IPP2 OUTPUT TRANSFORMS

WHAT ARE IPP2 OUTPUT TRANSFORMS?

IPP2 is RED's new image processing pipeline. IPP2 functions in three stages: Primary Raw Development to RWG/Log3G10, Grading, and Output Transform. It is the job of the Output Transform to correctly map the RWG/Log3G10 image to be displayed correctly on your monitor. It is the Output Transform that enables monitor independence on IPP2 grading.

STAGE	NAME	DESCRIPTION
1	**Primary Raw Development**	Conversion to REDWideGamutRGB
		Encode to Log3G10
2	**Grading**	Grading via ASC CDL
		3D Creative Cube allows user to place creative looks (that go beyond the scope of CDL) in the pipeline.
		Contrast
		User curves
3	**Output Transform**	Development to output color space via gamut mapping algorithm to stop camera colors going out-of-gamut.
		Output encoding to SDR or HDR with highlight rolloff and compression as appropriate.

Output Transforms are performed in camera (in RED cameras that support Full IPP2), RED SDK and REDCINE-X PRO as math and can also be represented as and used in the form of 3D cube LUTs.

Core to the philosophy of IPP2 is that technical controls are separate from artistic controls. The Output Transform is where we find some technical controls that effect the artistic look of the resulting image in the form of Tone Map Curve and Highlight Rolloff. This is because although such functions are a necessary technical component of an Output Transform their operation will impart a certain aesthetic on the resulting image.

IPP2 Output Transforms are designed to be the last stage in processing a RED image. It is advised that all grading operations occur before the Output Transform while the image is still in RWG/Log3G10.

COMPONENTS OF AN OUTPUT TRANSFORM

IPP2 Output Transforms are made up of a number of elements:

- Tone Map Curve
- Output Color Space
- Highlight Rolloff
- Output Gamma Space
- User Nits Limit (HDR2084 Only)

Each of these elements can be set independently thus allowing for Output Transforms that work in a wide variety of monitoring environments.

OUTPUT TRANSFORM FOR HDTV

A typical HDTV monitor uses REC709 primaries for the color space, and the assumed gamma of the image is standardized to BT1886 (gamma 2.4). The necessary settings for a standard dynamic range (SDR) HDTV are:

- Output Color Space = REC709
- Output Gamma Space = BT1886

The settings of Tone Map Curve and Highlight Rolloff will adjust the overall look of the resulting SDR image and are an aesthetic preference.

OUTPUT TRANSFORM FOR HDR

Professional HDR monitors adhere to SMPTE2084 (also known as Dolby Perceptual Quantizer, or PQ) and will generally accept images in a number of different color spaces including REC2020 (BT2100 specifies the REC2020 color space for HDR). RED's implementation of SMPTE2084 is called HDR2084 and includes the ability to have Highlight Rolloff to a specify nit brightness level. The suggested settings for HDR are:

- Output Color Space = REC2020
- Output Gamma Space = HDR2084

Some professional HDR monitors will hard clip when their brightness range is exceeded and produce artifacts. If this is the case, then you can use the "User Nits Limit" to set a limit to the encoded HDR image. The Highlight Rolloff control will be in effect and alter how the full HDR range up to 10,000nits is mapped into the specified brightness range.

Just as with SDR, the Tone Map Curve option is an aesthetic preference. By setting the Tone Map Curve the same between SDR and HDR Output Transforms, you will keep the overall tonality of the image compatible between both kinds of displays.

Alternatively Hybrid Log Gamma (HLG) can be used to encode HDR images. HLG uses a relative rather than an absolute brightness encoding and therefore does not need "user Nits Limit". Images encoded via HLG are compatible for viewing on a standard SDR monitor. The suggested settings for HLG use are:

- Output Color Space = REC2020
- Output Gamma Space = Hybrid Log Gamma

GUIDE TO IPP2 OUTPUT TRANSFORM SETTINGS

TONE MAP CURVE

None	Use when you've designed your own Tone Map Curve as part of grading, or when combining with 3D Creative cubes that impart a tonal adjustment.
Low	Low contrast applied to image.
Medium	Medium contrast applied to image.
High	High contrast applied to image.

OUTPUT COLOR SPACE

REC 709	Standard color space for HDTV.
Adobe 1998	Adobe's color space often used in still photography.
P3	Color space used in projectors for digital cinema.
P3 D65	Color space used in projectors for digital cinema with D65 white point.
REC 2020	Standard color space for UHD and HDR.
ProPhotoRGB	Wide gamut color space sometimes used in still photography.
REDWideGamutRGB	The input image is assumed to be REDWideGamutRGB and hence this setting will mean no color space conversion is applied.

HIGHLIGHT ROLLOFF

None	No highlight rolloff is applied. This is not recommended other than for special applications.
Hard	Compresses highlights the most.
Medium	-
Soft	-
Very Soft	Compresses highlights the least leading to a very filmic look.

GAMMA CURVE

Linear	No encoding curve is applied.
BT1886	Standard encoding for SDR HDTV (gamma is 2.4 for BT1886).
HDR2084	Standard encoding for HDR.
REDLogFilm	RED's version of the Cineon transfer function.
Log3G10	Log3G10 is the IPP2 log encoding curve.
Hybrid Log Gamma	Encoding for HDR with SDR compatibility.