

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

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National foreword

This Part of BS EN 61079 has been prepared by Technical Committee EPL/12 and is the English language version of EN 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*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 1079-5:1993, published by the International Electrotechnical Commission (IEC).

BS EN 61079 is a multipart standard. The other Parts published to date are:

- Part 1:1995 *Radio-frequency measurements on outdoor units*;
- Part 2:1995 *Electrical measurements on DBS tuner units*;
- Part 3:1995 *Electrical measurements of overall performance of receiver systems comprising an outdoor unit and a DBS tuner unit*.

This Part of BS EN 61079 defines the conditions and methods of measurement to be applied to MAC/packet decoder units. The unit can either be connected to the output of a DBS tuner unit or be a part of it. Limit values of the various parameters of the decoder are not specified.

Cross-references

Publication referred to	Corresponding British Standard
	BS 3549 <i>Methods of measuring and expressing the performance of television receivers</i>
IEC 107-1:1977	Part 1:1979 <i>General considerations and electrical measurements other than those at audio-frequencies</i>
IEC 107-2:1980	Part 2:1981 <i>Electrical and acoustic measurements at audio-frequencies</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 60, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Methods of measurement on receivers for satellite
broadcast transmissions in the 12 GHz band
Part 5: Electrical measurements on decoder units for
MAC/packet systems

(IEC 1079-5:1993)

Méthodes de mesure sur les récepteurs
d'émissions de radiodiffusion par satellite
dans la bande 12 GHz
Partie 5: Mesures électriques sur les
décodeurs pour les systèmes MAC/paquet
(CEI 1079-5:1993)

Meßverfahren für Empfänger für
Satelliten-Rundfunkübertragung im
12-GHz-Bereich
Teil 5: Elektrische Messungen an Dekodern
für MAC/Paket-Systeme
(IEC 1079-5:1993)

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Foreword

The text of document 12A(CO)169, as prepared by Subcommittee 12A, Receiving equipment, of IEC Technical Committee 12, Radiocommunications, was submitted to the IEC-CENELEC parallel vote in April 1992.

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Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A and Annex ZA are normative and Annex B is informative.

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Section 1. General

1.1 Scope and object

The object of this part of IEC 1079 is to define the conditions and methods of measurement to be applied to MAC/packet decoder units.

The specifications of the limit values of the various parameters of the decoder are outside the scope of this part.

This unit can either be connected to the output of a DBS tuner unit or be a part of it. The methods of measurement concerning the DBS tuner part are described in part 2 of IEC 1079.

The input signal is a baseband video signal encoded according to one of the following MAC standards:

- D-MAC/packet;
- D2 MAC/packet.

The output signals are:

- red, green, blue colour signals (R, G, B);
- one or more audio signal(s);
- the composite synchronization signal.

NOTE The methods of measurement can also be used for MAC/packet receivers with built-in MAC decoder units if R, G, B output signals are available.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 1079. At the time of publication of this standard, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1079 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 107-1:1977, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 1: General considerations. Electrical measurements other than those at audio frequencies.*

IEC 107-2:1980, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 2: Electrical and acoustic measurements at audio frequencies.*

IEC 107-3:1988, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 3: Electrical measurements on multichannel sound television receivers using subcarrier systems.*

IEC 107-4:1988, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 4: Electrical measurements on multichannel sound television receivers using the two-carrier FM system.*

IEC 107-5:1992, *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 107-6:1989, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 6: Measurement under conditions different from broadcast signal standards.*

IEC 933-1:1988, *Audio, video and audiovisual systems — Interconnections and matching values. Part 1: 21-pin connector for video systems — Application No. 1.*

Section 2. General explanation of terms

For the purpose of this part of IEC 1079, the following general definitions apply.

2.1 MAC/packet decoder unit

The function of this unit is to process an incoming baseband video MAC signal issued from a DBS tuner unit and to decode it in order to provide R, G, B colour, audio and composite synchronization signals which can be applied to a monitor or a TV set having an appropriate audiovideo connector such as the one defined by IEC 933-1.

The exact configuration of the unit depends on overall product design and the related type of MAC/packet system that the equipment is designed to process.

In the description of the measurement methods, it is assumed that the arrangement of the units is similar to the notional block diagram shown in Figure 1.

Section 3. General notes on measurements

3.1 General conditions

3.1.1 Introduction

Measurements should be carried out in accordance with the following conditions to ensure measurement reliability.

3.1.2 Test site

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

3.1.3 Environmental conditions

Sections 3, 4 and 5 of IEC 107-1 shall be applied.

3.1.4 Power supply

A power supply equivalent to the rated voltage and rated frequency of the unit shall be used. The fluctuation of the power supply voltage and frequency during the tests shall not exceed $\pm 2\%$ and harmonic components of the power supply shall not exceed 5 %.

3.1.5 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.

Alternatively, the precision class may be quoted as stated in the relevant publications.

3.1.6 Stabilization period

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

3.2 Setting of the decoder

Unless otherwise specified, all adjustments of the decoder should be set to nominal (for video and audio parts).

Special care should be taken concerning saturation and contrast settings. They can be checked using the colour-bar test signal and observing that R, G, B output colour signals are as close as possible to those shown in Figure 17.

3.3 Video, audio and digital test signals

3.3.1 Video test signals

Most video measurements are performed on one of the outgoing R, G, B colour signals which are derived from both luminance and chrominance components. In order to easily determine the characteristics of each processing channel, the video test signals exist in two forms:

- one for the luminance channel testing (referred to as “L”) where the test signal is included in the luminance part of the line;
 - one for the chrominance (referred to as “Ch”) where the test signal is included in the chrominance part of the video line.
- a) Multiburst L and Ch signals.
 - b) Complex wobble L and Ch signals (real part).
 - c) Complex wobble L and Ch signals (imaginary part).
 - d) Modulated pulses signal L and Ch signals.
 - e) Pulse and bar L and Ch signals.
 - f) Rising ramp L and Ch signals.
 - g) Eight-riser staircase L and Ch signals.
 - h) 50 % grey level signal.
 - i) 75 % colour-bar signal.
 - j) Bow-tie signal (even line), bow-tie signal (odd line).
 - k) Low frequency black to white transition signal

Examples are shown in Figure 2, but complete signal description is provided in the Annex A.

NOTE 1 The nominal dynamic range of the MAC video is 1 V. In this text, signals will be described as ranging from – 0,5 V to + 0,5 V as follows:

	Chrominance	Luminance
Nominal dynamic range	– 0,5 V to + 0,5 V	– 0,5 V to + 0,5 V
Offset (relative to standardized signal descriptions)	0 V	– 0,5 V
Relative gain (relative to standardized signal descriptions)	0,733 for Eu' 0,927 for Ev'	1
Black signal	0 V	– 0,5 V
50 % grey signal	0 V	0 V
White signal	0 V	+ 0,5 V

NOTE 2 In the figures showing the colour output signals, a gain is arbitrarily applied in order to set the range between 0 and + 0,7 V.

NOTE 3 The test signals are usually defined on one or two successive lines. It is always assumed that field and frame structures comply with the relevant MAC system. Normalized reference signal on line 624 should also be present.

NOTE 4 The time interval T used in the text is equal to the reference sampling period:

$$\frac{1}{20,25} \mu\text{s} = \frac{64}{1\,296} \mu\text{s} = 49,38 \mu\text{s}$$

3.3.2 Audio test signals

Due to the form of audio transmission used in the MAC system, it is necessary either to use an audio-frequency signal generator incorporating the relevant encoding and formatting device or a test signal generator with data sequences in a memory that provides pure sine waves at discrete frequencies.

The audio test signals necessary to perform the tests described in this standard are defined as follows:

Frequencies: From 40 Hz to 15 kHz. If the test generator only provides a given number of discrete frequencies, they should be:

40 Hz, 100 Hz, 200 Hz, 500 Hz, 1 kHz, 2 kHz, 5 kHz, 7,5 kHz, 10 kHz, 12 kHz, 15 kHz.

Amplitude: Full-scale amplitude is defined for a digital signal as maximum signal with respect to the encoding system specifications. Full-scale amplitude is defined *after* pre-emphasis and is thus the same for all frequencies *after* encoding. As a consequence, at the output of the decoder, full-scale amplitude is different according to the frequency of the signal. In some case full-scale minus X dB amplitude is used (X = 60 dB, ...) (see Figure 4).

In order to perform most audio tests, and especially amplitude response tests, it is more convenient to dispose of a signal whose amplitude is the same for all frequencies within the audio-frequency band. In order to avoid overloading of the analogue to digital converter after the pre-emphasis filter, the reference amplitude is defined as being the full-scale amplitude minus 20 dB for a 1 kHz audio-frequency signal at the input of the audio encoder (see Figure 4).

Modes:

- mono/stereo
- high quality (HQ), medium quality (MQ);
- Lin 1, Lin 2, Comp 1, Comp 2 encoding laws;

where “Lin” stands for linearly coded audio mode and “Comp” stands for companded audio mode.

NOTE 1 An analogue audio signal entering the MAC/packet encoder should be corrected with an audio pre-emphasis law according to Recommendation J.17 of CCITT (see Figure 3).

NOTE 2 Sine waves in medium-quality encoding are limited to 7,5 kHz in frequency.

3.3.3 Data signal content

The data component content shall comply with the line and frame structure of the relevant MAC/packet specification; i.e. line and frame synchronization words plus all additional data necessary to make the decoder work properly should be present.

However, the packets which are not used for transmitting an audio signal should be filled with pseudo-random sequences properly encoded and formatted. These packets shall have the dummy packet address (1023).

3.4 Reference signals

3.4.1 Reference video signal

The reference video signal is the colour-bar test signal as defined in 3.3.1.

3.4.2 Reference audio signal

The reference audio signal is the 1 kHz sine wave signal, in Lin 1 mode, with the reference amplitude as defined in 3.3.2.

3.5 Standard measuring conditions

Unless otherwise specified, the following conditions apply:

- 1) Data burst content: pseudo-random sequence with synchronization words.
- 2) Energy dispersal: none.
- 3) Reference video signal: a 75 % colour-bar signal as defined in A.3.7.
- 4) Reference data burst: a pseudo-random binary sequence properly encoded and formatted.

Whatever the test arrangement is, the decoder outputs shall be checked to see that they are properly loaded with 75 Ω .

3.6 Measuring instruments

3.6.1 Test signal generator

The test signal generator shall be capable of providing:

- baseband video test signals as specified in 3.3.1 with the reference data burst specified in 3.3.3;
- the reference baseband video signal specified in 3.4 with the audio test sequences specified in 3.3.2.

The undefined part of the data burst shall be pseudo-random sequences with appropriate synchronization words.

The output baseband composite signal amplitude is 1 V $\pm$ 5 % when loaded with 75 Ω .

3.6.2 Line inserter

The line inserter, if used, shall be capable of inserting into a MAC signal any type of signal in the frequency range 0 MHz to 20 MHz. The inserted signal can take place either in chrominance or luminance parts as the operator chooses.

3.6.3 Spectrum analyzer

The spectrum analyzer shall have a minimum frequency range of 20 MHz or more.

3.6.4 Automatic data acquisition system

It may be a simple digital oscilloscope with a convenient data transmission link which can be connected to a calculator. Its minimum bandwidth shall be 20 MHz.

3.6.5 Video analyzer

For timing measurements on the composite synchronization signal a classical 625-line video analyzer can be used.

It may include features of the video noise meter mentioned in 3.6.8.

3.6.6 Oscilloscope

The oscilloscope used shall be a dual trace model, and its frequency range shall exceed 20 MHz.

3.6.7 Low-pass filter

When performing noise measurements, a low-pass filter shall be connected at the signal output (R or G or B). Unless a specific filter is standardized, it is recommended that the filter specified in CCIR Recommendation 567-3 be used.

3.6.8 Video noise meter

If a video noise meter is used, it shall be capable of measuring the noise component on a steady-level signal when externally synchronized. Internal noise measuring and weighting filters shall be by-passed, if they do not comply with the MAC system specifications.

3.6.9 Video monitor

This monitor is used to perform subjective evaluation. It shall have an appropriate R, G, B synchronization input connector.

3.6.10 Quasi-peak voltmeter

For audio signal-to-noise measurements a quasi-peak voltmeter shall be used as in IEC 107-2 and IEC 107-4. This equipment is in conformity with CCIR Report 468-4.

3.6.11 Reference matrix circuit

Measurements on the video part are usually done using one of the three colour signals. To be able to use video component measuring equipment which already exists, it is necessary to recompose the R, G, B colour signals in order to obtain the three component signals, luminance Y and chrominance $E_{u'}$ and $E_{v'}$. The performances of this matrix circuit shall comply with the tolerances required for the measurements.

Section 4. Video signal measurements

4.1 Video signal distortion

This section deals with both linear and non-linear video signal distortions. Due to the fact that within the decoders the chrominance and luminance signals are processed through different channels and are only available in the mixed R, G, B form at the output, it is necessary, in most cases, to define a specific test signal for each channel.

The video measurements are usually done using the outgoing R, G, B colour signals, but, if preferred, it is also possible in some cases to use a matrix circuit as described in 3.6.11 to obtain conventional Y, $E_{u'}$, $E_{v'}$ signals. It is then possible to use video measuring equipment which is not specific to the MAC systems.

The reference audio signal specified in 3.4.2 shall be used for all video signal measurements unless otherwise specified.

4.1.1 Amplitude versus frequency response

4.1.1.1 Introduction

The test measures the amplitude/frequency response of chrominance and luminance channels of the decoder.

4.1.1.2 Method of measurement

The measurement is performed using a multiburst type test signal, defined for each channel according to its theoretical bandwidth.

The test arrangement is shown in Figure 5.

4.1.1.2.1 Measuring conditions

- a) For luminance channel testing: multiburst L test signal.
- b) For chrominance channel testing: multiburst Ch test signal.

4.1.1.2.2 Measurement procedure

- a) Apply the test signal to the decoder video input.
- b) For luminance testing, display one of the R, G, B colour signals on an oscilloscope.

In the case of chrominance testing, display an R or B signal.

- c) Use the two-step portion of the test signal as amplitude reference and measure the amplitude of each burst in its steady part so as to avoid the transient response distortion.

4.1.1.2.3 Presentation of results

The results shall be listed in a table or plotted graphically in linear relative scale or decibels.

The frequency scale shall show the frequency of each burst before and after decompression (i.e. in 3 : 2 ratio for luminance and 3 : 1 for chrominance).

4.1.1.3 Alternative method of measurement

If a MAC video inserter is available, the measurement can be conducted using a pure sine wave restricted to the luminance or chrominance part of the signal according to the channel tested. A very-low frequency square signal is used for amplitude reference (see Figure 6).

4.1.2 Group delay characteristics

4.1.2.1 Introduction

The test emphasizes the group delay characteristics versus frequency for both luminance and chrominance channels.

4.1.2.2 Method of measurement

The measurement is performed using a train of modulated pulses quite similar to the 20 T test signal used for the PAL/SECAM standards.

The resulting signal allows the comparison of the propagation delay of the frequency of modulation with that of the low-frequency envelope.

The test arrangement is shown in Figure 5.

4.1.2.2.1 Measuring conditions

- a) For luminance channel testing: modulated pulses L test signal.
- b) For chrominance channel testing: modulated pulses Ch test signal.

4.1.2.2.2 Measurement procedure

- a) Apply the test signal to the decoder input and collect one of the R, G, B output signals for luminance and an R or B signal for chrominance testing.
- b) Display the output signal on an oscilloscope with a 64 μ s time window.
- c) Obtain the amplitude and group delay for each modulated pulse (thus for each modulating frequency) using the nomogram shown in Figure 7. Due to time decompression, the values indicated by the nomogram shall be multiplied by a factor 3/2 and a factor 3 for luminance and chrominance channels, respectively.

4.1.2.2.3 Presentation of results

The results of group delay characteristics as a function of frequency shall be listed in a table indicating the frequencies after decoding (i.e. by applying a 2/3 ratio for luminance and a 1/3 ratio for chrominance).

A photographic record or graphical plot shall be given.

4.1.3 Automatic amplitude and phase measurements within the video band

4.1.3.1 Introduction

This test allows both amplitude and phase response to be obtained over the video frequency band provided that an automatic data acquisition system is available. In this case, it replaces the two preceding tests and provides more complete results.

4.1.3.2 Method of measurement

The test signal is a complex wobble transmitted on two successive frames. The test arrangement is shown in Figure 8.

4.1.3.2.1 Measuring conditions

- For luminance channel testing: the two complex wobble L signals (real and imaginary) on two successive frames.
- For chrominance channel testing: the two complex wobble Ch signals (real and imaginary) on two successive frames.

4.1.3.2.2 Measurement procedure

- Apply the test signal to the decoder input and connect the data acquisition system to one of the R, G, B outputs.
- Trigger an acquisition procedure during two lines separated in time by a frame.
- The computing device should have a discrete Fourier transform (DFT) algorithm in order to provide the following information:

$$\left. \begin{array}{l} f_r(k) \rightarrow F_R(p) \\ f_i(k) \rightarrow F_I(p) \end{array} \right\} F(p) = F_R(p) + jF_I(p)$$

where

$f_r(k)$ and $f_i(k)$ are the resulting output signals to real and imaginary parts of the complex wobble test signal respectively

$F(p)$ is the complex discrete Fourier transform of the channel response

where

$$j = \sqrt{-1}$$

k is the number of the time sample

p is the number of the frequency sample

The transfer function $H(p)$ of the channel is thus:

$$H(p) = \frac{F(p) e^{\left(\frac{jp^2\pi}{512}\right)}}{\sqrt{512}}$$

This complex transfer function can be decomposed in module response $A(\omega)$ and phase response $\phi(\omega)$ versus frequency.

$$A(\omega) = \frac{|F(p)|}{\sqrt{512}} \quad \phi(\omega) = \text{Arg}(F(p)) + \frac{p^2\pi}{512}$$

where

$$\omega = 2\pi\Delta f \times p \text{ and } \Delta f = \frac{1}{512 T}$$

4.1.3.2.3 Presentation of results

The results shall be presented as two plots for each channel. One is the module expressed in relative amplitude or decibels, the other is phase in degrees or radians as a function of frequency at the output.

4.1.4 Pulse response

4.1.4.1 Introduction

This test permits the determination of the pulse response capabilities of each channel. Because of the sampling at 20,25 MHz performed inside a MAC decoder, it is preferable to define a pulse which would have very little power outside of the 10,125 MHz frequency band in order to avoid aliasing problems.

4.1.4.2 Method of measurement

The measurement is carried out using a 6 T and 12 T pulse test signal and the test arrangement as shown in Figure 5.

4.1.4.2.1 Measuring conditions

- a) For luminance channel testing:
 - chrominance: null level;
 - luminance: 6 T pulse followed by a bar signal for amplitude reference. Overall amplitude is limited to 70 % of maximum.
- b) For chrominance channel testing:
 - chrominance: 12 T pulse followed by a bar signal for amplitude reference. Overall amplitude is limited to 70 % of maximum;
 - luminance: null level (0 V).

4.1.4.2.2 Measurement procedure

- a) Apply the test signal to the decoder input and display one of the R, G, B output signals on an oscilloscope with a 64 μ s time window.
- b) Measure the departure of peak level of the pulse signal from the amplitude reference at the steady part (B) of the bar signal shown in Figure 9.
- c) Measure the amplitude of the pulse signal relative to the peak amplitude at each time period on a $\pm 15 T_m$ time interval.

T_m is equal to $\frac{3}{2} T$ for luminance testing and T_m is equal to 3 T for chrominance testing, where $T_m = 0$ at the peak of the pulse.

4.1.4.2.3 Presentation of results

The results shall be presented in a table with the amplitude in per cent of peak level for each sample between $\pm 15 T_m$. A photographic record or graphical plot can also be given.

4.1.5 Bar signal response

4.1.5.1 Introduction

This test examines both step response and bar tilt distortions. The bar signal used as test signal has its transition defined so as to have very little power over 10,125 MHz.

4.1.5.2 Method of measurement

The test signal used is an NT transition bar signal where $N = 4$ or 8 and $N \times T$ is the duration of the transition. Test arrangement is shown in Figure 5.

4.1.5.2.1 Measuring conditions

- a) For luminance channel testing:
 - chrominance = zero level;
 - luminance = 4 T transition bar signal;
 - amplitude is limited to 70 %;
 - duration of bar = 400 T
- b) For chrominance channel testing:
 - chrominance = 8 T transition bar signal;
 - luminance = mid-grey level (0 V);
 - amplitude is limited to 70 %;
 - duration of bar = 200 T.

4.1.5.2.2 Measurement procedure

- a) Apply the test signal to the decoder input and display one of the R, G, B output signals on an oscilloscope with a 64 μ s time window.
- b) Adjust the oscilloscope as in Figure 10 so that the half amplitude points correspond to m1 and m2.
- c) Set point A (before transition) at black level (0 V) and point B (middle of the bar) at reference level (1 V).
- d) Measure the maximum departure of bar amplitude at the points between C1 and C2 from that of point B (i.e. excluding 2,5 % of the bar duration on each side). Express this departure or "bar tilt" as a percentage of level at point B.
- e) Measure the rise time which is defined as the duration between points at 90 % and 10 % of B level.

4.1.5.2.3 Presentation of results

The results are given in a table with line tilt and rise time measurements for each channel. A photographic record or graphical plot can also be given.

4.1.6 Low-frequency distortion

4.1.6.1 Introduction

This test examines low frequency lags which can be observed on long periods from several lines to several frames.

4.1.6.2 Method of measurement

The test uses a low-frequency black to white transition signal. The test arrangement is shown in Figure 5.

4.1.6.2.1 Measuring conditions

The test signal used has chrominance parts corresponding to zero and luminance alternatively at the white level (+ 0,5 V) and the black level (– 0,5 V). The periodicity of the signal is typically one frame duration (40 ms) but it can be modified from duration of a few lines to several frames.

4.1.6.2.2 Measurement procedure

- a) Apply the test signal to the decoder input and display one of the R, G, B output signals on an oscilloscope with a time window of one frame (40 ms).
- b) Adjust the oscilloscope so that the half-amplitude points of the bar transitions coincide with points m1 and m2, and so that the mid points of black and white periods correspond with points A and B (see Figure 11).
- c) Measure the maximum departure of the bar amplitude at the points between C1 and C2 from that of point B. (These points are defined at 1 % of frame duration away from midpoints m1 and m2 respectively.)
- d) Express the variation of the bar amplitude, with respect to the reference level at point B as a percentage of the level difference between points A and B, A being taken as the zero reference level.

4.1.6.2.3 Presentation of results

The result shall be expressed as a relative amplitude in per cent and a photographic record or graphical plot given.

4.1.7 Linearity

4.1.7.1 Introduction

This test shows the linearity of the luminance and chrominance channels throughout the whole dynamic range. Two methods are given.

4.1.7.2 Method of measurements using a ramp signal

The measurement is carried out using a uniform ramp signal from – 0,5 V to + 0,5 V. Test arrangement is shown in Figure 5.

4.1.7.2.1 Measuring conditions

- a) For luminance channel testing: rising ramp L signal.
- b) For chrominance channel testing: rising ramp Ch signal.

NOTE Amplitude of the rising ramp is 1 V for L signal but is limited to 0,9 V for Ev' Ch signal and 0,7 V for Eu' Ch signal, in order to make sure that colour signals do not exceed their nominal dynamic range.

4.1.7.2.2 *Measurement procedure*

- a) Apply the test signal to the decoder input and display the green output signal on an oscilloscope with a time window of 64 μ s (one line).
- b) Using a graphical plot of displayed signal or by measuring directly on the oscilloscope, evaluate the maximum departure of the ramp from the ideal line determined by a least squares method.

4.1.7.2.3 *Presentation of results*

For each channel express the maximum departure from ideal response as a percentage of the outgoing ramp signal dynamic range. A graphical plot shall be given.

4.1.7.3 *Method of measurement using a staircase signal*

This measurement is performed using a regular staircase from $-0,5$ V to $+0,5$ V. Test arrangement is shown in Figure 5.

4.1.7.3.1 *Measuring conditions*

The test signal is an eight riser staircase defined as follows:

- a) for luminance channel testing:
 - chrominance = zero level;
 - luminance = nine levels of 75 T duration each, ranging from $-0,5$ V to $+0,5$ V in equal steps.
- b) for chrominance channel testing:
 - chrominance = nine levels of 35 T duration each, ranging from $-A$ to $+A$ in equal steps.
 $A = 0,35$ V for Eu'
 $A = 0,45$ V for Ev'
 - luminance = mid-grey level (0 V).

4.1.7.3.2 *Measurement procedure*

- a) Apply the test signal to the decoder input and display the output colour signal on an oscilloscope with a time window of 64 μ s.
- b) Measure the amplitude of each step on the oscilloscope relative to one-eighth the maximum video dynamic range.
- c) An alternative way is to insert a derivative filter¹⁾ after the selected R, G, B output and to measure the height of the peaks due to each transition. The result is then expressed relative to the nominal peak value (see Figure 12).

4.1.7.3.3 *Presentation of results*

For chrominance and luminance channels the maximum departure from expected result or mean result shall be provided. A graphical plot or photographic record shall be given.

4.1.8 *Response to a ramp signal in the case of scrambled/descrambled signals*

4.1.8.1 *Introduction*

This test is intended to show the possible signal impairment due to scrambling and descrambling processing.

Single-cut and double-cut scrambling shall be tested.

4.1.8.2 *Method of measurement*

The measurement is carried out in the same way as linearity measurement and requires the same test signals as in 4.1.7.2. It is assumed that a MAC scrambled source is available together with the information needed for the decoder to descramble the signal. See test arrangement in Figure 14.

¹⁾ A filter such as one of those shown in CCIR Recommendation 567-3, part C, Annex 2, can be used (see Figure 13).

4.1.8.2.1 *Measuring conditions*

a) Single-cut line rotation

the ramp test signal used is the same as in the chrominance channel linearity testing since the cut point occurs in the chrominance part of a MAC line.

b) Double-cut component rotation

the ramp test signal used is the same as in the luminance channel linearity testing since the cut points occur in both the chrominance and luminance parts of a MAC line.

4.1.8.2.2 *Measurement procedure*

The procedure is the same as for the linearity measurement. Measurement is done on the R or B signal for the single-cut or double-cut scrambling.

Evaluate the maximum discontinuities at the cut points as a percentage of the dynamic range. As the cut points differ from one line to the other, the measurement can either be averaged over several lines or done using the persistence of display on an analogue oscilloscope.

4.1.8.2.3 *Presentation of results*

Results are presented in a table giving the results of measurements for the two cases of scrambling. A photographic record or graphical plot shall be given.

4.2 Unwanted signals

4.2.1 Signal-to-noise in nominal conditions

4.2.1.1 *Introduction*

This test examines noise impairment due to the video signal processing in a MAC/packet decoding chain.

4.2.1.2 *Method of measurement*

The measurement is made without weighting filter using conventional measurement procedures.

4.2.1.2.1 *Measuring conditions*

The test signal is a uniform 50 % grey signal:

- chrominance: zero level;
- luminance: grey level = 0 V.

4.2.1.2.2 *Measurement procedure*

- a) Apply the test signal to the decoder input.
- b) Measurement is performed on the R, G, B output signals successively.
- c) Measure the noise level using an apparatus with a bandwidth wider than the channel band (i.e. 5,6 MHz). All weighting filters are removed. The noise voltage is an r.m.s. value and the signal value is the maximum level measured either on the black to white transition or on the white bar of the colour-bar signal.
- d) To perform the measurements, it is possible to use either double trace visual method on an oscilloscope or some conventional video noise measuring equipment which accepts an external composite synchronization signal.

NOTE In case of very good signal-to-noise ratio, it may be more convenient to use the luminance rising ramp signal in order to point out the quantizing noise.

4.2.1.2.3 *Presentation of results*

The results shall be expressed as a ratio in decibels and all the test and measurement parameters shall be recorded.

4.2.2 Suppression of energy dispersal signal

4.2.2.1 *Introduction*

In the case of satellite transmission of the MAC signal, it is usual to add a low-frequency (25 Hz) triangular signal synchronized with the frame for energy dispersal purposes.

The decoder should therefore include a clamping system which removes the energy dispersal signal and restores the d.c. level.

4.2.2.2 Method of measurement

The measurement is carried out by measuring the frame tilt of the decoded signal when an energy dispersal similar to that encountered after an FM demodulator is added to the input signal (see Figure 15).

4.2.2.2.1 Measuring conditions

The video signal used is the same as for bar tilt measurement:

- chrominance: zero level;
- luminance: grey level = 0 V.

The energy dispersal signal is defined by:

- triangular signal with amplitude as defined for the satellite considered;
- frequency: 25 Hz synchronous with the frame.

4.2.2.2.2 Measurement procedure

- Apply the test signal with the added energy dispersal signal to the decoder input and display one of the R, G, B outputs on an oscilloscope with a time window of one frame (40 ms) or one line.
- Express the maximum signal departure as a percentage from a steady video level over the frame duration.

4.2.2.2.3 Presentation of results

Measurement results shall be provided in relative amplitude or decibels.

4.2.3 Spectrum aliasing

4.2.3.1 Introduction

Due to the fact that the signal is sampled for compression and decompression purposes, aliasing problems may arise if Shannon filtering requirements are not met.

4.2.3.2 Method of measurement

By means of a MAC video inserter, a sine wave of critical frequency is inserted during the luminance time window and applied at the decoder. The test arrangement is shown in Figure 16.

4.2.3.2.1 Measuring conditions

The test signal is defined as follows:

- chrominance: zero level;
- luminance: sine wave of $\pm 0,35$ V amplitude and frequency F (MHz) ranging from 11 MHz to 15 MHz either continuously or by 1 MHz step.

4.2.3.2.2 Measurement procedure

- Apply the luminance multiburst test signal to the decoder input and display the R or B signal on a spectrum analyzer.
- Note the level of each burst in order to have amplitude references.
- Apply the test signal defined above to the video input of the inserter.
- Measure the level of the peak on the spectrum analyzer at $13,5 - \frac{2}{3} F$ (MHz).

4.2.3.2.3 Presentation of results

The results are listed in two tables, one for the multiburst results and the other for sine waves at F (MHz). Levels are expressed in relative amplitude or decibels.

4.3 Time domain demultiplexing

4.3.1 Accuracy of colour decoding

4.3.1.1 Introduction

The purpose of this measurement is to examine the quality of the colour matrix processing.

4.3.1.2 Method of measurement

Test arrangement is shown in Figure 5.