) Repeat for each sampling frequency, if required.
e) The dynamic range(D dB) is calculated from the following equation:

$$D \text{ dB} = 20 \lg (N/100) + 60$$

5.4.3 Out-of-band noise ratio

5.4.3.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 6.

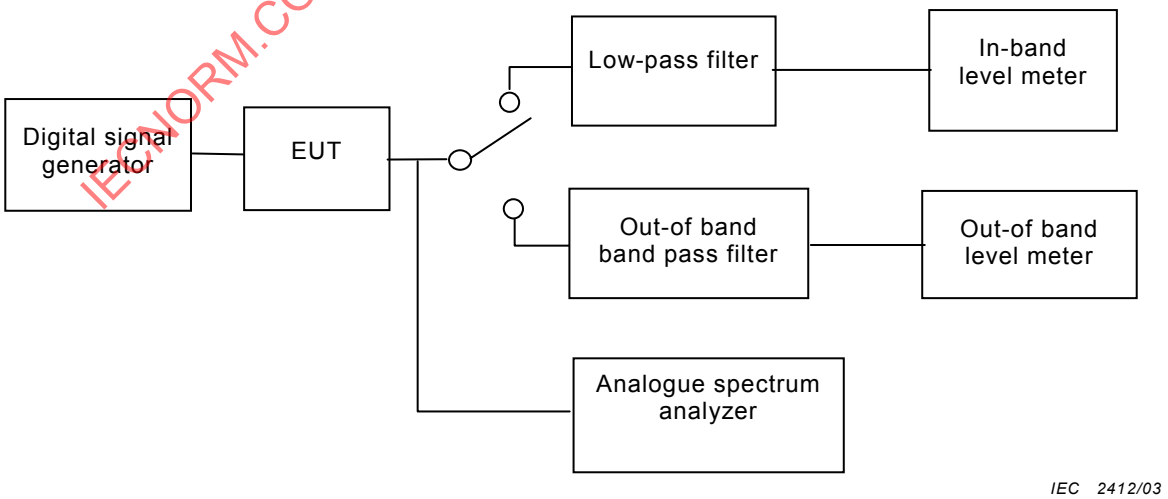


Figure 6 – Connection diagram of equipment

5.4.3.2 Input signal

Frequency: 997 Hz, 10 007 Hz, 14 501 Hz, 19 997 Hz and the upper band-edge frequency.

Signal level: full-scale level (0 dB_{FS}).

5.4.3.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the input signal to the EUT.
c) Read the indication of the in-band level meter as A dB_{FS}.
d) Read the indication of the out-of-band level meter as B dB_{FS}.
e) The out-of-band noise ratio is obtained from the equation:

$$\text{Out-of-band noise ratio} = (B - A)\ \text{dB}.$$

5.4.4 Channel separation

5.4.4.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 7.

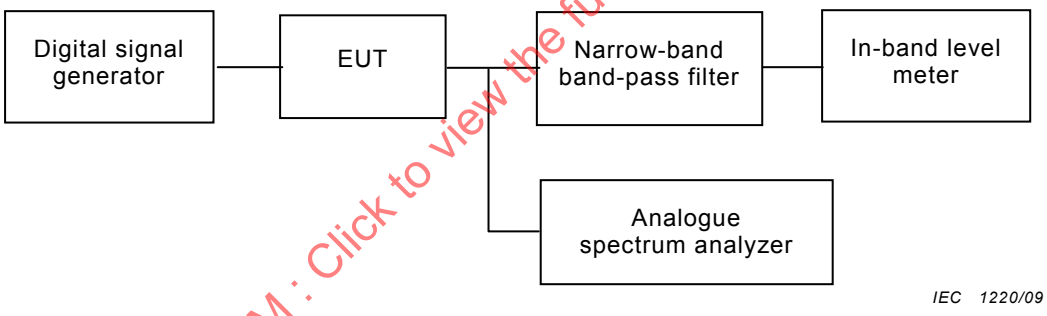


Figure 7 – Connection diagram of equipment

5.4.4.2 Input signal

Frequency: 997 Hz and other frequencies in IEC 61606-1, Table 1, if necessary.

Signal level: full-scale level.

5.4.4.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the input signal at 997 Hz to all channels which are bound in a single stereo source.
c) Adjust the balance control of the EUT so as to obtain equal output levels. If the output levels cannot be adjusted, correct the measured values by the level difference.
d) Measure the level of the output signal as A dB_{FS}.
e) Apply digital zero to the input terminal of the selected channel and apply the same signal as c) to other channels.

f) Measure the level of the output signal of the selected channel generated by the leakage from unwanted channels as B dB. Repeat the same measurement for other frequencies if needed.

g) Channel separation is obtained from the following equation:

$$\text{channel separation} = (A - B) \text{ dB}$$

h) Change the selected channel and repeat steps e) to g).

5.5 Distortion characteristics

5.5.1 Level non-linearity

5.5.1.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 8.

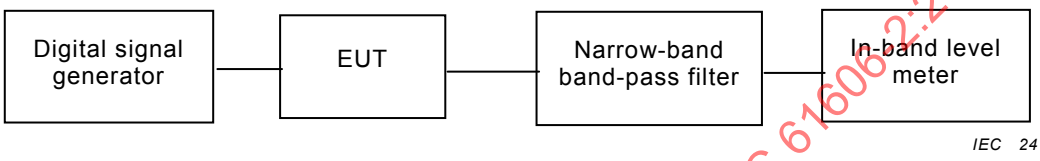


Figure 8 – Connection diagram of equipment

5.5.1.2 Input signal

Frequency: 997 Hz.

Signal level: given in Table 1.

Table 1 – Levels for measurement

Nominal level dB_{FS}	
–0	–82
–6	–89
–12	–100
–20	–108
–30	–113
–40	–120
–50	–132
–60	–137
–70	

NOTE For 16 bit systems, use the signal level from the Table 1 that are less than 100 dB_{FS}.

When a 20 bit system is measured, –80 dB_{FS} or –90 dB_{FS} may be used instead of –82 dB_{FS} or –89 dB_{FS} respectively.

When a 24 bit system is measured, –80 dB_{FS} and –90 dB_{FS} and –110 dB_{FS} may be used instead of –82 dB_{FS} or –89 dB_{FS} or –113 dB_{FS} respectively.

5.5.1.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Set the level controller to the highest position if an output signal at the rated output signal level is not obtainable.

c) Apply the input signal to the EUT and read the indication of the in-band level meter.

d) Repeat the measurement for other signal levels within the required signal range.

e) The linearity is obtained from the difference between the theoretical output level and the actual measured value.

5.5.2 Distortion and noise

5.5.2.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 9.

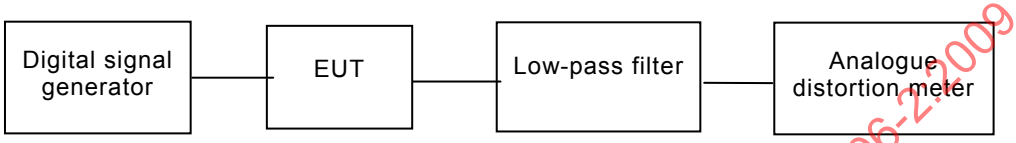


Figure 9 – Connection diagram of equipment

5.5.2.2 Input signal

Frequency: 997 Hz or as given in IEC 61606-1, Table 1, if needed.

Signal level: full-scale level (0 dB_{FS}).

5.5.2.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the input signal at 997 Hz to the EUT.

c) Read the indication of the analogue distortion meter.

d) Repeat the measurement for other input frequencies.

5.5.3 Intermodulation

5.5.3.1 Block diagram of measuring devices

Connect the EUT and measuring instrument as in Figure 10.

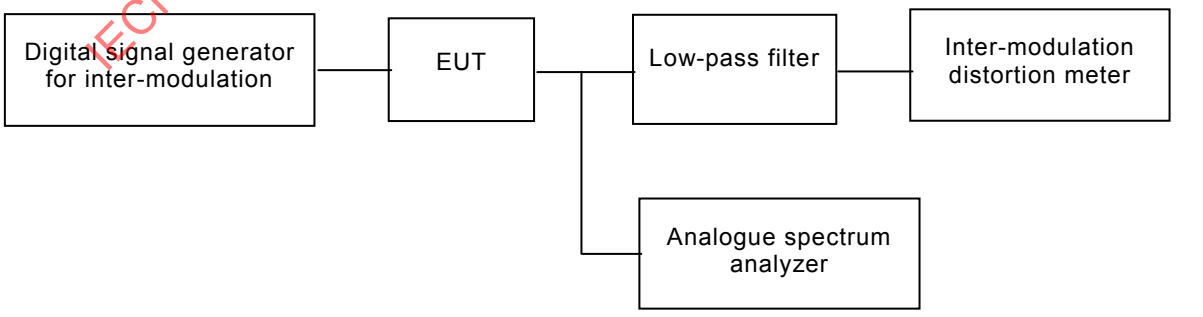


Figure 10 – Connection diagram of equipment

5.5.3.2 Input signal

The signal specified in IEC 61606-1, 4.6.2.2 shall be used.

5.5.3.3 Procedure

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply the input signal to the EUT
c) Measure the intermodulation distortion of the output signal using the intermodulation distortion meter.

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

6.1 General

The methods of measurement described in the following sub-clauses apply to equipment where the input signal is an analogue signal and the output signal is a digital audio signal. All specifications described in IEC 61606-1 are applicable to this standard and are described below. These sub-clauses specify the details of measurement methods for consumer use equipment.

There are two types of EUT. One is a EUT with digital output terminals and other is a EUT without digital output terminal. The EUT without digital output terminal is typically recording equipment such as DAT, CD-R and similar.

6.2 Input/output characteristics

6.2.1 Analogue to digital level calibration

6.2.1.1 Block diagram of measuring devices

6.2.1.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 11.

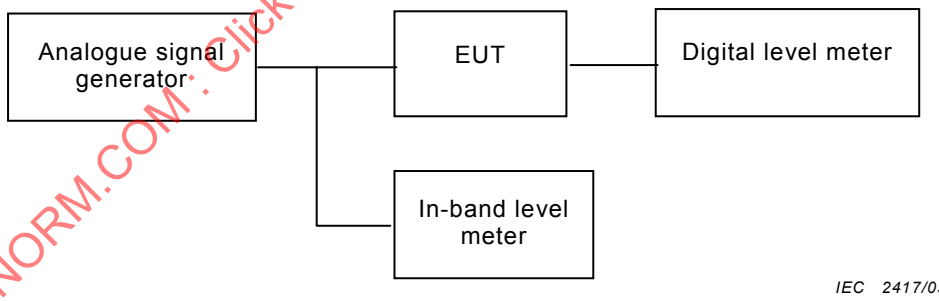


Figure 11 – Connection diagram of equipment

6.2.1.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 12.

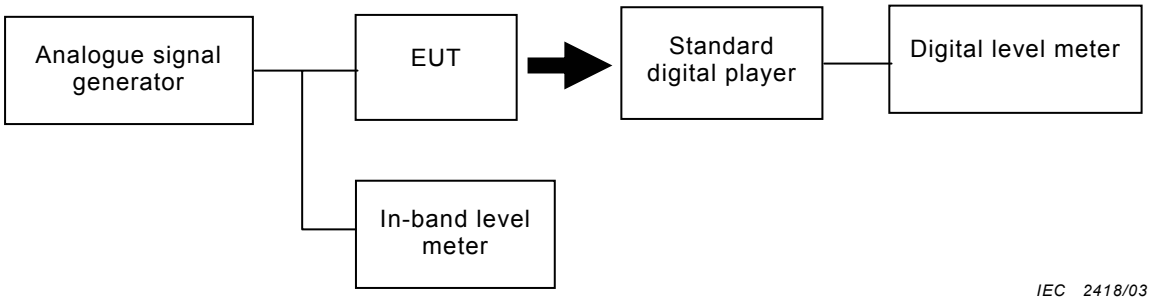


Figure 12 – Connection diagram of equipment

6.2.1.2 Input signal

Frequency: 997 Hz.

Signal level: normal measuring level (0,2 V r.m.s.)

6.2.1.3 Procedure

6.2.1.3.1 Equipment with digital output terminals

The following procedure applies.

a) Set the controls of the EUT to the standard settings specified in 4.5.

b) Apply the input signal to the EUT so that the normal measuring level of –20 dB_{FS} is obtained by varying the input signal around 0,2 V r.m.s.

c) Read the indication of the in-band level meter, A V r.m.s.

d) Ten times A V r.m.s. is the analogue full-scale level.

6.2.1.3.2 Equipment without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the input signal with levels of –6 dB to +6 dB from the normal measuring level in 1 dB steps and record the signal to a recording medium.

c) Reproduce the recorded signal using the standard player and read the output signal level on the digital level meter.

d) Estimate the analogue input signal level, A V r.m.s., which corresponds to 1/10 of the full-scale output level. ($10 \times A$ V r.m.s.) is the analogue full-scale level.

6.2.2 Maximum allowable input amplitude

6.2.2.1 Block diagram of measuring devices

6.2.2.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 13.

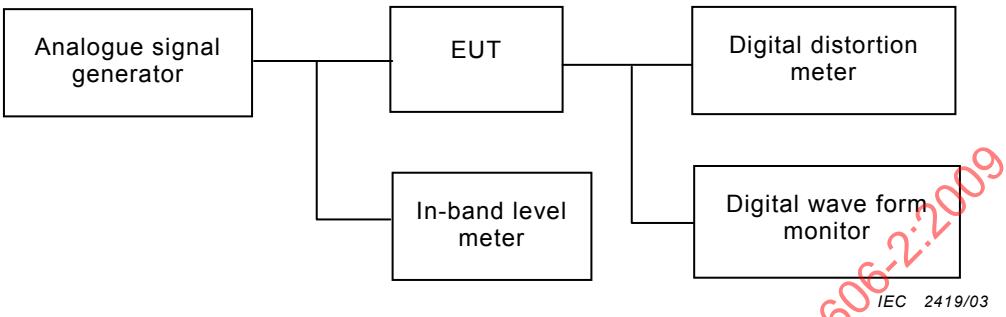


Figure 13 – Connection diagram of equipment

6.2.2.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 14.

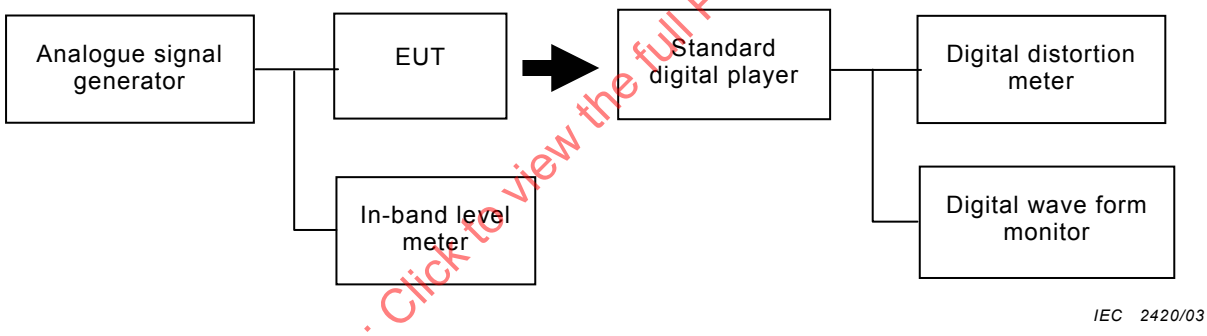


Figure 14 – Connection diagram of equipment

6.2.2.2 Input signal

Frequency: 997 Hz.

Signal level: from 0 V r.m.s. to in excess of the analogue full-scale level.

6.2.2.3 Procedure

6.2.2.3.1 Equipment with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the input signal and increase the signal amplitude gradually from 0 V r.m.s. If the level of the digital output terminal exceeds the normal measuring level (–0 dB_{FS}), adjust the level controller to maintain the output level to the normal measuring level.

c) Measure the input signal amplitude where further increase of the input signal level results in 1 % distortion in clipping of the output signal.

d) For EUT without a level control, measure the input signal level with 1 % distortion output signal.

6.2.2.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) For EUT with an input signal level indicator, estimate the maximum non-clipping input signal level for the A/D converter.

c) Apply the input signal to the EUT and record the output signal to a recording medium for an input level range of –10 dB to +6 dB above the estimated non-clipping input signal level in 1 dB steps.

d) Measure the distortion of the output signal from the recorded medium using a player.

e) Measure the distortion and when the distortion exceeds 1 %., read the indication of the distortion meter as a % and input level as A dB.

f) Measure the distortion when input signal level is $(A - 1)$ dB as b %.

g) Find the level L dB which gives distortion of 1 % to the EUT from the following equation:

$$L \text{ dB} = \{A - (a - 1)/(a - b)\} \text{ dB}$$

h) In case both a and b exceed 1 %, or are less than 1 % , adjust the input signal level to the EUT so that an input signal is available where a exceeds 1 % and b is less than 1 %.

6.2.3 Gain difference between channel and tracking error

6.2.3.1 Block diagram of measuring devices

6.2.3.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 15.

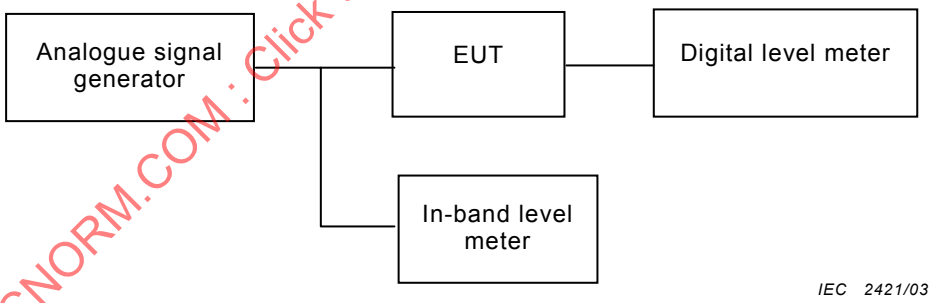


Figure 15 – Connection diagram of equipment

6.2.3.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 16.

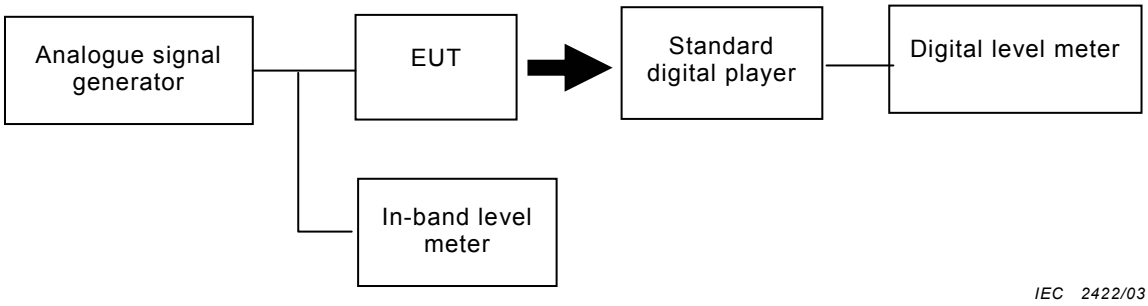


Figure 16 – Connection diagram of equipment

6.2.3.2 Input signal

Frequency: 997 Hz.

Signal level: normal measuring level (0,2 V r.m.s.).

6.2.3.3 Procedure

6.2.3.3.1 EUT with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Set the level controller to its position of highest gain.
c) Apply the input signal to each channel of the EUT.
d) Measure the output levels of all channels, then calculate gain differences from the largest gain channel to other channels. The maximum value of this data is the gain difference.
e) Measure the output signal level for each channel by decreasing the position of the level controller.
f) Calculate the gain difference of each position of the level controller.
g) The tracking error is the largest gain difference when the level controller is shifted to a specified attenuation range, or attenuation range of the level controller is moved from 0 dB to –60 dB.
h) For EUT without a level control the gain difference is the level difference between channels at the largest gain.

6.2.3.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Set the level controller to its position of highest gain.
c) Apply the input signal to each channel of the EUT and record the output signals to a recording medium for a specified attenuation range, or attenuation 0 dB to –60 dB.
d) Measure the signal level of the output for each channel from the recorded medium using the standard player.
e) Calculate the level difference of each signal levels.
f) The maximum level difference is the tracking error.
g) The level difference at 0 dB attenuation is the gain difference.

h) For EUT without a level control, the gain difference is the level difference between channels at the largest gain.

6.3 Frequency characteristics

6.3.1 Frequency response

6.3.1.1 Block diagram of measuring devices

6.3.1.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 17.

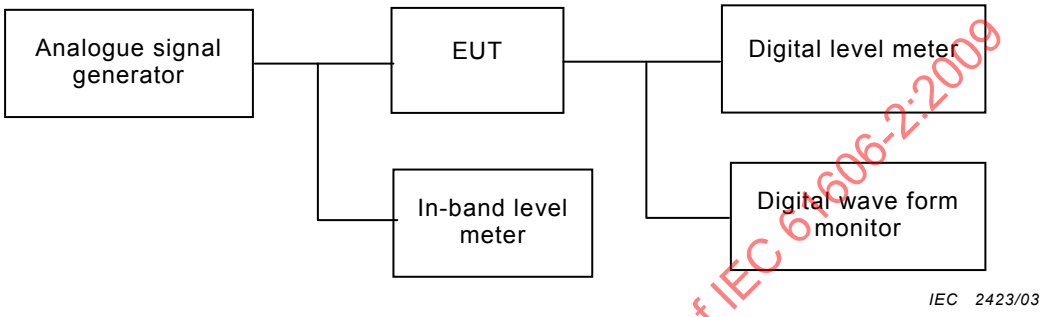


Figure 17 – Connection diagram of equipment

6.3.1.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 18.

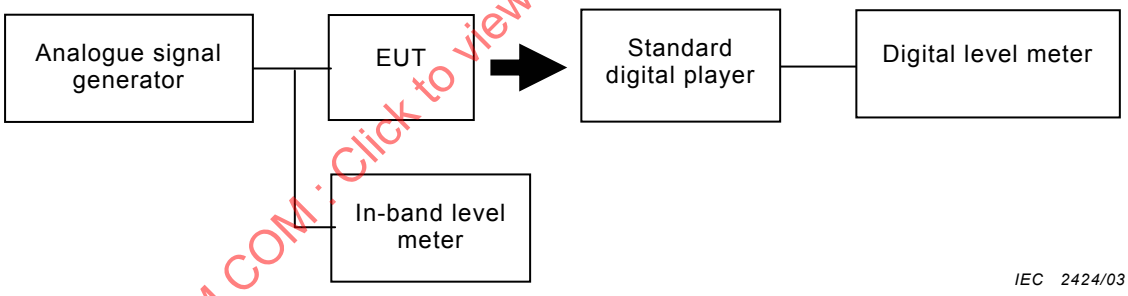


Figure 18 – Connection diagram of equipment

6.3.1.2 Input signal

Frequency: a) spot frequencies: see IEC 61606-1, Table 1.

b) sweep frequency: the frequency range is from 16 Hz to 1/2 *x* f_s which is the same as the comment under the Table 1 of IEC 61606-1.

Signal level: normal measuring level (0,2 V r.m.s.).

6.3.1.3 Procedure

The following prodecure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the 997 Hz sine signal at the normal measuring level to the EUT.

c) If the EUT has a digital output terminal, measure the output signal with the digital level meter.

d) If the EUT has no digital output terminal, record the output signal on to a medium and measure the output signal level from the standard digital player which replays the medium.

e) Apply other spot frequencies at the same signal level to the EUT, and get the output signal level by the same measurement as in c) and d).

f) Calculate the differences between the 997 Hz output and other frequency outputs.

g) The results are presented in a table or graphically.

h) The frequency response may also be measured using a sweep signal generator.

6.3.2 Group delay

6.3.2.1 Block diagram of measuring devices

6.3.2.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 19.

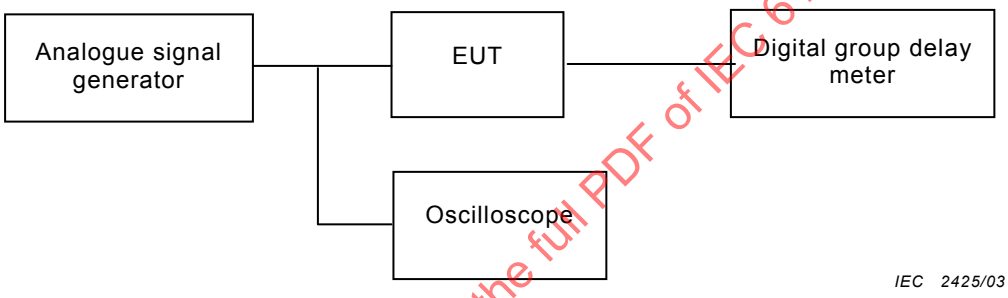


Figure 19 – Connection diagram of equipment

6.3.2.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 20.

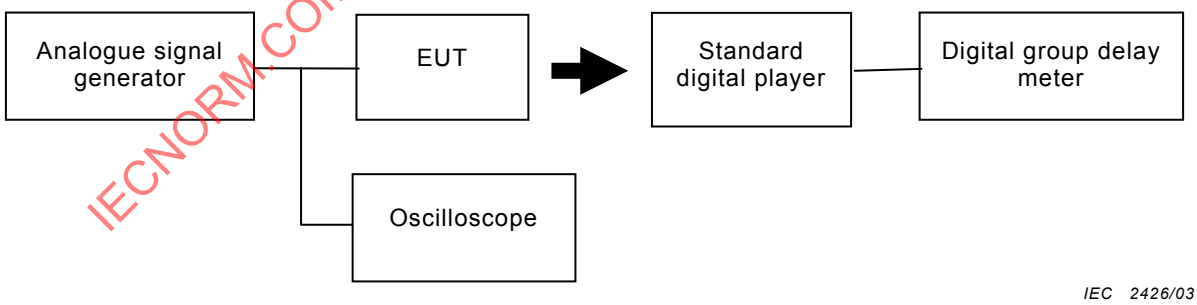


Figure 20 – Connection diagram of equipment

6.3.2.2 Input signal

The input signal described in IEC 61606-1, 4.6.2.3.1 shall be used.

6.3.2.3 Procedure

6.3.2.3.1 EUT with digital output terminals

The following procedure applies.

a) Set EUT to the standard settings specified in 4.5.

b) Apply the input signal to the EUT.

c) Read the delay time τ_R of the 997 Hz component on the digital group delay meter.

d) Read the delay time τ_C of the measuring frequency *f*.

e) The group delay of the EUT, τ , at the measuring frequency, *f,* is given by:

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

6.3.2.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the input signal to the EUT and record the output into a medium.

c) Reproduce the signal recorded in the medium and read the delay time τ_R of the 997 Hz component on the digital group delay meter.

d) Read also the delay time τ_C of the measuring frequency *f* component at the Digital group delay meter.

e) The group delay of the EUT, τ , at the measuring frequency, *f,* is given by:

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

6.4 Noise characteristics

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

6.4.1.1 Block diagram of measuring devices

6.4.1.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 21.

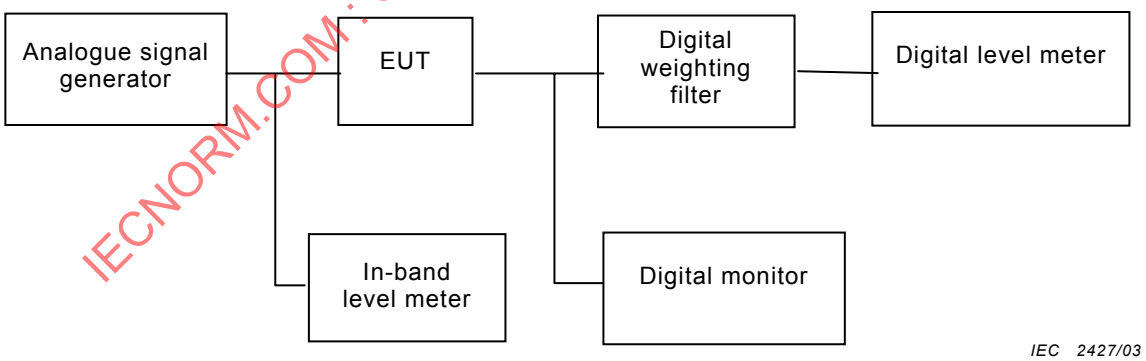


Figure 21 – Connection diagram of equipment

6.4.1.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 22.

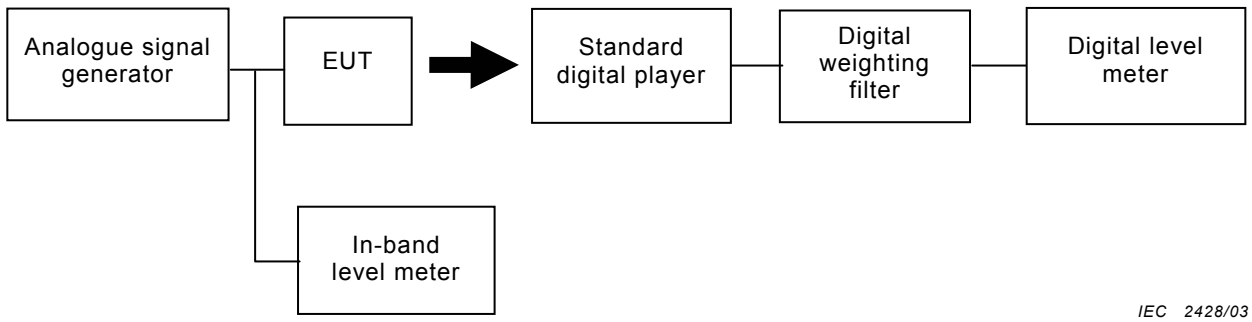


Figure 22 – Connection diagram of equipment

6.4.1.2 Input signal

a) Reference signal: frequency: 997 Hz.
signal level: analogue full-scale level.

b) Noise measuring condition: terminated the analogue input terminals with a normal source impedance.

6.4.1.3 Procedure

6.4.1.3.1 EUT with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply an input reference signal a) and measure the output level of the EUT, A dB_{FS}.

c) Disconnect the analogue input signal and set the input terminal as input condition b). Measure the output signal level, B dB_{FS}.

d) Calculate the signal-to-noise ratio from the following equation:

Signal-to-noise ratio = $(A - B)$ dB.

6.4.1.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply the reference signal to an input terminal and record the output signal to a medium.

c) Replay the recorded medium using a standard medium player and measure the output signal level A dB_{FS}.

d) Disconnect the analogue input signal and set input terminals as input condition b), and record the output signal to a recording medium.

e) Replay the recorded medium using a standard medium player and measure the output signal level B dB_{FS}.

f) Calculate the signal-to-noise ratio from the following equation:

Signal-to-noise ratio = $(A - B)$ dB.

6.4.2 Dynamic range

6.4.2.1 Block diagram of measuring devices

6.4.2.1.1 EUT with digital output terminal

Connect the EUT and measuring instrument as in Figure 23.

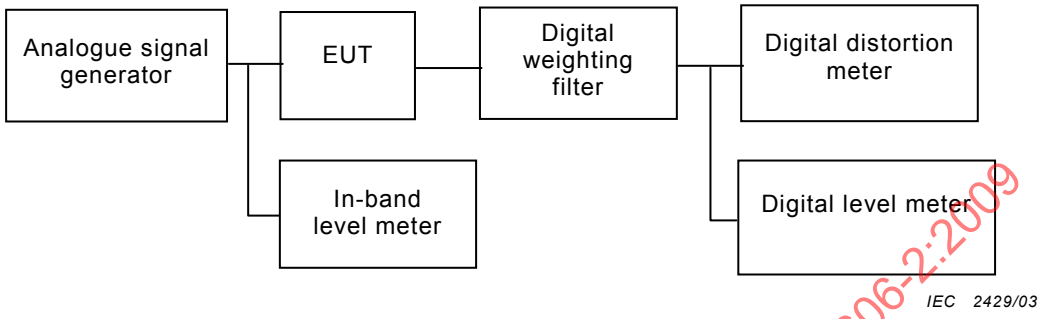


Figure 23 – Connection diagram of equipment

6.4.2.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 24.

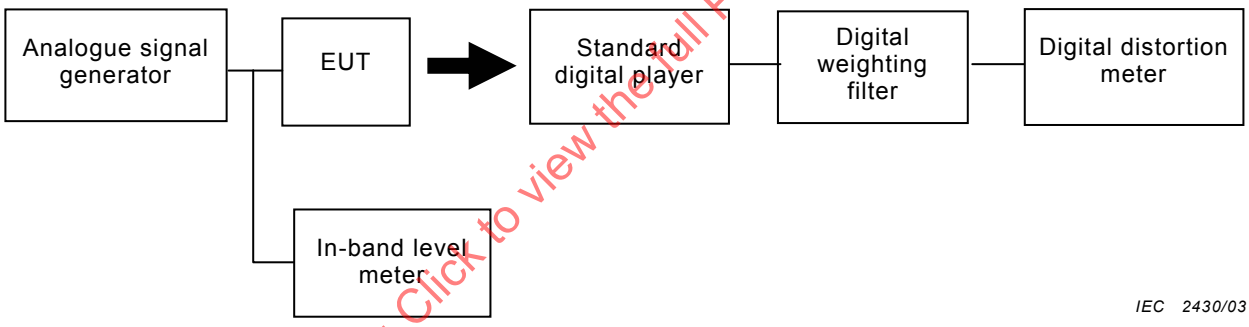


Figure 24 – Connection diagram of equipment

6.4.2.2 Input signal

Frequency: 997 Hz.

Signal level: –60 dB from analogue full-scale level.

6.4.2.3 Procedure

6.4.2.3.1 EUT with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply an input signal to the EUT.
c) Adjust the input signal level so that the output signal level is – 60 dB_{FS}.
d) Read the indication of the digital distortion meter and convert the reading into dB as A.
e) The dynamic range D is calculated from the equation:

Dynamic range D = [A + 60] dB

6.4.2.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Apply an analogue input signal to the EUT.
c) Record the output signal to a recording medium.
d) Replay the recorded medium and read the distortion indicated by the digital distortion meter.
e) Convert the reading into dB as A.
f) The dynamic range D is calculated from the equation:

Dynamic range D = [A + 60] dB

6.4.3 Folded noise

6.4.3.1 Block diagram of measuring devices

6.4.3.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 25.

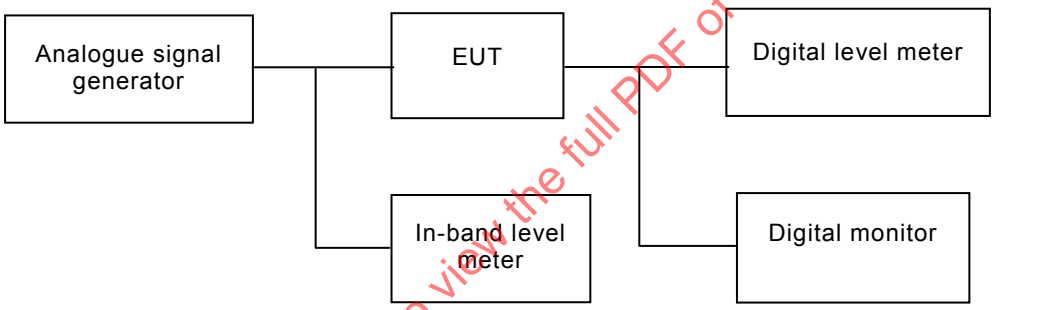


Figure 25 – Connection diagram of equipment

6.4.3.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 26.

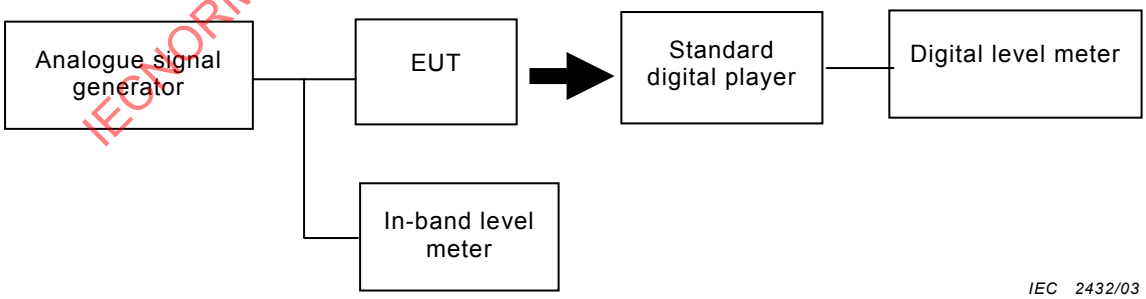


Figure 26 – Connection diagram of equipment

6.4.3.2 Input signal

Interfering frequency: f_1, f_2, f_3 (refer to Table 2).

$f_1 = f_s$ – upper band-edge frequency

$f_2 = f_s$ – 10 kHz

$f_3 = f_s - 1$ kHz

Signal level: analogue full-scale level.

Table 2 – Interfering frequency

f_s kHz	f_1 kHz	f_2 kHz	f_3 kHz
32,0	14,5	22,0	31,0
44,1	24,1	34,1	43,1
48,0	26,0	38,0	47,0
88,2	48,2	78,2	87,2
96,0	52,0	86,0	95,0
176,0	96,0	166,0	175,0
192,0	104,0	182,0	191,0

6.4.3.3 Procedure

6.4.3.3.1 EUT with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply an analogue input signal of 997 Hz at analogue full-scale level to the EUT and measure the output level A dB_{FS}.

c) Apply an interfering signal to the input terminal of the EUT and measure the output signal level, B dB_{FS} using a digital level meter.

d) The folded noise level is calculated from the equation:

Folded noise = $(B - A)$ dB.

6.4.3.3.2 EUT without digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.

b) Apply an analogue input signal of 997 Hz at analogue full-scale level to the EUT and record the signal to a medium.

c) Reproduce the recorded signal in the medium using a standard digital player and measure the maximum output level A dB_{FS} using a digital level meter.

d) Apply an interfering signal to the input terminal of the EUT and record the signal to a medium.

e) Reproduce the recorded signal in the medium using a standard player and measure the output signal level, B dB_{FS} using the digital level meter.

f) The folded noise level is calculated from the equation:

Folded noise = $(B - A)$ dB.

6.4.4 Cross-talk

6.4.4.1 Block diagram of measuring devices

6.4.4.1.1 EUT with digital output terminals

Connect the EUT and measuring instrument as in Figure 27.

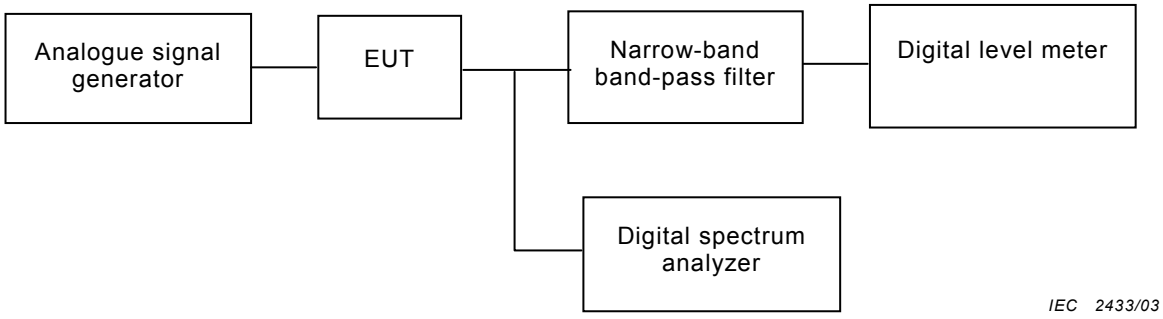


Figure 27 – Connection diagram of equipment

6.4.4.1.2 EUT without digital output terminals

Connect the EUT and measuring instrument as in Figure 28.

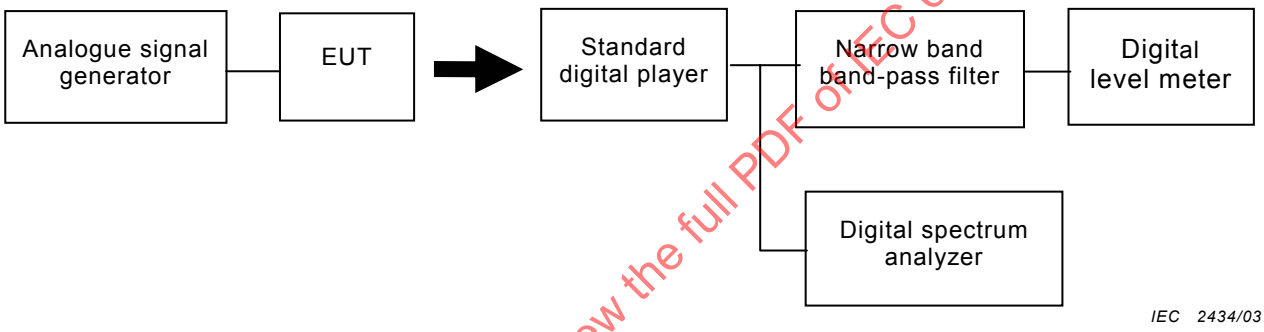


Figure 28 – Connection diagram of equipment

6.4.4.2 Input signal

Frequency: given in IEC 61606-1, Table 1.

Signal level: –3 dB from analogue full-scale level.

6.4.4.3 Procedures

6.4.4.3.1 EUT with digital output terminals

The following procedure applies.

a) Set the EUT to the standard settings specified in 4.5.
b) Set the input selector to the wanted source group.
c) Apply the input signal to a selected channel of the wanted source group.
d) Read the output level of selected channel as A dB_{FS}.
e) Terminate the input terminal of the selected channel by the normal source input impedance.
f) Apply the same input signal as step 3) to the input terminal of unwanted source group channels which are not selected by selector.
g) Measure the output signal level at the output terminal of the selected channel in the wanted source group as B dB_{FS}.
h) The cross-talk attenuation is given by the equation: $(A - B)$ dB.