

Circuit Simulation Project

<https://esim.fossee.in/circuit-simulation-project>

Name of the participant : Sakshi Pandey

Title of the circuit : Design of a Compact On-Chip Static IR Drop Detector System

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Problem statement:

As SoCs scale, static IR-drop in the power delivery network causes performance loss and reliability issues. Existing on-chip detectors are often area- and power-hungry, making them unsuitable for large-scale integration. There is a need for an area-efficient on-chip static IR-drop detector and evaluator that can provide accurate, distributed monitoring with minimal design overhead.

Description :

With continuous technology scaling, the reduction in supply voltage makes integrated circuits increasingly vulnerable to even small voltage drops across the power delivery network. Such **static IR drops** can degrade performance and compromise reliability. Accurate on-chip measurement of supply voltage noise is therefore essential for evaluating IR drop and enabling adaptive power management strategies. In this work, we present an **area-efficient static IR-drop detection and evaluation scheme** based on a ring oscillator. The proposed approach achieves reliable detection with minimal design overhead, while providing the capability to feed real-time information to power management units for voltage scaling and compensation.

Circuit Diagram(s) :

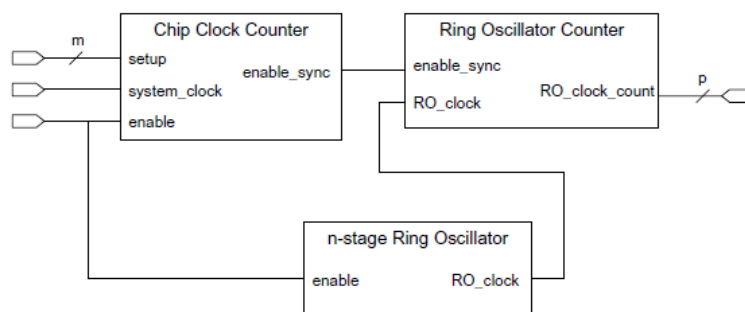


Fig 1: Ring Oscillator based static IR drop detector

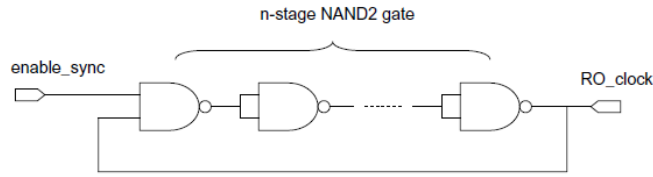


Fig 2: N-stage NAND2 Ring Oscillator with enable signal

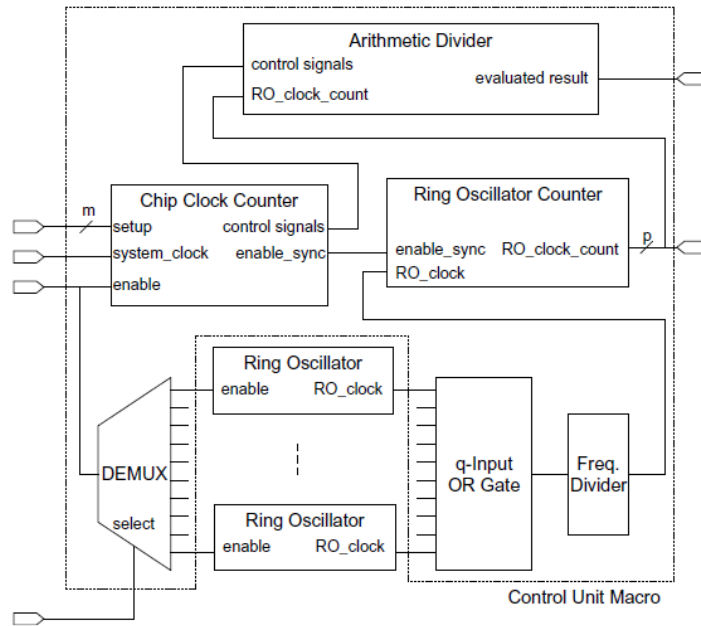


Fig 3: IR detector shared by multiple ring oscillator

Results:

Comparison of Simulation Result

V _{dd} Drop	RO with 11 NAND2 Gates		RO with 59 NAND2 Gates	
	ROC Value Reduced Ratio	Standard Deviation	ROC Value Reduced Ratio	Standard Deviation
0.5%	0.72%	0.08%	0.69%	0.11%
1%	1.39%	0.09%	1.39%	0.12%
1.5%	2.08%	0.08%	2.08%	0.12%
2%	2.77%	0.11%	2.79%	0.11%
2.5%	3.47%	0.11%	3.48%	0.13%
3%	4.18%	0.13%	4.18%	0.15%
3.5%	4.89%	0.14%	4.89%	0.17%
4%	5.59%	0.16%	5.60%	0.17%
4.5%	6.31%	0.18%	6.32%	0.21%
5%	7.02%	0.19%	7.03%	0.22%
5.5%	7.76%	0.22%	7.77%	0.22%
6%	8.49%	0.23%	8.49%	0.22%
6.5%	9.21%	0.25%	9.23%	0.25%
7%	9.96%	0.26%	9.97%	0.27%
7.5%	10.68%	0.28%	10.71%	0.27%
8%	11.44%	0.29%	11.46%	0.31%

Reference(s) :

- An area efficient on-chip static IR drop detector/evaluator (<https://ieeexplore.ieee.org/abstract/document/5118186>)
 - History Of IR detectors (<https://link.springer.com/article/10.2478/s11772-012-0037-7>)