INTERNATIONAL STANDARD

IEC 61606-2

First edition
2003-10

Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics –

Part 2:
Consumer use

Reference number
IEC 61606-2:2003(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (http://www.iec.ch/searchpub/cur_fut.htm) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (http://www.iec.ch/online_news/justpub/jp_entry.htm) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC
61606-2

First edition
2003-10

Audio and audiovisual equipment –
Digital audio parts – Basic measurement
methods of audio characteristics –

Part 2:
Consumer use

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE   V

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION
_____

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

Part 2: Consumer use

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61606-2 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

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

FDIS	Report on voting
100/695/FDIS	100/716/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 2: Consumer use

1 Scope

This part of IEC 61606 deals with the basic measurement methods of the audio charac-teristics 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. Specific 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 61606-1, *Audio and audiovisual equipment – Digital audio parts – Basic measurement methods of audio characteristics – Part 1: General*

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

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

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 Definitions

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

3.1.1

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

3.1.3

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

3.1.4

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

3.2   Explanation of terms

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

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

4.1   Environmental conditions

As in IEC 61606-1.

4.2   Power supply

As in IEC 61606-1.

4.3   Test signal frequencies

As in IEC 61606-1.

4.4   Standard setting

As in IEC 61606-1.

4.5   Preconditioning

As in IEC 61606-1.

4.6 Measuring instruments

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

4.6.1 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:

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

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

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

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 *fs*. 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

$t \leq L/2$

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

4.6.2 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:

$$V_{total} = (V_{f1}^2 + V_{f2}^2 + V_{f32}^2 + \dots V_{fn}^2)^{1/2}$$

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:

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

The total distortion D is obtained from the equation:

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

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

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

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. 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.

5.1 Input/output characteristics

5.1.1 Maximum output amplitude

5.1.1.1 Input signal

Frequency: 997 Hz

Signal level: full-scale level

5.1.1.2 Procedures

Set the EUT to the standard setting specified in 4.4.

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 %.

5.1.2 Gain difference between channels

5.1.2.1 Method of measurement

Connect the EUT and measured equipment as in Figure 1.

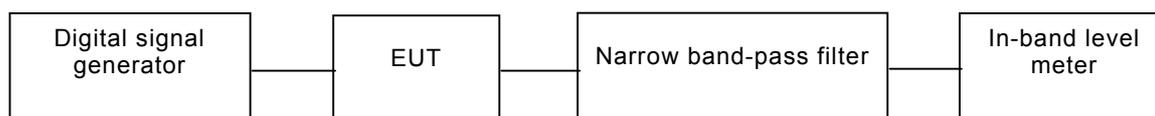| Digital signal generator	EUT	Narrow band-pass filter	In-band level meter

Figure 1 – Connection diagram of equipments   IEC   2407/03

5.1.2.1.1 Input signal

Frequency: 997 Hz.

Signal level: normal measuring level (–20 dB$_{FS}$).

5.1.2.1.2   Procedure

a) Set the EUT to the standard settings specified in 4.4.

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.

5.2   Frequency characteristics

5.2.1   Frequency response

5.2.1.1   Method of measurement
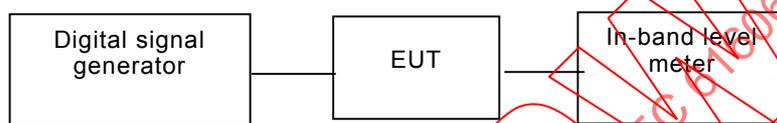
Connect the EUT and measured equipment as in Figure 2.

IEC 2408/03

Figure 2 – Connection diagram of equipments

5.2.1.1.1   Input signal

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 method see IEC 61606-1, Table 2.

Signal level: normal measuring level (-20 dB$_{FS}$).

5.2.1.1.2   Procedure

a) Set the EUT to the standard settings specified in 4.4.

b) Apply a reference signal to the EUT and measure the output signal with the r.m.s. 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.

5.2.2   Group delay (phase linearity)

5.2.2.1   Method of measurement

Connect the EUT and measured equipment as in Figure 3.

IEC 2409/03

Figure 3 – Connection diagram of equipments

5.2.2.1.1 Input signal

The signal generator for group delay measurement (described in IEC 61606-1, 4.6.1.3.1) shall be used.

5.2.2.1.2 Procedure

a) Set the EUT to the standard settings specified in 4.4.

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 delay time 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.

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

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

5.3 Noise characteristics

5.3.1 Signal-to-noise ratio

5.3.1.1 Method of measurement
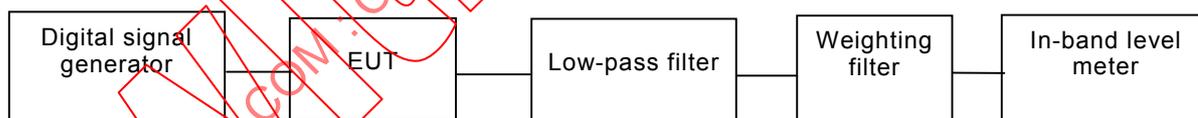
Connect the EUT and measured equipment as in Figure 4.

IEC   2410/03

Figure 4 – Connection diagram of equipment

5.3.1.1.1 Input signal

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

          Frequency = 997 Hz.

Signal (*B*):   Digital zero.

5.3.1.1.2 Procedure

a) Set the EUT to the standard settings specified in 4.4.

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: $SN = (A - B)$.

5.3.2   Dynamic range

5.3.2.1   Method of measurement

Connect the EUT and measured equipment as in Figure 5.

IEC   2411/03

Figure 5 – Connection diagram of equipment

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

5.3.2.1.1   Input signal

Frequency: 997 Hz.

Signal level: −60 dB$_{FS}$.

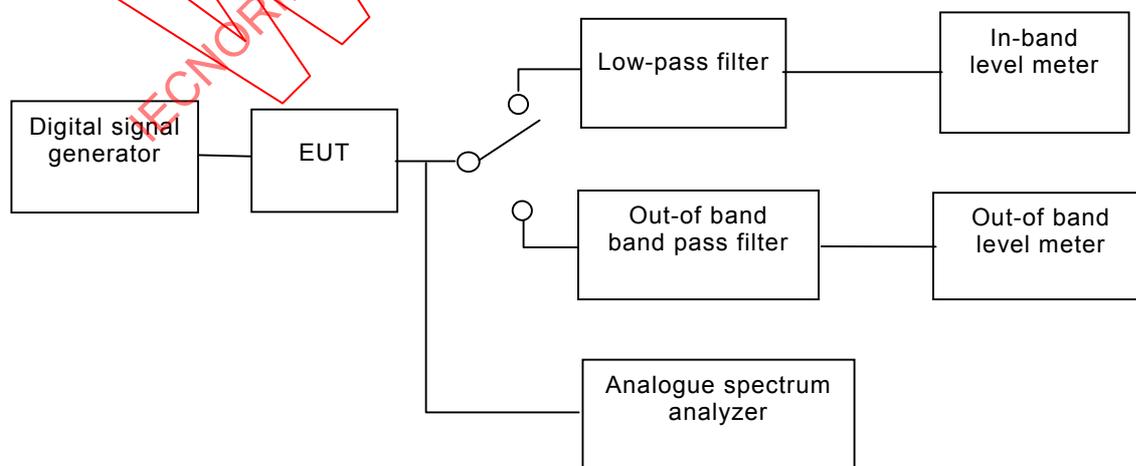### 5.3.2.1.2   Procedure

a)   Set the EUT to the standard settings specified in 4.4.

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:

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

5.3.3   Out-of-band noise ratio

5.3.3.1   Method of measurement

Connect the EUT and measured equipment as in Figure 6.

IEC   2412/03

Figure 6 – Connection diagram of equipment

5.3.3.1.1 Input signal

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

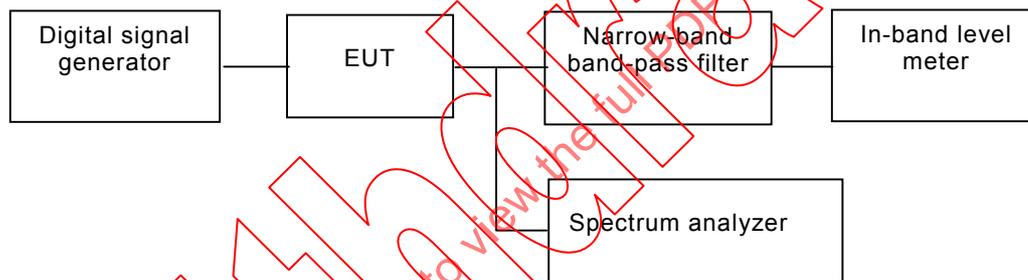Signal level: full-scale level (0 dB$_{FS}$).

5.3.3.1.2 Procedure

a) Set the EUT to the standard settings specified in 4.4.

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:

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

5.3.4 Channel separation

5.3.4.1 Method of measurement

Connect the EUT and measured equipment as in Figure 7.

IEC   2413/03

Figure 7 – Connection diagram of equipment

5.3.4.1.1 Input signal

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

Signal level: full-scale level.

5.3.4.1.2 Procedure

a) Set the EUT to the standard settings specified in 4.4.

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 of the selected channel and apply the same signal applied in item c) to the input of the other channel.

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 equation: channel separation = $(A - B)$ dB.

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

5.4   Distortion characteristics

5.4.1   Level non-linearity

5.4.1.1   Measuring methods

Connect the EUT and measured equipment as in Figure 8.

Digital signal generator		EUT		Narrow-band band-pass filter		In-band level meter
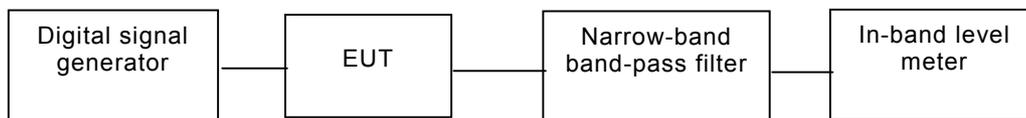
IEC   2414/03

Figure 8 – Connection diagram of equipment

5.4.1.1.1   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}.

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}.
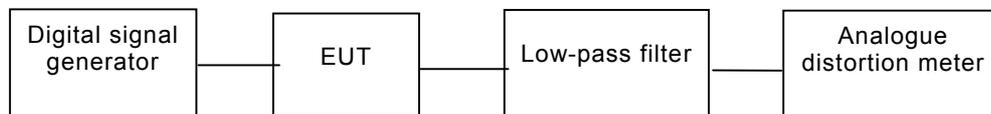
5.4.1.1.2   Procedure

a) Set the EUT to the standard settings specified in 4.4.

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 input signal levels for the signal level range to be tested.

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

5.4.2   Distortion and noise

5.4.2.1   Method of measurement

Connect the EUT and measured equipment as in Figure 9.

IEC   2415/03

Figure 9 – Connection diagram of equipment

5.4.2.1.1   Input signal

Frequency: 997 Hz or as given in IEC 61606-1, Table 1, if needed.
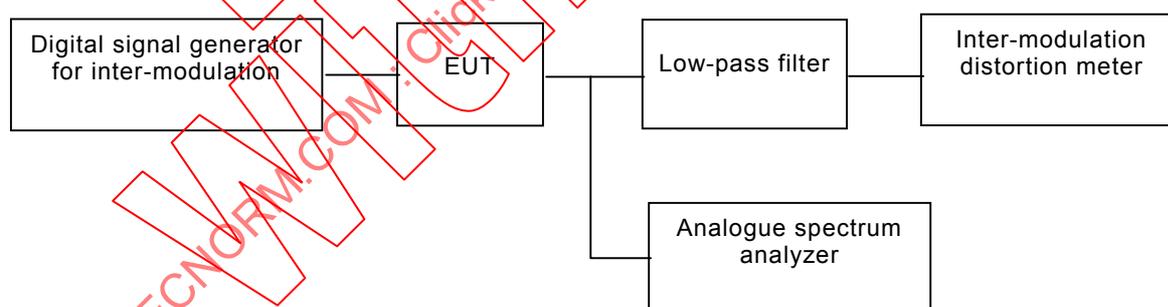Signal level: full-scale level (0 dB$_{FS}$).

5.4.2.1.2   Procedure

a) Set the EUT to the standard settings specified in 4.4.
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.

5.4.3   Intermodulation

5.4.3.1   Method of measurement

Connect the EUT and measured equipment as in Figure 10.

IEC   2416/03

Figure 10 – Connection diagram of equipment

5.4.3.1.1   Input signal

The signal specified in IEC 61606-1, 4.6.1.2 shall be used.

5.4.3.1.2   Procedure

a) Set the EUT to the standard settings specified in 4.4.
b) Apply the input signal to the EUT and measure the intermodulation distortion of the output signal using the intermodulation distortion meter.

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

The methods of measurement described in the following subclauses 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 subclauses specify the details of measurement methods for consumer use equipment.

There are two types of equipment with digital output terminals and no digital output terminal. The equipment without output terminals is typically recording equipment such as DAT, CD-R and similar.
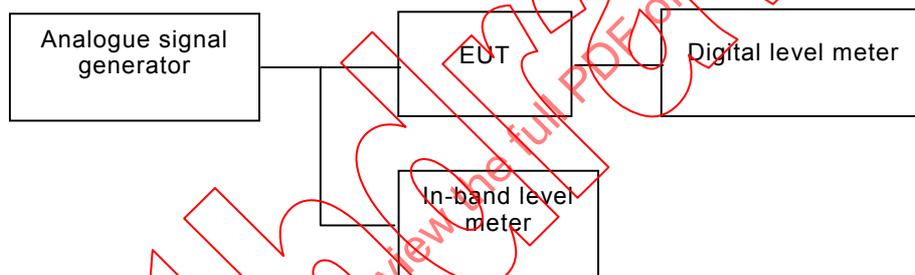
6.1   Input/output characteristics

6.1.1   Analogue to digital level calibration

6.1.1.1   Method of measurement

a) **EUT with digital output terminals**

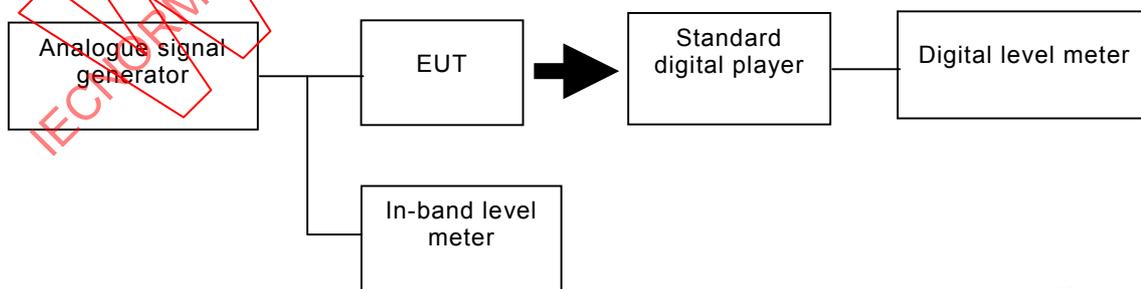Connect the EUT and measured equipment as in Figure 11.

IEC 2417/03

Figure 11 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 12.

IEC 2418/03

Figure 12 – Connection diagram of equipment

6.1.1.1.1   Input signal

Frequency :   997 Hz.

Signal level: normal measuring level (0,2 V r.m.s. in the case of general purpose audio for consumer).

6.1.1.1.2   Procedure

a) **Equipment with digital output terminals**

1) Set the controls of the EUT to the standard settings specified in 4.4.

2) 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.

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

4) Ten times A V r.m.s. is the analogue full-scale level.
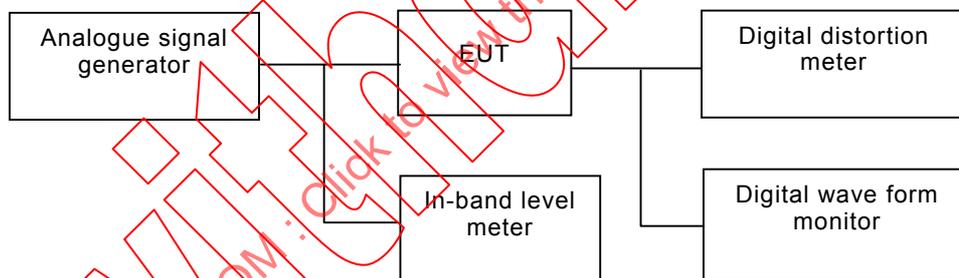
b) **Equipment without digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

2) 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.

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

4) Estimate the analogue input signal level, A V r.m.s., which corresponds to 1/4 of the full-scale output level. ($4 \times A$ V r.m.s.) is the analogue full-scale level.

6.1.2   Maximum allowable input amplitude

6.1.2.1   Method of measurement

a) **EUT with digital output terminals**

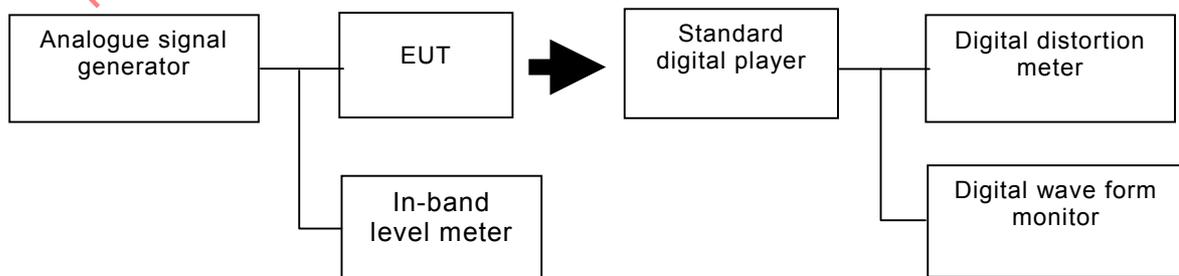Connect the EUT and measured equipment as in Figure 13.

IEC   2419/03

Figure 13 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 14.

IEC   2420/03

Figure 14 – Connection diagram of equipment

6.1.2.1.1   Input signal

Frequency: 997 Hz.

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

6.1.2.1.2   Procedure

a) **Equipment with digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

2) Apply the input signal and increase the signal amplitude from 0 V r.m.s.

   If the level of the digital output terminal exceeds the normal measuring level (–20 dB$_{FS}$), adjust the level controller to maintain the output level to the normal measuring level.

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

4) For EUT without a level control, measure the input signal level with 1 % distortion output signal.
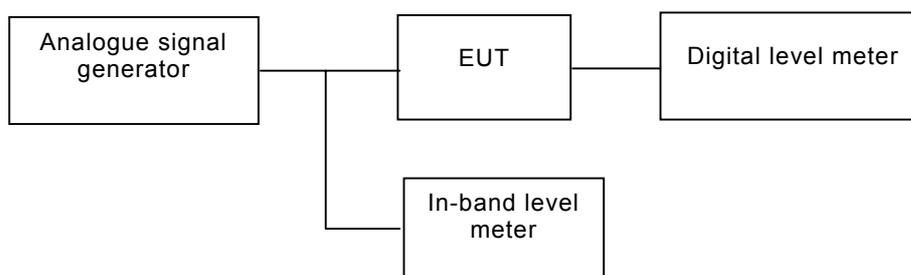
b) **EUT without digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

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

3) 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.

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

5) Measure the distortion a per cent exceeding 1 % and record the input signal level to the medium as A dB, and the distortion b %, which should be less than 1 %, with an input signal level $(A – 1)$ dB.

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

   L dB = {$A – (a – 1)/(a – b)$} dB.

7) 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 %.

6.1.3   Gain difference between channel and tracking error

6.1.3.1   Method of measurement

a) **EUT with digital output terminals**

Connect the EUT and measured equipment as in Figure 15.

Figure 15 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 16.

```
┌──────────────┐      ┌─────────┐        ┌──────────────┐      ┌──────────────────┐
│ Analogue     │      │  EUT    │   ▶    │  Standard    │      │ Digital level    │
│ signal       │      │         │        │  digital     │      │ meter            │
│ generator    │      │         │        │  player      │      │                  │
└──────────────┘      └─────────┘        └──────────────┘      └──────────────────┘
        │        │
        └────────┤
                 │     ┌──────────────┐
                 └─────│ In-band level│
                       │ meter        │
                       └──────────────┘
```
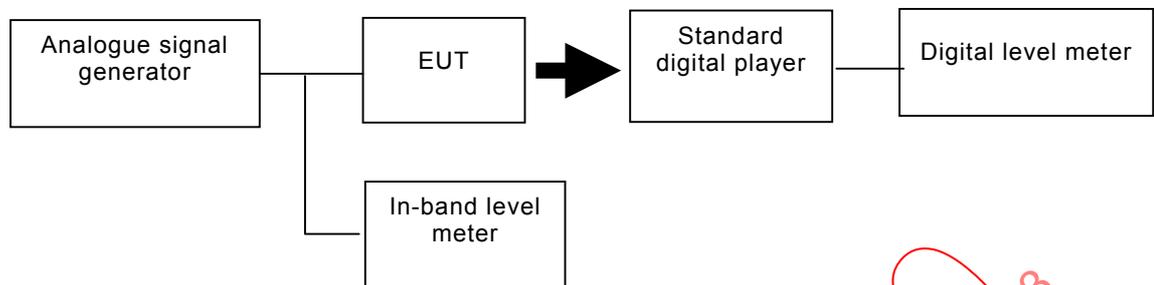
IEC 2422/03

Figure 16 – Connection diagram of equipment

6.1.3.1.1　　Input signal

Frequency:　　997 Hz.

Signal level:　normal measuring level (0,2 V r.m.s. in the case of general purpose audio for consumer).

6.1.3.1.2　　Procedure

a) **EUT with digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

2) Set the level controller to its position of highest gain.

3) Apply the input signal to each channel of the EUT.

4) 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.

5) Measure the output signal level for each channel by decreasing the position of the level control.

6) Calculate the gain difference of each channel with reference to the channel having the largest gain.

7) The tracking error is the largest gain difference when the level controller is changed to a specified attenuation range, or attenuation is changed from 0 dB to –60 dB.

8) For EUT without a level control the gain difference is the level difference between channels at the largest gain

b) **EUT without digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

2) Set the level controller to its position of highest gain.

3) 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.

4) Measure the signal level of the output for each channel from the recorded medium using the standard player.

5) Calculate the level difference of each channel with reference to the channel with the highest gain.

6) The maximum level difference is the tracking error.

7) The level difference at 0 dB attenuation is the gain difference.

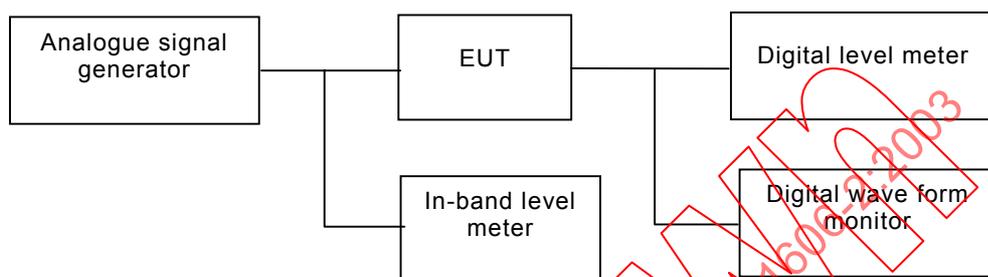8) For EUT without a level control, the gain difference is the level difference between channels at the largest gain.

6.2 Frequency characteristics

6.2.1 Frequency response

6.2.1.1 Method of measurement

a) **EUT with digital output terminals**

Connect the EUT and measured equipment as in Figure 17.
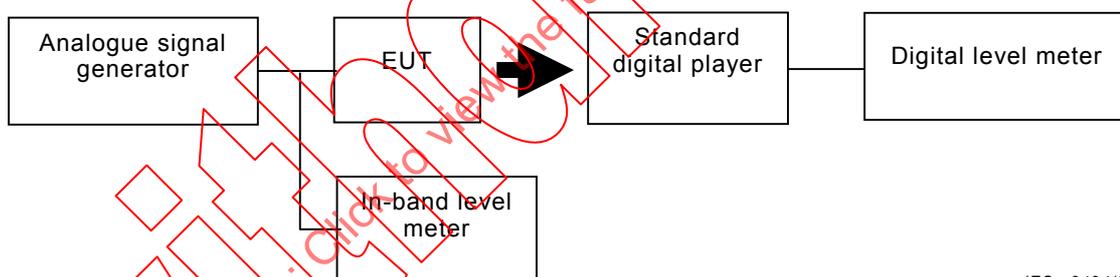

IEC 2423/03

Figure 17 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 18.

IEC 2424/03

Figure 18 – Connection diagram of equipment

6.2.1.1.1 Input signal

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

b) sweep frequency: see IEC 61606-1, Table 2.

Signal level: normal measuring level (0,2 V r.m.s. in the case of general purpose audio for consumer).

6.2.1.1.2 Procedure

a) Set the EUT to the standard settings specified in 4.4,

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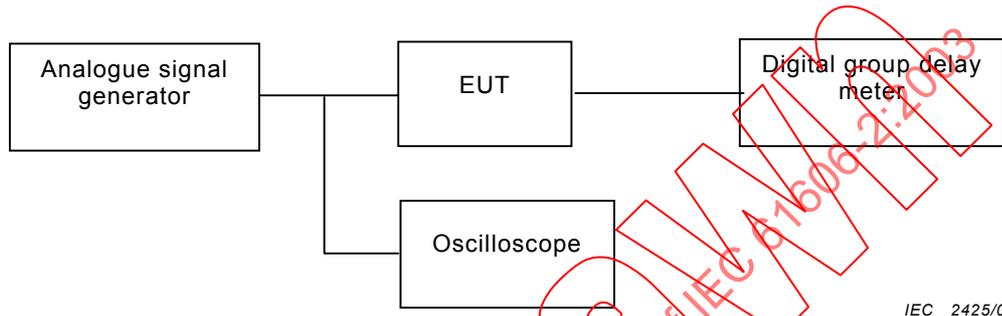
f) Calculate the differences between the 997 Hz output and other frequency outputs.

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

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

6.2.2   Group delay

6.2.2.1   Method of measurement

a) **EUT with digital output terminals**
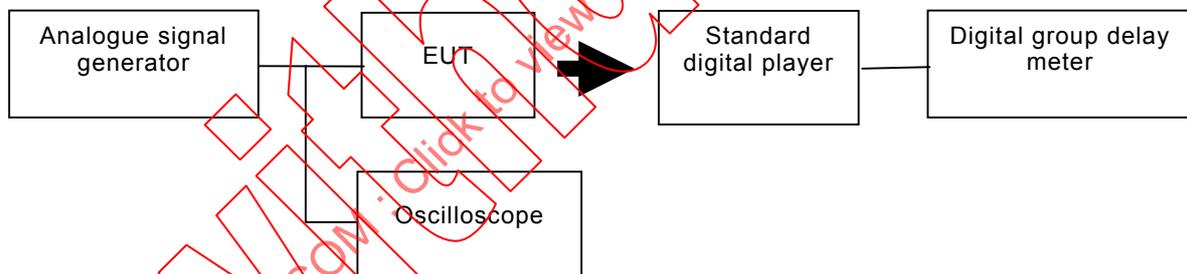
Connect the EUT and measured equipment as in Figure 19.

Figure 19 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 20.

Figure 20 – Connection diagram of equipment

6.2.2.1.1   Input signal

The input signal described in IEC 61606-1, 4.6.1.3.2 shall be used.

6.2.2.1.2   Procedure

a) **EUT with digital output terminals**

1) Set EUT to the standard settings specified in 4.4.

2) Apply the input signal to the EUT.

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

4) Read the delay time τ_C of the measuring frequency f.

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

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

b) **EUT without digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

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

3) 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.

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

5) The group delay of the EUT, τ, at the measuring frequency, f, is given by:
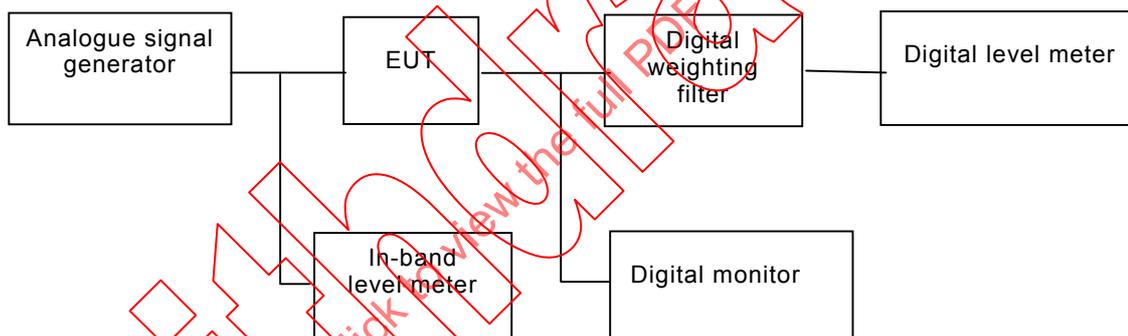
$$\tau = \tau_C - \tau_R.$$

6.3   Noise characteristics

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

6.3.1.1   Method of measurement

a) **EUT with digital output terminals**

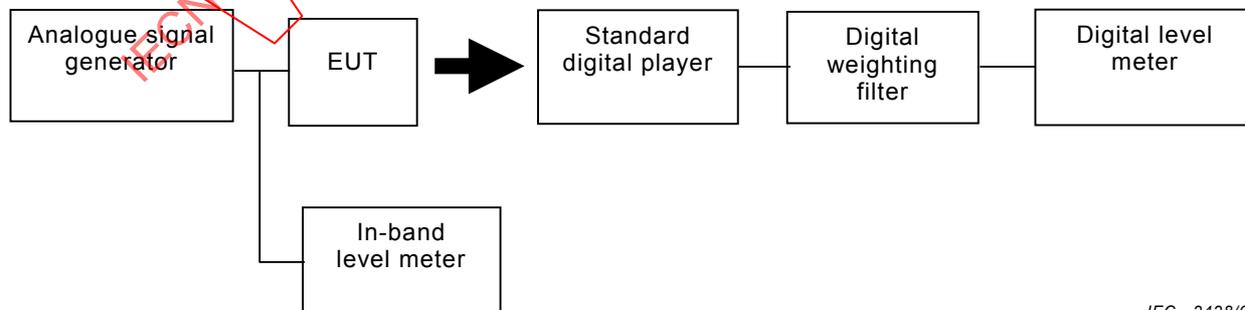Connect the EUT and measured equipment as in Figure 21.

IEC   2427/03

Figure 21 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 22.

IEC   2428/03

Figure 22 – Connection diagram of equipment

6.3.1.1.1 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.

6.3.1.1.2 Procedure

a) **EUT with digital output terminals**

 1) Set the EUT to the standard settings specified in 4.4.

 2) Apply an input reference signal a) and measure the output level of the EUT, A dB$_{FS}$.

 3) Disconnect the analogue input signal and set the input terminal as input condition b). Measure the output signal level, B dB$_{FS}$.

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

 Signal-to-noise ratio = $(A - B)$ dB.
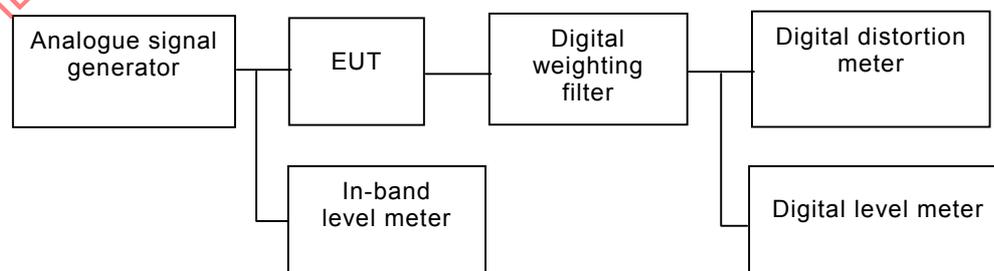
b) **EUT without digital output terminals**

 1) Set the EUT to the standard settings specified in 4.4.

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

 3) Replay the recorded medium using a standard medium player and measure the output signal level A dB$_{FS}$.

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

 5) Replay the recorded medium using a standard medium player and measure the output signal level B dB$_{FS}$.

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

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

6.3.2 Dynamic range

6.3.2.1 Method of measurement

a) **EUT with digital output terminal**

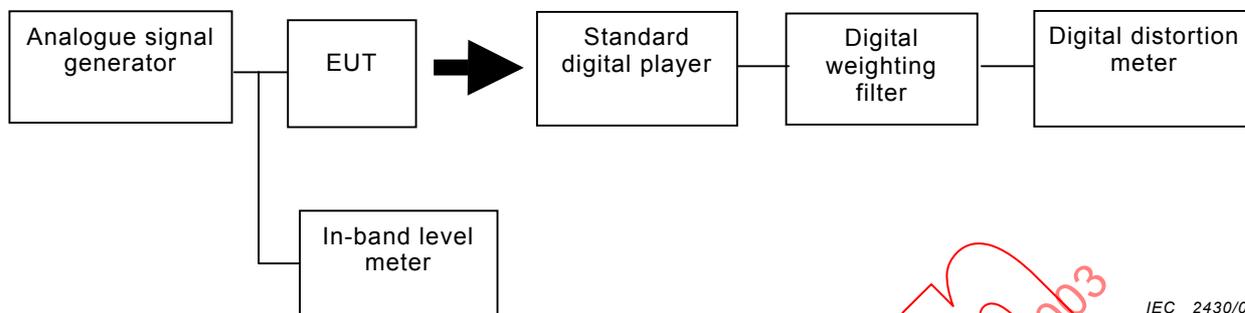 Connect the EUT and measured equipment as in Figure 23.

IEC 2429/03

Figure 23 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 24.

IEC   2430/03

Figure 24 – Connection diagram of equipment

6.3.2.1.1   Input signal

Frequency: 997 Hz.

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

6.3.2.1.2   Procedure

a) **EUT with digital output terminals**
   1) Set the EUT to the standard settings specified in 4.4.
   2) Apply an input signal to the EUT.
   3) Adjust the input signal level so that the output signal level is –60 dB$_{FS}$.
   4) Read the indication of the digital distortion meter and convert the reading into dB as A.
   5) The dynamic range D is calculated from the equation:
      Dynamic range $D = [A + 60]$ dB
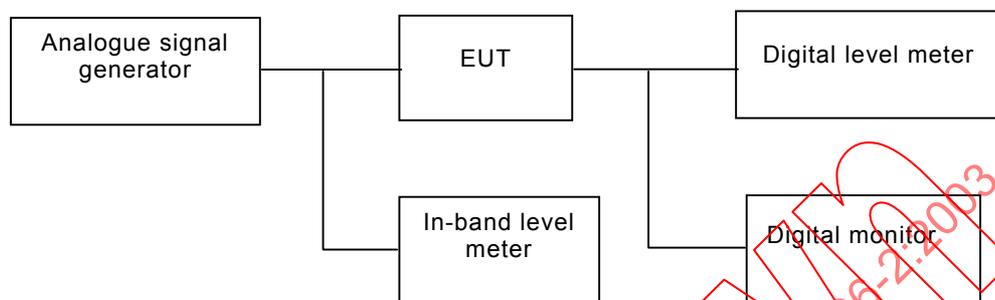
b) **EUT without digital output terminals**
   1) Set the EUT to the standard settings specified in 4.4.
   2) Apply an analogue input signal to the EUT.
   3) Record the output signal to a recording medium.
   4) Replay the recorded medium and read the distortion indicated by the digital distortion meter.
   5) Convert the reading into dB as A.
   6) The dynamic range D is calculated from the equation:
      Dynamic range $D = [A + 60]$ dB

6.3.3   Folded noise

6.3.3.1   Method of measurement

a) **EUT with digital output terminals**

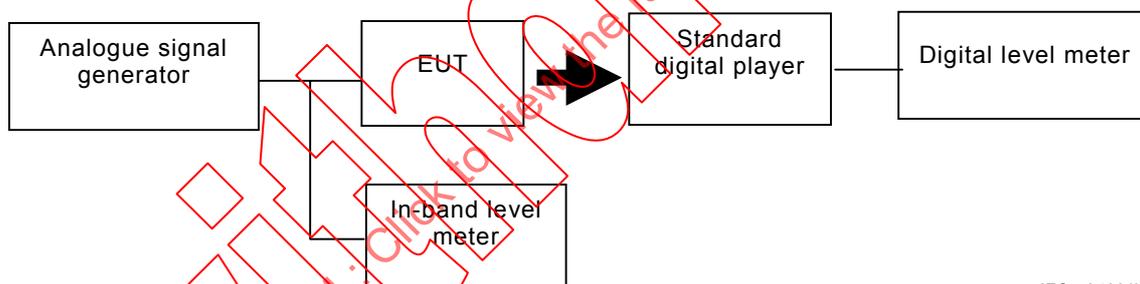Connect the EUT and measured equipment as in Figure 25.

Figure 25 – Connection diagram of equipment

b) **EUT without digital output terminals**

Connect the EUT and measured equipment as in Figure 26.

Figure 26 – Connection diagram of equipment

6.3.3.1.1   Input signal: interfering signal

Frequency: $f1$, $f2$, $f3$ (these are interfering frequencies).

$f1$ = fs – Upper band-edge frequency

$f2$ = fs – 10 kHz

$f3$ = fs – 1 kHz

Table 2 – Upper limited measuring frequency

fs kHz	$f1$ kHz	$f2$ kHz	$f3$ kHz
32,0	14,5	22,0	31
44,1	24,1	34,1	43,1
48,0	26,0	38,0	47
88,2	48,2	78,2	87,2
96,0	52,0	86,0	95
176	96,0	166	175
192	104,0	182	191

Signal level: analogue full-scale level.

6.3.3.1.2   Procedure

a) **EUT with digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

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

3) 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.

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

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

b) **EUT without digital output terminals**

1) Set the EUT to the standard settings specified in 4.4.

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

3) 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.

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

5) 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.

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

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

6.3.4   Cross-talk

6.3.4.1   Method of measurement

a) **EUT with digital output terminals**

Connect the EUT and measured equipment as in Figure 27.