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Spec No: 001-14649

Spec Title: LUPA-300 FREQUENTLY ASKED QUESTIONS - AN6019

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Replaced by: None

LUPA-300 Frequently Asked Questions - AN6019

This document describes and answers to most frequently asked questions from customers.

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1. FPN and PRNU Correction

Like all CMOS image sensors the LUPA-300 suffers from something we call FPN (fixed pattern noise). Because of the processing and the pixel design all pixels have small offset differences when compared to each other. This fixed noise can be easily correct. It can be corrected by subtracting a dark frame (which also contains these fixed offset differences) on a pixel by pixel basis. The noise can be corrected as follows (calibration):

$$Vn = Gn - Bn$$

Vn = Data of a pixel after a calibration

Gn = Data of a pixel before carrying out a calibration

Bn = Black calibration data of the pixel

Next to FPN there is also a different kind of fixed noise which can be corrected. This noise is called PRNU (pixel response non uniformity) and it is caused by the difference in gain from pixel to pixel. It basically means that pixels will respond in a different way to the same amount of light. This can also be easily corrected. FPN and PRNU correction:

$$Vn = (256 / [Wn – Bn + 1]) \times (Gn – Bn)$$

Vn = Data of a pixel after a calibration

Gn = Data of a pixel before carrying out a calibration

Bn = Black calibration data of the pixel

Wn = White (Gray) calibration data of the pixel

This correction should be performed on a pixel by pixel. To have the white and black calibration data you should take a black image first (cover the sensor, but make sure no value is absolute zero) and second take a grey image (between 70% and 100% of illumination).

2. Exposure Time Calculation

The total exposure time of the LUPA-300 is being set by the res1_length SPI register (register address 4). The maximum value of this register is 479, the minimum is 2. This register specifies the amount of readout lines the internal reset pulse needs to remain high. Knowing this, the total exposure time of the imager can be calculated from this register value.

Exposure time = (Nr. Lines-res1_length) * (ROT + Nr. Pixels * clock period)

As you can see in the formula above the exposure time depends also on the clock speed and window size that is read out. When we assume the nominal clock speed is used (80 MHz), a full window is read out (640 x 480) and a res1_length register value of 100 is uploaded we get the following result:

Exposure time= (480 – 100) * (400 ns + 12.5 ns * 640) = 3.2 ms

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3. Setting the Multiple Slope Pulses

Within the total exposure time, two additional reset pulses can be given to achieve a higher optical dynamic range (multiple slope). When this multiple (triple) slope is acquired the appropriate bits in the sequencer register (register address 0) should be set. The time when these occur is also uploadable using SPI registers. They are located in register addresses 5 (res2_timer) and 6 (res3_timer). The time when these pulses occur is also calculated with the same formula:

Additional reset high=(Res2_timer) * (ROT + Nr. Pixels * clock period)

This means that the number you fill out in the res2_timer register should always be bigger than the res1_length register. The res3_timer register on its turn should always be bigger than the res2_timer register.

4. X and Y Reverse Readout

When the X or Y readout direction needs to be changed, the appropriate bit in the sequencer register (register address 0) should be set. Additionally, the start_X (register address 1) and start_Y (register address 2) address should be changed as well. When reverse X readout is used, the start_X address should be set to 79. When reverse Y is used, the start_Y address should be set to 479 (assuming we want to read out a full window).

Note: When reverse X readout is enabled, the readout of the imager will start from right to left but the readout of the kernels (4 pixels wide) will still be from left to right. This means that remapping (mirror every 4 pixels) of the data will be necessary in the system.

5. Dark Offset Level

The default value for the Voffset register (register address 10) is 85. This value is too high, as the full range of the internal ADC is not used with this setting. A value of 72 is preferred for this register. We advise a Voffset register upload with this value after power-up for the best performance.

6. Socket for LUPA-300

For the moment Cypress has no knowledge of a socket being available for the LCC48 package of the LUPA-300. Most customers solder the component directly on their development board.

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