

# SEMICONDUCTOR



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FOCUSED ON EMERGING SEMICONDUCTOR COMPANIES

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## Radar Scope

### Endura

Endura was formed in October 2013 as a fabless semiconductor company providing power management solutions for the microelectronics industry. Endura has developed patented system-level solutions for low-power mobile devices in the most advanced process nodes. Its focus areas are embedded power management for very demanding SoC CPU type applications, as well as stand-alone PMICs. Endura is a portfolio company of the Bridgewest Group and is fully funded. The company has R&D centers in Dublin, Ireland and San Diego, California.

Endura's eVR, sVR, and ATC solutions reduce BOM cost and power usage, while increasing performance. eVR is embedded high efficiency, ultra-fast response, cost-effective voltage regulator IP tailored for demanding application domains of SoC like CPU and GPU. sVR is a high efficiency, fast response, cost-effective stand-alone system PMIC voltage regulator solution for less demanding SoC application domains. ATC (Active Transient Control) is patented thermal and power management IP,

with adaptive control suppressing voltage transients due to parasitic components while minimizing decap requirements.

The target market size is \$50+ billion, according to Endura. Competitors include Ferric Semiconductor, Lion Semiconductor, Gazelle Semiconductor, Dialog, TI, Richtech, Maxim, STMicro, Fairchild, and ROHM, among others. Endura's solution offers high switching frequency, 1us current sensing, seamless transient PFM/PWM, automatic phase shedding up 4 phases, flat efficiency across the entire load range, faster DVFS and start-up speed, PPA improvements, under/overshoot protection, BOM cost savings, elimination of passives, and a smaller board footprint.

Endura currently has multiple engagements. The company has disclosed a commercial partnership with **MediaTek** that aims at demonstrating power, performance, and area improvements at advanced process nodes. This marks the first milestone of Endura's embedded power solutions, using deep submicron technology. Endura and MediaTek have taped out eVR and ATC in advanced process nodes and MediaTek's latest product

offerings will include Endura's technology at the lowest process nodes.

In 2016, the company will offer 28nm and 10nm eVR, sVR and ATC. In 2017, the company plans to offer 7nm eVR, sVR and ATC. Endura is pursuing direct marketing of the sVR PMIC as well as licensing. Endura has foundry partnerships with TSMC and GlobalFoundries, and is in conversations with other large foundries.

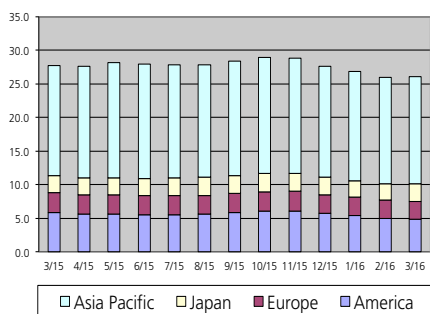
Taner Dosluoglu, Co-founder & CEO (previously director of engineering at Dialog Semi)

Hassan Ihs, Co-founder & CTO (previously a mixed-signal design consultant and CTO & Co-founder of Primachip)

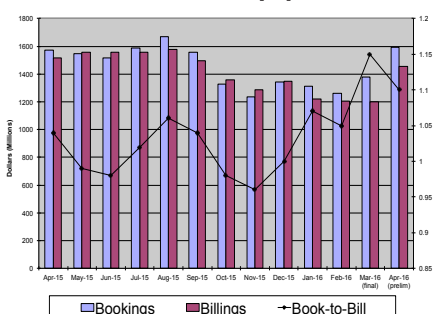
Massih Tayebi, Ph.D., Co-founder (Founding Partner and Chairman of the Bridgewest Group)

Patrick John Quinn, Head of Ireland design centre (previously Technical Steering Board Member at Micro-

SIA Global Sales (\$B)



SEMI's N. American Equipment BK/BL



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## Radar Scope

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electronic Circuits Centre Ireland and Leader, Analog Mixed Signal Research at Xilinx)

UCD Nova, Belfield  
Dublin 4, Ireland  
www.enduratechnologies.com

## Omni Design

Omni Design Technologies was founded in 2015 to develop ultra-low power IP cores, including ultra-low power analog circuits, highly efficient interface circuits and connected sensors. The company is self funded and has raised a small angel round. Omni Design has delivered its first product to a Japanese customer, generating revenue, and as a lean IP company, doesn't currently need additional capital. The company has less than ten employees and will be growing.

The company's patented and proprietary technology dramatically lowers power and provides superior performance, architected from the ground up to take advantage of deep sub-micron CMOS processes. Its IP offerings target SoCs that address a wide range of application areas including IoT, test and measurement, high-speed interfaces, communications, medical imaging, and sensor hubs. Today's IoT and wearable applications often require always-on circuits. Omni Design offers IP featuring extremely low voltage and current requirements, even for mundane circuits such as a bandgap reference, significantly extending battery life.

High open-loop gain, high closed-loop bandwidth, and low noise are simultaneously required in an op-amp for high performance circuits. The limited headroom in modern nanoscale CMOS, has made the limitations of op-amps increasingly challenging.

Omni Design's SWIFT™ is a new circuit technology that uses tried and tested op-amp based architectures for signal

processing. SWIFT dramatically relaxes all aspects of op-amp performance requirements, including open-loop gain, bandwidth, noise, and offset voltage. SWIFT permits the use of simple low power op-amps to be employed in place of highly complex, high power alternatives in high performance circuits. SWIFT is extensively employed in Omni's IPs to increase analog channel speed, to reduce power consumption, and to dramatically increase circuit performance.

Using its core technology, as well as select IP from partners, Omni Design is also building a Sensor IP Platform that fulfills the need for sensor nodes to function for 10+ years on a coin cell battery while communicating with both each other and end users.

Kush Gulati, Ph.D., President and CEO (previously co-founder, President and CEO of Cambridge Analog Technologies, which was acquired by Maxim whereupon he served as Executive Director and GM of the Advanced IP Solutions Group)

Harry Lee, Ph.D., CTO (Professor and the Director of Center for IC and Systems in the Department of Electrical Engineering and Computer Science, MIT; co-founder of Cambridge Analog Technologies and SMA L Camera Technologies)

Sid Dutta, VP (previously Design Director at Silicon Labs, Executive Director at Touchstone, and Design Director in the optical connectivity group at Maxim)

Hyun Boo, Ph.D., Design Director (Ph.D. in electrical engineering and computer science from MIT in 2015. His research focus at MIT was on energy-efficient design of high-resolution & high-speed ADCs and high performance opamp-based switched capacitor circuits)

Drew Peck, Advisory Board, Business Development (20 years at Donaldson Lufkin & Jenrette™ and Cowen & Company, where he was a partner and managing director leading

the firm's semiconductor equity research)

1525 McCarthy Blvd., Suite 1125  
Milpitas, CA 95035  
Tel: 408.727.6377

Boston Design Center  
44 Manning Rd., Suite 220  
Billerica, MA 01821  
www.omnidesigntech.com

## Silicon Mobility

Silicon Mobility was founded in December 2015 as a fabless semiconductor company "enabling the design of cleaner, safer and smarter mobility." The company acquired the assets of Scaleo chip after it failed to secure additional funding and shut down in 2015. Scaleo chip was founded in 1996 to develop ICs for automotive electronics. Silicon Mobility has received funding from Capital-E and Cipio Partners and has roughly 10 million euros in total funding, including national funding and other sources. The company has 30 employees.

Silicon Mobility develops flexible, real-time, safe and open semiconductor solutions for highly demanding and critical embedded systems such as automotive, aeronautics, railways and drones. Silicon Mobility's products are at the heart of engine electrification, hybridization, autonomous and driverless vehicle control.

Competitors include tier-one semiconductor companies such as Freescale/NXP, Infineon, Renesas and STmicroelectronics. Silicon Mobility said these companies use Bosch generic timer (GTM) IP as the heart of real-time microcontrollers for complex automotive applications such as powertrain, power steering, chassis and transmission control. Silicon Mobility argues that GTM is very complex; in contrast, its solution is far easier to program, lending itself well to today's hybrid systems.

The company is developing standard ARM cpu-based products and is on the fast track to deliver mass production next year. Partners and tier one customers are already engaged.

Bruno Paucard, President and CEO (previously CEO of Scaleo chip, a fabless semiconductor company focused on automotive microcontrollers addressing powertrain, body control, driver information and infotainment applications)

Pascal Jullien, VP Engineering (previously VP Engineering at Scaleo chip)

Vincent Cruvellier, VP Operations (previously VP of Operations & Quality Director at Scaleo chip)

David Fresneau, VP Sales and Marketing (previously director of marketing & business development at Scaleo chip)

Sophia-Antipolis, France  
silicon-mobility.com

## Startup Profiles

### Anokiwave

Anokiwave was founded in October 2000 to develop highly integrated core chip solutions that enable emerging mm-Wave and Active Electronically Steerable Antenna (AESA) markets. In May 2015, Anokiwave closed Series B funding led by JP Carney, CEO and co-founder of Revolabs, Lamberto Raffaelli, and COM DEV International. The company is based in San Diego, CA and operates design centers in Phoenix, AZ and Boston, MA.

Anokiwave recently released the first commercially available Ka-band transceiver quad core IC for 5G communications markets. The AWMF-0108 operates at 27.5-30 GHz, supports 4 Tx/Rx radiating elements, and includes all beam steering controls for 5-bit phase and gain control. The device operates in half duplex, enabling a single antenna to support both Tx and Rx operation. Patent-pending IP blocks implemented in silicon enable low-cost

hybrid beam forming for multi-antenna arrays with high energy efficiency.

A primary enabler for a planar 5G array is for the Tx/Rx functionality to physically fit in the lattice at mmW frequencies with the required integration level. The AWMF-0108 is a highly integrated half-duplex transmit-receive IC in a QFN-style surface mount plastic package measuring 6mm x 6mm x 0.9mm, easily fitting within the typical 5.3mm lattice spacing at 28 GHz.

Anokiwave offers a family of X-Band silicon core ICs for radar and communications AESA comprised of Single Beam and Dual Beam Low NF and High IIP3 Quad Core ICs. These devices integrate a 4 channel beamformer, LNA, and PA supporting 4 radiating elements. The ICs feature either a low noise figure or a high input linearity, and are further divided by dual beam Rx/single beam Tx or single beam Rx/single beam Tx. The X-band family of ICs are highly integrated TDD (time-division duplex) transmit-receive ICs in a 7mm x 7mm x 0.9mm QFN-style surface mount plastic package, easily fitting within the typical 15mm lattice spacing at 10 GHz.

The AWMF-0106 medium power front-end IC completes the family of X-band radar solutions. The AWMF-0106 is an integrated power amplifier, low noise amplifier, limiter, and T/R switch intended to provide a low noise, medium power front-end for the Anokiwave X-band core ICs, forming a compete plug and play chipset for X-band radar. The device is fabricated in 0.25um GaAs.

The K- and Ka-Band silicon core IC family for satellite communications AESA is comprised of 4- and 8-element Rx Quad Core ICs for K-Band and 4- and 8-element Tx Quad Core ICs for Ka-Band. The company also offers Ka-Band III/V front-end power amplifiers for SATCOM, AESA, and point-to-point radio communications and E-Band III/V front-end amplifier solutions for point-to-point radio communications.

Robert Donahue, CEO (previously Chief Strategy Officer and COO of MACOM and Chief Strategy Officer of WIN Semiconductor)

Nitin Jain, Ph.D., CTO, Founder, and Chairman (previously worked at M/A-Com and Assistant Professor at the ECE department of Indian Institute of Science, Bangalore India)

David Corman, Chief Systems Architect (previously at Motorola Government Electronics group in Phoenix where he was the architect and lead technologist for the Iridium Block 1 space-based K-band and Ka-band electronics suite and co-founder of US Monolithics before its acquisition by ViaSat)

William Boecke, CFO (previously VP and CFO of Hittite Microwave and VP and Corporate Controller at PRI Automation)

Deborah Dendy, VP of Operations (most recently Engineering Director for ViaSat's Advanced Microwave Products Group)

Dr. Ian Gresham, Distinguished Fellow of Technology (previously Director of R&D and IC Systems Architect for NXP)

Robert McMorrow, VP of Engineering, New England Design Center (previously Senior Designer for Black Sand Technologies and VP of Technology and CTO of Xikota Device)

Gaurav Menon, VP of Engineering, San Diego Design Center (previously responsible for the development of Ku & Ka band PAs, LNAs, mixers and full transceiver modules for the satellite communications market at US Monolithics)

Gary St. Onge, VP of Sales (previously Director for New Product Engineering at MACOM and SVP of International Sales at WIN Semiconductors)

Carl Frank, VP Business Development (previously held business development and operations leadership positions at TRX Systems, Honeywell Technology Solutions, and Techno-Sciences)



## Startup Profiles

(Continued from page 3)

Andrew Crofts, VP of Applications (previously Field Applications Director at MACOM)

12555 High Bluff Drive  
San Diego, CA 92130  
www.anokiwave.com

### Atomera

Atomera (formerly known as Mears Technologies, see Jan 2007 issue) was formed in 2001 to develop semiconductor materials, processes and IP. The company is focused on licensing its proprietary materials platform across the \$350+ billion semiconductor industry.

In March 2015, Atomera closed a private placement of \$14.75 million in convertible notes. In April 2016, Atomera, closed a private offering of approximately \$6 million in senior secured convertible notes. The company has raised \$85 million to date. Atomera has roughly 15 employees, having had a larger research team in the past while it was developing its core technology.

Atomera has developed the Mears Silicon Technology™ (MST) platform, which allows transistors to be made smaller, faster, more reliably and with better energy efficiency. MST reduces gate leakage and increase drive current (performance) in CMOS semiconductors. It also reduces variability in key parameters, which is one of the most significant problems facing the industry and is limiting yield, power and performance.

MST can be implemented using equipment already deployed in semiconductor manufacturing facilities and is complementary to other nano-scaling technologies already in the semiconductor industry roadmap, such as strain, SOI, high-k/metal gate, and FinFETs. MST CMOS is expected to offer a particular competitive advan-

tage at the 65nm node cost-benefit “sweet spot” for IoT devices.

MST CMOS technology is an ultra-thin film of reengineered semiconductor that improves the conductive “channel” at the heart of a transistor, enabling increased mobility and drive current. These benefits are believed to be applicable to a variety of IC types including microprocessors, DRAM, SRAM, flash, and other memory ICs, power management and RF and mixed-signal devices.

Drive and effective current increases of 10%-20% and improved mobility at high and low fields have already been demonstrated during third party evaluations. The performance improvements can also be traded-off for chip area shrink (cost) and/or reduced voltage (power reduction). Gate leakage reduction of up to 50% by impeding unwanted current flow in the vertical direction has also been demonstrated during third party evaluations.

Measurements also support improved reliability, better noise performance and reduced variability. The improved channel doping – a more ordered, steep retrograde well/channel profile – delivers up to 50% reduction in Vt variability and improved transistor matching.

MST lends itself to further enhancement and customization, as the epitaxial layer design can be optimized for specific applications based on performance priorities and cost targets. Atomera argues that MST provides a stronger value proposition than the leading enhancement and scaling options (including stress memorization, eSiGe, Dual Stress Liner, SOI, and HKMG) for manufacturers that are looking to extend the life of their fabs.

MST does not require any additional mask steps and is a very small percentage cost adder. For analog chips, benefits include lower power and smaller die size. For digital chips,

benefits also include increased performance equivalent to roughly ½ to a full process node shrink. The company anticipates that partners will be running production wafers in 2017. Atomera is also doing research that will be applicable to the FinFET arena.

Scott Bibaud, President and CEO, Board Director (previously SVP and GM of Altera’s Communications and Broadcast Division and EVP and GM of the Mobile Platforms Group at Broadcom)

Robert Mears, Ph.D., CTO, Founder (leading expert in photonics and nano-scale material engineering; invented the Erbium Doped Fiber Amplifier (EDFA); authored or co-authored approx. 250 publications and patents; Emeritus Fellow of Pembroke College, Cambridge, England)

Erwin Trautmann, EVP of Business Development, Board Director (served as CEO and a director from 2011-2015; formerly SVP at KLA-Tencor where he was most recently responsible for the global service and support division)

Frank Laurencio, CFO (previously held CFO roles at Sycomp, Orbis Global, Bubbly and OnStor)

Dmitri Choutov, Ph.D., VP of Engineering (previously Director of Product Management at Lam Research)

Ron Cope, COO (previously VP of Operations & General Manager for SyChip-Murata)

750 University Avenue, Suite 280  
Los Gatos, CA 95032  
Tel: 408.442.5248

20 Walnut Street, Suite 8  
Wellesley, MA 02481  
Tel: 617.2190600  
www.atomera.com

### Sol Voltaics

Sol Voltaics was founded in 2011 to improve the efficiency of solar energy capture, generation and storage

through the use of nanomaterials. The company recently raised \$17 million in Series C equity and grant funding. The round was led by new investor Riyadh Valley Company (RVC), the VC arm of King Saud University in Riyadh, Saudi Arabia. Long-term investors Umoe, FAM, Industrifonden, and Nano Future Invest also contributed to the \$12.5 million in equity. The Swedish Energy Agency and the European Union's Horizon 2020 research and innovation program provided over \$4.5 million in additional grants. Other investors include Teknoinvest and Kagra Gruppen AS. The company has raised \$38M to date from investors and non-dilutive funding and will seek additional capital. Sol Voltaics has roughly 35-40 employees.

To overcome the physical limits of current mainstream single-junction technology, the photovoltaic industry needs to find a low-cost dual-junction technology. Sol Voltaics is developing a high-volume production platform for its patented Aerotaxy nanowire solar film tandem-layer technology process. The company's nanowire solar cell technology will dramatically improve the efficiency of conventional solar modules at competitive costs. The company has a strong IP portfolio.

Gallium arsenide (GaAs) has been used in performance-category solar modules for years because of its high conversion efficiencies. However, it is expensive relative to other solar materials. The photonic effect of Sol Voltaics' nanowires and the low cost of Aerotaxy production of Solfilm™ minimizes cost by dramatically reducing the amount of GaAs and other expensive materials required. The GaAs nanowires in Solfilm consist of only a small number of atoms, but are fully functioning solar cells.

Sol Voltaics produces GaAs nanowires through an economical, high-throughput process called Aerotaxy® invented by company founder and Lund University professor Lars Samuelson.

Nanowires and nanotubes are typically produced through an epitaxial process on silicon or sapphire substrates, which is time-consuming and expensive. Aerotaxy creates nanomaterials by suspending active materials in gases intermingled in precisely controlled environment. Aerotaxy generates nanowires within milliseconds and can produce them on a continuous basis at comparatively low temperatures.

The company's go-to-market product, SolFilm, a solar panel additive containing GaAs nanowires, promises to dramatically increase the efficiency of silicon solar modules. Adding SolFilm on crystalline silicon modules increases today's average panel of 15.5% conversion efficiency to beyond the silicon limits of 23-24%. Sol Voltaics will ship SolFilm to PV companies for integration in crystalline silicon modules for commercially feasible, highly efficiency tandem-junction solar panels.

Sol Voltaics recently achieved a major breakthrough with the successful alignment of GaAs nanowires in a thin film. When integrated in a tandem-junction architecture on mainstream crystalline silicon panels, Sol Voltaics' nanomaterials innovations will enable PV module efficiencies of greater than 27%. In addition to the nanowire alignment breakthrough, Sol Voltaics has progressed through several generations of development of its Aerotaxy technology over the past few quarters.

The target market size is greater than \$30B, according to the company. Competition comes from other potential new materials and approaches. SolFilm is simple and very cost effective, boosting module efficiencies by at least 50%, with only a 5-10% cost increase. First SolFilm samples will be delivered to select PV cell/module partners during the latter part of 2017 or early 2018. The company has LOIs from several top-10 PV cell/module manufacturers.

Erik Smith, CEO (previously SVP of Sales and Marketing at Ultratech, head of Flextronics' \$400M Solar and Semi Division, CEO and founder of Alta-Energy, and COO of Alchimier)

Dr. Lars Samuelson, Founder & Chief Scientific Officer (director of the Nanometer Structure Consortium, the primary center for nanoscience in Sweden. A Fellow of the Institute of Physics, FInstP in the U.K., a member of the Royal Swedish Academy of Engineering Sciences and a member of the Royal Swedish Academy of Sciences)

Dr. Mikael Björk, Director Technology (previously a research staff member at IBM Research in Switzerland and director at QuNano)

Dr. Ingvar Åberg, Director Cell Engineering and Applications (previously held technical positions at silicon solar cell manufacturer Evergreen Solar and night vision camera start-up Noble Peak Vision)

Dr. Greg Alcott, Director Aerotaxy (previously led a team of engineers responsible for tool and process integration at Applied Materials SunFab)

Dr. Jonas Ohlsson, Director IP (previously a co-founder of QuNano and has served QuNano and its spin-outs, Glo and Sol Voltaics variously as Research Coordinator, Research Director, Epitaxy Director and now as IP Director)

Dr. Martin Magusson, Office of the CSO (previously coordinated the startup of Pronano AB, a nanotechnology institute associated with the Nanometer Structure Consortium at Lund University)

Marie Svensson, Director of Finance (previously with QuNano AB, later split up into GLO AB, Sol Voltaics AB and QuNano AB)

Scheelevägen 22  
SE-223 63 Lund, Sweden  
Tel: +46 46 2116000  
www.solvoltaics.com ■

# People

**AMD** has appointed Board member **John Caldwell** as Chairman, succeeding Bruce Claflin who has been Chairman since March 2009 and will continue to serve as a Board member. Caldwell joined AMD's Board in 2006 and has held a variety of Committee positions including most recently Compensation and Leadership Resources Committee Chair and Nominating and Corporate Governance Committee membership.

**DSP Group** has appointed **Daniel Amir** as corporate VP, business development, strategy and investor relations. Amir previously was a Managing Director at Ladenburg Thalmann, where he headed the equity research team covering semiconductor and hardware stocks. He previously headed the semiconductor research practices at Lazard Capital Markets and WRHambrecht.

**eSilicon** has appointed **Bruce Newton** as VP of worldwide human resources, reporting to CEO Jack Harding. Newton has held senior HR management positions at companies including Deloitte, Software AG, DHL International and Telstra Telecom.

**Impinj**, a provider of RAIN RFID solutions, announced investments in the company's channel program including launching a Partner Portal to help channel partners secure growth opportunities and drive increased revenue. Impinj has hired **Gene Spies** as VP of Global Distribution and Channels. Spies was most recently a key leader in the channel programs at Nexsan and Connected Data.

**Infineon** has enlarged its Management Board from three to four members. **Jochen Hanebeck**, currently Division President Automotive, is appointed as Member of the Board for the newly introduced Operations department. Infineon produces in 19 factories on three continents. **Dr. Helmut Gassel**, currently Division President Industrial Power Control, is appointed as Member

of the Board for Strategy Development, Sales & Marketing and Regions. This is because **Arunjai Mittal**, currently Member of the Board responsible for these departments, will leave Infineon due to family reasons. **Peter Schiefer**, currently Head of Operations, will become Division President Automotive. **Dr. Peter Wawer**, currently member of the Management Board of the Power Management & Multimarket Division and will also become Division President Industrial Power Control.

**Marvell** has appointed **Richard Hill** as Chairman. Hill has served as a member of the Board of Tessera since August 2012 and as Chairman since March 2013. He also served as Tessera's Interim CEO from April 15, 2013 until May 29, 2013. **Michael Strachan** has been appointed as an independent Director. Strachan's appointment expands the number of Board members to eleven. Before his retirement in 2008, Strachan was a partner at Ernst & Young. He also served on the Board of LSI from 2009 until the company was sold to Avago in 2014. **Mitchell Gaynor** has been appointed as EVP, Chief Legal Officer, and Secretary. Gaynor most recently served as EVP, General Counsel, and Secretary at Juniper Networks.

**Micralyne**, a manufacturer of MEMS and its parent company FTC Technologies, have appointed **Ian Roane** as President and CEO, replacing Mike Ciprick, who was CEO for the last four years and now reports to Roane as CFO. Roane has worked closely with Micralyne since February 2014, first as an advisor and then as a board member since February 2015. Prior to Micralyne, he held CEO positions at Kaben Wireless Silicon and Sound Design Technologies, a spin-off from Gennum.

**Optomec**, a supplier of production grade additive manufacturing systems for 3D printed metals and 3D printed electronics, has appointed **Doug Welter**, former VP and GM at Phillips Semi (now NXP), to the newly created position of COO. At Phillips' Standard IC Division Welter served as VP and

GM and had P&L responsibility for operations in California, Arizona, the Netherlands, Germany, Thailand, and Taiwan. At Motorola, he was GM of the Automatic Test Equipment Group with P&L responsibility for its internal and external semiconductor test equipment business.

**POET Technologies**, a developer of opto-electronics fabrication processes, announced that **Peter Copetti**, current Executive Co-Chairman of the Board, will be stepping down from the Board and his position as Executive Co-Chairman to pursue other opportunities.

**PsiKick** has appointed **Philip Carmack** as CEO and a member of the Board. **Brendan Richardson**, founding CEO, has transitioned to VP of Business Development. Most recently, Carmack was CEO of Aptina until its acquisition by ON Semi in June 2014. Prior to Aptina, he launched and ran the Mobile Business Unit at NVIDIA. PsiKick develops battery-less IoT sensor nodes and systems. Leveraging Sub-Threshold design and ultra-low-power circuit techniques, PsiKick's SoCs consume less than 20µW.

**Qorvo** has appointed **Mark Murphy** as CFO, succeeding Steven Buhaly, who is retiring. Murphy most recently served as EVP and CFO of Delphi Automotive.

**Rambus** announced that CFO **Satish Rishi** plans to retire in the first week of August.

**Rudolph Technologies** has appointed **Debbora Ahlgren** as VP of global customer operations, leading the company's sales and service organization. Ahlgren previously served in a variety of executive roles, including VP and GM for field operations for Agilent, and VP of sales and marketing for OptimalPlus.

**Silego** has appointed **Mike Noonan** to lead sales and business development. Most recently Noonan was interim CEO and Board Director at Ambiq Micro. He was also the Chairman and co-founder of Silicon Catalyst. Previously he led



sales, marketing and product lines at GlobalFoundries, NXP and National. He also served on the GSA Board of Directors.

**Skyworks** has appointed **Liam Griffin** as CEO and a member of the board. **David Aldrich**, Skyworks' CEO since 2000, will assume the newly established role of executive chairman and, in that position, will continue to serve as the chairman. Aldrich has served as CEO of Skyworks and its predecessor Alpha Industries, since 2000. During that time, annual revenue grew from \$126 million in 1999, when he became president and COO, to over \$3.2 billion as of fiscal 2015. Griffin joined Skyworks in August 2001 as head of sales and marketing. In 2011, he was promoted to EVP and in May 2014 was named company president. Before joining Skyworks, Griffin was VP of worldwide sales at Dover and held product management and process engineering positions at AT&T's Microelectronics and Network Systems' businesses.

**Spectra7 Microsystems** (TSX: SEV) announced the sudden death of its President and CEO, **Tony Stelliga**. Stelliga has been on the Board, and has led the Company as its President and CEO, since 2013. He was formerly the Chairman and CEO of Quellan, which was acquired by Intersil in 2009. Prior to Quellan and Intersil, he held senior management and strategic positions at Intel following its acquisition of Softcom in 1999, where he was founder, Chairman and CEO. **Dave Mier**, CFO, and **Cynthia Cole**, VP, General Counsel and Corporate Development, have been jointly appointed on an interim basis to lead the management team.

**Thin Film Electronics** has appointed **Christian Delay** as SVP Strategic Marketing and GM Software Platforms. In this role, he will define the strategy for developing software solutions that extend and deepen Thinfilm's partnerships and enable consumers to interact with connected objects using their mobile devices. Delay previously

was responsible for the strategy and growth of Ask Partner Network's (APN, an IAC company) Mobile business. **Bill Cummings** has joined the management team following his promotion to SVP Corporate Communications. Cummings joined Thinfilm in March 2014 as VP Marketing & Communications.

**ViXS** has appointed **Dr. Arun Netravali** to its Board of Directors. Netravali is a pioneer in the field of digital video technology including a pivotal role in the industry's transition from analog to digital and HD TV. Currently, he is the managing partner of Omni Capital and was previously a director of various companies including Agere, Level 3 Communications and LSI. Previously, he was the President of Bell Labs from 1999 to 2002, and CTO and Chief Network Architect at Lucent.

**Xilinx** has appointed **Saar Gillai**, **Ron Jankov**, and **Dr. Tom Lee** to its Board of Directors. Gillai currently serves as SVP and GM of HP's Enterprise Communications Solutions Business. Jankov is the CEO of GlobalLink1 Capital, an investment firm he founded in 2014. Prior to this, he served as SVP and GM of Processors and Wireless Infrastructure for Broadcom. Previously, he was President and CEO of NetLogic, culminating in its acquisition by Broadcom in 2012. Dr. Lee is a Professor of Electrical Engineering at Stanford. He has co-founded Matrix Semiconductor (acquired by SanDisk), ZeroG Wireless (acquired by Microchip), and Ayla Networks. ■

## Funding

**1366 Technologies** has received a \$10 million investment from the Hanwha Investment, a Korean private equity/venture capital firm. The funds will be used toward the construction of 1366's first large-scale commercial factory, scheduled to be online in 2017. 1366's Direct Wafer manufacturing process offers significant advantages over traditional cast-and-saw wafer production technologies. The process makes wafers in a single step, pulling them directly

from molten silicon instead of today's multi-step, energy- and capital-intensive approach.

**Acacia Communications**, a provider of high-speed coherent optical interconnect products, has priced its IPO (Nasdaq: ACIA) of 4.5 million shares at \$23 per share. Goldman Sachs, BofA Merrill Lynch and Deutsche Bank are acting as joint bookrunners, and Needham, Cowen and Northland Securities are acting as co-managers.

Acacia was founded in 2009. The number of customers who have purchased and deployed its products has increased from eight in 2011 to more than 25 during the twelve months ended March 31, 2016. Revenue for 2015 was \$239 million, a 64% increase from \$146 million of revenue in 2014. Revenue for the three months ended March 31, 2016 was \$85 million.

By converting optical interconnect technology to a silicon-based technology, a process Acacia refers to as the "siliconization of optical interconnect," Acacia is able to offer products that meet the needs of cloud and service provider customers in a simple, open, high-performance form factor that can be easily integrated in a cost-effective manner with existing network equipment.

Acacia has introduced ten optical interconnect modules, five coherent DSP ASICs and three silicon PICs since 2009. Acacia's products include a series of low-power coherent DSP ASICs and silicon PICs that Acacia has integrated into families of optical interconnect modules with transmission speeds ranging from 40 to 400 Gbps for use in long-haul, metro and inter-data center markets. Acacia's modules perform a majority of the digital signal processing and optical functions in optical interconnects and offer low power consumption, high density and high speeds at attractive price points.

**Hologram** (formerly known as Konekt) has launched its cellular platform for the IoT and raised \$4.8 million in

## Funding

(Continued from page 7)

funding led by Drive Capital. In contrast to legacy cellular connectivity solutions, which are still geared towards mobile phones and tablets, the Hologram platform is purpose-built for developing and deploying IoT products. By running its own cellular network, Hologram is able to provide an end-to-end connectivity solution that marries a global cellular network with fully-certified hardware and a cloud platform for device messaging. Hologram has more than 50,000 existing connections globally and initial customers including Kelloggs, Metromile and Placemeter.

**Infineon** has completed a \$935 million private placement of notes. This is the first such transaction in the company's history. The proceeds will replace the five-year US Dollar term loan granted by banks to Infineon in August 2014 for the acquisition of International Rectifier.

**Kateeva** has closed \$88 million in Series E funding. Kateeva's YIELDjet platform leverages inkjet printing with novel innovations to perform critical steps in the OLED manufacturing process. New investors include BOE, Cybernaut Venture, GP Capital Shanghai, Redview Capital, and TCL Capital, all located in China. They join existing investors Samsung Venture Investment Corporation (SVIC), Sigma Partners, Spark Capital, Madrone Capital Partners, DBL Partners, New Science Ventures, and VEECO Instruments. The company has raised \$200 million since it was founded in 2008. This year, the market for plastic and flexible OLED displays will reach \$2.1 billion, according to IDTechEx. By 2020, it will surpass \$18 billion. Mobile phones and wearables are currently the two main applications.

**Sensifree** has completed a \$5 million Series A funding round led by TransLink Capital with participation from existing and new investors, including UMC Capital, and an undisclosed strategic investor. The investment adds to seed investment made by Samsung's Catalyst

fund and brings total funding to \$7 million. Sensifree was founded to develop "patented, low power electromagnetic sensors that accurately collect a range of continuous biometric data without the need to touch the human body." The company's first product is a heart rate sensor for wearable devices. ■

## Mergers & Acquisitions

**AMD and Nantong Fujitsu Microelectronics** have closed the transaction to create a joint venture offering differentiated assembly, test, mark, and pack (ATMP) capabilities to both AMD and a broader range of customers. NFME's affiliates have purchased an 85% share of AMD's Penang, Malaysia and Suzhou, China ATMP operations and act as controlling partner for the new joint venture business. AMD received from NFME approximately \$371 million, with net cash proceeds of approximately \$320 million. AMD retains a 15% ownership of the Penang and Suzhou operations.

**ARM** has acquired **Apical** for \$350 million in cash. Apical is a leader in imaging and embedded computer vision technology that will allow next generation devices to understand and act intelligently on information from their environment. Apical's advanced imaging products are used in more than 1.5 billion smartphones and approximately 300 million other consumer/industrial devices including IP cameras, digital stills cameras and tablets.

**AIXTRON** and **Grand Chip Investment**, a 100% indirect subsidiary of the **Fujian Grand Chip Investment Fund**, have entered into an agreement. AIXTRON shareholders will be offered 6 Euros in cash per each ordinary share. The transaction values AIXTRON's equity, including net cash, at approximately 670 million Euros and reflects a 50.7% premium to the three-month volume weighted average share price prior to announcement. AIXTRON is a provider of deposition equipment

to the semiconductor industry. The company was founded in 1983 and is headquartered in Herzogenrath (near Aachen), Germany.

**GlobalWafers** and **Topsil** have signed an agreement pursuant to which GlobalWafers will acquire Topsil's entire silicon business at a price of DKK 320 million on a debt-free basis before transaction costs. Topsil has been working with GlobalWafers for many years. In 2000, Topsil outsourced its Danish wafer production to GlobalWafers, which has since been a wafer processing supplier to Topsil. GlobalWafers is one of the top 6 largest silicon wafer manufacturers. Founded 1981, it was the semiconductor business unit of SAS (Sino-American Silicon Product) and spun off as GlobalWafers in 2011.

**INSIDE Secure** is about to reach an agreement to sell its semiconductor business to **WISeKey International**, a Swiss cybersecurity company, for an enterprise value of CHF 13 million (\$13.2 million), net of transferred cash. The completion of the contemplated transaction would mark the final step in the repositioning of INSIDE Secure as a software security and technology licensing company. WISeKey is an existing customer of INSIDE Secure in the field of anti-counterfeiting solutions. The scope of the transaction largely comprises the semiconductor activities of INSIDE Secure for the IoT, anti-counterfeiting and brand protection, EMV payment card and secure access, which generated pro forma revenue of \$33.6 million in 2015.

**Knowles** has entered into a definitive agreement with **Loyal Valley Innovation Capital** to sell its mobile consumer electronics speaker and receiver product line. Terms were not disclosed.

**MaxLinear** has signed a definitive agreement to acquire certain assets and IP related to the **wireless infrastructure backhaul business** of Broadcom for \$80 million in cash. Broadcom's wireless infrastructure backhaul business employs approximately 120



people and reported approximately \$29.6 million in revenue in 2015. The company recently acquired Microsemi's Broadband Wireless Division, which was previously part of PMC-Sierra. MaxLinear estimates the SAM for wireless infrastructure backhaul baseband and RF transceivers market to be approximately \$700 million in 2016, and approaching \$1 billion by 2021, excluding the incremental market opportunity represented by anticipated future 5G deployments.

**Microsemi** has completed the sale of a non-strategic component of a board level systems and packaging business to **Mercury Systems** for \$300 million in cash.

**POET Technologies** has signed a definitive agreement to acquire **BB Photonics**, a designer of Integrated Photonic solutions for the Datacom market, for approximately 2,000,000 shares of POET stock. BB Photonics is a pre-revenue, New Jersey-based photonics company that currently develops Photonic Integrated Components for the Datacenter market. The company utilizes a Platform Technology approach using Embedded Dielectric Technology, which is intended to enable on-chip athermal wavelength control and lower the total solution cost of datacenter photonic ICs. This acquisition will provide POET with additional differentiated IP and know how for future product development at its facilities in Singapore recently acquired through the DenseLight transaction. ■

## Business Updates

**Akoustis** (OTCQB: AKTS), manufacturer of BulkONE™ single crystal piezoelectric bulk acoustic wave (BAW) RF filters for mobile wireless, has achieved record-breaking 12.5% K-squared performance from 3.4GHz BAW devices constructed from patented Undoped single crystal AlN. K-squared is an important parameter and determines the bandwidth of high band BAW RF filters used in mobile smartphones.

In comparison, incumbent K-squared performance from undoped polycrystalline AlN resonators is limited to approximately 6-7%. According to Mobile Experts, approximately 25% of all 4G/LTE RF filter-band shipments in 2016 will require high frequency and/or high K-squared resonator building blocks. Akoustis is currently working towards performance requirements in support of engagements with potential design clients and strategic partners.

**ALLOS Semiconductors** has transferred its latest generation GaN-on-Si epiwafer technology in less than twelve weeks to a major international industry player. This is part of a comprehensive joint project to accelerate the GaN-on-Si power semiconductor product development of that customer. ALLOS also completed the first phase of a customer project to develop market-ready GaN-on-Si power semiconductor products. ALLOS' customer is a major international industry player who has systematically invested into GaN-on-Si epitaxy and device processing in recent years.

**Crystalplex**, a pioneer in the development of high stability quantum dots, has announced a new development enabling increased brightness and color stability for LCD displays using cadmium-free Sapphire™ quantum dots. Quantum dots (QDs) enrich the brightness and color quality of LCD displays. The availability of stable, cadmium-free quantum dots is expected to accelerate the adoption of QD technology in consumer electronic devices, as cadmium is a regulated material in many countries. Crystalplex is a 12-year-old nanoparticle R&D concern.

**CYNORA**, a leader in TADF (thermally activated delayed fluorescence) materials, has made significant progress in its highly efficient blue material developments during the last 6 months, a strong indicator for reaching performance levels requested by the OLED industry. CYNORA has been working on organic TADF emitting materials during the

last 5 years. Since 2015, CYNORA has applied its experience to develop pure organic highly efficient blue dopants for vacuum deposition. CYNORA owns a broad IP portfolio on TADF with over 100 patent families and is aiming for over 600 patents.

**MEMSIC** has shipped its 1 billionth MEMS sensor.

**Nova Measuring Instruments** announced that several foundry customers recently placed orders exceeding \$20 million in aggregate for its Optical CD and X-Ray metrology solutions. The majority of orders will be delivered during Q3. The orders include Nova's integrated and stand-alone optical metrology toolset combined with NovaMARS advanced modeling solution, and Nova's advanced X-Ray metrology solution, which combine X-Ray Photoelectron Spectroscopy (XPS) and X-Ray Fluorescence (XRF) for materials and thin-film measurements. The tools will support manufacturing in multiple technology nodes of 10nm and above.

**RJR Technologies**, a developer of high performance Air Cavity Plastic (ACP) packaging, has shipped over 10 million ACP packages. RJR's milestone reflects the increasing use of plastic packages in high performance, high frequency RF applications. Manufacturers that replace ceramic packages featuring an expensive composite-type metal base with ACP2 with a copper base can reduce the packaging costs of RF power transistors by as much as 50% while improving thermal dissipation by 30%.

**StoreDot**, a nanotechnology materials pioneer known for its super-fast battery charging technology, has unveiled a 55-inch display powered by StoreDot's MolecuLED™ technology. This metal-free approach to color conversion is the first and only fully organic solution that is positioned to replace traditional Quantum Dot technology. The MolecuLED is an organic color conversion layer that delivers very competitive wide color gamut. It allows for displays that produce vivid colors, are more

## Business

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cost effective, and are environmentally friendly.

The **SIA**, representing U.S. leadership in semiconductor manufacturing, design, and research, welcomed recommendations agreed to by global semiconductor industry leaders at the 20th annual meeting of the **World Semiconductor Council (WSC)** this week in Seoul, Korea. The agreement outlines a series of policy proposals to strengthen the industry through greater international cooperation. Recommendations from this year's meeting are included in the **2016 WSC Joint Statement**.

A primary goal of the WSC is to ensure timely implementation of the expanded Information Technology Agreement (ITA), which is set to take effect on July 1. The expanded ITA covers an estimated \$1.3 trillion in global sales of tech products and eliminates tariffs on new and innovative semiconductor products, including multi-component semiconductors (MCOs). This is the first expansion of the ITA since 1996, when the agreement was originally concluded. The WSC also reaffirmed government policies should be guided by market-based principles. ■

## Market Research

**Worldwide sales of semiconductors** reached \$26.1 billion for the month of March 2016, a slight increase of 0.3% compared to the previous month's total of \$26 billion, report the **SIA**. Sales for Q1'16 were \$78.3 billion, down 5.5% compared to the previous quarter and 5.8% lower than Q1'15. Global semiconductor sales increased in March for the first time in five months, but soft demand, market cyclicity, and macroeconomic conditions continue to impede more robust growth. Q1 sales lagged behind last quarter across

nearly all regional markets, with the Americas showing the sharpest decline.

**North America-based manufacturers of semiconductor equipment** posted \$1.59 billion in orders worldwide in April 2016 and a book-to-bill ratio of 1.10, according to **SEMI**. The three-month average of worldwide bookings in April 2016 was \$1.59 billion, 15.6% higher than the final March 2016 level of \$1.38 billion, and 1.3% higher than the April 2015 order level of \$1.57 billion. The three-month average of worldwide billings in April 2016 was \$1.46 billion, 21.5% higher than the final March 2016 level of \$1.2 billion, and 4% lower than the April 2015 billings level of \$1.52 billion. Bookings reached their highest levels in eight months and billings levels also significantly improved in April. The data reflect strong investments in 3D NAND and in China.

**Worldwide semiconductor revenue** will fall for a second consecutive year to \$324 billion, down 2.3% from the previous year according to **IDC**. Semiconductor revenues will log a CAGR of 1.9% from 2015-2020, reaching \$364 billion in 2020. LTE mobile phones will continue to grow moderately by 8% this year compared to 52.5% in 2015. Ongoing weakness in consumer PC demand and oversupply will hamper memory prices for DRAM and NAND until Q3 and result in revenues shrinking by 20% and 10%, respectively. Excluding memory from the forecast, the semiconductor market would grow 1.7% this year.

The consumer semiconductor market fell by 11% to \$46.1 billion in 2015 on weak system demand and pricing pressure in the core tablet and digital TV markets, while semiconductor revenues grew for smart home, wearables, set-top boxes (STBs), and gaming consoles. Through the 2020 forecast period, the consumer semiconductor market is expected to grow at a CAGR of 6% as consumer IoT applications should outpace market growth and

DTVs benefit from the emerging 4K upgrade cycle.

Semiconductor revenue for the computing industry segment will decline 6.2% this year and will show a negative CAGR of -0.9% for the 2015-2020 forecast period. Semiconductor revenue for the mobile wireless communications segment will fall 4.4% year over year, this year, with a CAGR of 0% for 2015-2020. Semiconductor revenue for LTE mobile phones will experience an annual growth rate of 8% in 2016 and a CAGR of 6.3% for 2015-2020. ■

## Products

**ARM** has announced the first multicore, 64-bit ARMv8-A processor test chip based on TSMC's 10FinFET process technology. Simulation benchmarks show impressive power and efficiency gains relative to TSMC's 16FinFET+ process technology, which is currently used to implement chips powering many of today's leading premium smartphones.

**Arteris** has introduced a semiconductor design technology that enhances the ability of SoC architects to create efficient cache-coherent systems with IP sourced from multiple vendors. The distributed heterogeneous cache-coherent interconnect will help system designers achieve higher frequency, lower power consumption and reduced time-to-market in producing differentiated SoCs that span multiple design domains such as mobility, HDTV, enterprise storage, automotive advanced driver assistance systems (ADAS), micro-server and networking markets.

**Broadcom** has introduced the first 60GHz wireless mesh (60G WiMesh) chipset designed for wireless infrastructure applications including mobile backhaul and wireless access points. The chipset consists of a BCM20130 baseband SoC and a BCM20138 RF transceiver chip, both of which are implemented in standard CMOS process. Based on steerable beamforming tech-

nology, the chipset provides a robust, cost-effective 60GHz wireless solution addressing the “last-mile problem” for wireless infrastructure.

Compared with other 60GHz wireless solutions, which are either short range or expensive, the Broadcom 60G WiMesh solution does not need high gain fixed antennae and allows the formation of a self-organizing, community-based wireless mesh network in the 60GHz spectrum.

**Cambridge CMOS Sensors (CCS)** has launched its range of  $\mu$ Bright infrared sources, the latest of its gas sensor components for low-power, long life optical gas sensing solutions. Designed to operate across the wideband IR range (2 to 14 $\mu$ m) the  $\mu$ Bright sensors can be used to continually sense gases, such as carbon dioxide, and ethanol vapors in NDIR (nondispersive infrared) systems at low power.

The CCS11x family of IR sources incorporate a new patented plasmonic structure, which has a layer of metallic dots with a defined geometry which creates a resonant effect, increasing the optical emissions of the CCS11x sources. The devices use CCS’s patented micro-hotplate design to deliver high optical emissions across a broad range (2 $\mu$ m to 15 $\mu$ m) of IR wavelengths with a very stable, low drift output. The plasmonic structure and the micro-hotplate are fabricated using a standard CMOS process.

The micro-hotplate is formed from a dielectric membrane, supported on a silicon substrate, with a central Tungsten heater, produced by a Deep Reactive Ion Etch (DRIE) MEMS process. The inherently low thermal mass allows for rapid heating to high temperatures (up to 600°C), allowing pulse mode operation at high frequencies, high emission and significantly reduced power consumption.

**Cavium** has unveiled OCTEON TX, a complete line of 64-bit ARM-based SOCs for control plane and data plane

applications in networking, security, and storage. This new product line is composed of 4 product families - CN80XX, CN81XX, CN82XX and CN83XX with 1 to 24 full custom, enhanced 64-bit ARM v8.1 cores. This product line is optimized to run multiple concurrent data and control planes simultaneously for security and router appliances, NFV and SDN infrastructure, service provider CPE, wireless transport, NAS, storage controllers, IOT gateways, printer and industrial applications. The 1 to 4 core CN80XX and CN81XX product families will be sampling in Q2, and the 8 to 24 core CN82XX and CN83XX will be sampling in Q3.

**Innosilicon**, a provider of Bitcoin and Litecoin ASIC solutions, announced that the first 14nm A4 Dominator ASIC has passed sample test and is ready for mass shipment in 2 months. With more than quadruple the power efficiency over the previous generation, the A4 ASIC offers up to 4Mhs per chip LTC hash power with as low as 1.5W/Mhs power consumption. This will allow for next-gen A4 based scrypt miners reaching 400Mhs to 500Mhs hash power per box.

**InvenSense** has introduced the first TDM (Time Division Multiplexed) MEMS microphone that can support up to 16 microphones on one bus. Up to now, device makers had to pick from microphones with interfaces that supported no more than two on a bus leading to complex and expensive solutions for an array of microphones. The ICS-52000 low noise microphone allows a microphone array to connect directly to digital processors without the need for audio converters in the system. All microphones in the array are able to synchronize their acoustic capture enabling precise audio processing.

**Movidius** announced the Fathom Neural Compute Stick, a deep learning acceleration module, and Fathom deep learning software framework. Both tools will allow powerful neural networks to be moved out of the cloud, and deployed natively in end-user devices.

The Fathom Neural Compute Stick is an embedded neural network accelerator. With the company’s ultra-low power, high performance Myriad 2 processor inside, the Fathom Neural Compute Stick can run fully-trained neural networks at under 1 Watt of power. Fathom supports the major deep learning frameworks in use today, including Caffe and TensorFlow.

**Quanergy Systems**, a provider of LiDAR sensors and smart sensing solutions, has unveiled the S3-Qi, a miniature solid-state LiDAR sensor that is 15% the size of the previous solid-state model (S3).

**Skipio** announced the first G.fast solution to deliver up to 1.5Gbps in combined upstream and downstream performance by dynamically allocating the bandwidth in each direction in real time. With dynamic bandwidth allocation, ATT believes it can offer up to 750Mbps in both downstream and upstream performance over coax with today’s chipsets. In the next generation G.fast chipsets, ATT should be able to double that target, achieving as much as 1.5Gbps in each direction.

**Semtech** has introduced the EV8600 dual modem (PLC+RF SoC) with integrated LoRa wireless RF technology. The EV8600 is the first fully integrated PLC and LoRa modem for smart grid, smart metering and IoT applications. By offering both a Power Line Communications (PLC) modem operating at 10-500KHZ and a RF modem operating in the range of 142-1050MHz, the EV8600 enables virtually 100% connectivity coverage with a single chip. The EV8600 also offers a LoRa fallback mode in the event of a complete network outage.

**Silego** has expanded its pFET integrated power controller portfolio with a new family of self-powered, 1.6 mm<sup>2</sup>, single-channel and dual-channel very low-power controllers with reverse-current protection. Designed for all high-side, 1.5V to 5.5V power rail applications, these new pFET power



## Products

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controllers achieve an ultra-stable 23mΩ RDS(on) over temperature. Using Silego's CuFET technology, these products can handle load currents up to 4A and exhibit low thermal resistance. The reverse-current protection feature is very useful in applications where a VOUT-to-VIN backfeed current to the VIN power source is to be avoided. Compared to other pFET load switches, these products combine higher-performance lower RDS(on) pFET structures, lower supply current operation, and multiple protection features into very PCB space-efficient solutions.

**TowerJazz** has announced volume production of a new RF technology capable of integrating a wireless front-end module (FEM) on a single chip, tailored to meet the challenges of IoT applications. The TowerJazz process enables integration of power amplifiers (PAs), switches, and low noise amplifiers as well as CMOS digital and power control on a single die.

TowerJazz's new RF technology includes a 0.18µm SiGe PA device with best-in-class silicon-based performance, a low Ron-Coff switch device, a SiGe low noise amplifier, 5V CMOS for power control, 0.18µm CMOS for integrating MIPI or other digital content as well as thick Cu metal layers for low-loss inductors and matching components. TowerJazz has partnered with **Skyworks** to deliver a first of its kind integrated wireless FEM using this technology.

**UltraMemory** is developing a 3D DRAM chip, which includes a Through Chip Interface (TCI), enabling low-cost and low-power wireless communication between stacked DRAM when compared to TSV technology. UltraMemory has selected NanoSpice and NanoSpice Giga from **ProPlus Design Solutions**, a provider of giga-scale parallel SPICE simulation, SPICE modeling solutions and Design-for-Yield (DFY) applications, to simulate its

super-broadband, super large-scale memory design. Takao Adachi, President and CEO

**VORAGO** has introduced the first ARM Cortex-based MCUs designed specifically for radiation and extreme temperature operation without up-screening. Based on the company's patented and proven HARDSIL technology, VORAGO's VA108x0 microcontrollers provide system designers with built-for-purpose embedded solutions that reduce development complexity and power consumption, while increasing reliability and longevity. HARDSIL is the underlying technology that allows VORAGO MCUs to inherently withstand extreme temperature (-55°C to 200°C) and radiation.

**Xilinx** has expanded its 16nm UltraScale+ product roadmap with new acceleration enhanced technologies for the Data Center. The products will deliver the combination of Xilinx's 16nm FinFET+ FPGAs with integrated High-Bandwidth Memory (HBM), and support for the recently announced Cache Coherent Interconnect for Acceleration technology (CCIX). CCIX is initially driven by a group of seven companies to enable an acceleration framework that works with multiple processor architectures. ■

## Licensing & Partnerships

**Agnisys**, a provider of a common specification-driven development flow to describe registers and sequences for SoC and IP design, verification, firmware and validation, announced **Istuary Innovation Group** has licensed IDesignSpec (IDS) for Enterprise Storage IC design and verification. IDesignSpec is register specification software for accurate implementation of addressable registers and the creation of RTL code, firmware and verification models. Istuary's Innovation Labs will use Agnisys' IDS to design and verify Enterprise Storage chips. Istuary is comprised of three business units:

Innovation Labs, Venture Capital, and Idea Labs. Istuary was founded in Vancouver, BC in 2013 and now employs over 600 in Canada, USA and China.

**AMD, ARM, Huawei, IBM, Mellanox, Qualcomm, and Xilinx** have joined forces to bring a high-performance open acceleration framework to data centers. The companies are collaborating on the specification for the new Cache Coherent Interconnect for Accelerators (CCIX). For the first time, a single interconnect technology specification will ensure that processors using different instruction set architectures (ISA) can coherently share data with accelerators and enable efficient heterogeneous computing. [www.ccix-consortium.com](http://www.ccix-consortium.com)

**Exagan**, a provider of gallium nitride (GaN) semiconductors for power converters, has begun a strategic partnership to develop and commercialize GaN-on-silicon products with **HIREX Engineering**, a company of **Alter Technology Group** (TÜV NORD GROUP's Aerospace and Electronics Business Unit). The partnership's goal is to establish the reliability of GaN-on-silicon while also demonstrating the performance improvements to be gained and the low risk of integrating the technology. Founded in 2014 with support from CEA-Leti and Soitec, Exagan's GaN power switches are designed for manufacturing in standard 200-mm wafer fabs to provide high-performance, high-reliability products through a robust supply chain. The company's G-FET products offer very high power-switching performance with extremely low conduction losses.

**GainSpan** in collaboration with **GEO Semi** and **ON Semi** have introduced a low-power, battery-operated video doorbell reference design capable of streaming HD video and two-way, telephony quality audio over Wi-Fi networks. The solution features GEO's MAX64380 video compression chip and ON Semi's AR0330 CMOS image sensor integrated with GainSpan's GS2011M Wi-Fi module on a small PCB.

The GainSpan GS2011M serves as the system host controller, running embedded streaming protocols and application software, also developed by GainSpan. The platform delivers 1080p (1920x1080) HD video at 30fps and utilizes the MAX64380's internal audio processing features to deliver high quality, full duplex voice audio with on-board acoustic echo cancellation and noise reduction. ON Semi's AR0330 1/3-Inch optical format CMOS image sensor delivers superior imaging quality in low light conditions. Using its 2304 x 1296 active-pixel array, this device has the capacity to capture 3MP still images.

**Infineon** and **imec** are working on highly integrated CMOS-based 79 GHz sensor chips for automotive radar applications. Imec contributes its expertise in high-frequency system, circuit and antenna design for radar applications, complementing Infineon's radar sensor chip knowledge. The development of a first demonstrator in 28nm CMOS technology is well under way. Functional CMOS sensor chip samples are expected in Q3 with a complete radar system demonstrator scheduled for the beginning of 2017.

Typically, there are up to three radar systems in today's vehicle equipped with driver assistance functions. In the future, with fully automated cars up to ten radar systems and ten more sensor systems using camera or lidar technologies may potentially be utilized. Compared to the mainstream 24GHz band, the 77GHz and 79GHz bands enable a finer range, Doppler and angular resolution. Radar prototypes with integrated MIMO antennas will be able to detect large objects as well as pedestrians and bikers.

**Intermolecular** announced that its ReRAM technology is now available for licensing, marking the launch of the company's new IMI Discoveries licensed products business. Resistive Random Access Memory (ReRAM) is a nonvolatile memory technology ideally suited for stand-alone storage

class memory, embedded applications such as IOT, smart cards and a NOR flash replacement for microcontrollers. IMI's ReRAM IP and know-how, which includes a unit cell comprising of multilayers of transition metal oxides and variants between electrodes, can be optimized for application-specific devices, performance and reliability. Customers adopting IMI's ReRAM technology can leverage benefits such as low power operation and improved data retention using small footprint (6-10F2), manufacturing-friendly materials and backend of the line (BEOL) compatible thermal budget.

**MagnaChip** has expanded its line of 0.18u multiple-time programmable IP (MTP-IP) devices. Jointly developed with **Yield Microelectronics** (YMC) of Taiwan to address the increasing MTP-IP demand for MCU and touch IC applications, it also enables cost-effective IC designs and high performance non-volatile memory solutions. The new MTP-IP was developed by using MagnaChip's 0.18u mixed-signal 5V processes, which significantly reduces the number of mask layers and manufacturing process steps, making it possible to provide cost-competitive MTP solutions. The new MTP-IP is operable from 1.8V~5.5V, making the solution suitable for MCU applications. YMC, located in Taiwan's Chu-Pei city, is an embedded logic multiple-time non-volatile memory (NVM) IP provider.

**Mobileye** and **STMicro** are co-developing the next (5th) generation of Mobileye's SoC, the EyeQ5, to act as the central computer performing sensor fusion for Fully Autonomous Driving (FAD) vehicles starting in 2020. To meet power consumption and performance targets, the EyeQ5 will be designed in advanced 10nm or below FinFET technology node and will feature 8 multithreaded CPU cores coupled with 18 cores of Mobileye's next-generation vision processors. Taken together, these enhancements will increase performance 8X over

the current 4th generation EyeQ4. The EyeQ5 will produce more than 12 Teraops per second, while keeping power consumption below 5W. Samples 1H18. The EyeQ5 continues Mobileye's long-standing cooperation with STMicro. Mobileye products are or will be integrated into car models from 25 global automakers.

**Resonant** (NASDAQ: RESN), a designer of filters for RF front-ends that specializes in delivering designs for difficult bands and complex requirements, has signed another licensing agreement with an existing customer. The license agreement encompasses three SAW duplexer designs for high volume Bands.

**Semtech** announced that the open LoRaWAN networking protocol, used in low power, wide area networks (LPWANs) for IoT applications, took another step toward becoming a worldwide standard when **Orange S.A.**, one of the largest mobile network operators in Europe, officially joined the board of the 300+ member LoRa Alliance. In September 2015, Orange announced it would build a LPWAN network based on the LoRaWAN protocol to provide a foundation for a range of smart city IoT applications.

**Sivers IMA** has signed an agreement with **Blu Wireless Technology**, a company that designs and licenses baseband modem IP for mmWave applications, including the 802.11ad standard within the Wi-Fi Alliance (WiGig). Blu will integrate and optimize its WiGig Hydra baseband modem IP with Sivers IMA's WiGig RFIC. This will enable Sivers IMA to market a complete WiGig solution compliant with the 802.11ad standard. This includes a baseband modem and a transceiver with steerable antennas. Like Sivers IMA's other products, its WiGig solution is based on its own SiGe RFIC.

**Thin Film Electronics** has formed a partnership with **Hopsy**, a USA local craft beer marketplace and beer delivery service. The two companies

## Licensing & Partnerships

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will collaborate to integrate ThinFilm's NFC OpenSense technology into a variety of locally produced craft beers across the U.S.

Hopsy was created as an alternative distribution system through which customers can order fresh draft beer directly from local breweries and have it delivered right to their door. The beer is packaged in 32-ounce containers called "growlettes," and each container will feature an NFC OpenSense tag as part of its label. The wireless NFC tags will enable microbreweries to engage with consumers, educate customers, and differentiate their respective brands. ■

## Design Wins

**Ferrotec** has sold a Temescal UEFC series evaporator, the first Auratus Enhanced system to be installed in China, to **Hangzhou Liangdongxin Micro-**

**electronics.** Hangzhou Liangdongxin Microelectronics was established by Hangzhou Li-On Microelectronics, a supplier of power semiconductors in China, as a provider of GaAs foundry service in China. With the addition of the Temescal UEFC system to the Liangdongxin foundry, their customers will benefit from near-perfect uniformity and reduced material consumption.

**NXP** and **Wayv** have unveiled the first battery operated, handheld portable cooking appliance, the Wayv Adventurer. NXP's RF module solution, which delivers 250W of RF power at high efficiency, combined with Wayv's RF antenna, helps deliver excellent cavity efficiency for effective power transfer to the food. The technology platform includes NXP's MKW40Z Kinetis MCU with a 2.4GHz signal generator, a MMA25312 pre-driver, MHT1008 driver and MHT1004 final stage amplifier into a single, integrated closed-loop module.

**Silicon Creations**, a supplier of semi-custom analog and mixed-signal

IP, has deployed **Silvaco's** Custom Design Flow for 10nm silicon node designs. Silicon Creations utilized a number of Silvaco products, including Gateway schematic editor, Expert hierarchical IC layout editor, and SmartSpice analog circuit simulator. Silicon Creations, founded in 2006, is self-funded and growing. The company has development centers in Atlanta, Ga., and Krakow, Poland.

**Veeco** announced that **SemiConductor Devices** (SCD, www.scd.co.il), a supplier of high-end infrared (IR) detectors and laser diodes, has purchased a Veeco GEN200 Molecular Beam Epitaxy (MBE) system to meet the expanding demand for the production of IR detectors. According to Maxtech International, the worldwide market for commercial and dual-use IR systems is expected to grow at a CAGR of 10%, from \$3.2 billion in 2015 to \$5.6 billion in 2021. Maxtech International also reports that newer IR detectors are increasingly being produced with MBE technology. ■

## Company Financials

Company	Symbol	Next Qtr Outlook	Current Qtr				Last Qtr			Yr-ago Qtr			Sales Growth	Qtr	Ending
			Sales	Net	Margin	GM	Sales	Net	GM	Sales	Net	GM			
Actions Semi	ACTS	\$13.5-14.5M	12	-3.9	-33%	35%	12	-7.2	11%	11	-5.0	24%	14%	1Q16	31-Mar
Adesto	IOTS	\$10.1-10.3M	10	-1.5	-15%	49%	12	-3.3	46%	10	-2.3	0.4	5%	1Q16	31-Mar
Amtech	ASYS	\$30-33M	23	-1.5	-7%	27%	22	-4.0	27%	24	-2.3	0.3	-7%	1Q16	31-Mar
Analog Devices	ADI	\$800-840M	779	170.6	22%	66%	769	164.5	62%	821	205.3	66%	-5%	2Q16	30-Apr
Applied Materials	AMAT	Up 14-18%	2450	320.0	13%	41%	2257	286.0	41%	2442	364.0	42%	0%	2Q16	1-May
Diodes	DIOD	\$230-240M	223	-1.7	-1%	29%	214	0.7	25%	206	11.1	31%	8%	1Q16	31-Mar
Exar	EXAR	Up 7-12%	37	-2.2	-6%	40%	37	-7.1	39%	44	-2.9	41%	-16%	4Q16	27-Mar
GSI Tech	GSIT	\$12.2-13.2M	12	-0.1	-1%	50%	13	-0.8	50%	13	-2.7	50%	-7%	4Q16	31-Mar
Immersion	IMMR	n/a	14	-2.7	-20%	99%	17	1.1	99%	16	-0.1	99%	-17%	1Q16	31-Mar
Intermolecular	IMI	\$12-12.5M	15	-1.7	-12%	67%	14	-1.9	68%	7	-7.0	62%	104%	1Q16	31-Mar
Invensense	INVN	n/a	80	-22.9	-29%	43%	120	1.9	42%	99	0.4	43%	-20%	4Q16	3-Apr
IXYS	IXYS	Up	80	6.2	8%	30%	75	2.3	32%	83	7.8	31%	-4%	4Q16	31-Mar
Lattice	LSCC	\$97-103M	97	-19.7	-20%	59%	101	-45.5	53%	89	-53.3	54%	9%	1Q16	2-Apr
Magnachip	MX	\$156-162M	148	8.1	5%	23%	152	22.9	20%	165	-20.0	21%	-10%	1Q16	31-Mar
Maxlinear	MXL	\$100-104M	103	19.1	19%	60%	99	-8.5	56%	35	-4.7	61%	190%	1Q16	31-Mar
Mentor	MENT	\$245M	228	-13.4	-6%	81%	337	60.3	86%	272	-9.9	82%	-16%	1Q17	30-Apr
MoSys	MOSY	n/a	2	-6.9	-460%	40%	2	-6.5	44%	0.8	-8.0	75%	88%	1Q16	31-Mar
NVIDIA	NVDA	\$1.35B	1305	196.0	15%	58%	1401	207.0	56%	1151	134.0	57%	13%	1Q17	1-May
ON Semi	ON	\$835-875M	817	36.0	4%	34%	840	54.1	33%	871	55.1	34%	-6%	1Q16	1-Apr
Resonant	RESN	n/a	0	-3.1	n/a	n/a	n/a	n/a	n/a	0	-2.2	n/a	#DIV/0!	1Q16	31-Mar
Rubicon	RBCN	Flat	4	-7.3	-170%	-126%	3	-12.7	-356%	9	-8.3	-57%	-52%	1Q16	31-Mar
Semtech	SMTC	\$130-140M	131	6.9	5%	60%	119	1.2	59%	130	-0.1	60%	1%	1Q17	1-May
SMIC	SMI	Up 3-7%	634	51.8	8%	24%	610	30.1	29%	510	51.6	29%	24%	1Q16	31-Mar
Sunpower	SPWR	\$310-360M	385	-85.4	-22%	13%	374	-127.6	5%	441	-9.6	21%	-13%	1Q16	3-Apr
Synopsys	SNPS	\$595-610M	605	69.4	11%	78%	569	60.0	77%	557	55.6	78%	9%	2Q16	30-Apr
TowerJazz	TSEM	\$300M	278	65.9	24%	22%	255	22.1	25%	226	-73.1	15%	23%	1Q16	31-Mar



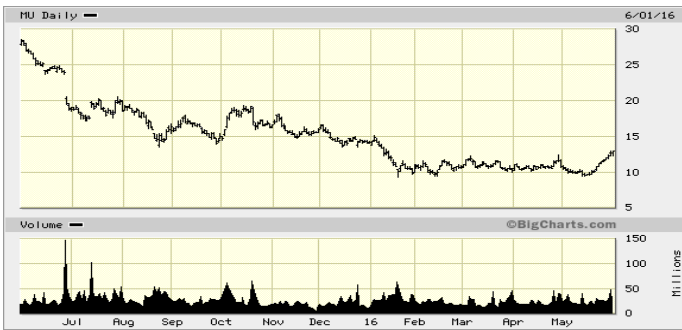
### Philadelphia SOX Index



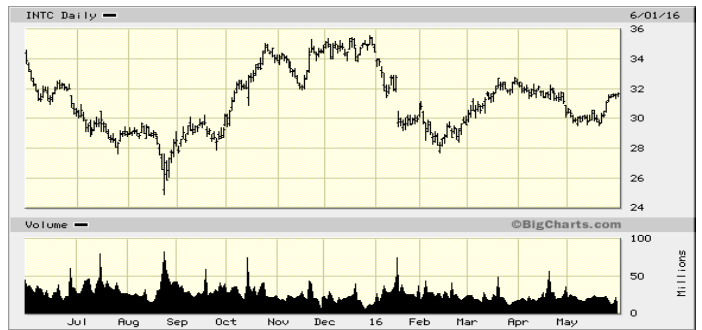
### TSMC – Foundry Barometer



### Micron – DRAM Barometer



### Intel



### Analog Devices



### NVIDIA



### Applied Materials



### ON Semiconductor



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**Publisher:** Cliff Hirsch, cliff@pinestream.com

**Tel:** 781.647.8800

**Email:** info@pinestream.com

**Web:** www.pinestream.com

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