

SMTA International Conference 2012

**Orlando, Florida, USA
14-18 October 2012**

Volume 1 of 2

ISBN: 978-1-62276-896-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2012) by Surface Mount Technology Association (SMTA)
All rights reserved.

Printed by Curran Associates, Inc. (2013)

For permission requests, please contact Surface Mount Technology Association (SMTA)
at the address below.

Surface Mount Technology Association (SMTA)
5200 Wilson Road
Suite 215
Edina, MN 55424

Phone: (952) 920-4682
Fax: (952) 926-1819

www.smta.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Volume 1

ADVANCED PACKAGING

AAT1: BEND AND SHOCK RELIABILITY OF BGAS AND CSPS

Board Level Reliability Cyclic Bend Test Study on WCSP Packages	1
<i>Andy Zhang, Siva Gurrum, Vikas Gupta</i>	
Drop Reliability Test on Different Dimensional Lead-Free Wafer Level Chip Scale Packages	7
<i>Sivasubramanian Thirugnanasambandam, Namo Vijayakumar, Jiawei Zhang, John Evans, Fei Xie, Daniel Baldwin</i>	
Mechanical Reliability: Updated Results from a Spherical Bend Test Program	16
<i>John McMahon, Brian Standing</i>	
On the Fatigue Life of Microelectronic Interconnects in Cycling With Varying Amplitudes	22
<i>Y. Jaradat, J. E. Owens, A. Qasaimeh, B. Arfaei, P. Borgesen, L. Yin, M. Anselm</i>	

AAT2: BGA/LGA THERMAL CYCLING RELIABILITY

Assessing The Impact on Temperature Cycling Reliability of High Levels of Voiding in BGA Solder Joints	29
<i>Grace Qin, Lei Nie, Francis Toth Jr., Raiyo Aspandiar, Ian Williams</i>	
BGA Thermal Cycle Solder Joint Integrity Using a Nonconcentric Microvia in Pad Structure	40
<i>David Hillman, Dave Adams, Tim Pearson, Ross Wilcoxon</i>	
LGAs vs. BGAs — Lower Profile and Better Reliability	47
<i>S. Joshi, B. Arfaei, A. Singh, M. Gharaibeh, M. Obaidat, A. Alazzam, P. Borgesen, L. Yin, M. Meilunas, M. Anselm</i>	

AAT3: IMPACT OF MICROSTRUCTURE ON SOLDER

Method for Determination of Accrued Damage and Remaining Life During Field-Usage in Lead-Free Electronics	58
<i>Pradeep Lall, Mahendra Harsha, Kai Goebel</i>	
Should Intermetallic Thickness Measurements be Needed to Determine Solder Joint Reliability?	73
<i>Scott Butars, Chonglun Fan, Raiyo Aspandiar</i>	
The Stability of Cu₆Sn₅ in the Formation and Performance of Lead-Free Solder Joints	83
<i>Keith Sweatman, Tetsuro Nishimura, Kazuhiro Nogita</i>	

AAT4: PROCESS SOLUTIONS FOR ADVANCED POP AND FINE PITCH CSPS

Influence of Alloy Combination and PCB Location on Package on Package (PoP) Component Assembly Drop Test	88
<i>Andrew Daya, S. Manian Ramkumar</i>	
Fine Pitch (0.4mm) TMV Package on Package Assembly in Air	94
<i>Rafael Padilla, Yutaka Hashimoto, Satoru Akita, Derek Daily, Tokuro Yamaki, Takayuki Yoshida, Masato Shimamura</i>	
Assembly and Design Challenges for New Generation 0.4/0.4mm Pitch Package on Package (POP) and 0.3mm Pitch Chip Scale Package (CSP)	101
<i>Jonas Sjoberg, Ranilo Aranda, David Geiger, Murad Kurwa</i>	
PCB Assembly Process Development and Characterization of 0.3mm μCSP Packages	109
<i>Weiping Wu, Restyfonte Familiara, L. M. Lin, Mohd Yusuf, Hien Ly, Chryst Shee</i>	

AAT5: ADVANCES IN COPPER WIRE BONDING TECHNOLOGY

Overview of Copper Wire Bonding Technology	117
<i>Andrew Mawer, Chu-Chung Lee, Tu Anh Tran, Les Postlewait</i>	

Copper Wire Bond Failure Mechanisms	124
<i>Randy Schueller</i>	
Electroless NiPdAu Plating for Cu Wire Bonding	132
<i>Yoshinori Ejiri, Takehisa Sakurai, Yoshiaki Tsubomatsu, Kiyoshi Hasegawa</i>	

AAT6: TRENDS IN ADVANCED PACKAGING

Development and Optimization of Through Silicon Via Interposers	142
<i>Pejman Monajemi, Michael Newman, Cyprian Uzoh, Charles Woychik, Lina Ayat, Terrence Caskey</i>	
Investigations into 0.3mm Pitch Assembly and Reliability	147
<i>Denis Barbini, Michael Meilunas</i>	

AAT7: 3D PACKAGING AND INTEGRATION

3D Technology — A Promising Approach in the Field of Smart System Integration	159
<i>M. Juergen Wolf, Klaus-Dieter Lang</i>	
3D Packaging for High Computing With Wide IO Processor-Memory Interface	163
<i>Illyas Mohammed, Ron Zhang, Rajesh Katkar</i>	
Effect of Solder Paste and Flux Type on Board Level Reliability of a 3D Wafer Level Chip Scale Package	173
<i>Fei Xie, Daniel F. Baldwin, Paul Houston, Brian Lewis</i>	

BUSINESS

BUS1: SUPPLY CHAIN MANAGEMENT VIA PREDICTIVE COST AND ASSEMBLY PROCESS MODELING

Improving Supply Chain Velocity Through Six-Sigma Application and Tools	181
<i>Harsh Kohli</i>	
Leveraging Manufacturing Solutions in FMEA	187
<i>Jay Gorajia</i>	
A Focus on Productivity and Profitability: Several Case Studies	194
<i>Ronald Lasky</i>	

CONTRACT MANUFACTURING SYMPOSIUM

EMS: GLOBAL STRATEGIES FOR LOWERING EMS COSTS

The Evolving Nature of Offshore/Onshore Options	198
<i>Curtis Campbell</i>	
Force Multiplication-Supporting Complex Customer Requirements at a Regional Level	204
<i>Rick Herndon</i>	
Re-shoring: Total Cost of Ownership, a Contract Manufacturing Guide	208
<i>Alexander Zeitler</i>	

ENVIRONMENT

ENV: ROHS AND CONFLICT MINERALS REGULATIONS AND IMPACT

Can RoHS Conversion Actually Reduce Product Cost?	214
<i>Philip Divita, David Steele, John Kanavel, Chrys Shea</i>	

EVOLVING TECHNOLOGIES SUMMIT

ET1: PCB EMBEDDED TECHNOLOGY — THE DEVELOPMENT, APPLICATION AND RELIABILITY

Integration of Electronic Components into PCB for Electromobility Application	219
<i>Thomas Hofmann, Stefan Gottschling</i>	
Development of Embedded Power Electronics Modules for Automotive Applications	223
<i>L. Böttcher, S. Karaszkiwicz, A. Ostmann, D. Manassis</i>	
Embedding and Reliability of Discrete Capacitors Into Build Up Layers of Printed Circuit Boards	231
<i>Thomas Löher, Joao Marques, Martin Haubenreisser, Andreas Ostmann, Norbert Bauer</i>	

ET2: ADVANCED MATERIALS AND PRINTING

Process Developments for Micro-Electronics Packaging With Direct Printed Additive Manufacturing.....	237
<i>R. X. Rodriguez, K. Church, X. Chen</i>	
Novel Processing Methods for Electronic Materials	244
<i>Alan Rae</i>	
Non-isocyanate, Non-mercury Polyurethane Encapsulation Resins.....	249
<i>Xiaoping Lei, Darren Hodson</i>	

AIMS / HARSH ENVIRONMENTS SYMPOSIUM

HE1: LEAD-FREE SOLDERS FOR SUSTAINED ELEVATED TEMPERATURE SERVICE

Reliability of BiAgX Solder as a Drop-in Solution for High Temperature Lead-Free Die Attach Applications.....	256
<i>Hongwen Zhang, Ning-Cheng Lee</i>	
Reliability of Passive and Active Components with Differences According to Lead-Free Paste Characterization	261
<i>Jörg Trodler, Heinz Wholrabe, Rüdiger Knofe</i>	

HE2: EXPERIMENTAL DETERMINATION AND MODELING OF MATERIALS FOR HIGH RELIABILITY DEVICES

Electrical Performance Evaluation of High-Frequency Laminates as a Function of Temperature	271
<i>Brian Wright</i>	
Reliability Assessment of a SMT Assembly with Prediction of its Board-Level Interconnect Life Distribution	277
<i>Jingsong Xie, Haiyu Qi, Jun-Ke Zhang, Feng-Hua Zhou, Chun-Yong Tang, Jaccy Wang, Ding-Jun Xie, Li-Li Chen, Chang Wang</i>	
Designing a Silicone System to Reduce Permeability to Moisture.....	286
<i>Julie Harber, Michelle Velderrain</i>	

HE3: TESTING AND FAILURE MECHANISMS IN HARSH OPERATIONAL ENVIRONMENTS

iNEMI Creep Corrosion Project: Investigation of Factors That Influence Creep Corrosion on Printed Circuit Boards — Part 2	292
<i>Haley Fu, Cherie Chen, P. Singh, Jing Zhang, Anil Kurella, Xu Chen, Xiaodong Jiang, Jennifer Burlingame, Simon Lee</i>	
Area-Array Electronics Models and Survivability Under 50,000G Shock Loads	300
<i>Pradeep Lall, Kewal Patel, Ryan Lowe, Mark Strickland, Dave Geist, Randall Montgomery, Jim Blanche</i>	
Alternative Testing Methods for Electronic Assemblies.....	312
<i>Mathias Nowotnick, Andrej Novikov, Dirk Schade, Bob Sykes</i>	

HE4: SCREENING AND PROLONGED OPERATION FOR HARSH ENVIRONMENTS

If You Can't Take the Heat (There Are Other Options...) 317
Robert M. S. Simon

New Interconnection for High Temperature Application: HotPowCon (HPC) 321
Jörg Trodler, Mathias Nowotnick, Andreas Fix, Timo Heberholz

Aging Effects on Creep Behavior of Lead-Free Solder Joints and Reliability of Fine-Pitch Packages 327
Jiawei Zhang, Zhou Hai, Sivasubramanian Thirugnanasambandam, John Evans, M. J. Bozack, Yifei Zhang, J. C. Suhling, Richard Sesek

LEAD-FREE SOLDERING TECHNOLOGY SYMPOSIUM

LF1: INEMI PB-FREE ALLOY CHARACTERIZATION PROJECT REPORT: THERMAL FATIGUE PERFORMANCE

iNEMI Pb-Free Alloy Characterization Project Report: Part I — Program Goals, Experimental Structure, Alloy Characterization, and Test Protocols for Accelerated Thermal Cycling 335
Gregory Henshall, Jian Miremadi, Elizabeth Benedetto, Aileen Allen, Richard Parker, Richard Coyle, Joe Smetana, Jennifer Nguyen, Weiping Liu, Keith Sweatman, Keith Howell, Ranjit S. Pandher, Derek Daily, Mark Currie, Donald Moore, Tae-Kyu Lee, Julie Silk, Bill Jones, Stephen Tisdale, Fay Hua, Michael Osterman, Bill Barthel, Thilo Sack, Polina Snugovsky, Ahmer Syed, Joelle Arnold, Graver Chang

iNEMI Pb-Free Alloy Characterization Project Report: Part II — Thermal Fatigue Results for Two Common Temperature Cycles 348
Richard Parker, Richard Coyle, Joe Smetana, Gregory Henshall, Elizabeth Benedetto

iNEMI Pb-Free Alloy Characterization Project Report: Part III — Thermal Fatigue Results for Low Ag Alloys 359
Keith Sweatman, Keith Howell, Richard Coyle, Richard Parker, Gregory Henshall, Elizabeth Benedetto, Jian Miremadi, Aileen Allen, Weiping Liu, Ranjit S. Pandher, Derek Daily, Mark Currie, Donald Moore, Jennifer Nguyen, Tae-Kyu Lee, Michael Osterman, Joelle Arnold, Graver Chang

iNEMI Pb-Free Alloy Characterization Project Report: Part IV — Effect of Isothermal Preconditioning on Thermal Fatigue Life 376
Richard Coyle, Joe Smetana, Richard Parker, Gregory Henshall, Elizabeth Benedetto, Michael Osterman, Donald Moore, Graver Chang, Joelle Arnold, Tae-Kyu Lee

LF2: DEPENDABLE ELECTRONICS WITH LEAD-FREE COMPONENTS/SYSTEMS (MANAGING THE TRANSITION TO A “GREEN WORLD”)

Dependable Electronics with Lead-Free Components/Systems - Overview 390
A. J. Rafanelli

Dependable Electronics with Lead-Free Components/Systems – Test and Reliability 415
A. J. Rafanelli

Tin Whisker Risk Management for High Reliability Systems 469
David Pinsky

LF3: DEPENDABLE ELECTRONICS WITH LEAD-FREE COMPONENTS/SYSTEMS (CONTINUED)

GEIA-HB-0005-3 Rework/Repair Handbook to Address the Implications of Lead-Free Electronics and Mixed Assemblies in Aerospace and High Performance Electronic Systems 499
David Hillman

Lead-Free and Supply Chain Management for High Reliability Systems 525
David Pinsky

Review of Lead Free Control Plan Requirements 546
Linda Woody

LF4: LEAD-FREE SOLDER JOINT RELIABILITY: MEET THE EXPERTS

Systematic Investigation of Impact of SMT Parameters, Isothermal Aging and Alloy Microstructure on Lead-Free BGA Solder Joint Reliability	566
<i>Weidong Xie, Tae-Kyu Lee, Steven Perng</i>	
SnAgCu Lead-Free Electronics Reliability Under Combined Temperature and Vibration Environments	575
<i>Pradeep Lall, Geeta Limaye</i>	
Solder Alloy Creep Constants for Use in Thermal Stress Analysis	584
<i>Robert Darveaux, Corey Reichman</i>	
Latest Developments in Testing Pb-free Electronic Assemblies: A Report on the Revision A Update to GEIA-STD-0005-3	594
<i>Anthony Rafanelli</i>	

MANUFACTURING EXCELLENCE

MF1: ALTERNATE SOLDER ALLOYS FOR VARIOUS APPLICATIONS

Lead-Free Alloy Development	599
<i>Karl Seelig</i>	
SnZn Solder Alternative for Low Cost Pb-free Surface Mount Assemblies	605
<i>Gavin Jackson, Ian J. Wilding, Richard Boyle, Puwei Liu, Matthew Holloway, Maurice N. Collins, Eric Dalton, Jeff Punch</i>	
Ag-Au-Ge Alloys for High Temperature Geothermal and Oil Well Electronics Applications	613
<i>P. T. Vianco, R. Grant, J. A. Rejent, T. B. Crenshaw, A. C. Kilgo</i>	
Case Study: Development of a Low Temperature Tin-Bismuth-Silver Solder Paste	625
<i>Emmanuelle Gu��n��, C��line Puechagut</i>	

MF2: RUGGEDIZED ELECTRONICS — COATINGS AND UNDERFILLS

Types of Conformal Coatings, Applications and Process Issue Mitigation	633
<i>David Allen</i>	
New Underfill Materials Designed for Increasing Reliability of Fine-Pitch Wafer Level Devices	639
<i>Brian J. Toleno, Hoseung Yoo, Rong Zhang, Stanley Hu</i>	
Plasma Polymerization: A Versatile and Attractive Process for Conformal Coating	644
<i>Andy Brooks, Siobhan Woollard, Gareth Hennighan, Tim Von Werne</i>	

MF3: CONNECTOR RELIABILITY: DEFECT DETECTION AND THE END OF ROHS LEAD EXEMPTIONS

Compliant Pin Interconnect Challenging and Reliability after January 1, 2012 RoHS Exemption	650
<i>David He, Yu Xiang, D. F. Chung, Paul Wang, Livia Hu, Bobby Dayal, Karl Sauter, Tim Norman, Jorge Martinez-Vargas</i>	
Lead-Free SMT Connector Process Exposure, Reliability, Quality, and Yield Assessment for High Thermal Mass Assemblies	658
<i>Jimmy Chow, John McMahon, Heather McCormick, Russell Brush, Vejeyathaas Thambipillai, Kok Wei Khoo, Matthew Kelly, Marie Cole</i>	

MF4: HEAD-IN-PILLOW AND NON-WET OPEN DEFECT REDUCTION

Material and Process Optimization for Head-in-Pillow Defect Elimination	668
<i>Timothy Jensen, Ronald Lasky, Sehar Samiappan</i>	
Overcoming Head-in-Pillow Defects in Hybrid LGA Socket Assembly	674
<i>Marie Cole, Theron Lewis, Jim Bielick, P. K. Pu, Stephen Hugo, Phil Isaacs, Eddie Kobeda, Matthew Kelly, Su Bing, Alex Chen, James Huang, Kevin Liu, John McMahon, Brian Standing</i>	
The Challenges of Non-Wet-Open BGA Solder Defect	684
<i>Dudi Amir, Satyajit Walwadkar, Srinivasa Aravamudhan, Lilia May</i>	

MF5: ADVANCED INSPECTION TECHNIQUES FOR PRINTED CIRCUIT BOARD ASSEMBLY

Surface Flatness and Bond Thickness Measurement Methods Using the Acoustic Microscope	695
<i>Janet E. Semmens</i>	
3D Board Level X-ray Inspection Via Limited Angle Computer Tomography.....	699
<i>David Bernard, Dragos Golubovic, Evstatiin Krastev</i>	

MF6: PROVEN TECHNOLOGIES FOR NEXT GENERATION LEAD-FREE REWORK

Considerations for Reduced Cost Micro Array Component Rework	711
<i>Edward Zamborsky</i>	
Automated Site Redress Method Application for Pb-Free Rework	714
<i>Sven Peng, Wayne Zhang, P. K. Pu, Phil Isaacs, William Uy, Henley Zhou</i>	

MF7: OPTIMIZING THERMAL PERFORMANCE IN PRINTED CIRCUIT BOARD ASSEMBLIES

Heatsink Adhesive Bonding Investigation	721
<i>Smile Ling, Jim Bielick, Michk Huang, Wayne Zhang, Blue Wang, Xiaoyun Xia, Divas Liu</i>	
Evaluation of Phase Change Thermal Interface Materials by In-situ Methods and Their Application Dependent Performance Parameters	729
<i>Scott Allen</i>	

SMT MANUFACTURING AND ASSEMBLY

SMT1: BOTTOM TERMINATION COMPONENTS — PART 1

Bottom Termination Component Land Pattern Design and Assembly for High Reliability Electronic Systems	743
<i>Scott Nelson</i>	
Board Level Reliability and Assembly Process of Advanced QFN Packages	753
<i>Li Li, Brian Smith, Joe Smetana, Richard Coyle, Alex Chan, David Geiger, Chris Katzko, Jeffrey Changbing Lee</i>	
Simple, Fast High Reliability Rework of Leadless Devices	759
<i>Bob Wettermann</i>	

SMT2: BOTTOM TERMINATION COMPONENTS — PART 2

The Effects of Preforms in Paste on Voiding Under Large Area Surface Mount (BTC) Components	764
<i>Ellen Tormey, Jerry Sidone, Westin Bent, Karen Tellefsen, Paul Koep, Rahul Raut</i>	
The Effect of Thermal Pad Patterning on QFN Voiding	773
<i>Derrick Herron, Yan Liu, Ning-Cheng Lee</i>	
Using SPI, AXI and CT X-ray Data to Improve SMT Process With QFN Devices.....	779
<i>Stephen Chen, Tho Vu, Hung Le, Alan Chau, Elliott Le, Phuong Chau, Hao Cui, Raymond Tran, Roy Chung, Bryan Goble, Nadarajan M. Singaram, Golden Xu, Zhen (Jane) Feng, David A. Geiger, Murad Kurwa, Evstatiin Krastev</i>	

SMT3: SMT PRINTING TECHNOLOGY

Influence of Printer Settings on Step Stencil Design	785
<i>Carmina Läntzsch, Georg Kleemann</i>	
Which New Stencil Technologies Provide the Best Paste Printing Performance?	793
<i>Richard Brooks, John Carr, Marty Carr</i>	
Understencil Wiping: Does it Benefit Your Process?.....	801
<i>David Lober, Mike Bixenman, Chrys Shea, Ed Naus</i>	

SMT4: CLEANING: MECHANICS, MATERIALS AND WHERE THEY BRING VALUE TODAY

High Speed Cleaning in a Reduced Manufacturing Footprint..... 810
Steve Stach, Mike Bixenman, Dale Lee

Comparative Cleaning Study to Showcase the Effective Removal of OA Flux Residues 823
Jigar Patel, Umut Tosun, Michael McCutchen

No Clean Flux Residue and Reliability - An EMS Perspective 837
Jennifer Nguyen, David Geiger, Dennis Willie, Murad Kurwa

SMT5: FUTURE OF CLEANING AND CLEANLINESS TESTING

The IPC-B-52 SIR Test Vehicle — A Discussion of the Current Test Vehicle Design and Possible Modifications for the Future..... 843
Mitchell Ferrill, Matthew Kelly, Wai Ma, Nandu Ranadive, Cheikhou Ndiaye, Jim Bielick, Simin Bagheri

Cleaning No-Clean Flux and Related Reliability Issues 853
Eric Camden

Water Soluble Lead-Free Process Chemistry for High Voltage and High Reliability Hardware Requirements 860
Matthew Kelly, Mitchell Ferrill, Wai Ma, Nandu Ranadive, Cheikhou Ndiaye, Simin Bagheri, Prakash Kapadia

SMT6: BGA BACKWARDS COMPATIBILITY? — THE MIXED METAL DILEMMA

Voiding Behavior in Mixed Solder Alloy System 870
Yan Liu, Derrick Herron, Joanna Keck, Ning-Cheng Lee

Development of Processing Parameters for Soldering Lead-Free Ball Grid Arrays Using Tin-Lead Solder 878
William Fox, Ben Gumpert, Linda Woody

Thermal Fatigue Reliability and Microstructural Characterization of a Large, High Density Ball Grid Array with Backward Compatible Assembly..... 886
Richard Coyle, Richard Popowich, Peter Read, Debra Fleming, Raiyo Aspandiar, Vasu Vasudevan, Steve Tisdale, Iulia Muntele

SMT7: VOID REDUCTION AND JOINT RELIABILITY

Interconnection Reliability of Interposer and Reballing Options for Ball Grid Array Backward Compatibility 894
Richard Coyle, Richard Popowich, Peter Read, Debra Fleming, Michael Meilunas, Martin Anselm, Mike Oswald

Optimizing Solder Paste for Void Minimization with Vacuum Reflow 903
Keith Sweatman, Takashi Nozu, Tetsuro Nishimura

A New Approach to Void-Free Reflow Soldering 911
Rolf Diehm, Mathias Nowottnick, Uwe Pape

SUBSTRATES

SUB1: SOLDERABILITY AND RELIABILITY ON PRINTED CIRCUIT BOARD SURFACE FINISHES

Immersion Gold: Why More Is Not Better..... 918
Hank Lajoie, James Trainor

The Re-emergence of Immersion Tin Final Finish 924
Bernhard Wessling, Holger Merkle, Karl Wengenroth, Mario Orduz

Electroless Nickel/Immersion Silver — A New Surface Finish for PCB Applications..... 933
Ernest Long, Lenora Toscano

SUB2: CREEP OCCURRENCE AND CORROSION PRODUCTS

Data Mining for Creep Corrosion on Desktop Computers 940
David C. Cook

Study of Sulfide Films Grown on Printed Circuit Boards..... 943
Anil Kurella, Balu Pathangey

Corrosion Mechanisms of Lead-Free PCB Surface Finishes in Corrosive Environments 948
Chen Xu, W. D. Reents Jr., D. A. Fleming, J. P. Franey, G. E. Derkits Jr., P. Ahern, B. Wright, K. Demirkan, R. L. Opila, K. Hannigan, M. Reid, J. Punch, M. N. Collins

SUB3: MISCELLANEOUS TOPICS RELATING TO FA AND PROCESS OF PCBs

Filling Characteristics of Process for Electroplating Copper into Microscopic Recessed Features 960
Maria Nikolova, Jim Watkowski

Pad Cratering Susceptibility 966
Wong Boon San, Julie Silk

Investigation of CAF Failures in Printed Circuit Board Assemblies..... N/A
Aravind Munukutla, Brent Pingrey, Gerald Gmerek

SUB 4: SURFACE FINISH FOR ASSEMBLY AND RELIABILITY

Study of the Deposit Characteristics of Electroless (Autocatalytic) Silver as a Final Finish for LED Package..... 975
Shigeo Hashimoto, Katsuhisa Tanabe, Masayuki Kiso, Daisake Hashimoto, Donald Gudczauskas, George Milad

Long Term Reliability of Eutectic Sn-Pb and Pb-free Solder Joints Made to the ENEPIG Surface Finish 980
William Johannes, Paul Vianco, Jerome Rejent, Bonnie McKenzie

Package Substrate Advancements Through Improved Adhesion of Electroless Copper to Dielectrics 989
Lutz Brandt, Zhiming Liu, Tafadzwa Magaya, Patrick Brooks, Robin Taylor

THEATRE SESSIONS

THEATRE 1: EXPANDING AND IMPROVING PRINTING FUNCTION THROUGH STENCIL INNOVATION

Flux Reservoir Stencil Printing 995
William Coleman, Matthew S. Read

THEATRE 2: SMT PLACEMENT

Precision Height Stand-off Block With Inline High Speed Placement Machine 1002
Steven Perng, Weidong Xie, Nguyet Anh Nguyen

THEATRE 3: MATERIALS AND SOLDERING PROCESSES FOR TODAY'S ASSEMBLIES

Increase of SMT Process Robustness Through the Right Selection of Solder Pastes..... 1007
Jose M. Servin, Cynthia Gomez

Epoxy Fluxes: Dip Assembly Process Issues and Reliability..... 1018
Pericles A. Kondos, Michael J. Meilunas, Martin K. Anselm

Optimizing PTH Hole-Fill Using Lead-Free Wave Soldering..... 1027
Jennifer Nguyen, David Geiger, Murad Kurwa

Lessons Learned in Developing and Optimizing a Select Solder Process for Thermally Challenging Boards..... 1033
Thomas Gervascio

THEATRE 4: THROUGHPUT, LIFESPAN, AND PARTNERING

Low Cost Process Optimization in High Mix, Low Rate Manufacturing Environment 1038
Thomas Seitz, Brian Asti, Brandon Kidney, William Presley

Process Control Utilizing Component Risk Mitigation Test Plans 1052
Andrew Buchan, Rachel Garcia, Clifton Aldridge, Jimmy Lucero, Mark Northrup

Shared Resource Technology Centers: Industry-Focused Development Resources for the Electronics Manufacturing and Microsystems Industry 1059
Christopher Mather

THEATRE 7: INNOVATIVE PACKAGING SOLUTION

xFD: A Very Thin Two and Four Die Package Solution for High Performance DDR SDRAM 1069
Vern Solberg, Simon McElrea, Wael Zohni

THEATRE 8: A TRAINED TECHNICAL WORKFORCE IS CRITICAL

Providing a Trained Technical Workforce to the Electronics Manufacturing Industry — New College Approaches 1074
Christopher Mather

Author Index