INTERNATIONAL STANDARD

IEC
62122

Methods of measurement for consumer-use digital VTRs – Electronic and mechanical performances

Méthodes de mesure pour les magnétoscopes numériques destinés au grand public – Performances électroniques et mécaniques

Reference number
IEC 62122:2002(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 (www.iec.ch/catlg-e.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 On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.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 (www.iec.ch/JP.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
62122

First edition
2002-03

Methods of measurement for consumer-use digital VTRs – Electronic and mechanical performances

Méthodes de mesure pour les magnétoscopes numériques destinés au grand public – Performances électroniques et mécaniques

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **T**

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

METHODS OF MEASUREMENT FOR CONSUMER-USE DIGITAL VTRs – ELECTRONIC AND MECHANICAL PERFORMANCES

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

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

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

International Standard IEC 62122 has been prepared by TA 7: Moderate data rate storage media and equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

FDIS	Report on voting
100/452/FDIS	100/480/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.

Annex A is for information only.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

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

METHODS OF MEASUREMENT FOR CONSUMER-USE DIGITAL VTRs – ELECTRONIC AND MECHANICAL PERFORMANCES

1 Scope and object

This standard specifies the basic methods of measurement for evaluating the electronic and mechanical performances of consumer-use digital VTRs.

The formats of open reel VTRs, Beta, VHS, and 8 mm VTRs have been standardized. Methods of measurement for these analogue VTRs have been standardized in IEC 61041-1, IEC 61041-2, IEC 61041-3, IEC 61041-4, IEC 61041-5, and IEC 61146-3. Digital VTR 6,35 mm DV format and 12,65 mm D-VHS format have now been brought on the market. The methods of measurement for these consumer-use digital VTRs should be specified and standardized.

With these measurement techniques, some items for the evaluation of performances specific to digital VTRs have also been included.

There are two objectives for the proposed methods of measurement. One is to check the interchangeability and characteristics of the equipment under test which are indispensable to manufacturers, and the other is to evaluate the quality of image and sound, which concerns the customer. The latter is a priority for consumer satisfaction.

Since a consumer can use only general-purpose instruments, any test which needs dismantling of apparatus and requires special instruments is in principle not specified. As error rate is important for digital equipment, an example of a method for measuring error rate is given in annex A.

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 60094-3:1979, *Magnetic tape sound recording and reproducing systems – Part 3: Methods of measuring the characteristics of recording and reproducing equipment for sound on magnetic tape*

IEC 60386:1972, *Method of measurement of speed fluctuations in sound recording and reproducing equipment*

IEC 60883:1987, *Measuring method for chrominance signal-to-random noise ratio for video tape recorders*

IEC 61041-1:1990, *Non-broadcast video tape recorders – Methods of measurement – Part 1: General, video (NTSC/PAL) and audio (longitudinal) characteristics*

IEC 61041-5:1997, *Non-broadcast video tape recorders – Methods of measurement – Part 5: High-band video tape recorders including those equipped with Y/C video connectors (NTSC/PAL)*

IEC 61834 (all parts), *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems)*

ITU-R BT.471-1:1986, *Nomenclature and description of colour bar signals*

ITU-R BT.500-10:2000, *Methodology for the subjective assessment of the quality of television pictures*

ITU-R BT.1204:1995, *Measuring methods for digital video equipment with analogue input/output*

3   Terms and definitions

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

3.1
consumer-use digital VTR
consumer-use video tape recorder using digital recording technology, 6,35 mm to 12,65 mm width videotape and bandwidth compression technology for the image signal. Two tape formats are standardized, as defined in the following two definitions. Although different formats may be introduced in the future, fundamental measuring methods can be adapted to all formats

3.1.1
DV format
6,35 mm helical-scan VTR standardized in IEC 61834

3.1.2
D-VHS format
12,65 mm helical-scan VTR which will be standardized in the near future. Until then, refer to the outline of the D-VHS format in documents [1][1] and [2]

3.2
ferrofluid development
direct observation of the magnetization on the videotape by the adherence of iron powder to its surface by dipping the tape into a fluid containing powder of fine iron in order to observe the recorded pattern using a microscope

3.3
byte
unit which separates the information series 1 into m bits. m usually consists of 8 bits, but not always

3.4
error rate
ratio of the number of erroneous elements to the total number of elements reproduced and/or transmitted during a given time interval

NOTE 1   The elements may be, for example, digits, code words or blocks.

NOTE 2   "Error ratio" is defined in similar terms as in IEV 704-18-03.

3.5
byte error rate
error rate for a signal constructed from byte units

(number of erroneous byte units)/(total number of elements of byte units)

3.6
MPEG-2 transport stream
MPEG-2 TS
data transmission format standardized by ISO/IEC MPEG (Moving Picture image coding Experts Group)

3.7
three dimensional (3D) signal processing
TV video signal process taken from three viewpoints: the horizontal and vertical directions and the time domain. Generally, it contains the operation processing between the fields or between frames using a field memory or a frame memory

———————

[1] Figures in square brackets refer to the Bibliography.

3.8
audio operational output voltage
standard output voltage specified by the manufacturer for the audio analogue signal interface between equipment when the output terminal is terminated by a specified load impedance

3.9
audio operational input voltage
input voltage specified by the manufacturer to generate the audio operational output voltage at the output terminal

3.10
audio maximum output voltage
maximum audio output voltage that a VTR under test can generate. In this standard, it is the voltage for an output signal of 3 % harmonic distortion, or it can be the voltage just before clipping when the output signal is digitally clipped

4 Measuring conditions

4.1 General

All measurements shall be carried out in the environmental conditions specified by the manufacturer.

If not otherwise stated by the manufacturer or by the format standard, the device under test shall be conditioned for at least 3 h before measurement begins. An adequate warm-up time may be used instead of 3 h conditioning.

The environmental conditions during measurement, at least the temperature and the relative humidity, shall be recorded together with the presentation of the results of the measurements.

4.2 Environmental conditions

The environmental conditions for the measurements shall be:

Ambient temperature: 20 °C ± 1 °C

Relative humidity: 50 % ± 2 %

Air pressure: 96 kPa ± 10 kPa

Ambient temperature can be within a range of 5 °C and 35 °C, and relative humidity within a range of 45 % and 75 % if these tolerances do not affect the results of measurement. Record the temperature and humidity at the time of measurement along with the results of the measurement.

4.3 Power supply

Use the power supply that conforms to the power requirements for the VTR under test. Voltage regulation shall be ±2,5 % or better. The frequency fluctuation shall be ±1 % or better and the harmonic content shall be 2 % or less.

4.4 Test signal

Use the test signals specified below for measurement.

4.4.1 Video test signal

Use a video test signal which has a 100 % amplitude level white signal of 4 μs inserted in every horizontal period so that the results of measurement do not include errors caused by disturbance of the video AGC circuitry of the VTR under test. A video test signal which contains

the 100 % level white signal over eight horizontal video periods inserted in every vertical blanking period may be used as an alternative.

4.4.2　Colour bar signal

Use the standard colour bar signal that conforms to the ITU-R BT.471-1 type (b).

4.4.3　Video input signal for measuring audio characteristics

When measuring the audio characteristics for analogue in and analogue out, the colour bar signal of 4.4.2 shall be applied to the VTR and recorded simultaneously with an audio test signal to stabilize the VTR synchronization.

4.5　Measuring instruments

4.5.1　Noise meter

Frequency bandwidth

Luminance:	0,1 kHz to 10 MHz
Chrominance:	3,58 MHz ± 1,5 MHz (NTSC)
	4,43 MHz ± 1,5 MHz (PAL)

Cut-off frequency

HPF:	0,1/100 kHz
LPF:	0,5/3,0/4,2/6,0 MHz/THROUGH

Input signal

For luminance S/N:	white signal with superimposed signal (level of 230 mVp-p or less)
For chrominance S/N:	white signal with superimposed single colour signal, modulated carrier

Measuring method

Luminance:	0 dB = 0,714 V (RMS value) for NTSC
	0 dB = 0,700 V (RMS value) for PAL.
Chrominance AM noise:	RMS value of detected AM noise
Chrominance PM noise:	RMS value of detected PM noise
Gated noise position:	Not gated until 4 µs before rising edge of white signal
Output noise signal:	Not saturated by the input signals specified above
Input terminal:	Composite video input terminal and Y/C separate signal input terminal such as S Video terminal

4.5.2　Audio signal generator

Frequency range:	4 Hz to 20 kHz in sinusoidal wave form
Output voltage:	Not less than 2 V
Total harmonic distortion:	Less than 0,001 % in the frequency range of 20 Hz to 20 kHz

4.5.3　Audio level meter

This meter shall measure the true root mean square voltage of an a.c. waveform. But an a.c. voltmeter with the scaling of root mean square value that measures the average value of rectified voltage is applicable for the measurements of sinusoidal waveform voltage.

| Accuracy: | Within ±2 % in the frequency range of 4 Hz to 20 kHz |
| Range: | −90 dB(V) to +20 dB(V) |

4.5.4 Audio mixed frequency oscillator

This instrument shall generate a waveform of two sinusoidal signals that are mixed in a specific ratio. Total harmonic distortion of each sinusoidal signal shall be less than 0,001 %.

4.5.5 Audio harmonic distortion meter

This meter shall measure residual harmonic and noise components with the exception of the fundamental component.

Indication accuracy:	Within ±3 %
Minimum measurable value:	Less than 0,001 % (The full-scale is 0,01 %)
Input impedance:	More than 100 kΩ

4.6 Video test tape

Use the video test tape which conforms to the video tape specifications of the VTR under test. Record the type of the tape and the name of the manufacturer of the tape with the results of measurement.

5 Methods of measurement for mechanical characteristics

5.1 General

The calibration tape that is prepared by the format supplier can confirm general interchangeability.

The tape pattern of a digital VTR is the same helical-scan system as that used in an analogue VTR, and can be observed by ferrofluid development. Digital VTR has a different tracking system from existing systems and has a high-density recording system. The measuring conditions will be clarified and the means of obtaining high measurement accuracy will be described.

5.2 Tape speed

To obtain the tape speed, observe the magnetization pattern of the tape by a ferrofluid developed tape on which a specified test signal is recorded.

5.2.1 Test signal

a) For DV format:
   The test signal shall be a sinusoidal waveform whose wavelength is about 1,6 μm on the tape. In the case of the DV format 9 000 min^{-1} system, the frequency is 6 MHz.

b) For D-VHS format:
   The test signal shall be a MPEG-2 TS.

5.2.2 Measurement

Record the test signal and develop the tape by the ferrofluid development. Then using a microscope, observe the magnetized pattern along the longitudinal line in the middle of the tape for more than 30 mm. Obtain the same azimuth track interval p using the following

equation and referring to figure 2. For the D-VHS format, obtain the CTL pulse pitch p in the same way.

$$p = \frac{l}{n} \quad \text{mm}$$

where

l is the distance of the measurement;

n is the number of the same azimuth tracks (or the number of the CTL pulses) over the distance l.

Use the following equation to obtain the tape speed v:

$$v = \frac{p}{p_r} \times v_r \quad \text{mm/s}$$

where, for the DV format

Reference pitch per 2 tracks	$p_r = 2 \times 10 \times 10^{-3} / \sin(\theta_r)$	mm	
Track angle	$\theta_r = 9{,}1668°$		
Reference speed	$v_r = 18{,}831/1{,}001$	mm/s	for NTSC
	$18{,}831$	mm/s	for PAL

For the D-VHS format:

p_r, θ_r, v_r: refer to the D-VHS format.

If the VTR under test can be operated at more than one tape speed, measurements shall be repeated at each of the speeds and the mode used for each test shall be stated.

5.2.3   Presentation of the results

Tape speed: mm/s   (mode)

5.3   Flatness of the RF envelope

This is the ratio of the minimum amplitude of the RF envelope at the head amplifier output with respect to the maximum amplitude.

5.3.1   Test signal

a) For DV format, the test signal shall be the colour bar signal of 4.4.2.

b) For D-VHS format, the test signal shall be a MPEG-2 TS.

5.3.2   Block diagram

See figure 3.

5.3.3   Measurement

Record and reproduce the test signal, and observe the RF signal at the head amplifier output on the oscilloscope. Obtain the maximum amplitude of the RF envelope, e_{max}, and the minimum amplitude, e_{min} (figure 4).

The flatness of the RF envelope is:

$$\text{Flatness} = \frac{e_{min}}{e_{max}} \times 100 \quad \%$$

5.3.4   Presentation of the result

Flatness of the RF envelope: %

5.4   Linearity

This measurement determines the track displacement using the ferrofluid development method, using the cross-tape track measurement technique which has been used for conventional analogue VTRs.

5.4.1   Test signal

a) For the DV format, the test signal shall be a sinusoidal waveform whose wavelength is about 1,6 µm on the tape. In the case of the DV format 9 000 min^{-1} system, the frequency is 6 MHz.

b) For the D-VHS format, the test signal shall be an MPEG-2 TS.

5.4.2   Measurement

Record the test signal and develop the recorded tape by a ferrofluid. Measure the cross-tape track height h_1, h_2, ... h_n of the even track from the reference position (see figure 5 for the DV format; figure 6 for the D-VHS format). Obtain each of the track location errors (linearity error) using the following equation.

$$\Delta h_1 = (h_1 - h_r)\cos\theta_r$$
$$\Delta h_2 = (h_2 - 2 \times h_r)\cos\theta_r$$
$$\vdots$$
$$\Delta h_n = (h_n - n \times h_r)\cos\theta_r$$

where

Δh_n is the track location error, in µm

θ_r is the reference track angle, in °

h_r is the reference cross-section track pitch (for 2 tracks)

$$h_r = 2 \times T_p \times \frac{1}{\cos\theta_r} \times \frac{v}{v_r} \quad \text{µm}$$

v is the actual tape speed   in mm/s

v_r is the reference tape speed   in mm/s

For the DV format:

θ_r =   9,1668 °

v_r =   18,831/1,001   mm/s   for NTSC

            18,831   mm/s   for PAL

T_p =   10   µm

For the D-VHS format:

θ_r, v_r, T_p: refer to the D-VHS format.

The track location error (Δh_1, Δh_2 ... Δh_n) shall be observed as shown in figure 7 and the peak-to-peak value shall be obtained.

5.4.3 Presentation of the results

Linearity: μm p-p

5.5 Effective area starting position

This is the starting position of the track from the lower edge of the tape.

5.5.1 Test signal

a) For the DV format, the test signal shall be the colour bar signal of 4.4.2.

b) For the D-VHS format, the test signal shall be an MPEG-2 TS.

5.5.2 Measurement

Record the test signal and develop the recorded tape by a ferrofluid. Measure the distance from lower edge of the tape to the track starting position, as shown in figure 8.

The track starting position is:

> the front of the ITI signal for the DV format system,
>
> the front of the sub-code signal for the D-VHS format system.

5.5.3 Presentation of the results

Starting position: mm

5.6 Track displacement measurement by image processing

A new and more reliable technique for measuring track displacement of high-density recorded tape is presented here. An experimental report is given in the paper listed in the bibliography under [3].

5.6.1 Measurement system

Figure 9 shows the block diagram of the measurement system. A tape that has been developed with a ferrofluid is focused on a CCD (charge coupled device) camera through a microscope. The tape is placed on a table that can move in the x and y directions, be rotated, and is illuminated with a light source. The tape is adjusted so that the longitudinal direction of the tape coincides with the x-axis of the table and x-axis of the CCD camera. The microscope magnifies and focuses on the image of the tape so that an effective width of the tape is adjusted to the width of the active image area of the CCD camera. A light from the light source illuminates the tape, and reflection from the surface of the tape goes towards the CCD camera. The CCD camera output is stored in a frame grabber controlled by a computer. The computer calculates the entire image processing, controls the table with a table controller, and transfers the image to the frame grabber and the output to a printer and a monitor.

5.6.2 Image processing technique

The tape of a digital VTR is recorded so that the tracks have the same azimuth angle on every second track. When the tape is illuminated with a light source from a specified direction that depends on the optical set-up of the microscope, the reflection from only the tracks that have the same azimuth angle go into the CCD camera. Every other track is observed brightly, so the image of the tape is a grid of bright and dark stripes (see figure 10 a)).

Figure 10 b) shows a waveform of an intensity distribution cutting out the image on arbitrary x-coordinate of the tape (the origin of the Y-axis is the effective area lower edge). One wavelength is equal to the pitch of two tracks in the direction of the tape's width (y direction). In

this example, the waveform of an intensity distribution does not have a constant wavelength, because some tracks of the tape are displaced.

The Fourier transform of the waveform of the intensity distribution is computed, and Fourier spectra with some harmonics are obtained (see figure 10 c)).

The first harmonic together with its sidebands is extracted from the Fourier spectra, and is subjected to an inverse Fourier transform (see figure 10 d) and e)).

A waveform that is reproduced from inverse Fourier transform has real and imaginary parts without low and high frequency components (see figure 10 f)).

The phase angle $\phi(y)$ of the waveform of the intensity distribution is obtained at each pixel by computing an arctangent of the ratio of the imaginary part to the real part of the reproduced signal (see figure 10 g) and h)).

The differences between the actual phase angle $\phi(y)$ obtained by the process in g) and the calculated theoretical phase angle $\phi_r(y)$, are the displacement values of the track. The theoretical phase angle $\phi_r(y)$;

$$\phi_r(y) = \pi \times y / h_r$$

where h_r is one pitch of the track in the direction of the tape's width (see 5.4.2 and figure 10 i)).

The track displacement $\Delta h(y)$ is obtained for each pixel on an arbitrary x-coordinate of the image as follows;

$$\Delta h(y) = h_r \times (\phi(y) - \phi_r(y)) \times \cos\theta_r / \pi$$

where θ_r is the track angle (see 5.4.2 and figure 10 j)).

Thus, by proceeding from b) to j) in figure 10 for each x-coordinate of the image of the tape, the track displacement is computed for each pixel of the whole image.

This technique gives a two-dimensional displacement distribution of the tracks on the tape with a high measurement accuracy. This has been achieved because it has not been necessary to move the tape in the tape width direction by moving the table, which is the main cause of measurement error of the conventional technique. It also reduces the low and high frequency noises by smoothly translating the track position into the phase angle.

5.6.3 Measuring results

Some images, obtained by taking several images of the tape surface relative to the longitudinal direction of the tape, are subjected to the same image processing technique (see 5.4). The two-dimensional displacement distribution of the tape in the area including one whole track is obtained (see figure 11 a)).

The track displacement distribution in the direction of the tape's width is measured in the same way as the conventional technique (cross-tape track measurement technique), which gives the displacement by cutting out the data from the two-dimensional track displacement distribution (see figure 11 b)).

The track displacement distributions in the longitudinal direction of the track and in the longitudinal direction of the tape are also obtained (see figures 11 c) and d)). These track displacement distributions are not obtainable by using the conventional technique. It is possible to clarify the whole track displacement distribution and time-course changes of the displacement.

Figure 12 shows an example of calculated results for a track displacement distribution of a digital VTR, displayed on a monitor.

6 Video characteristics (analogue input/output)

6.1 General

As for base band analogue input and output, conventional measurement methods (of the analogue type) are available. Measuring instruments for analogue signals can be used in general waveform measurement.

The IEC has standardized the measurement methods for analogue video characteristics as in IEC 61041-1 and IEC 61041-5. Most of the items can be measured using these methods.

The quantization error at the stage of AD conversion has been detailed for broadcast use, and some methods are recommended in ITU-R BT.1204. For consumer VTR, this error appears to be the same as in broadcast VTR. In order to measure a signal-to-noise ratio precisely, it is desirable to apply the method described in ITU-R BT.1204.

A flat signal is used for this noise measurement, and the measured value is different from the one obtained when using a natural picture. To evaluate the noise, which is the difference between the input and output signals including the influence of the compression process, the picture quality measurement method of ITU-R BT.500-10 shall be used.

6.2 Luminance amplitude frequency response

For this measurement, subclause 2.3 of IEC 61041-1, is applicable.

The following test signal shall be used, because the signal bandwidth for digital VTR is wider than that of a conventional VTR.

6.2.1 Test signal

The test signal shall be a sine-wave multiburst signal with or without a chrominance burst according to figure 13.

a) For composite video input, see figure 13.
b) For S video input:
  - S luminance signal: use only the luminance portion of the test signal shown in figure 13;
  - S chrominance signal: use only the colour burst of the test signal shown in figure 13.

6.2.2 Block diagram

The block diagram for measurement shall be as follows:

a) for composite video input, see figure 14;
b) for S video input, see figure 15.

6.2.3 Measurement

The reference level $V_{ref(a)}$ shall be 100 % of the amplitude of the 100 % white output picture signal, i.e. from the blanking level to the white level.

The peak-to-peak amplitude V_{p-p} of each frequency burst of the output signal shall be put in relation with the reference level $V_{ref(a)}$ to obtain the amplitude/frequency response A:

$$A = 20 \lg \frac{V_{p-p}}{V_{ref(a)}} \text{ dB}$$

6.2.4 Presentation of results

The results of measurement of the composite video signal and the S video signal shall be reported in a table showing the frequency in MHz and A in dB.

6.3 Chrominance amplitude frequency response

This measurement gives the amplitude/frequency response of the chrominance channel.

6.3.1 Test signal

The test signal shall be a 50 % white level superimposed on five frequency bursts having a peak-to-peak amplitude of 100 % with a chrominance burst according to figure 16. The frequencies f_1 to f_4 of the bursts are correlated with the colour sub-carrier frequency f_{sc} as follows.

$$f_1 = f_{sc} - 50 f_h$$
$$f_2 = f_{sc} - 25 f_h$$
$$f_3 = f_{sc} + 25 f_h$$
$$f_4 = f_{sc} + 50 f_h$$

where f_h is the horizontal line frequency.

a) For the composite video input, see figure 16.
b) For the S video input:
   – S luminance signal: use only the luminance portion of the test signal shown in figure 16.
   – S chrominance signal: use only the colour portion of the test signal shown in figure 16.

6.3.2 Block diagram

The block diagram for measurement shall be as follows:

a) for the composite video input, see figure 14;
b) for the S video input, see figure 15.

6.3.3 Measurement

The reference level $V_{ref(a)}$ shall be 100 % of the amplitude of the burst, with the frequency f_{sc} measured in the middle of the burst.

The peak-to-peak amplitude V_{p-p} of each frequency burst measured in the middle of the burst shall be put in relation with the reference level $V_{ref(a)}$ to obtain the amplitude/frequency response B:

$$B = 20 \lg \frac{V_{p-p}}{V_{ref(a)}} \text{ dB}$$

6.3.4 Presentation of results

The results of the measurement of the composite video signal and the S video signal shall be reported in a table showing the frequency deviation from f_{sc} in kHz and B in dB.

6.4   Luminance diagonal resolution

Refer to IEC 61041-5, 2.4.

6.5   Luminance frequency characteristics of diagonal resolution (i)

Refer to IEC 61041-5, 2.5.

6.6   Luminance frequency characteristics of diagonal resolution (ii)

Refer to IEC 61041-5, 2.6.

6.7   Luminance non-linear distortion

For this measurement, IEC 61041-1, 2.4 is applicable.

For a VTR equipped with an S video connector, only the luminance portion and only the colour burst portion of the test signal, shown in figure 17, shall be used for this measurement.

6.8   Luminance waveform distortion (linear distortion)

For this measurement, IEC 61041-1, 2.5 is applicable.

For a VTR equipped with an S video connector, a specific portion of the test signal in figure 18 and the luminance output of S video terminal shall be used for this measurement.

a) For the luminance input at the S video terminal: apply only the luminance signal.

b) For the chrominance input at the S video terminal: apply only the colour burst signal.

6.9   Chrominance waveform distortion

This measurement defines the waveform distortion of the reproduced envelope of the chrominance signal.

6.9.1   Test signal

The test signal for measurement shall be as follows:

a) for the composite video input, see figure 19.

b) for the S video input:
   –   S luminance signal: use only the luminance portion of the test signal shown in figure 19.
   –   S chrominance signal: use only the colour burst of the test signal shown in figure 19.

6.9.2   Block diagram

The block diagram for measurement shall be as follows:

a) for the composite video input, see figure 14;

b) for the S video input, see figure 15.

6.9.3   Measurement

Record and reproduce the test signal as illustrated in figure 19.

Apply the reproduced signal obtained from the composite video output connector or S video output connector to the oscilloscope, and observe the waveform.

Calculate the measurement result using the following formulae in accordance with figure 20, and show results as percentages.

$$\text{Overshoot} = \frac{b}{a} \times 100 \ (\%)$$

$$\text{Streaking} = \frac{b}{a} \times 100 \ (\%)$$

$$\text{Smear} = \frac{b}{a} \times 100 \ (\%)$$

Rise time = t_1

Fall time = t_2

6.9.4   Presentation of results

Overshoot:	%
Streaking:	%
Smear:	%
Rise time:	s
Fall time:	s

6.10   Luminance vertical waveform distortion

Refer to IEC 61041-5, 2.3.

6.11   Chrominance vertical waveform distortion

Refer to IEC 61041-5, 3.3.

6.12   Automatic Gain Control (AGC) operation

For this measurement, IEC 61041-1, 2.2 is applicable.

For a VTR equipped with an S video connector, a specific portion of the test signal in figure 17 and the luminance output of the S video terminal shall be used for this measurement.

a) For the luminance input at the S video terminal: apply only the luminance signal.

b) For the chrominance input at the S video terminal: apply only the colour burst signal.

6.13   Chrominance to luminance horizontal displacement

Refer to IEC 61041-1, 3.5.

6.14   Chrominance to luminance vertical displacement

Refer to IEC 61041-5, 3.2.

6.15   Luminance signal-to-noise ratio

6.15.1   General

For this measurement, IEC 61041-5, 2.1 is applicable.

For a digital VTR, the value of S/N may be widely dispersed because of the quantization error. In such a case, both the maximum and the minimum values shall describe the result.

Table 2 – Example: white level of test signal (8 bit system)

White level	For NTSC	For PAL
40 %	0,286 V	0,280 V
42 %	0,300 V	0,294 V
44 %	0,314 V	0,308 V
46 %	0,328 V	0,322 V
48 %	0,343 V	0,336 V
50 %	0,357 V	0,350 V
52 %	0,371 V	0,364 V
54 %	0,386 V	0,378 V
56 %	0,400 V	0,392 V
58 %	0,414 V	0,406 V
60 %	0,428 V	0,420 V
NOTE 1 White level is incremented by 2 % steps within ±10 % of the centre level according to IEC 61041-5, 2.1. Where 100 % white level is 0,714 Vp-p for NTSC and 0,700 Vp-p for PAL.		
NOTE 2 The absolute value of the white level is not specified.		

6.15.5   Presentation of the results

Presentation of the results shall be as follows:

–   The composite video connector

  Luminance S/N: dB   or   Maximum   dB

                                                    Minimum   dB

–   The S video connector

  Luminance S/N: dB   or   Maximum   dB

                                                    Minimum   dB

6.16   Chrominance signal-to-noise ratio

6.16.1   General

For this measurement, IEC 61041-5, 3.1 is applicable.

For a digital VTR, the value of S/N may be widely dispersed because of the quantization error. In such a case, both the maximum and the minimum values shall describe the result.

To evaluate the dispersion, it is desirable to take several measurements whilst changing the chrominance level of the test signal intermittently. The signal-to-noise ratio is measured at each level under equal interval step within quantization step. In practice, it is not easy to follow the above procedure. Repeated measurements for a sufficient period of time by randomly changing the chrominance level gives the maximum/minimum S/N in practice.

6.16.2   Test signal

The test signal for measurement shall be as follows:

a)   for the composite video input, see figure 26;

b)   for the S video input, see figures 27 and 28.

6.16.3   Block diagram

The block diagram for the measurements shall be as follows:

– The composite video:

AM colour S/N:	dB	or	Maximum:	dB
			Minimum:	dB
PM colour S/N:	dB	or	Maximum:	dB
			Minimum:	dB

– The S video:

AM colour S/N:	dB	or	Maximum:	dB
			Minimum:	dB
PM colour S/N:	dB	or	Maximum:	dB
			Minimum:	dB

7 Composite signal decoding characteristics (luminance and chrominance separation)

NOTE   This clause is applicable only to the NTSC system.

7.1 Luminance signal separation (general)

Refer to IEC 61041-5, 4.1.

7.2 Luminance signal separation at colour change points

Refer to IEC 61041-5, 4.2.

7.3 Chrominance signal separation

Refer to IEC 61041-5, 4.3.

7.4 Chrominance signal separation with three dimensional processing

This measurement determines the ratio of the luminance signal level to the standard chrominance signal which are mixed in the chrominance signal at the S output terminal when a composite video signal is applied to a three dimensional Y/C separator.

7.4.1 Test signal

The test signal shall be a multiburst signal as shown in figure 29.

The multiburst signal shifts 70 ns in the horizontal direction at every field, and comes back to the original position after 280 ns shift.

7.4.2 Block diagram

Refer to figure 30.

7.4.3 Measurement

Connect the oscilloscope to the S chrominance output connector and set the video tape recorder to record mode. Observe the colour burst and the luminance signal that remain in the S chrominance signal.

Measure the V_b (Vp-p) level of the colour burst and the levels of the residual luminance signal V_y (Vp-p) corresponding to the luminance frequencies of 3,0 MHz, 3,58 MHz, and 4,2 MHz.

Use the following equation to obtain the chrominance signal separation characteristics. Refer to figure 31.

$$\text{Chrominance signal separation} = 20\lg\left(0{,}40\times\frac{V_y}{V_b}\right)\text{dB}$$

7.4.4   Presentation of results

The presentation of the results shall be as follows.

Chrominance signal separation	at 3,00 MHz	dB
(residual luminance signal level)	at 3,58 MHz	dB
	at 4,20 MHz	dB

7.5   Luminance signal separation with three dimensional signal processing

This measurement determines the ratio of the standard luminance signal level to the chrominance (dot interference) signal, which are mixed in the luminance signal at the S output terminal when the composite video signal is applied to a three dimensional Y/C separator.

7.5.1   Test signal

The test signal shall be a colour-sweep signal as shown in figure 32.

The colour-sweep signal shifts 70 ns in the horizontal direction at every field, and comes back to the original position after a 280 ns shift.

7.5.2   Block diagram

See figure 33 for the block diagram for measurement.

7.5.3   Measurement

Connect the oscilloscope to the S luminance output connector, and set the video tape recorder to record mode. Observe the level of the S luminance signal V_s (Vp-p) and the residual chrominance signal V_c (Vp-p) at the S video output connector.

Use the following equation to obtain the luminance signal separation characteristic. Refer to figure 34.

$$\text{Residual chrominance signal characteristic} = 20\lg\left(\frac{100}{88}\times\frac{V_c}{V_s}\right)\text{dB}$$

7.5.4   Presentation of results

The presentation of the results shall be as follows:

Residual chrominance signal characteristic (dot interference):   dB

8   Audio characteristics (analogue input/output)

8.1   General

The internal audio signal processing of the DV format consists of digital 16 bit linear coding or 12 bit non-linear coding, but in these methods of measurement, only analogue input and output signals through AD/DA converters are used. The general measuring method of an analogue

tape recorder (IEC 60094-3, clause 12) is applicable. A signal level and frequency suitable for the digital VTR shall be specified.

8.2 Audio operational output voltage (with AGC)

8.2.1 Test signal

The test signal shall be a 1 kHz sinusoidal wave.

8.2.2 Block diagram

See figure 35 for the block diagram for measurement.

8.2.3 Measurement

If the VTR under test has an AGC, record the test signal of an operational input level specified by the manufacturer. Reproduce the recorded signal, and measure the output voltage from the output terminal with a specified load impedance.

The measurements shall be made for both audio channels.

8.2.4 Presentation of results

The presentation of the results shall be as follows:

Audio operational output voltage (with AGC):   mV

The measurements shall be made for both audio channels.

8.3 Audio operational input voltage (without AGC)

8.3.1 Test signal

The test signal shall be a 1 kHz sinusoidal wave.

8.3.2 Block diagram

See figure 35 for the block diagram for measurement.

8.3.3 Measurement

Adjust the setting of the volume control to the indicated position. Record and reproduce the test signal and measure the input voltage when the reproduced output voltage has to be the operational voltage specified by the manufacturer.

8.3.4 Presentation of results

The presentation of the results shall be as follows:

Audio operational input voltage (without AGC):   mV

The measurements shall be made for both audio channels.

8.4 Audio maximum output voltage

8.4.1 Test signal

The test signal shall be a 1 kHz sinusoidal wave.

8.4.2   Block diagram

See figure 35 for the block diagram for measurement.

8.4.3   Measurement

When the VTR under test has an AGC circuit, turn off the AGC and increase the test signal input level gradually, and measure the output level when it has a distortion of 3 %.

If the output signal waveform is observed with an oscilloscope to clip symmetrically, it is also good if a maximum output level is achieved before clipping.

8.4.4   Presentation of results

Maximum output voltage: V

8.5   Amplitude frequency response

8.5.1   Test signal

Use the sinusoidal signals with the specified level of audio operation input voltage and with the following frequencies:

4 Hz, 8 Hz, 20 Hz, 31,5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 10 kHz, 12,5 kHz, 16 kHz, 18 kHz and 20 kHz.

8.5.2   Measurement

Refer to IEC 60094-3, 12.3.1.

It is recommended to turn off the AGC.

8.6   Phase difference between channels

8.6.1   Test signal

For over 44,1 kHz sampling frequency system, use the 20 kHz sinusoidal signal and for 32 kHz sampling system, use 14 kHz.

8.6.2   Measurement

Refer to IEC 60268-3, 14.7.2.

8.6.3   Presentation of results

Phase difference between channels   degrees (measuring frequency =   kHz).

8.7   Signal-to-noise ratio

Refer to IEC 60094-3, 12.3.2.

The measuring frequency shall be 1 kHz and the input level shall be the specified operational voltage.

8.8   Dynamic range

8.8.1   Test signal

The test signal shall be a 1 kHz sinusoidal wave.

8.8.2 Measurement

Record the test signal so that the output level is 60 dB below the maximum output voltage of 8.4.

Measure the distortion of the reproduced signal by a distortion meter and let the reading A in decibels be an absolute value $|A|$.

Dynamic range = $|A|$ + 60 dB

The measurement shall be made for both audio channels.

8.8.3 Presentation of results

Dynamic range: dB (channel)

8.9 Harmonic distortion

Refer to IEC 60094-3, 12.3.6.

The test signal shall be a 1 kHz sinusoidal wave of the specified operational voltage.

8.10 Inter-modulation distortion

8.10.1 Test signal

The test signal shall be a mixed frequency signal of 60 Hz and 7 kHz, of a 4:1 amplitude ratio.

8.10.2 Measurement

Record the test signal so that the output level is the maximum output voltage of 8.4.

Measure the reproduced output signal using an inter-modulation distortion meter and observe the spectrum components.

8.10.3 Presentation of result

To be stated as a percentage.

The measurement shall be made for both audio channels.

8.11 Channel separation

8.11.1 Test signals

Test frequencies: 125 Hz, 1 kHz, 4 kHz, 10 kHz and 16 kHz.

Signal level: specified operational voltage.

8.11.2 Measurement

Refer to IEC 60094-3, 12.3.3.

8.11.3 Presentation of results

They shall be presented as a graph or a table of measured channel separation for each frequency.

8.12   Wow-flutter

Refer to IEC 60386.

8.13   Pitch difference between record and playback

8.13.1   Test signal

The test signal shall be a 20 kHz sinusoidal wave.

8.13.2   Measurement

Measure the frequency F_1 of the reproduced 20 kHz signal using a digital frequency counter.

$$\text{Pitch difference} = \frac{F_1 - F_0}{F_0} \times 100 \quad \%$$

where F_0 represents the frequency of the recorded signal.

8.13.3   Presentation of results

To be stated as a percentage.

9   Classification of the characteristics to be specified

The various measurements described in the clauses listed in this standard shall be implemented in accordance with needs of the manufacturer and/or user in order to determine the digital VTR performance. X indicates the important items in table 5. The letter R indicates measurements that may be omitted in assessing the VTR performance.

A = items which are independent of each other and which shall be measured to make a general assessment of a VTR,

B = additional items which may be measured to assess a VTR more precisely,

C = additional items which are less important.

Table 5 – Classification of the characteristics to be specified

Clause/subclause	A	B	C
Mechanical characteristics			
5.2 Tape speed	X		
5.3 Flatness of the RF envelope	X		
5.4 Linearity	X		
5.5 Effective area starting position	X		
5.6 Track displacement measurement by image processing		X	
Video characteristics			
6.2 Luminance amplitude frequency response	X		
6.3 Chrominance amplitude frequency response	X		
6.4 Luminance diagonal resolution		X	
6.5 Luminance frequency characteristics of diagonal resolution (1)		X	
6.6 Luminance frequency characteristics of diagonal resolution (2)		X	
6.7 Luminance non-linear distortion	X		
6.8 Luminance waveform distortion(Linear distortion)	X		
6.9 Chrominance waveform distortion	X		
6.10 Luminance vertical waveform distortion		X	
6.11 Chrominance vertical waveform distortion		X	
6.12 AGC operation	X		
6.13 Chrominance to luminance horizontal displacement	X		
6.14 Chrominance to luminance vertical displacement	X		

Clause/subclause	A	B	C
6.15 Luminance signal-to-noise ratio	X		
6.16 Chrominance signal-to-noise ratio	X		
Composite signal decode characteristics			
7.1 Luminance signal separation (general)	X		
7.2 Luminance signal separation at colour change points	X		
7.3 Chrominance signal separation	X		
7.4 Chrominance signal separation with three dimensional processing			R
7.5 Luminance signal separation with three dimensional signal processing			R
Audio characteristics			
8.2 Audio operational output voltage (with AGC)	X		
8.3 Audio operational input voltage (without AGC)	X		
8.4 Audio maximum output voltage	X		
8.5 Amplitude frequency response	X		
8.6 Phase difference between channels	X		
8.7 Signal-to-noise ratio	X		
8.8 Dynamic range		X	
8.9 Harmonic distortion		X	
8.10 Inter-modulation distortion			R
8.11 Channel separation		X	
8.12 Wow-flutter			R
8.13 Pitch difference between record and playback			R
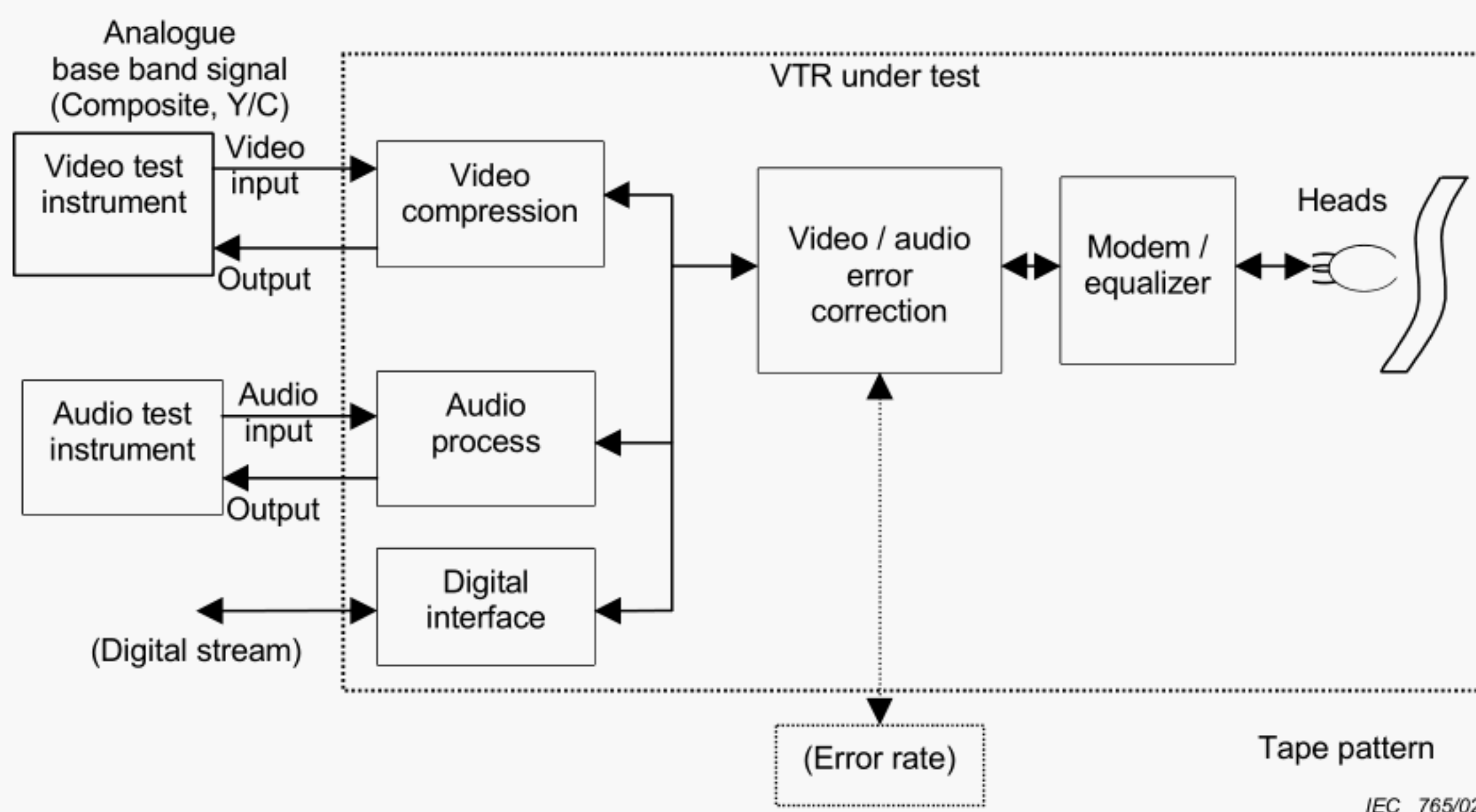
Figure 1 – Basic block diagram of measurement system
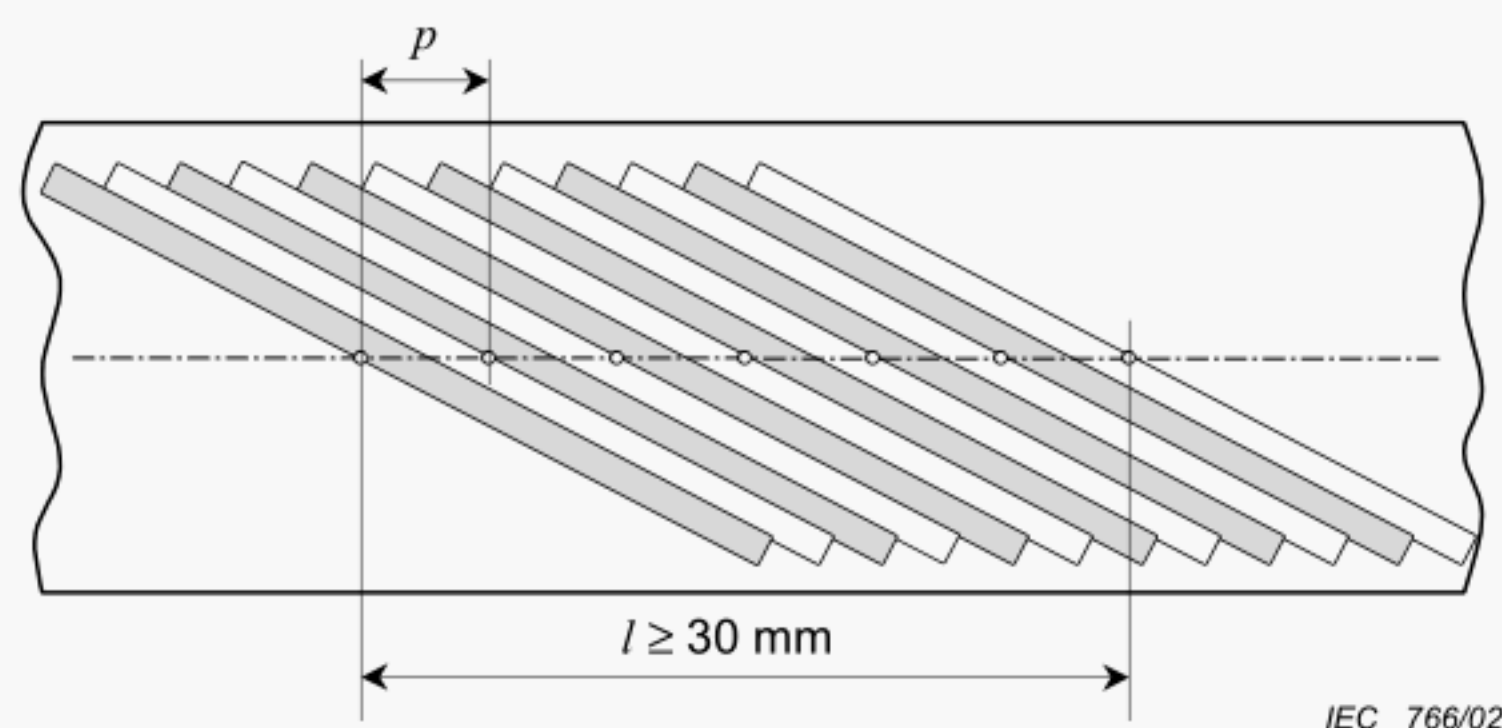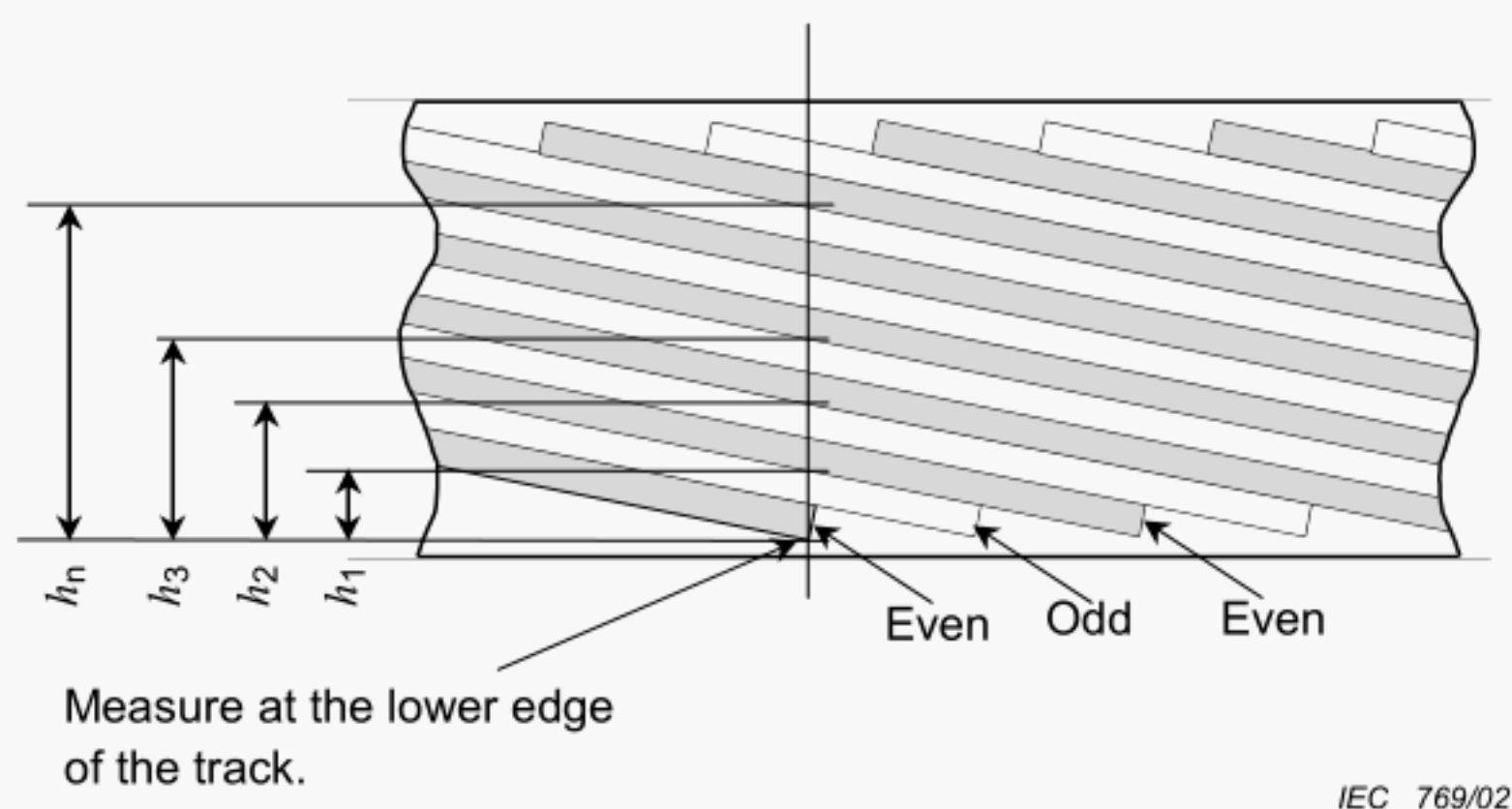

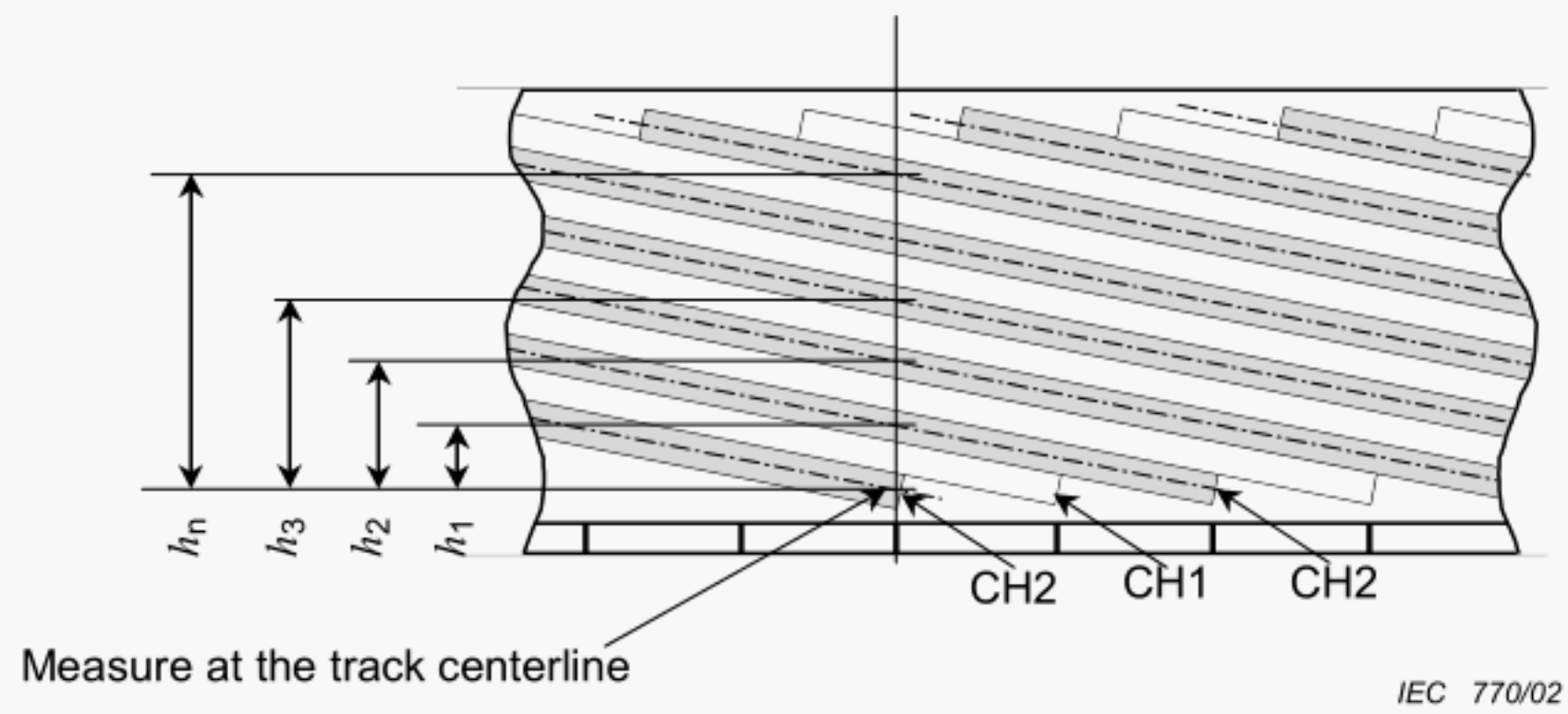**Figure 2 – Measuring method for track interval**

IEC   767/02
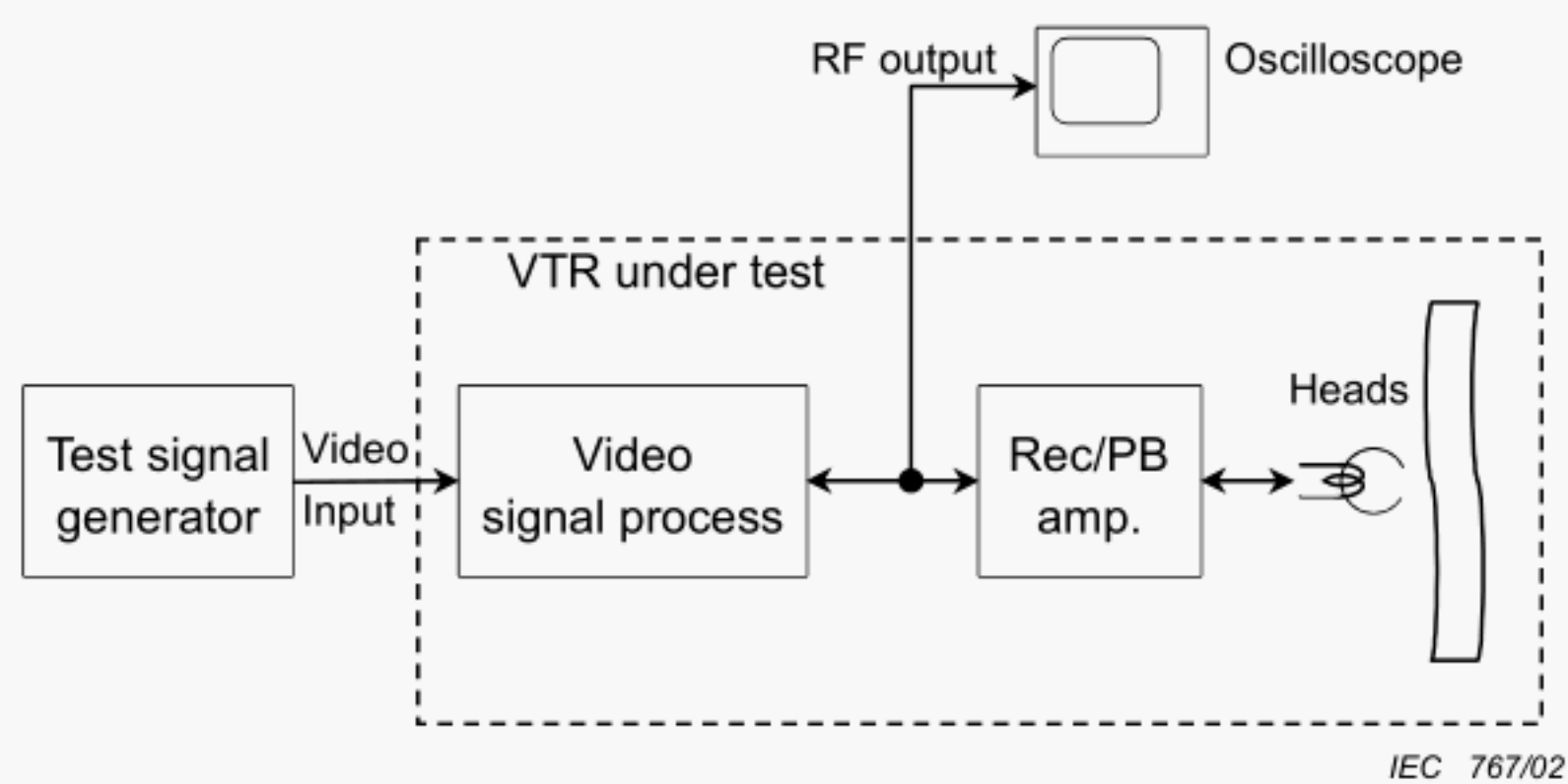
Figure 3 – Measuring block diagram for RF envelope flatness

Reproduced RF signal

e_{max} e_{min}

IEC   768/02
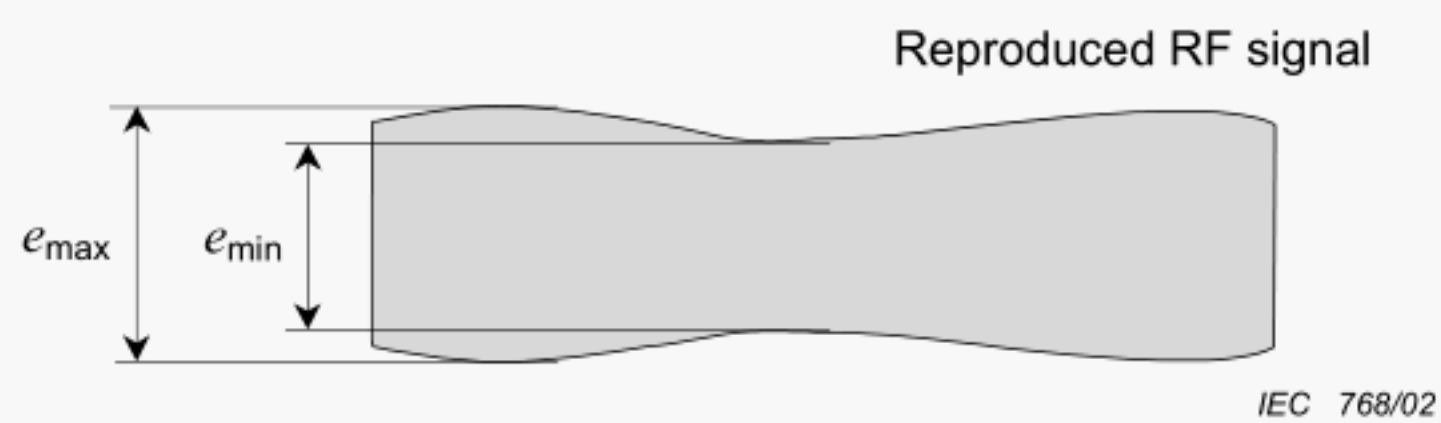
Figure 4 – Measuring method for RF envelope flatness

h_n h_3 h_2 h_1

Even   Odd   Even

Measure at the lower edge
of the track.

IEC   769/02

Figure 5 – Cross-tape track height for DV format

IEC 770/02

Figure 6 – Cross-tape track height for D-VHS format

Measure at the track centerline

CH2   CH1   CH2

h_n h_3 h_2 h_1

IEC 771/02
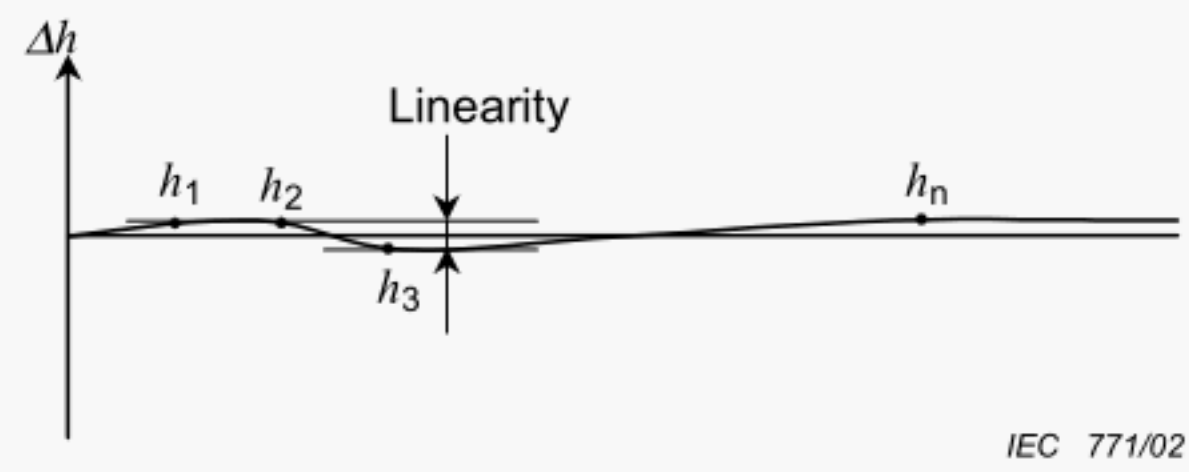
Figure 7 – Measuring method for linearity

Δh

Linearity

h_1 h_2 h_3 h_n

Lower edge

IEC 772/02
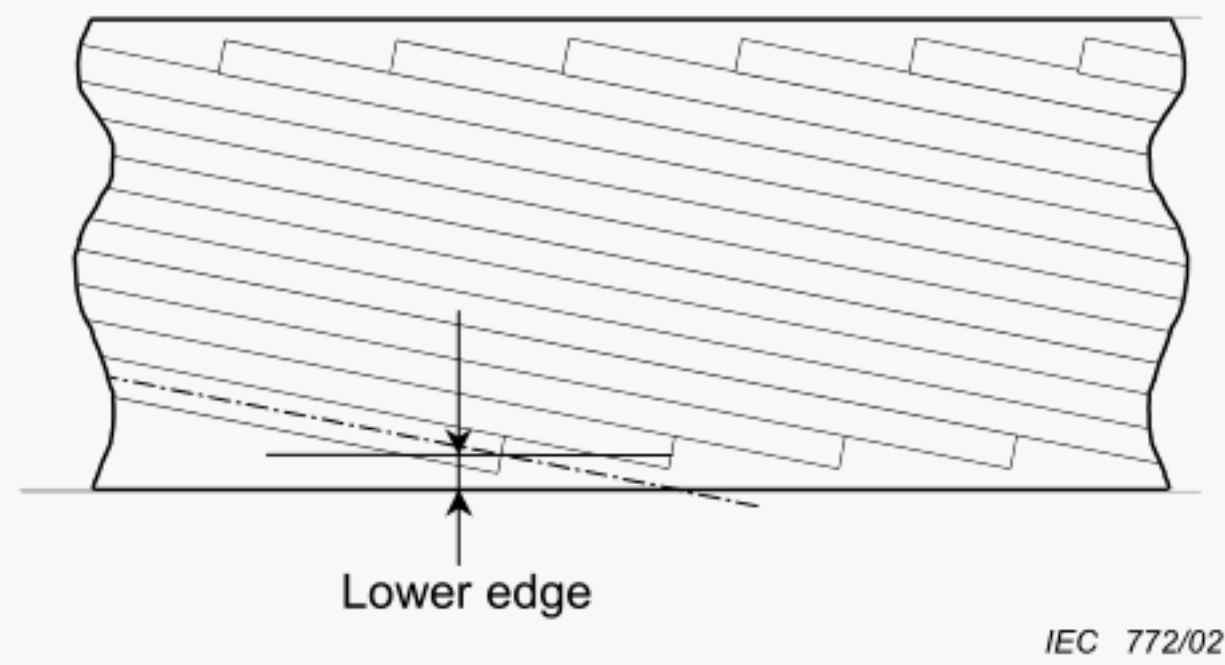
Figure 8 – Measuring method for the starting position

IEC 773/02
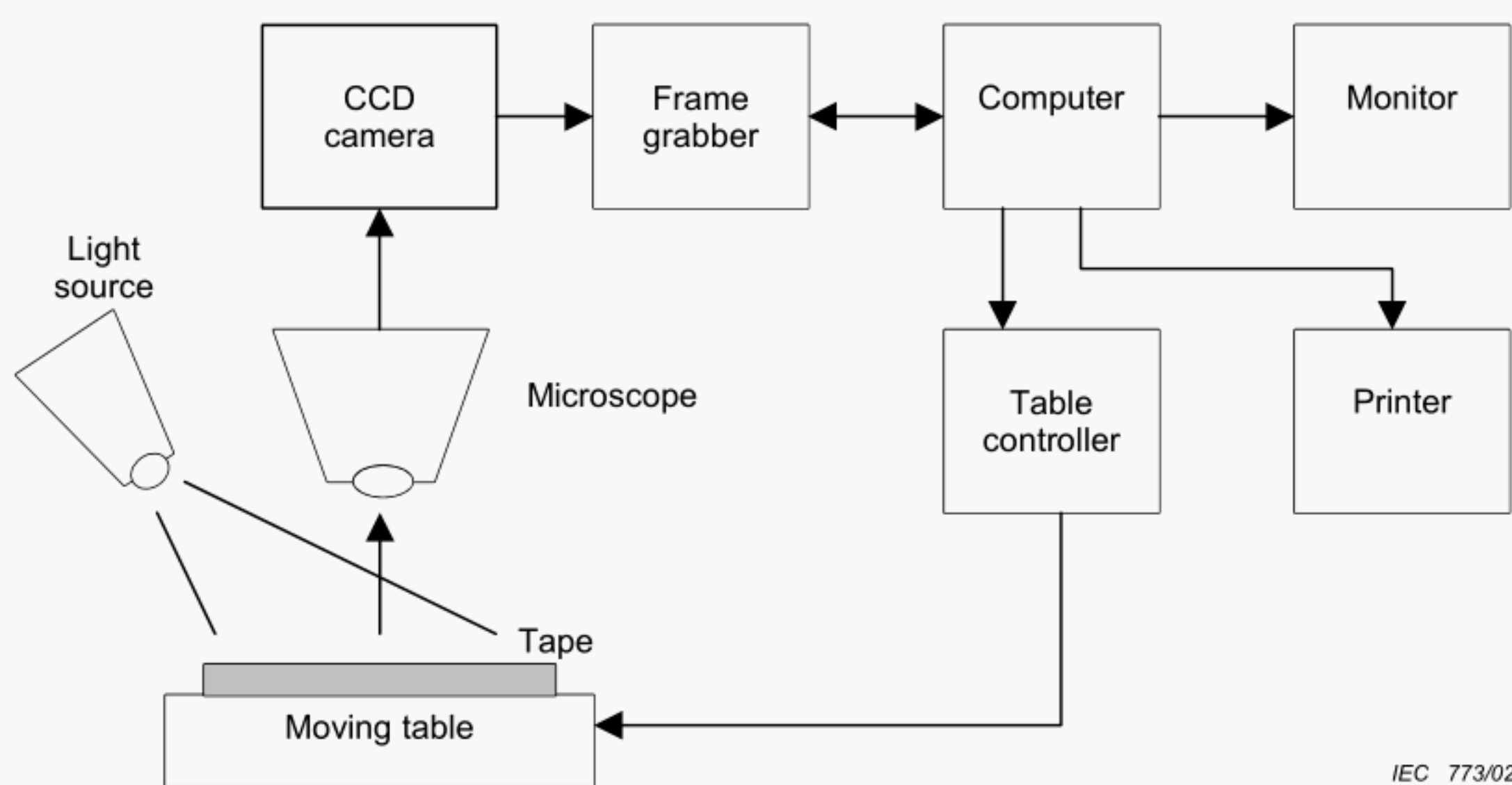
Figure 9 – Block diagram of the measurement system

Longitudinal direction of tape

Imaging area

Y

X

a) Schematic illustration of developed tape

Intensity

y

b) Waveform of intensity distribution

c) Fourier transform

d) Extraction of first harmonic

e) Inverse Fourier transform

Intensity

y

f) Reproduced waveform (real part)

g) Computation of phase angle

Phase $\phi(y)$

12π
10π
8π
6π
4π
2π
0

$\phi_r(y)$

$\phi(y)$

y

h) Phase angle distribution

i) Computation of track displacement

Displacement $\Delta h(y)$

$+$

0

$-$

y

j) Track displacement distribution

IEC 774/02

Figure 10 – Schematic diagram of the image processing technique

a) Two-dimensional track displacement distribution

- 1,5   0   + 1,5 (µm)

b) Tape width direction   **c) Longitudinal direction of track**   **d) Longitudinal direction of tape**
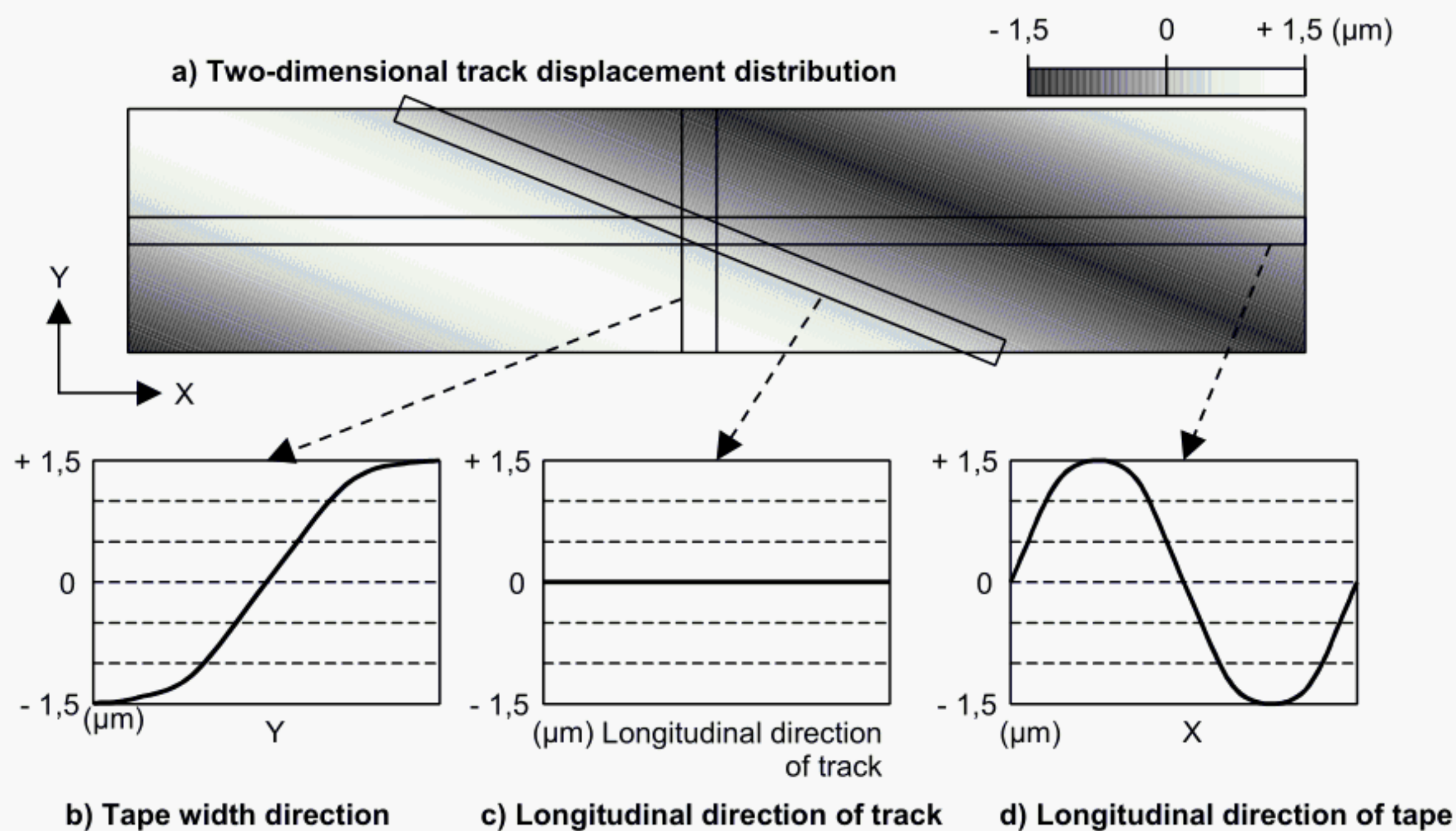
IEC 775/02

Figure 11 – Illustration of track displacement distribution (model)
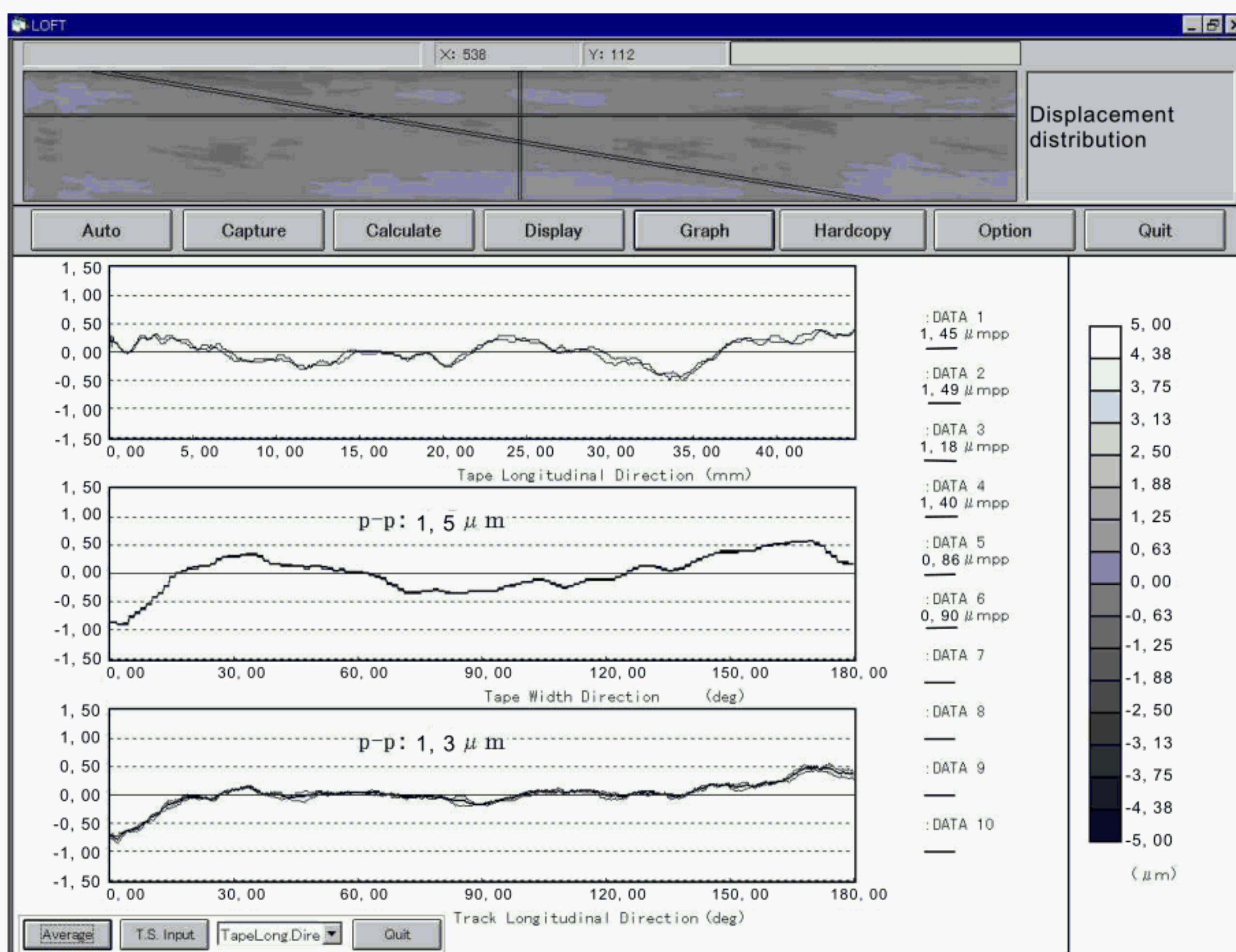
IEC 776/02

Figure 12 – Example of calculation results

	f1	f2	f3	f4	f5	f6
NTSC(MHz)	0,5	1,0	3,0	3,58	4,0	6,0
PAL(MHz)	0,5	1,0	2,0	4,0	4,8	5,8
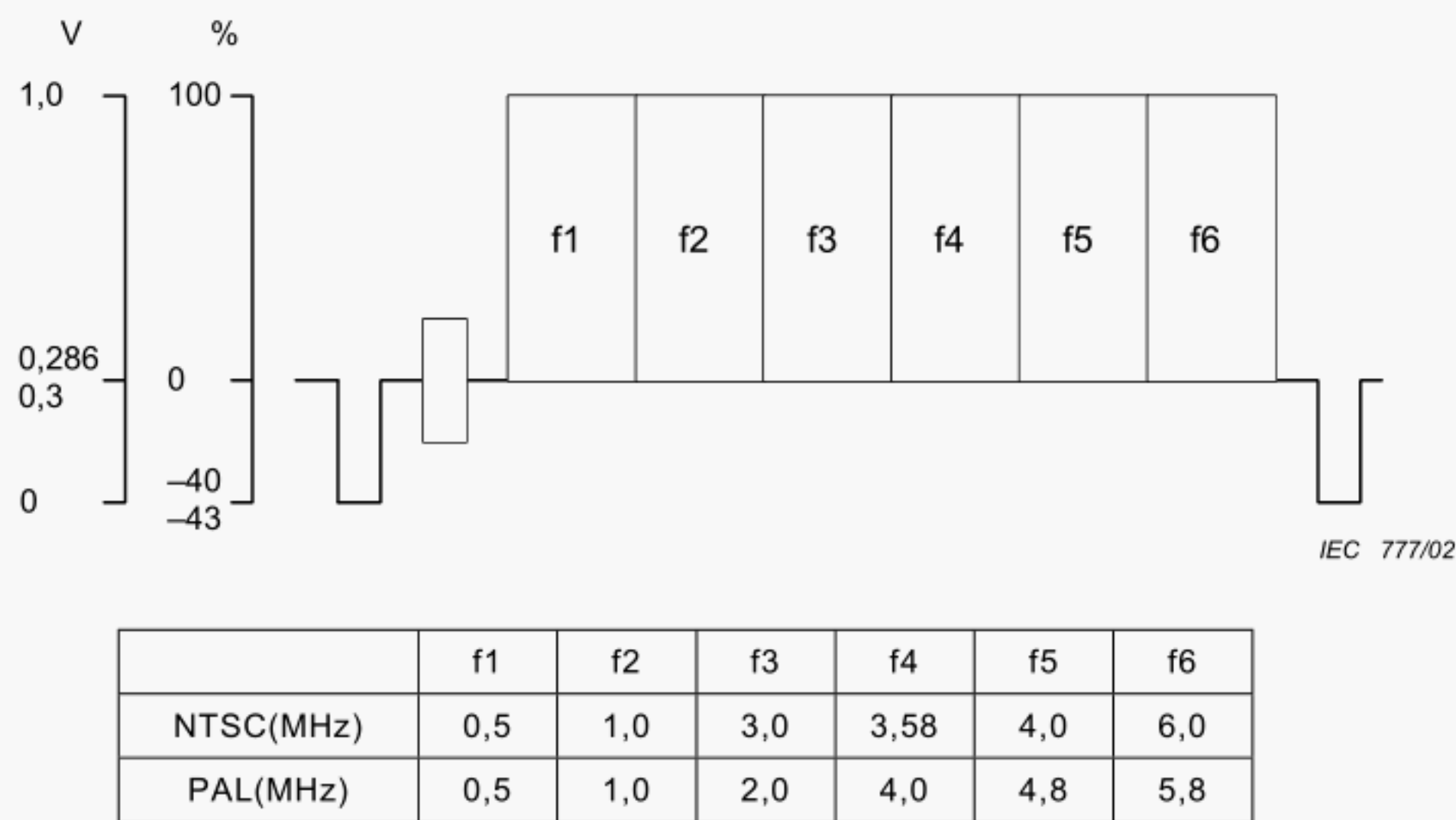
Figure 13 – Test signal for luminance amplitude frequency response
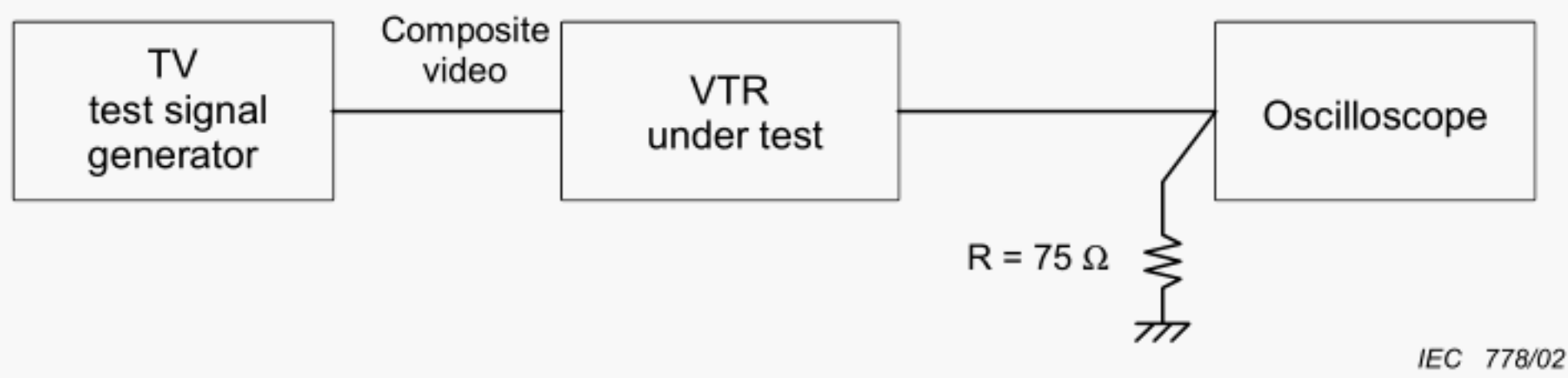
Figure 14 – Measuring block diagram for composite video signal
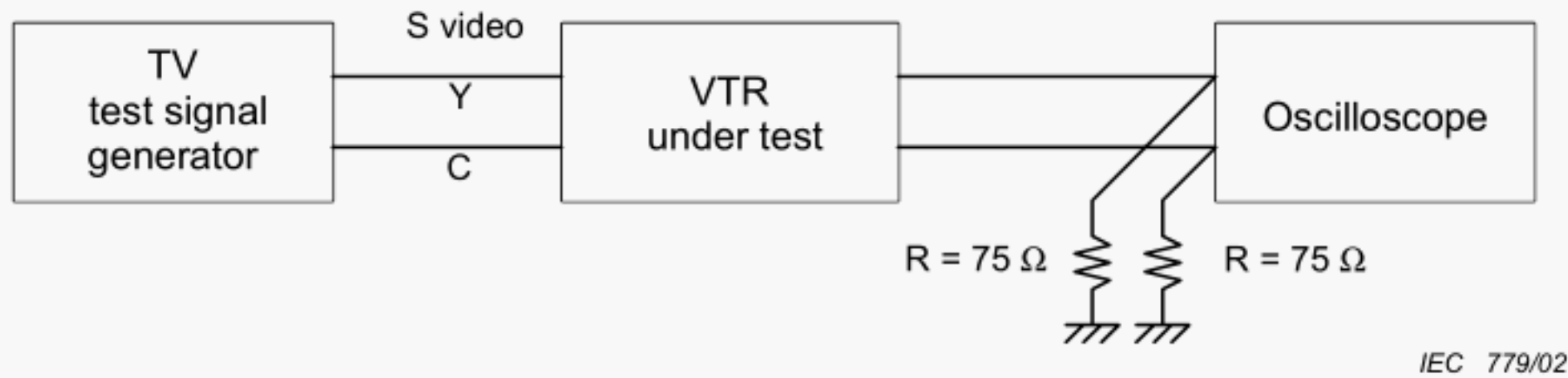
Figure 15 – Measuring block diagram for S video signal
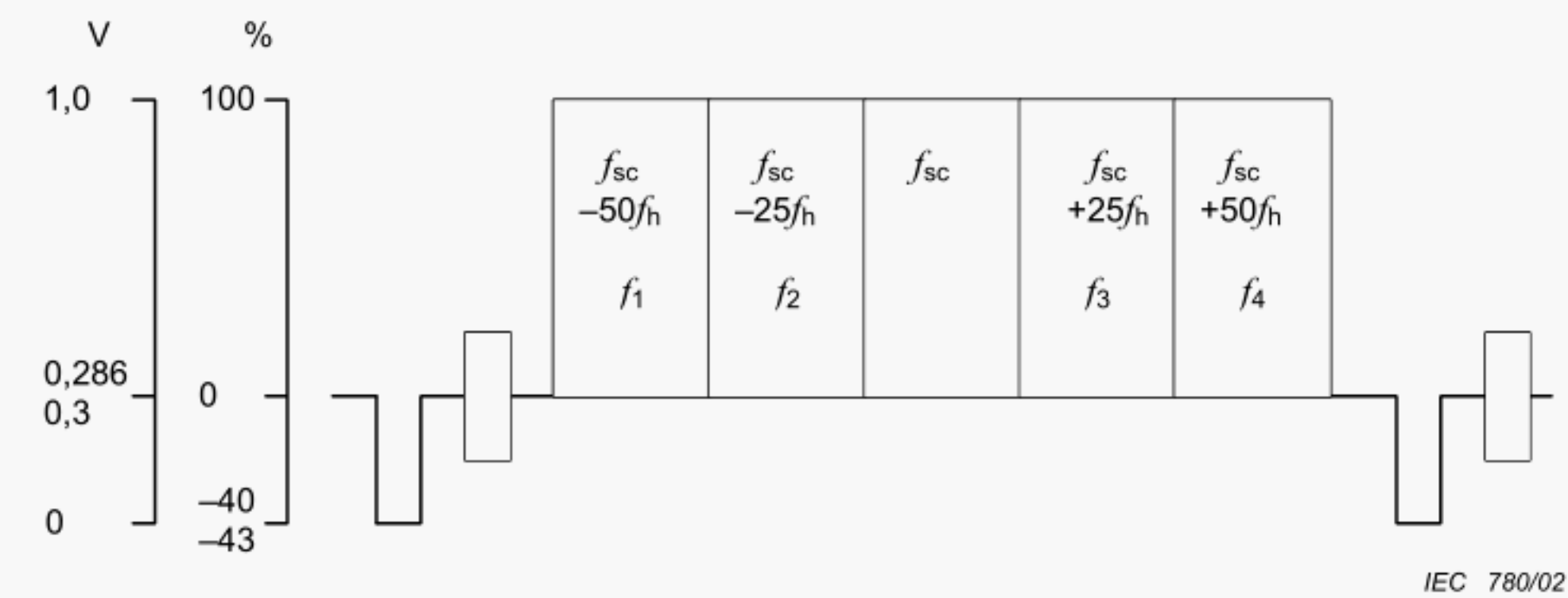
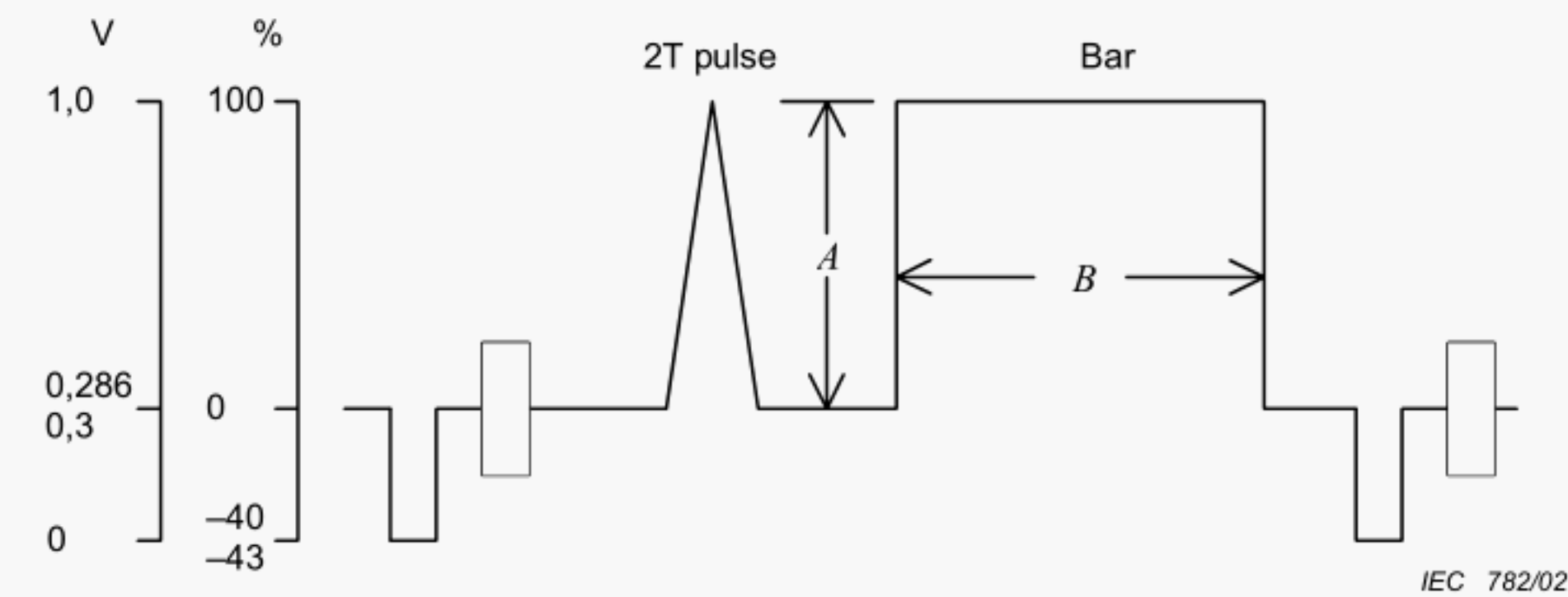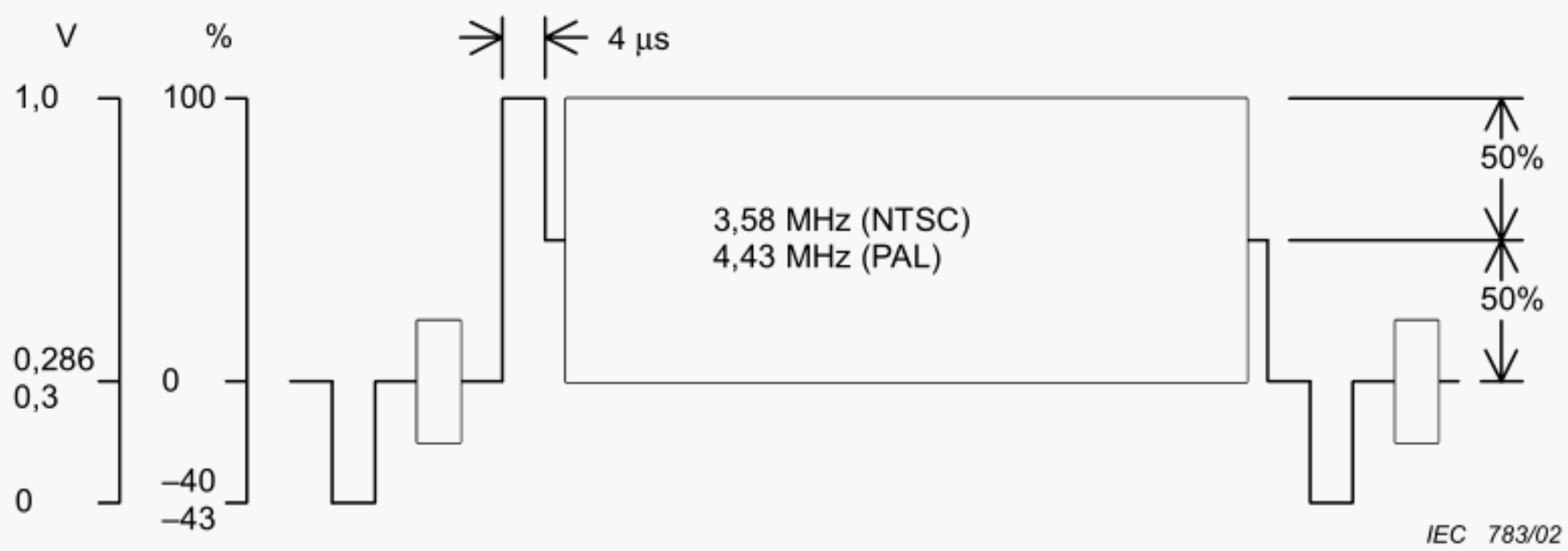**Figure 16 – Test signal for chrominance amplitude frequency response**
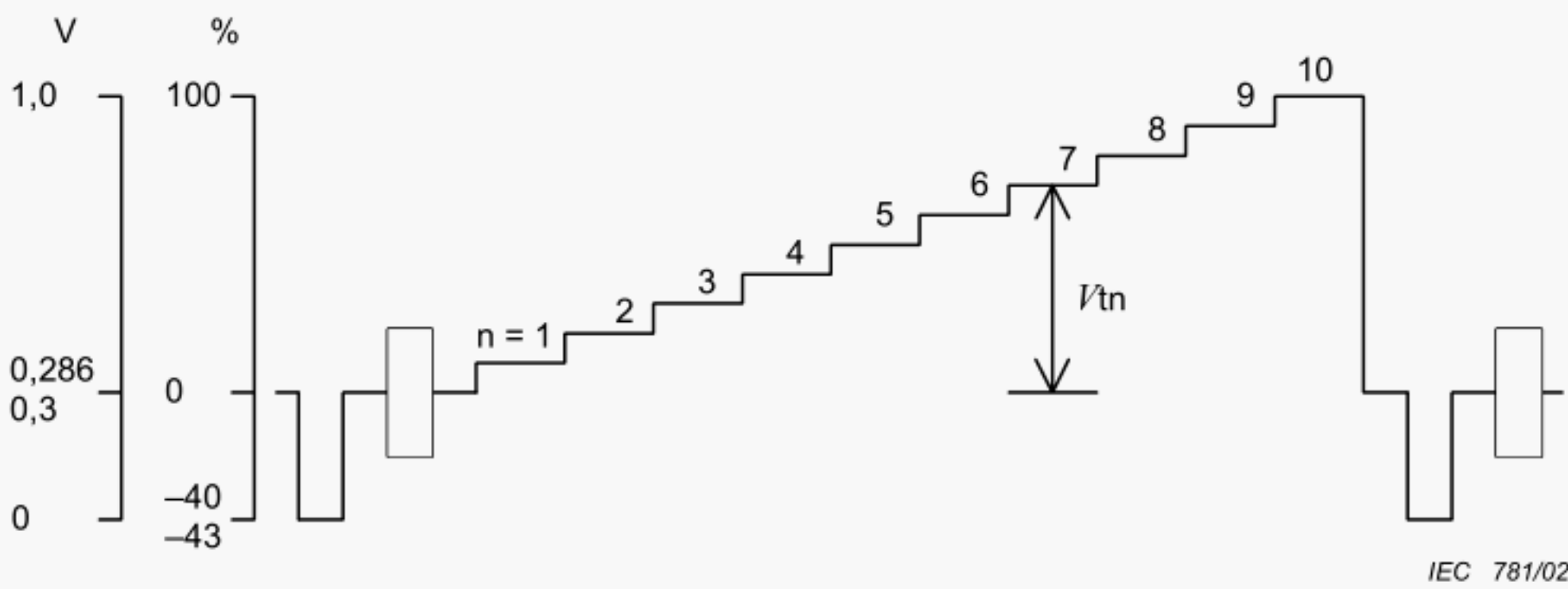
Figure 17 – Test signal for luminance non-linear distortion

A: 100 %

B: approximately 25 μs

2T: 0,25 μs (NTSC)/0,20 μs (PAL)
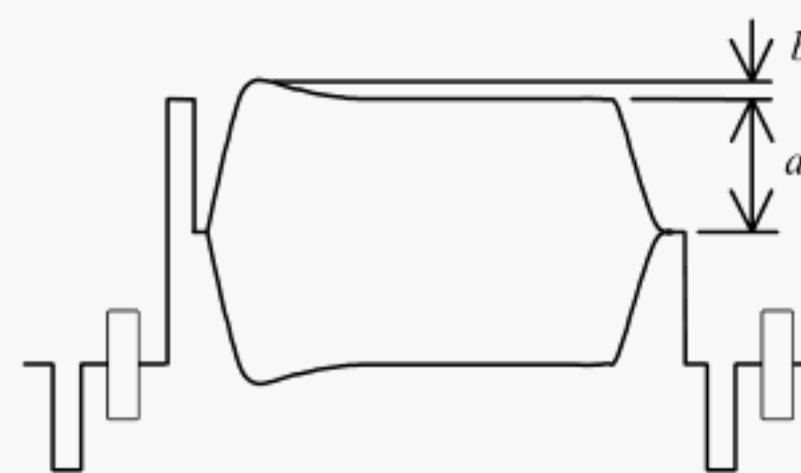
Figure 18 – Test signal for luminance waveform distortion

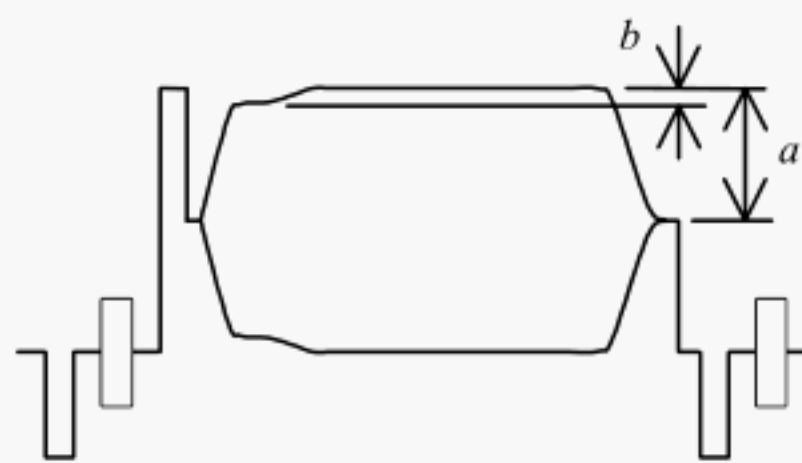**Figure 19 – Test signal for chrominance waveform distortion**
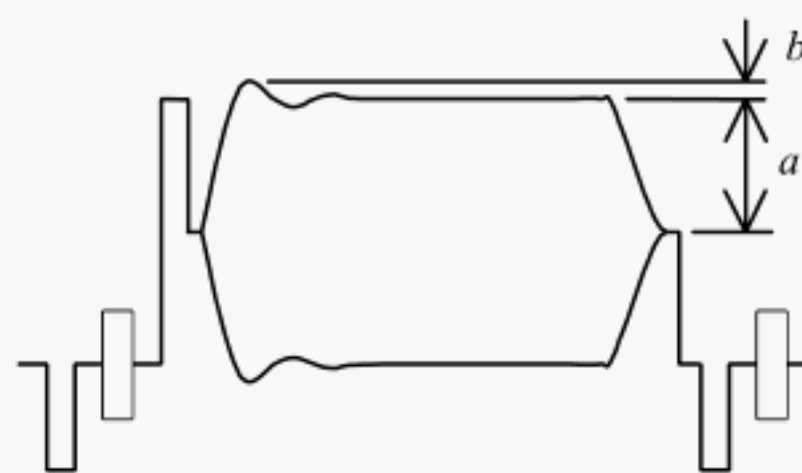
Amplitude = $\dfrac{b}{a} \times 100\ \%$
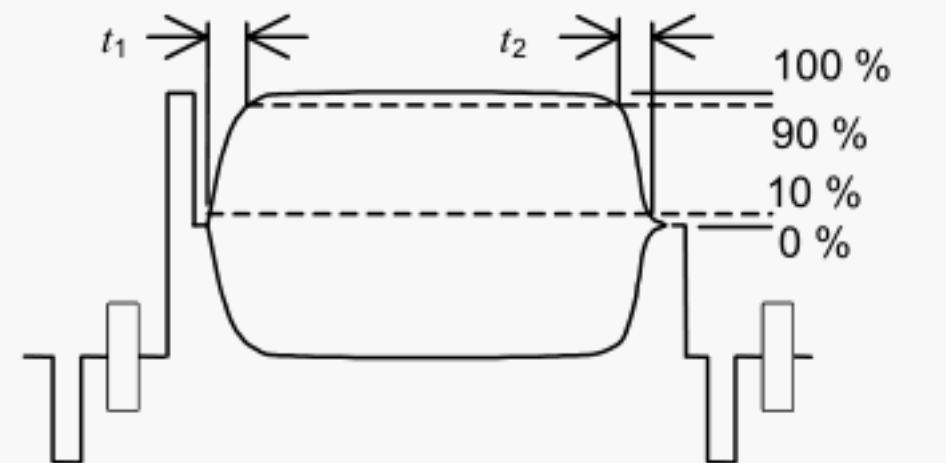
a) Overshoot

Amplitude = $\dfrac{b}{a} \times 100\ \%$

b) Streaking

Amplitude = $\dfrac{b}{a} \times 100\ \%$

Fall time = $t_2\ \mu s$

c) Smear
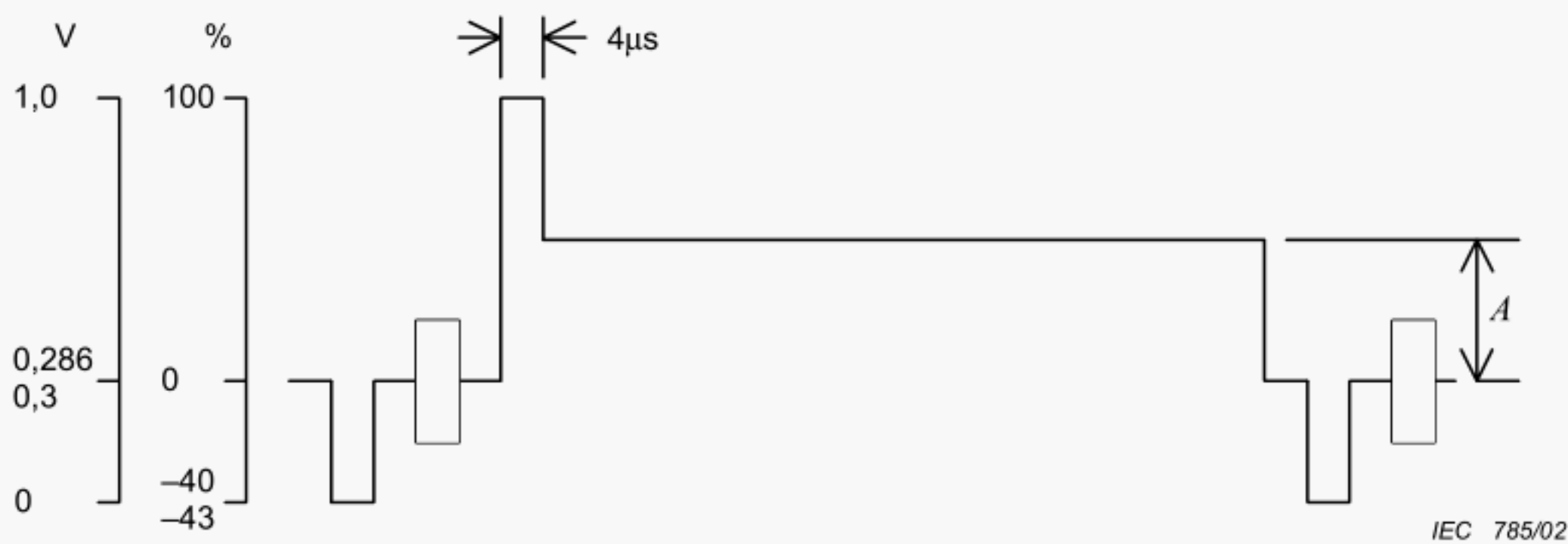
Rise time = $t_1\ \mu s$,

d) Rise and fall time

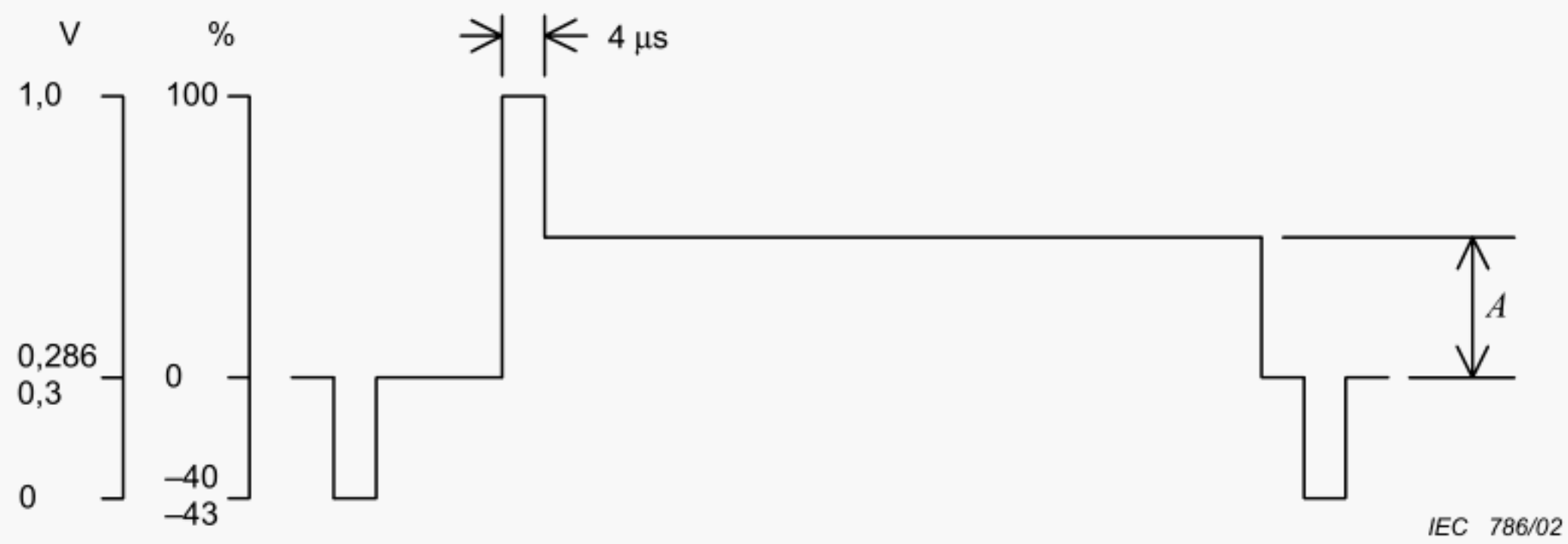**Figure 20 – Measuring method for chrominance waveform distortion**

A = 50 % ± α (variable)

Figure 21 – Composite video test signal for luminance signal-to-noise ratio

A = 50 % ± α (variable)

Figure 22 – S luminance test signal for luminance signal-to-noise ratio

A = 0,286 Vp-p (NTSC)

A = 0,300 Vp-p (PAL)

Figure 23 – S chrominance test signal for luminance signal-to-noise ratio
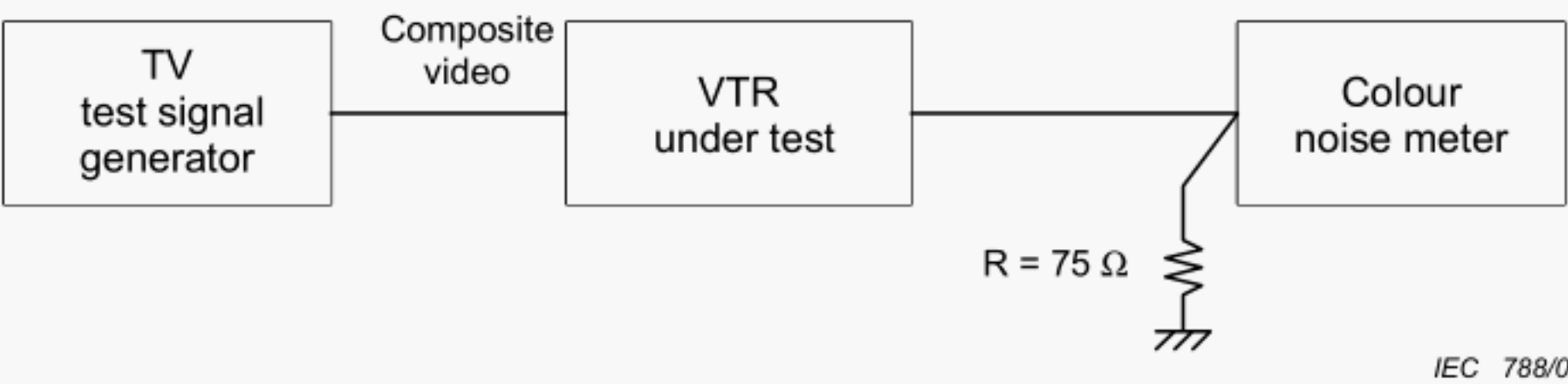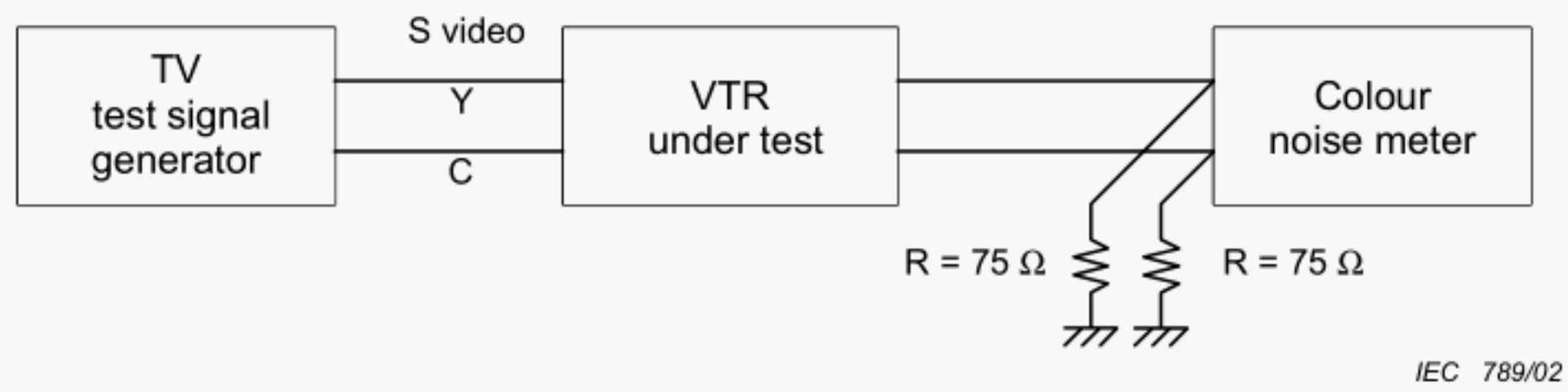

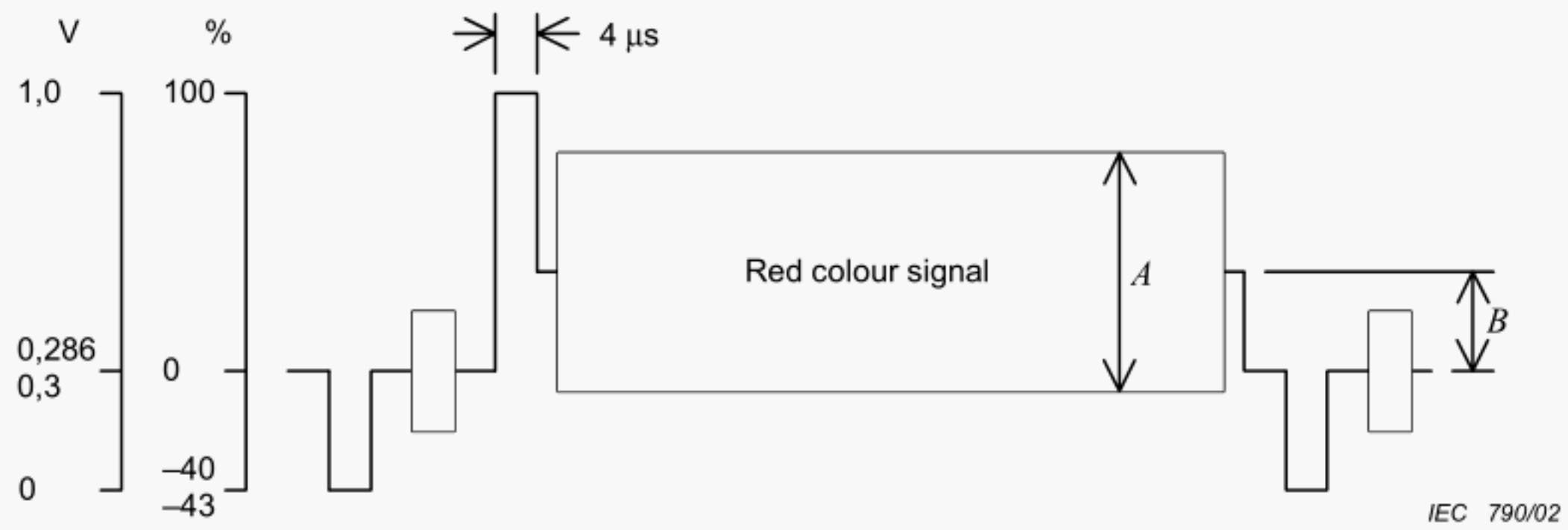**Figure 24 – Block diagram for composite video input**

Figure 25 – Block diagram for S video input

A = 88 % $\pm\,\alpha$ (variable), B = 28 % (NTSC)

A = 95 % $\pm\,\alpha$ (variable), B = 22,5 % (PAL)

Figure 26 – Composite video test signal for chrominance signal-to-noise ratio
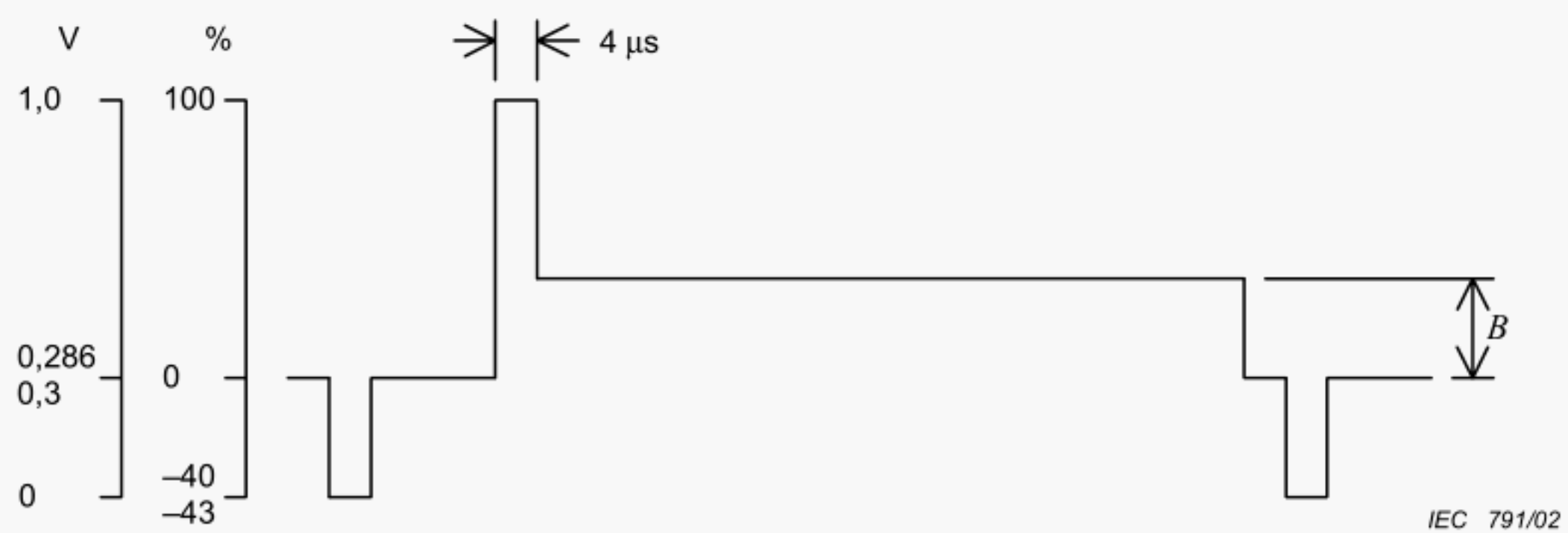
B = 28 % (NTSC)

B = 22,5 % (PAL)

Figure 27 – S luminance test signal for chrominance signal-to-noise ratio

A = 88 % $\pm\alpha$ (variable) (NTSC)

A = 95 % $\pm\alpha$ (variable) (PAL)
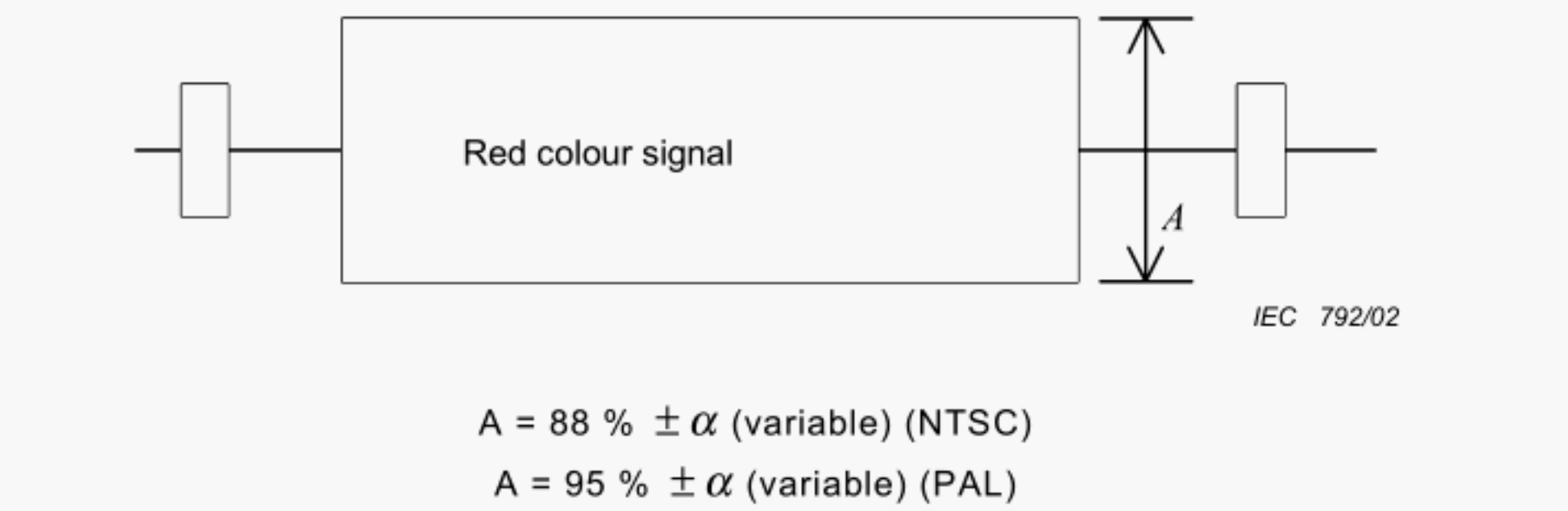
Figure 28 – S chrominance test signal for chrominance signal-to-noise ratio

Figure 29 – Test signal for 3D chrominance signal separation
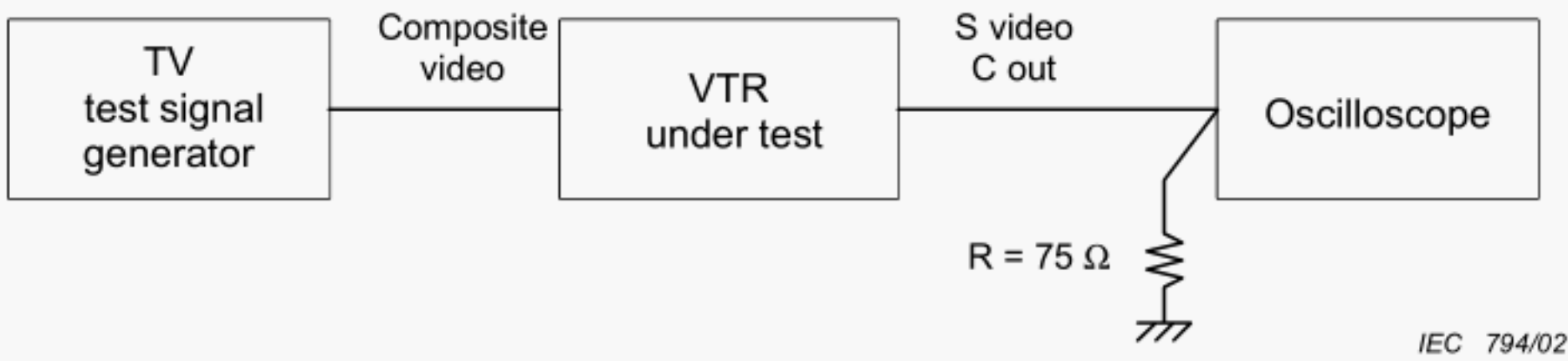
Figure 30 – Measuring block diagram for chrominance signal separation

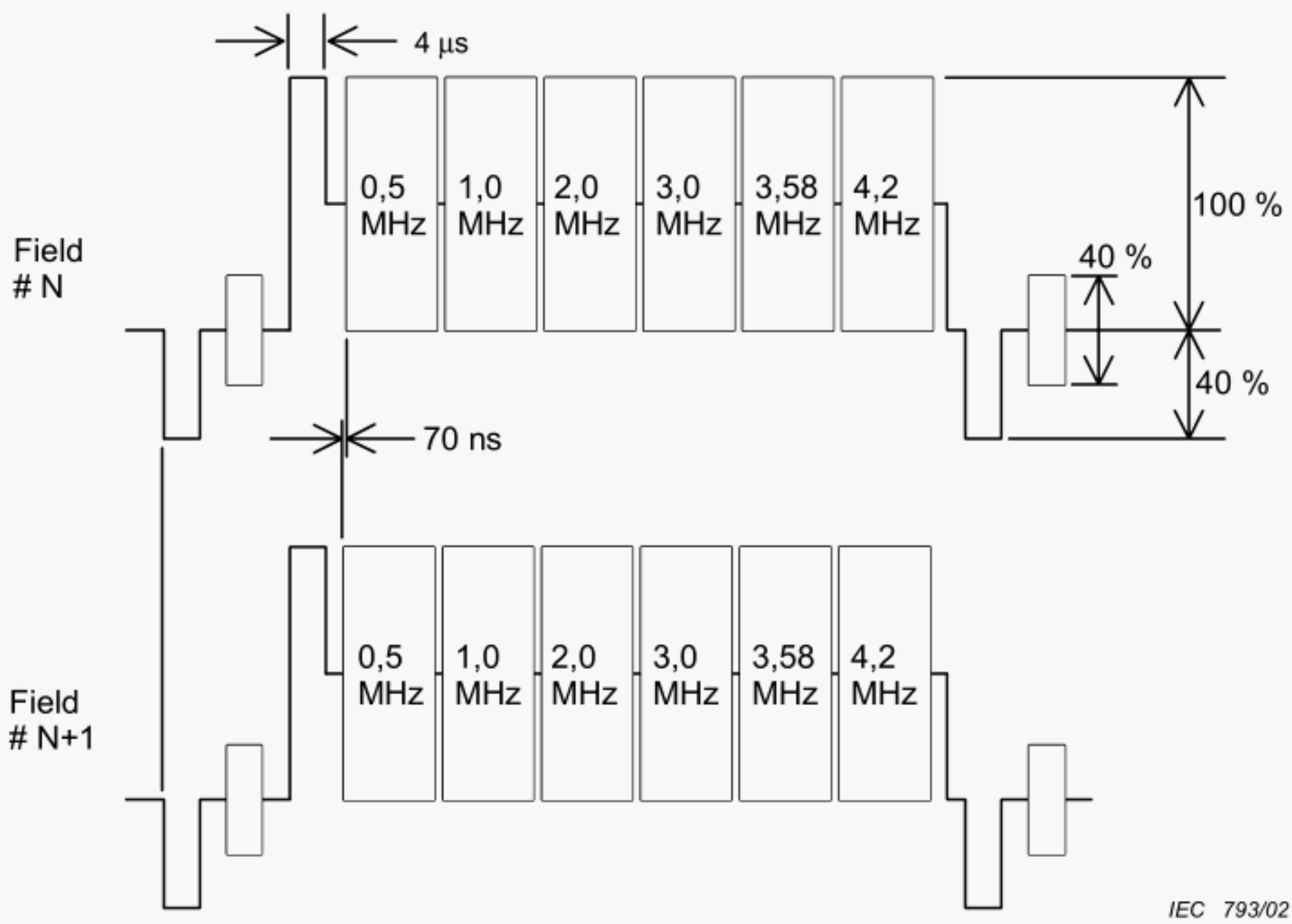**Figure 31 – Measuring method for 3D chrominance signal separation**

Figure 32 – Test signal for 3D luminance signal separation
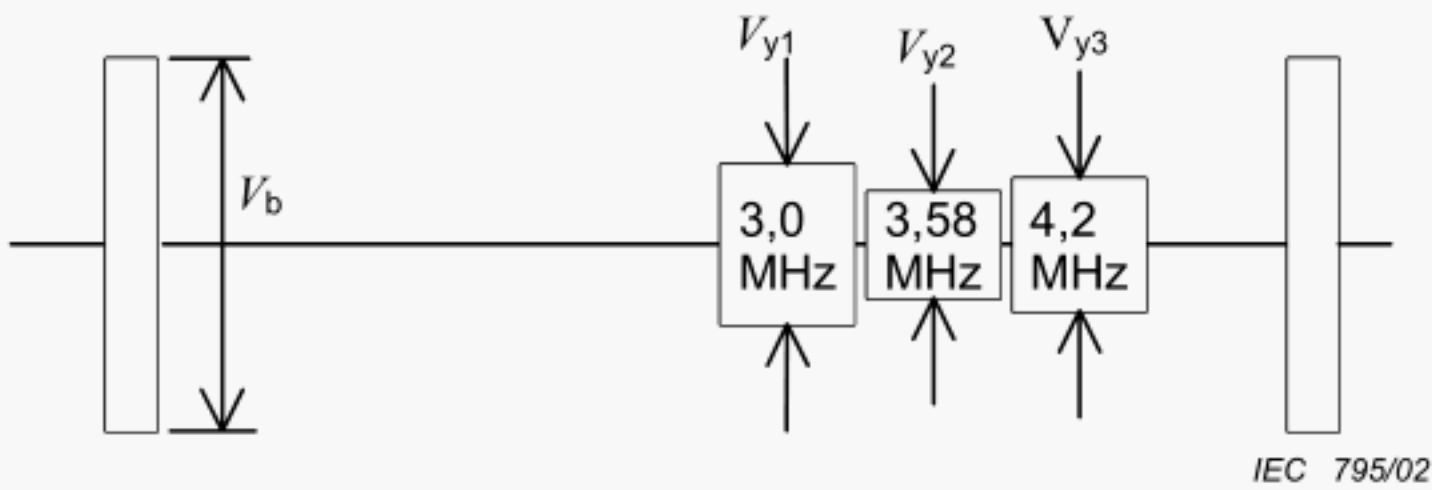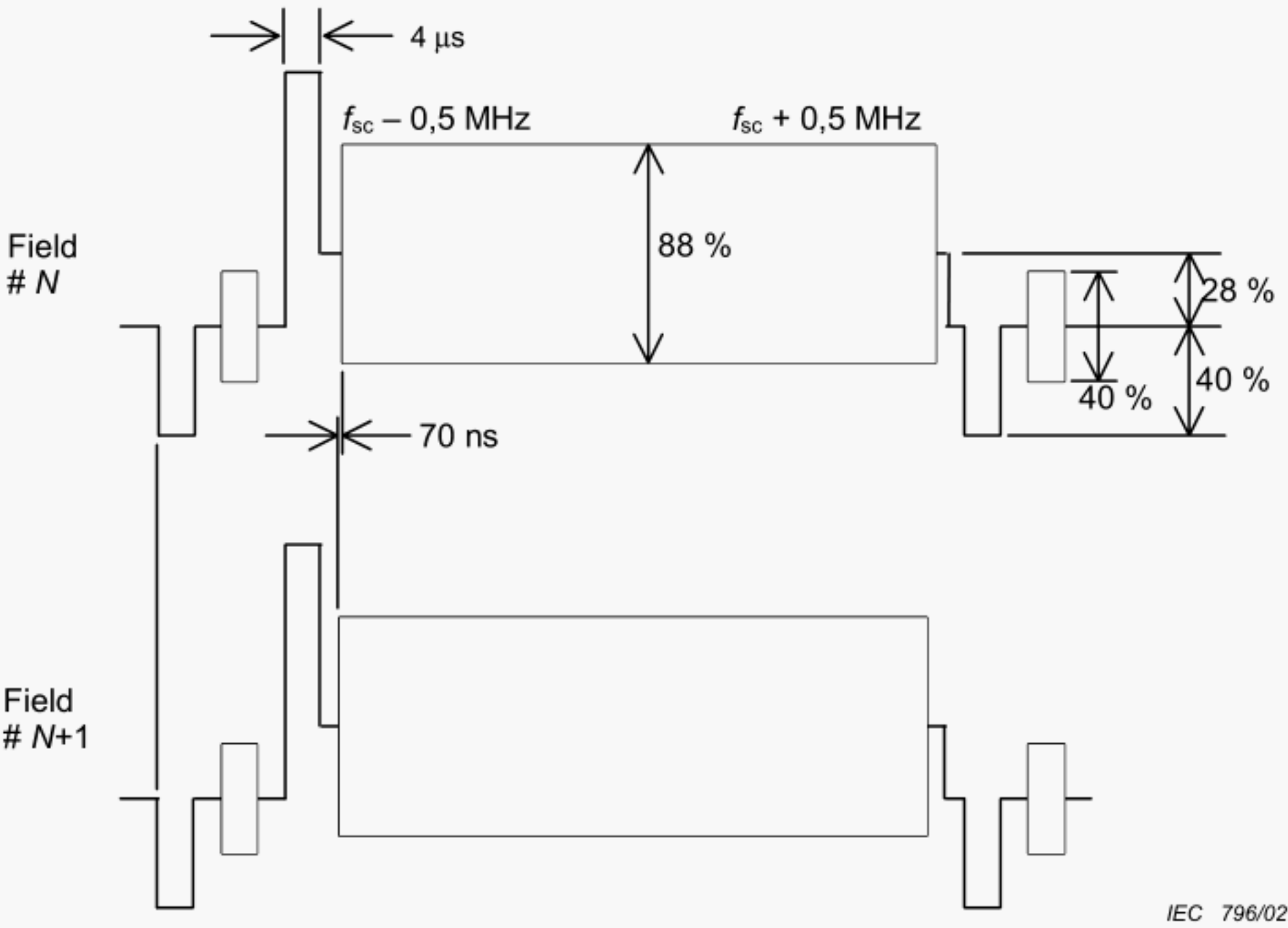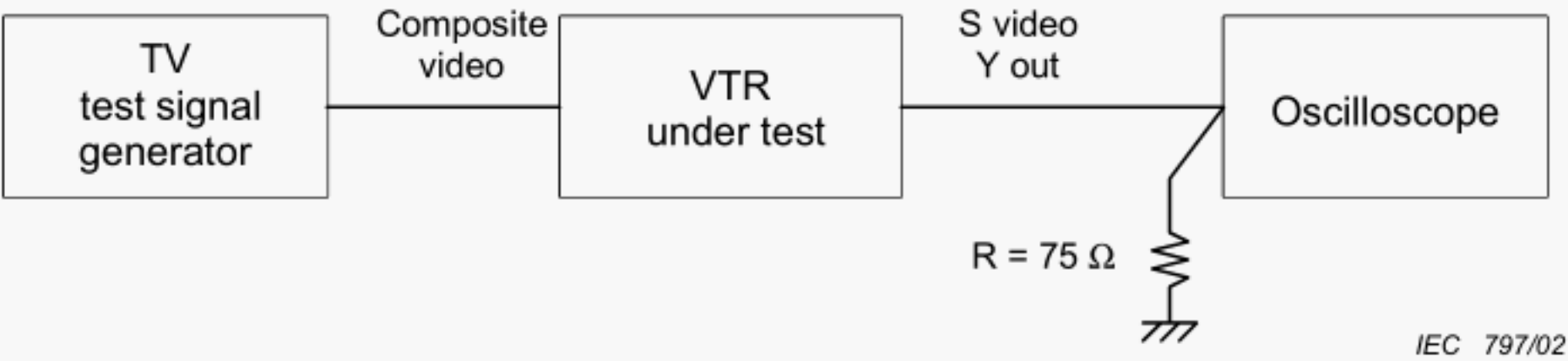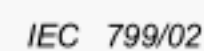

Figure 33 – Measuring block diagram for luminance signal separation

IEC 798/02

Figure 34 – Measuring method for 3D luminance signal separation

IEC 799/02

Figure 35 – Block diagram for audio characteristics

Annex A
(informative)

Error rate

A.1 Definition

This is the ratio of the number of errors detected by the error correction when recording and reproducing the test signal, with respect to the total number of data.

The method of measurement described in this annex needs a video tape recorder equipped with the interface that can transfer the number of errors detected.

A.2 Block diagram

The basic block diagram of the error rate measurement system is shown in figure 1.

The test input signals are the following:

The video test signal for the DV format recorder is the colour bar signal of 4.4.2.

The audio test signal for the DV format recorder is a 1 kHz sinusoidal wave with the level of audio operational input voltage.

The test signal for the D-VHS format recorder is an MPEG-2 TS, and is input through a digital interface.

A.3 Measurement

Record and reproduce the test signal. According to the digital VTR format, there are M inner parity bytes for the error correction and detection code (Reed Solomon Code) in every synchronization block (as shown in figure A.1).

The error bytes described below can be detected by using error correction.

If the error correction indicates no error detection,

there are no error detection bytes in the synchronization block.

If the error correction indicates one error detection,

there is one error detection byte in the synchronization block.

$$\vdots$$

If the error correction indicates $M/2$ error detections,

there are $M/2$ error detection bytes in the synchronization block.

If the error correction indicates other states,

there are $(M/2+1)$ error detection bytes in the synchronization block.

In playback mode, the total number of error bytes is calculated by the sum of the number of error detections in every synchronization block during measurement.

NOTE When the error correction frequently indicates $(M/2+1)$ error detections, the total number of error bytes cannot be calculated exactly.

A.4   Presentation of the results

Byte error rate
  = (the total number of error bytes)/(the number of synchronization blocks during measurement $\times N$)

N = the number of synchronization block data bytes

A.5   Example 1

Error rate calculation example of the DV format (as shown in figure A.2).

When a DV format recorder is measured for a period of 12 frames, the total number of data bytes reproduced during measurement is calculated as below.

The total number of data bytes = 85 bytes × 163 synchronization blocks × 10 tracks ×12 frames.

The total number of error bytes is calculated as below.

The number of synchronization blocks detecting 1 error byte shall be defined as E_1.
The number of synchronization blocks detecting 2 error bytes shall be defined as E_2.
The number of synchronization blocks detecting 3 error bytes shall be defined as E_3.
The number of synchronization blocks detecting 4 error bytes shall be defined as E_4.
The number of synchronization blocks detecting 5 error bytes shall be defined as E_5.

Consequently,

the total number of error bytes = $E_1 + 2{\times}E_2 + 3{\times}E_3 + 4{\times}E_4 + 5{\times}E_5$.

Hence the error rate is calculated as below.

Error rate = (the total number of error bytes)/(the total number of data bytes).

A.6   Example 2

Error rate calculation example of the D-VHS format (as shown in figure A.3).

When a D-VHS format recorder is measured for a period of 30 frames, the total number of data bytes reproduced during measurement is calculated as below.

The total number of data bytes = 107 bytes × 336 synchronization blocks × 2 tracks × 30 frames.

And the total number of error bytes is calculated as below.

The number of synchronization blocks detecting 1 error byte shall be defined as E_1.
The number of synchronization blocks detecting 2 error bytes shall be defined as E_2.
The number of synchronization blocks detecting 3 error bytes shall be defined as E_3.
The number of synchronization blocks detecting 4 error bytes shall be defined as E_4.
The number of synchronization blocks detecting 5 error bytes shall be defined as E_5.

Consequently,

the total number of error bytes = $E_1 + 2{\times}E_2 + 3{\times}E_3 + 4{\times}E_4 + 5{\times}E_5$.

Hence the error rate is calculated as below.

Error rate = (the total number of error bytes)/(the total number of data bytes).

IEC 800/02

Figure A.1 – Structure of data-synchronization blocks

IEC 801/02
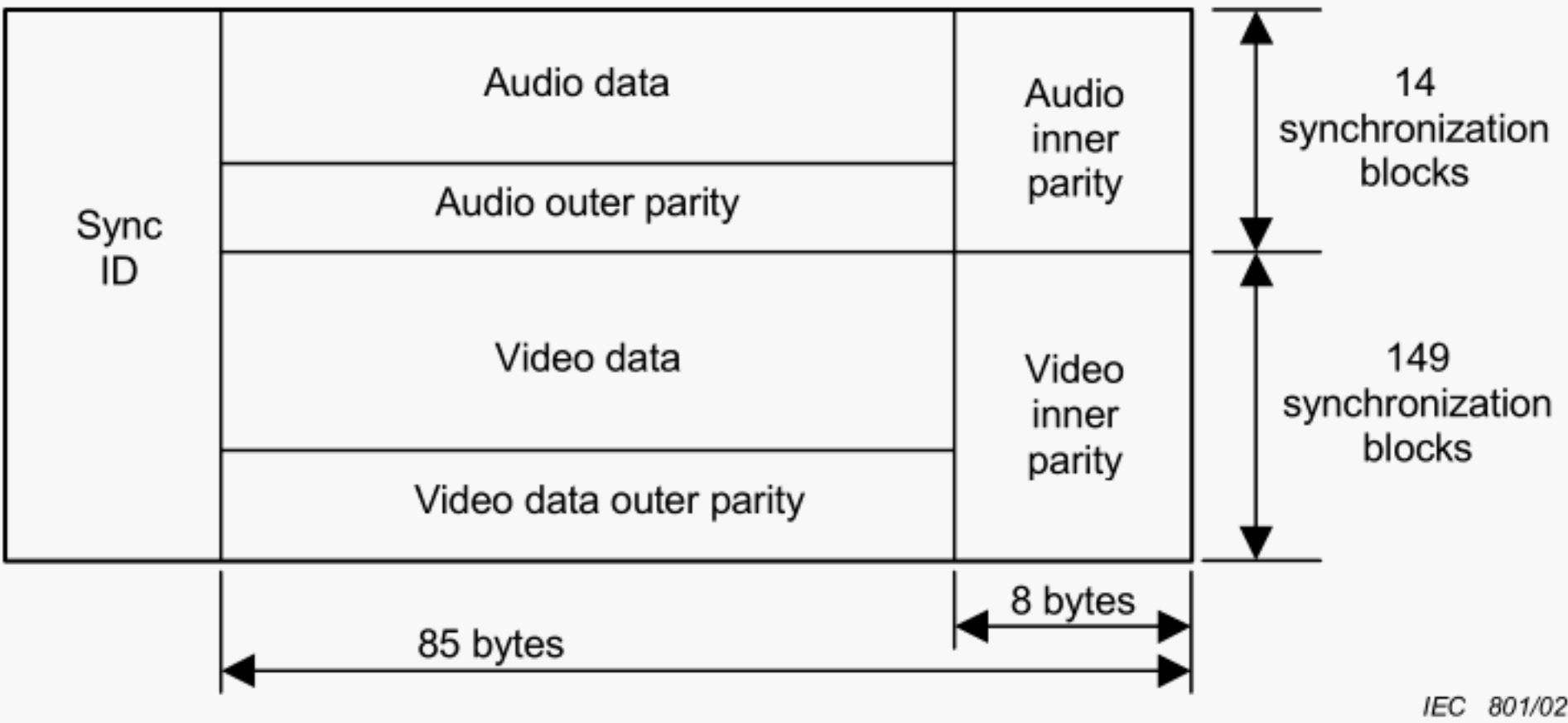
Figure A.2 – Structure of DV format data-synchronization blocks

IEC 802/02
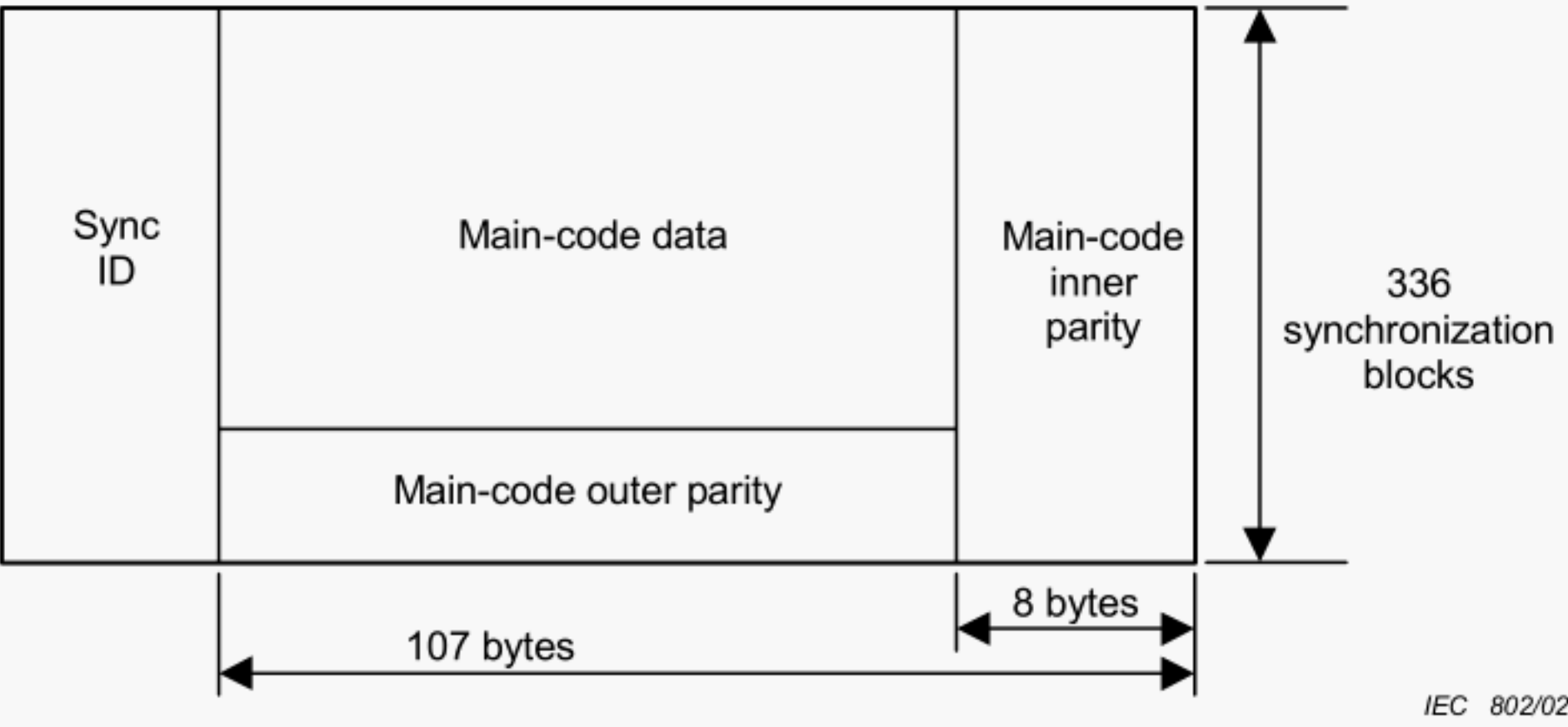
Figure A.3 – Structure of D-VHS format data-synchronization blocks

Bibliography

[1]   FUJITA, *et al.* "*Newly Developed D-VHS Digital Tape Recording System for the Multimedia Era*", IEEE Trans. on CE., Vol.42, No.3, (Aug. 1996)

[2]   NAKAI *et al.* "*Newly developed IRD built-in D-VHS VCR system for DVB broadcasts*", IEEE Trans. on CE., Vol.44, No.3, (Aug. 1998)

[3]   SOGABE, Y., MURATA, S. "*A development of analysis techniques for displacement of track patterns*" ITE Japan, Vol. 46, No. 10, pp. 1295-1300 (1992)

_____

Standards Survey

The IEC would like to offer you the best quality standards possible. To make sure that we continue to meet your needs, your feedback is essential. Would you please take a minute to answer the questions overleaf and fax them to us at +41 22 919 03 00 or mail them to the address below. Thank you!

Customer Service Centre (CSC)

International Electrotechnical Commission
3, rue de Varembé
1211 Genève 20
Switzerland

or

Fax to: **IEC**/CSC at +41 22 919 03 00

Thank you for your contribution to the standards-making process.

- -

A Prioritaire

RÉPONSE PAYÉE

SUISSE

Customer Service Centre (CSC)
International Electrotechnical Commission
3, rue de Varembé
1211 GENEVA 20
Switzerland

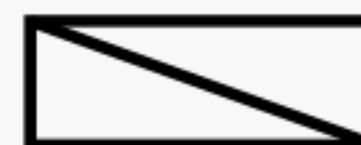**Q1** Please report on **ONE STANDARD** and **ONE STANDARD ONLY**. Enter the exact number of the standard: *(e.g. 60601-1-1)*

....

Q2 Please tell us in what capacity(ies) you bought the standard *(tick all that apply)*. I am the/a:

purchasing agent	❏
librarian	❏
researcher	❏
design engineer	❏
safety engineer	❏
testing engineer	❏
marketing specialist	❏
other..	

Q3 I work for/in/as a: *(tick all that apply)*

manufacturing	❏
consultant	❏
government	❏
test/certification facility	❏
public utility	❏
education	❏
military	❏
other..	

Q4 This standard will be used for: *(tick all that apply)*

general reference	❏
product research	❏
product design/development	❏
specifications	❏
tenders	❏
quality assessment	❏
certification	❏
technical documentation	❏
thesis	❏
manufacturing	❏
other..	

Q5 This standard meets my needs: *(tick one)*

not at all	❏
nearly	❏
fairly well	❏
exactly	❏

Q6 If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date	❏
standard is incomplete	❏
standard is too academic	❏
standard is too superficial	❏
title is misleading	❏
I made the wrong choice	❏
other	

Q7 Please assess the standard in the following categories, using the numbers:
(1) unacceptable,
(2) below average,
(3) average,
(4) above average,
(5) exceptional,
(6) not applicable

timeliness..
quality of writing...................................
technical contents.................................
logic of arrangement of contents ....
tables, charts, graphs, figures...............
other ....

Q8 I read/use the: *(tick one)*

French text only	❏
English text only	❏
both English and French texts	❏

Q9 Please share any comment on any aspect of the IEC that you would like us to know:

....
....
....
....
....
....
....
....
....
....
....
....

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND