EBU – TECH 3263

Specification of Grade-1 colour production monitors

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Specification of grade-1

colour production monitors

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Introduction

Experts in video origination equipment grouped in the framework of the EBU Technical Committee have decided that it would he useful to publish in the form of an official EBU publication the results of their common experience in the field of grade-1 colour picture monitors.

The specification set out in this document is intended to show the targets to be met by these monitors. The EBU recognises that for certain parameters, the specified characteristics can he obtained with the integrated circuits available today, whilst for others, further developments will he necessary. The EBU hopes that, with this document, monitor manufacturers will be more aware of the relative importance attached by the broadcasters to the principal characteristics of this equipment and will thus be able to orientate their equipment design towards products that respond more fully to the users wishes.

Scope of the specification

The first edition of this specification, issued in January 1991, concerned grade-1 colour picture monitors utilising cathode-ray tubes of 4:3 aspect ratio. This second edition extends the specifications to cover the requirements of monitors fitted with cathode-ray tubes in the 16:9 aspect ratio; consideration is also given to the display of 16:9 pictures on 4:3 monitors and 4:3 pictures on 16:9 monitors. The opportunity has also been taken to update other aspects of the specification, in particular the bibliographical references.

Grade-1 monitors are high-quality monitors that only be used under controlled ambient lighting conditions for the alignment and monitoring of programme sources in both studios and outside-broadcast environments.

Test methods

Where appropriate brief descriptions of relevant test methods are given. These are for guidance only and any other test methods achieving equivalent results may be used.

To distinguish easily between specifications and test methods, the latter are printed in *italic*.

1. Manufacturing standards

The basic design and construction of the monitor shall conform to the provisions of EBU document Tech. 3215 [11], unless requirements that are more stringent are set out below.

2. Environmental conditions

The monitor shall perform in accordance with this specification over an ambient temperature range of 0° to +40°C.

Given an ambient temperature within the range specified above, a period of twenty minutes shall be allowed after the monitor is switched on before it is expected to perform in accordance with the specification. The monitor shall then maintain this performance for a period of at least twenty hours.

One minute after it his been switched on, the monitor shall produce subjectively acceptable pictures. For guidance, it is anticipated that the monitor shall perform with tolerances no worse than twice those indicated in this specification during the first twenty minutes of operation.

The monitor, when switched on at a temperature between 0° and +40°C, shall continue to function without failure within the temperature range of +20° to +45°C.

The monitor shall continue to function in accordance with this specification in a humidity range of 10% to 75% (non-condensing).

The monitor shall function in accordance with this specification at a height of up to 3000 m

Within a temperature range of -35° to +70°C, it shall be possible to store the monitor without damage.

3. Power supplies

3.1 General

The monitor shall fulfil in all respects the electrical safety requirements given in IEC Publication 65 [2], and any other mandatory regulations in force in the country of purchase and use.

Mains voltage variations of between +10% and -10% of the nominal operating voltage shall not impair the performance of the monitor.

Mains frequency variations of ±12 Hz with respect to the nominal operating frequency shall not impair the performance of the monitor.

If the monitor requires a DC supply from an external power source, the preferred supply voltage shall be 12V.

The power consumption of the monitor shall be clearly stated on a suitable permanent label on the monitor.

All metallic plug and socket shells containing conductors carrying voltages in excess of 30V AC (RMS) or 50V DC shall have a satisfactory earth connection, whether the plugs and/or sockets are fully mated or not.

If, in a power supply connector, a special pin provides the earth connection, this pin shall mate before any other pin in the connector.

The monitor shall be provided with a mains voltage selector giving a choice from a suitable range of input voltages. An indication of the operating voltage selected shall be visible from the outside of the case.

3.2. Regulation

Variation in height or width of the active picture with contrast variations in the range 5 to 100 cd/m^2: < 0.5%

Test method: The monitor is set to normal operating conditions (see chapter 4, Section 1). A full-field white signal is connected to the monitor input and the picture height and width are observed as the contrast control is varied over the range stated.

Variation in height or width of the active picture with instantaneous changes of average picture level (APL) between 12.5% and 87.5% < 1%

Test method: The monitor is set to normal operating conditions (see chapter 4, Section 1). The picture height and width are observed as input signal is switched between the stated APLs (see footnote to Chapter 4, Section 2.3.).

3.3. Protection

The monitor should be protected to avoid damage caused by:

- excessive EHT voltage,
- excessive EHT current:
- interruption of any input signal:
- failure of field-scan circuits,
- failure of line-scan circuits,
- failure of power supply regulation circuits:
- excessive current demand from the power supply:
- failure of the mains power supply (the monitor shall attain operating conditions in accordance with the present specifications 20 minutes after the power supply is restored);
- Overheating.

4. Mechanical characteristics

The monitor shall be designed and constructed so that it operates correctly even when subjected to vibration and shock such as may be expected either at, or during transport to and from, an outside-broadcast location.

The monitor shall be provided with suitable handles positioned so as to enable the unit to be lifted and carried without undue difficulty, thus minimising the risk of injury to personnel.

The design shall facilitate maintenance by providing at least:

- easy access to all parts, although safety protection must be given to those parts that are hazardous;
- modular construction employing secure locking devices (which should be of a "quick-release" form);
- easy replacement of the cathode-ray tube, indicator lamps and fuses.

The cathode-ray tube shall be fitted with an implosion guard.

The chassis, external metalwork, metallic switch dollies, adjusting screws, etc. shall have satisfactory isolation or shall be connected to the (mains or video) earth. Information supplied with the monitor shall include details of special earthling arrangements.

5. Interference

5.1. Interference to other equipment

There shall be no noticeable interfering effects between two similar monitors placed immediately above, below or alongside one another, whilst they are displaying signals which are asynchronous but which share a common scanning standard.

The monitor shall not, under any circumstances, cause radiation to be emitted or cause power line interference to be emitted which is either a nuisance or which contravenes such statutory regulations as are in force in the country where the monitor will be used.

In any case, the monitor shall at least conform to the relevant EEC Recommendation [3]

Spurious radiation of electric or magnetic fields, whether emanating from the body of the monitor or from inter-connecting cables, shall be kept to a level which will not cause undesirable interactions with other appara-tus used in the vicinity of the monitor (e.g. other monitors, microphones, tape-machines, etc.).

5.2. Interference to the monitor

The performance of the monitor shall not be affected by:

- external electric fields (notably those resulting from radiation in the frequency bands from LF to SHF) at strengths up to 120 dBμV/m^2;
- magnetic fields having flux densities up to 2.10^{-4} T.

Some effect on performance may be allowed at greater flux densities, up to 10^{-3} T, provided that the ultimate subjective result is acceptable.

5.3. Acoustic noise

All acoustic noise, and in particular that from fans, scan circuit components and transformers, shall be minimised.

6. Equipment handbooks

The operational and/or maintenance documentation accompanying the monitor shall conform to the provisions set out in EBU document Tech. 3239 [4]

7. Primary operational controls and indicators

The primary controls shall be front facing and easily accessible. The following controls and indicators shall he provided:

a) Mains ON/OFF switch plus ON indicator:

b) ON AIR tally indicator;

c) Manual degaussing control (this does not preclude the provision of automatic degaussing):

d) Brightness control (with a pre-set position for calibrated operation):

e) Contrast control (with pre-set position for calibrated operation):

f) Switches:

- aspect ratio selector 4:3/16:9;
- auto/manual aspect ratio selection;
- Video input selector (see section 10);
- internal/external sync selector;
- Pulse cross (optional);
- monochrome operation[1];
- notch filter OUT/AUTO (controlled by colour-killer in AUTO mode);
- selection of remote or local control of video input selection.

8. Secondary controls

These controls shall be in a drawer or concealed behind a flap, but shall be front-facing and readily accessible for setting-up purposes. These controls shall be secured by a mechanical or software lock.

a) Switching of individual RGB channels to permit individual or combined displays;

b) Switching between underscan (normal) and overscan modes for both 4:3 and 16:9 scan settings (see sections 23 and 30):

c) Separate scan adjustments for both 4:3 and 16:9 modes;

d) Convergence adjustment (if applicable);

e) Colour balance adjustment (black levels and gains):

f) Chrominance level (saturation) adjustment with a pre-set position for calibrated operation and a light or other tally system at the front surface to indicate operation in “non calibrated" mode,

g) Blanking of vertical-interval data and test signals;

h) Inhibition of automatic operation of the colour-killer in the absence of the Colour burst (optional).

It is anticipated that controls for simple/delay PAL, chromaticity matrix ON/OFF. RGB gains, RGB black levels and focus (with appropriate protection), will be conveniently located for ready access.

[1] For composite or colour-difference component inputs, monochrome working shall be achieved by reducing the saturation to zero and switching the notch filter out. For RGB primary inputs, monochrome working shall be achieved by linking together the input connectors.

9. Enhanced operational features and alignment facilities

The following features would be considered as enhancements and are optional.

a) Internal sources of test signals for use in the alignment of the monitor in accordance with the procedure set out in EBU Recommendation R23 - 1987 [5]. These signals are:

- 14/19 and 14/23 grids;
- 100/0/100/0 or 100/0/75/0 colour bars;
- PLUGE signal.

b) Automatic set-up of the following parameters:

- Contrast;
- brightness;
- white balance;
- grey balance;
- chrominance level (saturation).

c) A bus system to permit:

- interconnection with other monitors;
- remote control;
- adjustments governed by a ”master" monitor;
- the addition of a detector and indicator for wide screen signalling data carried in line 23 [6].

d) Remote control of other operations in addition to selection of video inputs.

10. Input signal standards

For normal use, and during tests, the monitor shall accept signals conforming to the currently-used 625-line/50-field television standards. The monitor shall be able to accept signals in composite, component and primary form in accordance with the following standards:

- composite PAL or SECAM encoded signals specified in ITU-R Recommendation BT.470 [7]
- parallel analogue component signals according to EBU Standard N10 [8]
- primary RGB signals in accordance with EBU Technical standard N20 [9]
- serial digital component signals in accordance with ITU-R Recommendation BT.656 [10]

In the case of composite signals, the monitor shall be able to accept signals in the standard (PAL or SECAM) specified by the user. A minimum of two inputs should be provided for composite signals.

A synchronising signal input is required. This should be designed to accept negative-going pulses

Inputs for test signals are optional.

Other signal standards not listed above are not covered by the present specification and should be negotiated separately.

11. Input signal amplitudes

The Monitor shall perform fully in accordance with this specification with input signals originating from a 75 Ω source having the following levels:

- composite PAL or SECAM encoded signals; 1.0 Vp-p ±6 dB
- component signals:
  - luminance signal (composite): 1.0 Vp-p ±6 dB
  - Colour -difference signals (non-composite): 0.7 Vp-p ±6 dB
- primary RGB signals:
  - composite signals: 1.0 Vp-p ±6 dB
  - non-composite signals: 0.7 Vp-p ±6 dB
- serial digital component signals: 0.8 Vp-p ±6 dB
- test signals: 1.0 Vp-p ±6dB
- synchronizing signals: -4.0 Vp-p –15/+3dB

The maximum permitted common-voltage component allowed on any signal is ±3V DC

12. Input impedance

All inputs should have high impedance in order to permit bridging. They may also be provided with a switch to permit internal 75 Ω resistive termination.

Passive bridging or loop-through is not acceptable for digital inputs. Only active loop-though inputs, having a nominal input impedance of 75 Ω, should be used.

The tolerance on the resistance of the 75 Ω terminations should be as follows:

- composite encoded inputs: ±0.2%
- analogue component inputs: ±0.1%
- RGB primary inputs: ±0.1%
- serial digital component inputs: see footnote[1]
- test and sync inputs: ±1.0%

Test method: Measurements are made at the input with a digital resistance meter. The monitor should be ON.

13. Cross-talk from unselected video inputs

Cross-talk from unselected video inputs affecting the wanted input: better than -54 dB at frequencies between 50 Hz and 7.0 MHz.

[1] The tolerance on the impedance of digital inputs can be quite large. Provided the input signal amplitude (Section 11.) and the input return loss (Section 14.) are within the specified tolerance, the automatic equaliser at the digital inputs of the monitor will compensate adequately for any impedance variations occurring under normal operating conditions.

Test method: The brightness and contrast controls are set using a PLUGE signal [5] to give a white level of 100 cd/m^2. All inputs are terminated and the monitor is locked to external sync. Measurements are made at the cathode-ray tube electrodes using a 100:1 probe (see Section 15). A 2T pulse-and-bar signal and a 7.0 MHz video sweep multiburst signal are applied, as "hostile " signals, to the unselected inputs.

14. Input return loss

The return loss at the inputs to the monitor should conform to the following specifications, under the stated conditions:

- any analogue video signal input: >35 dB at frequencies between 50 Hz and 7.0 MHz
- serial digital input: >15 dB at frequencies between 5 and 270 MHz
- sync input: >35 dB when fed with a standard sync pulse signal

Test method: Measurements are made using a return loss bridge.

15. Test methods - general notes

Unless stated otherwise, the test signals and performance shall conform to ITU-T Recommendation J61 [11]

The measurements in this chapter are made at the outputs of the RGB amplifiers driving the cathode-ray tube. In monitors, the output impedance of these amplifiers is high. To minimise loading effects, measurements should therefore be made differentially between the cathode and the grid of the cathode-ray tube using a pair of very high-impedance (100:1) oscilloscope probes. The capacity of these probes should be very low and any capacitive effects should be compensated where appropriate.

Tests can most easily be made using an oscilloscope that has a calibrated DC offset facility.

In general, the specifications and measurement results referred to in this chapter are expressed with respect to the video signal amplitude from black level to peak-white level.

Several of the tests require the monitor to be aligned for "normal" operation. This condition is obtained by using a PLUGE signal and setting the brightness, contrast and colour-balance controls to give a white level of 100 cd/m^2. The settings of the brightness and contrast controls are noted to permit the normal conditions to be restored as required during the tests

It should be possible to switch between the 4:3 and 16:9 scanning modes without having to reset basic video settings (black level, contrast, etc.). If necessary, separate preset adjustments should be provided for each aspect ratio.

16. Gain stability

Test Method: (general) The monitor is set for "normal" operation. A 1.0 V composite monochrome staircase test signals is connected to all composite, RGB or test video inputs, preferably by looping one to another. The inputs are correctly terminated.

The choice of appropriate test signals for the other inputs (analogue or digital component) is under study.

16.1 Effect of selecting different inputs

Variations in any one RGB channel gain when selecting different inputs: <1.5 %

Test method: Variations in the output of the red channel are measured as different inputs are selected. The test is repeated for the green and blue channels

16.2 Differences between the RGB channel gains

Difference in gain between the RGB channels, for any selected input: <0.5%

Test method: same as Section 16.1.

16.3 Variations due to changes in average picture level (APL)

Relative change in gain with a change in APL from 12.5% to 87.5 % at each RGB channel output and for any selected input: < 1 %

Test method: Using a suitable staircase signal generator feeding the selected input, switch between APLs of 12.5% and 87.5%[1]. Express the measured variations in channel output as a percentage of the output amplitude for an APL of 12.5%.

17. Contrast control tracking

Relative differences between gains in the RGB channels caused by variations of the contrast control giving light outputs ranging from 15 to 100 cd/m^2: <1%

18. Frequency responses and medium-time linear distortions (RGB and test inputs)

Test method: The monitor is set for "normal " operation. The test signals are a sweep-frequency sinewave, the 2T pulse-and-bar signal and a 50 Hz square wave, according to the frequency range under examination.

18.1 High frequencies

Amplitude-frequency response between 100 kHz and 6.0 MHz: flat ±0.5 dB

Variations from flat response between 6.0 MHz and 8.0 MHz: -3 to 0 dB

18.2 Medium frequencies

K rating obtained from the 2T pulse-to-bar ratio < 0.5%

Test method: Set the 2T pulse amplitude to 100% on the centre scale of the K-rating graticule. Read the percentage amplitude of the mid-point of the bar from the centre scale of the graticule, to determine the percentage amplitude difference between the pulse and bar. Divide the result by four to obtain the Kpulse-to-bar rating.

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[1] An APL of 12.5% is obtained by generating a full-field test signal in which every fourth line contains a staircase signal and the remaining lines are at black level. An APL of 87.5% is obtained with a full-field test signal in which every fourth line is a staircase and the remaining lines are at peak-white level.

K rating obtained from the line bar of the 2T pulse-and-bar waveform, Kbar: < 0.5%

Test method: Adjust the oscilloscope horizontal time-base so that the half-amplitude points of the bar pass through the outer limits of the K-rating graticule. Kbar is the maximum departure in level of the top of the bar from the level at the centre of the bar, expressed as a percentage of the level at the centre. (Note: take account of the worst half of the bar only, and ignore the ends of the bar beyond the points indicated on the graticule.)

18.3 Low frequencies

K rating obtained from the 50 Hz sqare-wave response, K_{50Hz}: < 1%

Test method: The K_{50Hz} rating is the maximum departure in the level of the top of the white patch waveform form the level at the centre of the patch, expressed as a percentage of the level at the centre.

19. Short-time linear distortions (RGB and test inputs)

K rating obtained from the 2T pulse response, K_{pulse}: <1%

Test method: The K_{pulse} rating is obtained from the pulse-shape portion of the graticule.

20. Video non-linearity

Video non-linearity: <2%

Tests method: Measurements are made using the 5-riser staircase signal specified in CCIR Recommendation 567-2 [10].

21. Brightness control characteristics

21.1 Range of operation

Minimum variation of DC level at RGB channel outputs, relative to "normal" setting: < 20%

Test method: The monitor is set for “normal" operation. Measure the DC level of the black step of a stair-case signal, at the output of each of the RGB channels. Vary the brightness control over its entire range and measure the variations in DC level of the black step. This variation is expressed as a percentage of the level under normal operating conditions.

21.2 Effect on video signal amplitude

Variation of video signal amplitude over full range of brightness control: < 2%

Test method: Using a staircase test signal, vary the brightness control over its full range and note the variations in signal amplitude at the RGB channel outputs. This variation is expressed us a percentage of the amplitude under “normal” operating conditions.

21.3 Tracking

Differences between black levels measured at RGB channel outputs, caused by variations of the brightness control: imperceptible

Test method: The monitor is set for “normal” operation. Verify that no differences can be measured between the RGB black levels, regardless of the setting of the brightness control.

22. Black level stability

Test method: (general) An objective definition of imperceptibility is under study and it is hoped that limit values for a measurable parameter can be specified later.

22.1 Effect of temperature and mains supply variations

Over the range of temperatures specified in Section 2, and the mains voltage and frequency variations specified in Section 3.1, variations in the black levels measured a the outputs of the RGB chains should be imperceptible over a period of twenty hours.

22.2 Effect of selecting different inputs

Variations in the black levels measured at the outputs of tile RGB chains, when selecting different inputs, should be imperceptible.

22.3 Differences between the RGB outputs

Relative changes of black level between the RGB channel outputs when selecting different inputs should be imperceptible.

22.4 Effect of changes of average picture level

Variations of black level measured at any RGB channel output, with changes in APL between 12.5% and 87.5% should be imperceptible.

Test method: The monitor is set for "normal" operation. APLs of 12.5% and 87.5% are obtained as described in the footnote to Section 16.3. An objective definition of “imperceptible” is under study; it is hoped that limiting values for a measurable parameter can be specified later.

23. Scanning performance test methods - general notes

The specifications in this Chapter shall apply to both normal (underscan) and overscan conditions.

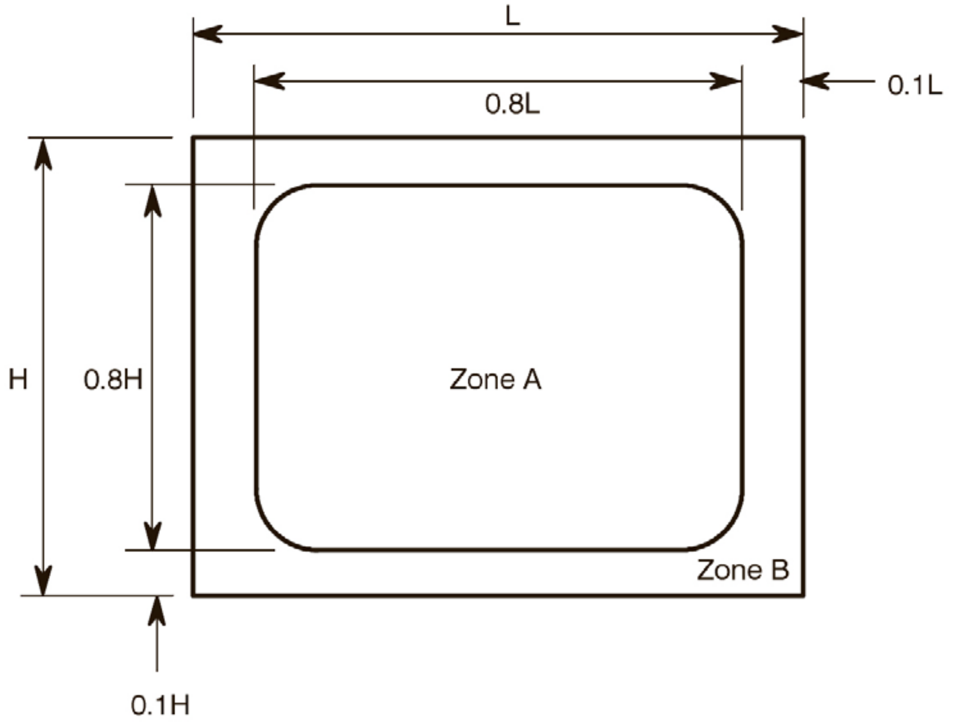
The normal (underscan) condition is defined as being that in which the active width and height of the picture are adjusted so that all four corners of the raster are just within the visible area.

The overscan condition is defined as that in which maximum use is made of the active display area.

When using a 16:9 display in 4:3 mode, the overscan condition is defined as that in which maximum use is made of the active display area, whilst maintaining a 4:3 aspect ratio. This will necessarily show black vertical bands at the left and right hand sides of the active picture, but no black bands will be visible at the top and bottom. When a 4:3 display is used in 16:9 mode, the *overscan condition will leave horizontal black bands at the top and bottom of the active picture but not at the sides.*

The active width of the picture corresponds to the 52µs active line of the video signal. The active height corresponds to the lines containing the picture information only; it excludes lines occupied by vertical interval data and/or test signals.

For the definition and measurement of the raster characteristics, the picture area is divided into two zones, shown below. The proportions are valid regardless of the aspect ratio.



Zone A corresponds with the safe title area whose dimensions, expressed in terms of those of the transmittcd area, are defined for motion-picture films in ISO Standard 1223-1995 [12] and EBU document Tech. 3218 [13].

Fig. 1 – Definition and measurement of raster characteristics

24. Hum effects

Hum effects should be negligible

Test method: A recommended method is under evaluation.

25. Geometry errors

Superposition errors of the test transparency and the corresponding electronic pattern

- within Zone A: <0.5% of picture height
- over the whole field: < 1% of picture height

Change of picture centre position when switched between any combinations of normal scan or overscan and 4:3 or 16:9 aspect ratio: < 1% of picture height.

Test method: A suitable geometry test transparency is used, having an aspect ratio of 4:3 or 16:9 as appropriate. The projection distance should be the same as the viewing distance. The measured geometry is that at, or projected onto, a plane tangential to the centre of the screen; this point should coincide with the centre of the active picture.

26. Interlace

The interlacing should be better than 45:55.

Test Method: It is recognised that this parameter is difficult to measure. It is mentioned here to ensure that its importance is not neglected. Any appropriate test method may be used.

27. Convergence

- errors within Zone A: <0.15% of picture height
- errors over the whole field: <0.2% of picture height.

Test Method: It is recognised that this parameter is difficult to measure. It is mentioned here to ensure that its importance is not neglected. Any appropriate test method may be used.

28. Blanking

Horizontal and vertical blanking shall be provided so that flyback lines or burst signals are not visible under normal conditions of brightness and contrast. Blanking pulses shall not cause any visible vertical or horizontal patterns, and they shall not encroach into the active picture area or into the lines reserved for vertical-interval insertion signals.

Additional vertical blanking may be provided to eliminate the display of vertical-interval insertion signals of all types. This should be controlled by a switch on the secondary control panel.

29. Line oscillator

- pull-in range: 15 625 ±500 Hz
- hold-in range: 15 625 ±1500 Hz
- jitter: <20 ns.

Test method: The pull-in and hold-in ranges should be checked using a variable-frequency pulse generator: The jitter is checked using a 2T pulse displayed on the screen.

30. Scan amplitudes

Normal (underscan): All four corners of the active picture area shall just be visible.

Overscan: If a monitor is used to show pictures in the same aspect ratio as the display tube (4:3 pictures on a 4:3 monitor, 16:9 pictures on a 16:9 monitor), the scan amplitudes shall increase by at least the minimum amount necessary to conceal the edges of the active picture area, whilst maintaining the original aspect ratio.

If a 4:3 monitor displays 16:9 pictures, the overscan applies only to the left and right-hand sides of the picture area; there will be black bands at the top and bottom.

If a 16:9 monitor displays 4:3 pictures, the oversean applies only to the top and bottom of the picture area; there will be black hands at each side.

31. Display tube performance - general note

These display tube specifications should be respected regardless of whether the display tube is physically a 4:3 or 16:9 type, and regardless of whether the monitor is operating in 4:3 or 16:9 scan mode.

32. Chromaticity tolerances

The chromaticity tolerances shall conform to the recommendations set out in EBU document Tech. 3213 [14].

Test method: Measurements may be made using spectro-photometric or other appropriate methods.

33. Phosphor element spacing

The phosphor element spacing or other unavoidable discontinuities in the phosphors, and the accuracy of the beam focussing, shall be adequate to display a spatial frequency of 5.75 MHz with the scans set to normal (underscan).

Test method: Measurements may be made using a calibrated microscope.

34. Blemishes

When viewed at a minimum distance of four times the picture height, no blemishes caused, for example, by missing or unexcited phosphor areas, streaking, Moiré patterning or shading shall be observable on the monitor screen, at any contrast level up to a white level of 100 cd/m^2.

Test method: This test is performed with a full-field white signal connected to the test or composite video input. An examination is made for blemishes while displaying four rasters in turn - red, green blue and white - each at various contrast levels

35. Purity (white uniformity)

No purity errors shall he observable on the monitor screen at any contrast level up to a white level of 100 cd/m^2.

Test method: A measurement procedure for white uniformity is given in EBU document Tech. 3273 [15]

36. Gamma

The assumed gamma of the display tube is equal to 2.8

Test Method: A measurement procedure is given in EBU Document 3273 [15]

37. PAL decoder performance (systems B, D, G, H, I)

37.1 Test method - general note

Unless stated otherwise, measurements should be made at the RGB outpts of the decoder. The notch filter should be switched to AUTO (i.e. under control of the colour killer). Where appropriate, the test signals and procedures shall conform to ITU-T Recommendation J.67 [11]

37.2 Colour killer

The colour killer shall operate when the burst amplitude falls below 100 mV and shall introduce an attenuation of at least 50 dB in the chrominance channel.

Test method: The decoder is fed from a colour-bar generator having the facility to vary the amplitude of the portion of the composite signal containing the colour burst.

37.3 Luminance processing

37.3.1 Luminance frequency response and medium-term linear distortions

a) High frequencies

Amplitude-frequency response between 100 kHz and 5.5 MHz: flat ±0.5 dB

Test method: The measurement is made using a 0.7Vp-p video sweep signal including sync and blanking pulses but without a colour burst.

b) Medium frequencies

K rating obtained from the 2T Pulse-to-bar ratio, Kpulse-to-bar: < 0.5 %

Test method: See Chapter 4, Section 4.2.

c) Low frequencies

K rating obtained from the 50-Hz square-wave response, K50Hz: < 1%

Test method: See Chapter 4, Section 4.3.

37.3.2 Short-time linear distortion

a) Monochrome working

K rating obtained from the 2T pulse response, without burst, Kpulse: < 1 %

b) Colour working

K rating obtained from the 2T pulse response, with burst, Kpulse: < 2%

37.3.3 Luminance non-linearity

Luminance non-linearity: < 2%

Test method: The monitor is fed with the signal described in the footnote to 16.3. The signal should not contain a colour burst. The measurements are made on a line containing the staircase signal, for average picture levels of both 12.5% and 87.5%.

37.3.4 Notch response

Frequency response of the colour sub-carrier notch filter: -3dB at 3.68 MHz +0.1 MHz

at least -18dB at 4.43 MHz

-3dB at 5.18 MHz ±0.1 MHz

Test method: The test signal is a video sweep signal of amplitude 0.7 Vp-p including sync and blanking pulses and the colour burst. The measurement is made at a point in the luminance circuit of the decoder after the notch filter (which is switched into circuit) but before the Y, R-Y, B-Y matrix.

37.4 Chrominance processing

37.4.1 Chrominance frequency response

Chrominance frequency response: better than -1dB at 4.43 MHz ±1MHz

at least -3dB at 4.43 MHz ±1.5 MHz

at least -20dB at 4.43 MHz ±4 MHz

Test method: The test signal is the same as in Section 37.3.4. The measurement is made at the demodulator output.

37.5 Chrominance-luminance delay inequality

Delay time between the chrominance and luminance signals: + 20 ns

Test method: A 2T pulse-and-bar signal with colour burst is applied to the decoder input via a colour gain and delay test set. Using a two-channel oscilloscope, the pulse portion of the signal in the Y, R-Y and B-Y channels is monitored, immediately before the matrix. Timing errors between the channels are assessed using the calibrated delay facility of the test set.

38. SECAM decoder performance

38.1 SECAM identification

A colour phase detector will ensure synchronism between the D_R/D_B switching of the decoder and that of the incoming SECAM signal.

A colour-killer circuit will recognise the presence of a SECAM signal and, if the D_R/D_B switching of the decoder is in colour phase, the chrominance channel will deliver the demodulated D_R and D_B signals which are de-matrixed to give RGB.

It should be possible to select between two modes of identification, using a switch on the secondary control panel:

- “field identification" using the lines containing modulated subcarrier present in the field-blanking intervals (lines 7 to 15 and 320 to 328)
- “line identification" using the unmodulated subcarrier reference bursts in the back porch of the line-blanking intervals (not present during field-blanking intervals).

The identification circuits will block the chrominance channel if the colour phase is not correct, or if the subcarrier amplitude is not in the range +3 to -12 dB with respect to the nominal level.

Also, if the line identification mode is selected, the chrominance channel will be blocked if the timing of the start of the subcarrier reference burst is outside the range -1 to +2 µs with respect to the nominal timing (5.6 µs after the leading edge of the line sync pulse).

38.2 Luminance processing

38.2.1 Test method - general note

Measurements should be made at the RGB outputs of the decoder with the chrominance channel blocked.

Where appropriate, the test signals and procedures shall be in accordance with ITU-T Recommendation J.61 [11]

38.2.2 Clamp

With regard to fluctuations in the blanking level of the input signal, the clamp should function as a first-order high-pass filter (absence of overshoots on transitions).

Rejection ratio:

- at zero frequency: > 60 dB
- at 50 Hz 20 dB (approx.)

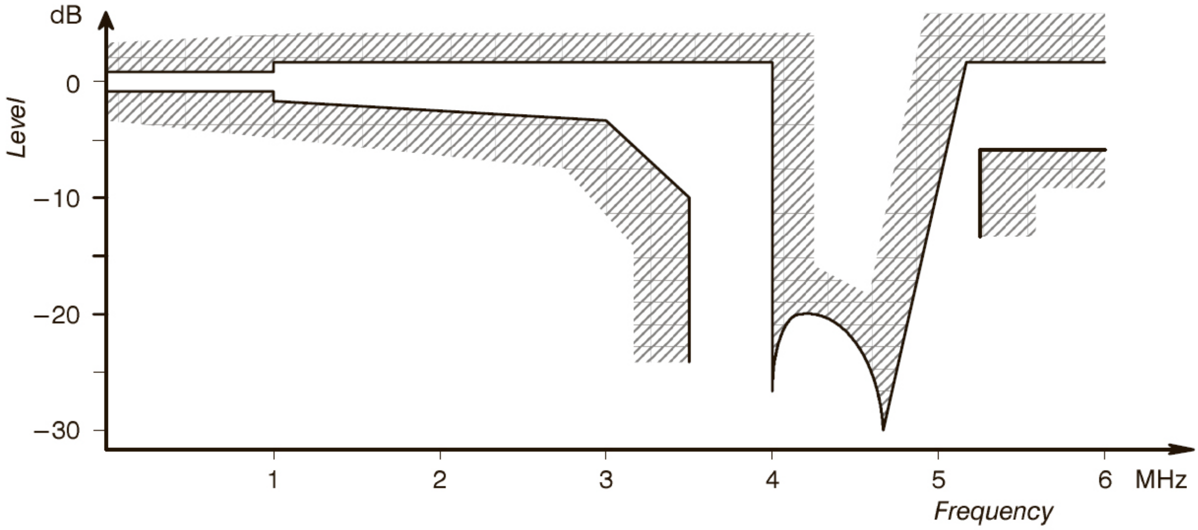
For test purposes, it should be possible to disable the clamp by means of internal links.

38.2.3 Filtering (luminance extraction)

The luminance passband mask is shown in Fig. 2. The associated phase correction serves to achieve the following specifications:

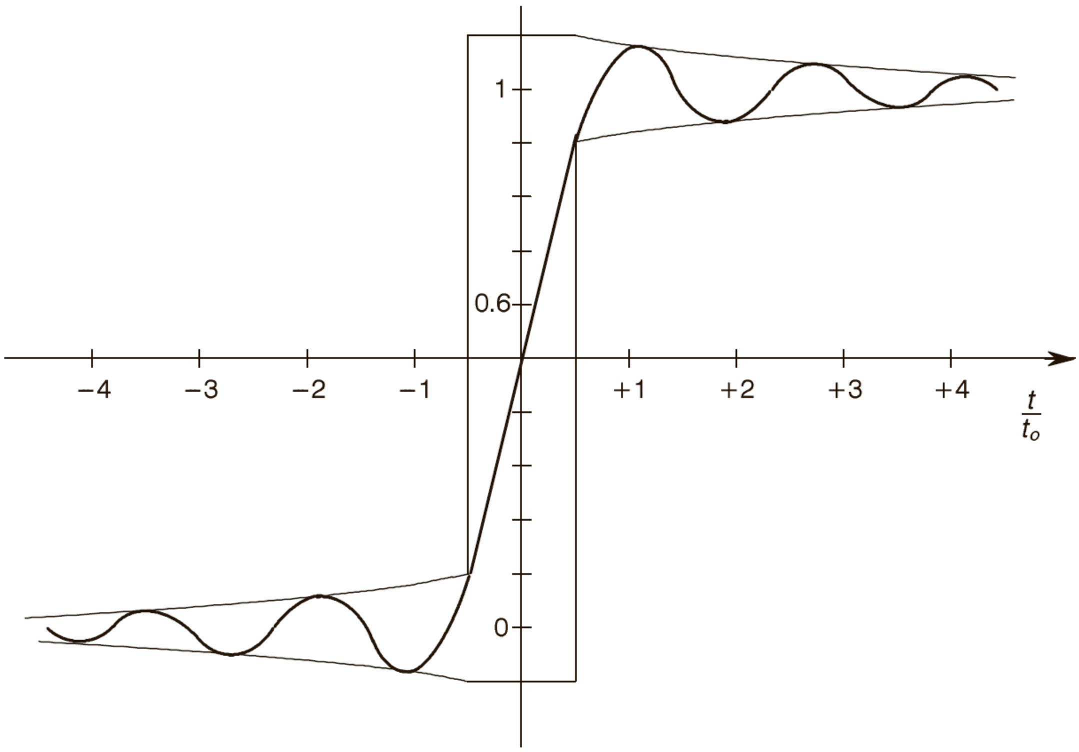
- rise-time (10% to 90%) < 150 ns
- $K_{pulse\text{-}to\text{-}bar}$ <15%
- overshoot on transitions within mask shown in Fig. 3, with t_0 = 150 ns
- asymmetry < 14 mV (± 2%) between intervals -2 and +2 in mask shown in Fig. 3

Test method: These parameters are measured using the 2T pulse-and-bar signal and the B1/B2 signal (10% to 90% rise-time of B2 signal is 112 ns).



Upper part (dB)	+0.1	+0.2	(+0.2)	-27	-20	-30	+0.2
Lowerpart (dB)	-0.1	-3	-10				-6
Frequency (MHz)	0 to 1	3	3.5	4.020	4.286	4.686	5.5

Fig. 2 - Luminance passband mask (SECAM)



Note: For $t/t_0 \leq 0.5$, the template is defined by two exponentials having the exponent $-t/t_0$ and asymptotic at ± 1%.

Example: the upper, falling exponential curve has the equation: $1 + 0.09e^{0.5-t/t_0} + 0.01$

Fig. 3 - Transient response mask (SECAM)

38.2.4 Other luminance characteristics

Baseline distortion (streaking)

Test method: The test signal is a 50 Hz square wave. The clamp is disabled during the test.

Luminance non-linearity at nominal level: < 1%

at + 3 dB: < 2%

Signal-to-noise ratio: (under study)

Aperture correction is an optional feature. Where fitted, it shall have a front-panel control that may or may not include control of the amplitude. The aperture control must have no perceptible influence in the frequency range occupied by chrominance components.

38.3 Chrominance processing

38.3.1 Test method - general note

With the exception of measurements on the HF de-emphasis filter, these measurements are made at the input to the de–matrixing circuit.

38.3.2 HF de-emphasis filter

The combination of the bandpass filter and the HF de-emphasis filter shall give a transfer function whose tolerances, compared to the nominal transfer function of the HF de-emphasis filter alone (see Appendix A), are as follows:

Amplitude	Group delay	Frequency
± 0.3 dB	30 ns	4.286 MHz ± 0.5 MHz
± 0.5 dB	70 ns	4.286 MHz ± 1.5 MHz

The filter centre frequency (arithmetic mean of the points at which the response is 6 dB below that near the centre) shall be 4.286 MHz ± 10 kHz.

38.3.3 One-line delay

If the one-line delay is introduced at HF with ultrasonic components, two delay-lines should be used (one for D_R, the other for D_B), in order to cancel any D_R/D_B cross talk in the decoder. In addition, the signals should be switched at both the inputs and the outputs of each delay line, at one-half of the line frequency.

The passband and matching of these delay-lines should be such that the demodulated signals from the direct path and the delayed path have the same transient and low frequency responses.

Delay time: 64 μs ± 20 ns

Peak-to-peak amplitude of echoes with delays greater than 64 μs: < 2%
(relative to nominal amplitude of D_R or D_B)

Test method: The test signal has 100/0/75/0 colour bars at the top of the field, followed by uniform grey at the bottom. The demodulated DR/DB signal is measured on the first grey line.

Peak-to-peak amplitude of echoes with delays less than 64 μs: < 2%
(relative to nominal amplitude of D_R or D_B)

Test method: The test signal is a full-field of any uniform colour. The non-uniformity of the level of the demodulated D_R and D_B signals is measured.

38.3.4 Discriminators

Linearity

Static linearity, expressed in terms of the relative amplitude error in the demodulated signal:

- for nominal frequency deviation (± 280 kHz for D'_R = ± 1, ± 230 kHz for D'_B = ± 1): < 1%
- during normal operation: < 2%
- for frequency deviation of ± 1.3 MHz: < 7%

Black level stability

Black level error (stability of rest frequencies): ± 2 kHz throughout the active line

The black-level error should be independent of the subcarrier phase switching. The tolerance applies to all black levels, even when regenerated.

38.3.5 Characteristics of the demodulation circuits

All the demodulation characteristics in this section must be respected with modulated chrominance signal amplitudes in the range +3 dB to -20 dB with respect to the nominal amplitude.

Video de-emphasis

Tolerance on frequency responce of the video de-emphasis network, at frequencies up to 1.5 MHz, with respect to nominal response (Appendix B): + 0.5 / - 0.3 dB

Overall frequency response

Amplitude/frequency response at frequencies up to 1.3 MHz: flat + 0.5 / - 1.0 dB

Test method: A sinusoidal modulating signal is used, having an amplitude compatible with the nominal frequency deviation.

Transient response

Tolerance on colour transitions: within mask shown in Fig. 3, with t_o= 530 ns and within mask shown in Fig. 4

Test method: A 100/0/25/0 colour-bar signal is fed to the monitor input. The mask of Fig. 3 is used to verify the edges of the demodulated signal. The edge of the green-magenta transition of a 100/0/75/0 colour-bar signal is checked using the mask of Fig. 4.

Residual subcarrier

Peak-to-peak amplitude of residual signals at frequencies above 3.5 MHz, relative to the nominal amplitude of the demodulated signals: <-40 dB

(E.g., the residual HF signal amplitude should not exceed 5 mV_{p-p} if the amplitude of the D_R signal is 500 mV).

This tolerance must be respected at any subcarrier amplitude in the range - 12 to + 6 dB, with respect to the nominal amplitude.

Test method: The residual subcarrier level is measured at the output of a high -pass filter with 3 dB cut-off at 3.5 MHz.

38.4 Decoded RGB signals

Dematrixing gain

Relative errors in dematrixing coefficients: < 0.5%

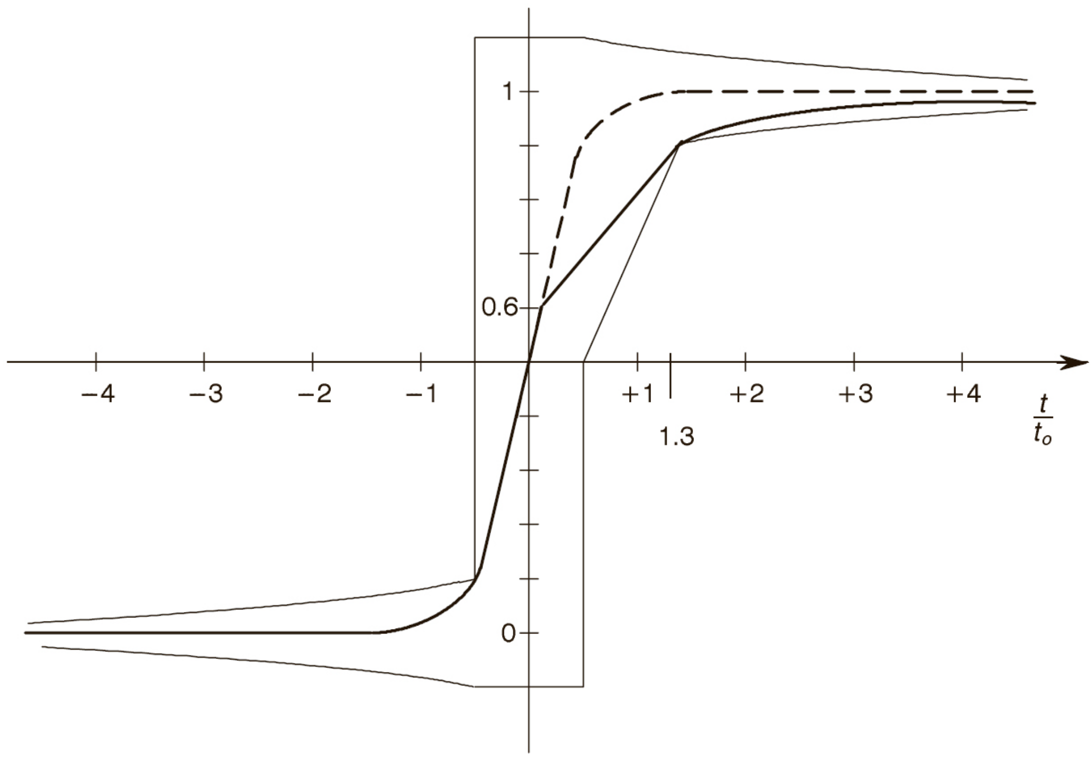
Accuracy of relative levels of E'_Y, D'_R and D'_B at input to dematrixing network in preset (calibrated) position: better than 1%

Black levels

Black-level accuracy in monochrome images, for the D'_R and D'_B signals: better than 1% of nominal amplitude

Luminance - chrominance delay inequality

Relative propagation delays affecting luminance and chrominance components: 0 ± 20 ns



Note: Characteristics as in Fig. 3 except that the upper, rising exponential has the equation: $1 + 0.09e^{1.3a-t/t0}$ -0.01 starting from t/t_0 = 1.3

Fig. 4 - Green/magenta transition in DR, for 100/0/75/0 colour bars (SECAM)

Test method: The propagation delays affecting the luminance and chrominance components of the input signal should be adjusted so that the half-amplitude points of transitions in the E'_Y, D'_R and D'_B signal paths coincide, with the stated tolerance. The input signal is delivered by a SECAM coder meeting the SN 1721 A specification [16], and whose coincidence has been adjusted to the nominal value.

The test signal is a magenta-grey or grey-magenta transition in a 100/0/75/0 colour-bar signal, whose transitions are not clipped (the term "grey" is taken in its widest sense, between black and white).

A magenta-grey-magenta test pattern may be obtained by connecting an EBU 100/0/75/0 colour-bar signal to the SN 1721 A coder as follows:

coder input	**colour- bar component**
red	blue
green	black
blue	blue
Chrominance transitions:	ΔD_R = 235 kHz
	ΔD_B= 152 kHz
Luminance transitions:	ΔY= 217 mV

An alternative test signal having white/magenta/white and magenta/green transitions may be created as follows:

coder input	**colour- bar component**
red	green
green	blue
blue	green
Chrominance transitions:	ΔD_R = 235 kHz
	ΔD_B = 152 kHz
Luminance transitions:	ΔY= 483 mV
	ΔY =308 mV

Appendix A Nominal amplitude-frequency response of the SECAM HF de-emphasis filter

Frequency (kHz)	ΔG/G	ΔG/G (dB)	Frequency (kHz)	ΔG/G	ΔG/G (dB)
2800	0.1059	-19.51	4300	0.9946	-0.05
2900	0.1105	-19.14	4400	0.7673	-2.31
3000	0.1160	-18.72	4406.25	0.7504	-2.50
3100	0.1226	-18.23	4500	0.5437	-5.30
3200	0.1308	-17.67	4600	0.4103	-7.74
3300	0.1410	-17.02	4700	0.3291	-9.66
3400	0.1538	-16.26	4800	0.2760	-11.18
3500	0.1702	-15.38	4900	0.2392	-12.43
3600	0.1918	-14.35	5000	0.2125	-13.46
3700	0.2210	-13.12	5100	0.1923	-14.32
3800	0.2620	-11.64	5200	0.1766	-15.06
3900	0.3226	-9.83	5300	0.1641	-15.70
4000	0.4181	-7.58	5400	0.1540	-16.25
4100	0.5793	-4.75	5500	0.1457	-16.73
4200	0.8400	-1.52	5600	0.1388	-17.15
4250	0.9656	-0.31	5700	0.1329	-17.53
4286	1.000	0.00			

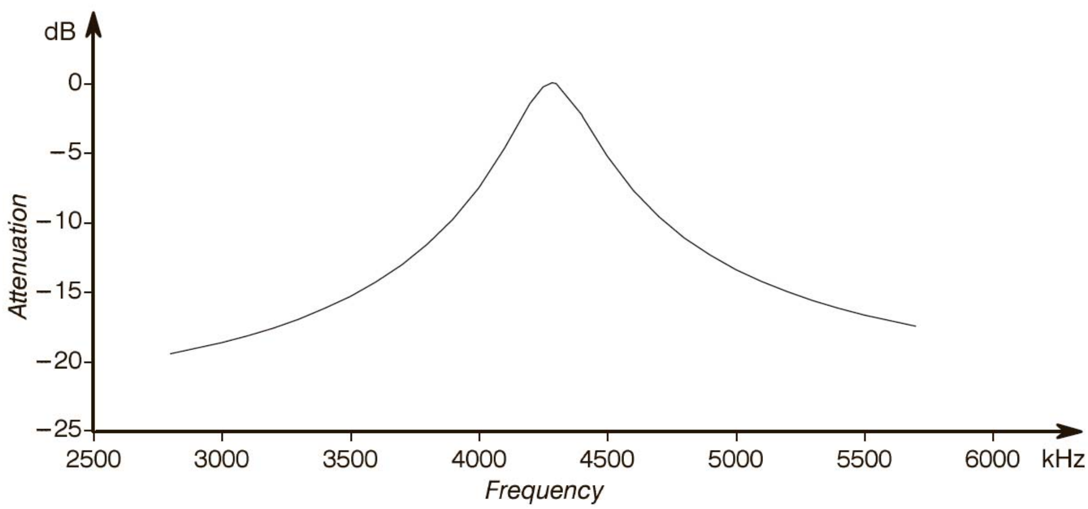


Figure A.1

Appendix B Nominal amplitude-frequency response of the SECAM video de-emphasis filter

Frequency (kHz)	ΔG/G	ΔG/G (dB)
10	0.9939	-0.06
20	0.9764	-0.21
30	0.9494	-0.46
40	0.9158	-0.77
50	0.8783	-1.13
60	0.8392	-1.53
70	0.8004	-1.94
80	0.7631	-2.35
90	0.7281	-2.76
100	0.6956	-3.16
200	0.4970	-6.08
300	0.4209	-7.52
400	0.3866	-8.26
500	0.3688	-8.67
600	0.3586	-8.91
700	0.3521	-9.07
800	0.3478	-9.18
900	0.3449	-9.25
1000	0.3427	-9.31

Frequency (kHz)	ΔG/G	ΔG/G (dB)
1100	0.3411	-9.35
1200	0.3399	-9.38
1300	0.3389	-9.40
1400	0.3381	-9.42
1500	0.3375	-9.44
1600	0.3370	-9.45
1700	0.3366	-9.46
1800	0.3362	-9.47
1900	0.3359	-9.48
2000	0.3357	-9.49
2100	0.3355	-9.49
2200	0.3353	-9.5
2300	0.3351	-9.5
2400	0.3349	-9.5
2500	0.3348	-9.51
3000	0.3344	-9.52
3500	0.3341	-9.53
4000	0.3339	-9.53
4500	0.3338	-9.54

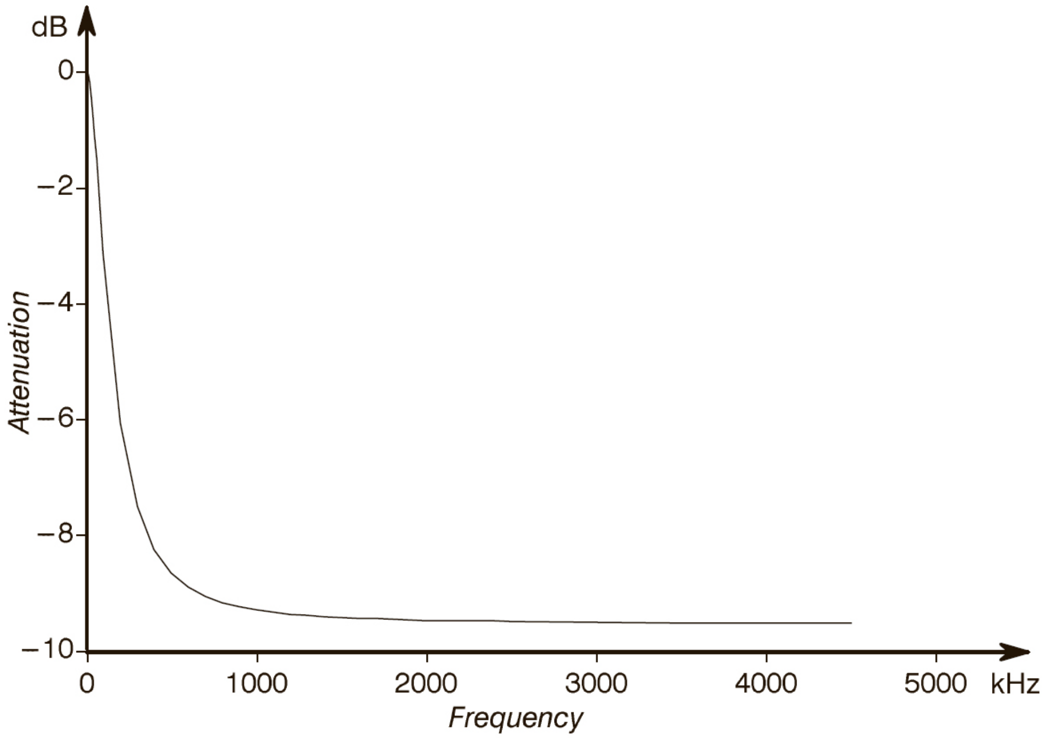


Figure B1

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