UNIVERSITI PUTRA MALAYSIA

MARCH-BASED DIAGNOSIS ALGORITHM FOR STATIC RANDOM-ACCESS MEMORY STUCK-AT FAULTS AND TRANSITION FAULTS

MASNITA BINTI MAT ISA

MARCH-BASED DIAGNOSIS ALGORITHM FOR STATIC RANDOM-ACCESS MEMORY STUCK-AT FAULTS AND TRANSITION FAULTS

By

MASNITA BINTI MAT ISA

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

January 2012

This thesis is dedicated to

My parent,

Mat Isa bin Wahab & Piah binti Saman

My brothers and sisters,

And

My nephews and nieces.

Haziq, Athirah, Wafiy, Humairah, Widad, Insyirah,

Tariq, Sara, Balqish, Batrisya, Huda and Khaulah.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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The fast growing of technologies has enabled the Static Random Access Memories (SRAMs) to contain higher density of cell array which make it prone to be affected by defects. This factor contributes to challenges faced in the area of memory testing. Functional test is a standard testing procedure to determine the functionality of the memory by performing a sequence of read write operations to detect faults. March tests are widely used during functional testing due to its higher fault coverage and less time complexity. March tests are developed based on functional fault model (FFM) such as stuck-at faults (SAFs), transition faults (TFs) and coupling faults (CFs). Recent March tests have incorporate a diagnostic capability that enables faults not only to be detected but also distinguished. The diagnosis capability of March tests are verified based on generated fault syndromes dictionary that correspond to the detection of targeted faults during read operations. However, existing March tests with diagnostic capability were not able to distinguish between SAFs and TFs.

Therefore, this thesis proposed a new two phase algorithm based on March tests to specifically distinguish the two faults.

The fault syndrome based on read operations of the proposed algorithm is generated to determine its diagnostic capability. The SAFs and TFs are able to be distinguished from each other when different syndromes are generated for each fault. The fault syndromes are then validated by simulating the sequence of propose algorithms on defect free test circuit and test circuit that contains defects mapped to SAFs and TFs. The test circuit consists of write circuitry, six transistors (6T) SRAM cell and sense amplifier circuit. The simulation also includes the testing of MATS++ and March C- algorithms in order to verify the circuit functionality and validate the types of defects belong to both SAFs and TFs. Findings shows that the propose algorithm generates different fault syndromes for SAFs and TFs hence make them distinguishable. Results obtained from simulation validate the generated fault syndromes thus confirmed the ability of this algorithm to detect and distinguish between SAFs and TFs.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

ALGORITMA DIAGNOSIS STATIC RANDOM-ACCESS MEMORY BERDASARKAN ALGORITMA MARCH UNTUK KESALAHAN STUCK-AT DAN KESALAHAN TRANSISI

Oleh

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Teknologi yang berkembang pesat telah membolehkan Static Random Access Memory (SRAM) mengandungi kepadatan pelbagai sel yang tinggi yang membuatkan ia mudah terkesan oleh kecacatan. Faktor ini menyumbang kepada cabaran yang dihadapi di dalam bidang ujian memori. Ujian fungsi merupakan prosedur ujian biasa untuk menentukan keberkesanan memori dengan menggunakan urutan operasi bacaan dan tulisan untuk mengesan kerosakan. Ujian March digunakan secara meluas semasa ujian fungsi disebabkan oleh liputan kesalahannya yang lebih tinggi dan kurang kerumitan masa. Ujian March dibangunkan berdasarkan kepada model kesalahan fungsi (FFM) seperti kesalahan stuck-at (SAFs), kesalahan transisi (TFs) dan kesalahan bergandingan (CFs). Ujian March yang terkini telah menggabungkan kebolehan diagnostik yang membolehkan kesalahan dikesan dan juga dibezakan. Kebolehan diagnostik ujian March disahkan berdasarkan kepada kumpulan sindrom kesalahan yang dijana berdasarkan kepada pengesanan kesalahan

yang dikenalpasti semasa operasi bacaan. Walaubagaimanapun, ujian March dengan kebolehan diagnostik yang sedia ada tidak mampu untuk membezakan diantara SAFs dan TFs. Oleh itu, tesis ini mencadangkan algoritma dua fasa yang baru berdasarkan kepada ujian March khusus untuk membezakan kedua-dua kesalahan.

Sindrom kesalahan berdasarkan kepada operasi bacaan algoritma yang dicadangkan di keluarkan untuk mengenalpasti kemampuan diagnostiknya. SAFs and TFs mampu untuk dibezakan antara satu sama lain apabila sindrom yang berbeza dijana untuk setiap kesalahan. Sindrom kesalahan akan di sahkan dengan simulasi algoritma yang dicadangkan keatas litar ujian tanpa kesalahan dan litar ujian yang mengandungi kecacatan yang mewakili SAFs dan TFs. Litar ujian mengandungi litar tulisan, enam transistor (6T) SRAM sel dan litar penguat pengesanan. Simulasi juga turut melibatkan ujian algoritma MATS++ dan March C- untuk mengesahkan fungsi litar dan mengesahkan jenis kecacatan milik kedua-dua SAFs dan TFs. Hasil ujian menunjukkan algoritma yang dicadangkan menjana sindrom kesalahan yang berbeza untuk SAFs dan TFs yang membuatkan mereka dapat dibezakan. Keputusan yang didapati dari simulasi mengesahkan sindrom kesalahan yang dijana sekaligus mengesahkan keupayaan algoritma ini untuk mengesan dan membezakan antara SAFs dan TFs.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_____

MASNITA BINTI MAT ISA

Date: 31 January 2012

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