EBU

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VIDEO SIGNAL TOLERANCE IN DIGITAL TELEVISION SYSTEMS

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Video Signal Tolerance
in Digital Television Systems

EBU Committee	First Issued	Revised	Re-issued
TC	2000	2000	2016

Keywords: Gamut, Luminance, RGB Levels, HDR, HLG, PQ, Spatial Filtering.

Recommendation

The EBU, considering that,

- video levels have traditionally been measured with devices that display a trace, such as a traditional waveform monitor,
- that readings in mV no longer give relevant information in digital signal infrastructures,
- television systems now include high dynamic range and wide colour space images as well as standard dynamic range and colour space images in the same digital container,
- that a certain tolerance can be allowed in digital signal levels,

recommends that

the guidelines in Annex 1 be used when measuring and assessing video signal levels.

Annex 1: Guidelines for measuring and assessing video signal levels

Introduction

In a video signal, each primary component should lie between 0 and 100% of the video range between black level and the peak level (R and G and B). Ideally, video levels should lie within the specified limits so that programmes can be distributed without adjustment.

When television signals are manipulated in YUV form, it is possible to produce "illegal" combinations that, when de-matrixed, would produce R, G or B signals outside the range 0% to 100%.

Video Signal Tolerance

In practice it is difficult to avoid generating signals slightly out of range, and it is considered reasonable to allow a small tolerance, therefore,

the EBU recommends that,

- *the RGB components and the corresponding Luminance (Y) signal should not normally exceed* the "Preferred Minimum/Maximum" range of digital sample levels in the table below.

Any signals outside the "Preferred Minimum/Maximum" range are described as having a gamut error (or as, being out of gamut). Signals shall not exceed the "Total Video Signal Range", overshoots that attempt to "exceed" these values may clip.

System Bit Depth	Range in Digital Sample (Code) Values		
	Expected Video Range	**Preferred Min. / Max.**	**Total Video Signal Range**
8 bit	16 - 235	5 - 246	1 - 254
10 bit	64 - 940	20 - 984	4 - 1019
12 bit	256 - 3760	80 - 3936	16 - 4079
16 bit	4096 - 60160	1280 - 62976	256 - 65279

Video Signal Filtering

In order to remove transient over and under-excursions of the signals, and to minimise the effect of high frequency noise on the colour gamut measurements, the use of appropriate filters in all measurement channels is recommended.

For interlaced signals

A quarter band filter applied horizontally and a half band filter applied vertically is recommended.

Horizontal Filter Coefficients: 1/16, 2/16, 3/16, 4/16, 3/16, 2/16, 1/16

Vertical Filter Coefficients: 1/4, 1/2, 1/4 applied intra field[1] .

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[1] In certain extreme cases vertical filtering on interlaced content could cause hue shifts that may affect measurements.

For progressive signals

A quarter band filter applied horizontally and a half band filter applied vertically is recommended.

Horizontal Filter Coefficients: 1/16, 2/16, 3/16, 4/16, 3/16, 2/16, 1/16

Vertical Filter Coefficients: 1/4, 1/2, 1/4

Signal Issues

Certain operations and signal processing may produce relatively benign gamut overshoot errors in the picture therefore,

the EBU further recommends that

- *measuring equipment should indicate an "Out-of-Gamut" occurrence only after the error exceeds 1% of an integrated area of the active image.*

Signals outside the active picture area shall be excluded from measurement.

Experience has shown that colour gamut "legalisers" should be used with caution as they may create artefacts in the picture that are more disturbing than the gamut errors they are attempting to correct. It is advisable not to "legalise" video signals before all signal processing has been carried out.