

ALEXA SXT / ALEXA65 / ALEXA Mini / AMIRA

High Dynamic Range Looks with ARRI Digital Cameras

I N F O R M A T I O N

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Version History

Version	Author	Change Note
2016-06-01	Harald Brendel	Version 1.0
2017-05-24	Jan Fröhlich	Updated from Rec. 2020 to Rec. 2100 and from AMIRA and MINI SUP4 to SUP5.
2017-05-30	Harald Brendel	Adapted to new functions in camera (auto-selection of monitor color space and look for EVF). Added appendix.
2017-07-14	Christian Grafwallner	Finalized document for first release

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1 Introduction

The next big shift in our industry is towards High Dynamic Range (HDR). HDR is enabled by brighter displays, which allow a greater range from black to the brightest image content. HDR delivers a significant improvement in picture quality; providing greater contrast between shadow areas and highlights, deeper color saturation and higher perceived sharpness.

Interest in HDR has been driven by television manufacturers and content providers, since higher resolution alone has not prompted consumers to buy new TV sets or pay a premium for content. Manufacturers are therefore releasing second-generation UHD TV sets that can display HDR, new laser projectors are being installed to show HDR images in cinemas, and broadband streaming services have started streaming content in HDR. This paper describes HDR monitoring with ARRI digital cameras and HDR postproduction with images generated by ARRI digital cameras.

2 New HDR Look file is not compatible with older camera SUP releases

Please be aware the new HDR .aml Look file described in this document can be used only in the most recent SUP 5.0 release or higher for ALEXA Mini and Amira.

For ALEXA SXT and ALEXA 65 the SUP 2.0 updated must be installed.

The new HDR Look file needs also an update of ARRI Color Tool to version 1.5.0.1

http://www.arri.com/camera/alexa/tools/arri_color_tool/

and ARRIRAW Converter to version 3.5.0.9

http://www.arri.com/camera/alexa/tools/arriraw_converter/

Please contact digitalworkflow@arri.de, if someone wants to use for ALEXA SXT SUP 1.0 the previous HDR Looks from the HDR Q&A web page. http://www.arri.com/camera/alexa/learn/hdr_faq/

3 HDR Monitoring

There are two possible ways to accomplish HDR monitoring with ARRI digital cameras.

3.1 Using the Log C Signal

The Log C signal encodes the full dynamic range of the ALEV III sensor and can be converted into an HDR monitoring signal by means of a 3D LUT. The 3D LUT can be loaded into an external device that sits between the camera and the monitor. Some HDR monitors allow the user to load a 3D LUT. In this case, the monitor is directly connected to the camera.

We provide 3D LUTs for conversion of LogC footage into an HDR signal. The names of the 3D LUTs are formed according to the following scheme:

ARRI_colorSpace-E0TF-#peakWhiteK-#diffuseWhite_#meshPoints.ext

The name part **colorSpace** is either "Rec2100", which stands for the color space defined as part of ITU-R Rec. BT.2100-0¹, or "P3D65", which combines the color primaries typically used for mastering in digital cinema with a D65 white point.

¹ <https://www.itu.int/rec/R-REC-BT.2100-0-201607-l/en>

The name part **EOTF** refers to the electro-optical transfer function (EOTF). ITU-R Rec. BT.2100-0 allows the use of two different HDR EOTFs: Perceptual Quantizer, “PQ” originally defined in SMPTE ST-2084², and Hybrid Log-Gamma “HLG” originally defined in ARIB STD-B67³.

SMPTE ST-2084 encodes absolute luminance values. The digit at the position marked with **#peakWhite** specifies the maximum luminance value in the 3D LUT. We offer 3D LUTs for 1000, 2000, and 4000 nits. The 3DLUTs are based on different tone-mapping curves depending on the maximum luminance.

When switching both monitor and camera from an 1K PQ LUT to the respective 1K HLG LUT, the displayed image should look identical.

The intended target luminance for diffuse white objects under typical lighting conditions are denoted by **#diffuseWhite**. We provide 3D LUTs that render diffuse white towards an approximate luminance of 100 or 200 cd/m². The 3D LUTs rendering diffuse white towards 200 cd/m² are compatible with the BBC recommendations for creating HLG compatible HDR signals.

3D LUTs differ in the number of mesh points per channel. The number may be 33 or 65 and is given in the name part **meshPoints**. For preview, the smaller 3D LUT will be sufficient. For rendering in postproduction, we recommend using 3D LUTs with a size of 65. Note that the 3D LUTs in the camera look files (see below) have 33 mesh points.

Finally, the extension **ext** depends on the file format of the 3DLUT. For example, the 3D LUT **ARRI_Rec2100-PQ-1K-200_33.cube** is a 3D LUT for Rec. BT.2100 with PQ EOTF, a maximum luminance of 1000 cd/m² that renders typically lit and exposed diffuse white objects to ~200 cd/m² and is formatted in the DaVinci Resolve .cube format with a resolution of 33 mesh points.

3.2 Using ALF-2 ARRI Look Files

For AMIRA, ALEXA Mini and ALEXA SXT cameras we offer 3D LUTs for Rec. BT.2100 HDR monitoring. These 3D LUTs are in the ARRI Look File ALF-2 format and allow on-set viewing when an HDR monitor is connected to the camera. Since the number of 3D LUT mesh points in a camera look file is always 33, it's not part of the name. The look files are named as follows:

ARRI 2100 EOTF #peakWhiteK #diffuseWhite.aml

The parameters **EOTF**, **#peakWhiteK** and **#diffuseWhite** are defined in the preceding paragraph.

4 HDR Postproduction

The same 3D LUTs used for HDR monitoring can also be used for HDR color grading. Our advice is to use the larger 3D LUT having 65 mesh points per channel for mastering in HDR. The workflow is similar as in any DI⁴-style postproduction. ARRIRAW or Log C footage is loaded into the color grading software. When ARRIRAW footage is used the software will convert it to Log C. The color-corrected Log C images are converted by the 3D LUT and viewed on a HDR monitor and when rendering deliverables.

Using these HDR-LUTs and HDR monitoring, typical color grading operations like ASC CDL based transformations can be used as if one was color grading for SDR (Standard Dynamic Range).

5 Caveats

Usage of the look file has some caveats. Please carefully read the following notes:

5.1 In-Camera Color Processing

When one of the ALF-2 HDR look files is loaded and activated in camera, the monitoring output is encoded for a display with an HDR (PQ or HLG) EOTF. Therefore, the image will only be displayed on a monitor that

² <https://doi.org/10.5594/SMPTE.ST2084.2014>

³ https://www.arib.or.jp/english/html/overview/doc/2-STD-B67v1_0.pdf

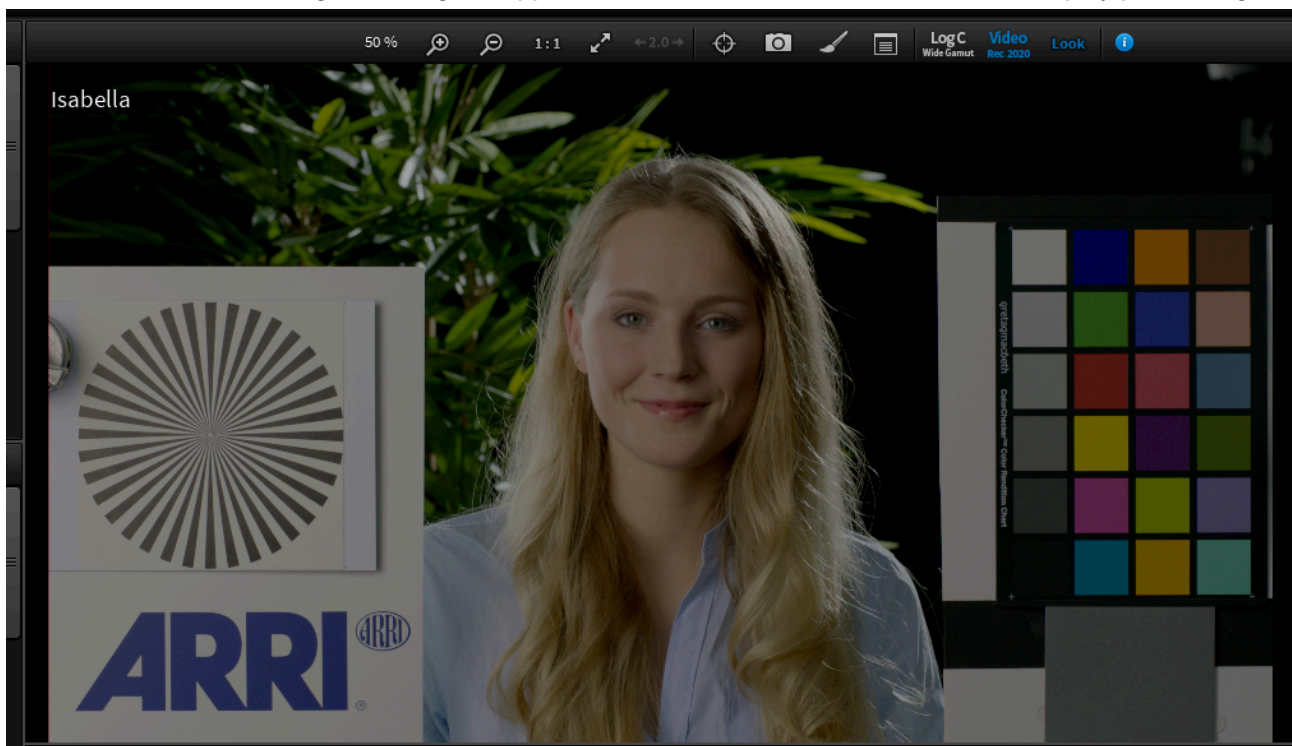
⁴ Digital Intermediate

provides the respective Rec. BT.2100 transfer functions (PQ or HLG). Monitors with a gamma-curve as transfer function, like traditional on-board monitors or the EVF, will not display a correct image when supplied with a signal encoded an HLG or PQ EOTF-providing display. PQ images supplied to a traditional “gamma” EOTF monitor will show an image that looks similar to a Log C image. HLG encoded images supplied to a traditional “gamma” EOTF monitor look less flat, but are still displayed desaturated. When an HDR ALF-2 look file is loaded and activated in the camera, the ALEXA Classic 709 look is automatically selected for the EVF. We recommend to use the same look for all other HD-SDI outputs attached to SDR (Standard Dynamic Range) monitors.

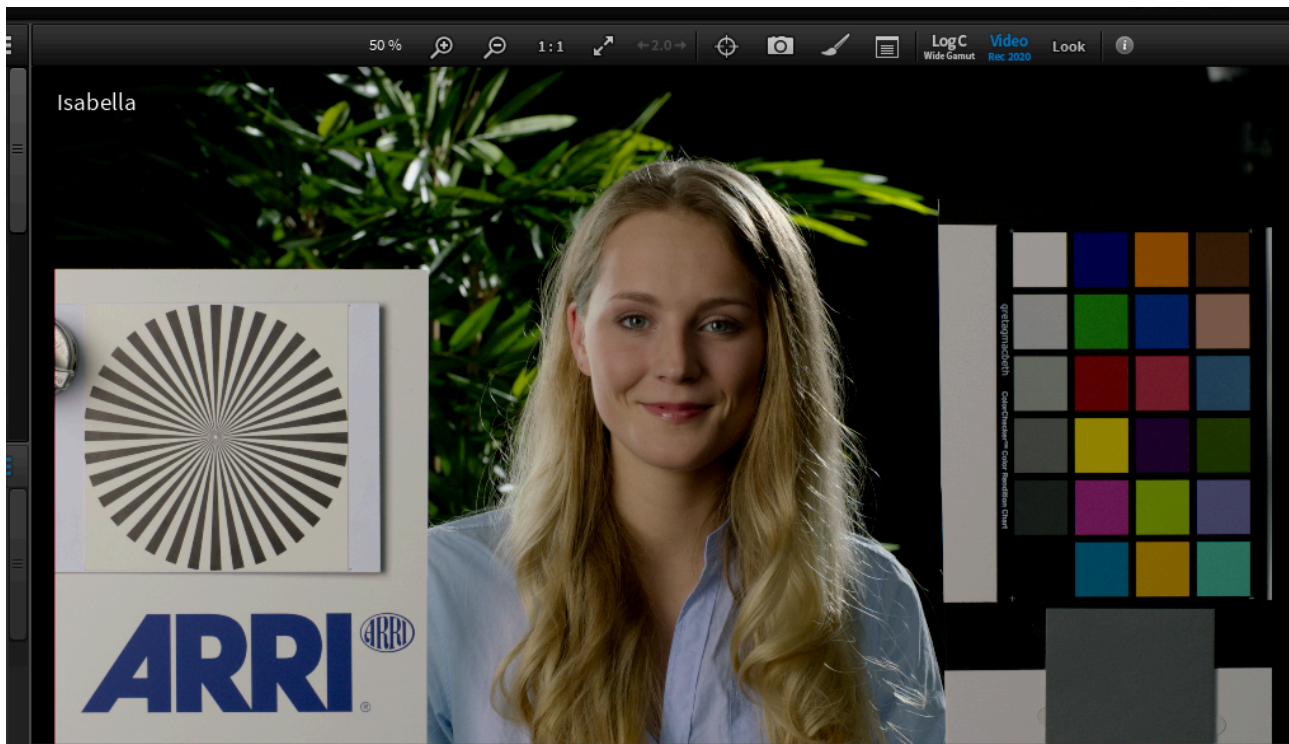
The color management system of the camera can not properly convert the HDR signal into other color spaces. Therefore, the SDI output of the camera connected to the HDR monitor and the monitor itself have to be set to Rec. BT.2020. This setup is to be used regardless whether the mastering is in Rec. BT.2020 or P3 color space. In the latter case a 3D LUT for P3 color space can be used in color grading but not in-camera.

5.2 Embedded Looks

If an HDR ALF-2 file was activated, the ProRes Log C or ARRIRAW files recorded will contain the HDR 3D LUT in metadata. That means, however, that the image will not be properly displayed in systems that use the embedded 3D LUT and are not connected to an HDR display having the selected Rec. BT.2100 transfer function. This includes ARRI’s imaging applications, such as the ARRI Color Tool (ACT) and the ARRIRAW Converter (ARC). In this case, the user must override the embedded look with a look suited for SDR displays. In the ARC and ACT software you can simply turn off any look by clicking on the “Look” button in the tool bar above the image, causing the application to fall back on its traditional SDR display processing.



The figure shows the Isabella test image in the ACT displayed with a look for Rec. BT.2100 PQ. The appearance of the image is wrong since the computer display has standard dynamic range.



The same test image shown with the look turned off. The ACT software will apply the default look for the selected SDR target color space (Rec. BT.2020). When the correct display profile is activated in the preferences, the image will appear correctly in the computer display.

6 Appendix

6.1 Color Spaces

ITU Rec. BT.2020 defines the color space for UHD but no transfer curve of the monitor. Therefore, it's assumed that the UHD reference monitor has standard dynamic range and has the same transfer curve as a HD reference monitor. This would be a legacy gamma curve as defined in ITU Rec. BT.1886.

ITU Rec. BT.2100 defines two different transfer curves for HDR monitors (PQ and HLG) and a color space, which is the same as in BT.2020.

Because of this parallelism, you set the monitor color space in the camera to "Rec. 2020" but load a "Rec. 2100" look when you want to work with HDR.

7 Questions & Contact

If you have any questions about HDR Looks, please contact us via digitalworkflow@arri.de.