Xenon and LED Flash Support with the 3MP Image Sensor

The following information is provided by Cypress Applications Engineering to suggest how the CYIWOSC3000AA 3MP image sensor may support Xenon Flash Tube and LED Flash implementations.

Note: These are suggestions only and have not been fully tested by Cypress.

General: By writing to I^2C, the image signal processor could cause the general-purpose IO pin to toggle, effectively controlling a flash. All timing information would have to come from the ISP. It would be easier for the ISP to control the flash directly using the VSYNC signal of the imager.

Following are three possible implementations for Flash implementation and support with the CYIWOSC3000AA 3MP CMOS imager.

Implementation with Xenon Flash Tube

With Xenon flash, there is a 100-µs flash duration (i.e., instantaneous). Using such a flash, the timing is easier to implement, however the issue here is that Xenon flash tubes in cell phone applications have high power requirements.

When using a Xenon flash, the Integration time (tint) should be set to full frame (value = 0 equivalent to 1548 rows of tint).

The VSYNC signal can be programmed to go high or low when entering the “VBLANK” stage. (by default, this is 16 “virtual” rows added to the end of the image frame where the imager can do signal processing).

Since a Xenon flash provides enough light in ~100 µs, (less than a row time), the requirement is for Xenon flash to discharge during the VSYNC.

Since tint = 0, all rows will be integrating, and so the flash is detected.

The first row to read out will have primarily seen ambient light, and then a final “strobe”. The last row in the frame will have initially seen the strobe, and then will get a full frame of ambient light (i.e., first and final row see the strobed scene at opposite sides of their integration period).

The issue here is the frames per second. The user must decide what an acceptably fast fps is to avoid hand jitter. Because full tint (tint = 0) is required, exposure time is limited to fps, usually too slow to avoid jitter. Example: a 24-MHz clock has about 7 fps, or a tint of 1/7 sec. With a 48-MHz clock, 15 fps may be just fast enough for some designers.

Using a mechanical shutter with this mode allows the effective exposure time to be decreased.

During the VBLANK period, you open the shutter, fire the strobe and close the shutter. All rows will have seen the strobed scene, and a long, black period (basically the strobe + full tint of black).

The mechanical shutter and the flash discharge can be synced off of the VSYNC signal, with a delay in the flash discharge relative to shutter open.

Implementation with LED Flash

With the use of an LED flash (significant “on” time required) the user must decide how much “on” time is required to bounce enough photons off the target to make a significant difference to the image quality.

Here, you again have the ISP turn on the LED flash based on VSYNC toggling (to show entering the VBLANK period). The difference here is that you increase the VBLANK period (adding “virtual rows” to allow more time for the LED to emit light).

You have to add a number of VBLANK rows equal to required LED on time. Since tint still = 0, during this whole VBLANK period, all the active rows are integrating light, and hence picking up the LED lighting.

The issue here is that you have lowered your fps by an amount equal to the virtual rows you have added. So even in a fast system with a 48-MHz clock (15 fps), you need approximately 1/10 sec LED on time. You now have a max fps of 1/15 sec (for fps max), plus 1/10 sec for VBLANK = 5/30 sec = 1/6 sec or 6f ps. There is going to be a lot of blur (blue means lots of time to capture ambient lighting).

Again, a mechanical shutter can be used with this mode (synced off VSYNC transition) that can be open only during the LED on period, then closed for the time to read through 1 frame (the 1/15 sec in the above example which provides an effective tint of 1/10 sec (the LED on time).

Implementation with LED Flash—Another LED Option

Turn the LED on during a certain VBLANK period (call it VBLANK 0). In this case, VBLANK can again be the preprogrammed default, and tint can be programmed to any length (light and LED strength allowing).

Read out one full frame of junk data (first row sees less of LED on than final row since LED is on during whole frame readout)

Enter next VBLANK (VBLANK1), keep the LED on and read out a second frame. During this frame, all rows will see the LED on for their complete integration time (and all rows see the same integration time).

Enter into the final VBLANK (VBLANK2) and finally shut off 0 the LED.

The benefit is that you can set a fast tint to avoid blur. The downside is that you need to capture 2 frames of data for 1 valid frame, and you have to leave the LED on for twice as long as should be required.

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