APPLICATION NOTE #8

GLOBAL AND ROLLING SHUTTERS

For image capture in a traffic enforcement application, a flash is often necessary to produce well lit images. Due to technical differences in their structure, sensors interact differently with flashes, and necessitate different flash features to produce correctly exposed images.

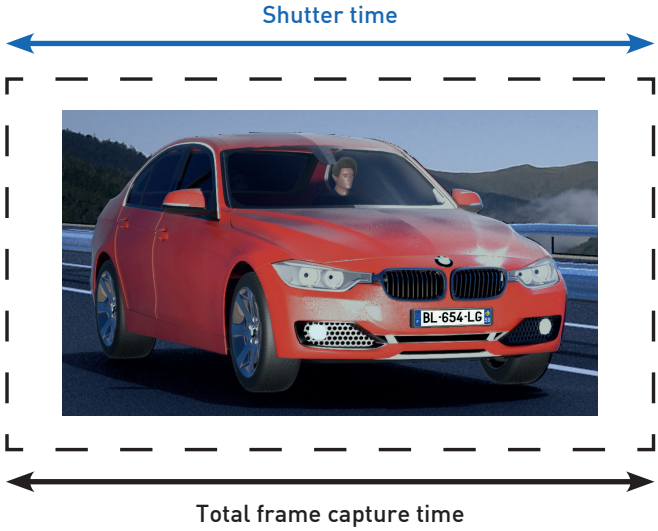
Sensors come in two types known as "Global Shutter" and "Rolling shutter".

In this document, we will detail how these sensor types will interact with a flash.

What are "Global Shutter" and "Rolling Shutter"

The terms **"Global Shutter"** and "**Rolling Shutter**" refer to a way to collect information from a sensor and transfer it to a memory.

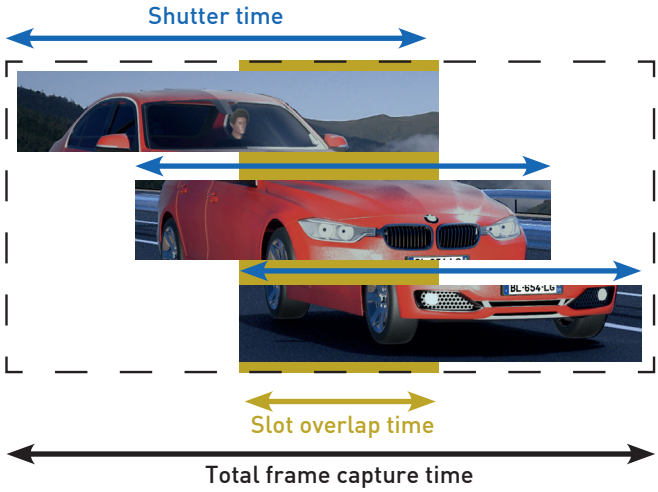
- in "**Global Shutter**" sensors, the information of a whole frame is captured all at once: all the pixels are exposed simultaneously, then all the data is transferred to the memory. Global Shutter sensors are usually of the CCD type. Their sensitivity in low-light conditions is average, and they are commonly found in industrial cameras.



AN IMAGE IS **GRABBED ALL AT ONCE:**

- **Total frame capture time = Shutter time**

- in **"Rolling Shutter"** sensors, the information coming from the pixels is read sequentially, line by line or "slot by slot". This means that not all pixels of a frame are exposed at the exact same instant: when the first pixels are grabbed, the last ones may be -or may not be- exposed yet. Rolling Shutter sensors are found in CMOS technology. They usually have a high sensitivity and tend to produce high-quality images. They are usually found in photographic still cameras.

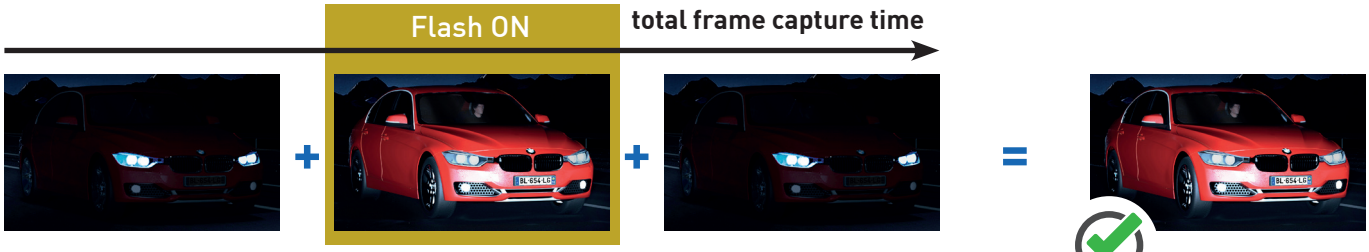


AN IMAGE IS **GRABBED SEQUENTIALLY** (3 slots in this example).

- **Total frame capture time > Shutter time**
- **all the slots are exposed together during a variable (and possibly =0) Slot overlap time**
- **a long Shutter time implies a long Slot overlap time**

How do the two sensor types interact with a flash to capture images?

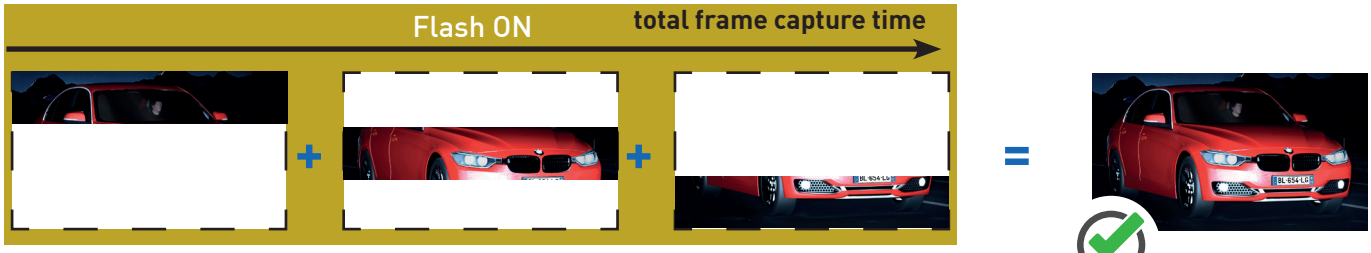
GLOBAL SHUTTER



The short-duration flash freezes the motion, takes less energy to expose the image, and is less dazzling for drivers. The flash unit can be smaller, and have a longer life. Fast sequences are possible (multiple shots per second).

FAIL-SAFE SOLUTION

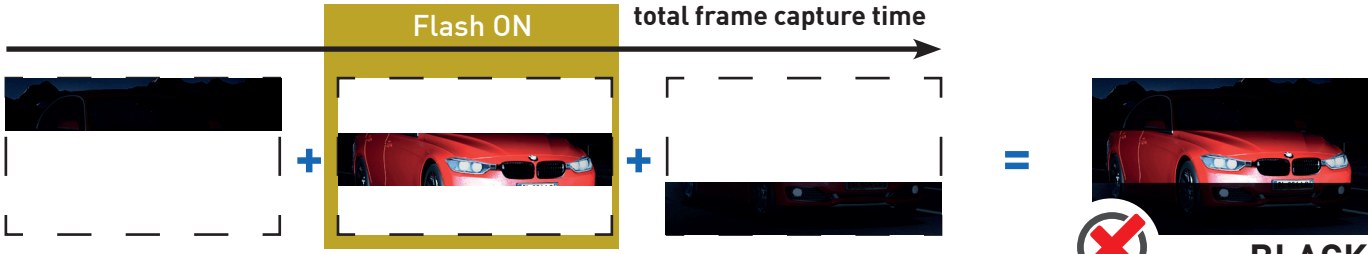
ROLLING SHUTER SHORT SHUTTER TIME LONG FLASH



A long flash can expose all the "slots" even with a short shutter time, but at the cost of a massive light emission resulting in: more dazzle for drivers, larger and more fragile flash units, reduced repetition capability for the flash unit.

POORLY EFFICIENT

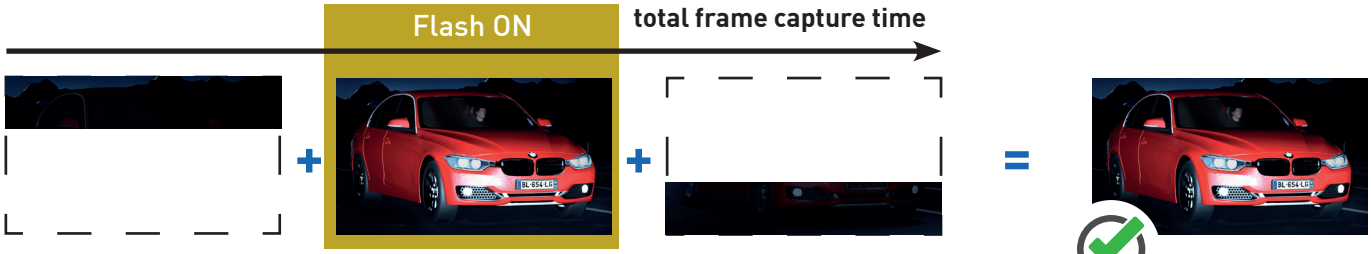
ROLLING SHUTER SHORT SHUTTER TIME SHORT FLASH



Due to the short shutter time, not all "slots" capture light simultaneously (slot overlap time = 0): some of them are not illuminated by a short flash, creating dark strips on the final image frame.

BLACK STRIPS

ROLLING SHUTER LONG SHUTTER TIME SHORT FLASH



With a long shutter time, a short flash (if correctly synchronized) is able to expose all the "slots" of an image and freeze the motion. A long exposure means that ambient light will impact image brightness, create motion blur, and deform the image (rolling shutter effect). The camera's frame rate is reduced due to long shutter time.

POSSIBLE COMPROMISE