SLOVENSKI STANDARD
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Recommended methods of measurement on receivers for television broadcast transmissions -- Part 8: Measurement on D2-MAC/packet equipment (IEC 60107-8:1997)

Recommended methods of measurement on receivers for television broadcast transmissions -- Part 8: Measurement on D2-MAC/packet equipment

Meßverfahren für Empfänger von Fernseh-Rundfunksendungen -- Teil 8: Messungen an D2-MAC/Paket-Einrichtungen

Méthodes recommandées pour les mesures sur les récepteurs de télévision -- Partie 8: Mesures sur les équipements D2-MAC/paquet

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Meßverfahren für Empfänger von Fernseh-Rundfunksendungen Teil 8: Messungen an D2-MAC/Paket-Einrichtungen (IEC 60107-8:1997)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 100A/31/FDIS, future edition 1 of IEC 60107-8, prepared by SC 100A, Multimedia end-user equipment, of IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60107-8 on 1997-07-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A and B are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60107-8:1997 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60107-1	1977	Recommended methods of measurement on receivers for television broadcast transmissions Part 1: General considerations Electrical measurements other than those at audio-frequencies	-	-
IEC 60107-5	1992	Part 5: Electrical measurements on multichannel sound television receivers using the NICAM two-channel digital sound-system	EN 60107-5	1992
IEC 61079-2	1992	Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band Part 2: Electrical measurements on DBS tuner units	EN 61079-2	1993
IEC 61079-5	1993	Part 5: Electrical measurements on decoder units for MAC/Packet systems	EN 61079-5	1993
ITU-T Recommendation J.61	1990	Transmission performance of television circuits designed for use in international connections	-	-
ITU-R Recommendation BT 601-5	1995	Encoding parameters of digital television for studios	-	-
ITU-R Recommendation BO 650-2	1992	Standards for conventional television systems for satellite broadcasting in the channels defined by appendix 30 of the Radio Regulations	-	-
EBU SPB 489	1985	Specification of D2-MAC/packet system	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RECOMMENDED METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS –

Part 8: Measurements on D2-MAC/packet equipment

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 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 60107-8 has been prepared by subcommittee 100A: Multimedia end-user 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
100A/31/FDIS	100A/46/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.

Annexes A and B are for information only.

RECOMMENDED METHODS OF MEASUREMENT ON RECEIVERS FOR TELEVISION BROADCAST TRANSMISSIONS –

Part 8: Measurements on D2-MAC/packet equipment

1 General

1.1 *Scope and object*

The object of this part of IEC 60107 is to define quality parameters and to provide a guideline for measurement on D2-MAC/packet equipments, under uniform and repetitive conditions. The D2-MAC/packet process is specified in EBU SPB 489.

The specifications of the limit values of the various parameters of the equipments are outside the scope of this standard; however theoretical curves and references are provided which could be used as a guide for presentation of measurement results.

The characterization of signal performances at the radiofrequency interface is difficult to specify and measure; however, correlation elements between RF measurement and baseband measurement are given in annex A. Relations between subjective quality assessment and objective measurement of parameters are developed in annex B.

1.2 *Normative references*

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60107. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60107 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60107-1: 1977, *Recommended methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Electrical measurements other than those at audio-frequencies*

IEC 60107-5: 1992, *Recommended methods of measurement on receivers for television broadcast transmissions – Part 5: Electrical measurements on multichannel sound television receivers using the NICAM two-channel digital sound-system*

IEC 61079-2: 1992, *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band – Part 2: Electrical measurement on DBS tuner units*

IEC 61079-5: 1993, *Methods of measurement on receivers for satellite broadcast transmissions in the 12 GHz band – Part 5: Electrical measurements on decoder units for MAC/packet systems*

ITU-T Recommendation J.61: 1990, *Transmission performance of television circuits designed for use in international connections*

ITU-R Recommendation BT 601-5: 1995, *Encoding parameters of digital television for studios*

ITU-R Recommendation BO 650-2: 1992, *Standards for conventional television systems for satellite broadcasting in the channels defined by appendix 30 of the Radio Regulations*

EBU SPB 489: 1985, *Specification of D2-MAC/packet system*

2 Definitions

For the purpose of this part of IEC 60107, the following definitions apply.

2.1 **hypothetical reference chain:** The distribution of global tolerances between the various elements of a television system, from the picture source to the display.

NOTE – The notional block diagram of such a chain is shown in figure 1 and each block is described below.

2.1.1 **studio encoder:** Single entity providing the D2-MAC/packet baseband signal.

2.1.2 **modulator:** This entity modulates the baseband signal into the appropriate signal for the foreseen transmission/broadcasting system.

2.1.3 **transmission/broadcasting system:** The transmission/broadcasting system may be either:

- a terrestrial broadcasting system;
- a satellite broadcasting system;
- a distribution system on coaxial support;
- a distribution system on optical support.

2.1.4 **receiving equipment:** The receiving equipment may be split into two parts: a demodulation unit and a decoding unit, or may consist of a decoding unit only.

The demodulation unit comprises a radiofrequency input, a selection-demodulation unit and a baseband output.

The decoding unit comprises a baseband input, a decoding unit, and an audiovisual components output.

2.2 **interfaces:** Three types of interfaces can be distinguished: baseband (see also points 1, 4 and 5 of figure 1), radiofrequency (see also points 2 and 3 of figure 1) and audiovisual component signals (see also points 0, 6 and 7 of figure 1).

NOTES

1 The receiving equipment interfaces are described below for a better understanding of the measurements (see points 0 to 7 of figure 1).

a) point 3 shows the RF input from cable distribution or from outdoor unit for satellite reception;

b) point 5 shows the regulated baseband D2-MAC/packet output generally used for control and measurement;

c) point 6 shows the output interface of a D2-MAC/packet decoder used in IEC 61079-5 for measurements on the quality of the restored picture components;

d) point 7 shows another interface possibility which allows to use the current measurement equipment which is generally developed for measurement on Y, Cr and Cb. Unfortunately, its use requires the installation of a reference matrixing.

2 Unless otherwise specified in this standard, the measurements are assumed to be done at point 5 and the decoded signal is assumed to be observed at point 6 of figure 1.

2.3 *Quality parameters for a D2-MAC/packet signal*

2.3.1 *Parameters for the MAC signal*

2.3.1.1 **MAC analogue waveform:** The MAC analogue waveform is derived directly from the 4:2:2 standard for digital television (see ITU-R 601-3). MAC coding consists of sequentially transmitting chrominance information compressed in a ratio of 3, and luminance information compressed in a ratio of 3/2. Based on the sampling frequencies used in 4:2:2 (13,5 MHz for luminance and 6,75 MHz for chrominance), the sampling frequency in MAC is 20,25 MHz, and the nominal band is 8,4 MHz (or 5,6 MHz in luminance after decompression).

2.3.1.2 **nominal signal amplitude:** The difference between the white level and the black level transmitted in line 624.

NOTE – The nominal amplitude of the MAC signal is 1 V.

2.3.1.3 *Distortion*

2.3.1.3.1 **gain/frequency response distortion:** The gain variation between the circuit input and output, over the frequency range extending from the frame frequency to the nominal system cut-off frequency, relative to the gain at an appropriate reference frequency.

2.3.1.3.2 **phase distortion:** The difference in degrees relative to the linear phase characteristic over a frequency band extending from, ideally, 0 Hz to a defined upper frequency.

2.3.1.3.3 **group delay time distortion:** The difference between the group delay time for each frequency and the group delay time at a determined frequency, expressed in nanoseconds.

2.3.1.3.4 **long time distortion:** When a test signal simulating a sudden variation of the black or white luminance component, or vice versa, is applied to a circuit input, long time distortion appears if clamping level variations (medium grey level) of the signal at the output do not precisely follow the signal clamping level at the input. These variations are either in exponential form, or more frequently in dampened oscillatory form at very low frequency.

2.3.1.3.5 **distortion of duration of the order of one frame:** When a test signal simulating a variation of the luminance component from black to white with a period of the same order as the frame duration (40 ms), with an amplitude equal to the nominal amplitude of the luminance signal, is applied to the circuit input, distortion is defined as the modification to the shape of the test signal at the output.

2.3.1.3.6 **distortion of duration of the order of one line:** When a test signal simulating a variation of the black to white luminance component, with a period of the same order as the line duration, is applied to the circuit input, distortion is defined as the modification to the shape of the test signal at the output.

NOTE – A period with a duration equivalent to a few picture elements is excluded from the measurement at the start and at the end of the test signal.

2.3.1.3.7 **short duration distortion (transient response):** When a short impulse (or a fast transition) with an amplitude equal to the nominal amplitude of the luminance signal and with a determined shape is applied to the circuit input, the distortion is defined as the modification of the shape of the output impulse (or transition) relative to its original shape.

2.3.1.3.8 **distortion due to echoes:** Distortion corresponding to the amplitude and phase superposition of the direct signal with the same signal delayed and attenuated.

2.3.1.3.9 **low frequency non-linear distortion:** The proportional error between the amplitude of the signal at the input and at the output of the circuit when the signal varies between the black and the white on the duration of one line for a defined value of the average component of the picture.

2.3.1.4 *Noise*

2.3.1.4.1 **continuous random noise:** The signal/noise ratio, in the case of continuous random noise, is defined as the ratio in decibels of the nominal luminance signal amplitude (1 V), to the Root Mean Square (r.m.s.) of the noise measured after limitation of the band.

NOTES

1 The weighted signal/noise ratio is defined as the ratio in decibels of the nominal luminance signal amplitude to the r.m.s. noise value, measured after limitation of the band and weighted with a given network.

2 The power measurement should be made with an instrument with a defined time constant or integration duration.

2.3.1.4.2 **low frequency noise:** The signal-to-noise ratio is defined as the ratio in decibels between the nominal amplitude of the luminance signal (1 V) and the r.m.s. noise level. (The measurement is carried out in the bandwidth starting from 0 to half the line frequency (7,8 kHz)).

NOTE – A major source of low frequency noise is the clamp processing which introduces two types of noise:

– clamp noise, resulting from the transformation of the broadband noise into low frequency noise, due to the clamp processing;

– clamping impairment, resulting from the limited clamping performance on d.c. component restoration and on rejection of additive low frequencies such as 50 Hz or energy dispersal.

2.3.1.4.3 **clamping performance:** The performance of a clamping circuit evaluated by measuring both the clamp noise and the clamping impairment, as defined in the note to 2.3.1.4.2.

NOTE – The optimization of the performances in each case is achieved by opposite adjustments of the same parameters (time constant). This leads to finding a compromise, depending on the conditions of use, between the desired performances in both cases.

2.3.1.4.4 **interferences:** The signal to interference ratio is defined as the ratio in decibels of the nominal luminance signal amplitude (1 V) to the peak-to-peak interference amplitude.

2.3.2 *Data signals*

2.3.2.1 **duobinary waveform:** The digital signal containing sound and data information is coded in duobinary form, as described in the D2-MAC/packet system specification.

NOTE – The principle of this duobinary code is to provide coding at three levels (–1, 0, +1). The extreme levels represent logical level 1 and the intermediate level represents logical level 0. This electrical representation provides the advantage of compacting the contents of the spectral signal by a factor of two. The amplitude of the duobinary burst is 80 % of the amplitude of the picture signal without taking the overshoots into account (see figure 2).

2.3.2.2 *Quality parameters on the digital signal*

2.3.2.2.1 **Bit Error Ratio (*BER*):** The ratio between the number of errors detected and the number of bits transmitted during a given period.

$$BER = \frac{\text{Number of errors (T)}}{\text{Number of bits transmitted (T)}}$$

2.3.2.2.2 **eye diagram:** The superposition of all the configurations of the data signal (see figure 2).

2.3.2.2.3 **equivalent degradation:** The *S/N* ratios measured after adding a Gaussian noise to the received signal to obtain the selected bit error ratio and the expected *S/N* given by theory for the same bit error ratio.

NOTE – *S* is the nominal signal amplitude.
N is the noise power measured without weighting in a 5 MHz band, corresponding to the duobinary data spectrum bandwidth.

2.3.2.2.4 **operating margin:** The difference between the received *S/N* ratio and the *S/N* ratio measured after adding a Gaussian noise to the received signal to obtain the selected bit error ratio.

NOTE – *S* is the nominal signal amplitude.
N is the noise power measured without weighting in a 5 MHz band, corresponding to the duobinary data spectrum bandwidth.

3 Measurements

3.1 *Introduction*

Measurement methods applicable to a D2-MAC/packet signal fall within two categories:

Manual methods which may be carried out using conventional measurement instruments (oscilloscope, noise measurement device, etc.) and similar to those used on PAL or SECAM composite signals.

Automatic methods which make considerable use of digital signal processing techniques and which can only be carried out by an automatic specialized measuring instrument.

In any case, the results of measurements depend not only on the performances of the equipment under test but also on the quality of the input signal and the accuracy of the measuring instruments, which, if known, shall be stated in the appropriate form. Alternatively, the results may be compared to those obtained, under the same conditions, from a reference equipment.

IEC 61079-1, IEC 61079-2, IEC 60107-1 and IEC 60107-2 contain specifications and recommendations that also apply to this standard.

3.2 *General conditions*

3.2.1 *Introduction*

Measurements shall be made in accordance with the following conditions to ensure repeatable results.

3.2.2 *Testing site*

Measurements shall be carried out at a location that is not subject to external radiofrequency interference. If interference cannot be avoided, the tests shall be carried out in a screened room.

3.2.3 *Accuracy of measuring instruments*

The accuracy of the measuring instruments used, if known, shall either be stated as a percentage or in decibels as appropriate.

3.2.4 *Stabilization period*

Unless otherwise specified, measurements should be started at the time when stabilization of the characteristics is obtained.

3.3 *Description of test signals*

Test signals start at the 244th line sample (sampling period T = 49,38 ns), they are preceded by the 10,4 µs duobinary burst and a clamp interval of 750 ns not shown on the figures illustrating these signals.

3.3.1 *Test signal No. 1*

Test signal No. 1 (see figure 3 and table 1) is a mandatory signal transmitted in line 312. It is designed for automatic measurement and consists of a bipolar bar signal with polarity inversion between even and odd frames. Positive and negative Blackman type pulses are contained in the even frame signal only.

The first part of the signal (k = 225 to 612) is provisionally fixed at 0 V. It may be used later for the insertion of complementary test signals.

NOTE – A 6T Blackman type pulse is defined as:

$-3T \leq t \leq 3T$: $x(t) = 0{,}42 + 0{,}50 \cos \pi t/3T + 0{,}08 \cos 2\pi t/3T$;

Otherwise: $x(t) = 0$;

where T is the 20,25 MHz clock period.

3.3.2 *Test signal No. 2*

Test signal No. 2 (see figure 4 and table 2) is a mandatory signal transmitted in line 623. It is designed for automatic measurements of noise and non-linear distortion at low frequencies. It includes a rising ramp (even frames) and falling ramp (odd frames). This inversion can establish a distinction between linear and non-linear distortion (distortion asymmetry).

3.3.3 *Test signal No. 3*

Test signal No. 3 (see figure 5 and table 3) is a mandatory signal transmitted in line 624. The first part of this line contains grey, white and black reference levels. The second part of the line contains a complex wobbulation.

In order to avoid taking non-linear phenomena into account, this wobbulation is transmitted on four frames with the following sequence:

- 1st even frame, real part, positive polarity;
- 1st odd frame, imaginary part, positive polarity;
- 2nd even frame, real part, negative polarity;
- 2nd odd frame, imaginary part, negative polarity.