Logs, LUTs, HDR & Monitors

Human Eye Dynamic Range:

The dynamic range is the ratio of the maximum light intensity (whites) to the minimum light intensity (blacks). When looking at a room the eye quickly moves around and the pupil varies in size to allow more or less light in based on the amount of light in each area of the room. Our brain makes a synthesis of all these “snap shots” (of varying lighting conditions, i.e.: exposures) and combines them into a mental image. Of course this process takes place unconsciously. The ability for us to see from dark to bright is what constitutes the human eye dynamic range. The human eye is generally attributed a dynamic range of up to 20 or even 24 stops. Because of the sunlight outside, the human eye has evolved less sensitive to bright light and more sensitive to shadows.

Monitors & Televisions Dynamic Range:

The ideal monitor would provide 20 stops of dynamic range to match the human eye performance. Traditionally, television sets and monitors had a dynamic range of 6 stops that matched the cameras dynamic range of 6 stops. The latest generation of AMOLED monitors boasts 10 stops.

Between The Human Eye & The Monitor- The Camera Dynamic Range:

Digital cameras are racing to deliver a greater dynamic range than the 6 stops of their predecessors. Most state of the art cameras are now at or above 10 stops of dynamic range. For example, the Arri© Amira™’s published specification is a dynamic range exceeding 14 stops.
When trying to display these higher dynamic range cameras on a monitor with a 6-stop dynamic range, the image will look very flat. The greater the difference between the images and the monitor dynamic ranges, the flatter it will look.
In the past, to solve this problem, broadcasters mapped the first 5 stops from the camera directly to the first 5 stops of the monitor. This preserved the shadows and mid-tones of the image. The remaining camera stops over the first 5 stops were mapped to the remaining stops of the monitor –via compression, resulting in the entire loss of information taking place in the bright areas.

Camera Gamma Curves & Logs: In recent years, HD cameras manufacturers have instead adopted custom Gamma curves. The gamma curves compression is spread differently over the dynamic range than the traditional mapping. The gamma curves compress more and more as the stops get higher.
Some gamma curves use **Log (logarithmic) compression** so that each brighter stop is compressed 2x more than the prior one (F10 is 2x more compressed than F9).
Thus came the S-Log, Log-C etc… to capture up to 14 stops of dynamic range.
Going back to our 6 or 10 stops monitor: if the camera output with a gamma curve applied is displayed directly on the monitor, the image will look very low in contrast (“flat”) as even the mid-range stops get some amount of compression. This is called “shooting flat” from the way it looks on a traditional monitor.

Monitor Gamma Correction: LUT:

Look Up Tables enable us to make the “flat” footage look “normal” on a monitor. Instead of compressing (camera gamma), they un-compress (monitor LUT). They bring out to the human eye on the monitor the dynamic range that was recorded via the camera Log curve. The LUT applied in the monitor during production gives a representation of how the footage will look in post-production.
Of course camera manufacturers propose their own LUTs to decode the Log modes in their respective cameras. In the meantime, custom LUTs are often used in post for creative purpose.

Transvideo 7” StargateFHD monitor features several pre-programmed profiles (Linear, Rec709, Canon Log, Log C & S-Log). In addition a 3D LUT function is available to modify the look of the video on the monitor to preview the artistic effect or to load cameras manufacturers’ specific LUTs (3D LUT format only).
The 7” StargateFHD also provides an HDR Clipping function based on HLG (Hybrid-Log Gamma) adjustable from 1 to 12. These settings are used to determine whether HDR might be used for a specific scene and understand its impact in the highlights.

Transvideo CinemonitorHD Evolution3 SuperBright & X-SBL (Software 7.0 & above) also feature pre-programmed profiles (Linear, Rec709, S-Log, S-Log2, S-Log3, Canon Log, Log C). HDR renditions are provided via the HDR clipping function (adjustable from 1 to 12), and by an adjustable Proportion Highlight function (1 to 12).

There are currently **2 accepted HDR standards for monitors:**
1/ A monitor with a brightness rating of 1000 Nits or more (backlight or OLED) is not necessarily HDR compatible. To be HDR compatible it also needs the black levels to be 0.05Nits or lower.
2/ The 2nd standard requires the brightness to be above 540Nits and the black levels below 0.0005Nits.
HDR is all about the Range, not just the maximum or the minimum value alone.

What about RAW?

Raw is the data directly from the sensor. It is not video yet, therefore it is not a Log.
To simplify: the advantage of shooting RAW is that it gives the greatest flexibility in post production since no video processing has been applied yet. The main drawback is that the files are very large.

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