Photodiode Response Measurement Technique using Low Laser Intensity

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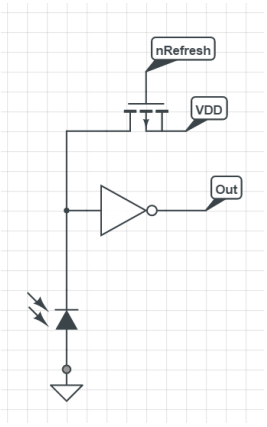
1. Abstract

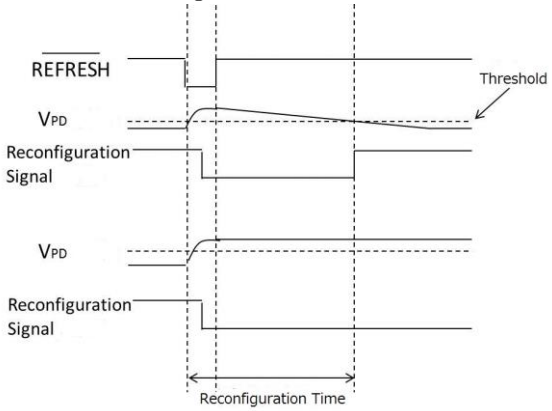
This paper presents a proposal of a photodiode sensitivity measurement methodology using a low light intensity. We have demonstrated that the measurement methodology can clearly remove the propagation delay factor and can only extract photodiode sensitivity.

2. Introduction

Overall ORGA setup consists of a laser array, a holographic memory, and a fine-grained programmable gate array on a VLSI chip with photodiodes. The chip is composed of I/O Blocks (IOBs), Configuration Logic Blocks (CLBs) and Switching Matrices (SMs). Each of these blocks has multiple photodiodes that can be turned on by laser.

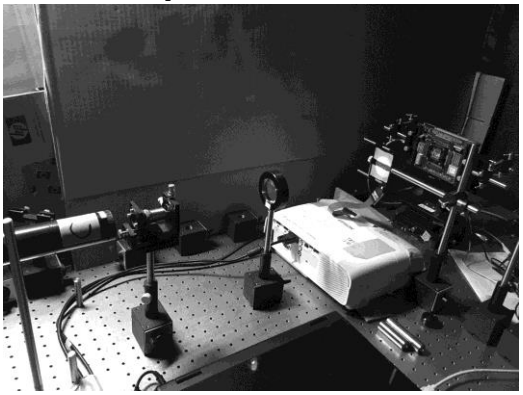


The basic photodiode circuitry is shown above. The Refresh signal is connected to the gate of the transistor. The source of the transistor is connected to VDD and the drain is connected to the photodiode whose other end is grounded.



The reconfiguration timing diagram is shown above. When light is incident on the photodiode the junction capacitance of the transistor is discharged at a rate proportional to the incident light intensity. When it falls below the threshold the reconfiguration signal (output of inverter) inverts its state and goes high. The time form refresh going low to reconfiguration signal going high is the reconfiguration time and this must be minimized for faster operation.

3. Experimental setup and results



The experimental setup included a He-Ne laser with an average output power of 30 mW at 632.8 nm. A collimator and a lens of f = 200 mm was used. A L3B00Z-G84G liquid crystal spatial light modulator of Epson make was utilized for focusing the laser beam onto the ORGA VLSI. The reconfiguration time was measured by implementing a measurement circuitry on the VLSI chip and the result is shown below:

LUT Diode	PD=1 [μ s]	PD=0.5 [μ s]	PD=0.1 [μ s]
0	8	22	70
1	11	24	86
2	9	18	86
3	11	22	109
4	12	23	84
5	9	26	97
6	15	28	122
7	13	29	106

A new photodiode characteristic measurement methodology was highlighted that used varying light intensity to remove propagation delay from reconfiguration time measurement.

References

[1] S.Kubota and M. Watanabe, " A multi-context programmable optically reconfigurable gate array without a beam splitter, "IEEE International Midwest Symposium on Circuits and Systems, pp. 971 - 974, August 2009.