OZO

OZO EXPOSURE GUIDE

Updated 12-06-2016

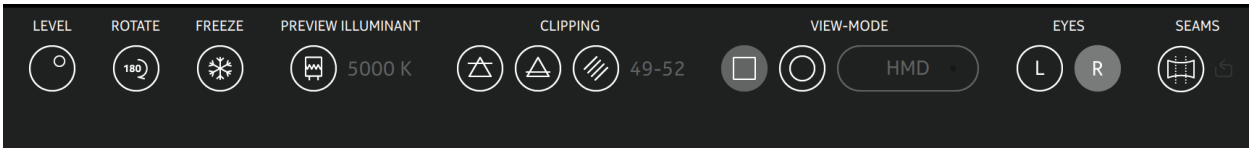
Overview

This documentation provides general guidelines for effective lighting and exposure control of the OZO camera. It will be useful to understand the following terms: **ISO, IRE, f-stop, dynamic range, shutter speed, white balance, color temperature**, **clipping, temporal** and **fixed pattern noise** prior to reading this document.

Basic Camera Information

- Sensitivity: 400 ISO
- Aperture; f 2.4
- Dynamic Range: 10 stops
- Data precision: 10bit RAW (RGB monitoring path)
- Color Correction: White Balance at reference color temperature illuminants

Using Exposure Tools In Remote

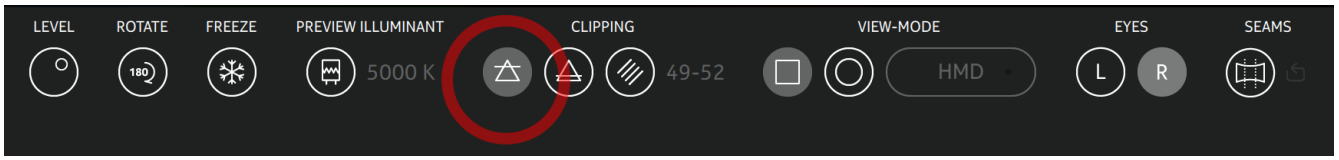


The Exposure Tools panel in Remote

OZO Remote provides a variety of exposure indicators, which include programmable zebras, pixel clip and crush false color overlay, and high-resolution freeze frame. It is very important to note the camera RAW sensor data (accessible via Cinema DNG files) contains slightly more detail than these RGB monitoring tools might suggest.

It is a good idea when working with complex lighting to make frequent reference to the OZO exposure tools.

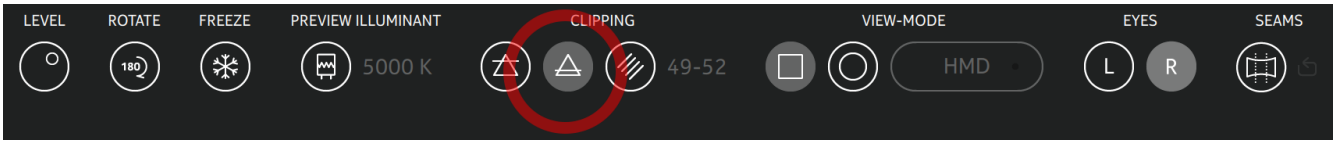
The red pixel clip false color overlay gives an indication of overexposed zones in your frame. Treat the border of these red zones as a rough guideline and know that footage exported from OZO Creator in Cinema DNG format will have slightly more latitude in the highlights than indicated here.



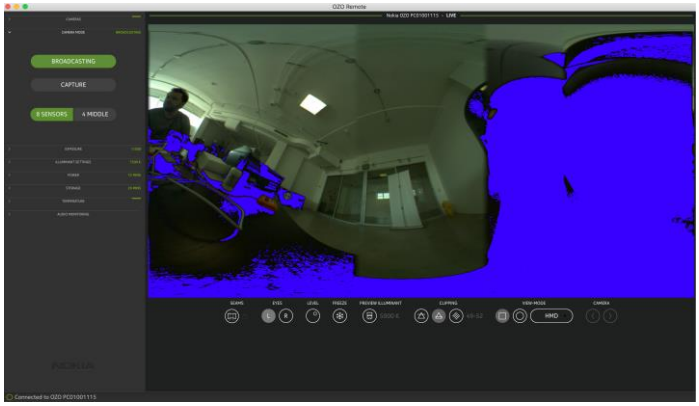
Clipping Button

Example of red false color overlay indicating 100 IRE regions

The blue pixel crush false color overlay gives an indication of underexposed zones in your frame. Treat the border of these blue zones as a rough guideline and know that footage exported from OZO Creator in Cinema DNG format will have slightly more latitude in the lowlights than indicated here.



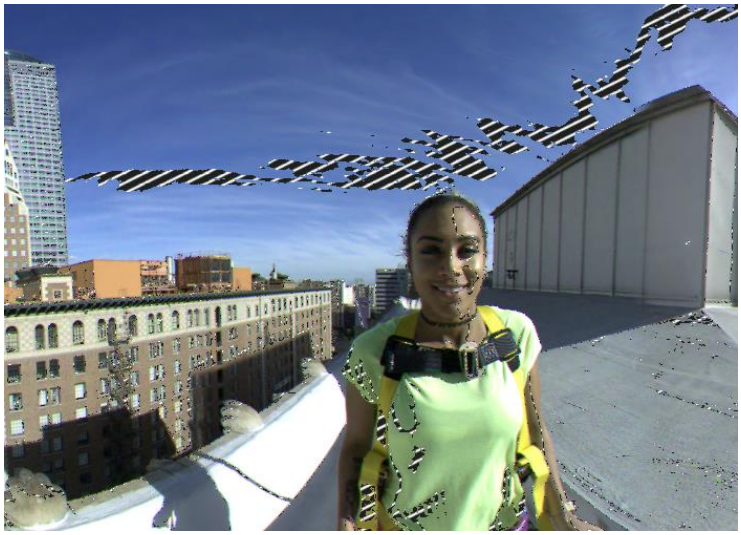
Crushing button



An example of “crushing” overlay. Blue=no detail from lack of light.

Programmable “zebra” overlays allow the user to identify a desired exposure range in the image by an animated striped pattern. This feature can have a variety of uses but is typically used to highlight skin tone exposure with programed values between 40-50 IRE. To use the feature adjust camera exposure until the subject’s skin tones have the zebra overlay.

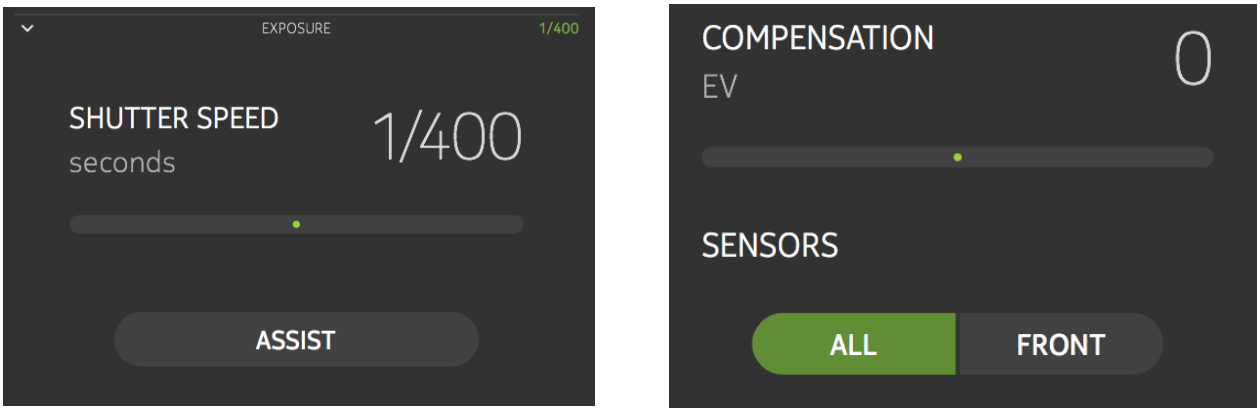
Zebra toggle button



Zebras on skin tones, sky, and buildings

When setting exposure, pay special attention to the direction of the available light. Shooting subjects with a 360 degree FOV, especially in day exterior circumstances, can be quite challenging compared to cinema or ENG applications. Identifying camera placements out of direct sunlight will help significantly in controlling exposure, ensuring better dynamic range, color balance and motion characteristics in your captured footage.

Exposure Assist



Exposure Assist tools

Exposure assistance tools were introduced in OZO Remote V1.3.0. The tools are quite simple and most functionality will be intuitive or is covered in the **Remote Help** document. Because of this coverage, this section will primarily describe how best to use the Assist tools to operate the camera without image preview. Operating without image is not recommended but may be necessary when weather or environment prevents the use of a computer or cables. It may also be favorable in a situation where time is more important than quality. Sometimes the camera must be setup in seconds and in these situations the Assist tools are quite helpful. The fastest path to recording adequately exposed footage is as follows:

1. Turn the camera on, allow it to boot up until the far right (**capture**) button is flashing red every 3 seconds.
2. Press the **capture** button down for at least 4 seconds until the capture LED blinks regularly.
3. After pressing, the LED will keep blinking while exposure is calculated before returning to its previous state.
4. Press the **capture** button to begin recording.

Added functionality for the **ASSIST** tools includes **ALL/FRONT** and **COMPENSATION**. **ALL/FRONT** allows the user to select whether the **ASSIST** will use all sensors to calculate exposure or only the front two. In a situation where a certain action MUST be captured properly, it might be advantageous to point **OZO** at the subject and use **ASSIST** with **FRONT** selected.

Compensation allows the image to be set 1-2 stops over or under exposed. In a dark room with highlights coming through the windows, it might be advantageous to set the **COMPENSATION** for 2 stops over (to the right) in order to allow the dark areas of the image to be brighter. Similarly, if you were in a very sunny environment but needed to preserve detail on something in a highlight, two stops under exposed might be a good choice.

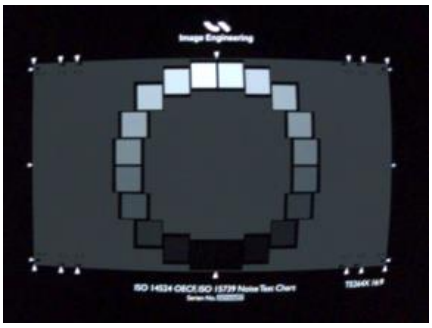
Exposure Time and Motion Blur

Users familiar with cinema cameras will be used to shooting with a 180-degree shutter, which at OZO's frame capture rate of 30 fps, corresponds to an exposure time of 1/60th Sec. This provides a film-like motion blur. However, in uncontrolled lighting environments, shooting at 1/60th Sec may not be possible and you may have to reduce exposure time (increase shutter speed) to avoid over-exposure. It is very important to note that on OZO higher shutter speeds will not tend to produce "choppy" imagery in the way conventional cameras might.

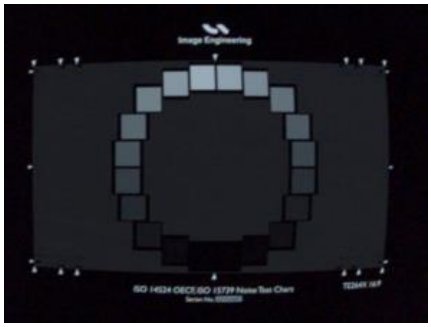
Maximizing Dynamic Range

The primary goal of adjusting exposure on any camera is to achieve an appropriate balance between preserving highlight detail and minimizing noise in lowlights. An overexposed image will provide very clean shadow areas but harshly clipped highlights. An underexposed image will have very good highlight detail at the expense of noisy shadows. These general principles are modified by the effect of post-production tools, especially noise reduction, which can clean up blacks, however clipped highlights are more difficult to eliminate post-capture.

If noise reduction in post-production is not available to you, we recommended slightly overexposing the scene to minimize shadow area noise at the cost of clipping in highlight areas. This approach best approximates the response of human eyesight sensitivities in real world environments, and has the added advantage of avoiding shadow area noise adversely affecting compression in the final MP4 encoded VR videos sent to the end user.



1/180 Shutter. "Correctly" Exposed



1/500 Shutter. "Under" Exposed

In the above images, "expose for skin tone" is illustrated in the left image, and "protect the highlights" is illustrated in the right image. The former technique is commonly used in broadcast applications, and is very suitable for the range of lighting environments commonly experienced shooting VR, the other technique is commonly used in cinema applications, and is better suited to applications where lighting can be closely controlled. Observation of the second image shows increasing noise in the mid and lower value grey chips, which can become quite noticeable in a video clip unless noise reduction is applied in post-production.

Illuminant setting (White Balance)

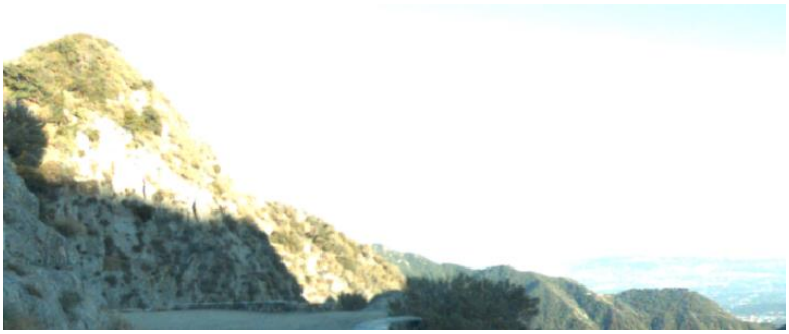
To provide the most natural looking results, the color matrix used by OZO software to convert between camera RAW data and RGB monitoring and output paths, uses a gain value computed from the average of exposures in the R and G and B channels, and with slightly different gains at each Illuminant Color Temperature setting.

What this means is that up to 1/2 stop of additional dynamic range can often be squeezed out of captured RAW footage when in post-production, and maybe visualized in the monitor path when shooting, by either not selecting an illuminant or choosing an illuminant opposite of your lighting condition, eg. balancing at 2800k rather than 6500k while outside on a sunny day might reveal more sky detail and so assist in setting exposure.

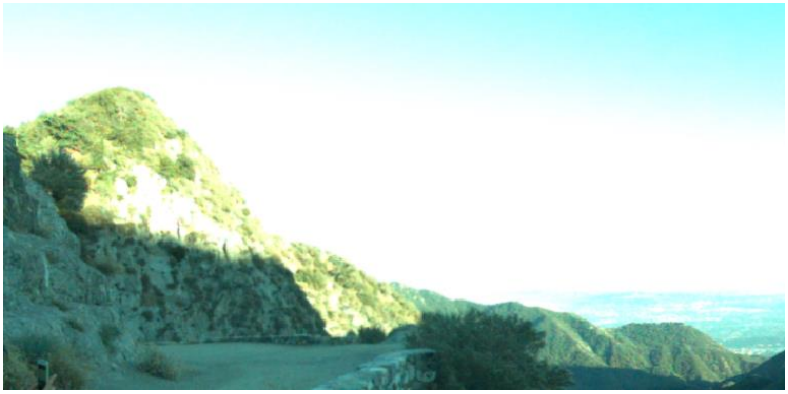
Note that the Illuminant value used during image capture is only saved as metadata, not burned into the RGB images. Thus, it can be changed to any value desired prior to exporting DPX or Open EXR files from the OZO Creator software, and can be added at any time in downstream post-tools when exporting Cinema DNG files.

Image #1. 5600k. Properly white-balanced panorama.

Image #2. 4200K. The white balance is removed from Image #1 by selecting an “incorrect” illuminant.



5600k. Blow up. There is apparent loss of highlight detail in the hill, poor definition between hill and sky, and loss of detail in the far background.



4200K. Blow up There is additional highlight detail visible in the hill, better definition between hill and sky, and more detail in the far background.

Recap

- Use a shutter speed as close to 1/60th second as possible (even in a daylight exterior setting and have to use a much lower value.).
- Slightly overexpose to minimize shadow noise rather than underexpose to protect the highlight details. There is a bit more highlight detail available in Cinema DNG exported files than shown on a monitor and indicated by the clipping tools.
- As monitoring is post-White Balance, you can experiment with different illuminant settings to get a more accurate idea of how much detail you are really shooting in the camera RAW domain and so may be recoverable in post.

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