UHD Single-Master HDR-SDR Production

Shading and Grading Production Reference

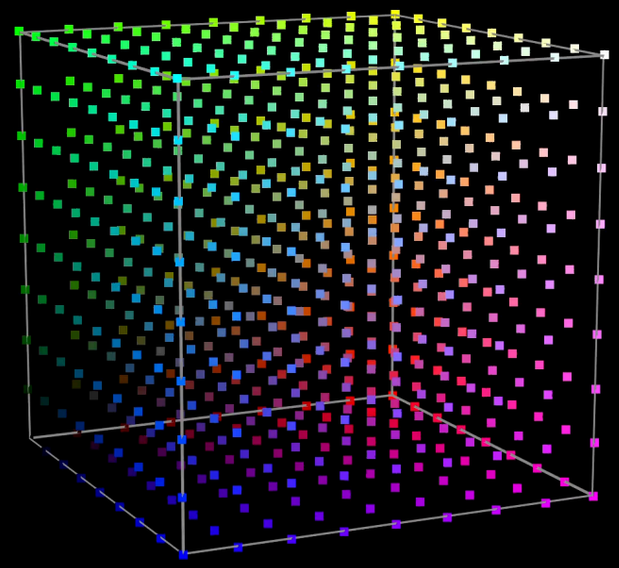
UHD HDR-SDR Single-Master Live Production Method

This eBook will evolve as we document the complete workflow.

Lesson Two will review Shading/Grading.

It is provided as a reference for production teams.

Apple Book Store Link is here:
http://books.apple.com/us/book/id6443508953



Lesson 2

HDR-SDR Displays

ADJUSTMENTS FOR SHADING & GRADING

Live Broadcast Production
Adjustments
HLG and SDR Displays
•
Optimal Gain-Staging
For Consumer Delivery
Of HDR and SDR

Display Adjustment Instructions

Side-by-Side Dual-Focused HDR-SDR Shading

In the Single-Master production workflow, camera shading is performed in HLG BT.2100 using a native HLG reference display. HLG-to-SDR LUTs provide a “predictive” conversion which is also used for SDR program output during SDR transmission. NBCU LUT3 using during HDR-to-SDR conversion is designed to consistently maintain the original artistic intent when compressing highlights and converting the color space from HDR-BT.2100(BT.2020) to SDR-BT.709.

Native HLG cameras are shaded so that “Diffused White” is equal to approximlately 75% of the signal level. This is equal to 203cd/m^2 if an HLG displays peak white equals 1,000cd/m^2(nits). No contrast adjustments are necessary on 1,000cd/m^2 HLG displays. Displays lower than 1,000nits require a contrast adjustment so that 75% graphic white is equal to 203cd/m^2. HLG is in-essence display-referred once adjusted.

An HLG camera signal is passed thru NBCU LUT3 which enables shaders a preview of the camera’s appearance as it will be seen thru legacy SDR transmission. Generally a shader can selectively monitor a camera or program output through a router.

Legacy SDR camera signals are converted to HLG using NBCU LUT2. LUT2 uses a conversion which attempts to match the color look of an SDR camera to the HLG camera. Some subjectively choose to use LUT1 for a more saturated look during conversion.

SDR displays must be adjusted using the contrast control so a peak-white(100% signal level) equaling 203cd/m2.

ITU-R BT.2129describes adjustment of SDR displays for “Program Master Monitoring”. BT.1886(SDR EOTF) is designed for adjustment between 100-200cd/m^2.

Monitoring HDR and SDR Side-by-Side With a Unified Reference Graphics White and MidGray

HLG REFERENCE DISPLAY
Peak White = 600-to-1000nits
REFERENCE WHITE CONTRAST ADJUSTMENT = 203 nits

SDR BT.1886 REFERENCE DISPLAY
Peak White = 203nits
CONTRAST ADJUSTMENT TO 203 nits

Set HLG Graphic/Reference White = SDR Graphics White

HLG @ 75%(203nits) = SDR @ 100%(203nits)

Setting a “unified reference white” luminance level between HLG and SDR displays allows comparisons of both images side-by-side and avoids eye adaption issues to the luminance differences in the main focal areas of the images (see display adjustments on the next page.

Dual-Focussed Monitoring with a Unified HDR-SDR Reference White

Avoiding Eye Adaption issues with differing HDR-SDR luminance levels

1. Adjust Luminance using CONTRAST Control (Observe value)
2. Store Contrast control value in display “User Preset”
3. Recall “User Preset” via Function Key assignment on display

Option 1 - Shader can observe Reference HDR levels (and highlights)	
Display Type	Adjustment Value
HDR Display	ADJUST: Reference White = 203nits
SDR Display	ADJUST: Peak White = 203nits

Option 2 - Where shader has eye strain	
Display Type	Adjustment Value
HDR Display	ADJUST : 100-137nit Reference White
SDR Display	Reference Peak White = 100nits

Verifying HDR and SDR display Reference White Levels

SM-208 Display Luminance Meter

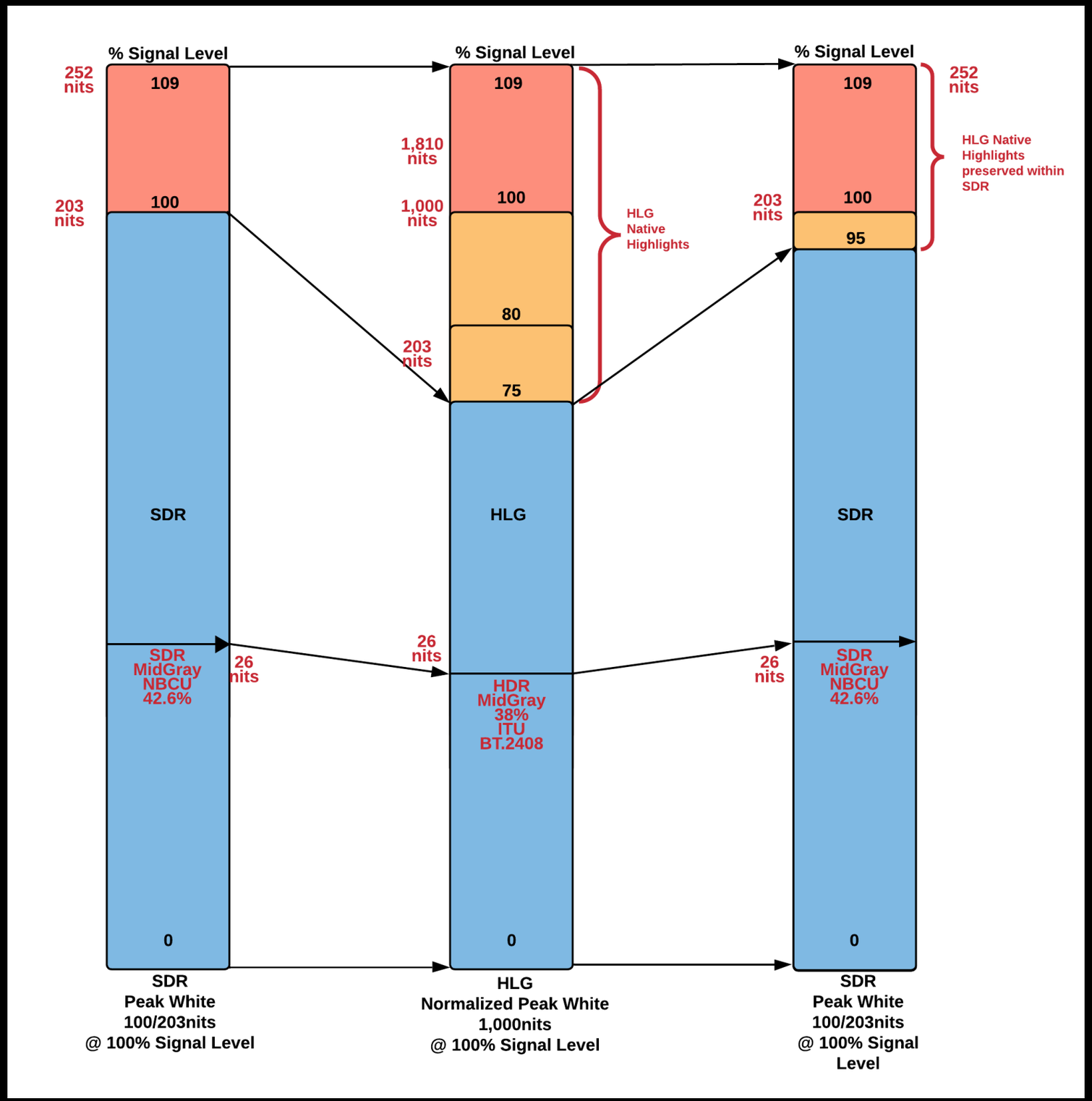
Contrast Control Adjustments with meter

HDR Reference White Measurement

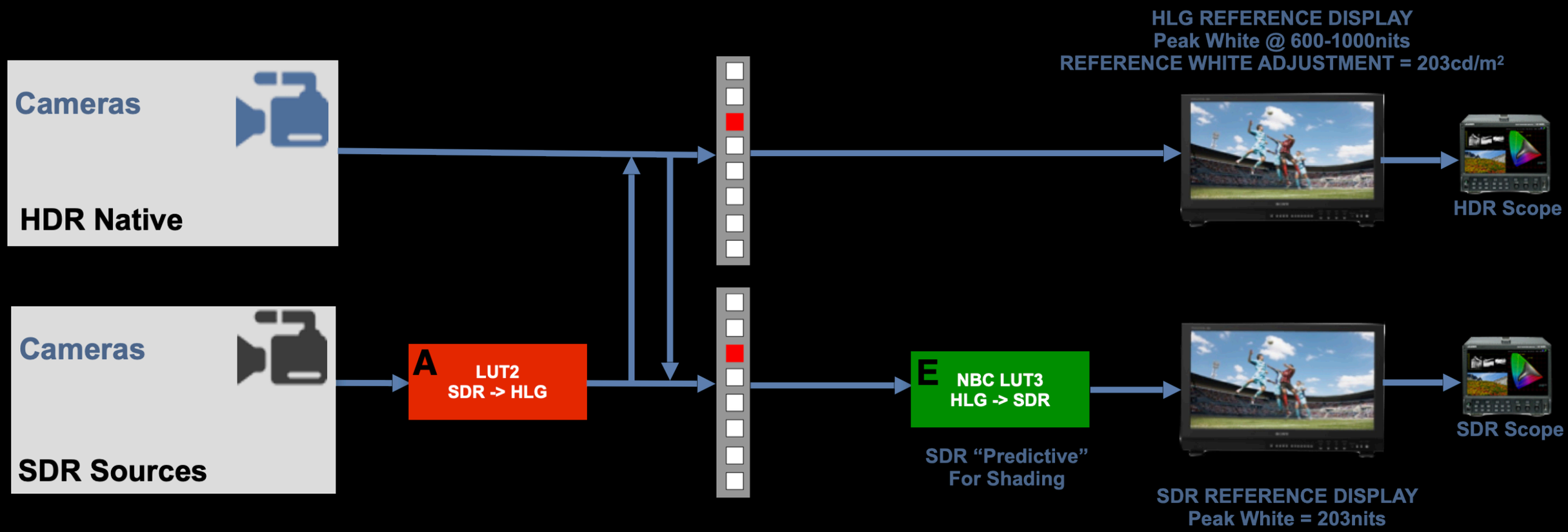
SDR Reference White Measurement

DOWNLOAD: HDR Reference White Color Bars

A Unified Reference/Graphics White and MidGray



Shading HDR and SDR Cameras



Shading HDR Cameras

HLG REFERENCE DISPLAY
Peak White @ 600-1000nits
REFERENCE WHITE ADJUSTMENT = 203cd/m²

Cameras

HDR Native

HDR Scope

E NBCU LUT3
HLG -> SDR

SDR “Predictive”
For Shading

SDR Scope

SDR REFERENCE DISPLAY
Peak White = 203nits

Shading SDR Cameras

HLG REFERENCE DISPLAY
Peak White @ 600-1000nits
REFERENCE WHITE ADJUSTMENT = 203cd/m²

HDR Scope

Cameras

SDR Sources

A LUT2
SDR -> HLG

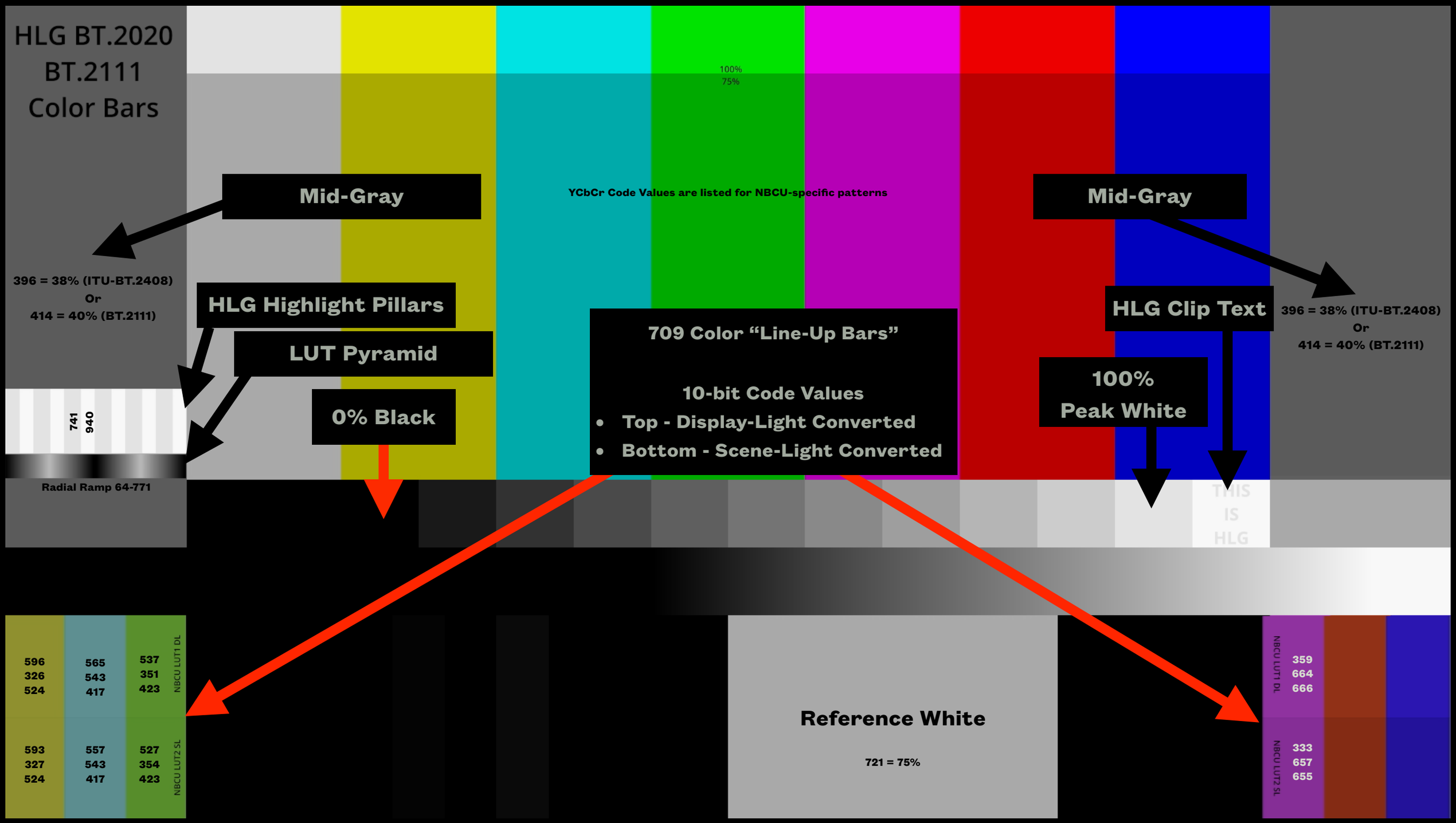
E NBCU LUT3
HLG -> SDR

SDR “Predictive”
For Shading

SDR Scope

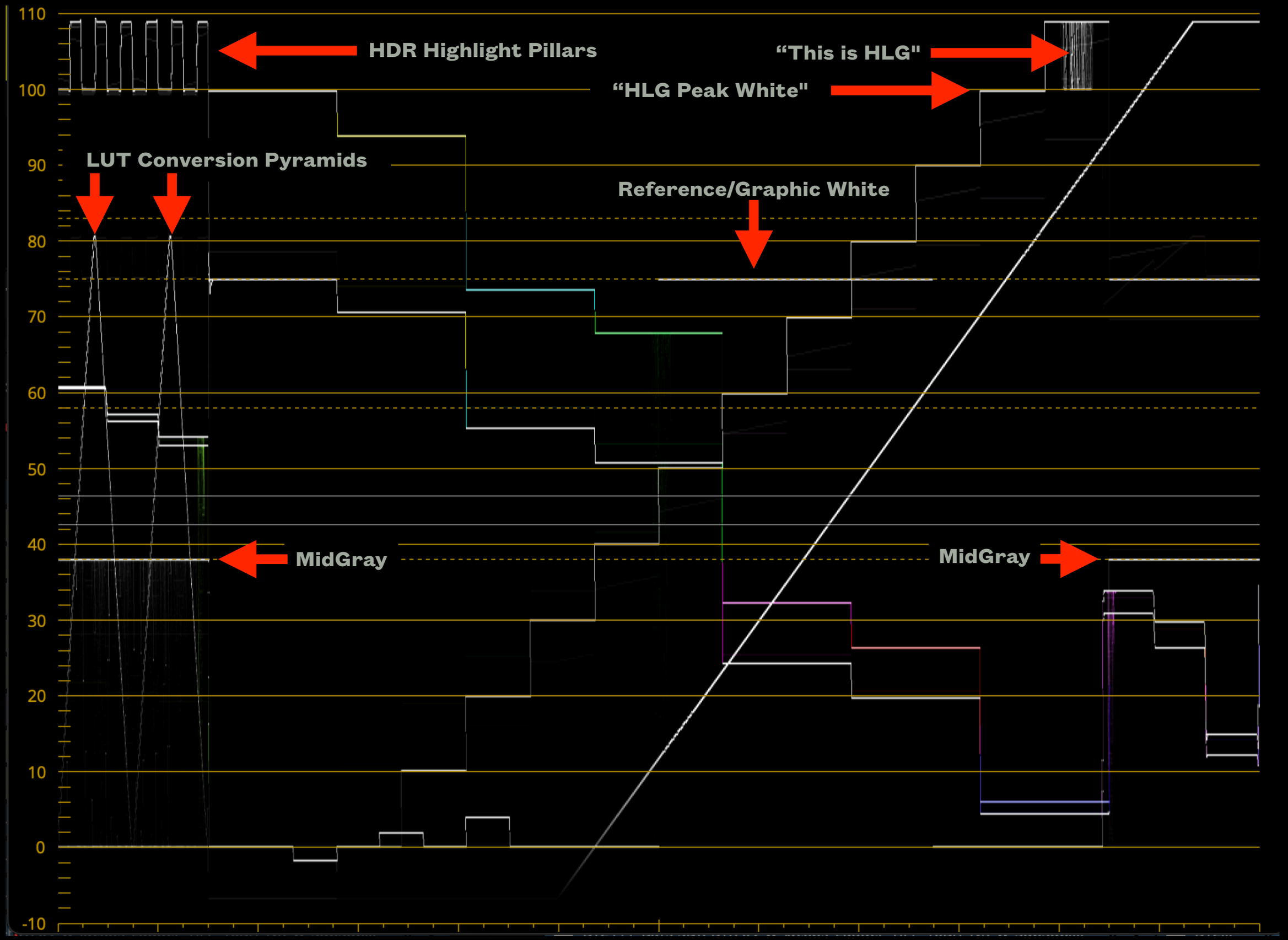
SDR REFERENCE DISPLAY
Peak White = 203nits

HLG BT.2111 (Fancy) Color Bars



Since this HLG image is viewed in SDR-BT.709 it will not look quite correct

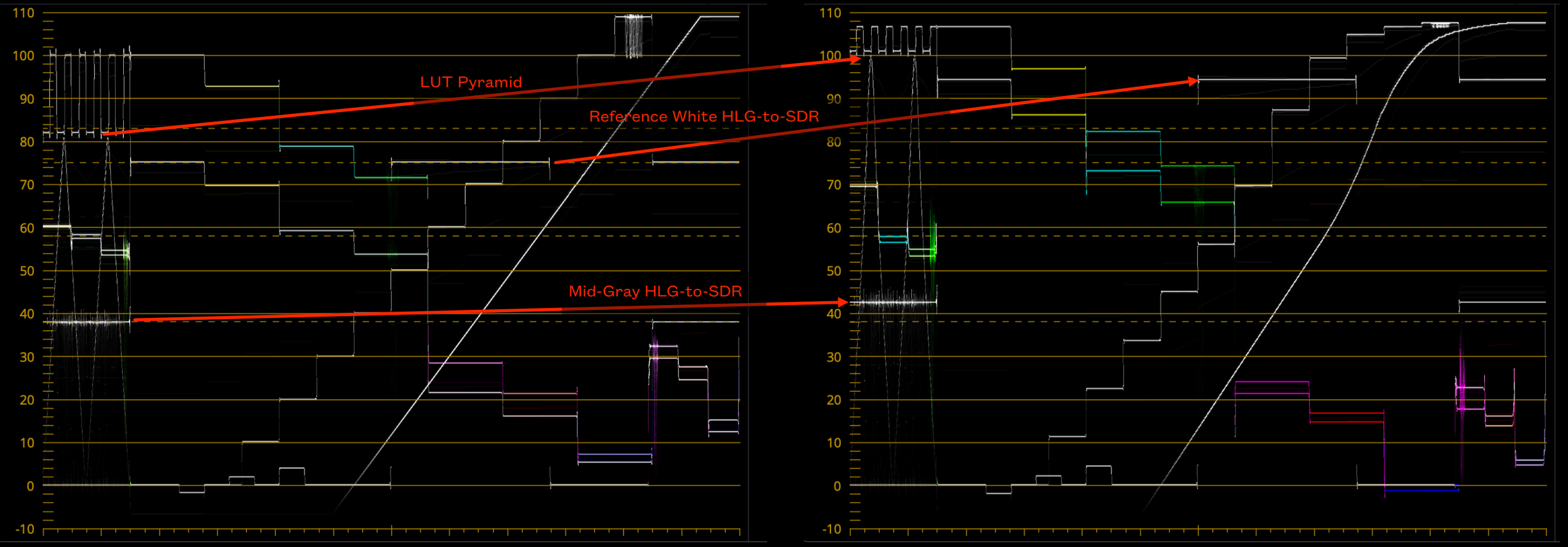
HLG Native BT.2111 (Fancy) Color Bars



HLG to SDR Conversion: NBCU - LUT3

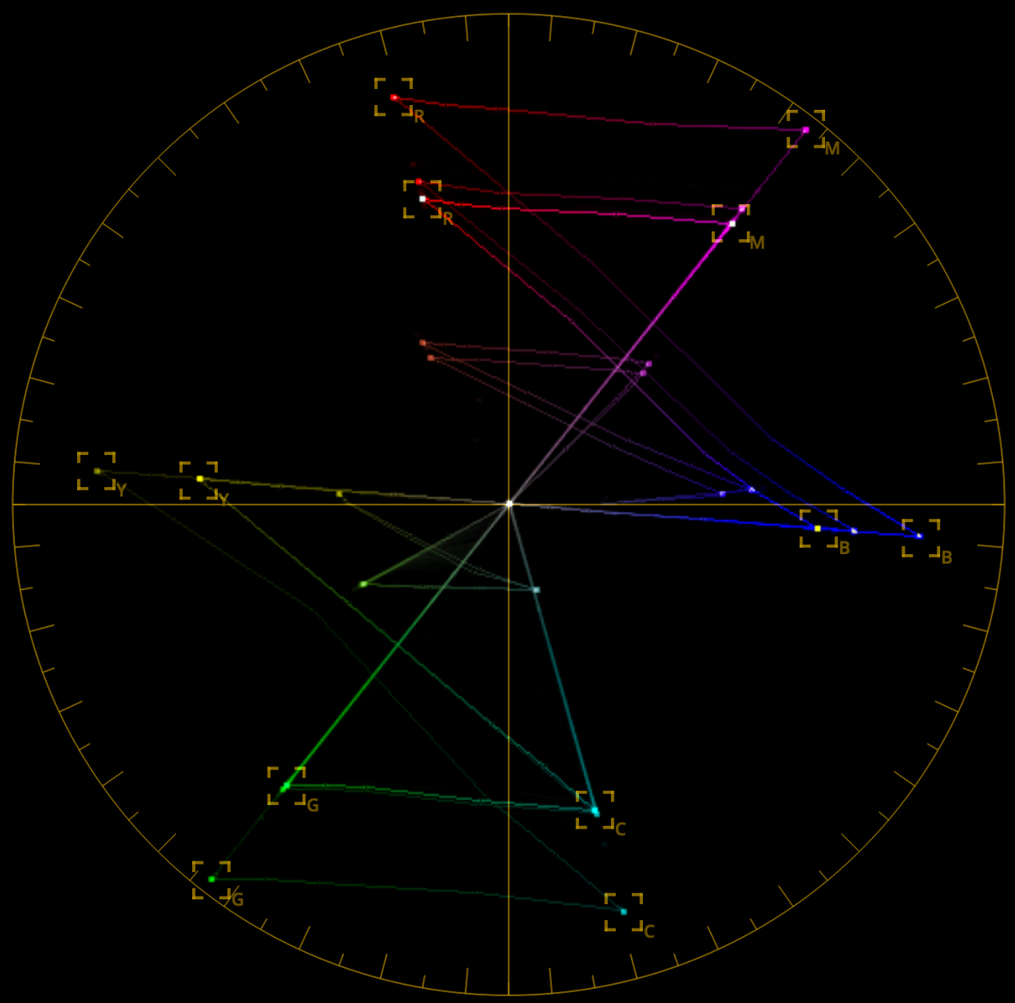
HLG Native Bars

HLG-to-SDR (LUT3)

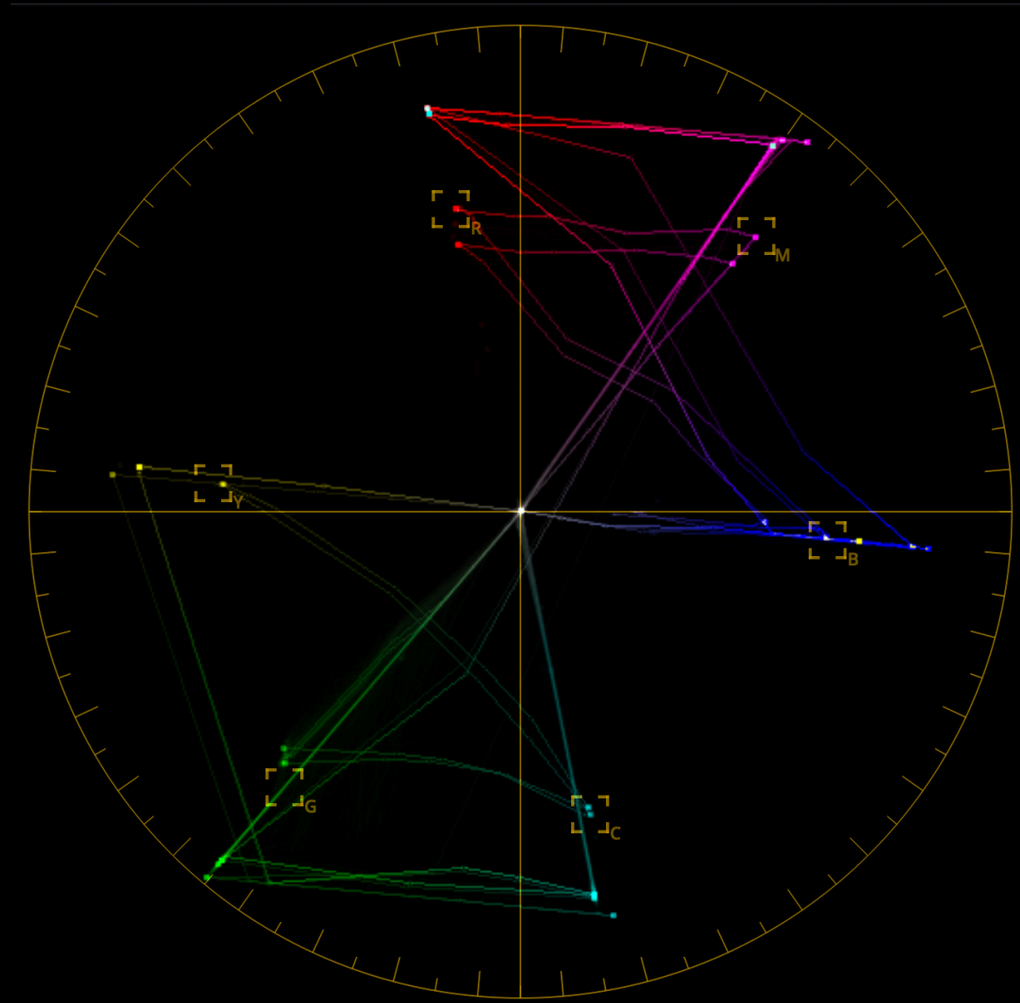


HLG to SDR Conversion: NBCU - LUT3

HLG 100/75%



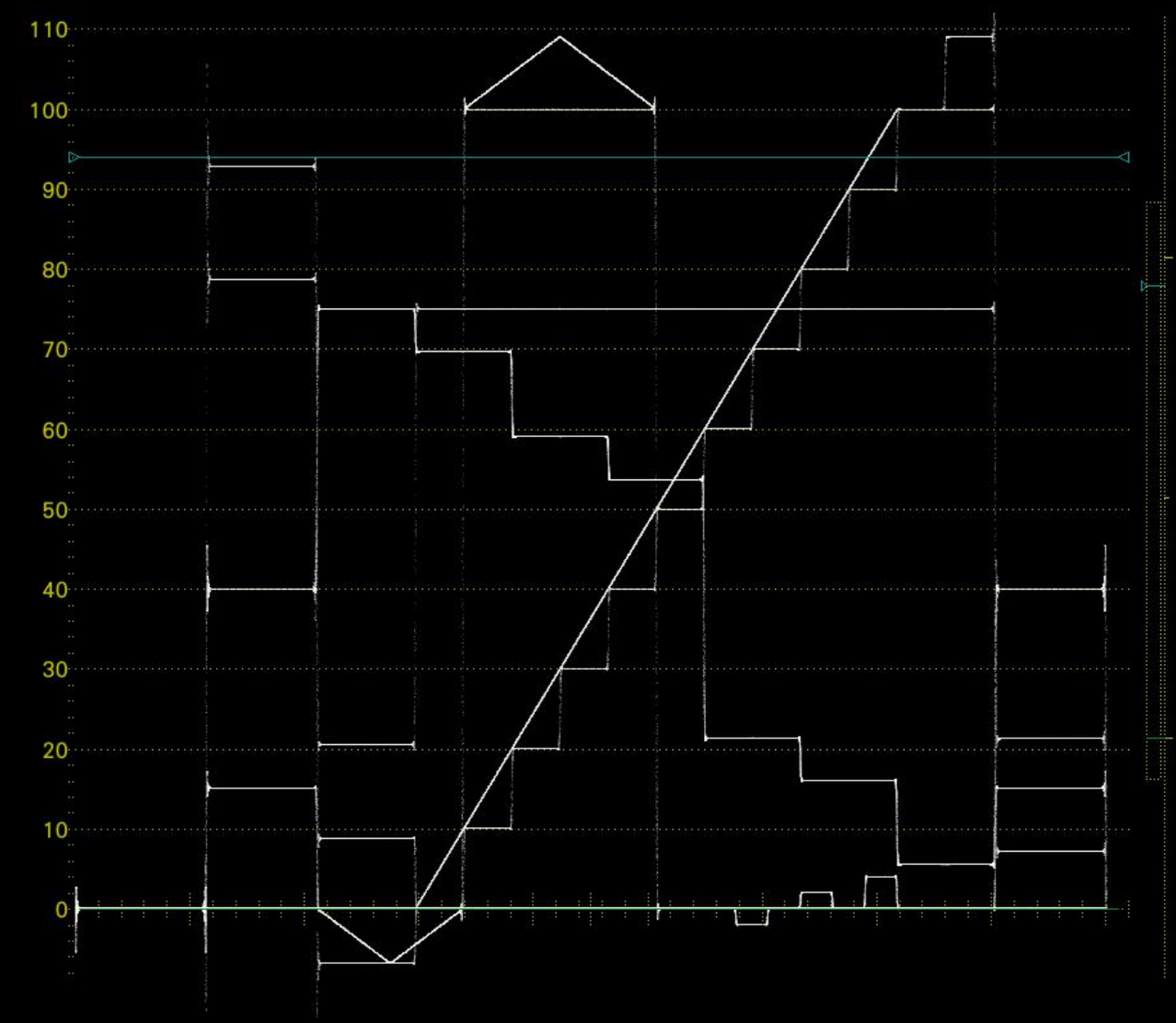
SDR 75%

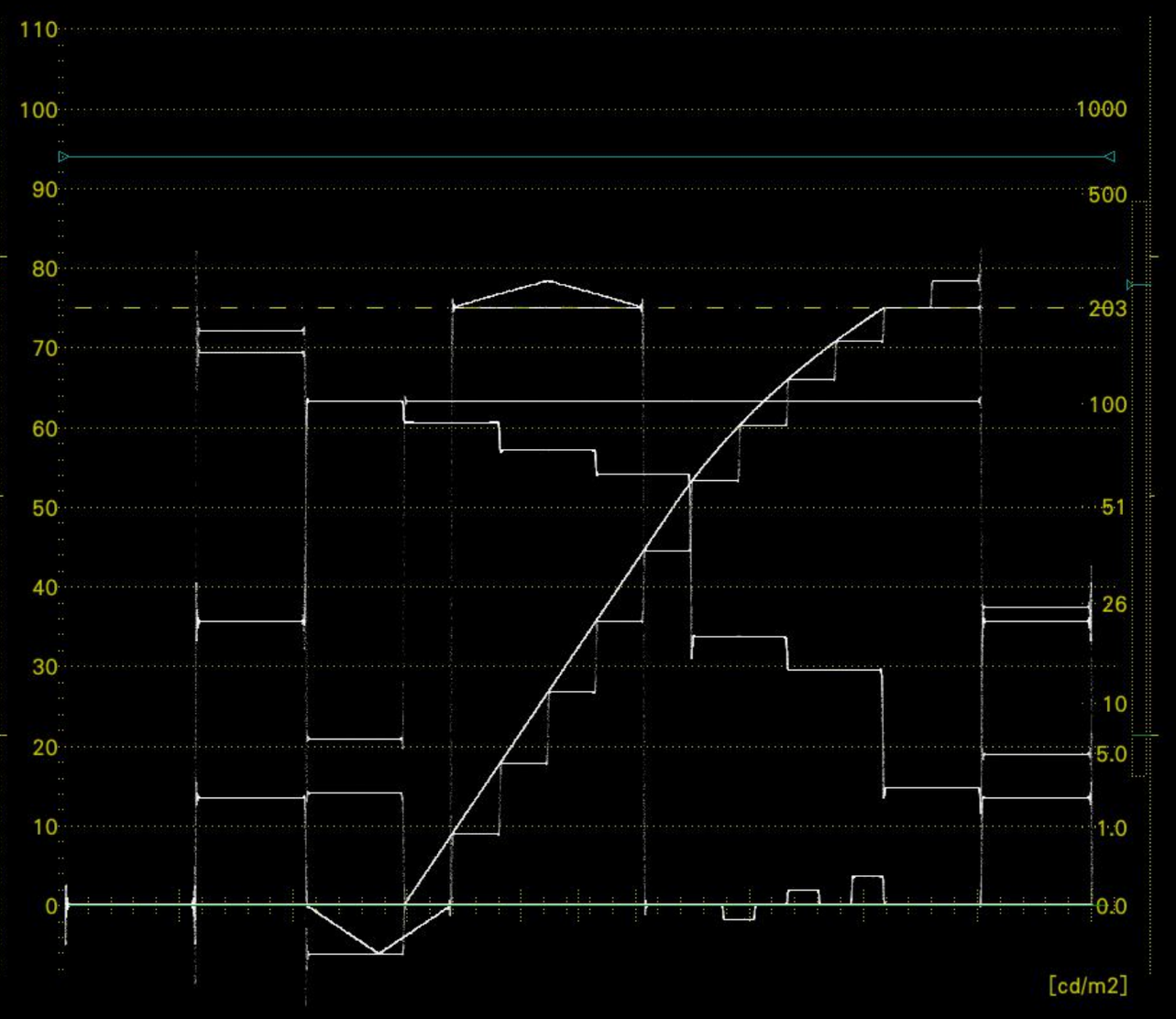


SDR to HLG Direct Upmapping- NBCU LUT1

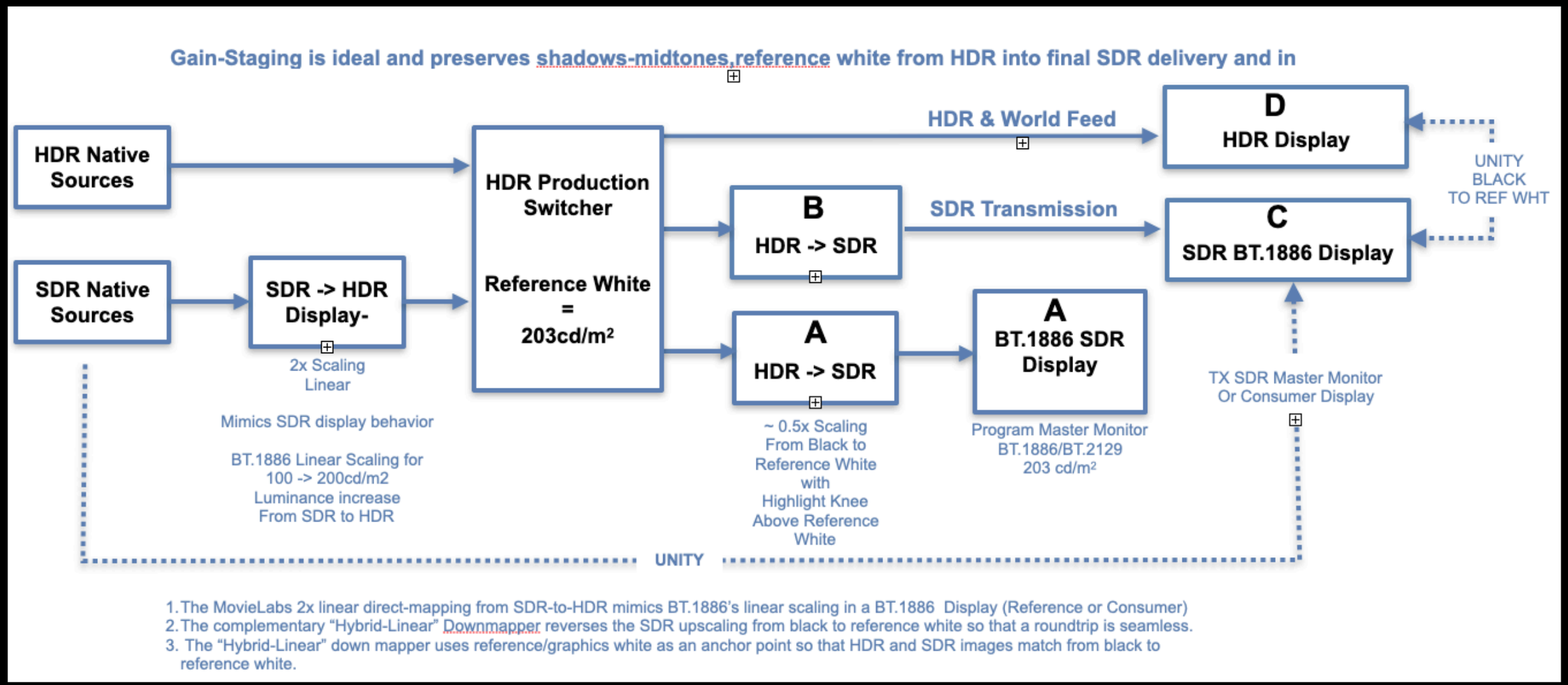
SDR

Converted SDR-to-HLG





UHD Single-Master - Optimal Gain Staging



Optimal gain-staging starts with shading SDR at 203nits which is closer to what todays consumer displays use.

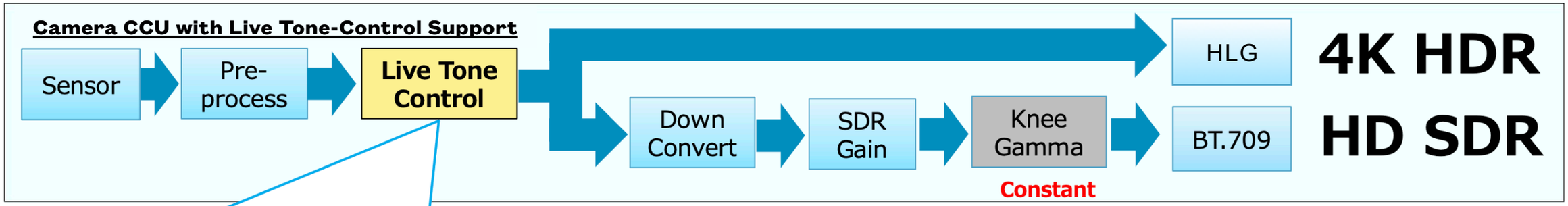
When the SDR shading display is set to 203nits, SDR peak-white is equal to HDR graphic white. This allows the two displays to be placed side-by-side.

SDR downmapping, applies a linear mapping so that the upmapping for a roundtrip is removed from HDR black to reference white. A knee is applied above HDR reference white so that some level of HDR highlights are preserved in SDR.

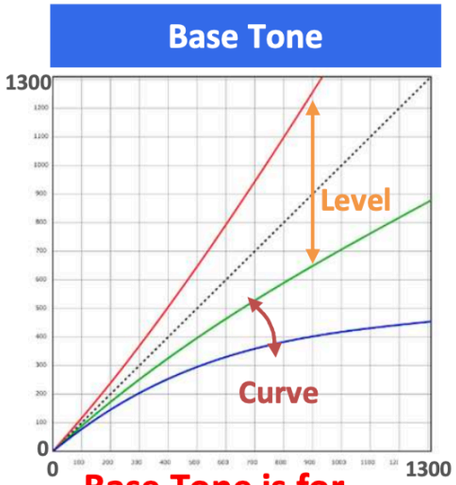
A consumer display typically rescales the video closer to 203nits providing optimal gain staging from source-to-consumer.

Sony HDR broadcast cameras: Live Tone-Controls

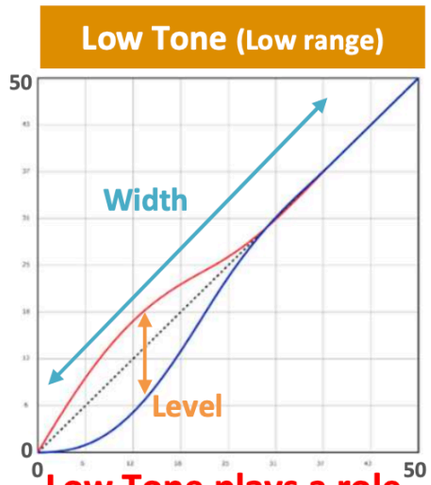
Sony Live Tone-Controls enable flexible tone setting in HDR Productions



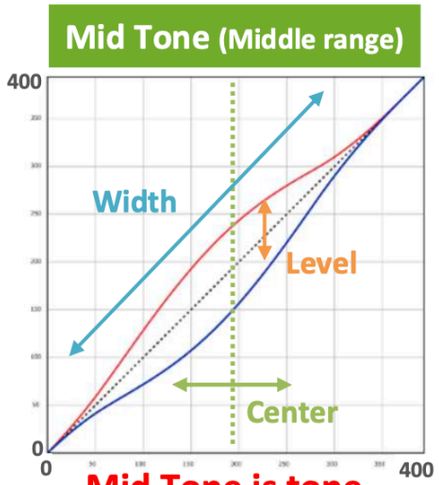
Relation between Tone curve and parameter



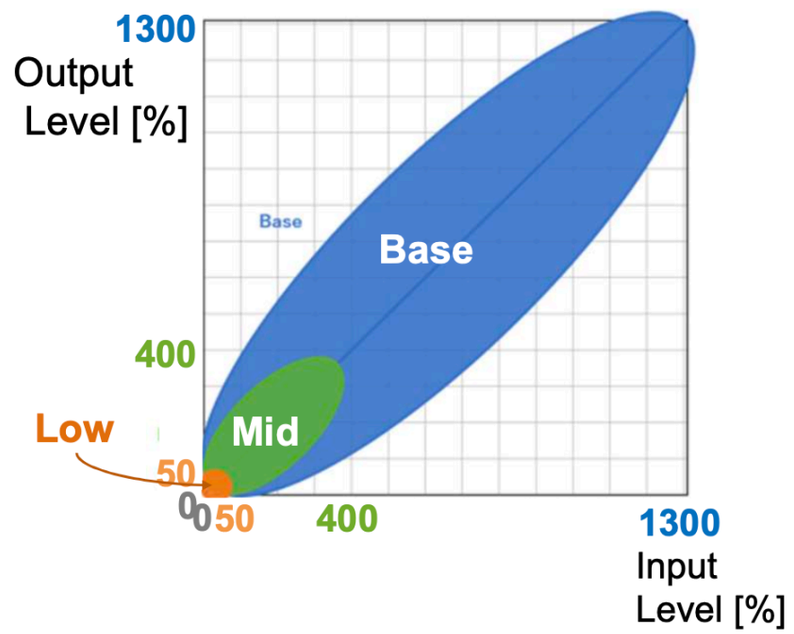
Base Tone is for overall tone adjust incl. bright part



Low Tone plays a role adjusting Black Gamma for dark part



Mid Tone is tone control of middle level area.



SDR to HLG Display Contrast Adjustments

Use Contrast Values below as initial setting

SDR / HDR REFERENCE DISPLAY CONTRAST ADJUSTMENT 10/14/23

*** Picture Adjustment: Make PRESETS that follow the HDR or SDR input selection ***

	SDR				HDR				
	SET CONTRAST VALUE	PEAK-WHITE LUMINANCE (nits)	COLOR SPACE / GAMMA		SET CONTRAST VALUE	REFERENCE-WHITE LUMINANCE (nits)	PEAK-WHITE LUMINANCE (nits)	COLOR SPACE / GAMMA	
BVM-HX310	812	203	709 / 2.4	BVM-HX310	400	203	1000	BT.2020 / BT.2100 (HLG)	a-Si TFT Active Matrix LCD
PVM-X2400	812	203	709 / 2.4	PVM-X2400	400	203	1000	BT.2020 / BT.2100 (HLG)	a-Si TFT Active Matrix LCD
PVM-X1800	812	203	709 / 2.4	PVM-X1800	400	203	1000	BT.2020 / BT.2100 (HLG)	a-Si TFT Active Matrix LCD
BVM-X300	812	203	709 / 2.4	BVM-X300	400	203	1000	BT.2020 / BT.2100 (HLG)	OLED
BVM-E171	2030	203	709 / 2.4	BVM-E171	1667	203	~ 600	BT.2020 / HLG 1.2	OLED

Verify HDR reference and SDR peak white luminance levels using SM-208 or similar probe

HLG Display Configuration Table

	BVM-171M	HDR Ref
Display: Peak White Luminance Level	600	1000
Black Level	0.00	0.00
HLG Variable System Gamma	1.1068	1.2000
MidGray	20.76	26.072
Graphic White	137.95	203.15