

Understanding HDR and EV

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Glossary

Aperture or F-stop: The ratio of focal length and lens opening diameter. The lens opening can be "stopped-down" by the diaphragm and the amount of light passing through the lens is proportional to the area that is "open". Therefore the exposure is proportional to the square of the aperture value. Going from f/8 to f/5.6 represents an increase in exposure of $(8/5.6)^2 = 2$, which is "one stop".

Bracketing - A series of photos of the same scene, made with differing EV settings, usually closely separated (1/3 or 1/2 EV). This is usually done to select one of the photos that best meets the needs afterwards, or to select the whole or part of the series to be processed as a HDR series. Bracketing inside the camera can be done by changing shutter speed, aperture or ISO for each of the shots in the series. The μ -Trigger, however, only has control over the shutter.

EV - Exposure Value, which is a measure of exposure in photography, meaning that a certain value represents all combinations of shutter speed and aperture leading to the same exposure for a given scene. The EV scale was set up relative to an exposure time of 1 second at an aperture of f/1.0, representing EV=0. This absolute scale is not important for practical use, where relative EV is being used. For instance: an exposure of +4EV can be achieved by increasing the shutter time one stop plus opening the aperture one stop (2 times 2 = 4). For HDR exposures multiple shots are made with intervals of 1, one half or one third EV.

HDR - High Dynamic Range, a digital photography technique to allow a large range of light intensities presented to the camera, that exceeds the dynamic range of its sensor, to be split up in various sub-ranges, which combined in software restore the entire range of light intensities of the scene, including the subtle dark details in shadows and likewise in high-lights. A single exposure could not have captured the entire range with the same fidelity. EV settings up to 4 are commonly used.

ISO - In photography the ISO value represents the sensitivity of the camera. It is a linear scale. The combination of EV (indicating light intensity) and ISO setting (the sensitivity) determines the correct setting of shutter time and aperture.

Shutter time - the length of time that light is allowed to fall on the sensor or film, either by a shutter in the lens or a curtain in the camera body. Is usually expressed in fractions of a second, like 1/15, 1/30, 1/60 etc. There is a linear relationship in shutter time and exposure.

Stop - This is the classical relative exposure interval, equal to a factor of 2. Going from 1/30 second to 1/15 represents one stop increase. Alternatively, going from an aperture of f/8 to f/5.6 likewise represents one stop increase in exposure (see explanation of Aperture).

The HDR/BKT mode in the μ -Trigger

For the μ -Trigger HDR and BKT functionality are the same, since both mean the same thing for the camera: make a series of images with different EV settings by varying the shutter time between shots. It is in post-processing where the HDR magic happens.

How to approach HDR photography using the μ -Trigger

Multiple shots of exactly the same scene (a tripod is essential) are to be combined in a single photo in order to fully capture the range of light intensities. For example: in bright sunlight one wishes to see definition in the white clouds at the same time as details in the dark shadows. Without using the HDR technique one usually settles for exposing the brightest part of the scene at the upper limit of the sensor range. One does this by checking the histogram on the camera. The result is very like what the eye sees when looking at the entire scene as a whole, because the eye adjusts for the bright parts.

If one wants to make a photo that captures the whole light range the HDR technique comes to the rescue. When done in moderation the result can be very pleasing with well-balanced colours. When done excessively the result can look alien with unrealistic colours in the scene.

The HDR series starts with estimating the exposure that should lie in the middle of the range. This is what we call the **Center** exposure and is usually the exposure that we will use if we were to make a single (non-HDR) image.

Next we decide how many **Frames** we want the HDR series to comprise: in practice we decide on 3, 5 or 7 separate exposures. And combined with this we have to decide what **EV** interval to use for these separate exposures. This is a two-dimensional problem to solve, where the quality of the final processed result is traded off against effort and post-processing time. More frames imply more effort and the EV interval must be large for scenes with extreme lighting range and should be less when the contrasts are smaller.

The table of exposures as implemented in the μ -Trigger is as follows:

				Center			
				3 Frames			
				5 Frames			
				7 Frames			
EV(+/-)	exp #1	#2	#3	#4	#5	#6	#7
1/3	-1.00	-0.66	-0.33	0.0	+0.33	+0.66	+1.00
1/2	-1.50	-1.00	-0.50	0.0	+0.50	+1.00	+1.50
1	-3.00	-2.00	-1.00	0.0	+1.00	+2.00	+3.00

The EV intervals are at steps of 1/3, 1/2 and 1 respectively. For each of the frames the μ -Trigger calculates the required shutter time from the EV increments as given in the table. The relation used for that is:

$$t_n = t_c 2^{EV}$$

where t_n is the shutter time for the frame and t_c is the center shutter time.

The μ -Trigger can reliably control the camera's shutter down to times of about 1/4 second. That means that the shutter time as calculated from the EV in the table is limited to 1/4 seconds minimum. As an example this is illustrated below for the condition of a Center time of 1/2 second. The shutter times in red fall below the limit of 1/4 second and will in practice be fixed at 1/4.

HDR/BKT shutter times							
				Center 0.5			
	1	2	3	4	5	6	7
EV+1 1/3	-1.00	-0.66	-0.33	0.00	0.33	0.66	1.00
time=	0.25	0.32	0.40	0.50	0.63	0.79	1.00
EV+ 1/2	-1.50	-1.00	-0.50	0.00	0.50	1.00	1.50
time=	0.18	0.25	0.35	0.50	0.71	1.00	1.41
EV+ 1	-3.00	-2.00	-1.00	0.00	1.00	2.00	3.00
time=	0.06	0.13	0.25	0.50	1.00	2.00	4.00

One a series of HDR shots have been taken the photos must be processed into a single high dynamic range image. That can be done by using one of the numerous software packages, such as Photoshop, easyHDR and Photomatix. For a review see: <http://captainkimo.com/hdr-software-review-comparison/>