# HDR Function of GO-5000/SP-5000 Camera Models:

***Abstract***
In general, if you are attempting to image a scene that includes areas that are very bright as well as areas that are very dark, it is difficult to reproduce the full range of lighting in a single image. Depending on the shutter or iris setting you select, either the bright areas will oversaturate and become clipped, or the dark areas will all merge into blackness.

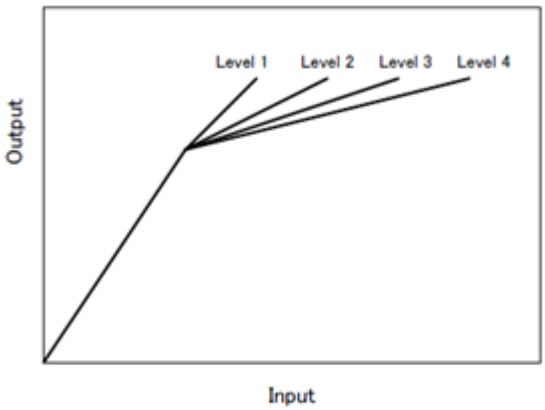
To solve this issue, HDR (High Dynamic Range) techniques can be used to extend the range of light intensities within a scene that can be captured without saturating or falling into blackness. JAI's GO-5000/SP-5000 cameras include a built-in HDR function in the monochrome models.

This document describes the mechanism of the HDR function in the GO-5000/SP-5000 monochrome models.

## 1. HDR function settings

To enable HDR mode, set: [Exposure Mode] = "Timed" and [HDR Mode] = "On"

The only parameter of HDR mode is HDR_SLOPE which has four variations: HDR_SLOPE Level 1, Level 2, Level 3, and Level 4. Based on this HDR_SLOPE setting, the camera changes the internal exposure behavior to achieve an HDR image.




| HDR Slope | Dynamic Range [%] |
|---|---|
| 1 | (200) |
| 2 | (400) |
| 3 | (800) |
| 4 | (1600) |

*Figure 1 - High Dynamic Range Feature*

## 2. Camera mechanism to achieve HDR

While some HDR functions require combining two exposures, the GO-5000/SP-5000 cameras achieve HDR in a single exposure. To do this, the exposure is divided into two steps: “step a” and “step b.” The ratio between steps a and b is defined by HDR_SLOPE. Using this ratio, the exposure time of step a and that of step b are calculated.

Step a: A threshold of brightness is defined. Once the brightness of a pixel reaches this threshold, exposure stops for that pixel.

Refer to Figure 2 as an example. The X axis shows exposure time and the Y axis shows brightness. Three pixels A, B, and C are described. Basically, once the exposure starts, the brightness of each pixel increases per exposure time. The slope (the speed at which the pixel’s brightness increases) is based on how bright the corresponding pixel is in the scene.

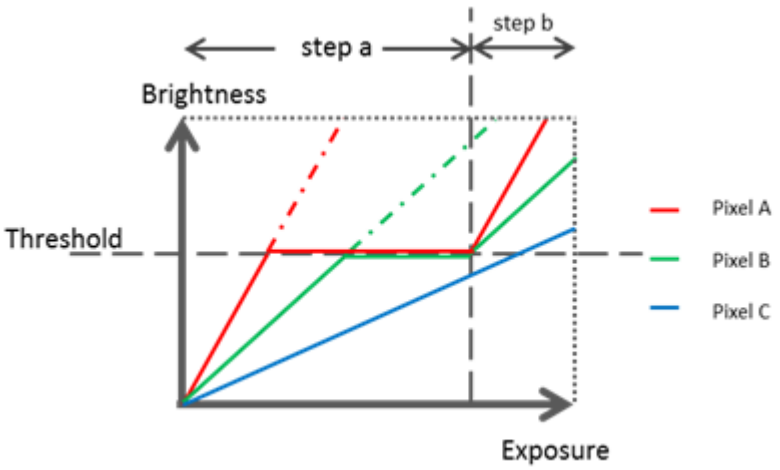



*Figure 2 - HDR Mode Behavior*

After a while, the brightness of pixel A reaches the threshold and the exposure for that pixel stops. This behavior is shown as solid red line. If pixel A were to continue exposure at this rate, it would have reached the saturation point before the end of the exposure period as shown by the dashed red line. By temporarily stopping exposure, saturation is avoided.

After a little more time has passed, pixel B reaches the same threshold and its exposure is also temporarily halted like pixel A.

Step b: At the end of the “step a” period, we enter “step b” and the exposure for pixels A and B restarts. This continues to the end of the exposure period. However, by pausing the exposure at the “step a” threshold, the total exposure for pixels A and B has been reduced to avoid reaching saturation.

On the other hand, a pixel such as pixel C does not reach the threshold during “step a.” It simply continues

exposure through both “step a” and “step b” without ever reaching saturation.

In this way, both bright areas of the image, such as pixels A and B, and darker areas of the image, such as pixel C, can, in a single image, both achieve exposures between saturation and blackness.

### 3. Selecting your settings

The total exposure time can be set using the camera’s “Exposure Time” setting. You should choose a setting that provides an acceptable exposure for the darker areas of the scene because the HDR function will be used to address the brighter areas of the scene.

Once you have set an exposure time, you can set the HDR_SLOPE parameter. As noted earlier, HDR_SLOPE determines the ratio of step a to step b. The table below shows the ratio for each level.

| HDR_SLOPE | Step a | Step b |
|---|---|---|
| Level 1 | 50% | 50% |
| Level 2 | 75% | 25% |
| Level 3 | 87.5% | 12.5% |
| Level 4 | 93.75% | 6.25% |

*Table 1 - HDR slope settings and step ratios*

Because the HDR function involves “compressing” the brighter pixels of an image into a smaller range of values, applying lower amounts of HDR to an image will result in better image quality. Therefore, it is recommended that you start with Level 1 when testing HDR on a specific scene. If there is still too much “white clipping” in the image, you can test Level 2, 3, and 4 as needed.

**End.**

# Technical Note

HDR Function of the GO-5000/SP-5000 Camera Models

**Revision History**

| Revision | Date | Changes |
|---|---|---|
| 1 | 2019/10/29 | New release |
| 2 | 2023/03/02 | Updated to note that HDR is for monochrome models only |
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