SWTW

IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

June 8 - 11, 2014 | San Diego, California

Welcome to the 24th Annual IEEE SW Test Workshop

IEEE

CPMT

IEEE COMPONENTS, PACKAGING AND MANUFACTURING TECHNOLOGY SOCIETY

Jerry Broz, Ph.D.

SW Test General Chair

Twenty-Four Years of Probe Technology

Many thanks to all of the 7500+ attendees from around the world !

IEEE SW-Test Workshop

- **SW Test is a Probe Technology Forum …**
  - Focused Technical Workshop for Wafer Test Professionals
  - Practical solutions to real problems
  - Balanced mixture of semiconductor manufacturer, and supplier as well as collaborative presentations
- **Informal Conference …**
  - Grass roots workshop format focused on technical exchange
  - Great social activities to facilitate friendly and informal discussions
  - Meet new people, talk about probe, and have a little fun !
- **Continue to adopt a "Green Initiative" …**
  - E-Proceedings and enviro-friendly practices

SW Test 2014 e-Proceedings

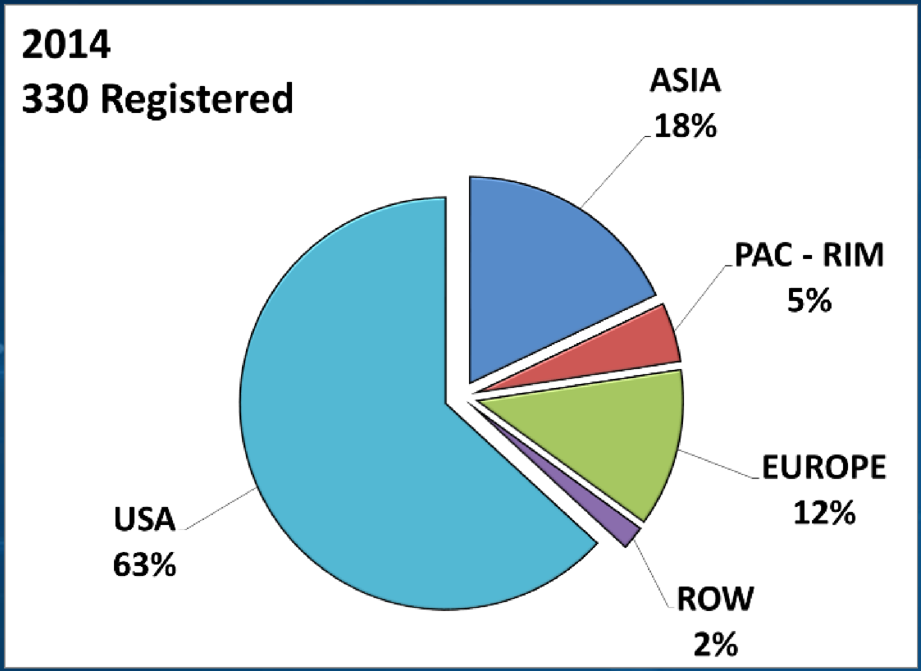
Password for Monday =

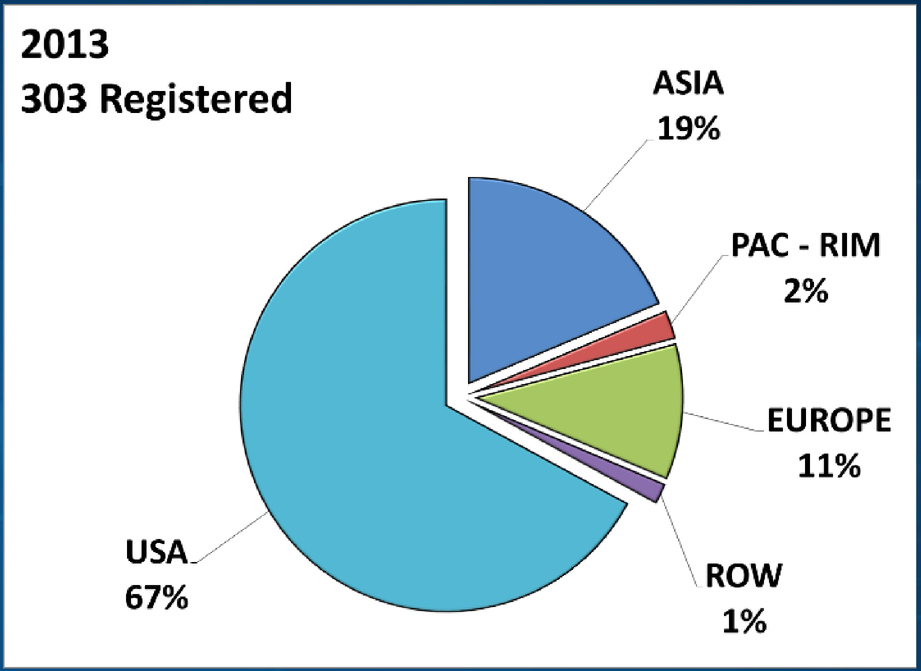
- **SW Test Team continues to be focused on a green initiative.**
- **Each day of the workshop will be available for download in a password protected file.**

  http://www.swtest.org

- **WiFi will be available during the entire workshop to allow access to website for download.**
- **The daily PDF file password will be announced through the day.**

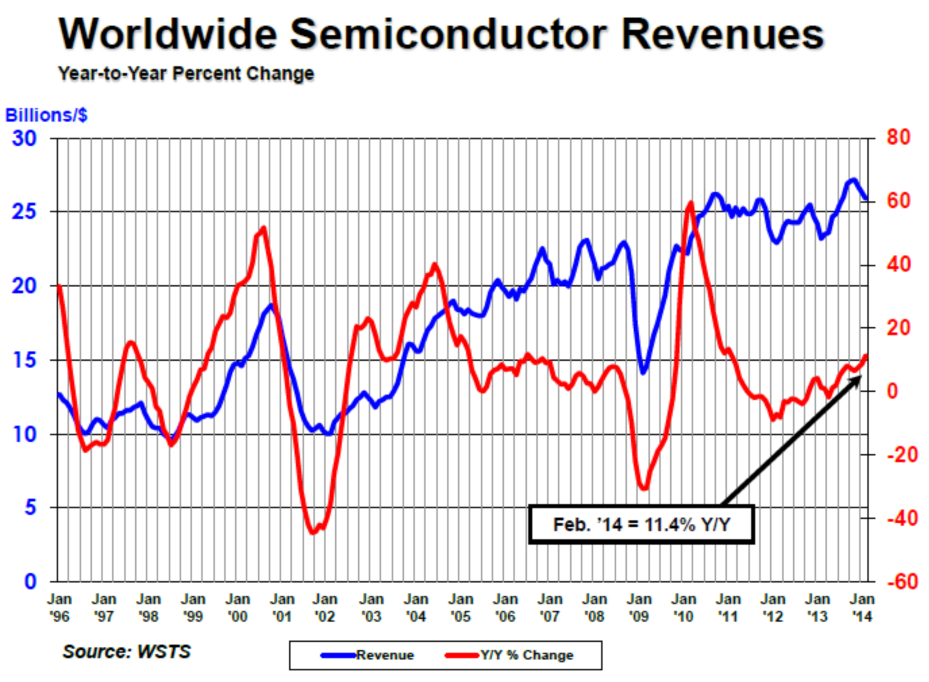
Attendance in 2014 is Strong !





15 out of 32 Podium Presentations have international authorship !

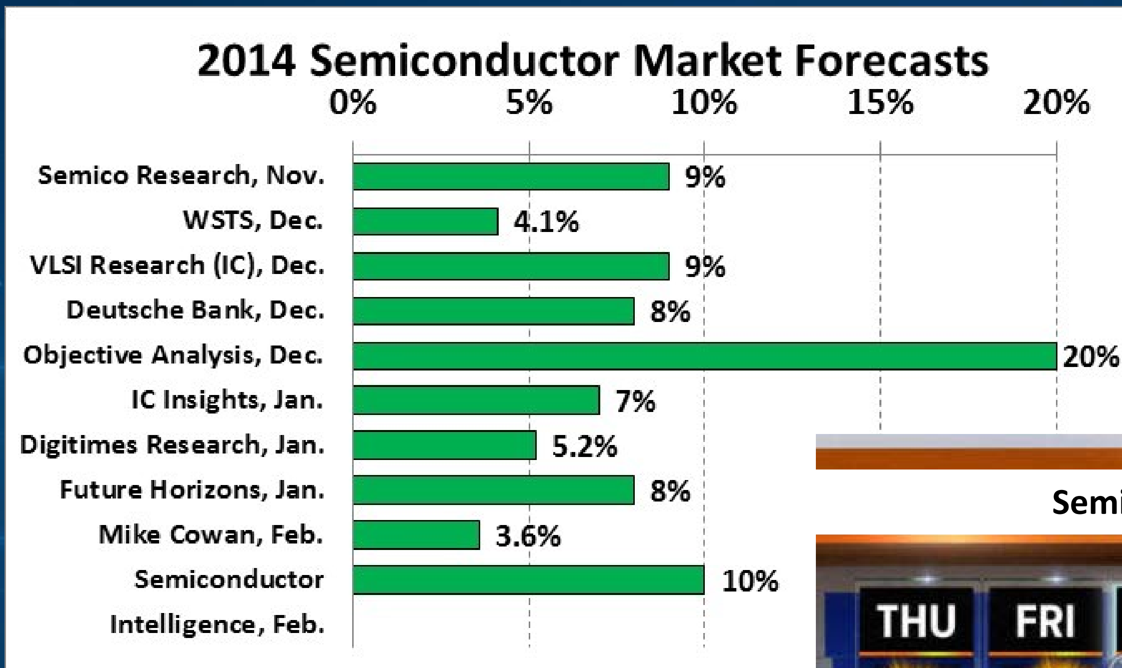
Industry Snapshot



2014 Forecast of IC Market Growth by Segment

Product Category	*2013 Growth*	*2014F Growth*
Tablet MPUs	*63%*	*35%*
DRAM	*32%*	*23%*
Cellphone App MPUs	*30%*	*19%*
Industrial/Other—App-Specific Analog	*23%*	*12%*
NAND Flash	*8%*	*12%*
32-bit MCU	*8%*	*10%*
Display Drivers	*16%*	*10%*
EEPROM/ROM/EPROM/Other	*8%*	*9%*
Auto—App-Specific Analog	*7%*	*8%*
Wired Comm—Spcl Purpose Logic/MPR	*4%*	*8%*
Total IC Market	***5%***	***7%***

Semi-Revenue Growth Forecast



Top Semi-Producers

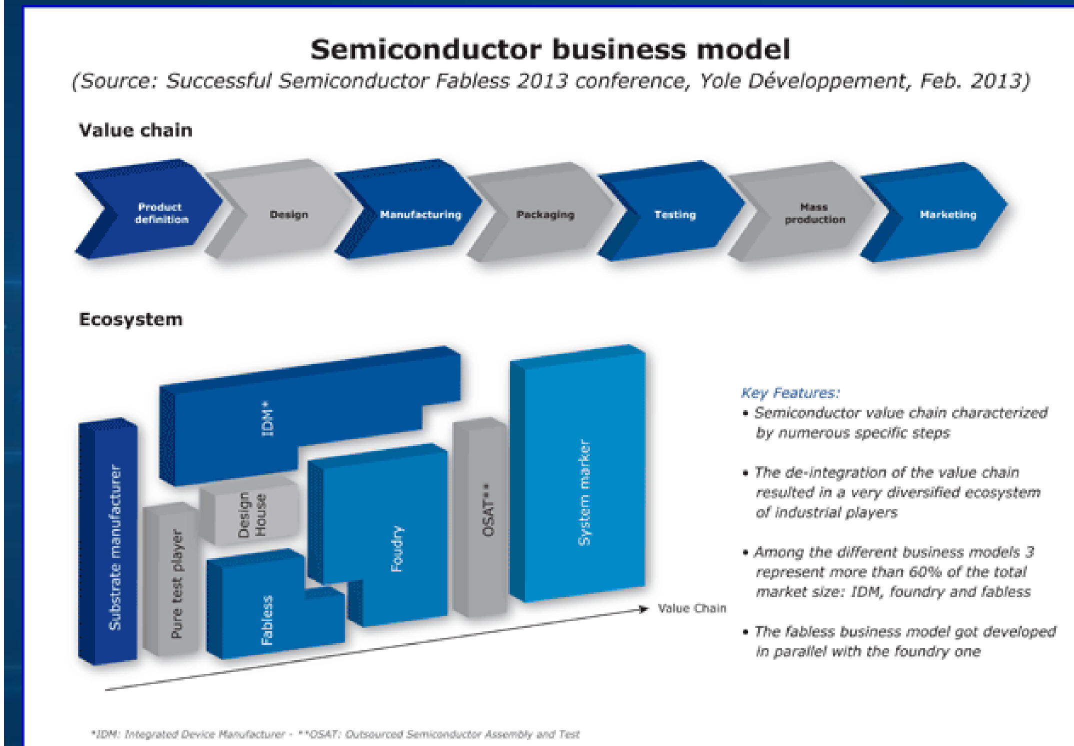
2013 Top 20 Semiconductor Sales Leaders ($M, Including Foundries)

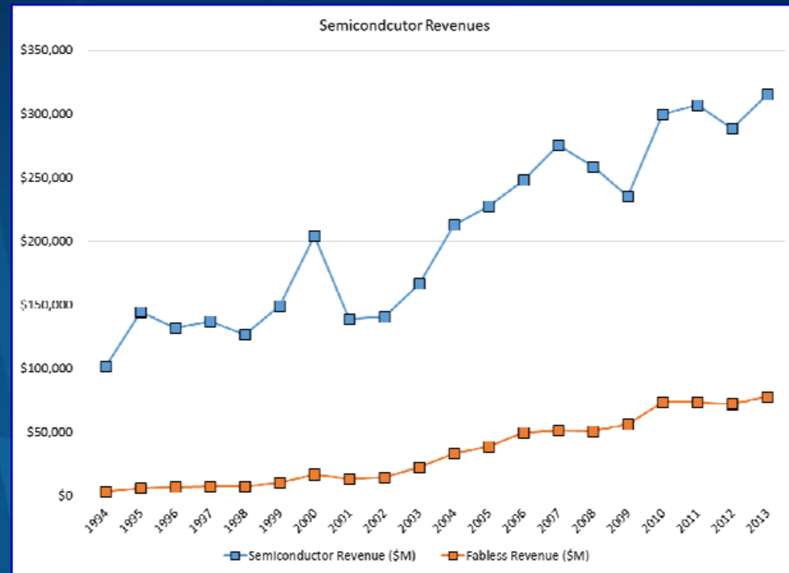
2013 Rank	2012 Rank	Company	Headquarters	2012 Tot IC	2012 Tot O-S-D	2012 Tot Semi	2013 Tot IC	2013 Tot O-S-D	2013 Tot Semi	2013/2012 % Change
1	1	Intel	U.S.	49,114	0	49,114	48,321	0	48,321	-2%
2	2	Samsung	South Korea	30,457	1,794	32,251	32,520	1,858	34,378	7%
3	3	TSMC*	Taiwan	16,951	0	16,951	19,850	0	19,850	17%
4	4	Qualcomm**	U.S.	13,177	0	13,177	17,211	0	17,211	31%
5	10	Micron***	U.S.	7,567	322	7,889	14,255	105	14,360	82%
6	8	SK Hynix	South Korea	9,057	0	9,057	12,970	0	12,970	43%
7	6	Toshiba	Japan	9,055	2,162	11,217	9,868	2,090	11,958	7%
8	5	TI	U.S.	11,376	705	12,081	10,794	680	11,474	-5%
9	11	Broadcom**	U.S.	7,793	0	7,793	8,219	0	8,219	5%
10	9	ST	Europe	6,227	2,137	8,364	5,847	2,167	8,014	-4%
11	7	Renesas	Japan	7,487	1,827	9,314	6,405	1,570	7,975	-14%
12	13	AMD**	U.S.	5,422	0	5,422	5,299	0	5,299	-2%
13	14	Infineon	Europe	3,078	1,850	4,928	3,402	1,858	5,260	7%
14	12	Sony	Japan	1,926	3,783	5,709	1,271	3,598	4,869	-15%
15	15	NXP	Europe	3,102	1,223	4,325	3,534	1,281	4,815	11%
16	22	MediaTek**	Taiwan	3,366	0	3,366	4,587	0	4,587	36%
17	17	GlobalFoundries*	U.S.	4,013	0	4,013	4,261	0	4,261	6%
18	19	Freescale	U.S.	3,180	571	3,751	3,371	636	4,007	7%
19	20	UMC*	Taiwan	3,730	0	3,730	3,959	0	3,959	6%
20	18	Nvidia**	U.S.	3,965	0	3,965	3,898	0	3,898	-2%
—	—	Top 20 Total		200,043	16,374	216,417	219,842	15,843	235,685	9%

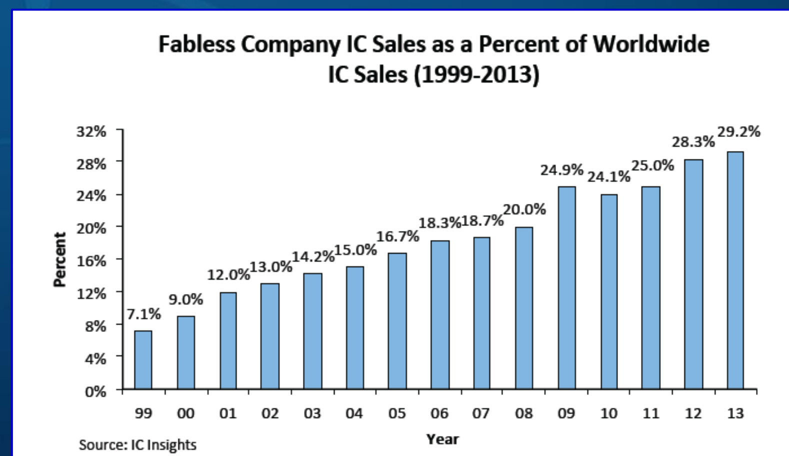
*Foundry **Fabless ***Includes Elpida's entire 2013 sales of $2.5 billion.

Source: Company reports, IC Insights' *Strategic Reviews* database

Consistent Fabless Growth







Top Fabless Producers

2013 Top 25 Fabless IC Suppliers

2013 Rank	2012 Rank	Company	Headquarters	2012 ($M)	2013 ($M)	% Change
1	1	Qualcomm	U.S.	13,177	17,211	31%
2	2	Broadcom	U.S.	7,793	8,219	5%
3	3	AMD	U.S.	5,422	5,299	-2%
4	5	MediaTek	Taiwan	3,366	4,587	36%
5	4	Nvidia	U.S.	3,965	3,898	-2%
6	6	Marvell	U.S.	3,144	3,352	7%
7	7	LSI	U.S.	2,506	2,370	-5%
8	8	Xilinx	U.S.	2,196	2,297	5%
9	9	Altera	U.S.	1,783	1,732	-3%
10	10	Avago	Singapore	1,479	1,619	9%
11	12	Novatek	Taiwan	1,256	1,398	11%
12	13	HiSilicon	China	1,178	1,355	15%
13	11	MStar	Taiwan	1,271	1,136	-11%
14	18	Spreadtrum	China	725	1,070	48%
15	14	CSR	Europe	1,025	961	-6%
16	15	Realtek	Taiwan	836	951	14%
17	16	Dialog	Europe	774	903	17%
18	19	Cirrus Logic	U.S.	714	772	8%
19	17	Himax	Taiwan	737	771	5%
20	21	Silicon Labs	U.S.	563	580	3%
21	22	MegaChips	Japan	553	577	4%
22	24	Semtech	U.S.	518	555	7%
23	23	PMC-Sierra	U.S.	531	508	-4%
24	25	IDT	U.S.	497	475	-4%
25	26	Microsemi	U.S.	450	433	-4%
		Top 25 Total	—	56,459	63,029	12%
		Other Total	—	15,650	14,882	-5%
		Total Fabless	—	72,109	77,911	8%

Source: Company reports, IC Insights' *Strategic Reviews* database

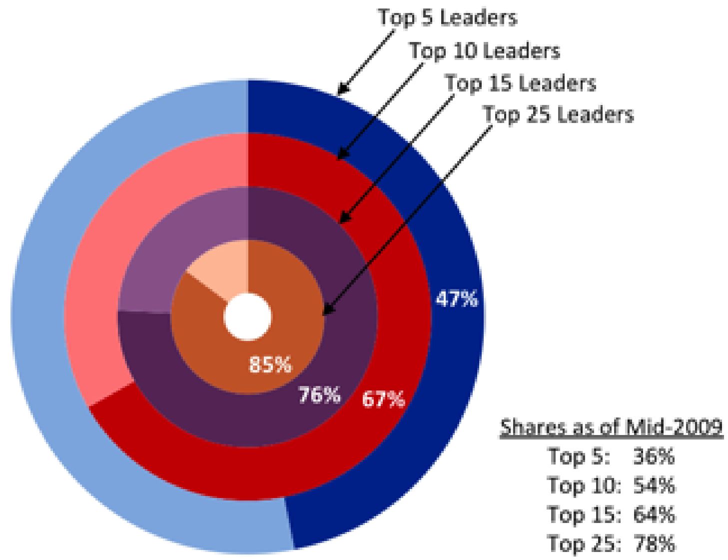
World Wide Capacities

Top 10 IC Wafer Capacity Leaders* as of Dec-2013
(200mm-Equiv. Wafers per Month x1000)

2013 Rank	Company	Headquarters Region	Installed Capacity (K w/m)	% of Worldwide Total
1	Samsung	South Korea	1,867	12.6%
2	TSMC	Taiwan	1,475	10.0%
3	Micron**	Americas	1,380	9.3%
4	Toshiba/SanDisk	Japan	1,177	8.0%
5	SK Hynix	South Korea	1,035	7.0%
6	Intel	Americas	961	6.5%
7	ST	Europe	551	3.7%
8	UMC	Taiwan	520	3.5%
9	GlobalFoundries	Americas	482	3.3%
10	TI	Americas	441	3.0%
—	Total	—	9,889	66.8%

*Includes shares of capacity from joint ventures.
**Includes the former Elpida and Rexchip fabs.
Source: Companies, IC Insights

Capacity Leaders' Shares of WW Capacity as of Dec-2013
(14.8 Million 200mm-Equiv. Wafers per Month Installed)



Source: Companies, IC Insights

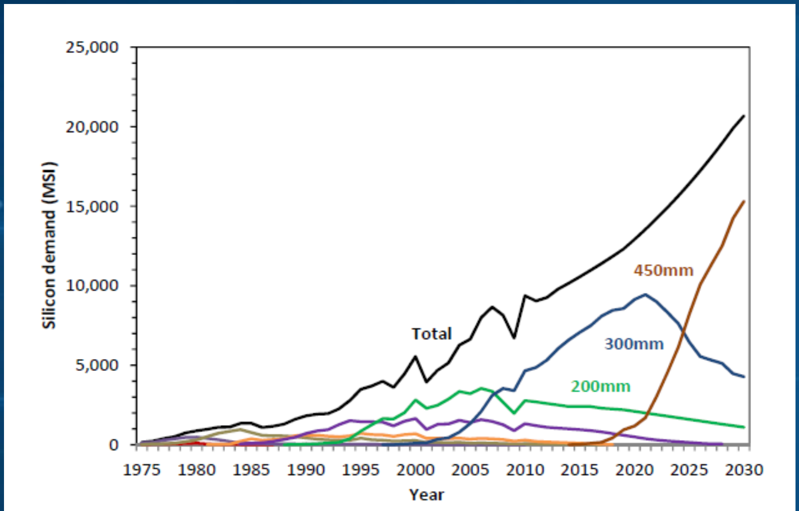
Installed Capacity Leaders per Wafer Size as of Dec-2013
(Ranked by Shares of Total WW Installed Monthly Capacity)

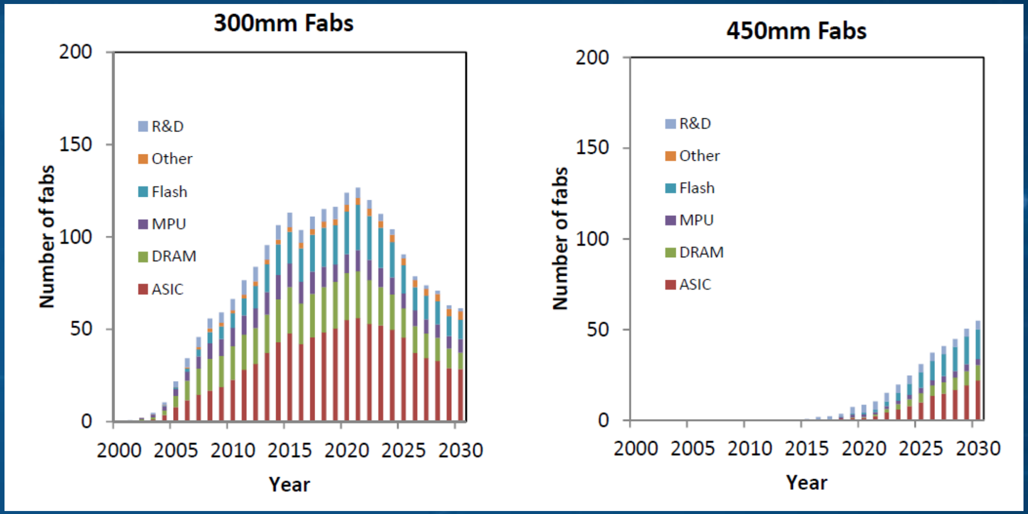
300mm Wafers	200mm Wafers	≤150mm Wafers
Samsung	TSMC*	STMicro
Micron*	Texas Instruments	CR Micro
Toshiba/SanDisk	UMC	Renesas
SK Hynix	Infineon	Panasonic
TSMC	Samsung	ON Semi/Sanyo
Intel*	Renesas	Silan Micro
GlobalFoundries	STMicro	TSMC
UMC	GlobalFoundries	Rohm/Lapis
Powerchip	Toshiba	Toshiba
Nanya*	Huahong Grace	KEC

*Includes shares of capacity from joint ventures.
Source: IC Insights

Transition to 450mm

- **Will 450mm demand grow ???**



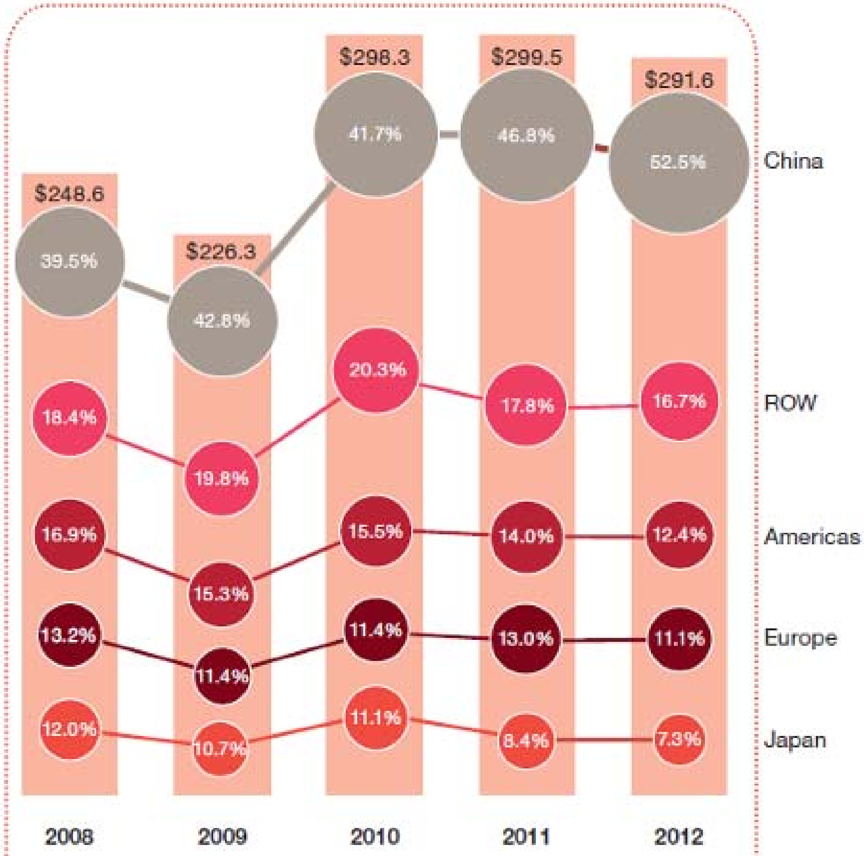


- TSMC, Intel, and Samsung made headlines when they all invested BILLIONS into ASML's efforts to develop 450mm wafers.
- These critical announcements signaled that all of the major logic manufacturers were on the same page for 450mm wafer development.

Is 450mm in a Holding Pattern ?

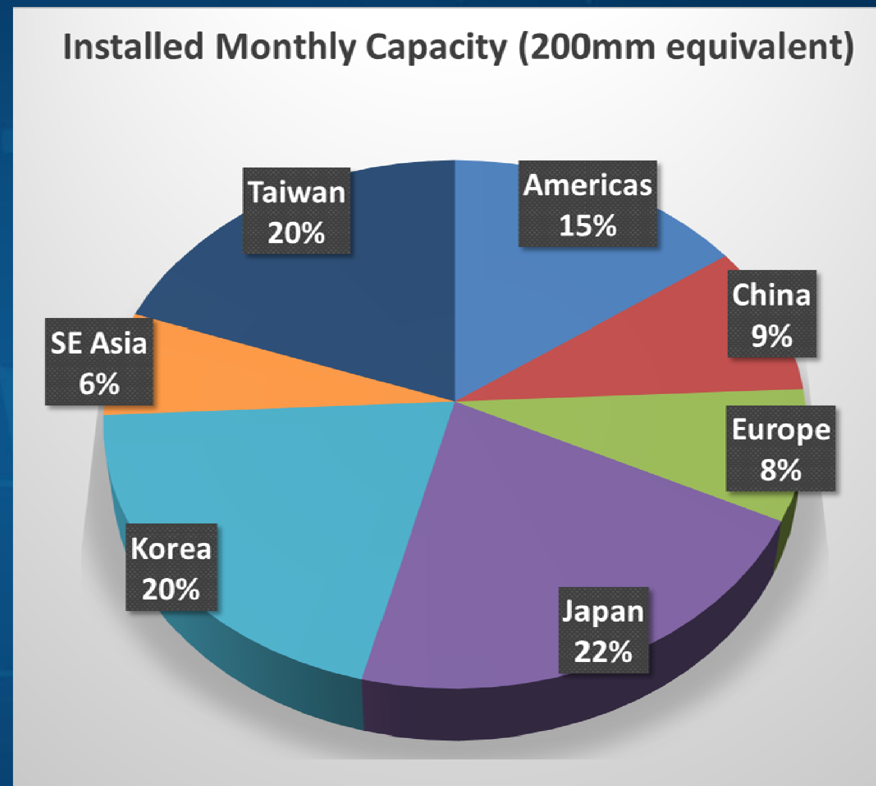
- **ASML has "paused" the development of next-gen 450mm hardware**
  - EUV, considered necessary to maintain Moore's Law, has also seen delays.
  - ASML predicted EUV will reach the stability levels by the 2H16 or 2017.
- **Applied Materials CEO Gary Dickerson says the 450mm migration "has definitely been pushed out from a timing standpoint.“**
- **Intel Fab D1X ($2B Oregon 450mm development fab) and Fab 42 in Arizona have been placed “on hold”.**
  - Intel which agreed in 2012 to invest $4.1B to help finance ASML developments in 450mm wafers and EUV lithography has "adjusted" the pace of its payments.
- **Samsung has suggested that it is not willing to risk losing market if a 450mm installation drive means less 300mm production.**
- **TSMC was critical of ASML’s progress on EUV and its plans for 450mm wafers may have been delayed another nine years to the 2023 Roadmap.**

Top Semi-Consumers WW



China's 2008–2012 share of consumption market based upon McClean Report 2013 (MCR 13) market history. Regional share of worldwide consumption market is based upon Gartner "Semiconductor Forecast Database, Worldwide" 2011–2017 1Q13 and prior with adjustments for dislocated purchases.

Source: SIA, MCR 13, CCID, Gartner



Source: SEMI.org

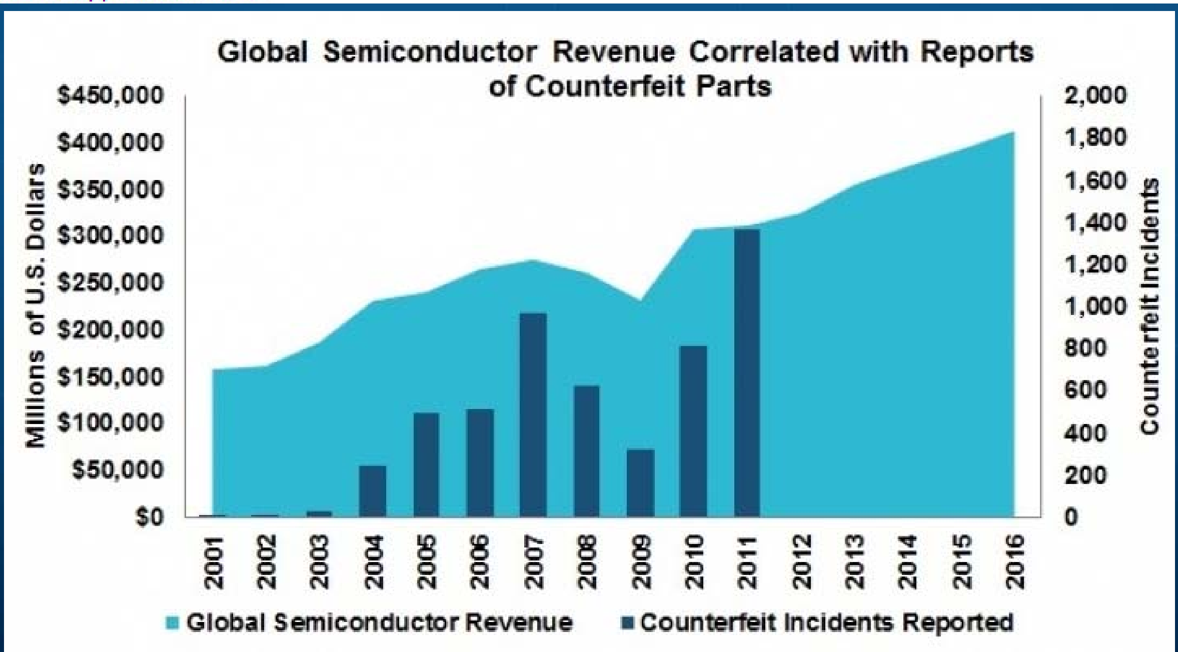
Growing Counterfeit Industry

- **One Counterfeit Part is built Every 15 Seconds**

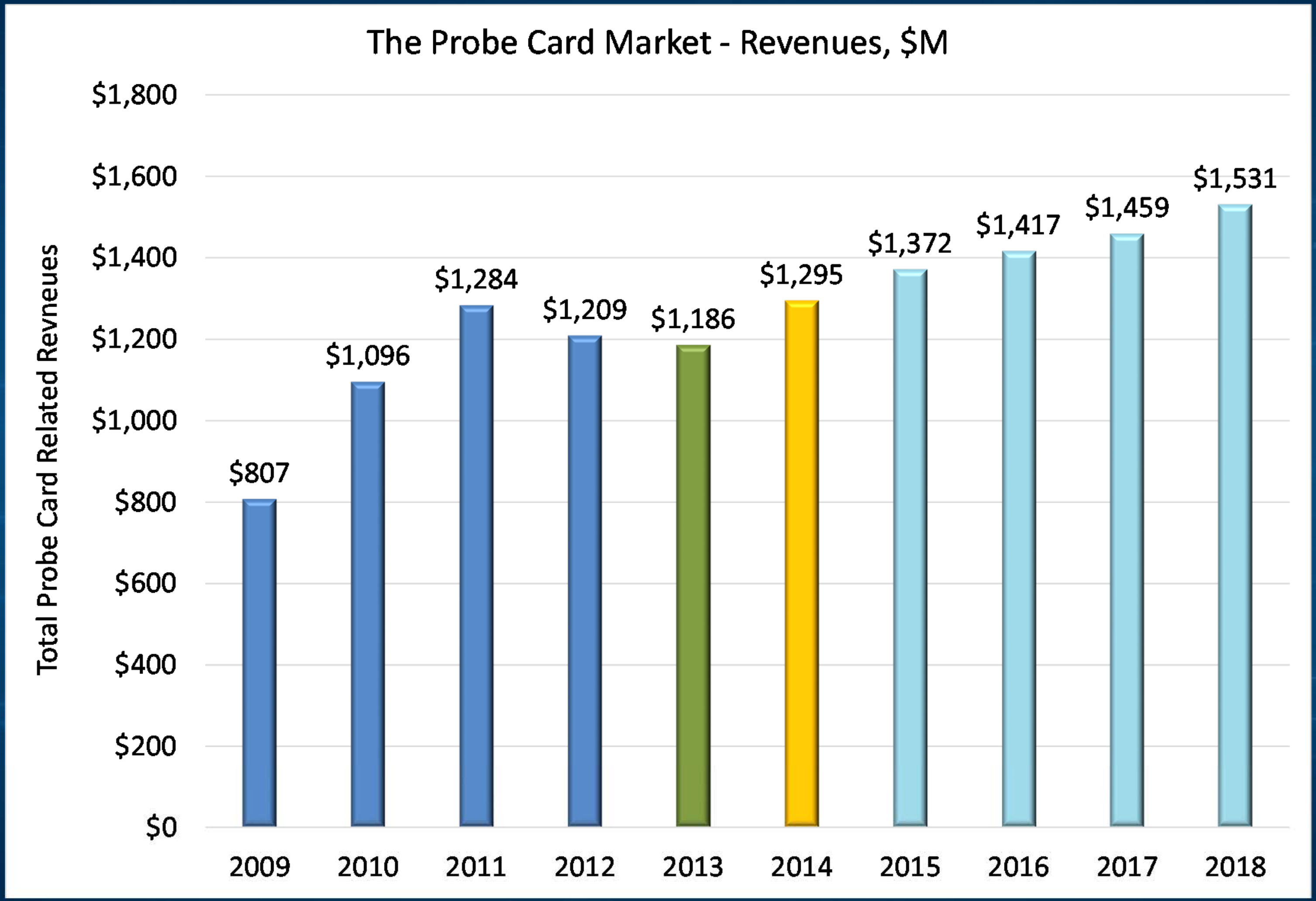
Percentage of Market Revenue for Most Commonly Counterfeited Product Types by Application Market in 2011
(Percentage Share of Revenue in Millions of U.S. Dollars)

Part Type	Industrial	Automotive	Consumer	Wireless	Wired	Compute	Other
Analog IC	14%	17%	21%	29%	6%	14%	0%
Microprocessor IC	4%	1%	4%	2%	3%	85%	0%
Memory IC	3%	2%	13%	26%	2%	53%	1%
Programmable Logic IC	30%	3%	14%	18%	25%	11%	0%
Transistor	22%	12%	25%	8%	10%	22%	0%

Source: IHS iSuppli March 2012

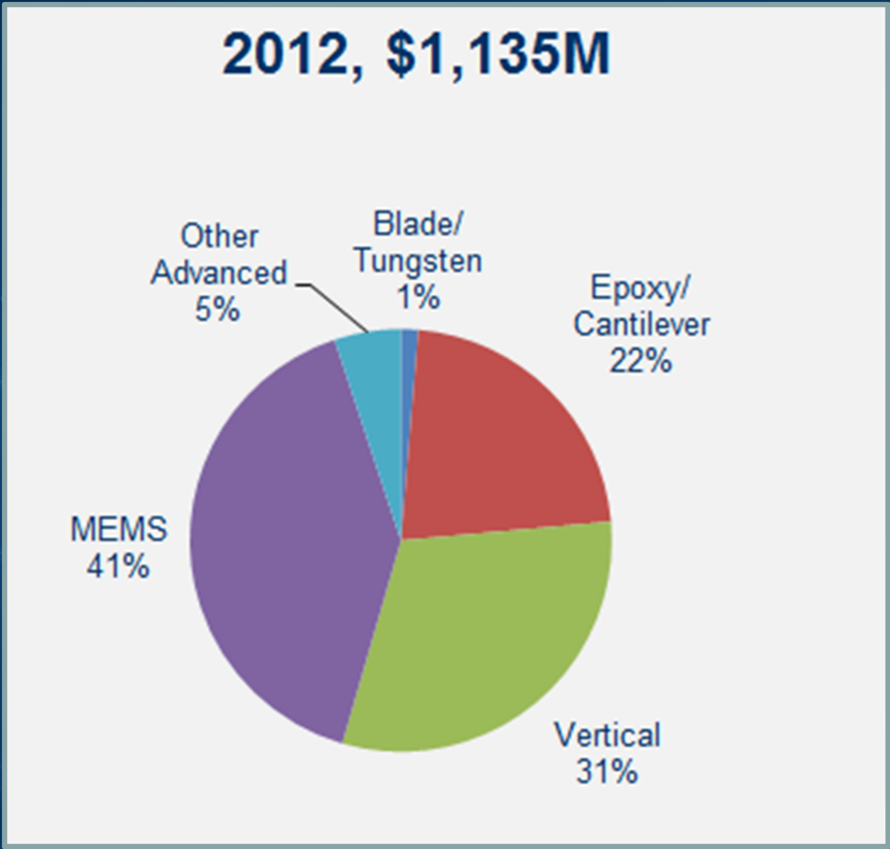


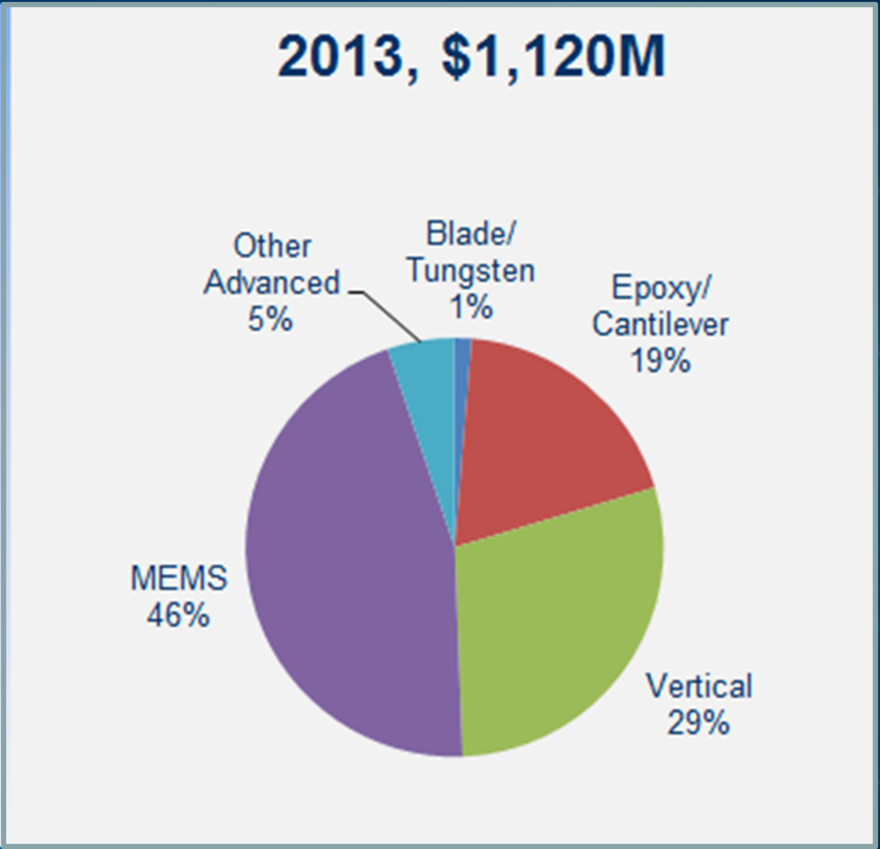
Semiconductor Probe Card Revenues



Thanks to John West and Risto Puhakka!

Revenue by Technology





Thanks to John West and Risto Puhakka!

Top Probe Card Vendors

Top 10 Semiconductor Probe Card Vendors 2013
Revenues in $M, Calendar Year (excludes service and spares)

2012	Rank -2011	Company	2012	2013	% Change
1	(2)	FormFactor, Inc.	178.5	231.5	23%
2	(1)	Micronics Japan Co., Ltd.	199.2	195.0	-2%
3	(5)	Technoprobe	63.4	99.9	37%
4	(3)	Japan Electronic Materials	117.6	81.6	-44%
5	(7)	MPI Corporation	55.8	63.5	12%
6	(6)	Will Technology	57.9	47.3	-23%
7	(17)	Microfriend	12.3	45.4	73%
8	(8)	Korea Instrument	39.0	41.9	7%
9	(9)	Cascade Microtech	37.8	41.0	8%
10	(10)	SV Probe	29.1	32.9	12%
		Other	344.9	239.6	-44%
		Semiconductor Probe Cards	1135.3	1119.5	-1%

Thanks to John West and Risto Puhakka!

24^{th} Annual SW Test Workshop

- **Technical Program for 2014**
  - Technical Tutorial on Sunday
  - Nine Focused Technical Sessions across three days
  - 32 Podium Presentations (… we are "over booked")
- **Products / Services EXPO**
  - 42 full size booths … SOLD OUT !
  - EXPO does not compete with Technical Program
- **Corporate Support Program … MANY THANKS !**
  - Platinum: BucklingBeam, FormFactor, International Test Solutions, JEM - America, MJC, MPI, R&D Altanova, and Teradyne Global Services
  - Gold: TechoProbe
  - Silver: Advanced Probing Systems, Microfabrica, SV TCL

Platinum Supporters

JEM

international TEST SOLUTIONS

MPI

R&D Altanova

BucklingBeam

GSO
TERADYNE GLOBAL SERVICES ORGANIZATION

MJC

FormFactor Inc.

Gold Supporters

TECHNOPROBE
Wafer Probing Technologies

Silver Supporters

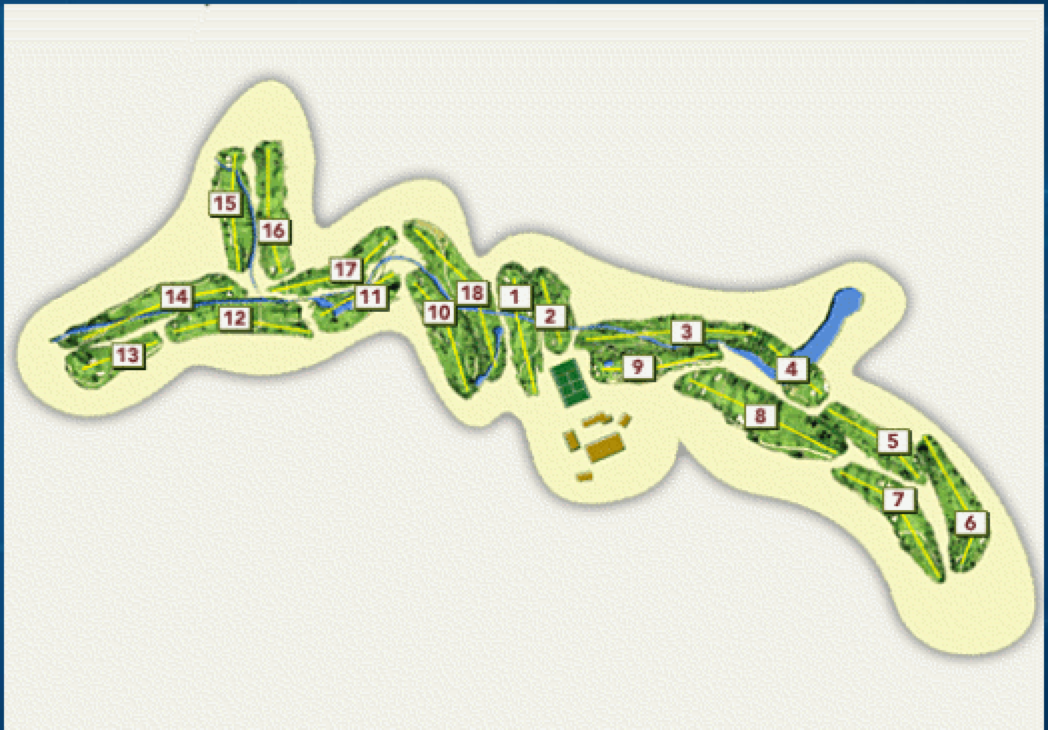
ADVANCED PROBING SYSTEMS, INC.

SV TCL
An SV Probe Company

MICROFABRICA

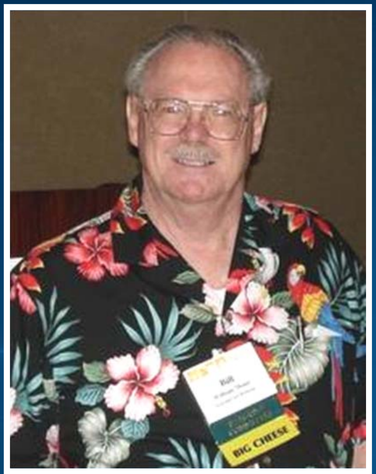
SW Test 2014 Golf Scramble

- **Corporate Supporters, Exhibitors, and Attendees**



Only golf course in San Diego to have hosted both PGA, LPGA, and Collegiate events

William R. Mann Student Grant



William R. Mann
(1943 to 2010)
Founder of SW Test
Sr. Member IEEE

- **Miss Noelle Blaylock** from Brigham Young University, Idaho, was awarded the student grant for IEEE SW Test Workshop 2014.
- William R. Mann Student Grant supports student participation at IEEE conferences and encourages interaction between students and technologists.
- Grants are awarded to undergraduate or graduate students who will present a paper or participate at either the IEEE ITC or IEEE SW Test (one grant per conference per year).
- Student Grant is still available for IEEE ITC !

A few words about 2014 …

- **SW Test is IEEE sponsored and a 100% non-profit activity.**
- **SW Test is a workshop held on a relaxed property with a program designed to promote and encourage friendly networking.**
- **Registration fee covers ONLY the food and beverages …**
  - Sunday reception and dinner
  - Daily breakfast, lunches
  - Daily AM and PM coffee breaks
  - EXPO reception, social function and dinner

- **All other costs are covered by Corporate Support and the Exhibitors at the EXPO !**
- **No other conference provides this type of focused, grassroots program.**

"We're not in it for the money …"

- **SW Test Executive Team has worked closely with the RBI staff such that every attendee has free parking, in-room internet, no resort fees, WiFi access during the workshop, and the best on-site conference room rate.**

- **SW Test Executive Team …**
  - Jerry Broz, Ph.D., General Chair and IEEE Sr. Member
  - Rey Rincon, Freescale Semiconductor, Technical Program Chair
  - Maddie Harwood, CEM Inc., Finance Chair
  - Caroline Ambrose, CEM Inc., EXPO / Registration Coordinator

"Who's Really to Blame …"

- **Program Committee …**
  - Darren James (Consultant)
  - Jan Martens (Goodgame Studios)
  - Patrick Mui (JEM America)
  - John Caldwell (Micron Technology)

IEEE SW Test is organized, coordinated, and executed through the volunteer efforts of your colleagues.

- **Steering Committee …**
  - Gunther Boehm (FeinMetall GmbH)
  - Michael Huebner, Ph.D. (FormFactor)
  - Amy Leong (Formfactor)
  - Clark Liu (PTI)
  - Mark Ojeda (Spansion)
  - Fred Taber (Taber Consulting)
  - Joey Wu (MPI)

- **New Members …**
  - Karen Armendariz (Celadon Systems)
  - Stevan Hunter, Ph.D. (ON Semi / BYU Idaho)
  - Gary Maier (IBM)
  - Al Wegleitner (Texas Instruments)

Technical Program / Agenda

- **Sunday, June 8**
  - Tutorial Sessions
    - **Thermal Analysis of Wafer Level Probes for Final Test**
      - Jay Drescher (Johnstech International)
    - **Comparison of Various RF Calibration Techniques in Production: Which is Right for You?**
      - Daniel Bock (Cascade Microtech)
    - **Measuring Probe, Socket and Device Capacitance and Inductance Through A Probe Card**
      - Gert Hohenwarter (GateWave Northern, Inc.)
  - Registration and Cocktails
  - Buffet Dinner and Keynote Presentation

Keynote Speaker

- **Sunday, June 8**

Ken Hansen

Vice President and CTO

freescale™ semiconductor

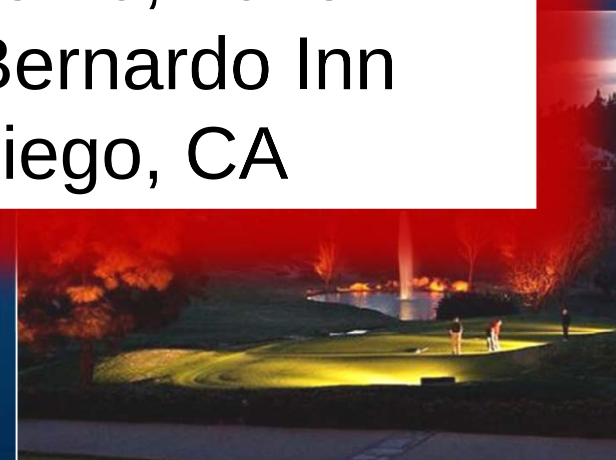
Semiconductor Market & Technology Trends

Technical Program / Agenda

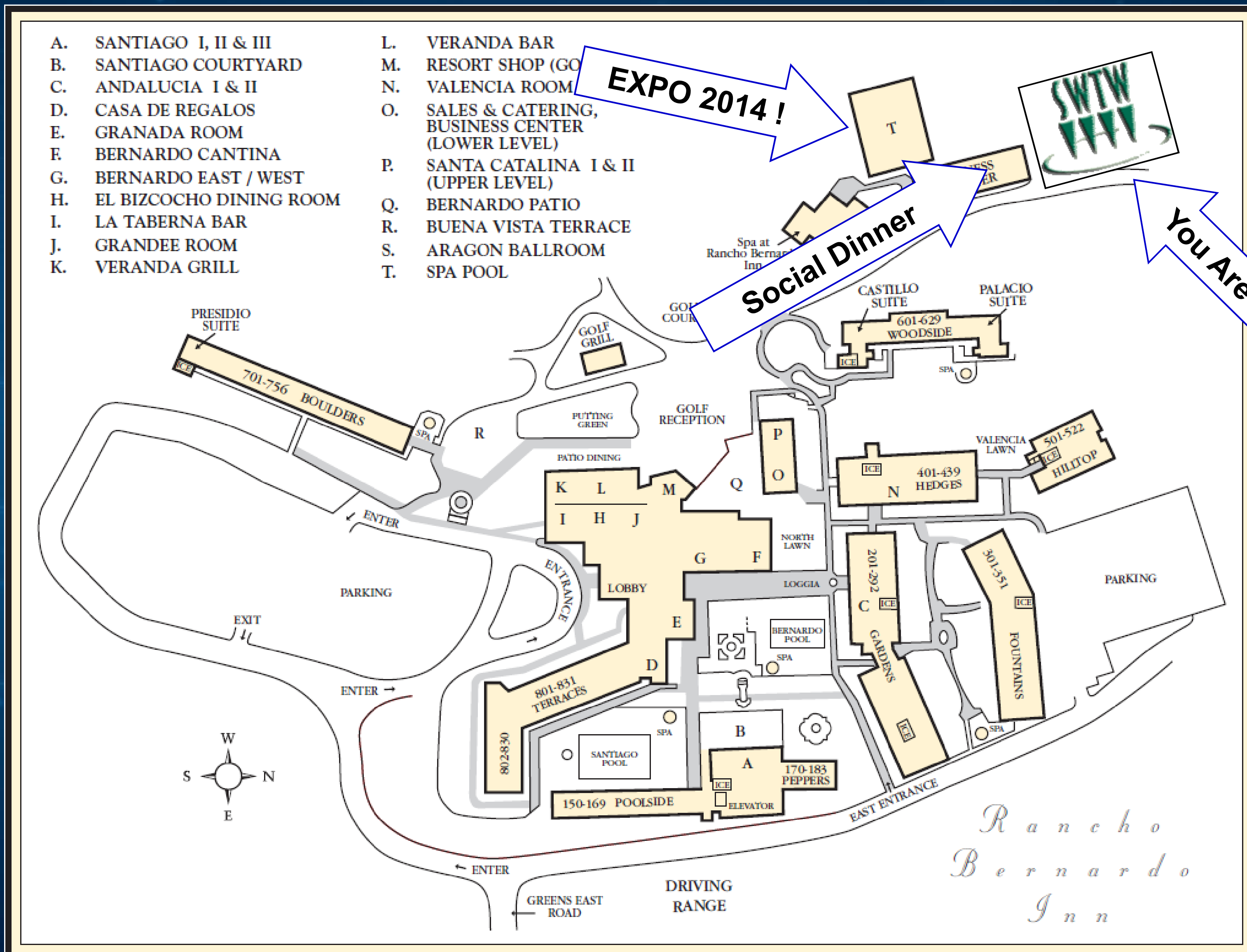
- **Monday, June 9**
  - Registration and Breakfast
  - Characterizing the Touchdown and the Damage
  - High Voltage, High Temperature, High Current
    - Lunch (Aragon Lawn)
  - Design & Testing Advanced Probecards
  - Advanced Vertical Technologies
  - EXPO 2014 w/ Dinner at Reception Stations
    - Networking at La-Taberna Bar

Rancho Bernardo 2014

IEEE SW Test 2015
June 7 to 10, 2015
Rancho Bernardo Inn
San Diego, CA



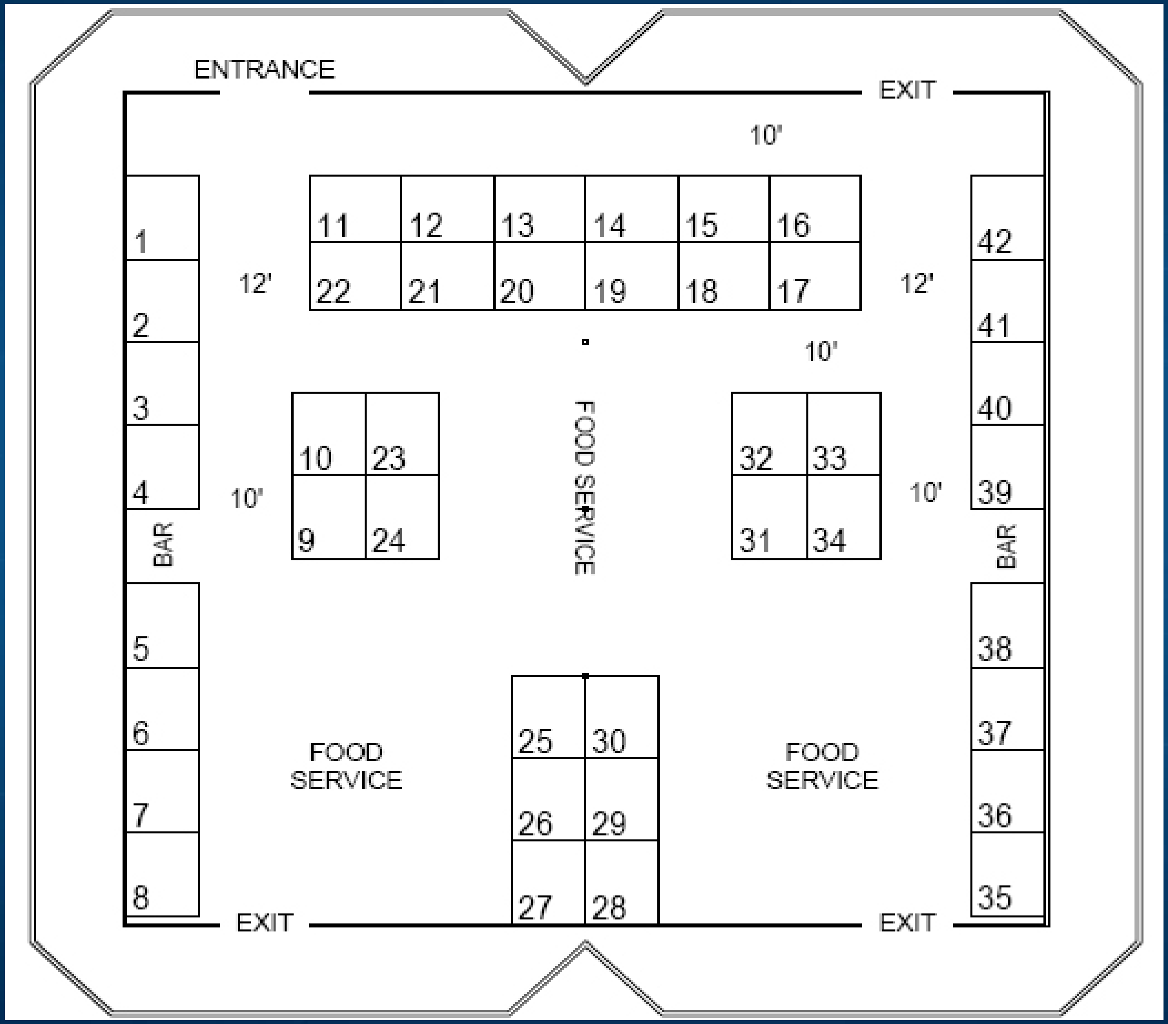
Map of the Area



IEEE SW Test EXPO 2014

- Accretech America
- AEHR Test Systems
- BucklingBeam Solutions … PLATINUM
- Cascade Microtech
- Complete Probe Solutions, Inc.
- Feinmetall GmbH
- Ferrotec (USA) Corporation
- FormFactor, Inc. … PLATINUM
- Hitachi Chemical Co,. Ltd.
- IMT Innovative Manufacturing Technology
- Integrated Technology Corporation
- Integrated Test Corp.
- International Test Solutions, Inc … PLATINUM
- Intest Silicon Valley
- IWIN Co.,Ltd.
- JEM America Corp. … PLATINUM
- Johnstech International
- Kanematsu USA Inc.
- Kita USA, Inc.
- LEENO
- Micronics Japan Co., LTD. … PLATINUM
- MPI Corporation … PLATINUM
- Multitest
- NTK Technologies
- Oxford Lasers
- Plastronics
- Pozzetta Products
- ProbeAce Co.,Ltd.
- Prober.com
- Qualmax Testech, Inc.
- R & D Altanova … PLATINUM
- Rika Denshi America, Inc.
- Rudolph Technologies
- SemiProbe, Inc.
- Specialty Coating Systems
- STAr/KVD
- SV TCL - SV Probe … SILVER
- T.I.P.S. Messtechnik GmbH
- TechnoProbe America … GOLD
- Tokyo Electron Limited (TEL)
- TSE Co.,Ltd.
- Wentworth Laboratories, Inc.

IEEE SW Test EXPO 2014



QR Code on Badges

- **QR codes on the backside of the badges**
  - First and Last Name
  - Organization
  - Email Address
- **Suggested Free Readers**
  - QRReader (TapMedia)
  - ScanLife (Scanbuy)
  - Many more free Apps are available
- **Download App and Test before entering the EXPO**

Technical Program / Agenda

- **Tuesday, June 10**
  - Registration and Continental Breakfast
  - Fine-Pitch Bump Probing
  - Selection, Use and Repair of Probecards
    - Lunch (Aragon Lawn)
  - Challenges of Wafer Level Chip Scale Test
  - EXPO 2014 w/ Refreshments will be served
  - Motown Madness and Review at Aragon Ballroom

Tuesday Social Celebrates Motown Sounds at RBI

- **Featuring … <u>The Motown Funk Brothers Duo</u>**
- **Cocktail reception on the Aragon Lawn**
- **Buffet Dinner and Relaxed Networking in Aragon Ballroom**
- ***Soul food* dishes that are iconic of music genre**
- **Kids <u>under 12</u> can join for free !**

Technical Program / Agenda

- **Wednesday, June 11**
  - Registration
  - Cost of Ownership
  - Probe Potpourri
  - Awards and Adjournment
  - Box Lunch (Aragon Lawn)

Recognition & Awards

- Most "Inspirational" Presentation
- Best Presentation, Tutorial in Nature
- Best Data Presented
- Best Overall Presentation

- Some other "Special Awards"

SWTW-2014 Awards

Most Inspirational Presentation

"Very Small Pitch Micro Bump Array Probing"

Gunther Boehm (FeinMetall GmbH)
Samuel Kalt (Team Nanotec)
Joerg Kiesewetter (Cascade-Microtech)
Armin Klumpp (Fraunhofer Institute)
Wolfgang Schaefer (FeinMetall GmbH
Erik Jan Marinissen (IMEC - Leuven)

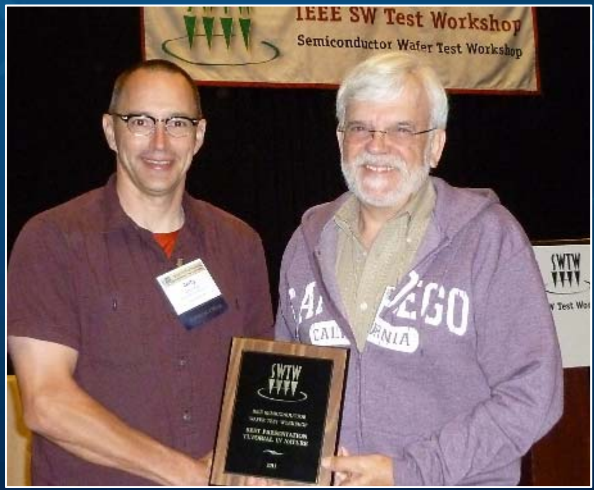
"Design Practice of High Payload Vertical Probe Card"

Joey Wu and Tony Yu
(MPI Corp., Taiwan)

Best Presentation, Tutorial in Nature

"What Burns My Probes !"

Richard Studnicki
(SanDisk – USA)



SWTW-2014 Awards

Best Data Presentation

"A Fine Pitch MEMS Probe Card with Built in Active Device for 3D IC Test"

Lakshmikanth Namburi
(Advantest America, Inc., USA)

Gary Maier
(IBM - Hopewell Junction , USA)

Best Overall Presentation

"Full wafer probe cards for mixed signal products"

Jan Martens, Marcel Bleyl, and Thomas Dabelstein (NXP Semiconductors GmbH)

Simon Allgaier and Joerg Behr
(Feinmetall GmbH)

That "Special" Award …

Bill Mann's Poorest Disguised Sales Pitch

"What happens at SW Test stays at SW Test !!"

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Want to Learn More ?

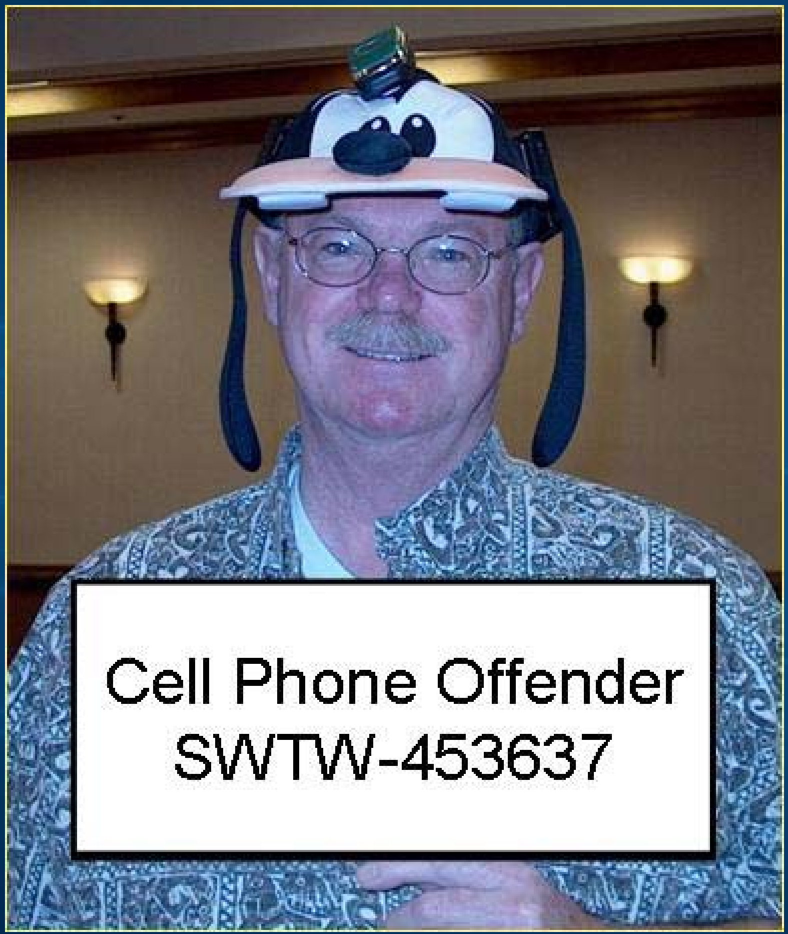
- **Electronic Components and Technology Conference**
  May 26 to 29, in San Diego, California
  http://www.ectc.net

- **Burn In & Test Strategies Workshop**
  March 15-18, 2015 in Mesa, Arizona
  http://www.bitsworkshop.org

- **IS-Test Workshop**
  May, 2015 in Freising, Germany
  http://www.is-test.com

- **ProbeCard Insider**
  Technology Blog by Paul Meter focused on Probe Cards
  http://probecardinsider.com

Silence your cell phone !!!



Thanks for your Support !

- **Contact the SW Test Team with any questions …**

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