Leica L-Log
Reference Manual

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1. Purpose of this document

This reference manual is meant as a technical guideline for dealing with 10 bit L-Log footage. While the main reason to record log footage is to maximize dynamic range and latitude in post production, it can be important for certain applications to be able to match footage from different sources in a defined manner. One requirement for this matching operation is the definition of the log curve used for recording, which is provided in this document. Another requirement is the specification of the color space the footage is recorded in, which is discussed in section 4.

2. L-Log curve characteristics

The L-Log gamma curve is plotted in Figure 1. Linear scene reflection (LSR) values are mapped to L-Log values following the calculation specification described in subsection 3.1. Figure 2 shows the L-Log gamma curve plotted until it reaches an L-Log value of 1.0.

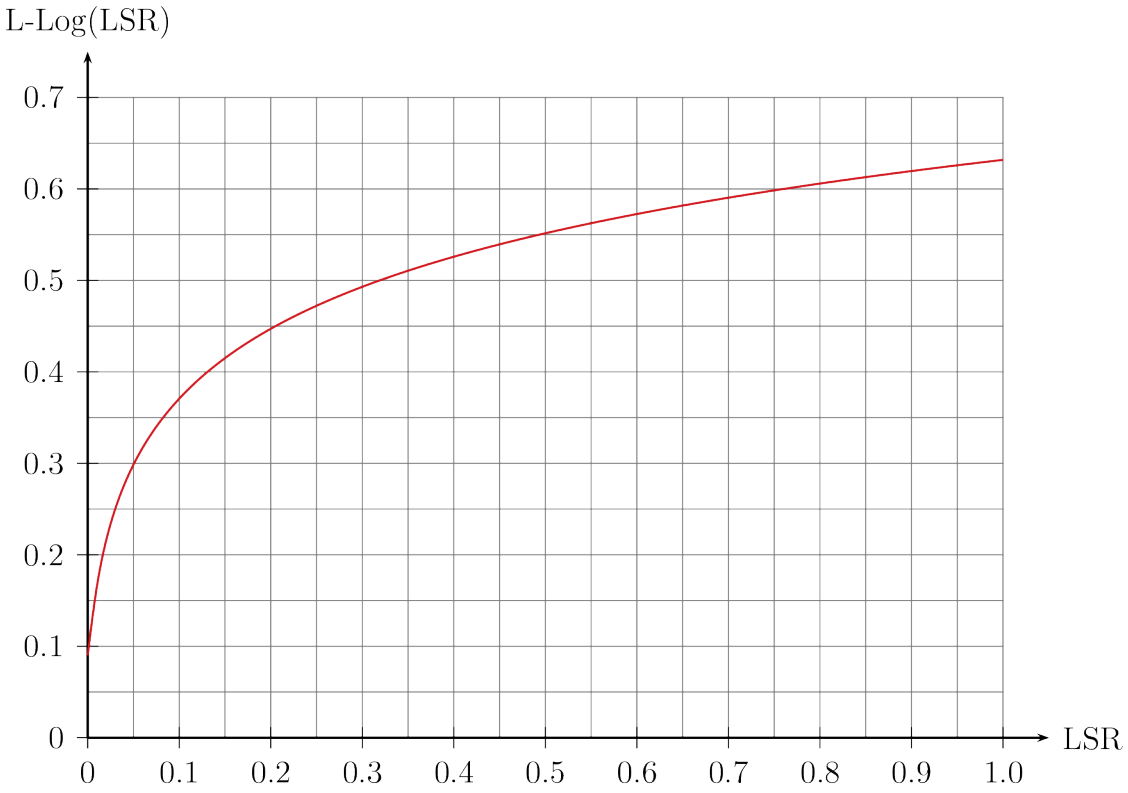

Figure 1: L-Log curve.

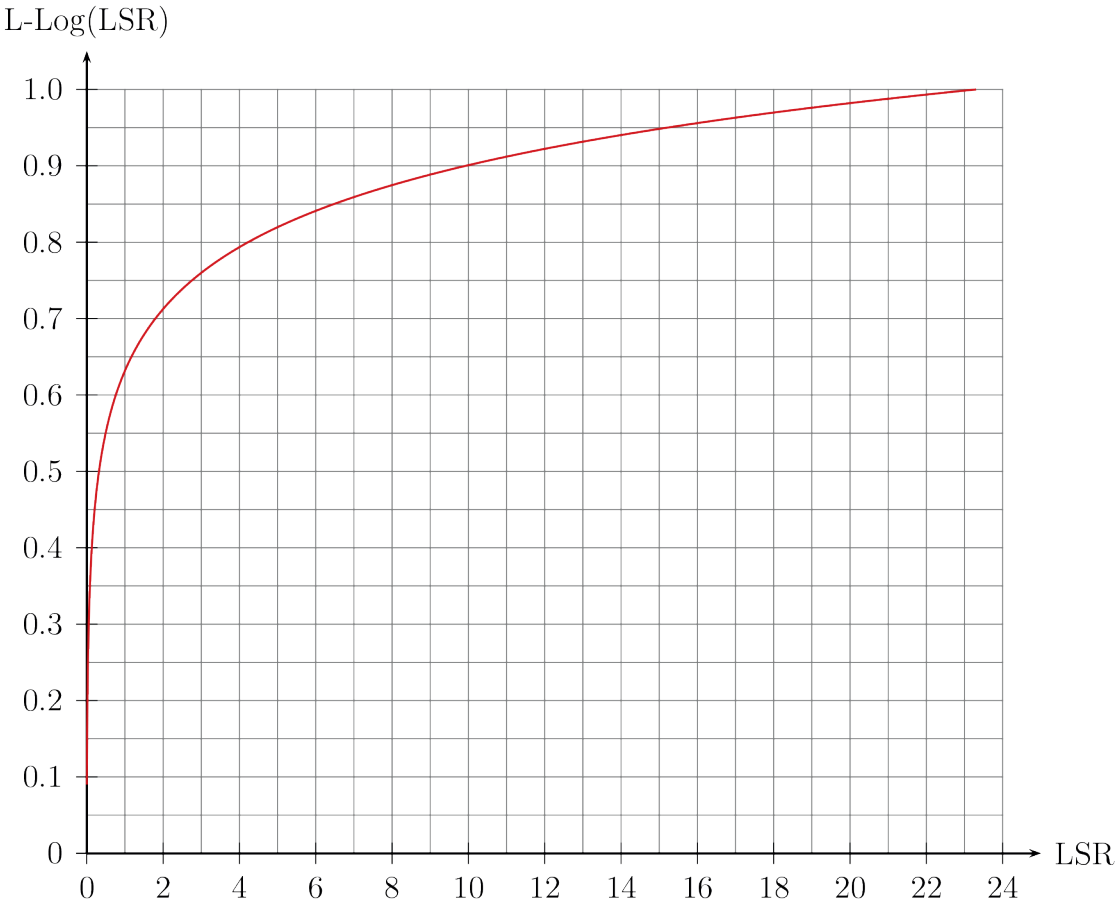

Figure 2: Extended L-Log curve showing when L-Log(LSR) value approaches 1.0.

2.1. LSR-to-L-Log conversion

For LSR-to-L-Log conversion the following calculation specification is given.

$$\text{L-Log(LSR)} = \begin{cases} a \cdot LSR + b & \text{for } LSR \leq 0.006 \\ c \cdot \log\left(d \cdot LSR + e\right) + f & \text{else} \end{cases}$$

where

$a = 8$
$b = 0.09$
$c = 0.27$
$d = 1.3$
$e = 0.0115$
$f = 0.6$

2.2. L-Log-to-LSR conversion

For L-Log-to-LSR conversion the following calculation specification is given.

$$LSR = \begin{cases} \frac{\text{L-Log(LSR)}-b}{a} & \text{for L-Log(LSR)} \leq 0.1380 \\ \frac{10^{\left(\frac{\text{L-Log(LSR)}-f}{c}\right)}-e}{d} & \text{else} \end{cases}$$

where

$a = 8$
$b = 0.09$
$c = 0.27$
$d = 1.3$
$e = 0.0115$
$f = 0.6$

2.3. Mapping of LSR to DV and IRE

Typical LSR values and their equivalent in 10 bit digital values (DV) as well as IRE are given in Table 1. Figure 3 shows a plot of the relationship between LSR and digital values.

LSR [%]	**L-Log [10 bit DV]**	**IRE [%]**
0	92	3
2	220	18
18	445	44
90	634	65
100	647	67
2330	1023	109

Table 1: Typical LSR values and their L-Log equivalent.

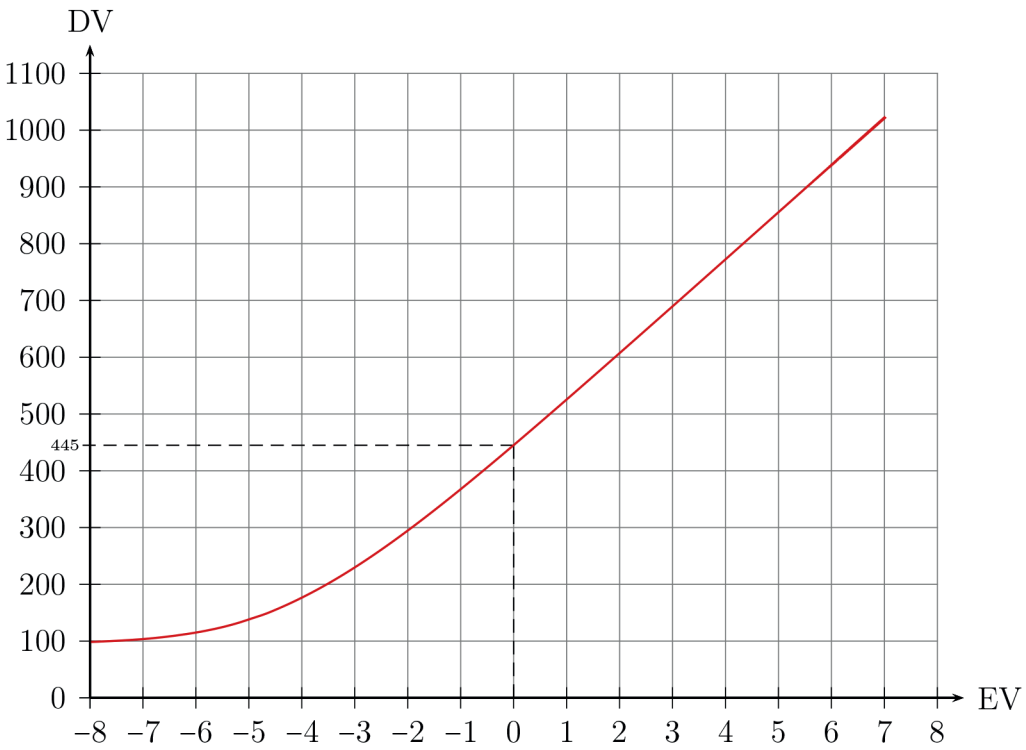

Figure 3: Relationship between linear scene reflection in exposure values and corresponding digital values of the L-Log curve. The value of 0 EV corresponds to 18% input reflection.

3. Colorimetric characteristics

With one exception L-Log uses the ITU-R BT.2020 color space, the properties of which are shown in table 2. Only Leica SL (Typ 601) with FW Update 3.8 and above uses ITU-R BT.709 color space. Figure 4 shows a comparison of common color spaces on a CIE 1931 chromaticity diagram.

Camera	Color space	White Point		Primary Colors					
		x_W	y_W	x_R	y_R	x_G	y_G	x_B	y_B
	ITU-R BT.2020	0,3127	0,3290	0,708	0,292	0,170	0,797	0,131	0,046
Leica SL (Typ 601)	ITU-R BT.709	0,3127	0,3290	0,640	0,330	0,300	0,600	0,150	0,060

Table 4: Color Space Properties

3.1. Colorimetric conversions

Converting from BT.2020 to XYZ color space is defined as:

$$\text{BT.2020 to XYZ} = \begin{bmatrix} 0.6370 & 0.1446 & 0.1689 \\ 0.2627 & 0.6780 & 0.0593 \\ 0.0000 & 0.0281 & 1.0610 \end{bmatrix}$$

The reverse conversion is defined as follows:

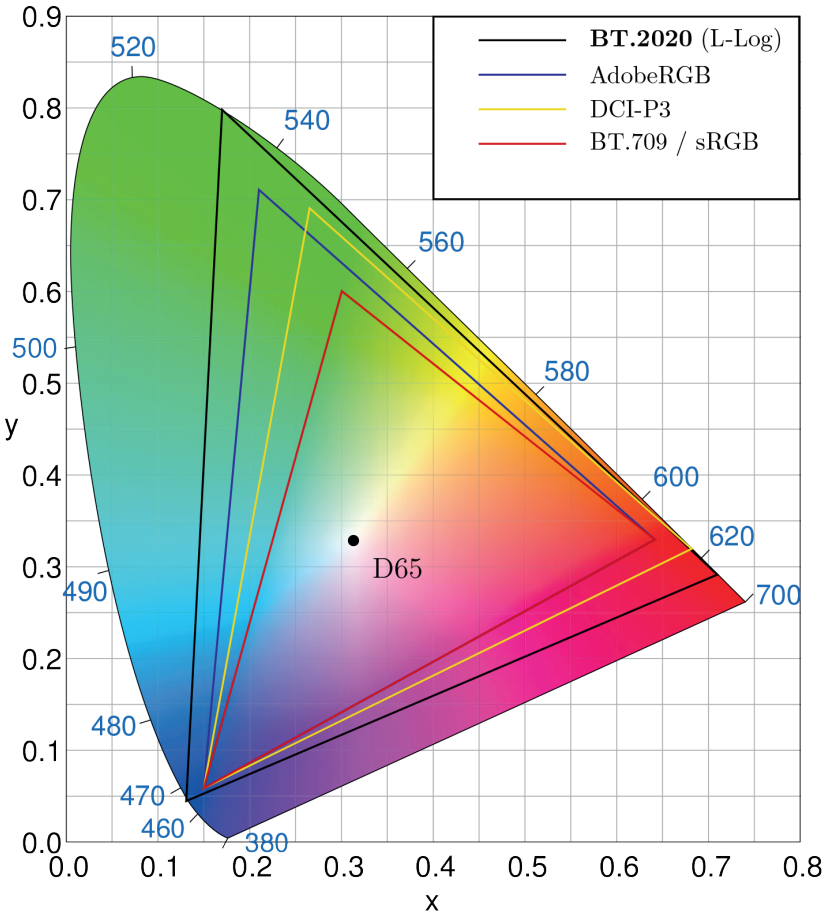

Figure 4: Comparison of color spaces.

$$\text{XYZ to BT.2020} = \begin{bmatrix} 1.7167 & -0.3557 & -0.2534 \\ -0.6667 & 1.6165 & 0.0158 \\ 0.0176 & -0.0428 & 0.9421 \end{bmatrix}$$

Converting from BT.709 to XYZ color space is defined as:

$$\text{BT.709 to XYZ} = \begin{bmatrix} 0.4123 & 0.3576 & 0.1805 \\ 0.2126 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9505 \end{bmatrix}$$

The reverse conversion is defined as follows:

$$\text{XYZ to BT.709} = \begin{bmatrix} 3.2410 & -1.5374 & -0.4986 \\ -0.9692 & 1.8760 & 0.0416 \\ 0.0556 & -0.2040 & 1.0570 \end{bmatrix}$$

Additional colorimetric conversions (i.e. between BT.2020 and BT.709) can be found in relevant literature.

DAS WESENTLICHE.
Leica Camera AG | Am Leitz-Park 5 | 35578 WETZLAR | GERMANY
Phone +49-6441-2080-0 | info@leica-camera.com | www.leica-camera.com