

Proceedings of the

16th Asian Test Symposium

ATS 2007

Table of Contents: ATS 2007

Proceedings of the 16th Asian Test Symposium

Foreword	xiii
ATS Steering Committee	xiv
Organizing Committee	xv
Program Committee	xvi
Reviewers	xviii
Test Technology Technical Council (TTTC) Activities Board	xix
Test Technology Educational Program (TTEP) Tutorial 1	xxii
Test Technology Educational Program (TTEP) Tutorial 2	xxiii
 Session 1A: Opening Session	
Plenary Opening	
Keynote Speech 1: New Paths for Test	3
<i>Jacob Abraham</i>	
Keynote Speech 2: Consumerization of Electronics and Nanometer Technologies: Implications on Test	4
<i>Sanjiv Taneja</i>	
Invited Talk 1: Testing of Power Constraint Computing	6
<i>T.M. Mak</i>	
Invited Talk 2: EDA to the Rescue of the Silicon Roadmap	7
<i>T.W. Williams</i>	
Invited Talk 3: Foundry Full-Scale Reliability Testing Capability Setup for Advanced Technology	9
<i>Kary Chien</i>	
 Session 2A: Fault Modeling and Functional Test	
The Region-Exhaustive Fault Model	13
<i>Abhijit Jas, Suriyaprakash Natarajan, and Srinivas Patil</i>	
Mining Sequential Constraints for Pseudo-Functional Testing	19
<i>Weixin Wu and Michael S. Hsiao</i>	
Estimating the Fault Coverage of Functional Test Sequences without Fault Simulation	25
<i>Irith Pomeranz, Praveen K. Parvathala, and Srinivas Patil</i>	
 Session 2B: Fault Diagnosis (I)	
Fast Bridging Fault Diagnosis Using Logic Information	33
<i>Alexandre Rousset, Alberto Bosio, Patrick Girard, Christian Landrault, Serge Pravossoudovitch, and Arnaud Virazel</i>	

Clues for Modeling and Diagnosing Open Faults with Considering Adjacent Lines _____	39
<i>Hiroshi Takahashi, Yoshinobu Higami, Shubei Kadoyama, Takashi Aikyo, Yuzo Takamatsu, Koji Yamazaki, Toshiyuki Tsutsumi, Hiroyuki Yotsuyanagi, and Masaki Hashizume</i>	
Fault Dictionary Based Scan Chain Failure Diagnosis _____	45
<i>Ruijeng Guo, Yu Huang, and Wu-Tung Cheng</i>	
Session 2C: Panel Session	
Test Education in the Global Economy _____	53
<i>Tim Cheng</i>	
Session 3A: Delay Test (I)	
Improving Timing-Independent Testing of Crosstalk Using Realistic Assumptions on Delay Faults _____	57
<i>Shahdad Irajpour, Sandeep K. Gupta, and Melvin A. Brewer</i>	
False Path Identification Using RTL Information and Its Application to Over-testing Reduction for Delay Faults _____	65
<i>Yuki Yoshikawa, Satoshi Ohtake, and Hideo Fujiwara</i>	
Using Programmable On-Product Clock Generation (OPCG) for Delay Test _____	69
<i>Brion Keller, Anis Uzjaman, Bibo Li, and Tom Snetben</i>	
An On-Line BIST Technique for Delay Fault Detection in CMOS Circuits _____	73
<i>Elham Khayat Moghaddam and Shaabn Hessabi</i>	
Session 3B: Test Compression	
A High Compression and Short Test Sequence Test Compression Technique to Enhance Compressions of LFSR Reseeding _____	79
<i>Seongmoon Wang, Wenlong Wei, and Srimat T. Chakrabar</i>	
Test Compression / Decompression Based on JPEG VLC Algorithm _____	87
<i>Hideyuki Ichihara, Yukinori Setobara, Yusuke Nakashima, and Tomoo Inoue</i>	
A Reconfigurable Broadcast Scan Compression Scheme Using Relaxation Based Test Vector Decomposition _____	91
<i>Aiman H. El-Maleh, Mustafa Imran Ali, and Ahmad A. Al-Yamani</i>	
Test Data and Test Time Reduction for LOS Transition Test in Multi-Mode Segmented Scan Architecture _____	95
<i>Syng-Iyan Wang, Po-Chang Tsai, Hung-Ming Weng, and Katherine Shu-Min Li</i>	
Session 3C: Power Aware Test (I)	
Resistive Bridging Faults DFT with Adaptive Power Management Awareness _____	101
<i>Urban Ingelsson, Paul Rosinger, S. Saqib Khursheed, Basbir M. Al-Hashimi, and Peter Harrod</i>	
Multi-Frequency Modular Testing of SoCs by Dynamically Reconfiguring Multi-Port ATE _____	107
<i>Dan Zhao, Ronghua Huang, and Hideo Fujiwara</i>	

An Efficient Peak Power Reduction Technique for Scan Testing _____	111
<i>Meng-Fan Wu, Kai-Shun Hu, and Jim-Lang Huang</i>	
High-MDSI: A High-level Signal Integrity Fault Test Pattern Generation Method for Interconnects _____	115
<i>Sungboon Chun, Yongjoon Kim, and Sungbo Kang</i>	
Session 4A: DFT (I)	
A RTL Testability Analyzer Based on Logical Virtual Prototyping _____	121
<i>Yu Huang, Nilanjan Mukherjee, Wu-Tung Cheng, and Greg Aldrich</i>	
Optimum Test Set for Bridging Faults Detection in Reversible Circuits _____	125
<i>Hafizur Rabaman, Dipak K. Kole, Debesh K. Das, Bhargab B. Bhattacharya</i>	
Layout-Aware Multi-Layer Multi-Level Scan Tree Synthesis _____	129
<i>Sying-Iyan Wang, Xin-Long Li, and Katherine Shu-Min Li</i>	
Session 4B: RF Test	
A Test and Diagnosis Methodology for RF Transceivers _____	135
<i>Hung-Kai Chen and Chauchin Su</i>	
Fourier Spectrum-Based Signature Test: A Genetic CAD Toolbox for Reliable RF Testing Using Low-Performance Test Resources _____	139
<i>Ganesh Srinivasan, Abhijit Chatterjee, and Vishwanath Natarajan</i>	
A BIST Technique for RF Voltage-Controlled Oscillators _____	143
<i>Hsieh-Hung Hsieh, Yen-Chih Huang, Liang-Hung Lu, and Guo-Wei Huang</i>	
Session 4C: Software Test	
An Improved Test Case Generation Method of Pair-Wise Testing _____	149
<i>Qian Feng-an and Jiang Jian-hui</i>	
System Testing Using UML Models _____	155
<i>Monalisa Sarma and Rajib Mall</i>	
Reconsideration of Software Reliability Measurements _____	159
<i>Shiyi Xu</i>	
Session 5A: Design Verification	
An Accurate Analysis of Microprocessor Design Verification _____	165
<i>Haibua Shen and Heng Zhang</i>	
Optimized Assignment Coverage Computation in Formal Verification of Digital Systems _____	172
<i>Majid Nabi, Hamid Shojaei, Siamak Mohammadi, and Zainalabedin Navabi</i>	
EHSAT Modeling from Algorithm Description for RTL Model Checking _____	178
<i>Xiaqing Yang, Jinian Bian, Shujun Deng, and Yanni Zhao</i>	

Session 5B: SOC Test

Thermal-Safe Test Access Mechanism and Wrapper Co-optimization for System-on-Chip _____ 187
Thomas Edison Yu, Tomokazu Yoneda, Krishnendu Chakrabarty, and Hideo Fujiwara

Design Reuse of on/off-Chip Bus Bridge for Efficient Test Access to AMBA-Based SoC _____ 193
Jaebon Song, Jubee Han, Dooyoung Kim, Hyunbeon Yi, and Sungju Park

Test Scheduling for Memory Cores with Built-In Self-Repair _____ 199
Tomokazu Yoneda, Yuusuke Fukuda, and Hideo Fujiwara

Session 5C: Panel Session

Next Generation Test, Diagnostics and Yield Challenges for EDA, ATE, IP and Fab—
A Perspective from all Sides _____ 207
Anis Uzgaman

Session 6A: Industry Session

IDDQ Test Challenges in Nanotechnologies: A Manufacturing Test Strategy _____ 211
Yu Wei P'ng, Moo Kit Lee, Peng Weng Ng, and Chin Hu Ong

Experimental Results of Transition Fault Simulation with DC Scan Tests _____ 212
Wataru Kawamura and Takeshi Onodera

A Review of Power Strategies for DFT and ATPG _____ 213
Brion Keller, Tom Jackson, and Anis Uzgaman

Concurrent Test Implementations _____ 214
Shawn Molavi and Toby McPheeters

Scan Diagnosis and Its Successful Industrial Applications—Yield Improvement, Verified Flow,
Accuracy, Layout Aware and Volume Diagnosis _____ 215
Wu Yang, Wu-Tung Cheng, Yu Huang, Martin Keim, and Randy Klingenberg

Session 6B: Analog Test

A 2-ps Resolution Wide Range BIST Circuit for Jitter Measurement _____ 219
Nai-Chen Daniel Cheng, Yu Lee, and Ji-Jan Chen

An Accurate Jitter Estimation Technique for Efficient High Speed I/O Testing _____ 224
Dongwoo Hong and Kwang-Ting (Tim) Cheng

Test Point Selections for a Programmable Gain Amplifier Using NIST and Wavelet Transform Methods _____ 230
Xinsong Zhang, Simon S. Ang, and Chandra Carter

Session 6C: Power Aware Test (II)

Impact of Simultaneous Switching Noise on the Static Behavior of Digital CMOS Circuits _____	239
<i>Florence Azais, Laurent Larguier, and Michel Renovell</i>	
Effect of IR-Drop on Path Delay Testing Using Statistical Analysis _____	245
<i>Chunsheng Liu, Yang Wu, and Yu Huang</i>	
Low Power Reduced Pin Count Test Methodology _____	251
<i>Krishna Chakravadhanula, Nitin Parimi, Brian Foutz, Bing Li, and Vivek Chickerman</i>	

Session 7A: Test Generation (I)

Test Generation for Crosstalk Glitches Considering Multiple Coupling Effects _____	259
<i>Minjin Zhang and Xiaowei Li</i>	
Simulating Open-Via Defects _____	265
<i>Stefan Spinner, Jie Jiang, Ilia Polian, Piet Engelke, and Bernd Becker</i>	
Test Generation for Transistor Shorts Using Stuck-at Fault Simulator and Test Generator _____	271
<i>Yoshinobu Higami, Kewal K. Saluja, Hiroshi Takahashi, Shin-ya Kobayashi, and Yuzo Takamatsu</i>	
Fault-dependent/independent Test Generation Methods for State Observable FSMs _____	275
<i>Toshinori Hosokawa, Ryoichi Inoue, and Hideo Fujiwara</i>	

Session 7B: Fault Diagnosis (II)

Improving Performance of Effect-Cause Diagnosis with Minimal Memory Overhead _____	281
<i>Huaxing Tang, Chen Liu, Wu-Tung Cheng, Sudabkar M. Reddy, and Wei Zou</i>	
An Efficient Diagnostic Test Pattern Generation Framework Using Boolean Satisfiability _____	288
<i>Feijun Zheng, Kwang-Ting Cheng, Xiaolang Yan, John Moondanos, and Ziyad Hanna</i>	
Programmable Logic BIST for At-speed Test _____	295
<i>Yu Huang and Xijiang Lin</i>	
Diagnostic Test Generation Targeting Equivalence Classes _____	301
<i>Iritib Pomeranz and Sudhakar M. Reddy</i>	

Session 7C: Soft Error Issue

Improving Circuit Robustness with Cost-Effective Soft-Error-Tolerant Sequential Elements _____	307
<i>Mingjing Chen and Alex Orailoglu</i>	
CREA: A Checkpoint Based Reliable Micro-architecture for Superscalar Processors _____	313
<i>Shijian Zhang and Weimin Hu</i>	
Monitoring Transient Errors in Sequential Circuits _____	319
<i>Ramashis Das and John P. Hayes</i>	

Frequency Analysis Method for Propagation of Transient Errors in Combinational Logic _____	323
<i>Shaohua Lei, Yinbe Han, and Xiaowei Li</i>	

Session 8A: DFT (II)

Scan Testing for Complete Coverage of Path Delay Faults with Reduced Test Data Volume, Test Application Time, and Hardware Cost _____	329
<i>Dong Xiang, Krishnendu Chakrabarty, Dianwei Hu, and Hideo Fujiwara</i>	

Flip-flop Selection to Maximize TDF Coverage with Partial Enhanced Scan _____	335
<i>Gefu Xu and Adit D. Singh</i>	

An On-Chip Test Clock Control Scheme for Multi-Clock At-Speed Testing _____	341
<i>Xiao-Xin Fan, Yu Hu, and Laung-Terng (L.-T.) Wang</i>	

Session 8B: Memory Test (I)

A Hybrid BIST Scheme for Multiple Heterogeneous Embedded Memories _____	349
<i>Li-Ming Deng and Cheng-Wen Wu</i>	

CAMEL: An Efficient Fault Simulator with Coupling Fault Simulation Enhancement for CAMs _____	355
<i>Hsiang-Huang Wu, Jin-Fu Li, Chi-Feng Wu, and Cheng-Wen Wu</i>	

Fast and Low Cost HW Bit Map for Memory Test Based on Residue Polynomial System over GF(2) _____	361
<i>Jochen Rivoir</i>	

Session 8C: Panel Session

Test Roles in Diagnosis and Silicon Debug _____	367
<i>Anis Uzuzaman</i>	

Session 9A: BIST

Programmable Scan-Based Logic Built-In Self Test _____	371
<i>Liyang Lai, Wu-Tung Cheng, and Thomas Rinderknecht</i>	

Evaluation of a BIST Technique for CMOS Imagers _____	378
<i>Livier Lizarraga, Salvador Mir, and Gilles Sicard</i>	

Built-In Speed Grading with a Process-Tolerant ADPLL _____	384
<i>Hsuan-Jung Hsu, Chun-Chieh Tu, and Shi-Yu Huang</i>	

Session 9B: Current Test

Testing RF Components with Supply Current Signatures _____	393
<i>S. Sermet Akbay, Shreyas Sen, and Abhijit Chatterjee</i>	

Current Testable Design of Resistor String DACs _____	399
<i>Masaki Hasbizume, Yutaka Hata, Tomomi Nishida, Hiroyuki Yatsuyanagi, and Yukiya Miura</i>	

Implementation of Defect Oriented Testing and ICCQ Testing for Industrial Mixed-Signal IC _____	404
<i>Liquan Fang, Yang Zhong, Henk Van de Donk, and Yizhi Xing</i>	

Session 9C: Power Aware Test (III)

Low-Capture-Power Test Generation by Specifying a Minimum Set of Controlling Inputs _____	413
<i>Nan-Cheng Lai and Syng-Jyan Wang</i>	

Scan Power Reduction through Scan Architecture Modification and Test Vector Reordering _____	419
<i>Chandan Giri, Pradeep Kumar Choudhary, and Santanu Chattopadhyay</i>	

Response Inversion Scan Cell (RISC): A Peak Capture Power Reduction Technique _____	425
<i>Bo-Hua Chen, Wei-Chung Kao, Bing-Chuan Bai, Shyue-Tsong Shen, and James C.-M. Li</i>	

Session 10A: Test Generation (II)

SUPERB: Simulator Utilizing Parallel Evaluation of Resistive Bridges _____	433
<i>Piet Engelke, Bettina Braitting, Ilia Polian, Michel Renouell, and Bernd Becker</i>	

Symbolic Path Sensitization Analysis and Applications _____	439
<i>Jian Kang, Sharad C. Seth, and Shashank K. Mehta</i>	

Improving Test Pattern Compactness in SAT-Based ATPG _____	445
<i>Stephan Eggersgluß and Rolf Drechsler</i>	

Session 10B: NOC/SOC Test

An HDL-Based Platform for High Level NoC Switch Testing _____	453
<i>Mahshid Sedghi, Armin Alaghi, Elnaz Koopabi, and Zainalabedin Navabi</i>	

Area Overhead and Test Time Co-Optimization through NoC Bandwidth Sharing _____	459
<i>Fawwaz Asmadi Hussin, Tomokazu Yoneda, and Hideo Fujiwara</i>	

Test Efficiency Analysis and Improvement for SOC Test Platforms _____	463
<i>Tong-Yu Hsieh, Kuen-Jong Lee, and Jian-Jhib You</i>	

Block Marking and Updating Coding in Test Data Compression for SoC _____	467
<i>Lei Zhang, Huaguo Liang, Wenfa Zhan, and Chiyun Jiang</i>	

Session 11A: Delay Test (II)

Enhanced Broadside Testing for Improved Transition Fault Coverage _____	473
<i>Iritib Pomeranz and Sudhakar M. Reddy</i>	

On Generating Vectors that Invoke High Circuit Delays—Delay Testing and Dynamic Timing Analysis _____	479
<i>I-De Huang and Sandeep K. Gupta</i>	

Test Generation for Timing-Critical Transition Faults _____	487
<i>Xijiang Lin, Mark Kassab, and Janusz Rajski</i>	

Session 11B: Memory Test (II)

Testing Comparison Faults of Ternary Content Addressable Memories with Asymmetric Cells _____ 495
Jin-Fu Li

Influence of Threshold Voltage Deviations on 90nm SRAM Core-Cell Behavior _____ 501
*Magali Bastian, Vincent Gouin, Patrick Girard, Christian Landrault,
Alexandre Ney, Serge Pravossoudovitch, and Arnaud Virazel*

Using FPGA Configuration Memory to Accelerate Yield Learning for Advanced Process _____ 505
Jenny Fan, Xiao-Yu Li, and Ismed Hartanto

Special Sessions on Analog Production Test

Special Session: Analog Production Test _____ 511
Fidel Muradali and Jochem Rivoir

Session 10C: Analog Production Test # 1

Issues Regarding New Product Release in Semiconductor Manufacturing _____ 515
Choon-Sang Chew

How the Noise Floor Affects the Production Yield _____ 516
Akimori Maeda

Integrated Test Solution for Embedded UHF/RF SOC _____ 517
Sean Lu and Dee-Won Lee

Production Test of High Volume Commercial RFIC _____ 518
Friedrich Taenzler

Session 11C: Analog Production Test #2

Bluetooth Hopping BER Testing Methodologies on a Production Test Platform _____ 521
David Bement and David Karr

Understanding GSM/EDGE Modulated Signal Test on Cellular BB SOC _____ 522
Deng Yue

Top 5 Issues in Practical Testing of High-Speed Interface Devices _____ 523
Takabiro J. Yamaguchi

Author Index _____ **525**

Call for Papers ATS 2008 _____ **528**