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PROPOSAL FOR EXPERIMENT AT RCNP

July 12, 2010

TITLE:**SER Measurement for Soft-error Hardened Circuits on a 65nm LSI****SPOKESPERSON:**

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RUNNING TIME: Installation time without beam .5 days(for each beam time)
 Test running time for experiment .5 days
 Data runs 3 days

BEAM LINE:

RING Cyclotron : WN course

BEAM REQUIREMENTS: Type of particle proton
 Beam energy 392 MeV
 Beam intensity $\leq 1\mu A$

BUDGET: Experimental expenses 0 yen

TITLE:**SER Measurement on a 65nm LSI****SPOKESPERSON:** Kazutoshi Kobayashi**SUMMARY OF THE PROPOSAL**

Soft errors on LSIs are categorized to SEU (Single Event Upset) and SET (Single Event Transient). Workstations for high reliability contains SRAMs with ECC but also FFs with some error resiliency for SEU.

Figure 1 is the proposed dual-modular FF called Cross-coupled Dual Modular Redundancy Flip-Flop (BCDMR-FF)[1]. It is based on the well-known BISER structure[2]. In the BCDMR FF, C-elements are duplicated to prevent multiple latches to be flipped by an SET pulse from the C-element. BCDMR achieves same area and better power and delay at 0.5V compared with the BISER. It is mainly because its cross-coupled structure reduces the size of the C-element that must have enough strength to flip the weak keeper.

In December, 2009, we were going to confirm the vulnerability of the BCDMR-FF by the neutron irradiation at RCNP. But it was not successful since no clock signal was applied to the DUT. But α particle irradiation was successfully done. The BCDMR-FF is 160x stronger than the conventional BISER FF at 160MHz clock frequency. We will have another neutron irradiation in July, 2010.

In this proposal, we explain the neutron irradiation measurement for a brand-new chip. It is an enhanced version of the first one already explained. We will implement these four circuit structures on a chip.

1. Shift Registers of custom layouts of the BCDMR and BISER FFs as in Fig. 2
2. Ring Oscillators to Measure Performance, Power and Variations
3. Minute and Long-ranged SET Pulse Capture Circuits
4. MCU Measurement and Well-Bias Capture Circuits

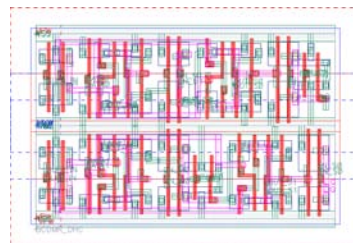
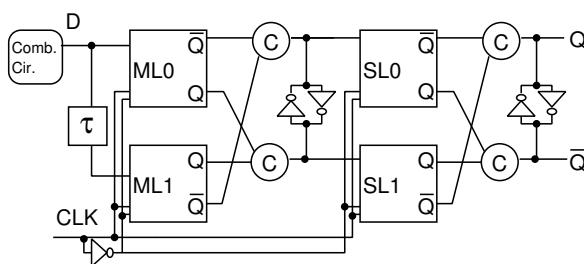


Figure 1: Bistable Cross-coupled DMR (BCDMR) FF.

Figure 2: Custom layout cell of the BCDMR FF