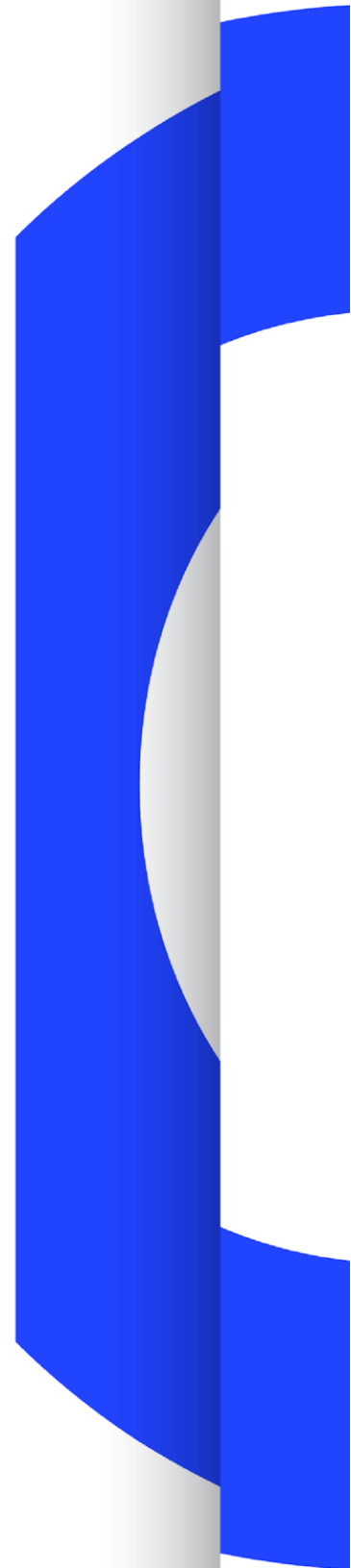# EBU
OPERATING EUROVISION AND EURORADIO

Tech 3376

BASELINE HDR CAMERA PAINTING CONTROLS

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Document History

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Acknowledgement

Abstract

At the EBU HDR Workshop 2022 (SWR, Baden-Baden), Members identified that whilst HLG HDR cameras from different manufacturers gave a consistent look in their default BT.2100 HLG mode, once painting controls had been applied, they were harder to match.

This document specifies settings for cameras from different manufacturers, which create a unified look similar in colour and tone to a traditional BT.709 camera. These baseline settings can be used as an initial setup, on top of which further adjustments may be applied to deliver the desired look.

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Baseline HDR Camera Painting Controls

1.   Introduction

At the EBU HDR Workshop 2022 (SWR, Baden-Baden) [1], Members identified that whilst HLG HDR [2] cameras from different manufacturers gave a consistent look in their default BT.2100 HLG mode, once painting controls had been applied, they were harder to match.

This document specifies two methods for generating settings for cameras from different manufacturers, which create a unified look similar in colour and tone to a traditional ITU-R BT.709 [3] camera. These baseline settings can be used as an initial setup on top of which further adjustments may be applied to deliver the desired look.

Members can create settings to be shared with EBU Members using the first method only. The settings are available to Members as profiles, published as supplements to this document.

The second method can be used within a single production, outside broadcast facility etc.

Where a specific camera model is not listed, settings for the nearest model from the same manufacturer may be used.

The values listed in the document may change with future firmware updates to cameras.

To closely match an HLG camera to the look of a BT.709 camera, a small increase in "gamma" in linear light below the HDR Reference White level, and an increase in saturation is required. This is shown in Figure 1. In addition, the linear portion of the ITU-R BT.709 reference OETF compresses shadow detail, so additional control of the shadow region may be required for a precise match.
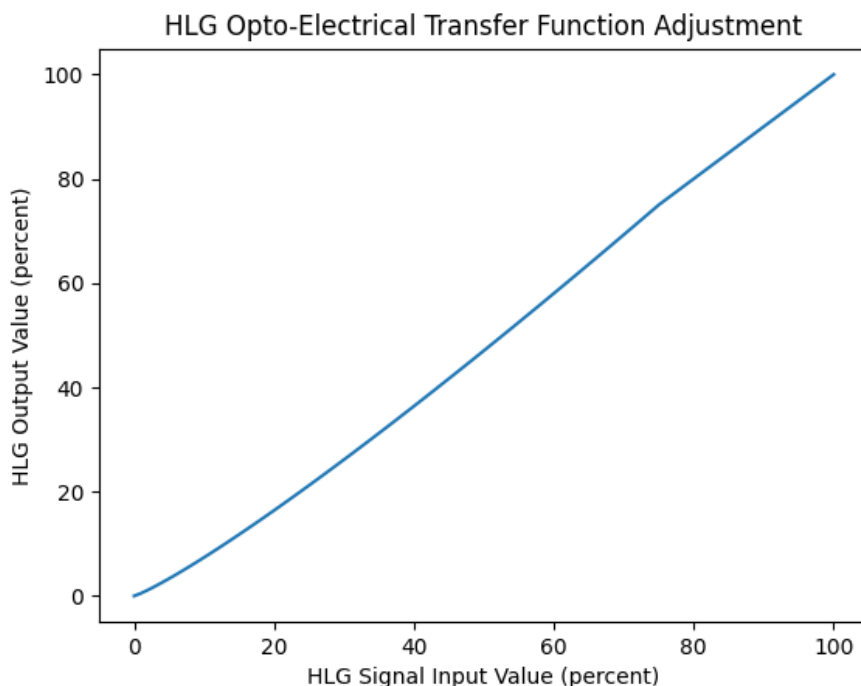

Figure 1: Suggested Opto-Electrical Transfer Function (OETF) adjustment

2.   Generating a Baseline HDR Camera Painting Controls Profile

The HDR Camera Base Profile is created by adjusting the HDR camera's painting controls so that:

* the shadow and mid-tone luminance,
* full image saturation, and
* full image hue

closely match those of an ITU-R BT.709 camera with no artistic adjustment.

2.1   Method 1 – Using an HDR camera and the SDR Reference Image

To create an HDR Camera Base Profile for the HDR Camera Under Test, a JAPE Color-Rendition chart[1][4], or preferably a DSC Chroma du Monde or SMPTE Cam Book or Chroma Selfie, illuminated by either D65 high TLCI lighting [5] or Daylight and camera outputs are monitored using Grade 1(B) reference monitors [6] (ideally one BT.709/BT.1886 [3][7] and one BT.2100HLG side-by-side), a waveform monitor (WFM) and vector scope. The HDR reference monitor is adjusted such that code value 940 is displayed at 400 cd/m^2 with a system gamma setting of 1.04 [2]. (This causes the HDR Reference White (75% HLG) to be displayed at 100 cd/m^2, matching the diffuse white level of a reference SDR display).

For this test:

* the HDR Camera Under Test is white balanced using an 18% grey card. The camera is then exposed so that the test chart white patch is code value 721, the iris closed, and the black level adjusted so that the black level is code value 64. The iris is then reopened.
* the SDR reference image is shown with a peak luminance of 100 cd/m^2.

The HDR Camera Under Test's HDR tone controls are adjusted to create a close measured match of the greyscale between the HDR output and the SDR reference image. Once the greyscale matches, the HDR saturation is adjusted to create a close visual match between the HDR outputs of the camera under test and SDR reference image.

Where the HDR Camera Under Test cannot be adjusted to match the required look, a user LUT may be used.

The SDR reference image can be downloaded from:

https://qc.ebu.io/testmaterial/?path=/TECH3376/

2.2   Method 2 – Using an HDR camera and the SDR output of an HDR camera

To create an HDR Camera Base Profile for the HDR Camera Under Test, a JAPE Color-Rendition chart1[1][4], or preferably a DSC Chroma du Monde or SMPTE Cam Book or Chroma Selfie, illuminated by either D65 high TLCI lighting [5] or Daylight is used and camera outputs are monitored using Grade 1(B) reference monitors [6] (ideally one BT.709/BT.1886 [3][7] and one BT.2100HLG side-by-side), a waveform monitor (WFM) and a vector scope. The HDR reference monitor is adjusted such that code value 940 is displayed at 400 cd/m^2 with a system gamma setting of 1.04 [2]. (This causes the HDR

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[1] Currently sold by Calibrite under the name 'ColorChecker', previously made by MacBeth then X-rite. DataColor make a similar chart that could also be used. https://calibrite.com/us/product-category/capture-solutions/
https://spyderx.datacolor.com/spyder-checkr-photo/

[2] See ITU-R BT.2100 Footnote 2 gamma formula.

Reference White (75% HLG) to be displayed at 100 cd/m^2, matching the diffuse white level of a reference SDR display).

For this test:

- the HDR Camera Under Test is white balanced using an 18% grey card. The camera is then exposed so that the test chart white patch is code value 721.
- the SDR Gain is then adjusted so that the SDR output of the camera has the test chart white patch at code value 940.
- The camera Iris is then closed and the HDR master black and any SDR black level offset adjusted so that both output blacks are at code value 64.
- The Iris is then re-opened.

The HDR Camera Under Test's HDR tone controls are adjusted to create a close measured match of the greyscale between the HDR output and the SDR output. Once the greyscale matches, the HDR saturation is adjusted to create a close visual match between the HDR and SDR outputs of the camera under test.

Where the HDR Camera Under Test cannot be adjusted to match the required look, a user LUT may be used.

3.   References

[1]   EBU HDR Workshop, https://tech.ebu.ch/events/2022/ebu-hdr-workshop

[2]   ITU-R BT.2100-2, *'Image parameter values for high dynamic range television for use in production and international programme exchange'*, International Telecommunication Union, Geneva, July 2018

[3]   ITU-R BT.709-6, *'Parameter values for the HDTV standards for production and international programme exchange'*, International Telecommunication Union, Geneva, June 2015

[4]   McCamy, C.S., Marcus, H., et. al., *'A Color-Rendition Chart'*, Journal of Applied Photographic Engineering, vol. 2, num 3., Summer 1976

[5]   EBU R 137, *'Television Lighting Consistency Index 2012 and Television Luminaire Matching Factor 2013'* Revision 2.0, European Broadcasting Union, Geneva, August 2016

[6]   EBU Tech 3320, *'User Requirements for Video Monitors in Television Production'* version 4.1, European Broadcasting Union, Geneva, September 2019

[7]   ITU-R BT.1886, *'Reference Electro-Optical Transfer Function for Flat Panel Displays used in HDTV Studio Production'*, International Telecommunication Union, Geneva, March 2011

Note: the above links were correct at the time of publishing this document.